Cell structure PPQs

Name: _____

Class: _____

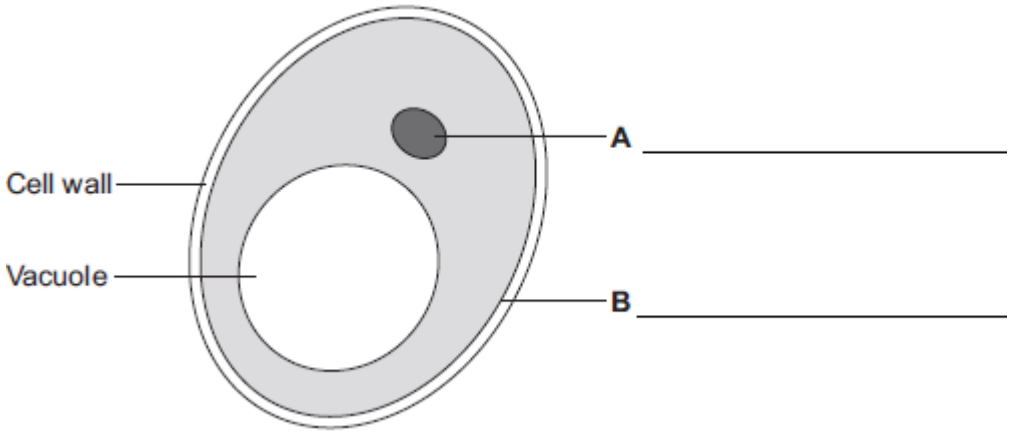
Date: _____

Time:	**33 minutes**
Marks:	**32 marks**
Comments:	**Self-assess using the mark scheme below. You can check your marks against the Examiners' comments to see if you fell into the same issues as the students who took that exam.**

Q1.

Human cells and yeast cells have some parts that are the same.

(a) The diagram shows a yeast cell.



Parts **A** and **B** are found in human cells and in yeast cells. On the diagram, label parts **A** and **B**.

(2)

(b) Many types of cell can divide to form new cells.

Some cells in human skin can divide to make new skin cells.

Why do human skin cells need to divide?

_____

_____

(1)

(c) Human stem cells can develop into many different types of human cell.

(i) Use the correct answer from the box to complete the sentence.

embryos	**hair**	**nerve cells**

Human stem cells may come from

_____

(1)

(ii) Use the correct answer from the box to complete the sentence.

cystic fibrosis	**paralysis**	**polydactyly**

Human stem cells can be used to treat

_____

(1)
(Total 5 marks)

Q2.

This question is about cell structures.

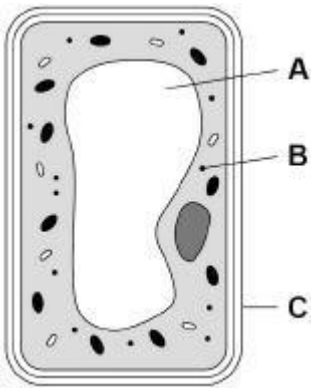
(a) Draw **one** line from each cell structure to the type of cell where the structure is found.

Cell Structure	Type of cell where the structure is found
Nucleus	Prokaryotic cells
Permanent vacuole	Plant cells only
Plasmid	Eukaryotic cells

(2)

(b) **Figure 1** shows a plant cell.

Figure 1



What are the names of structures **A**, **B** and **C**?

Tick **one** box.

Structure A	Structure B	Structure C	
Chloroplast	Vacuole	Cell wall	☐
Nucleus	Chloroplast	Cell membrane	☐
Vacuole	Mitochondrion	Cell membrane	☐

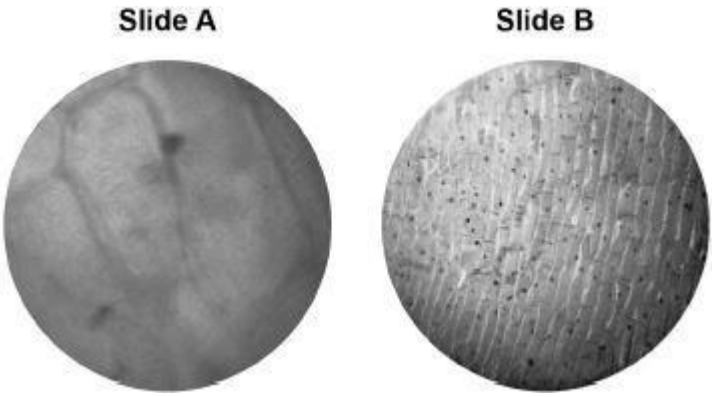
Vacuole	Ribosome	Cell wall	

(1)

A student observed slides of onion cells using a microscope.

Figure 2 shows two of the slides the student observed.

Figure 2



The cells on the slides are **not** clear to see.

(c) Describe how the student should adjust the microscope to see the cells on Slide A more clearly.

_____

_____

(1)

(d) Describe how the student should adjust the microscope to see the cells on Slide B more clearly.

_____

_____

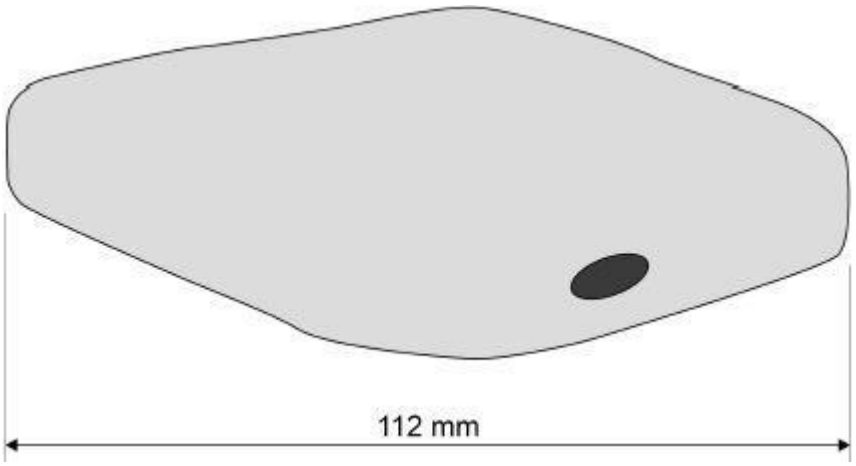
_____

(2)

(e) The student made the necessary adjustments to get a clear image.

Figure 3 shows the student's drawing of one of the cells.

Figure 3



The real length of the cell was 280 micrometres (μm).

Calculate the magnification of the drawing.

_____

_____

_____

_____

_____

Magnification = × _____

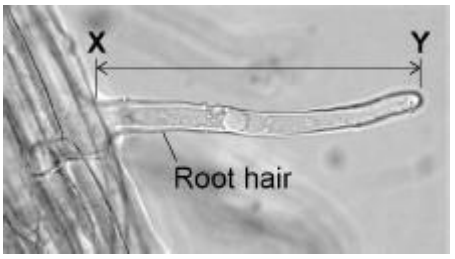
(3)

(Total 9 marks)

Q3.

Figure 1 shows a root hair viewed using a microscope.

Figure 1



(a) The root hair was viewed at a magnification of ×50

The image length of the root hair **X–Y** is 43 mm

Calculate the real length of the root hair in micrometres (μm).

_____

_____

_____

_____

_____

_____

Real length = _____ μm

(4)

(b) A microscope has a ×5 eyepiece lens.

Describe how to use this microscope to observe a prepared slide of root hair cells at a magnification of ×50

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

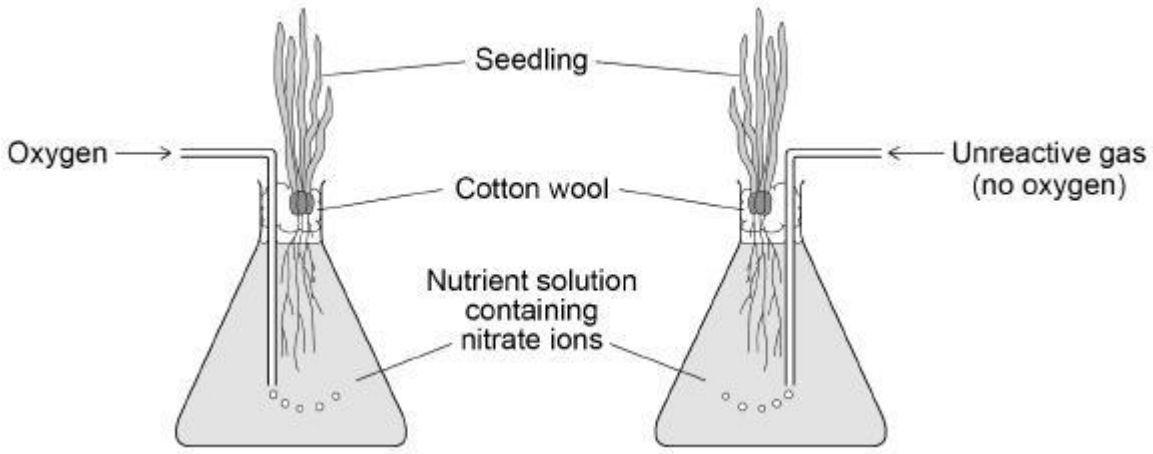
(4)

Root hair cells absorb water and mineral ions from the soil.

A scientist investigated the rate of nitrate ion uptake by two seedlings.

Figure 2 shows how the investigation was set up.

Figure 2



The scientist determined the mass of nitrate ions absorbed by each seedling every 30 minutes for 4 hours.

The table shows the results.

Time in hours	Total mass of nitrate ions absorbed by seedling in arbitrary units	
	With oxygen added	With no oxygen added
0	0	0
0.5	100	60
1.0	145	95
1.5	170	105
2.0	195	115
2.5	215	120
3.0	235	125
3.5	250	130
4.0	265	130

(c) Describe the changes in the rate of absorption of nitrate ions for the seedling with **no** oxygen added.

Use information from the table.

_____

_____

_____

_____

_____

_____

(3)

(d) Explain what the results in the table above show about how nitrate ions are absorbed.

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(e) Nitrate ions are essential for plants to grow.

Describe how nitrate ions are used in a plant to help the plant grow.

_____

_____

_____

_____

_____

_____

(3)

(Total 18 marks)

Q1.

(a) **A** = nucleus

allow phonetic spelling

1

B = (cell) membrane

1

(b) for repair / growth **or** to replace cells

ignore new cells / skin

1

(c) (i) embryos

1

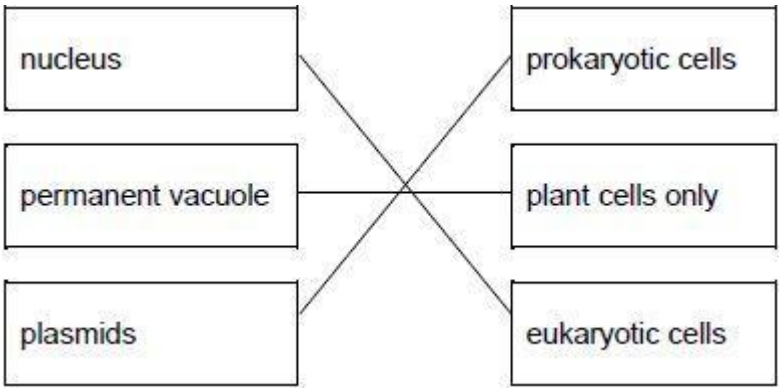
(ii) paralysis

1

[5]

Q2.

(a)



*allow **1** mark for one or two correct links*

2

(b)

vacuole	ribosome	cell wall

tick box takes precedence
if no tick is given, look at both the figure and the circling of words in the table
if writing is seen on the figure and in the table both must be correct

1

(c) turn the (fine focusing) knob until the cells are in focus

allow focus it

*do **not** accept increase magnification*

ignore decrease magnification
ignore clear

ignore references to resolution / illumination
ignore zoom in / out

1

(d) (rotate the) nosepiece / objective lens

allow change the (objective / eyepiece) lens

1

to a higher power (lens)

allow (to) increase the magnification
a comparator is required
ignore change / adjust the magnification
allow stronger or more powerful lens
ignore references to resolution / illumination unqualified
ignore zoom in / out
ignore references to an electron microscope

1

(e) conversion of units:
(112 mm ⟶) 112 000 (μm)
or
(280 μm ⟶) 0.28 (mm)

1

$$(\text{magnification} =) \frac{112}{0.28}$$

or

$$(\text{magnification} =) \frac{112000}{280}$$

*allow **1** mark for no conversion of units 112 / 280*
or
incorrect value from step 1 correctly substituted

1

400 (×)

*do **not** accept if units are given*
*if no other mark scored allow **1** mark for:*

$$\textit{magnification} = \frac{\textit{size of image}}{\textit{size of real object}}$$

a triangle with words or letters in is insufficient, as the correct rearrangement is needed

1

*an answer of 400 (×) scores **3** marks*

[9]

Q3.

(a) $$50 = \frac{43}{\text{size of real object}}$$

1

(size of real object =) $\frac{43}{50}$

1

(size of real object =) 0.86 (mm)

1

(size of real object =) 860 (μm)

an answer of 860 (μm) scores 4 marks

allow correct conversion of their calculated value

if no other marks awarded allow 1 mark for

$$\text{magnification} = \frac{\text{size of image}}{\text{size of real object}}$$

1

(b) **Level 2:** Scientifically relevant facts, events or processes are identified and given in detail to form an accurate account.

3–4

Level 1: Facts, events or processes are identified and simply stated but their relevance is not clear.

1–2

No relevant content

0

Indicative content

- place slide on stage
- use lowest power / ×4 objective lens (initially)
- adjust mirror **or** switch light on so light passes through slide
- move stage as close to lens as possible
- slide must not touch lens
- turn focussing knob so slide moves away from lens
- turn focussing knob until image comes into focus
- use fine focus to get clear image
- change objective lens to ×10
- ×5 eyepiece and ×10 objective lenses (gives total magnification of ×50)
- refocus slide using focussing knob

For Level 2 reference to how to focus the slide / cells **and** achieve magnification of ×50 is required

(c) any **three** from:

- (rate) fastest in the first 0.5 hours

  allow fastest rate is 120 units per hour (at start)

- (rate gradually) decreases after first 0.5 hours

  allow mean rate over 3.5 hours is 37.14 units per hour

  or

- (rate gradually) decreases throughout the investigation

- rate is constant between 1.0 and 2.0 hours

  or

- rate is constant between 2.0 and 3.5 hours

- (rate) becomes zero between 3.0 and 3.5 hours
  allow (rate) is zero after 3.5 hours
  allow 'it' for rate

3

(d) more nitrate ions are absorbed in the presence of oxygen
allow nitrate ions absorbed faster in the presence of oxygen

1

(which suggests) they are absorbed by active transport / uptake

1

which requires energy from respiration
*do **not** accept energy produced / created / made*

1

some nitrate ions absorbed by diffusion
or
some nitrate ions absorbed (by active transport / uptake) requiring energy from anaerobic respiration
or
some nitrate ions absorbed by active transport / uptake using oxygen already dissolved in the solution

1

(e) nitrate ions are used with glucose

1

to form amino acids

1

(which are) used to synthesise proteins (needed for growth)

1

[18]

Q1.

This question, on the topic of cell structure and cell division, was well answered by most students.

(a) The vast majority knew that structure A in the yeast cell was the *nucleus* and that structure B was the *cell membrane*. Common errors were to identify A as a chloroplast or mitochondrion and B as either the cytoplasm or the cell wall.

(b) Although just over half of the students understood that cell division was necessary in the skin for either growth or repair, many gave trivial answers such as ‘to make new skin’, ‘to let you stretch’ or ‘to stop you getting old’.

(c) (i) Two-thirds of the students correctly selected *embryos* as a possible source of human stem cells, although ‘nerve cells’ was a powerful distracter.

(ii) This part was more problematic, with only one-third of students selecting *paralysis* as a condition that might be treatable with stem cells, and ‘cystic fibrosis’ being incorrectly chosen by many.

Q2.

Foundation

(a) 57% of students demonstrated a good understanding of prokaryotic and eukaryotic cells and were awarded two marks. To achieve both marks all three structures had to be correctly linked to the type of cell where each structure is found.

When only one mark was awarded it was usually for identifying the nucleus as being found in eukaryotic cells.

(b) 59% of students were awarded the mark for identifying the vacuole, ribosome and cell wall in the plant cell.

Students were asked to tick one box, but some labelled the diagram, whilst others circled the names of the structures in the table.

(c) 17% of students achieved this mark. The cells on slide A appeared large, but blurred. The required response was a reference to focusing the image.

Many students referred to zooming in or out, to altering the magnification or using an electron microscope. All of these were ignored. However, if they said increase the magnification this was incorrect and negated a correct answer of focusing the image.

(d) The cells on slide B appeared small but in focus. The required response was a description of how to obtain a larger image. There were two marks available for this question:

- one was for reference to changing the lens
- one was for stating that the new lens would have a higher power or magnification.

3% of students achieved two marks, and 23% obtained one mark, usually for saying increase the magnification.

Changing or using a better magnification was insufficient. Many students referred to zooming in or out or said use an electron microscope, both of which were ignored.

(e) There were three marks available for this question.

- The first mark was for conversion of units. Many students did not attempt a conversion but could still go on to achieve two marks. A range of different errors were made which included multiplying or dividing by 10, 100 or 10 000, rather than by 1000. Some did not appreciate that a micrometre is smaller than a millimetre.
- The second mark was for correctly substituting into the rearranged equation to calculate magnification. This mark was allowed even if their initial conversion was incorrect.
- The final mark was for an answer of 400. Some students added a unit to their answer and this negated the mark.

33% of students achieved all three marks, and 33% achieved two marks. 24% of students scored zero. This was often for 280 ÷ 112 = 2.5

Higher

(a) Students demonstrated a good understanding of prokaryotic and eukaryotic cells. 87% of students achieved two marks. To gain both marks all three structures had to be correctly linked to the type of cell where each structure is found.

When only one mark was awarded it was usually for identifying the nucleus as being found in eukaryotic cells.

(b) Students demonstrated a good understanding of cell structure. 80% of students were awarded the mark for identifying the vacuole, ribosome and cell wall in the plant cell.

Students were asked to tick one box, but some labelled the diagram, whilst others circled the names of the structures in the table.

(c) 27% of students achieved this mark. The cells on slide A appeared large, but blurred. The required response was a reference to focusing the image.

Many students referred to zooming in or out, to altering the magnification or using an electron microscope. All of these were ignored. However, if they said increase the magnification this was incorrect and negated a correct answer of focusing the image.

(d) The cells on slide B appeared small but in focus. The required response was a description of how to obtain a larger image. There were two marks available for this question.

- One was for reference to changing the lens.
- One was for stating that the new lens would have a higher power or magnification.

45% of students obtained a mark. Where a mark was awarded it was usually for saying increase the magnification.

Changing or using a better magnification was insufficient. Many students referred to zooming in or out or said use an electron microscope, both of which were ignored.

(e) There were three marks available for this question.

- The first mark was for conversion of units. Many students did not attempt a conversion but could still go on to achieve two marks. A range of different errors were made which included multiplying or dividing by 10, 100 or 10 000, rather than by 1000. Some did not appreciate that a micrometre is smaller than a millimetre.

- The second mark was for correctly substituting into the rearranged equation to calculate magnification. This mark was allowed even if their initial conversion was incorrect.

- The final mark was for an answer of 400. Some students added a unit to their answer and this negated the mark.

22% of students achieved two marks. 56% of students scored zero marks. This was often for 280 ÷ 112 = 2.5

Q3.

(a) Around 38% of students gained full marks for calculating the length of the root hair in micrometres. Around 33% of students scored three marks because they made an error with the unit conversion. As mentioned earlier, more students are showing their working for the calculation.

The first marking point was for substitution into the equation given in the specification. The second marking point was for reorganisation of the equation to calculate the real length of the root hair. The third marking point was for correctly calculating the length in mm. The final mark was for converting this value to μm. This was an independent marking point, so a conversion of their incorrectly calculated length could gain this mark. This was often awarded. The most common errors related to incorrectly reorganising the equation, or an incorrect unit conversion.

(b) This extended response question highlighted that many students either did not understand how to use a light microscope, or could not explain the procedure in a clear step by step way.

Some students had not read the question carefully. Instead of starting with a prepared slide, they explained how they would prepare a slide, which was not creditworthy. Knowledge of the names of the parts of a microscope was poor.

If students only said that the ×10 objective lens should be used to give a total magnification of ×50, they gained one mark. In order to access Level 2, a detailed method in a logical sequence was needed, as well as a description of how to achieve a magnification of ×50. 9% of students achieved Level 2. Many responses lacked detail, or gave confused accounts of how to focus a microscope.

(c) This question asked students to describe the changes in the rate of absorption of ions for the seedling with no oxygen added. Many students compared the seedlings

with and without oxygen, saying the rate of absorption with oxygen was faster. This is a correct statement, but does not answer the question. Others described the change in mass of the ions absorbed, rather than the rate.

A fifth of students scored one or more marks. Where one mark was awarded, it was usually for saying that the rate gradually decreased as time went by. Students always find it more difficult to interpret data when it is given in a table, rather than displayed as a graph. It might help if students sketched the data as a graph, so the changes in rate would be more obvious. Alternatively they could calculate the rate at each time point.

(d) Around 79% of students scored one mark for saying that more nitrate ions are absorbed in the presence of oxygen. Stating that the ions were absorbed better was insufficient as at this level the idea of more or faster was required. Only a few went on to explain that this was because the ions were absorbed by active transport, which requires energy from respiration. The last marking point was rarely seen.

(e) Students found this question difficult and approximately 11% scored one or more marks. A direct description, of how nitrate ions are used to help plants grow, was required. Although nitrate ions are used to form other substances in a plant, the direct link between the formation of proteins for growth was needed.

Many students gave a description of nitrate ion uptake and transport in the plant, but this did not answer the question. Reference to active transport was often seen. Many thought that nitrate ions are transported in phloem. The use of nitrates as a food or as a source of energy was often stated. Some thought that nitrates contain glucose.

Cell division by mitosis PPQs

Name: _____

Class: _____

Date: _____

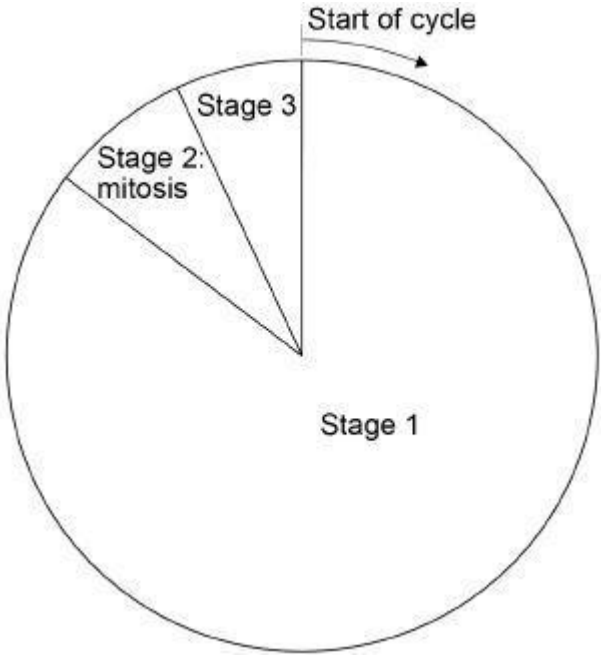
Time:	**28 minutes**
Marks:	**27 marks**
Comments:	**Self-assess using the mark scheme below. You can check your marks against the Examiners' comments to see if you fell into the same issues as the students who took that exam.**

Q1.

Cells divide in a series of stages called the cell cycle.

Stage 2 of the cycle is mitosis.

The diagram below shows a simplified cell cycle for a human body cell.



(a) Draw **one** line from each stage in the cell cycle to what happens during that stage.

Stage in the cell cycle	**What happens during that stage**
Stage 1	Nucleus divides
Stage 2	Cell divides into two
Stage 3	Copies of the DNA are made

(2)

(b) The mass of DNA in a human body cell at the start of the cell cycle is 6 picograms.

What mass of DNA will be in each of the new cells produced by this cell division?

Tick **one** box.

3 picograms ☐

6 picograms ☐

9 picograms ☐

12 picograms ☐

(1)

(c) Stem cells are undifferentiated cells.

Which statement about stem cells is correct?

Tick **one** box.

Animal stem cells are found in meristems ☐

Animal stem cells divide by meiosis ☐

Meristem cells in plants can differentiate throughout the life of the plant ☐

Meristem cells in plants can only differentiate into one type of cell ☐

(1)

Stem cells from human embryos can differentiate into most types of human cell.

Research is being done into the use of embryonic stem cells in medical treatments.

The long-term effects of using embryonic stem cells in patients are not well understood.

In therapeutic cloning, human embryos are produced using a donated human egg cell and a cell from the patient.

- The embryo produced contains the same genetic information as the patient.
- Stem cells are taken from the embryo and stimulated to divide to form cells the patient needs.
- The embryo is then destroyed.

(d) Suggest **two** advantages of therapeutic cloning.

1. _____

_____

2. _____

_____

(2)

(e) Suggest **two** disadvantages of therapeutic cloning.

1. _____

_____

2. _____

_____

(2)

(Total 8 marks)

Q2.

This question is about cell division.

(a) Write the biological structures from the box in the correct order of size.

cell	**chromosome**	**gene**	**nucleus**

Smallest

Largest

_____

_____

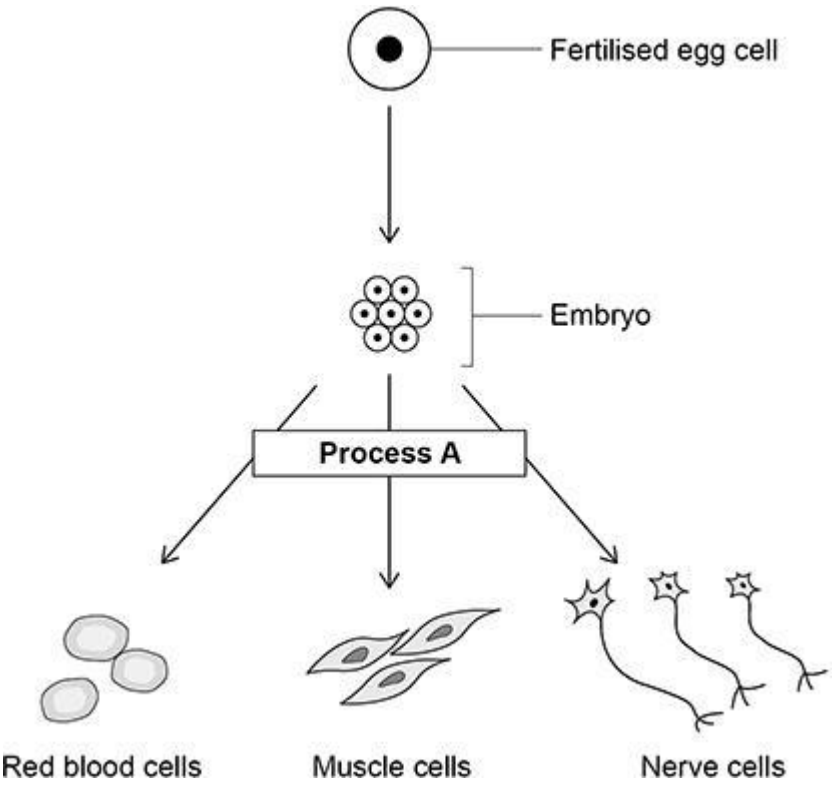
_____

_____

(1)

Figure 1 shows how a fertilised egg cell can produce specialised cells.

Figure 1



(b) Name **Process A**.

_____

(1)

(c) How many cell divisions are needed to form a 16-cell embryo from the original fertilised egg cell?

_____

_____

Number of cell divisions = _____

(1)

(d) In humans a fertilised egg cell contains 23 pairs of chromosomes.

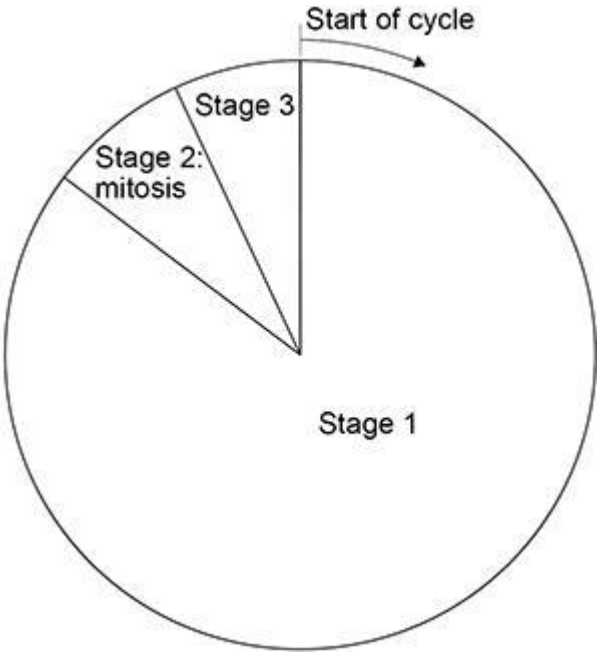
How many chromosomes will there be in each of the embryo cells?

_____

(1)

(e) **Figure 2** represents a cell cycle for a human embryonic cell.

Figure 2



Describe **one** change in the cell that occurs during **each** of the stages of the cell cycle.

Stage
1 _____

_____

Stage
2 _____

_____

Stage
3 _____

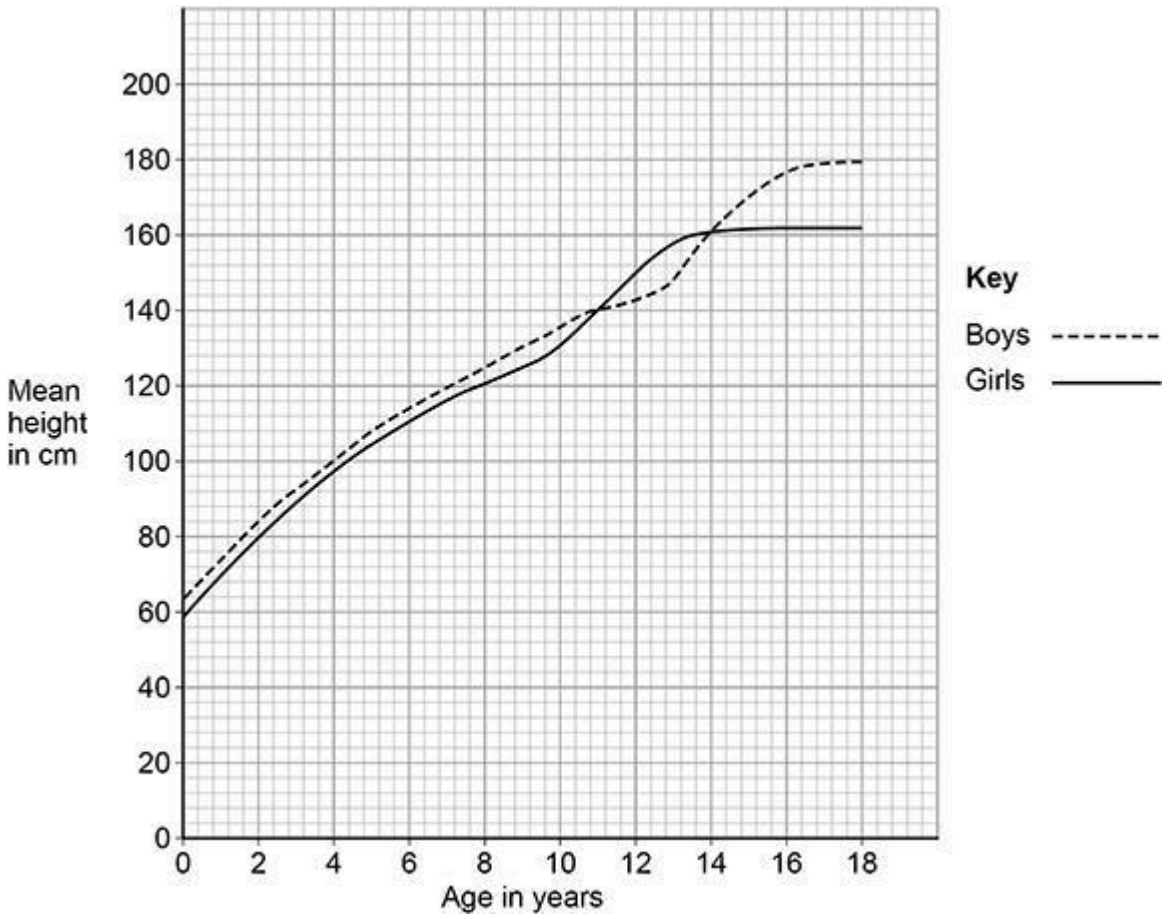
_____

(3)

Cell division is important in the growth of multicellular organisms.

(f) **Figure 3** shows the mean height of boys and of girls from birth to age 18 years.

Figure 3



Compare the growth of boys with the growth of girls.

Use data from **Figure 3** in your answer.

(6)

(g) Give **one** way that cell division by mitosis is important in **fully grown** animals.

_____

_____

(1)

(Total 14 marks)

Q3.

Read the information about stem cells.

> Stem cells are used to treat some human diseases.
>
> Stem cells can be collected from early embryos. These stem cells have not begun to differentiate, so they could be used to produce any kind of cell, tissue or organ. The use of embryonic stem cells to treat human diseases is new and, for some diseases, trials on patients are happening now.
>
> Stem cells can also be collected from adult bone marrow. The operation is simple but may be painful. Stem cells in bone marrow mainly differentiate to form blood cells. These stem cells have been used successfully for many years to treat some kinds of blood disease. Recently there have been trials of other types of stem cell from bone marrow. These stem cells are used to treat diseases such as heart disease.

Evaluate the use of stem cells from embryos or from adult bone marrow for treating human diseases.

You should give a conclusion to your evaluation.

_____

_____

_____

_____

_____

_____

_____

_____

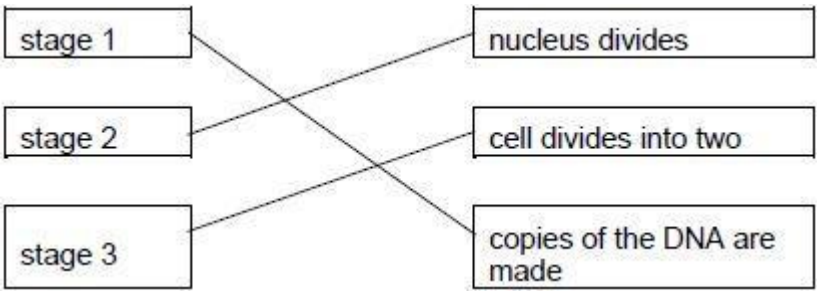
_____

_____

(Total 5 marks)

Q1.

(a)



*allow **1** mark for 1 or 2 correct*

credit can be given where students have matched the boxes correctly, for example numbering the boxes

2

(b) 6 picograms

1

(c) meristem cells in plants can differentiate throughout the life of the plant

1

(d) any **two** from:

- may cure / treat diseases
  or
  cure medical conditions
  or
  produce replacement cells / tissues / organs

  allow example e.g. diabetes / paralysis
  allow cells can be stored for future use
  ignore used in medical treatments
  ignore patient makes / grows cells / tissues / organs

- cells unlikely to be **rejected** by patient)

  ignore same genetic information

- cells / tissues of any type can be produced

  ignore differentiated into most types of cells

- many cells produced

- cells produced could be used for research

- would reduce waiting time for transplants

  ignore references to cost
  ignore all reference to producing babies / IVF

2

(e) any **two** from:

- (potential) life is killed / destroyed

allow embryo is killed
ignore embryo is destroyed
ignore embryo is a life / becomes a baby

- shortage of donors / eggs
- egg donation / collection has risks
- do not yet know risks / side effects of the procedure on the patient
  ignore long term effects are not well understood
  allow may cause tumours / cancer
- may transfer (viral) infection
- poor success rate
  allow in terms of viable egg / embryo / cell / tissue / organ production

2

ignore references to cost
ignore unethical unqualified
Ignore reference to religion / beliefs

[8]

Q2.

(a) gene

chromosome

nucleus

cell

must be in this order

1

(b) differentiation

ignore specialisation

1

(c) 4

allow 15

1

(d) 46

allow 23 pairs (of chromosomes)

1

(e) **Stage 1** any **one** from:
- (cell) growth
- increase in number of sub-cellular structures
  allow increase in number of organelles / ribosomes / mitochondria
- DNA replicates
  allow genetic material for DNA

allow DNA doubles / duplicates

- chromosomes double / duplicate / replicate

1

Stage 2 any **one** from:

ignore mitosis occurs

- (one set of) chromosomes is pulled to each end of cell

  allow chromosomes line up

  across the centre of the cell

  allow chromosomes move to opposite ends of the cell

- two nuclei form

  allow nucleus divides / splits (into two)

1

Stage 3 any **one** from:

- cytoplasm / membrane divides

  allow cytokinesis

- two identical cells formed

1

(f) **Level 2:** Scientifically relevant features are identified; the way(s) in which they are similar / different is made clear and (where appropriate) the magnitude of the similarity / difference is noted.

4–6

Level 1: Relevant features are identified and differences noted.

1–3

No relevant content

0

Indicative content

General comparisons:

- boys height at birth (slightly) greater than girls height
- boys are (slightly) taller than girls up to age 11
- correct height comparisons eg boys are approximately 4 / 5 cm taller than girls up to age 11
- girls and boys are the same height at age 11
- girls are taller than boys between age 11 and age 14
- girls and boys are the same height at age 14
- boys are taller than girls above age 14
- correct height comparisons eg boys are 5 to 18 cm taller than girls above age 14
- boys (eventually) grow taller than girls

- boys carry on growing for a longer time than girls
- girls stop growing age 13 / 14 / 15 **and** boys stop growing age 17 / 18

Rate comparisons:
- rate of growth similar up to age 10 / 11
- girls grow faster than boys between 10 / 11 and 14

  allow girls have a greater increase in height between 11 and 14
- growth spurt occurs at a younger age in girls
- growth spurt starts age 10 / 11 in girls **and** age 13 / 14 in boys
- increased rate of growth in girls aged 10 to 13 /14 **and** in boys aged 13 to 17 / 18

Key points for Level 2 are correct reference to 0-11 year period, 11-14 period and after age 14, with at least one correct reference to rate of growth or use of correct values of height and age to illustrate rate.

(g) repair of tissues

allow repair of organs

ignore repair of cells

or

replacement of cells

allow replacement of tissues

ignore replacement of organs

ignore growth

1

[14]

Q3.

Marks should **not** be awarded for simply copying the information provided
A mark may be awarded for a comparison between treatments if the answer only involves copied information

any **four** from:

*For all **4** marks to be awarded, there must be at least 1 pro and 1 con*

embryo stem cells – examples of

pros

- can treat a wide variety / lots of diseases / problems
- many available / plentiful
- using them better than wasting them

- painless

cons

- (possible) harm / death to embryo
- (relatively) untested / unreliable / may not work
  allow long term effects not known
  or *may be more risky*
- embryo can't be 'asked' / 'embryo rights' idea

<u>adult bone marrow stem cells – examples of</u>

pros

- no ethical issues (in collection) **or** permission given
- quick recovery
- (relatively) safe
  allow does not kill (donor) / low risk
- well tried / tested / know they work

cons

- operation hazards eg infection
- few types of cell / tissue produced **or** few diseases / problems treated
- painful so may deter donors

4

Conclusion to evaluation:

A reasoned conclusion from the evidence

1

[5]

Q1.

(a) 33% of students achieved both marks for knowing the sequence of events in the cell cycle. 51% of students achieved one mark, which was usually for realising that in the final stage the cell divides into two.

(b) The majority of students thought the mass of DNA in the new cells produced by mitosis would be half of that in the cell at the start of the cell cycle. 30% of students said the mass would be the same.

(c) The majority of students incorrectly thought that animal stem cells divide by meiosis. 31% of students correctly said that meristem cells in plants can differentiate throughout the life of the plant.

(d) The majority of students copied sentences from the information given in the question. There had to be some added value in order to be awarded marks. A fifth of students scored 1 mark. This was often for saying therapeutic cloning would produce replacement cells or could treat some diseases. Very few gained 2 marks. A lot of students confused therapeutic cloning with IVF treatment.

(e) The majority of students copied the sentence about the embryo being destroyed, which had no added value, and so it was ignored. Those who rephrased this to say a life is killed or destroyed were awarded a mark. Another common correct response was that the procedure may not work.

Q2.

Foundation

(a) A quarter of the students put gene, chromosome, nucleus and cell in order of increasing size.

(b) Fewer than a tenth of students gave the correct answer, differentiation. Some said specialisation, whilst most students thought the process was mitosis or cell division.

(c) 19% of students correctly calculated the number of cell divisions to form a 16-cell embryo.

(d) 41% of students knew that the cells of a human embryo have 46 chromosomes.

(e) 23% of the students scored any marks for this question. Most of these students scored a mark for Stage 1 by saying that the cell grows or that there is an increase in the number of sub-cellular structures. Some students thought Stage 1 was fertilisation, and they went on to describe the development of an embryo.

A mark for Stage 2 was less often awarded. Many students said mitosis happens, but as this was written on the cell cycle diagram it did not gain credit.

For Stage 3 many students only referred to two daughter cells forming, when reference to two identical cells was required. Reference to specialised cells being formed was seen quite a lot.

(f) The question asked students to compare the growth of boys with the growth of girls, using data from growth curves.

There are three main sections in the graph:

- a section from birth to age 10 or 11, where the height and growth rate of boys and girls is very similar
- a section from age 10 or 11 up to age 14, where girls grow faster than boys
- the section from 14 to 18 years, where boys continue to grow rapidly whilst girls have stopped growing.

Within each section there were several comparisons that could be made.

To score the highest marks reference to all three sections of the graph was required, in addition to at least one comparison of the rate of growth. This was rarely seen, where a quarter of students scored three marks. Similar proportions scored two marks and one mark, amounting to 81% scoring at least a single mark.

As the command word was 'Compare' it was important that comparative statements about boys and girls were made. All the statements given in the indicative content are comparisons.

Many responses gave descriptions of what they had learnt about puberty and growth spurts, but if they did not match the data given in the graph they were not credited. Any data given had to be correct.

Common errors in interpreting the graph included:

- boys grow faster than girls up to age 11
- boys grow shorter, or stop growing, at age 11
- girls stop growing at age 18.

(g) 8% of students scored this mark. The question asked for one way that mitosis is important in fully grown animals; so saying 'to grow' was not credited. Some students said for growth and repair, which was insufficient.

Replacement of cells or tissues was required. Repair of tissues, organs or wounds all gained credit. Repair of damaged cells is incorrect.

Many students said mitosis is needed for reproduction, or development of an embryo, both of which were ignored.

Higher

(a) 54% of the students put gene, chromosome, nucleus and cell in order of increasing size.

(b) Half of the students gave the correct answer, differentiation. Some said specialisation, whilst most students thought the process to produce specialised cells was mitosis, cell division or therapeutic cloning.

(c) 44% of the students correctly calculated the number of cell divisions to form a 16-cell embryo.

(d) 65% of students knew that the cells of a human embryo have 46 chromosomes.

(e) A quarter of students scored full marks, with 69% scoring at least one mark. Many students scored a mark for Stage 1 by saying that the cell grows or that there is an increase in the number of sub-cellular structures. Some students thought Stage 1 was fertilisation, and they went on to describe the development of an embryo.

A mark for Stage 2 was less often awarded. Many students said mitosis happens, but as this was written on the cell cycle diagram it did not gain credit.

For Stage 3 all the changes listed on the mark scheme were seen, but many students only referred to two daughter cells forming, when reference to two identical cells was required. Reference to specialised cells being formed was seen quite a lot, and was ignored.

(f) The question asked students to compare the growth of boys with the growth of girls, using data from growth curves.

There are three main sections in the graph:

- a section from birth to age 10 or 11, where the height and growth rate of boys and girls is very similar
- a section from age 10 or 11 up to age 14, where girls grow faster than boys
- the section from 14 to 18 years, where boys continue to grow rapidly whilst girls have stopped growing.

Within each section there were several comparisons that could be made.

To score the highest marks reference to all three sections of the graph was required, in addition to at least one comparison of the rate of growth. 30% of students scored four or more marks. More than two thirds of students scored three or more marks.

As the command word was ‘Compare’ it was important that comparative statements about boys and girls were made. All the statements given in the indicative content are comparisons.

Many responses gave descriptions of what they had learnt about puberty and growth spurts, but if they did not match the data given in the graph they were not credited. Any data given had to be correct.

Common errors in interpreting the graph included:

- boys grow faster than girls up to age 11
- boys grow shorter, or stop growing, at age 11
- girls stop growing at age 18.

(g) The question asked for one way that mitosis is important in fully grown animals, so saying ‘to grow’ was not credited. Many students said for growth and repair, which was insufficient. Repair of tissues, organs or wounds all gained credit. Many students said to repair damaged cells, which is incorrect. Replacement of cells or tissues was another acceptable response. Many said mitosis was important for reproduction, which was ignored.

Q3.

This question and the mark scheme were written to enable students to gain full marks whatever approach they took and it was pleasing to see many students rising to the challenge here and making some good attempts at the evaluation required. The majority of students compared the use of adult stem cells with the use of embryonic stem cells. Others took different approaches, including comparing the use of embryonic and / or adult stem cells to having no treatment or to having treatment by other methods. However it was often unclear which approach students had taken as they referred to particular features without identifying to which treatment they were referring.

Students should be made aware that simply copying or paraphrasing the information provided, including ascribing various parts to ‘advantages’ or ‘disadvantages’ will not gain marks. What is required in such questions is the addition of extra information or comparison of treatments based on the information provided. Hence statements such as ‘embryonic stem cells can be used to produce any kind of cell. Bone marrow stem cells can form blood cells’, gained no credit. However, the addition of a word such as ‘however’ or ‘but‘ to link these two sentences would be enough to gain a mark for a comparison. Similarly adding the idea that ‘embryonic stem cells can treat a wider variety of diseases’ not only includes a comparison but also extends the information regarding production of any kind of cell, tissue or organ into its use in treatment and would thus gain more credit. Some students immersed themselves in the vagaries of ethics, morals or ‘playing God’ without developing these any further. So answers, for example, that said ‘using embryo stem cells is unethical as embryos are living’ or ‘it is inhumane to collect cells from embryos’ gained no marks.

There was occasional confusion with embryo screening with references to wanting to select features, produce designer babies, or find out if the child would have CF, the ethics of this and the potential for parents to make choices regarding the use of, an as yet, unborn foetus. These were not credited, as being not relevant to the information in the question. Many students however, made excellent points referring to advantages and disadvantages of embryonic and adult stem cells. Unfortunately, students often wrote poor conclusions which frequently only restated pros and cons and failed to come to a decision. Answers such as ‘I can see both sides’ were by no means uncommon. Where conclusions to evaluations are asked for, students are expected to commit themselves to a firm decision, one way or the other, and then justify this decision. It was not unusual for students to gain extra marks for making fresh points in the conclusion.

Transport in cells PPQs

Name: _____

Class: _____

Date: _____

Time:	**25 minutes**
Marks:	**23 marks**
Comments:	**Self-assess using the mark scheme below. You can check your marks against the Examiners' comments to see if you fell into the same issues as the students who took that exam.**

Q1.

A single-celled organism has a large surface area to volume ratio.

(a) How does oxygen enter a single-celled organism?

Tick (✓) **one** box.

Active transport ☐

Diffusion ☐

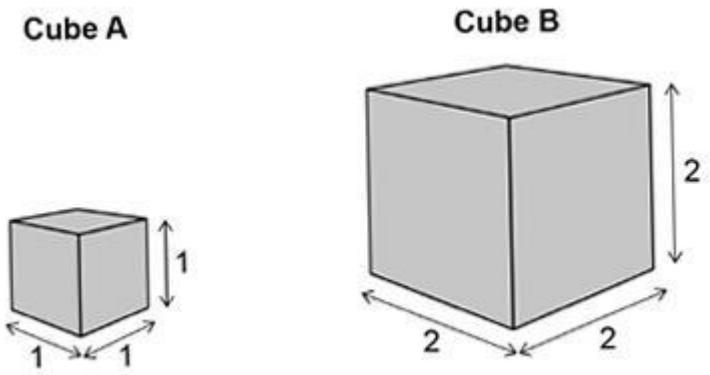
Osmosis ☐

(1)

Figure 1 shows two cubes.

The surface area to volume ratio for cube **A** is 6:1

Figure 1



(b) Calculate the surface area to volume ratio of cube **B**.

Surface area of one face of cube **B** _____

_____

Surface area of one face = _____

Total surface area of cube **B** _____

_____

Total surface area = _____

Volume of cube **B** _____

_____

Volume = _____

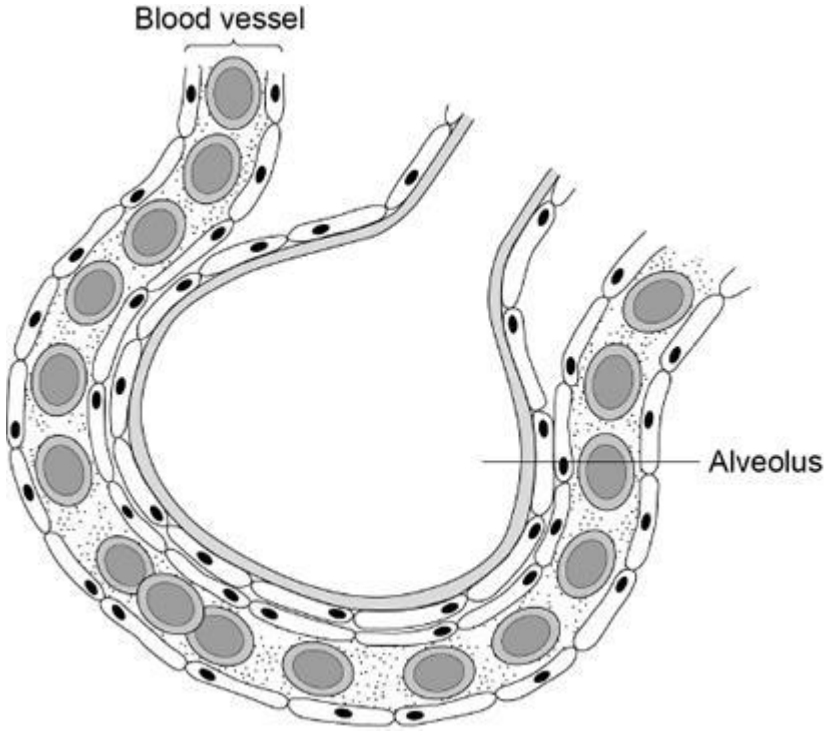
Surface area to volume ratio = _____ : _____

(4)

Multicellular organisms have exchange surfaces to absorb substances.

Figure 2 shows part of the exchange surface in the lungs.

Figure 2



(c) Oxygen passes from the alveolus into the blood.

Name the part of the blood that carries the most oxygen.

_____

(1)

(d) Name the gas that passes out of the blood into the alveolus.

_____

(1)

(e) Alveoli provide a large surface area for gas exchange.

Give **two** other ways the lungs are adapted for efficient gas exchange.

1 _____

_____

2 _____

_____

(2)

(Total 9 marks)

Q2.

A student investigated the effect of different concentrations of sugar solution on pieces of potato.

This is the method used.

1. Cut five pieces of potato.
2. Record the starting mass of each piece of potato.
3. Place each piece of potato in a different concentration of sugar solution.
4. After 24 hours remove the pieces of potato from the solutions.
5. Record the final mass of each piece of potato.
6. Calculate the change in mass for each piece of potato.

(a) What is the independent variable?

Tick (✓) **one** box.

Change in mass of the pieces of potato ☐

Concentration of the sugar solution ☐

Length of time the pieces of potato are in the solution ☐

Starting mass of the pieces of potato ☐

(1)

The table below shows the results.

Concentration of sugar solution in mol/dm^3	**Mass of potato at start in grams**	**Mass of potato after 24 hours in grams**	**Change in mass in grams**
0.0	7.94	10.14	2.20
0.1	7.95	9.10	1.15
0.2	7.96	8.21	0.25
0.3	7.93	7.53	–0.40

0.4	7.93	7.18	–0.75
0.5	7.95	7.00	–0.95

(b) Explain why the potato in 0.0 mol/dm^3 sugar solution increased in mass.

_____

_____

_____

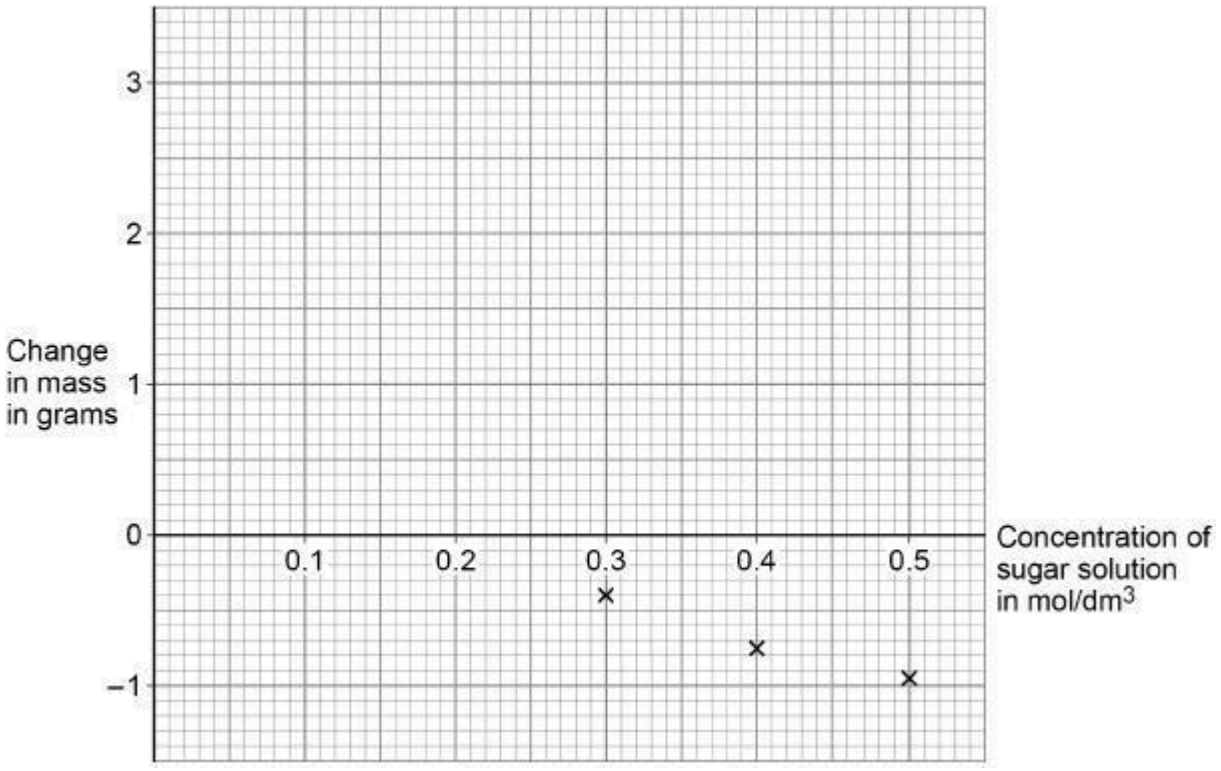
_____

(2)

(c) Complete the graph below.

Some of the results have been plotted for you.

You should:
- plot the data from table above
- draw a line of best fit through all the points.



(2)

(d) The mass of a piece of potato does **not** change when:

concentration of solution inside cells = concentration of solution outside cells

Determine the concentration of sugar solution inside the potato cells.

Use the graph above.

Concentration = _____ mol/dm^3

(1)

The table is repeated below.

Concentration of sugar solution in mol/dm^3	Mass of potato at start in grams	Mass of potato after 24 hours in grams	Change in mass in grams
0.0	7.94	10.14	2.20
0.1	7.95	9.10	1.15
0.2	7.96	8.21	0.25
0.3	7.93	7.53	–0.40
0.4	7.93	7.18	–0.75
0.5	7.95	7.00	–0.95

(e) Calculate the percentage change in mass for the potato in 0.2 mol/dm^3 sugar solution.

Use table above.

Use the equation:

$$\text{percentage change in mass} = \frac{\text{change in mass}}{\text{mass of potato at start}} \times 100$$

Give your answer to 3 significant figures.

_____

_____

_____

_____

_____

Percentage change in mass (3 significant figures) = _____ %

(3)

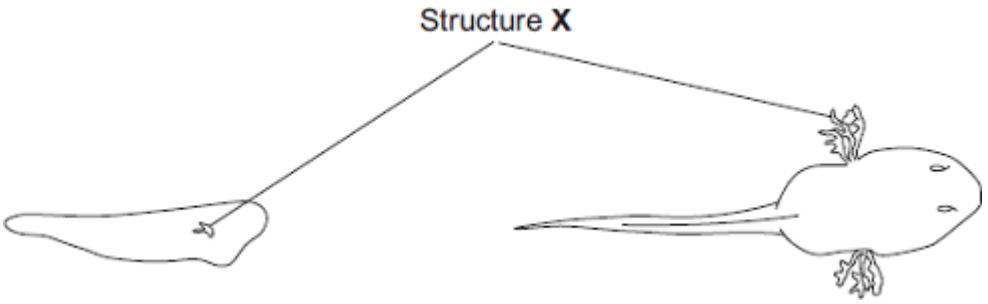
(Total 9 marks)

Q3.

The young stages of frogs are called tadpoles. The tadpoles live in fresh water.

The drawings show a tadpole just before hatching and three days after hatching.

Structure **X** helps in the exchange of substances between the tadpole and the water.



Tadpole just before hatching

Tadpole three days after hatching

(a) Name **one** substance, other than food, that the tadpole needs to exchange with the water in order to grow.

_____

(1)

(b) Suggest how the changes in the tadpole shown in the drawings help it to survive as it grows larger.

You should **not** refer to movement in your answer.
To gain full marks you should refer to structure **X**.

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(Total 5 marks)

Q1.

(a) diffusion

1

(b) (SA of one face = 2 × 2) =4

ignore units

1

(Total SA = 4 × 6) = 24

allow correct calculation using their calculated SA of 1 face × 6

1

(Volume = 2 × 2 × 2) =8

(SA:volume ratio =) 24:8 **or** 3:1

ratio must be consistent with their figures

1

(c) red (blood) cell(s)

allow erythrocyte(s)

1

(d) carbon dioxide

name takes precedence

allow CO_2

gnore CO^2 / CO2

ignore water (vapour)

1

(e)

ignore large surface area

ignore many alveoli

ignore moist lining

any **two** from:

- wall of alveolus (only) one cell thick
- wall of capillary (only) one cell thick
- cells of alveolus / capillary wall are flattened / thin
- good blood supply

if none of these mentioned

*allow **1** mark for idea of short distance between (air in) alveolus and blood*

- (well) ventilated

2

[9]

Q2.

(a) concentration of the sugar solution

1

(b) gained <u>water</u>

1

(water moves) by osmosis

or

(because) concentration of water outside the potato is greater than inside the cells / potato

allow converse statements

(because) concentration (of sugar solution) inside the potato is greater than outside the potato / cells

1

(c) all points correctly plotted

allow ± ½ a square

1

line of best fit drawn as a curve through all the points

ignore extrapolation of curve

1

(d) correct reading from their graph

allow ± ½ a square

allow answer in range 0.23 to 0.24 (mol/dm^3) if no line drawn

1

(e)

$$\frac{0.25 \times 100}{7.96}$$

allow $\frac{(8.21-7.96) \times 100}{7.96}$

1

= 3.14(070352)

1

3.14 (%)

allow correct rounding to 3 sig figs of an incorrectly calculated percentage change

1

[9]

Q3.

(a) oxygen / O_2

allow O_2
do not accept O^2

or

carbon dioxide / CO_2

allow CO2

do not accept CO^2

1

(b) any **four** from:

ignore references to tail used for locomotion

ignore reference to nostrils

- because structure X / gills has threads / filaments **or** is thin **or** tadpole has longer tail
- there is an increased surface area
- there is a shorter diffusion pathway
- therefore an <u>increase</u> in exchange

  ignore food
- eyes (now visible in older tadpole)
- so that food / danger etc can be seen

  accept reference to a good blood supply

  accept increased water flow over gills / tail will increase diffusion of gases

4

[5]

Q1.

(a) About 43% of students knew that oxygen enters a single celled organism by diffusion.
Active transport was the most common incorrect response.

(b) This structured calculation question differentiated between students very well. Approximately 17% of students gained full marks. Many students did not know how to calculate area or volume. Some of them tried to use squared or cubed numbers in their calculation. Many students gave a volume of 6, presumably by adding the numbers instead of multiplying them together.

For marking point 2, the total surface area calculation, students could make an error in calculating the surface area of one face and correctly multiply their answer by 6 to gain the second mark. Similarly, the surface area:volume ratio mark could be awarded if they gave a correct ratio for their calculated values of total surface area and volume.

(c) Around 60% of students correctly named red blood cells as the part of the blood that carries the most oxygen. Just saying blood cells was insufficient. The most common incorrect responses related to naming a type of blood vessel.

(d) About 56% of students correctly named carbon dioxide as the gas that passes out of the blood into the alveolus. Some students attempted to give the formula, rather than the name of the gas and errors were often made. For example CO2 or CO^2 did not gain the mark.

(e) About 18% of students gained one or two marks for this question. A lot of students repeated the stem of the question and said there are many alveoli providing a large surface area, which was ignored.

Common correct responses included having thin walls or having a good blood supply.
Some students referred to villi, whilst others wrote about the heart.

Q2.

This question assessed RPA 2, the effect of a range of sugar solutions on the mass of plant tissue. For any RPA investigation it is expected that students will know the dependent, independent and control variables. A third of the students identified the independent variable as the concentration of the sugar solution, but many selected the dependent variable.

For RPA 2 students should measure the change in mass or size of plant tissue and plot a graph. They should then use their graph to determine the concentration of sugar solution inside the cells. Students could not explain why the potato in 0.0 mol/dm^3 sugar solution increased in mass. For the graph, all three points had to be plotted correctly to gain 1 mark. This was generally done well. A curved line of best fit passing through all the points was expected, but if errors had been made in plotting a suitably drawn curve still gained credit. This might involve omitting an anomalous point from the curve. Very few students determined the concentration of sugar solution correctly, usually because they misread the scale.

When calculating the percentage change in mass, a common error was to omit multiplying by 100. This was just one mistake so 2 marks could be awarded for an answer of 0.0314, as this was rounded to 3 significant figures.

Q3.

(a) The vast majority of students gained credit for identifying oxygen and occasionally carbon dioxide.

(b) Some students were able to give complete descriptions of what makes a good surface for diffusion such as large surface area, thin, good blood supply and correctly linked this to an increase in exchange. The majority of students gained two marks for linking the increased surface area to the increase in exchange. In a number of cases, students did not make it clear that there was an increase in exchange, merely stating that exchange was ‘easier’ which is not creditworthy. Many students also identified the presence of eyes and their use in avoiding predators or finding food, but a significant number also discussed the adaptations in terms of locomotion.

Levels of organisation PPQs

Name: _____

Class: _____

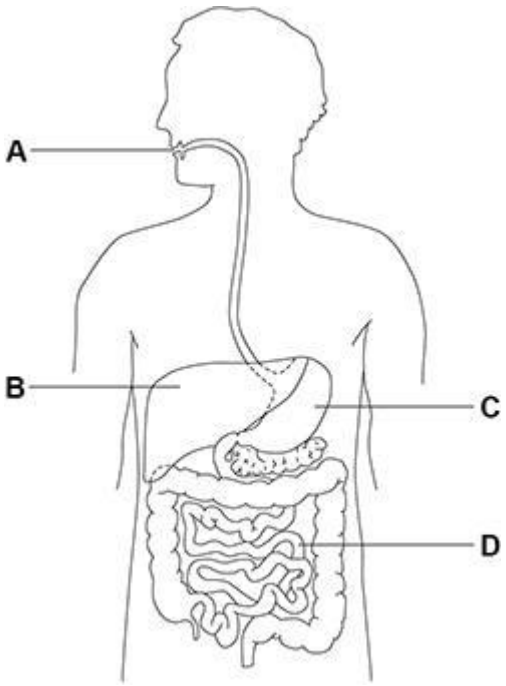
Date: _____

Time:	**37 minutes**
Marks:	**34 marks**
Comments:	**Self-assess using the mark scheme below. You can check your marks against the Examiners' comments to see if you fell into the same issues as the students who took that exam.**

Q1.

Foods are digested before they are absorbed into the blood.

The diagram below shows organs in the human digestive system.



(a) Which organ is the stomach?

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

(1)

(b) What type of enzyme is produced in the stomach?

Tick (✓) **one** box.

Carbohydrase ☐

Lipase ☐

Protease ☐

(1)

(c) Which term describes the pH in the stomach?

Give **one** reason why the stomach is this pH.

Tick (✓) **one** box.

Acidic ☐

Alkaline ☐

Neutral ☐

Reason _____

_

_____

(2)

(d) Which organ produces bile?

Tick (✓) **one** box.

Large intestine ☐

Liver ☐

Mouth ☐

Pancreas ☐

(1)

(e) How does bile help in the digestion of foods?

Tick (✓) **one** box.

It increases the surface area of fats. ☐

It is an enzyme that digests protein. ☐

It makes the pH in the small intestine acidic. ☐

(1)

A student tested different foods for the presence of protein, starch and sugar.

(f) Draw **one** line from each food molecule to the reagent used to test for the food molecule.

Food molecule	**Reagent**
Protein	Benedict's solution
Starch	Biuret reagent
Sugar	Iodine solution

(2)

(g) Give **one** safety precaution a student should take when using Benedict's solution.

_____

_____

(1)

(h) The table below shows the results for one food sample.

Test	**Benedict's test**	**Biuret test**	**Iodine test**
Colour after test	Red	Blue	Black

Which of the tests show positive results?

Tick (✓) **one** box.

All three tests ☐

Benedict's and Biuret tests only ☐

Benedict's and iodine tests only ☐

Biuret and iodine tests only ☐

(1)

(i) Starch molecules are **not** absorbed into the blood from the digestive system.

Give **one** reason why.

_____

_____

(1)

(Total 11 marks)

Q2.

Starch is digested to form sugar molecules in the digestive system.

(a) What is the name of the enzyme that digests starch?

_____

(1)

(b) Where are most food molecules absorbed?

Tick (✓) **one** box.

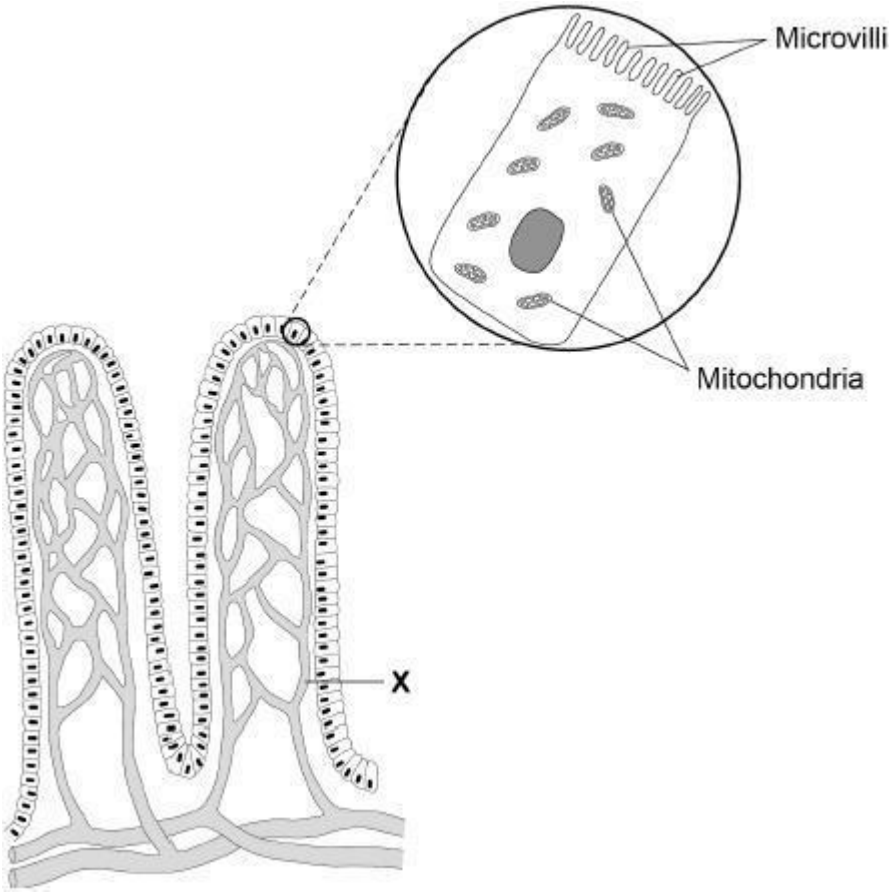
Large intestine	☐
Liver	☐
Small intestine	☐
Stomach	☐

(1)

Figure 1 shows two villi.

Figure 1 also shows one cell on the surface of a villus as seen using an electron microscope.

Figure 1



(c) Give **one** advantage of using an electron microscope compared with using a light microscope.

_____

_____

(1)

(d) What type of blood vessel is labelled **X**?

Tick (✓) **one** box.

Artery ☐

Capillary ☐

Vein ☐

(1)

(e) The real length of one villus is 0.8 mm

Calculate the image length if the villus is viewed at a magnification of ×20

Use the equation:

$$\text{magnification} = \frac{\text{size of image}}{\text{size of real object}}$$

_____

_____

_____

_____

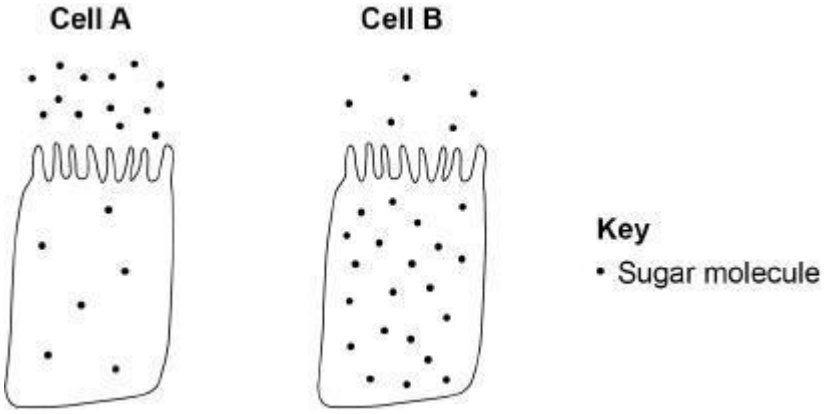
Image length = _____ mm

(3)

Figure 2 shows two cells from the surface of a villus.

There are sugar molecules inside and next to each cell.

Figure 2



(f) Name the process by which sugar moves into cell **A**.

_____

(1)

(g) Name the process by which sugar moves into cell **B**.

_____

(1)

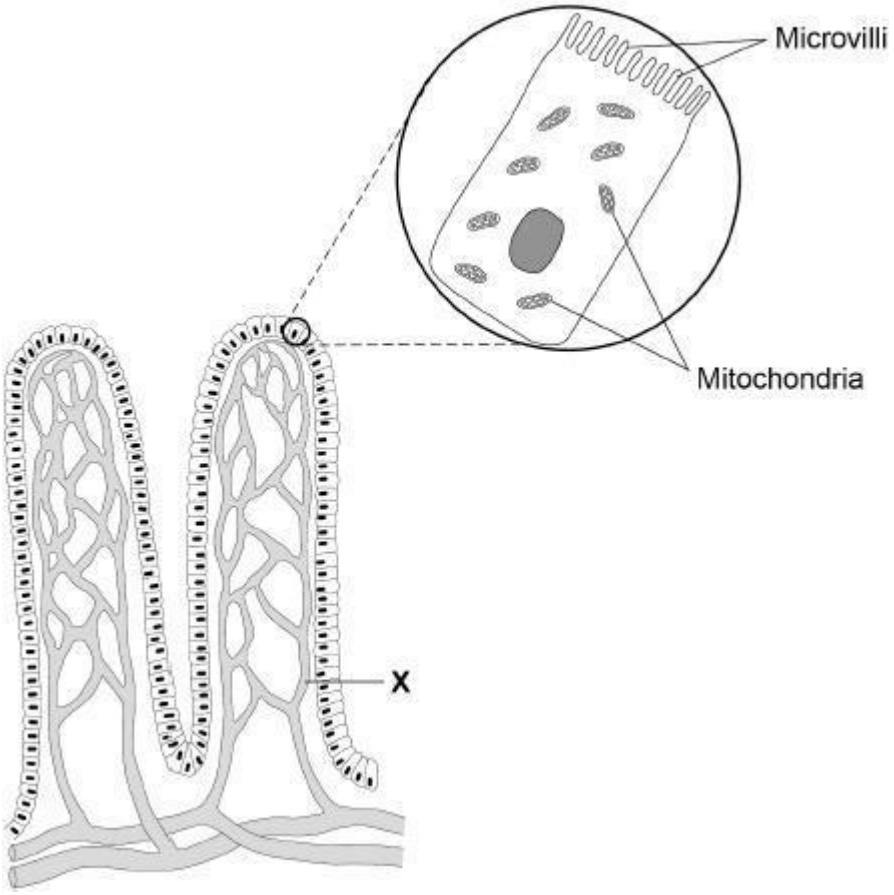
(h) Give **one** use of sugar in the body.

_____

(1)

(i) **Figure 1** is repeated below.

Figure 1



Explain how villi are adapted for efficient absorption of sugar molecules.

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(Total 14 marks)

Q3.

This question is about the heart.

(a) Why is the heart described as an organ?

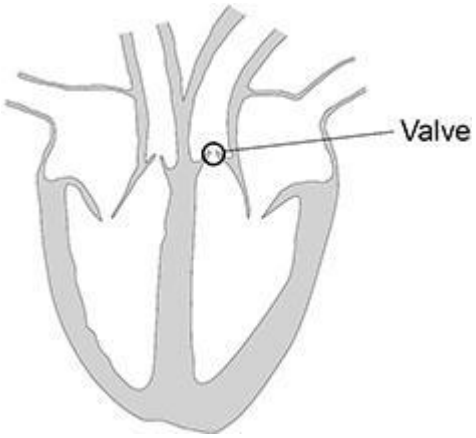
_____

_____

(1)

(b) Valves in the heart keep the blood flowing through the heart in one direction.

The diagram below shows the heart with one of the valves labelled.



Explain the effects on a person if the valve labelled in the figure above developed a leak.

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(c) Faulty heart valves can be replaced using biological or mechanical valves.

The faulty valve is replaced during an operation.

Biological valves:

- are from animals or human donors
- allow blood to flow through them normally
- wear out and stiffen over time, so may need to be replaced.

Mechanical valves:

- are made from synthetic materials
- may cause blood clots on the surface of the valve
- require anti-clotting drugs to be taken for the rest of the patient's life

- can last for a very long time in ideal conditions.

A young woman enjoys extreme sports and would like to start a family.

The woman needs a heart valve replacing.

Describe the advantages and disadvantages for this young woman of having a biological heart valve instead of a mechanical heart valve.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(Total 9 marks)

Q1.

(a) C

1

(b) **Mark with (c)**

protease

1

(c) **Mark with (b)**

acidic

1

reason:
any **one** from:
- produces (hydrochloric) acid
  allow contains (hydrochloric) acid
- optimum / best conditions for enzyme / protease to act
  allow optimum / best condition to digest food / protein
  allow ecf from (b)
  allow to kill microorganisms / bacteria / pathogens

1

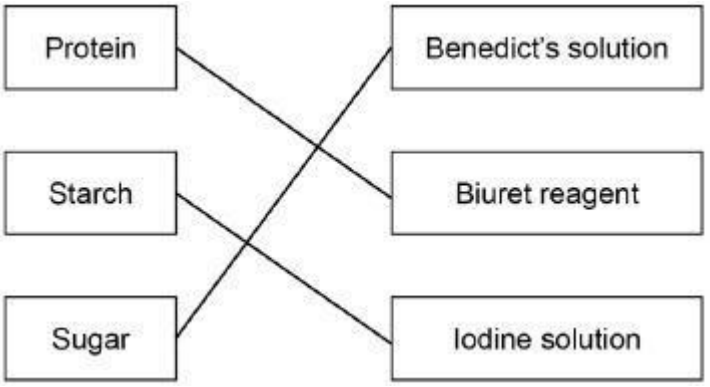
(d) liver

1

(e) it increases the surface area of fats

1

(f)



*all three correct for **2** marks*
*one or two correct for **1** mark*
extra line from a box negates that box

2

(g) any **one** from:
- wear goggles
- use a water bath to heat the solution / mixture
- wash spills from bench / skin

allow wash hands

allow wear gloves

ignore examples such as tie hair back or move bags under bench

1

(h) Benedict's and iodine tests only

1

(i) any **one** from:

- starch (molecule) is (too) large

  allow idea that starch needs to be broken down into small / soluble molecules

- starch (molecule) is insoluble

1

[11]

Q2.

(a) amylase

allow phonetic spelling
allow carbohydrase
*do **not** accept amylose*

1

(b) small intestine

1

(c) any **one** from:

- greater magnification
- higher resolving power

  allow can see (smaller) sub-cellular structures / parts

  allow can see more detail (inside cells)

  allow reference to 3-D images

1

(d) capillary

1

(e)

$$20 = \frac{\text{image length}}{0.8}$$

1

image length = 0.8 x 20

1

image length = 16 (mm)

1

(f) diffusion

1

(g) active transport

allow active uptake

1

(h) any **one** from:

- respiration

  allow as an energy source

  *do **not** accept to make / use / create / produce energy*
- to form glycogen
- to make amino acids / proteins

  allow to make lipid / fat

1

(i) **Level 2:** Relevant points (reasons/causes) are identified, given in detail and logically linked to form a clear account.

3–4

Level 1: Points are identified and stated simply, but their relevance is not clear and there is no attempt at logical linking.

1–2

No relevant content

0

Indicative content

- have (many) microvilli
- (to) increase surface area

- wall of villus only one cell thick **or** is thin
- capillaries are close to surface
- (so) short pathway

- good blood supply
- (to) transport food molecules away **or** to the body
- (and) maintain a diffusion gradient

- cells have many mitochondria
- (where) respiration takes place
- (where) energy is transferred
- (as) active transport requires energy
- energy is needed to absorb sugar / food / molecules

For Level 2 must make links between structure and it's function

[14]

Q3.

(a) it is made up of (different) tissues (that perform specific functions)

1

(b) some blood would flow back into the ventricle / heart

allow not all the blood would leave the ventricle / heart allow blood clot (may form in the heart)

*do **not** accept blood would flow back into the right ventricle*

1

(so) less oxygenated blood would be pumped to the body

ignore references to glucose

1

cells require oxygen for respiration
or
less aerobic respiration

allow more anaerobic respiration

1

(so) person would become out of breath

(so) lactic acid will build up

or
(so) less energy transferred

allow the idea of lacking energy

*do **not** accept less energy produced / made / created*

or
(so) person would be tired

1

(c) any **four** from:

(advantages of biological valve):
- reduced risk of blood clots which could cause heart attack or stroke
- reduced risk of blood clots during pregnancy / birth
- reduced risk of bleeding during pregnancy / birth
- do not need to take anti (blood) clotting drugs

ignore do not need to take blood thinners

allow do not need to take drugs for life

- no risk to foetus / baby from drugs
- reduced risk of serious bleeds if in an accident
- do not need to carry (anti-blood clotting) drugs when travelling

allow problems related to losing / obtaining drugs abroad

- low risk of rejection / immune reaction

*do **not** credit reference to rejection twice*

allow no risk of side effects from drugs

(disadvantages of biological valve):
- may be rejected

*do **not** credit reference to rejection twice*

- may have to go through surgery more than once

ignore risks from surgery unqualified

- may have to take immunosuppressant drugs

allow an animal might be killed

- have to wait for (suitable) donor

*max **three** marks if only advantages or disadvantages of biological valve given*

4

[9]

Q1.

(a) Three-quarters of the students correctly identified the stomach in the drawing of the human digestive system.

(b) 30% of students knew that a protease enzyme is produced in the stomach.

(c) Most students scored at least one mark, for knowing the pH in the stomach is acidic. A quarter of students also scored the second mark for saying the stomach produces an acid, or that acidic conditions provide the optimum conditions for enzymes in the stomach to work. Most students said 'to digest food', which was insufficient.

(d) Half of students knew that bile is produced by the liver. Most of the other students were evenly split between selecting the large intestine and the pancreas.

(e) 20% of the students said that bile increases the surface area of fats. More than half of the students thought that bile is an enzyme that digests protein.

(f) More than half of the students scored both marks for identifying the reagents used to test for protein, starch and sugar. Where a single mark was scored, this was usually for knowing that iodine solution is used to test for starch.

(g) 76% of students scored the mark, usually for saying to wear safety goggles when using Benedict's solution. Quite a lot of students said wear gloves or wash hands, both of which were allowed.

(h) 42% of students knew the colours for positive test results when using Benedict's solution and iodine solution. More than half thought the colour blue represented a positive Biuret test.

(i) Fewer than a fifth of students said that starch molecules cannot be absorbed into the blood because they are too big, or because they are insoluble. Many students said that starch is digested into sugar, but without reference to the size, or solubility, of the molecules. Quite a common answer was that starch would cause blood clots.

Q2.

This question was about the digestion of starch and absorption of sugar molecules. On the Foundation Tier, few students named the enzyme amylase and less than a third knew that foods are absorbed from the small intestine into the capillaries inside villi. A third of students said an advantage of the electron microscope over a light microscope is that it has a greater magnification. A few students correctly said an electron microscope has a higher resolution. Vague answers about clearer images or being able to see more did not gain credit.

Approximately a third of students correctly calculated image length in (e), but students should be aware that in most calculations a mark is given for the correct substitution into an equation. Few students showed this step, and where an incorrect rearrangement was made they scored 0 marks.

In (i) students were asked to explain how villi are adapted for efficient absorption of sugar molecules. Figure 2 had mitochondria and microvilli labelled, and a single layer of cells around blood vessels was shown. Students had to use these features and explain how they are useful in relation to absorbing sugar molecules. Some value had to be added, so

just listing these features could only gain a maximum of 2 marks. The mark scheme shows how logical links could be made.

Q3.

(a) 42% of students scored the mark for saying the heart is an organ because it is made up of different tissues working together. Some said it is made up of similar tissues, which was ignored.

(b) Students were asked to explain the effect that a leaky heart valve would have on a person. 56% of the students scored at least one mark, which was usually for saying that some blood would flow back into the heart. If the wrong chamber was named then this mark could not be awarded. As the question required an explanation the remaining marks had to link logically, so just saying the person would get tired was insufficient.

(c) Information about biological and mechanical heart valves was given in the question. When describing advantages and disadvantages of the biological valves, the student had to add some value to the information provided. Saying that biological valves have a reduced risk of blood clots adds little to the information given, so is not creditworthy. Something extra had to be added, as detailed in the mark scheme, as the question was set at high demand.

The advantage of a biological valve that the woman would not need to take anti-blood clotting drugs was often given, but reference to blood thinners was insufficient. If students just said ‘they wouldn’t have to take drugs’ this had to be qualified by adding ‘…for life’.

The disadvantage that the valve may be rejected was seen, and saying that it is unethical to use valves from animals was allowed.

Some students evaluated the use of biological and mechanical valves. To score marks they had to make the advantages and disadvantages for a biological heart valve over a mechanical valve clear.

Animal organ PPQs

Name: _____

Class: _____

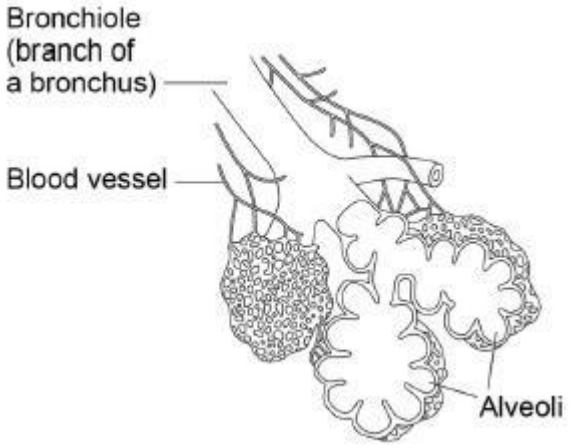
Date: _____

Time:	**35 minutes**
Marks:	**33 marks**
Comments:	**Self-assess using the mark scheme below. You can check your marks against the Examiners' comments to see if you fell into the same issues as the students who took that exam.**

Q1.

Figure 1 shows part of the lungs.

Figure 1



(a) Give **two** ways the lungs are adapted for efficient exchange of gases.

Describe how each adaptation helps to maintain efficient gas exchange.

Adaptation 1 _____

_____

Description _____

_____

Adaptation 2 _____

_____

Description _____

_____

(4)

(b) There are 5.4 million people with asthma in the UK.

What type of disease is asthma?

Tick **one** box.

An allergy ☐

A bacterial infection ☐

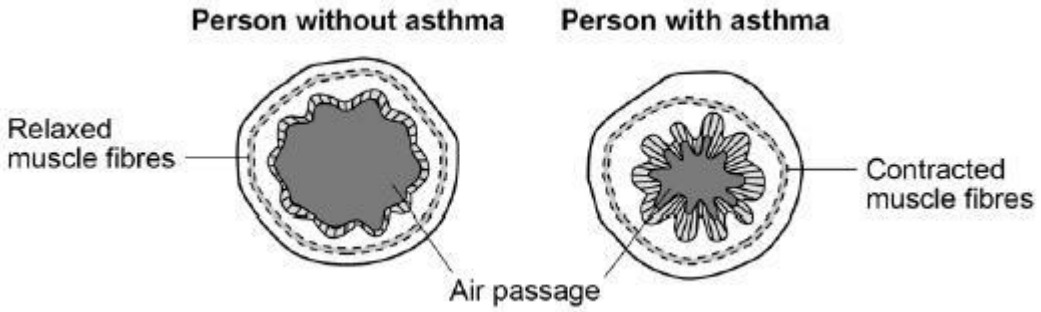
A cancer ☐

A viral infection ☐

(1)

(c) **Figure 2** shows cross-sections of bronchioles of two people.

Figure 2



Suggest why people with asthma often find it difficult to breathe.

_____

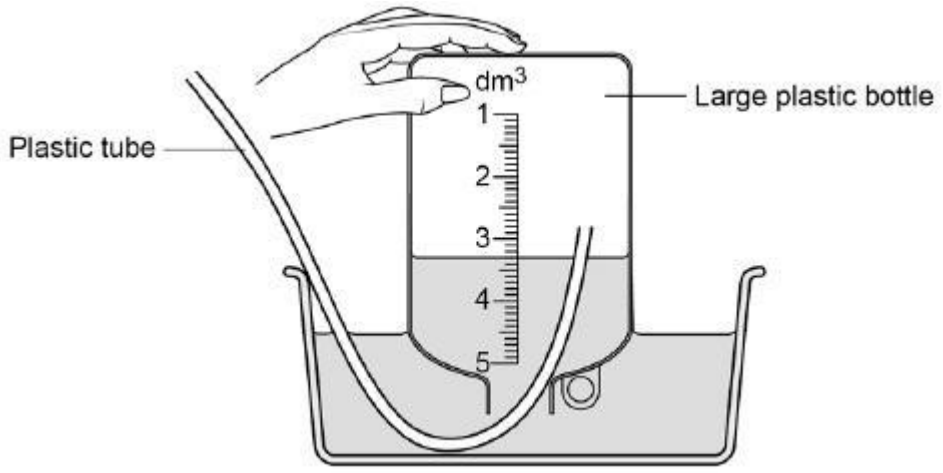
_____

(1)

(d) People with asthma often have a reduced lung volume.

Figure 3 shows the apparatus a student used to measure his lung volume.

Figure 3



This is the method used.

1 Fill the bottle with water.

2 Breathe out through the tube.

The volume of water pushed out of the bottle is equal to his lung volume.

What is the student's lung volume?

Volume = _____ dm^3

(1)

Scientists tested a new drug to treat asthma.

The scientists measured the lung volume of:
- volunteers without asthma
- some volunteers during a mild asthma attack
- other volunteers during a severe asthma attack.

Half the people in each group were given a placebo.

The other half of the people in each group were given the new drug.

The tests were carried out as a double blind trial.

(e) What is a placebo?

_____

_____

(1)

(f) Who knows which volunteers in a double blind trial are given the drug and which volunteers are given the placebo?

Tick **one** box.

The scientists but not the volunteers	☐
The scientists and the volunteers	☐
The volunteers but not the scientists	☐
Neither the volunteers nor the scientists	☐

(1)

(g) Suggest why it is a good idea that double blind trials should be used in drug testing?

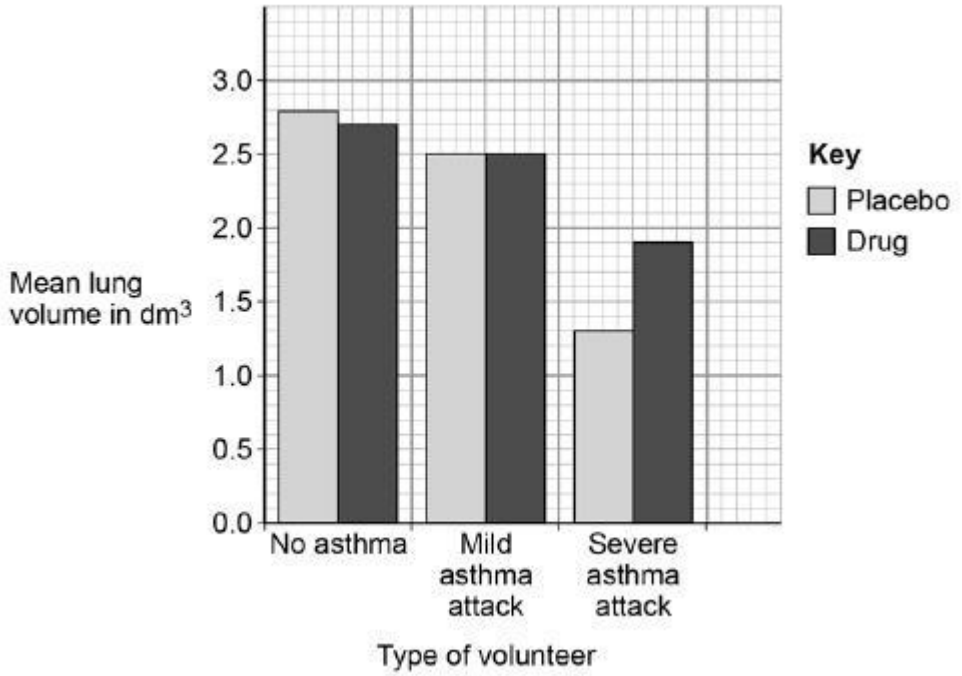
_____

_____

(1)

(h) **Figure 4** shows the results of the drug tests.

Figure 4



Give **two** conclusions that can be made about the usefulness of the drug.

1. _____

_____

2. _____

_____

(2)

(Total 12 marks)

Q2.

Describe how to test a sample of food for protein, starch and sugar.

Give the colours that would be seen if the food sample contained protein, starch and sugar.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(Total 6 marks)

Q3.

Amylase is an enzyme that digests starch.

(a) Which organs in the human digestive system produce amylase?

Tick (✓) **one** box.

Liver, small intestine and large intestine	☐
Salivary glands, stomach and liver	☐
Salivary glands, pancreas and small intestine	☐
Stomach, pancreas and large intestine	☐

(1)

A student investigated the effect of pH on the activity of amylase.

This is the method used.

1. Prepare amylase solution at pH 5
2. Mix the amylase solution with starch in a boiling tube.
3. Remove a drop of the amylase-starch mixture every 30 seconds and test it for the presence of starch.
4. Record the time when all the starch has been digested.
5. Repeat steps 1 to 4 using amylase solution prepared at pH 6, then at pH 7 and then at pH 8

(b) What was the independent variable in this investigation?

_____

_____

(1)

(c) Describe how the student would know when all the starch had been digested.

_____

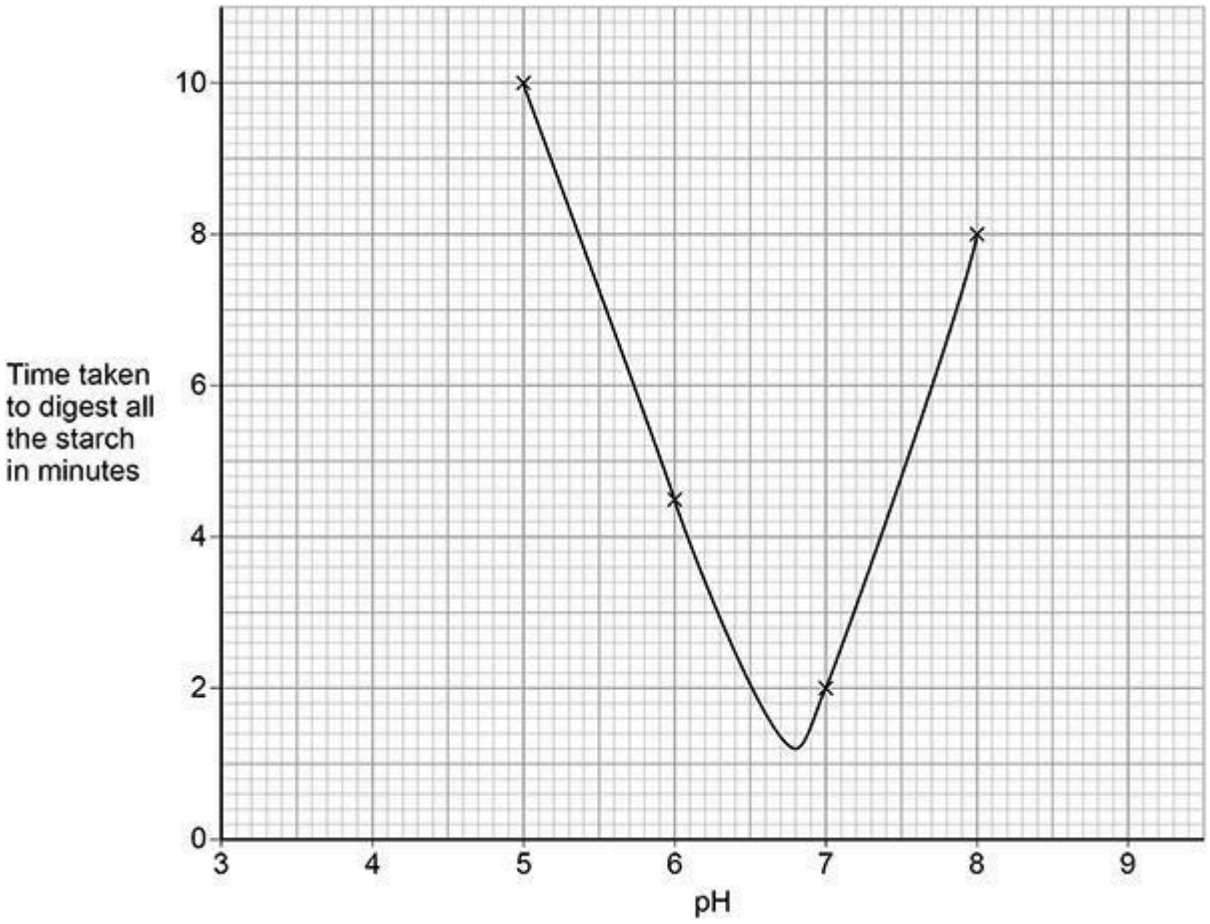
_____

_____

(1)

(d) **Figure 1** shows the student's results.

Figure 1



What was the optimum pH for the amylase?

Use **Figure 1**.

Optimum pH = _____

(1)

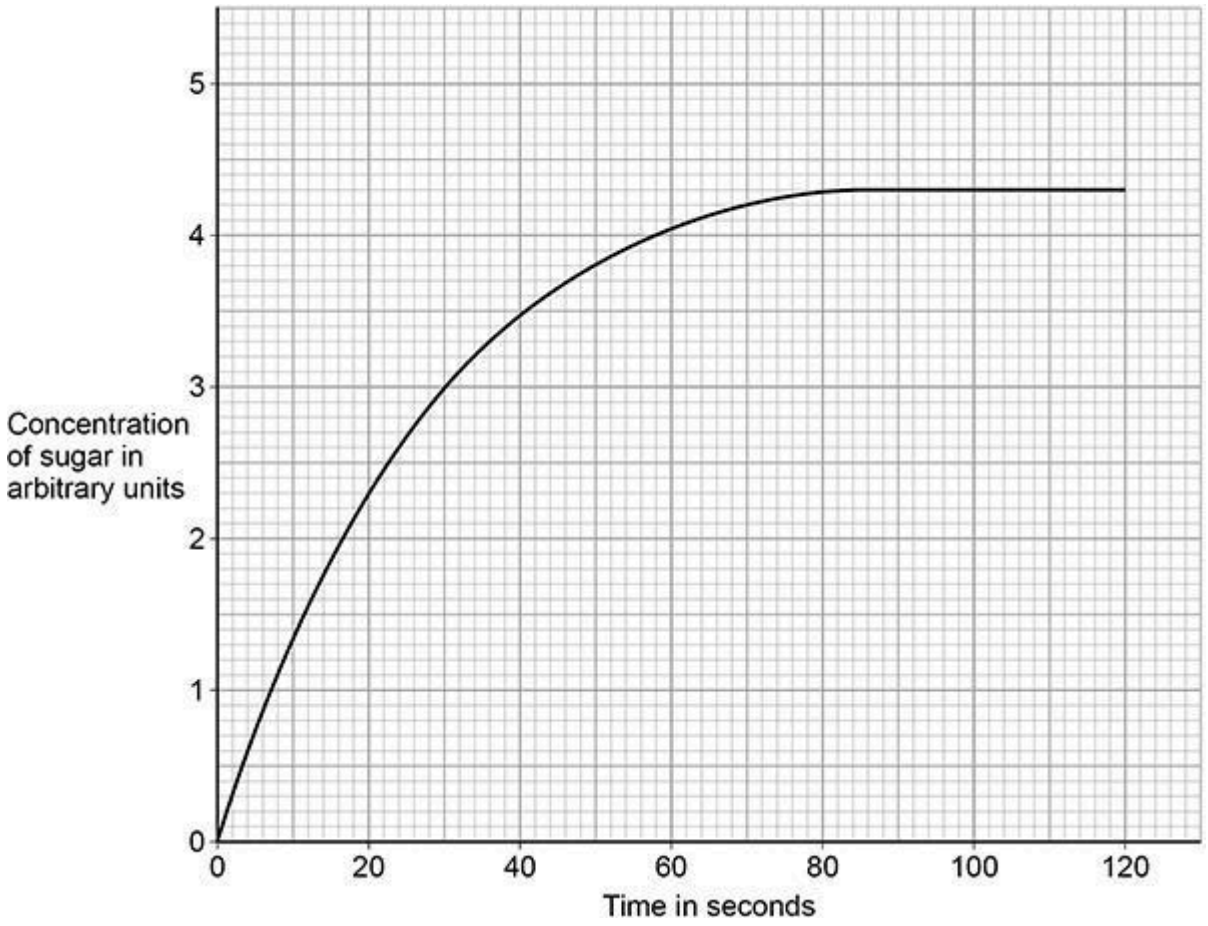
A scientist did a different investigation.

This is the method used.

1. Prepare amylase solution at the optimum pH.
2. Mix the amylase solution with starch in a boiling tube.
3. Measure the concentration of sugar every 10 seconds for 2 minutes.

Figure 2 shows the scientist's results.

Figure 2



(e) How much time did it take for the amylase to digest all the starch?

Use **Figure 2**.

Time to digest all the starch = _____ seconds

(1)

(f) Determine the rate of sugar production per minute at 40 seconds.

_____

_____

_____

_____

_____

_____

_____

Rate = _____ arbitrary units per minute

(4)

(g) Explain how the structure of enzyme molecules is related to the effect of pH on the activity of amylase.

(6)

(Total 15 marks)

Q1.

(a) any **two** adaptations with linked descriptions from:

- many alveoli to provide a large surface area
- good blood supply to maintain steep diffusion / concentration gradient
- thin walls so gases do not have far to diffuse / travel
- well ventilated to maintain steep diffusion / concentration gradient

__1__ mark for adaptation and __1__ mark for linked description
allow to collect oxygen __or__ to bring carbon dioxide to lungs

4

(b) an allergy

1

(c) any **one** from:

- narrow(er) / small(er) (air) passages / bronchioles
- less air / oxygen can pass through

1

(d) 3.3 (dm^3)

1

(e) any **one** from:

- fake drug
- inactive form of drug

1

(f) neither the volunteers nor the scientists

1

(g) to avoid / reduce bias

1

(h) any **two** from:

- drug only works for severe asthma attacks
  or
  drug only increased lung capacity in severe asthma attacks
- drug had little effect **or** slight reduction in healthy people
- drug had no effect in mild asthma attacks
- drug does not alleviate the problem entirely

2

[12]

Q2.

Level 3: The method would lead to the production of a valid outcome. All key steps are identified and logically sequenced.

5–6

Level 2: The method would not necessarily lead to a valid outcome. Most steps are identified, but the method is not fully logically sequenced.

3–4

Level 1: The method would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear.

1–2

No relevant content

0

Indicative content

Protein
- grind up food
- add Biuret (reagent / solution)

or
add copper sulfate (solution) **and** sodium hydroxide (solution)
or
add Biuret 1 and Biuret 2
- turns purple / lilac

Starch
- add iodine (solution)
- turns black / blue-black / dark blue

- ignore blue / purple

Sugar
- grind up food
- mix with water
- add Benedict's (reagent / solution)
- heat mixture (≥ 65 °C)
- in a water bath
- turns (brick) red / orange / brown / green / yellow

For Level 3 correct references to all three tests are needed.

[6]

Q3.

(a) salivary glands, pancreas and small intestine

1

(b) pH (of amylase / solution / buffer)

ignore upper and lower case letters
allow hydrogen ion / H^+ concentration
ignore acidity / alkalinity

1

(c) iodine (solution / reagent) would **not** turn black / blue-black

*allow iodine (solution / reagent) would **not** turn dark blue /*

dark purple

ignore iodine solution / reagent would not turn blue / purple

or

iodine solution / reagent would stay orange / brown

allow iodine (solution / reagent) would not change colour

1

(d) 6.8

answer line takes precedence

allow answer in range 6.75 to 6.85

1

(e) 82 (seconds)

answer line takes precedence

allow answer in range 80 to 84 (seconds)

1

(f) **View with Figure 2**

tangent drawn at 40 seconds

1

$$\text{(rate =)}\ \frac{\text{value for dy}}{\text{value for dx}}$$

eg

$$\text{(rate =)}\ \frac{2.25}{60}$$

1

calculation of rate at 40 seconds

(rate =) 0.0375 (arbitrary units per second)

allow an answer in the range 0.035 to 0.042 (arbitrary units per second)

1

(0.0375 × 60 =) 2.25 (arbitrary units per minute)

allow an answer in the range 2.1 to 2.5 (arbitrary units per minute)

if no other marks awarded allow 1 mark for

$$\left(\frac{3.5}{40} \times 60 =\right)$$

5.25 (arbitrary units per minute)

allow an answer in the range 5.175 to 5.25 (arbitrary units per minute) for this mark only

1

(g) **Level 3:** Relevant points (reasons/causes) are identified, given in detail and logically linked to form a clear account.

5–6

Level 2: Relevant points (reasons/causes) are identified, and there are attempts at logical linking. The resulting account is not fully clear.

3–4

Level 1: Points are identified and stated simply, but their relevance is not clear and there is no attempt at logical linking.

1–2

No relevant content

0

Indicative content

- enzymes are protein molecules
- (so) have a 3D structure
- lock and key theory
- have an active site
- (which) has a specific shape
- shape of active site will only match shape of substrate
- starch is substrate for amylase

- at pH values above or below the optimum the shape of active site is changed (in some molecules)
- (so) substrate can no longer fit the active site
- at extreme pH values enzyme is denatured
- (so) shape of active site is changed

- (so) amylase can no longer digest starch
- (so) rate of digestion decreases

For Level 3 reference to enzyme structure and effect of pH on enzyme activity are needed

[15]

Q2.

This question was common with Combined Science: Trilogy Biology Paper 1 Higher Tier.

This was an extended response question which assessed knowledge of Required Practical Activity 3: using qualitative reagents to test a sample of food for protein, starch and sugar. A fifth of students did not attempt the question and half scored zero. It was evident that only a few students were familiar with the practical. Very little knowledge of food tests was demonstrated.

Q3.

(a) Three-quarters of students knew that amylase is produced by the salivary glands, pancreas and small intestine.

(b) Three-quarters of the students correctly identified the pH of the amylase solution as the independent variable. Many did not write pH correctly, but as the skill was to identify the independent variable, this was ignored. Some students gave control variables, whilst a few gave the dependent variable.

(c) 30% of students answered this question correctly. The question was set at high demand, so to score the mark the student had to say that iodine solution would not turn blue-black, or iodine solution would stay orange. Both the test solution and the colour had to be given. Many students gave a description of the colour of the solution, but they did not name it.

(d) Half of the students interpreted the graph correctly and gave the optimum pH for the amylase as 6.8

(e) 92% of students interpreted the graph correctly. The time for all the starch to be digested was 82 seconds, but the vast majority of students gave the value 80 seconds. This was within the range allowed.

(f) This question was set at the highest level of demand. A third of students scored one mark. This was usually for the compensation mark. They calculated the mean rate of sugar production at 40 seconds. Some students drew a suitable tangent, but made errors when reading the change in concentration and the change in time from the graph. 4% of the students scored full marks for the question.

(g) 47% of students performed at Level 2 or above. Most students referred to enzymes having an active site, and some went on to describe how enzymes work. Less than a fifth of students clearly explained the effect of pH on the activity of amylase; with some saying that the enzyme could be denatured.

Plant organ PPQs

Name: _____

Class: _____

Date: _____

Time:	**40 minutes**
Marks:	**38 marks**
Comments:	**Self-assess using the mark scheme below. You can check your marks against the Examiners' comments to see if you fell into the same issues as the students who took that exam.**

Q1.

This question is about plant transport systems.

(a) Which **organ** in a plant absorbs water from the soil?

_____

(1)

(b) The concentration of nitrate ions in the soil is lower than the concentration of nitrate ions inside a plant.

How would the nitrate ions move from the soil into the cells of this plant?

Tick (✓) **one** box.

By active transport ☐

By diffusion ☐

By osmosis ☐

(1)

Dissolved sugars are transported in the phloem.

(c) What is the name of the process that moves dissolved sugars through the phloem?

Tick (✓) **one** box.

Evaporation ☐

Osmosis ☐

Translocation ☐

(1)

(d) Give **one** use of sugars in a plant.

_____

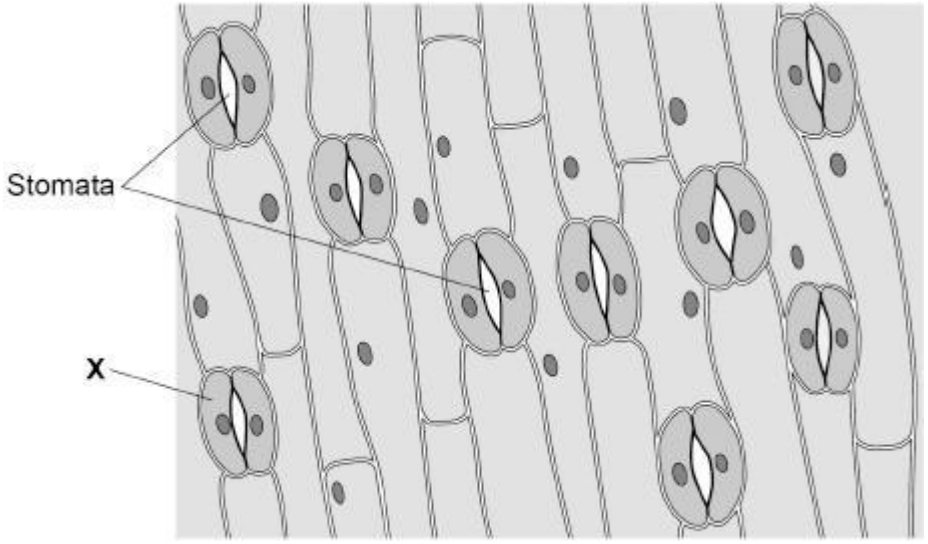
_____

(1)

Stomata are openings on the surface of a leaf.

Stomata allow gases to move into and out of a leaf.

The figure below shows the surface of a leaf.



(e) What is cell **X**?

Tick (✓) **one** box.

Guard cell ☐

Meristem cell ☐

Palisade cell ☐

(1)

(f) Why do the stomata open during the day?

Tick (✓) **one** box.

To allow carbon dioxide in ☐

To allow nitrogen in ☐

To allow oxygen in ☐

(1)

(g) The area of the leaf shown in the figure above is 0.25 mm^2.

Calculate the number of stomata per mm^2 for the leaf in the figure above.

Use the equation:

$$\text{number of stomata per mm}^2 = \frac{\text{number of stomata}}{\text{area in mm}^2}$$

_____

_____

_____

Number of stomata per mm^2 = _____

(2)

A student investigated the number of stomata per mm^2 on the upper and lower surfaces of leaves.

The leaves were taken from the same plant.

The table below shows the results.

Leaf	**Number of stomata per mm²**	
	Upper surface	**Lower surface**
1	0	37
2	1	36
3	2	30
4	1	32
5	1	35
Mean	1	**X**

(h) Calculate mean value **X** in the table above.

_____

_____

_____

X = _____

(2)

(i) Water vapour is lost through stomata.

Explain the difference in the number of stomata on the upper and lower surfaces of the leaves.

Use the table above.

_____

_____

_____

_____

_____

_____

(3)

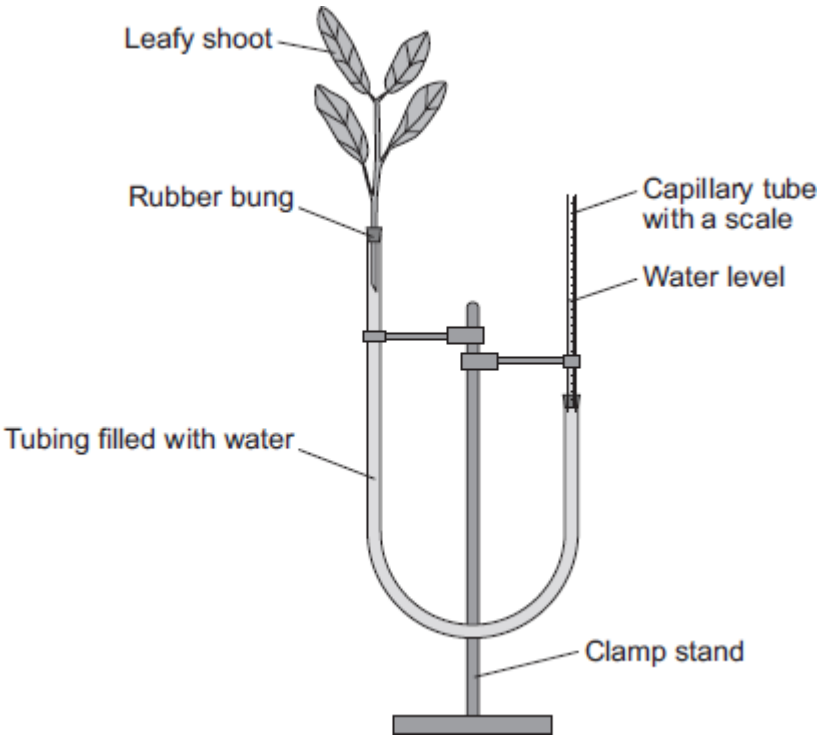
(Total 13 marks)

Q2.

A potometer is a piece of apparatus that can be used to measure water uptake by a leafy shoot.

Figure 1 shows a potometer.

Figure 1



Some students used a potometer like the one shown in **Figure 1.**

- They measured the water taken up by a shoot in normal conditions in a classroom.
- As the water was taken up by the shoot, the level of water in the capillary tube went down.
- The students recorded the level of the water in the capillary tube at 2-minute intervals for 10 minutes.

Table 1 shows the students' results.

Table 1

Time in minutes	0	2	4	6	8	10
Level of water (on scale) in capillary tube in mm	2.5	3.6	4.4	5.4	6.5	7.5

The area of the cross section of the capillary tube was 0.8 mm^2.

(a) (i) Complete the following calculation to find the volume of water taken up by the shoot in mm^3 per minute.

Distance water moved along the scale in 10 minutes = _____ mm

Volume of water taken up by the shoot in 10 minutes = _____ mm^3

Therefore, volume of water taken up by the shoot in 1 minute = _____ mm^3

(3)

(ii) The students repeated the investigation but this time placed the potometer next to a fan blowing air over the leafy shoot.

Suggest how the results would be different. Give a reason for your answer.

_____

_____

_____

_____

(2)

(b) The students repeated the investigation at different temperatures.

The results are shown in **Table 2.**

Table 2

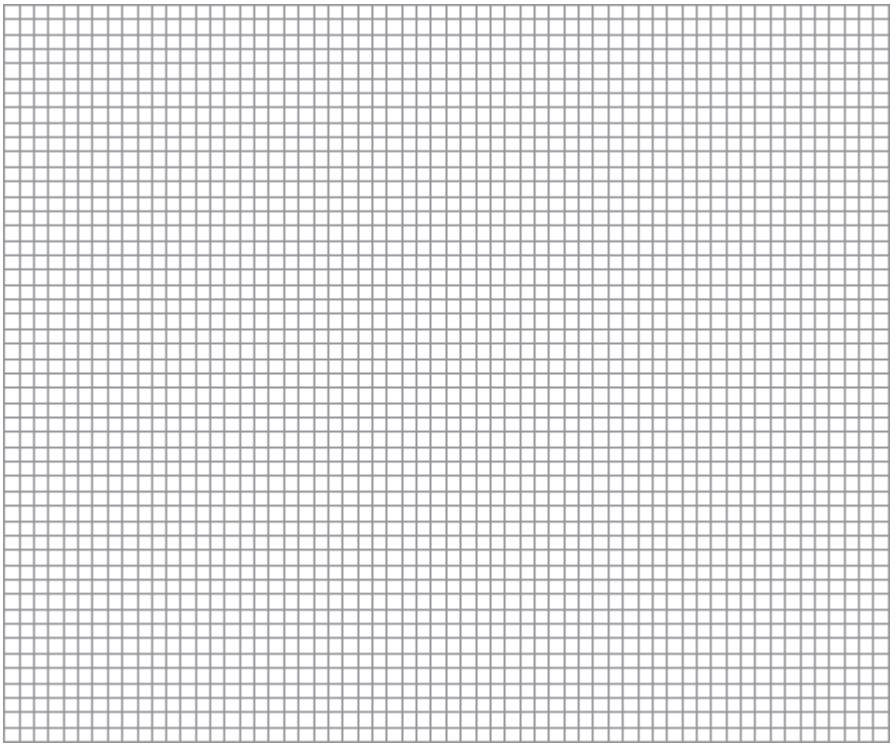
Temperature in °C	**Rate of water uptake in mm^3 per minute**
10	0
15	0.4
20	1.0
25	2.1
30	3.2

35	4.0
40	4.4

Plot the data from **Table 2** on the graph paper in **Figure 2**.

Choose suitable scales, label both axes and draw a line of best fit.

Figure 2



(5)

(c) What would happen to the leaves if the potometer was left for a longer time at 40 °C?

Explain your answer.

_____

_____

_____

_____

_____

_____

(3)

(Total 13 marks)

Q3.

This question is about plant transport systems.

(a) Describe how water is transported from the soil to the atmosphere through a plant.

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(b) Dissolved sugars are moved through a plant in phloem tissue.

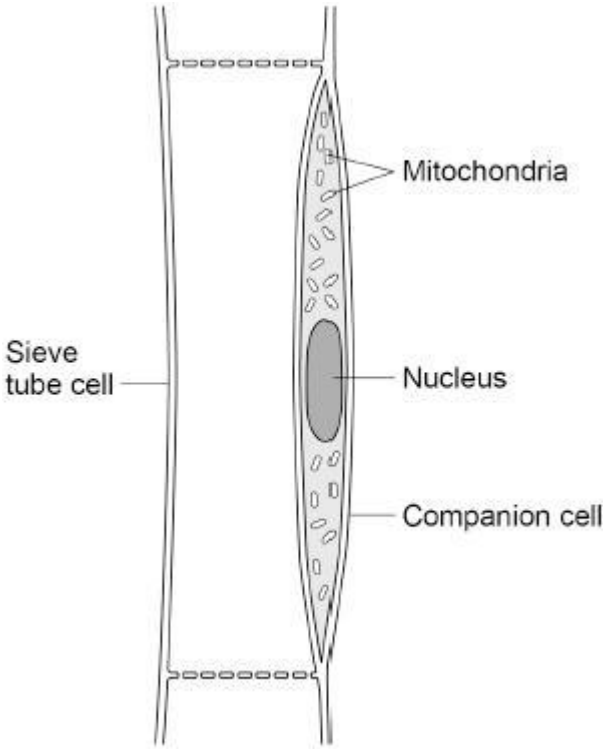
What is the name of the process that moves dissolved sugars through phloem tissue?

_____

(1)

Phloem tissue is made of sieve tube cells and companion cells.

The figure below shows a section of phloem tissue.



(c) Explain **one** way **sieve tube cells** are specialised for their function.

Use the figure above.

_____

_____

_____

_____

(2)

(d) What does the structure of the companion cells suggest about the process that moves dissolved sugars through the phloem tissue?

Give a reason for your answer.

Use the figure above.

_____

_____

_____

_____

(2)

(e) Describe why it is important that dissolved sugars are moved both upwards **and** downwards in a plant.

_____

_____

_____

_____

_____

_____

(3)

(Total 12 marks)

Q1.

(a) root

*do **not** accept root hair (cells)*

1

(b) by active transport

1

(c) translocation

1

(d) any **one** from:

- respiration

  allow to release energy

  *do **not** accept to produce / make / create energy*

  allow for growth
- (used) to produce starch
- (used) to produce fat / oil
- (used) to produce cellulose
- (used) to produce amino acids / protein

1

(e) guard cell

1

(f) to allow carbon dioxide in

1

(g) $\frac{9}{0.25}$

1

36

*do **not** accept if a unit is given allow correct calculation using*

$\frac{9}{25}$

1

(h) $\frac{37 + 36 + 30 + 32 + 35}{5}$

allow $\frac{170}{5}$

1

34

1

(i) there are fewer stomata on the upper surface of the leaves

allow converse statements a comparative term is required

1

(conditions on upper surface will:) any **one** from:
- be warmer
- be drier
- be more exposed to wind
- have more light

1

(so) less water will be lost

1

[13]

Q2.

(a) (i) 5.0

1

(5 × 0.8) **or** 4
allow ecf from distance

1

0.4
allow ecf from 10-min volume

1

(ii) increased (rate of uptake)

1

more transpiration / evaporation

1

(b) correct scales
allow reversed axes

1

correctly labelled axes with units

1

correct points
*one plot error = max **1** mark*

2

curved line of best fit
allow correct straight line

1

(c) leaves <u>wilt</u>

1

because plants lose too much water (by evaporation)

1

through the <u>stomata</u>
or
because cells become <u>plamolysed</u>
or
<u>stomata</u> close
controlled by <u>guard cells</u>

to prevent wilting

1

[13]

Q3.

(a) (absorbed from soil) by osmosis through root hair (cells)

allow (absorbed from soil) by diffusion through root hair (cells)

1

travels through xylem (vessels) to the leaves

ignore travels upwards in the xylem unqualified

1

lost through stomata (to atmosphere)

1

idea of driven by evaporation / transpiration

ignore evaporation / transpiration unqualified

1

(b) translocation

1

(c) have pores in the end walls

allow sap for dissolved sugars

1

(so) dissolved sugars / food / contents can move from cell to cell

or

no nucleus **or** few / no sub-cellular structures (1)

allow few / no organelles

ignore cells are empty

to maximise space for movement of dissolved sugars / food / contents (1)

allow thick / rigid cell wall (1) to withstand pressure inside cell

1

(d) any **one** from: (the process):

- requires energy
- is an active process
- uses active transport

1

(reason) cells have many mitochondria

allow flow of dissolved sugars / food in sieve tube cell is not impeded (1)

(reason) companion cell is flattened (1)

1

(e) sugars are made in the leaves by photosynthesis

allow glucose for sugar

allow sugars are not made in the root / meristems (by photosynthesis)

1

all cells / tissues need sugar for respiration

allow every cell / tissue needs sugar for respiration

allow whole plant needs sugar as an energy source

1

(sugars) transported to meristems for growth / cell division / mitosis

or

(sugars) transported for storage as starch / fat / oil

1

[12]

Q1.

This question was about plant transport systems. Half of the students said that water is absorbed from the soil through the root, with stem being a common incorrect response. The name of an organ was asked for, so naming root hair cells was incorrect. Almost half of the students knew that nitrate ions are absorbed from the soil by active transport, with the remaining students being equally split between diffusion and osmosis. Over half knew that translocation is the process which moves sugars through the phloem. A similar proportion of students correctly named the guard cells and knew that the stomata open during the day to allow carbon dioxide to enter the leaf.

The two calculation questions were done reasonably well. When calculating the number of stomata per mm^2 no tolerance was allowed on counting the number of stomata in the figure. A common error was to divide 9 by 0.25^2 which was incorrect. Students who showed their working and divided 9 by 25 giving an answer of 0.36 scored 1 mark. Students who added a unit to a correct answer only scored 1 mark. Almost three quarters of students correctly calculated the mean number of stomata on the lower surface of the leaf, but some gave the median value of 35 instead. Almost half the students scored 1 mark in (i) for saying there are fewer stomata on the upper surface of leaves, but very few could explain why. Many thought the stomata were to allow water to enter the leaf.

Q2.

(a) (i) This three-step calculation proved to be a good discriminator for students. About half the students gained full marks. Many students benefitted from the 'error carried forward (ecf)' rule; a significant number of responses put 7.5mm (highest recorded level), with $6mm^3$ and 0.6 mm^3 for parts 2 and 3 respectively. Some students also gave 29.9mm (total of all readings) with corresponding ecf.

(ii) Students were asked to predict how the results would be different in windy conditions. Over half the cohort was able to do this. Some students did not gain the second marking points because key terms like transpiration or evaporation were not used. More water loss was not sufficient.

Examples of misunderstandings in the responses included:

- increased temperature due to fan
- cooler due to fan, therefore needs less water
- responses in terms of photosynthesis
- direct effects of fan on plant, e.g. blowing it over.

(b) Two thirds of students scored full marks on plotting the graph. However, many students reversed the axes, which this was not penalized. The most common plotting error was at 10 °C which was either omitted or plotted at 0 °C. A curved line of best fit was expected but a straight one was accepted. A line drawn point-to-point was not accepted. A few students plotted a bar chart for which a maximum of three marks were awarded.

(c) This question on wilting was not well answered and only a third of students scored more than 1 mark out of 3. Few students were able to describe either the reasons for wilting or how it could be prevented. Key terms that were expected in the mechanism, like guard cells and stomata, were not used.

A significant number of responses were in terms of rate of uptake at 40°C rather than loss (referring back to 7aii possibly), and these often went on to argue that as the uptake was high the plant would get too much water and needed to lose some.

Other fairly common misunderstandings included:

- arguments relating to enzymes denaturing
- more photosynthesis due to warm temperature therefore stomata would be opened to let water in
- overheating, with no reference to water loss or wilting.

Q3.

This question was about plant transport systems and the questions required detailed responses. Few students could describe how water is transported from the soil to the atmosphere through a plant. Most responses lacked the correct terminology or detail. A third of students scored any marks. A fifth of students knew the term translocation.

Few students identified any adaptation of sieve tube cells, although a few noticed that companion cells have many mitochondria. Saying the cells had mitochondria was insufficient, as some are found in all plant cells.

A tenth of students could give a reason why dissolved sugars must be moved upwards and downwards in a plant. Some mentioned respiration, but did not link this to the question. A reference to the whole plant, or all cells, needing sugar for respiration was needed.

Communicable diseases PPQs

Name: _____

Class: _____

Date: _____

Time:	**33 minutes**
Marks:	**30 marks**
Comments:	**Self assess using the mark scheme below. You can check your marks against the Examiners comments to see if you fell into the same issues as the students who took that exam.**

Q1.

This question is about disease.

Rose black spot is a disease where black spots develop on the leaves of rose plants.

(a) What type of pathogen causes rose black spot disease?

Tick (✓) **one** box.

Bacterium	☐
Fungus	☐
Protist	☐
Virus	☐

(1)

(b) Plants with rose black spot disease often have yellow leaves.

Suggest **one** reason why the leaves are yellow instead of green.

_____

_____

(1)

(c) Explain why plants with yellow leaves grow slowly.

_____

_____

_____

_____

(2)

(d) The spread of rose black spot can be controlled using different methods.

Draw **one** line from each method of control to the explanation of how it works.

Method of control	**Explanation**
_____	Creates a barrier to the movement of

Remove and burn infected leaves	pathogens
	Pathogens are killed
	Reduces the chance of pathogens being spread by water droplets
Water the roots of the plant only, **not** the leaves	
	Reduces the temperature so pathogens reproduce less

(2)

(e) Tobacco plants may become infected with a pathogen called TMV.

What type of pathogen is TMV?

Tick (✓) **one** box.

- Bacterium ☐
- Fungus ☐
- Protist ☐
- Virus ☐

(1)

Malaria is a disease caused by a protist.

(f) How is the malaria pathogen transferred to humans?

_____

_____

(1)

(g) How can the spread of malaria pathogens be reduced?

Tick (✓) **one** box.

Avoid sexual contact ☐

Cook food thoroughly ☐

Drain water from swamps ☐

Use a tissue when sneezing ☐

(1)

(Total 9 marks)

Q2.

Bacteria can cause a variety of diseases in humans.

(a) What are **two** similarities between a bacterial cell and an animal cell?

Tick (✓) **two** boxes.

Both have a cell membrane. ☐

Both have a cell wall. ☐

Both have a nucleus. ☐

Both have cytoplasm. ☐

Both have plasmids. ☐

(2)

(b) Salmonella food poisoning is caused by bacteria in food.

Give **one** symptom of salmonella food poisoning.

Do **not** refer to vomiting or diarrhoea in your answer.

_____

_____

(1)

(c) What is the name of the first antibiotic developed?

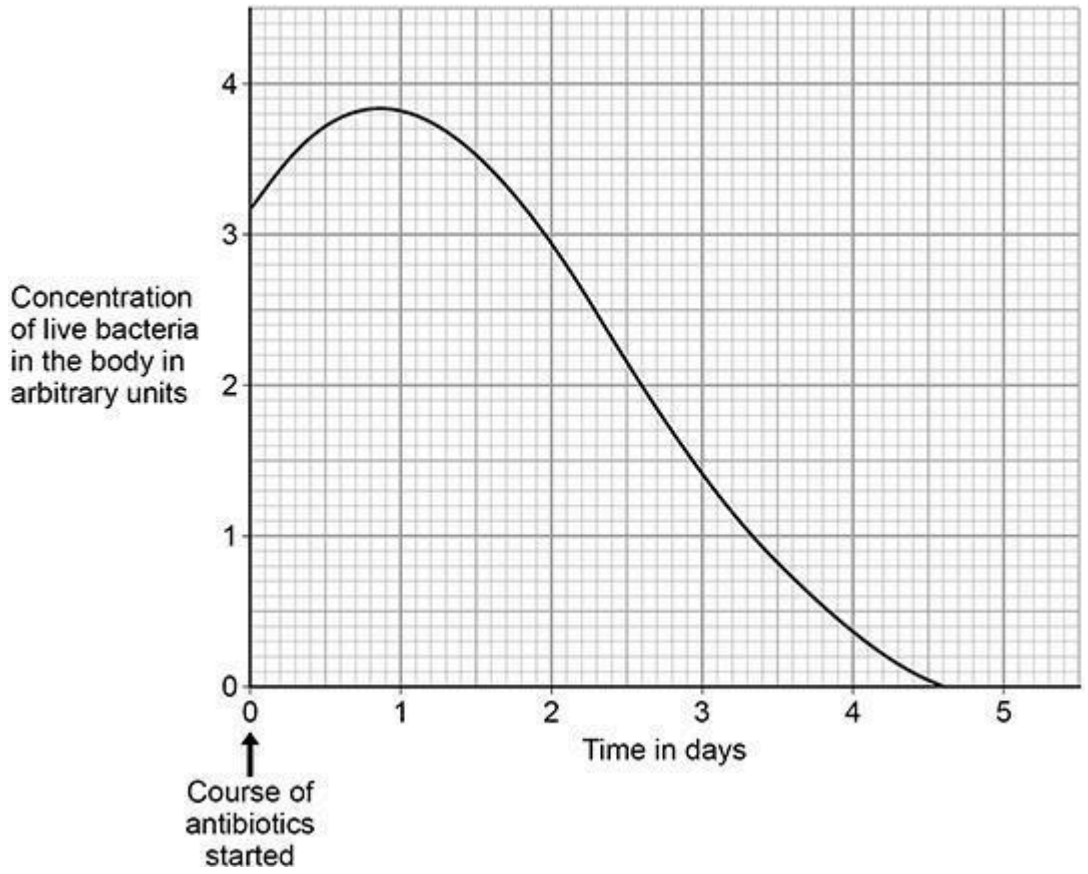
_____

(1)

A child with a severe bacterial infection was given a course of antibiotics.

Figure 1 shows how the concentration of live bacteria in the child's body changed when taking the course of antibiotics.

Figure 1



(d) The concentration of live bacteria in the body continued to increase after starting the course of antibiotics.

Suggest **one** reason why.

_____

_____

(1)

(e) After 3 days of taking the antibiotic:

- the child felt better
- there were still bacteria in the child's body.

Why did the child feel better?

Tick (✓) **one** box.

Bacteria had become immune to the antibiotic. ☐

The child had become resistant to the bacteria. ☐

There were fewer toxins in the body than at day 0 ☐

(1)

(f) Suggest why doctors do **not** give antibiotics to patients with minor infections.

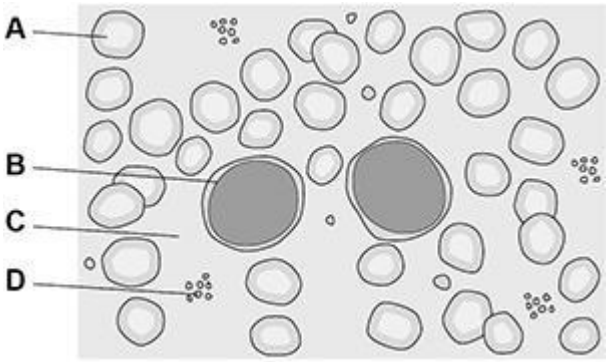
_____

_____

(1)

Figure 2 shows blood viewed using a microscope.

Figure 2



Blood viewed using a microscope © jarun011 / iStock

(g) A vaccine will stimulate the production of antibodies.

Which part of the blood in **Figure 2** produces antibodies?

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

(1)

(h) Which part of the blood in **Figure 2** starts the clotting process?

Tick (✓) **one** box.

A ☐ B ☐ C ☐ D ☐

(1)

(Total 9 marks)

Q3.

Cells are the basic units of all forms of life.

(a) Describe **four** differences between a bacterial cell and a plant cell.

1. _____

_____

2. _____

_____

3. _____

_____

4. _____

_____

(4)

(b) Gonorrhoea is a bacterial disease.

A new vaccine is being developed against gonorrhoea.

Describe how a vaccine would work to prevent gonorrhoea.

_____

_____

_____

_____

_____

_____

_____

_____

(4)

Another disease caused by bacteria is salmonella food poisoning.

In the UK, chickens are vaccinated against *Salmonella* bacteria to reduce the number of cases of food poisoning in humans.

(c) Explain how vaccinating chickens reduces the number of cases of salmonella food poisoning.

_____

_____

_____

_____

(2)

(d) Give **one** way that the spread of salmonella food poisoning from one human to another is controlled.

Do **not** refer to vaccination in your answer.

_____

_____

(1)

(e) The number of cases of salmonella food poisoning is usually higher in summer than in winter.

Suggest **one** reason why.

_____

_____

(1)

(Total 12 marks)

Q1.

(a) fungus

1

(b) less / no chlorophyll
or
chlorophyll has been broken down

allow reference to chloroplasts for chlorophyll

1

(c) less photosynthesis
or
less light absorbed

1

(so) less glucose / sugar formed

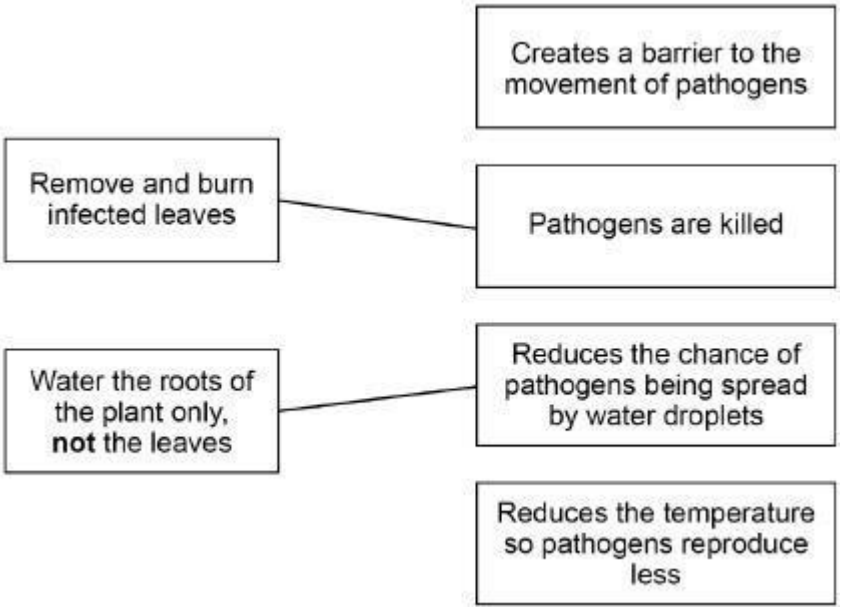
1

or

less light absorbed (1)

(so) less photosynthesis (1)

(d)



extra line from a box negates that box

2

(e) virus

1

(f) by mosquito bites

allow by mosquitos

1

(g) drain water from swamps

1

[9]

Q2.

(a) both have a cell membrane

1

both have cytoplasm

1

(b) any **one** from:

- fever

  allow high temperature

  allow sweating / chills

- abdominal / stomach cramps

  ignore vomiting / sickness / diarrhoea

  ignore feel unwell unqualified

  ignore rashes

1

(c) penicillin

allow phonetic spelling

1

(d) any **one** from:

- only a few bacteria killed so live bacteria continued to reproduce

  allow bacteria reproducing when course started

- time delay before antibiotic reached bacteria

  allow takes time (for antibiotic) to travel through the body

- time delay before antibiotic could kill bacteria

  allow takes time (for antibiotic) to work

1

(e) there were fewer toxins in the body than at day 0

1

(f) to reduce / prevent resistant strains / bacteria developing

ignore references to bacteria becoming immune

or

to reduce / prevent antibiotic resistance (in bacteria)

allow because they will get better without taking any antibiotics

ignore body will fight the infection unqualified

allow some infections are caused by viruses

allow because they have been told not to by NHS / NICE

1

(g) B

1

(h) D

1

[9]

Q3.

(a) any **four** from:

- bacterial cell is smaller (than a plant cell)

  allow converse statements 'it' refers to bacteria

- bacterial cell does **not** have chloroplasts (plant cell does)

  ignore chlorophyll

- bacterial cell does **not** have its DNA / genetic material inside a nucleus (plant cell does)

  *allow bacterial cell does **not** have a nucleus (plant cell does)*

  allow bacterial cell has DNA / genetic material in a ring / loop (plant cell does not)

  allow bacterial cell has DNA / genetic material free in cytoplasm

- bacterial cell (may) have plasmids (plant cell does not)

- bacterial cell does **not** have mitochondria (plant cell does)

- cell wall in bacterial cells is **not** made of cellulose (cell wall in plant cells is)

- bacterial cell does **not** have a large / permanent vacuole (plant cell does)

- bacterial cell has smaller ribosomes (than plant cells)

  *do **not** accept idea that bacterial cells do not have ribosomes*

  allow bacterial cell (may) have a flagellum (plant cells do not)

  allow bacterial cell (may) have a slime capsule (plant cell does not)

4

(b) any **four** from:

- dead / inactive / weakened form of pathogen / bacterium / microorganism is introduced / injected

  allow introduce / inject antigen(s) from the pathogen

  allow dead / inactive / weakened form of Gonorrhoea (bacteria) introduced / injected

  *do **not** accept inject Gonorrhoea disease*

- white blood cells stimulated to produce antibodies

*do **not** accept incorrect white blood cell, eg phagocyte*

- reference to memory cells made or remain
- on re-exposure specific / correct antibodies are made (very) quickly

  allow on re-exposure specific / correct antibodies are produced in large quantities
- bacteria / pathogens / microorganisms killed and do not produce a large enough population to cause the disease

  allow bacteria / pathogens / microorganisms killed and do not produce a large enough population to produce toxins

4

(c) fewer bacteria / pathogens in chicken / eggs / food

ignore references to immunity unqualified

allow fewer chickens / eggs will carry the bacteria / pathogens ignore chickens do not get disease / infected

1

(so) fewer bacteria are ingested (by humans)

allow idea of fewer bacteria being passed on to humans in food

or

fewer bacteria / pathogens ingested (by humans) (1)

(so) fewer toxins produced (1)

allow idea of fewer bacteria being passed on to humans in food (1)

1

(d) wash hands before preparing food

ignore wash hands unqualified

allow good food hygiene

wash hands after using the toilet

allow clean areas where a person has been ill

allow do not shake hands (with someone who has food poisoning)

1

(e) warmer weather so bacteria reproduce / increase faster

ignore bacteria are killed at low temperatures

allow food not cooked properly on barbeques

1

[12]

Q1.

(a) 59% of the students knew that rose black spot is caused by a fungus. Almost a fifth thought it was caused by a bacterium.

(b) 15% of students scored the mark for saying the leaves are yellow because they have little or no chlorophyll. Saying they had few chloroplasts was allowed. Some said the chloroplasts or chlorophyll had been damaged or destroyed, which was creditworthy, but saying the chloroplasts were killed was ignored. Quite a lot of students said the leaves were yellow because they couldn't photosynthesise.

(c) A third of students scored one mark, with very few achieving two marks. The most common correct answer was that there would be less photosynthesis. References to light were often phrased poorly. Leaves getting less light was ignored; they had to say less light was absorbed.

(d) Most students scored at least one mark, with 63% of students achieving both marks for the control of rose black spot.

(e) 40% of students knew that the pathogen TMV is a virus. A quarter thought it is a bacterium.

(f) Just under half the students knew that malaria is transferred to humans by mosquitos. A whole range of incorrect suggestions were given, including coughs and sneezes, sexual intercourse, in food or dirty water and by physical contact.

(g) 42% of students recognised that the spread of malaria pathogens can be controlled by draining water from swamps. Just over a quarter thought that using a tissue when sneezing would reduce the spread.

Q2.

Foundation

(a) A quarter of students scored both marks for identifying the cell membrane and cytoplasm as structures that are found in both bacterial and animal cells. Just over three-quarters scored at least one mark. Two fifths of students incorrectly thought that both types of cell contained a nucleus.

(b) One symptom of salmonella food poisoning was asked for, with students instructed not to refer to vomiting and diarrhoea. Almost half of the students were awarded the mark, usually for stomach ache or fever. Many described fever as having a high temperature or sweating, which were allowed. A few said 'nausea' which is equivalent to vomiting, and so was ignored. Many references to secondary symptoms of an infection were given, which could have applied to a wide range of infections. For example, tiredness, fatigue, headaches, dizziness, fainting or dehydration. These were all ignored. A primary symptom, such as those given in the specification, was needed.

(c) 36% of students said that penicillin was the first antibiotic developed. A wide range of phonetic spellings were accepted. The most common incorrect answers were the names of well-known painkillers. Quite a lot of students did not attempt the question.

(d) A fifth of students scored this mark. Most correct responses referred to a time delay

before the antibiotics became effective, or started working. A few students said the bacteria would be reproducing or multiplying. There was some confusion with antibodies, and incorrect references to bacteria fighting the antibiotics, or antibiotics fighting bacteria. Some thought that antibiotics make antibodies, whilst others said that the wrong antibiotic had been given.

(e) Half of the students knew that a child will start to feel better after taking antibiotics for a few days because there will be fewer toxins in the body. Most other students thought the child had become resistant to the bacteria.

(f) 15% of students scored the mark, usually for saying overuse of antibiotics could result in antibiotic resistance. Quite a lot of students said the patient or the antibiotic would become resistant, which was incorrect. A common mistake was to confuse immunity with resistance. Many students scored the mark for the idea that the person would get better without taking any antibiotics, which was allowed.

(g) A third of students thought antibodies are produced by red blood cells, with slightly fewer selecting the correct drawing of the white blood cell. It could be that students were unfamiliar with drawings of blood components.

(h) A third of students identified platelets as the part of the blood that starts the clotting process. Few selected plasma as their answer.

Higher

(a) 66% of students scored both marks for identifying the cell membrane and cytoplasm as structures that are found in both bacterial and animal cells.

(b) One symptom of salmonella food poisoning was asked for, with students instructed not to refer to vomiting and diarrhoea. 60% of the students were awarded the mark, usually for stomach ache or fever. Many described fever as having a high temperature or sweating, which were allowed.

(c) 01.3 64% of students knew that penicillin was the first antibiotic developed. A wide range of phonetic spellings were accepted. The most common incorrect answers were the names of well-known painkillers.

(d) Fewer than half of the students scored this mark. Most correct responses referred to a time delay before the antibiotics became effective, or started working. A few students said the bacteria would be reproducing or multiplying. There was some confusion with antibodies, and incorrect references to bacteria fighting the antibiotics, or antibiotics fighting bacteria.

(e) Two-thirds of students knew that a child will start to feel better after taking antibiotics for a few days because there will be fewer toxins in the body. Most other students thought the child had become resistant to the bacteria.

(f) 31% of students scored the mark, usually for saying overuse of antibiotics could result in antibiotic resistance. Alternatively, they scored the mark for the idea that the person would get better without taking any antibiotics, which was allowed.

Quite a lot of students said the patient or the antibiotic would become resistant, which was incorrect. A common mistake was to confuse immunity with resistance.

(g) A third of students correctly identified the drawing of the white blood cell as the cell that produces antibodies. More than half of the students thought the red blood cell produced antibodies; potentially as a result of students being unfamiliar with

drawings of blood components.

(h) 63% of students identified platelets as the part of the blood that starts the clotting process. Few selected plasma as their answer.

Q3.

(a) was answered very well. The most common differences described were that bacteria do not have a nucleus, but have plasmids, and that bacteria are smaller or bacteria do not have chloroplasts. To gain the mark related to plants having a vacuole, a reference to large or permanent was also needed. Some thought that bacteria do not have a cell wall, which is incorrect.

(b) was set at high demand and therefore required more than just a simple statement for each marking point, as detailed in the mark scheme. Students should be aware of the difference between a disease and a pathogen. Injecting a weakened form of a disease is incorrect. There was a wide range of responses given for (c) which was set at high demand. Many students thought the chickens got food poisoning. Others gave a description of how a vaccine works, which did not answer the question.

Most students did not seem to know how food poisoning is spread from one person to another. Washing hands was seen a lot, but this needed qualifying in relation to preparing food, or after using the toilet. In the final question a few students gained the mark for saying food was not cooked properly on barbecues. Many students thought that bacteria were killed at low temperatures in winter.

Photosynthesis PPQs

Name: _____

Class: _____

Date: _____

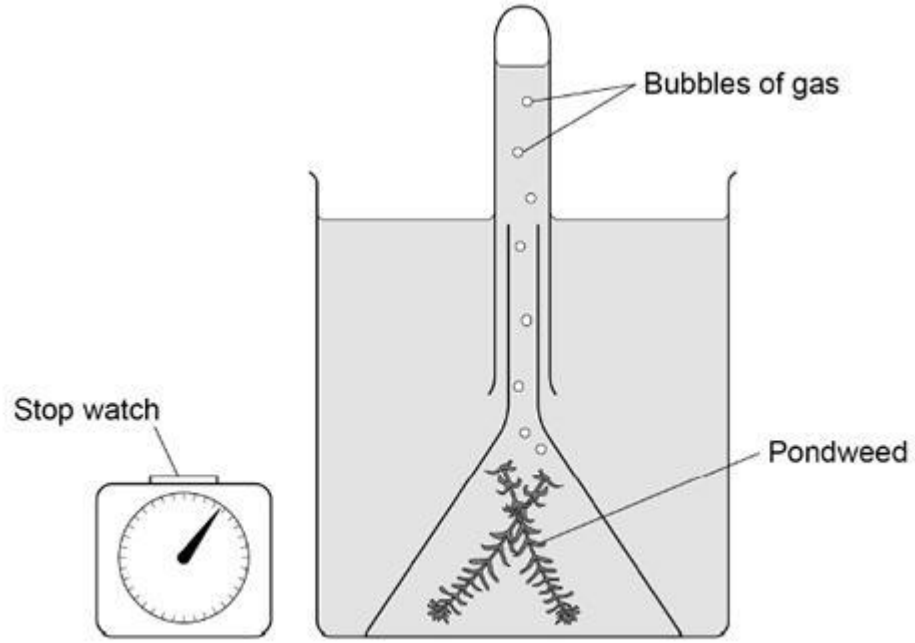
Time:	**34 minutes**
Marks:	**31 marks**
Comments:	**Self-assess using the mark scheme below. You can check your marks against the Examiners' comments to see if you fell into the same issues as the students who took that exam.**

Q1.

A student investigated the effect of light intensity on the rate of photosynthesis.

Figure 1 shows some of the apparatus used.

Figure 1



(a) Name the gas produced by the pondweed in the light.

_____

(1)

(b) Describe **one** way the student could change the intensity of light reaching the pondweed.

_____

_____

_____

(2)

(c) Describe how the student could use the apparatus in **Figure 1** to measure the rate of photosynthesis.

_____

_____

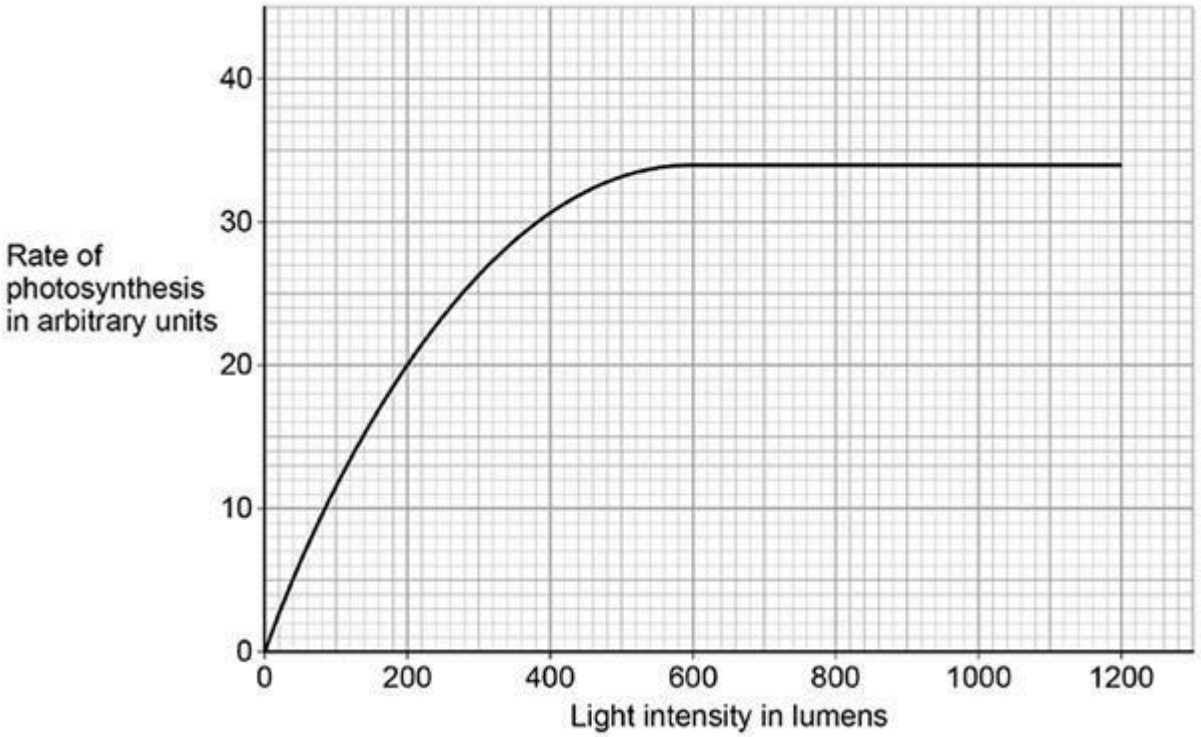
_____

_____

(2)

Figure 2 shows the student's results.

Figure 2



(d) What was the maximum rate of photosynthesis?

Maximum rate = _____ arbitrary units

(1)

(e) At which light intensity was light a limiting factor?

Tick (✓) **one** box.

200 lumens ☐

600 lumens ☐

1200 lumens ☐

(1)

(f) Light intensity can affect the rate of photosynthesis.

Give **one** other factor that can affect the rate of photosynthesis.

_____

(1)

(Total 8 marks)

Q2.

Plants absorb light for photosynthesis.

(a) Which is the equation for photosynthesis?

Tick (✓) **one** box.

$C_6H_{12}O_6 + 6\ O_2 \rightarrow 6\ CO_2 + 6\ H_2O$ ☐

$6\ CO_2 + 6\ H_2O \rightarrow C_6H_{12}O_6 + 6\ O_2$ ☐

$6\ H_2O + 6\ O_2 \rightarrow C_6H_{12}O_6 + 6\ CO_2$ ☐

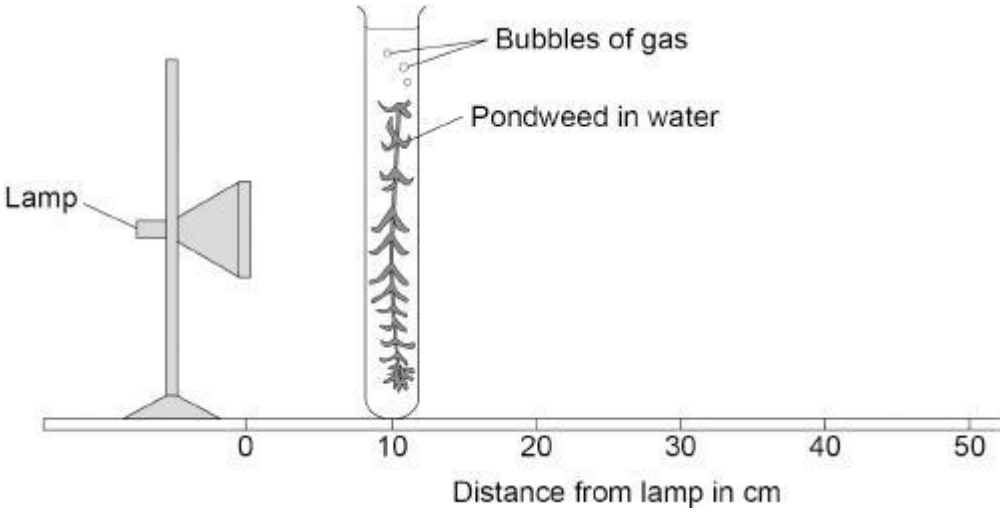
$6\ O_2 + 6\ CO_2 \rightarrow C_6H_{12}O_6 + 6\ H_2O$ ☐

(1)

A student investigated the effect of light intensity on the rate of photosynthesis.

Figure 1 shows the apparatus.

Figure 1



This is the method used.

1. Set up the apparatus as shown in **Figure 1**.
2. Place the pondweed 10 cm away from the lamp.
3. Switch on the lamp.
4. Record the number of bubbles of gas produced in 5 minutes.
5. Repeat steps 2 to 4 with the pondweed at different distances from the lamp.

(b) What was the independent variable in this investigation?

Tick (✓) **one** box.

Distance of the pondweed from the lamp	☐
Length of the piece of pondweed	☐
Number of bubbles of gas produced	☐
Time taken to collect the gas	☐

(1)

The lamp gets warm when it is on. This causes the temperature of the water to increase.

(c) Explain how an increase in temperature would affect the results of this investigation.

_____

_____

_____

_____

(2)

(d) Suggest **one** way the investigation could be improved so the temperature of the water does **not** increase.

_____

_____

(1)

(e) Suggest **two** improvements to the investigation so the results would be more valid.

Do **not** refer to controlling the temperature of the water.

1 _____

_____

2 _____

_____

(2)

The table below shows the results.

Distance of pondweed from the	**Number of bubbles of gas produced in 5**

lamp in cm	minutes
10	120
20	56
30	31
40	16
50	10

(f) Calculate the rate of photosynthesis when the pondweed was 40 cm from the lamp.

Give the rate of photosynthesis as the number of bubbles of gas produced per minute.

_____

_____

Rate = _____ bubbles of gas produced per minute

(1)

(g) Give **one** conclusion that can be made from the table above.

_____

_____

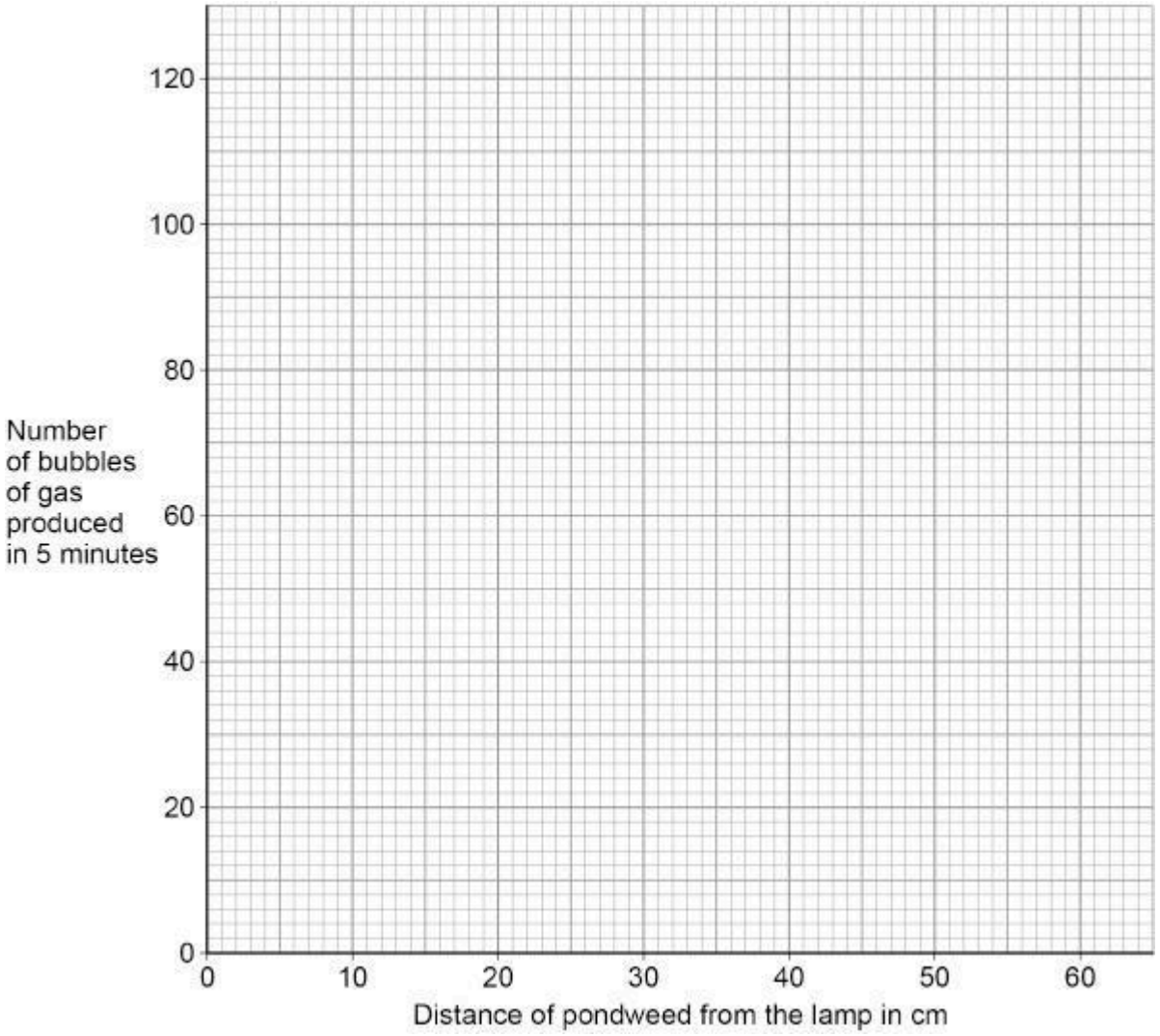
_____

(1)

(h) Plot the data from the table above on **Figure 2**.

Draw a line of best fit.

Figure 2



(3)

(i) Predict the number of bubbles that would be produced in 5 minutes if the pondweed was 60 cm from the lamp.

Use **Figure 2**.

Number of bubbles produced in 5 minutes = _____

(1)

(Total 13 marks)

Q3.

This question is about photosynthesis and food production.

(a) How can oxygen production be used to show the **rate** of photosynthesis?

_____

_____

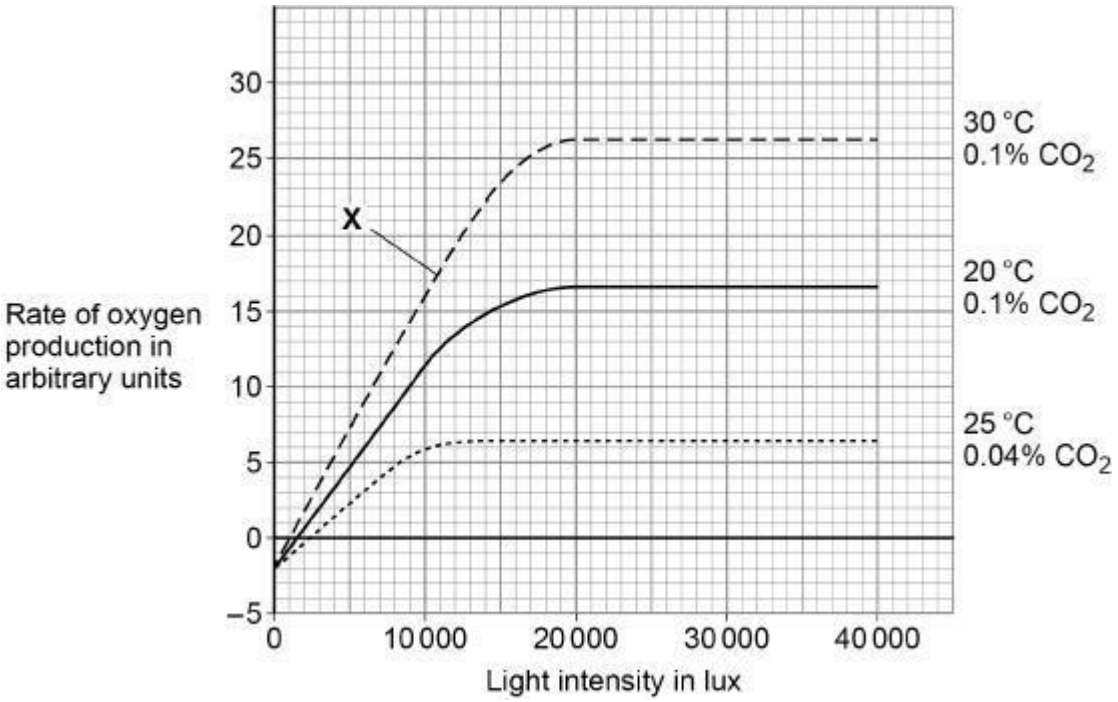
_____

(1)

Scientists investigated factors affecting the rate of photosynthesis in tomato plants.

The tomato plants were growing in a commercial greenhouse in the UK during winter.

The graph below shows the results.



The percentage of carbon dioxide in the Earth's atmosphere is 0.04%

(b) Name the factor that is limiting the rate of photosynthesis at point **X**.

_____

(1)

Farmers growing tomatoes commercially try to control the rate of photosynthesis and make maximum profit.

A farmer can control the temperature and carbon dioxide concentration in a greenhouse.

(c) What is the **minimum** light intensity a farmer should use to get the maximum rate of photosynthesis shown in above graph?

Light intensity = _____ lux

(1)

(d) The light intensity you gave in part (c) may **not** give the farmer maximum profit.

Explain why.

_____

_____

_____

_____

_____

_____

(3)

(e) Explain the results when the light intensity was 0 lux.

Use the diagram above.

_____

_____

_____

_____

_____

_____

_____

(4)

(Total 10 marks)

Mark schemes

Q1.

(a) oxygen

name takes precedence

allow O_2
ignore O^2 / O / O2

1

(b) (use) a lamp / light (source)

1

(and) move away and / or towards pondweed

*allow use different power ratings **or** use a dimmer switch*

*allow change the opacity of the beaker for **2** marks*

1

(c) count the number of bubbles

allow measure the volume of gas collected

1

in a given time

*allow for **2** marks measure time taken to collect a specific number of bubbles*

1

(d) 34 (arbitrary units)

allow a value in the range 33.5 – 34.5 (arbitrary units)

1

(e) 200 lumens

1

(f) any **one** from:

- temperature
- carbon dioxide (concentration)
- amount of chlorophyll

ignore light (intensity)

ignore heat
ignore oxygen

allow light colour / wavelength
allow water

ignore pH

1

[8]

Q2.

(a) $6\ CO_2 + 6\ H_2O \rightarrow C_6H_{12}O_6 + 6\ O_2$

1

(b) distance of the pondweed from the lamp

1

(c) bubbles (of gas) would be produced faster

allow more / bigger bubbles of gas would be produced (in a given time)

1

(because) enzymes work faster

allow (because) photosynthesis is controlled by enzymes

allow (because) photosynthesis would be faster

1

(d) any **one** from:

- use an LED (lamp)

  allow use a light that does not emit (a lot of) infrared / thermal radiation
- place a tank / beaker of water between the lamp and tube / pondweed
- put the tube in a beaker of water
- put the tube in a (thermostatically controlled) water bath
- place a piece of glass between the lamp and tube / pondweed

  allow place a heat shield between the lamp and tube / pondweed

1

(e) any **two** from:

- measure the volume of gas produced

  allow amount for volume allow use a cylinder / gas syringe to collect the gas

- allow the pondweed time to equilibrate

  allow a description of this

- repeat **and** calculate a mean

or

repeat **and** remove anomalies

ignore repeat unqualified

- control the concentration of carbon dioxide (in the water)

  *allow put the pondweed in sodium hydrogen carbonate (solution) **or** sodium bicarbonate (solution)*

- use the same bulb / lamp

  allow use the same type / size / age / piece of pondweed

  allow record the number of bubbles of gas produced in a longer period of time

2

(f) 3 (bubbles of gas produced per minute)

allow 3.2 (bubbles of gas produced per minute)

*do **not** accept 3.0 (bubbles of gas produced per minute)*

1

(g) as light intensity decreases the rate of photosynthesis decreases

allow as distance from lamp increases rate of photosynthesis decreases

allow as distance from lamp increases number of bubbles produced decreases

1

(h) all points plotted correctly

allow tolerance of ± ½ a small square

*allow **1** mark for four points plotted correctly*

2

line of best fit through their points

*do **not** accept line extended to 0, 0*

ignore extrapolations of line

1

(i) 8

allow correct value from their line ± ½ a small square

allow value in range 6 to 9 if a curved line of best fit is not drawn

1

[13]

Q3.

(a) measure the volume of oxygen produced in a given time

or

when more oxygen is produced in a given time the rate of photosynthesis is faster

a reference to rate is needed

allow gas for oxygen

allow when oxygen is produced faster the rate of photosynthesis is faster

ignore the faster the rate of photosynthesis, the more oxygen is produced

allow the slower the oxygen is produced the slower the rate of photosynthesis

or

less oxygen being produced in a given time, the slower the rate of photosynthesis

1

(b) light (intensity)

ignore temperature

1

(c) 20 000 (lux)

allow answers in range 19 500 to 20 500 (lux)

1

(d) there is a cost for heating the greenhouse

1

there is a cost for increasing the carbon dioxide in the atmosphere (of the greenhouse)

allow there is a cost for lighting (in winter)

1

(therefore) the additional costs might exceed the (additional) sale price / profit
or
(additional) costs could not be recovered by increasing the sale price of the tomatoes

ignore these additional costs would reduce profits unqualified

1

(e) when there is no light there is no photosynthesis

1

(so) no oxygen is produced

1

(but) respiration happens (all the time) and oxygen is used

1

(therefore) the net / overall oxygen production is negative / - 2 (arbitrary units)

*do **not** accept an answer of -2 (arbitrary units)*

unqualified

1

[10]

Q1.

(a) Over half of the students correctly named the gas that is produced when the pondweed is in the light as oxygen. When students are asked for the name of a chemical, they should write the name, not give the formula. If an incorrect formula is given, for example O2, O or O^2, the mark cannot be awarded.

(b) About 58% of students gained two marks for saying the light intensity could be changed by moving a lamp nearer to, or further from, the pondweed. Some suggested altering the temperature, using more pondweed or leaving it for a longer period of time. None of these gained credit.

(c) Half the students gained full marks for this question which differentiated between students very well. It was very clear when students had a real practical grasp of the investigation. They gave a concise response describing counting the bubbles of gas produced in a given time, or in one minute.

When only one mark was awarded this was usually for the first marking point; to count the bubbles. Other students described how to vary the light intensity, rather than describing what should be measured in order to calculate a rate.

(d) Around 83% of students correctly gave the maximum rate of photosynthesis as 34 arbitrary units. As is usual for graph readings, a tolerance of ± $\frac{1}{2}$ a small square was allowed. Therefore a value between 33.5 and 34.5 was allowed. Incorrect readings of 35 and 40 were commonly seen. Some students read the wrong axis and gave an answer of either 600 or 1200.

(e) About 12% of students identified the correct part of the graph when light intensity was limiting the rate of photosynthesis. The vast majority selected 600 lumens as the answer.

(f) The question asked for a factor that affects the rate of photosynthesis. Many students gave light intensity, which had been given in the question and was therefore ignored. Around 64% of students answered correctly with the most common correct response being temperature. The amount of carbon dioxide and water availability were other correct responses that were seen.

Q2.

This question was common with Combined Science: Trilogy Biology Paper 1 Higher Tier.

This question assessed knowledge and understanding of Required Practical Activity 5: investigating the effect of light intensity on the rate of photosynthesis. Two-fifths of students correctly identified the balanced equation for photosynthesis, with a similar proportion knowing that the distance of the pondweed from the lamp was the independent variable. Almost half of students stated a higher temperature would cause the pondweed to produce more bubbles, which was allowed. On the Foundation Tier students did not go on to explain why the rate would be faster at a higher temperature, nor did they suggest how the investigation could be improved so the temperature of the water did not increase. Many students did not understand what was being investigated, and suggested moving the lamp further away from the pondweed. A fifth of students scored one of the marks for (e), usually for saying that using the same pondweed would make the results more valid.

Quite a few students referred to carrying out repeats, but did not go on to say calculate a mean, or remove anomalies.

A third of students correctly calculated the rate of photosynthesis as 3 bubbles of gas per minute. The most common error was to divide the distance by the number of bubbles produced at that distance, or to multiply the distance by the number of bubbles. Over half of students made a correct conclusion describing the effect of light intensity on the rate of photosynthesis. Some students only described a pattern, such as ‘as distance increased the number of bubbles decreased’, which was insufficient. A reference to light intensity or distance from the lamp was needed, as well as a reference to the rate of photosynthesis, or to the number of bubbles produced. Cause and effect also had to be the correct way around, to link back to what the investigation was set up to find out.

Approximately two-thirds of students correctly plotted the results on the graph paper, using a small cross drawn with a sharp pencil. Only a few went on to join the points with a smooth curve. Most drew a ruled straight line. About a quarter of students extrapolated their line to predict the number of bubbles that would be produced if the lamp was 60 cm from the lamp.

Q3.

This question was about photosynthesis. Students often do not pick up on the word rate, so we usually embolden it in an attempt to prompt students to talk about something happening in a given time, or happening faster or slower. Saying that more oxygen would be produced if photosynthesis was faster was insufficient. The questions relating to limiting factors were answered well, but most students only scored 1 mark in (d) for saying there would be a cost for additional lighting.

(e) required students to explain why the rate of oxygen production had a negative value in the dark. Some students said there would be no photosynthesis in the dark, with a few going on to say that no oxygen is produced in the dark. Saying not much oxygen was produced was incorrect. Few students went on to mention respiration, so could not gain either of the last two marking points.

Respiration PPQs

Name: _____

Class: _____

Date: _____

Time:	**35 minutes**
Marks:	**33 marks**
Comments:	**Self-assess using the mark scheme below. You can check your marks against the Examiners' comments to see if you fell into the same issues as the students who took that exam.**

Q1.

Anaerobic respiration in yeast is called fermentation.

The equation for fermentation is:

glucose → ethanol + carbon dioxide

(a) How does the equation show that fermentation is an **anaerobic** reaction?

_____

_____

(1)

Fermentation in yeast is used in the manufacture of beer, wine and bread.

(b) Why is fermentation used when making beer and wine?

_____

_____

(1)

(c) Explain why fermentation is used when making bread.

_____

_____

_____

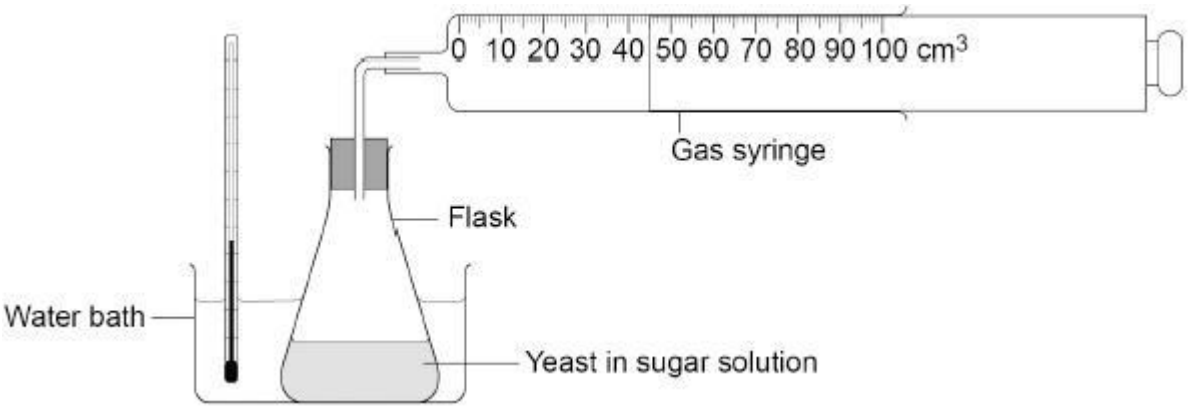
_____

(2)

A student investigated fermentation in yeast.

Figure 1 shows the apparatus.

Figure 1



This is the method used.

1. Mix yeast with sugar solution in a flask.
2. Put the flask in a water bath at 35 °C.
3. After 10 minutes attach a gas syringe to the flask.
4. Record the volume of carbon dioxide collected every 5 minutes for 1 hour.

(d) What volume of carbon dioxide has been collected in the gas syringe in the figure above?

Volume of carbon dioxide = _____ cm^3

(1)

(e) Why did the student wait 10 minutes before attaching the gas syringe?

Tick (✓) **one** box.

To allow time for the mixture to reach 35 °C ☐

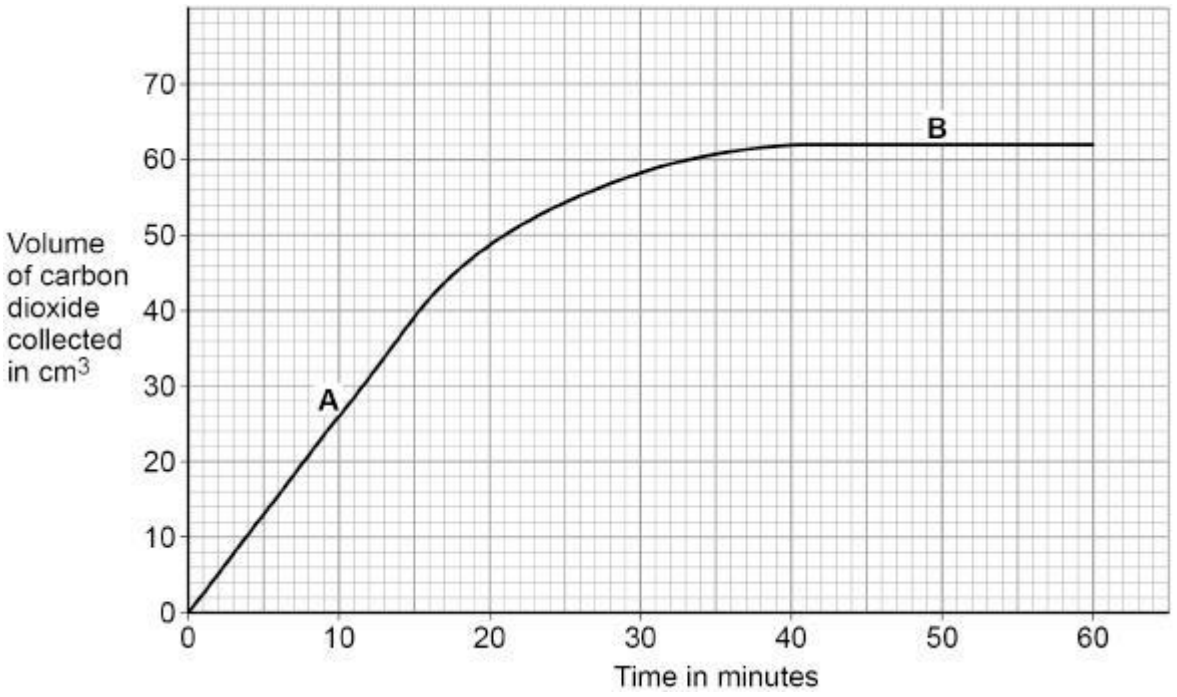
To allow time for the sugar to dissolve ☐

To allow time to draw a results table ☐

(1)

Figure 2 shows the results.

Figure 2



(f) **A** and **B** are different parts of the graph in **Figure 2**.

Draw **one** line from each part of the graph to the description of the reaction.

Part of the graph	Description of the reaction
	Carbon dioxide is **not** being produced
A	
	Carbon dioxide production is **fastest**
B	
	Carbon dioxide production is **slowing down**

(2)

The equation for fermentation is repeated here.

glucose → ethanol + carbon dioxide

(g) Suggest **one** reason why fermentation in the flask stopped.

_____

_____

(1)

(h) Fermentation is controlled by enzymes.

The investigation was repeated at 2 °C and at 75 °C.

No carbon dioxide was produced at either of these temperatures.

Suggest why **no** carbon dioxide was produced at 2 °C or at 75 °C.

Reason at 2 °C _____

_____

Reason at 75 °C _____

_____

(2)

(i) Anaerobic respiration also happens in animal cells.

Complete the equation for anaerobic respiration in animal cells.

Choose answers from the box.

carbon dioxide	ethanol	glucose	lactic acid	water

_____ → _____

(2)

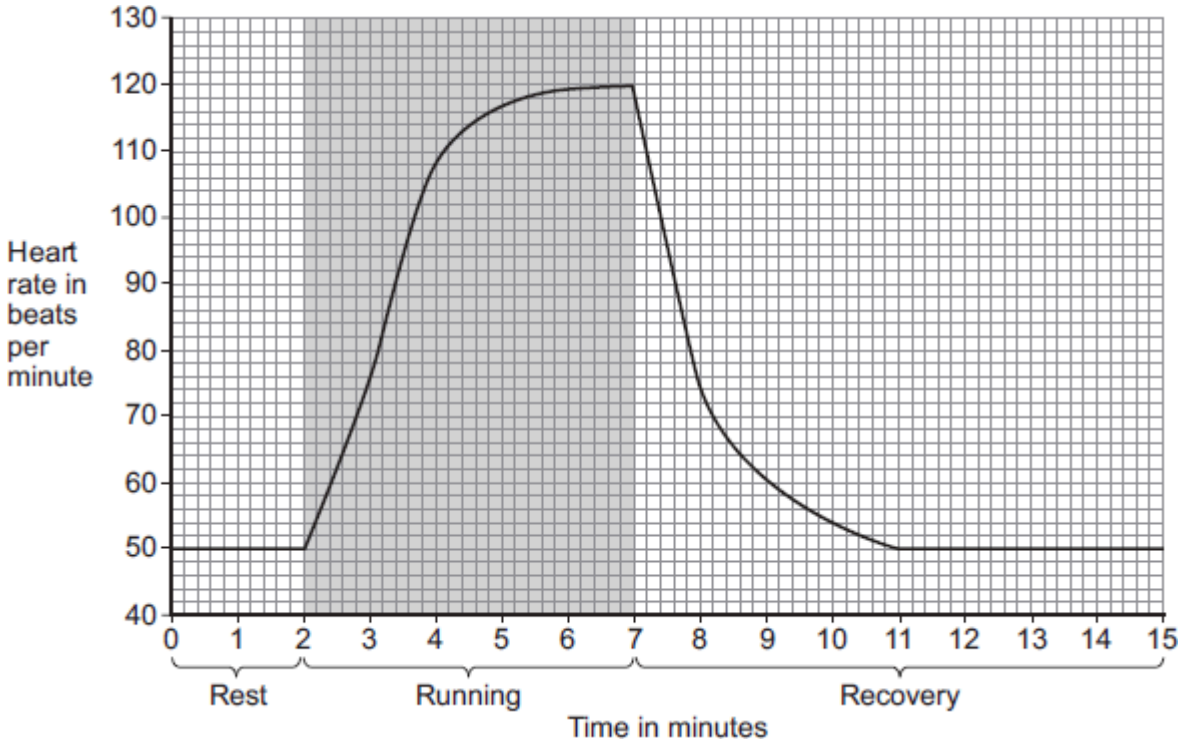
(Total 13 marks)

Q2.

A student ran on a treadmill for 5 minutes.

The speed of the treadmill was set at 12 km per hour.

The graph below shows the effect of the run on the student's heart rate.



(a) (i) What was the student's heart rate at rest?

_____ beats per minute

(1)

(ii) After the end of the run, how long did it take for the student's heart rate to return to the resting heart rate?

_____ minutes

(1)

(b) During the run, the student's muscles needed larger amounts of some substances

than they needed at rest.

(i) Which **two** of the following substances were needed in larger amounts during the run?

Tick (✓) **two** boxes.

carbon dioxide ☐

glucose ☐

lactic acid ☐

oxygen ☐

protein ☐

(2)

(ii) Why are the two substances you chose in part **(b)(i)** needed in larger amounts during the run?

Tick (✓) **one** box.

To help make more muscle fibres ☐

To release more energy ☐

To help the muscles to cool down ☐

(1)

(c) After exercise, a fit person recovers faster than an unfit person.

Let the student's heart rate at the end of exercise = **a**.

Let the student's heart rate after 2 minutes of recovery = **b**.

The table below shows how the difference between **a** and **b**, (**a** − **b**), is related to a

person's level of fitness.

(a − b)	**Level of fitness**
< 22	Unfit
22 to 52	Normal fitness
53 to 58	Fit
59 to 65	Very fit
> 65	Top athlete

What is the student's level of fitness?

Use information from the graph and the table.

a = _____ beats per minute

b = _____ beats per minute

(**a − b**) = _____ beats per minute

Level of fitness = _____

(3)

(d) The student repeated the run with the treadmill set at 16 km per hour.

The student's heart rate took 3 minutes longer to return to the normal resting rate than when running at 12 km per hour.

Give reasons why it took longer to recover after running faster.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(Total 12 marks)

Q3.

Eukaryotic cells respire continuously to transfer energy.

(a) Give **two** uses of energy transferred by respiration in eukaryotes.

1. _____

2. _____

(2)

(b) Name the cell structure in a eukaryotic cell where aerobic respiration occurs.

_____

(1)

(c) Muscle cells and plant cells can respire anaerobically.

Compare the processes of anaerobic respiration in muscle and plant cells.

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(d) Anaerobic respiration in muscle cells creates an oxygen debt.

What does oxygen debt mean?

_____

_____

(1)

(Total 8 marks)

Q1.

(a) no oxygen (reacting with the glucose)

ignore there is no air

1

(b) produces ethanol / alcohol

1

(c) produces carbon dioxide / gas

1

(which) makes the bread / dough rise

*allow idea related to making the bread lighter **or** affecting its texture*

1

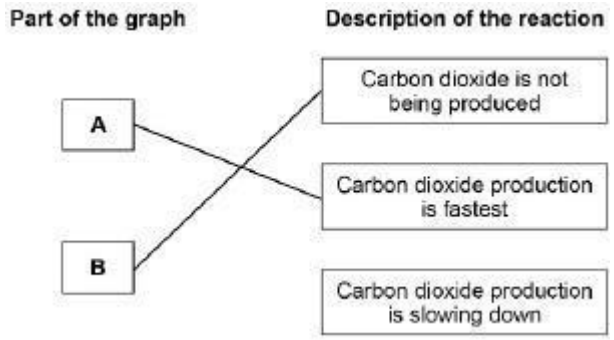
(d) 45 (cm^3)

1

(e) to allow time for the mixture to reach 35 °C

1

(f)



do **not** accept more than one line from a box on the left

1
1

(g) any **one** from:

- glucose / sugar / food ran out
- ethanol / alcohol killed the cells / yeast

ignore yeast / cells died unqualified

ignore produced ethanol / alcohol unqualified

1

(h) (2 °C) too cold (for enzymes / yeast to work)

allow yeast / enzyme was inactive

ignore yeast killed

allow no / few successful collisions

*do **not** accept enzymes are denatured*

1

(75 °C) enzymes denatured

allow enzymes destroyed

allow description eg change in shape of active site or of enzyme

allow yeast killed

*do **not** accept enzymes killed ignore references to collisions unqualified*

1

(i) glucose → lactic acid

***1** mark for each chemical must be in this order ignore formulae*

2

[13]

Q2.

(a) (i) 50

1

(ii) 4

accept 3.9 − 4.0

1

(b) (i) glucose

1

oxygen

1

(ii) to release more energy

1

(c) correct readings from graph:

a = 120

b = 60

allow 60 - 61

1

calculation correct for candidate's figures:

e.g. a − b = 60

1

level of fitness correct for candidate's figures:

e.g. very fit

1

(d) any **four** from:

- higher heart rate (at 16 km / h) (so takes longer to slow to normal)
- more energy needed
- not enough O_2 supplied / more O_2 needed / reference to O_2-debt
- (more) anaerobic respiration
- (more) lactic acid made / to be broken down / to remove / to oxidise

- higher blood flow needed to deliver (the required amount of) oxygen.

  'more' must be given at least once for full marks

  do not allow more energy produced

  allow higher blood flow to remove lactic acid / remove (additional) CO_2

4

[12]

Q3.

(a) any **two** from:

- synthesis of new molecules

  allow named molecule eg starch / glycogen / cellulose / lipids / fats / proteins / hormones / antibodies

- for active transport

- to keep warm (in mammals / birds)

  allow description

  allow to keep warm (in animals)

  allow for movement (in animals)

  allow for transmission of nerve impulses (in animals)

2

(b) mitochondria / mitochondrion

1

(c) both occur without oxygen

1

both release (a small amount of) energy

1

muscle cells produce lactic acid but plant cells produce ethanol

1

muscle cells do **not** produce carbon dioxide but plant cells do

marks can be awarded from correct word or balanced symbol equations

1

(d) the amount of oxygen needed to react with the lactic acid formed

allow the amount of oxygen needed to break down

***or** oxidise the lactic acid*

1

[8]

Q1.

This question was about anaerobic respiration. Two of the questions tested understanding of the equation for fermentation. The equation shows that fermentation is anaerobic because there is no oxygen reacting with the glucose. Many students thought it showed an anaerobic reaction because carbon dioxide was being produced or being used. In a later question some students thought fermentation stopped because the carbon dioxide had all been used up. Few students knew that fermentation is used to make beer and wine because ethanol or alcohol is produced, but more said yeast is used to make bread because it makes the dough rise. Hardly any students linked this to the production of carbon dioxide.

Most students recognised that the steepest part of the graph represented when the rate of gas production was the fastest, but more than half thought that the horizontal line on the graph showed that gas production was slowing down, when it had actually stopped being produced. Two-thirds of students scored a mark for saying no carbon dioxide was being produced at 2 ºC because it was too cold, or because it was not hot enough. Some said the enzymes were denatured at 75 ºC. A tenth of students identified the names of both the reactant and the product for anaerobic respiration in animal cells. Many students wrote down more than one reactant or product.

Q2.

(a) Almost every student was able to read the heart rate at rest from the graph, although there were a few more errors in working out how long it took for the heart rate to return to the resting rate following the 5 minute run, as some measured from an incorrect starting value and others to an incorrect end point.

(b) As in part (a), the vast majority were successful and were able to select glucose and oxygen correctly as the substances needed in larger amounts during the run, and knew that these substances helped to release more energy.

(c) Here, students were required to read two appropriate figures from the graph (the heart rate at the end of exercise = 120 bpm, and the heart rate after 2 minutes of recovery = 60 bpm), subtract one from the other (= 60) and consult the table to find the athlete's level of fitness (= 'very fit'). Only a very small percentage of students made any errors and, if this was in one of the readings from the graph, allowance was made for this by examiners in the calculation and the interpretation of the fitness level.

(d) The scenario here was slightly different from that of previous questions relating to the effect of exercise on heart rate − students had to explain why it took longer to recover from running at a higher rate. Most understood that running more quickly would require more energy and that more oxygen would need to be supplied to the muscles so a higher heart rate during exercise would be needed. Better students reasoned that a higher oxygen debt would accumulate due to anaerobic respiration and thus more lactic acid would need to be removed or broken down during recovery, resulting in the need for a higher rate of blood flow for a longer period during recovery and hence the heart rate taking longer to return to the resting rate. Almost two-thirds of the students were able to make at least 3 of the 4 points needed for full marks, with approximately one-third scoring 4 points.

Homeostasis PPQs

Name: _____

Class: _____

Date: _____

Time:	**25 minutes**
Marks:	**24 marks**
Comments:	**Self-assess using the mark scheme below. You can check your marks against the Examiners comments to see if you fell into the same issues as the students who took that exam.**

Q1.

Homeostasis regulates the internal conditions of the human body.

(a) Which **two** processes are regulated by homeostasis?

Tick (✓) **two** boxes.

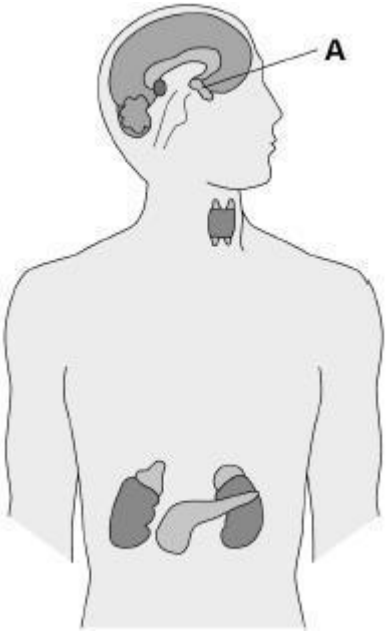
Controlling water output in urine	☐
Defending the body against pathogens	☐
How quickly you walk	☐
Keeping cool on a hot day	☐
Waking up in the morning	☐

(2)

Hormones are produced by glands in the endocrine system.

Each hormone has an effect on a target organ.

The diagram below shows glands of the endocrine system.



(b) What is the name of gland **A**?

Tick (✓) **one** box.

Pancreas ☐

Pituitary ☐

Thyroid ☐

(1)

Before eating a sugar-coated cereal a person had a blood glucose concentration of 5.2 mmol/dm^3

Soon after eating the cereal the person had a blood glucose concentration of 8.4 mmol/dm^3

(c) Calculate the increase in the blood glucose concentration.

_____

Increase = _____ mmol/dm^3

(1)

(d) The person needed medication to decrease their blood glucose concentration.

Suggest what disorder the person has.

_____

(1)

(e) There is a problem with the hormone control of the person.

What is the problem?

Tick (✓) **one** box.

The blood is not taking hormones to target organs. ☐

The pancreas is not releasing insulin. ☐

The pituitary gland is not being stimulated. ☐

(1)

(f) The person:
- works in an office
- drives to work
- is overweight

- watches the television and reads every night
- drinks a hot chocolate every night.

Suggest **two** lifestyle changes the person could make to help treat their disorder.

1. _____

_____

2. _____

_____

(2)

(Total 8 marks)

Q2.

The human body produces many hormones.

(a) (i) What is a *hormone*?

_____

_____

(1)

(ii) Name an organ that produces a hormone.

_____

(1)

(iii) How are hormones transported to their target organs?

_____

(1)

(b) Describe how the hormones FSH, oestrogen and LH are involved in the control of the menstrual cycle.

_____

_____

_____

_____

_____

_____

_____

_____

(3)

(Total 6 marks)

Q3.

Bacteria and viruses can reproduce quickly inside the body and make us feel ill.
These organisms may cause symptoms such as a high body temperature.

(a) How do bacteria and viruses make us feel ill?

_____

_____

(1)

Two common medicines are paracetamol and ibuprofen. These medicines help to reduce high body temperature.

Data was collected to find out whether paracetamol, ibuprofen or a combination of these two medicines was the best to reduce high body temperature in children.

Children who were ill with high body temperatures were identified at doctors' surgeries.

These children were put into three treatment groups:

Group 1: given paracetamol only
Group 2: given ibuprofen only
Group 3: given a combination of paracetamol and ibuprofen

The children in each group were matched for age and gender.

There were 50 children in each group.

The table below shows how often the medicines were given to the children in each group. The doses were as directed by the manufacturers.

	Time in hours						
	0	2	4	6	8	10	12
Group 1: Paracetamol only	P		P		P		P
Group 2: Ibuprofen only	I			I			I
Group 3:Paracetamol and ibuprofen	P&I		P	I	P		P&I

Key: P = paracetamol only
I = ibuprofen only
P&I = paracetamol and ibuprofen

(b) This investigation would have been improved if a fourth group of children had been included.

(i) The children in each group were matched for age and gender.

Suggest **one** other factor the children should have been matched for to make this investigation valid.

_____

(1)

(ii) What would the children in the fourth group have been given?

_____

_____

(1)

(iii) Suggest why this would have improved the investigation.

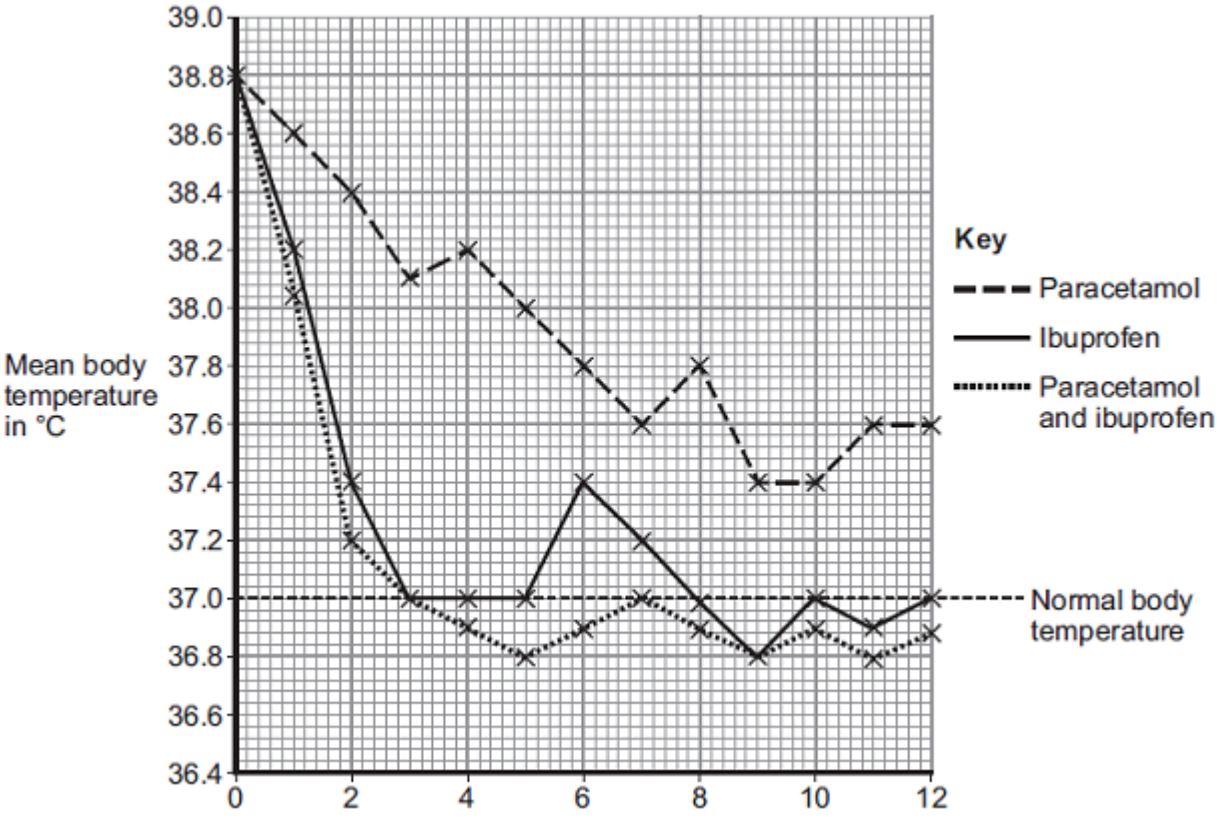
_____

_____

(1)

(c) The children's body temperatures were measured before any medicine was given and every hour after treatment started.

The mean body temperatures for each of the three groups are shown in the figure below.



(i) What was the difference in mean body temperature after 4 hours between the group taking paracetamol only and the group taking ibuprofen only?

_____

_____ °C

(1)

(ii) How many more hours did the mean body temperature stay normal or below normal, when taking both paracetamol and ibuprofen compared to taking ibuprofen only?

_____

_____ hours

(1)

(d) Doctors and nurses usually advise parents to give ibuprofen to children with a high body temperature.

Complete the sentences to suggest reasons why giving only ibuprofen might be better than giving only paracetamol or a combination of paracetamol and ibuprofen. You should use information from the table and the figure.

(i) Giving ibuprofen might be better than giving paracetamol because _____

_____

_____

_____

_____

(2)

(ii) Giving only ibuprofen might be better than giving a combination of paracetamol

and ibuprofen because _____

_____

_____

_____

_____

(2)

(Total 10 marks)

Q1.

(a) controlling water output in urine

1

keeping cool on a hot day

1

(b) pituitary

1

(c) (8.4 – 5.2 =) 3.2 ($mmol/dm^3$)

1

(d) diabetes

ignore type of diabetes

1

(e) the pancreas is not releasing insulin

1

(f) change diet

allow description of suitable diet change e.g. use sweetener in hot chocolate, eat less sugary / starchy food or stop eating sugar-coated cereal

1

take more exercise

allow description e.g. go to gym instead of reading and TV, walk / cycle to work

allow change to an active job

if no other marks awarded allow 1 mark for lose weight.

1

[8]

Q2.

(a) (i) any **one** from:

- chemical messenger / message
  allow substance / material which is a messenger
- chemical / substance produced by a gland
  allow material produced by a gland
- chemical / substance transported to / acting on a <u>target</u> organ
- chemical / substance that <u>controls</u> <u>body</u> <u>functions</u>

1

(ii) gland / named endocrine gland

brain alone is insufficient

allow phonetic spelling

1

(iii) in blood / plasma **or** circulatory system **or** bloodstream

accept blood vessels / named

*do **not** accept blood cells / named*

1

(b) *each hormone must be linked to correct action*

apply list principle

ignore the gland producing hormone

FSH stimulates oestrogen (production) / egg maturation / egg ripening

ignore production / development of egg

1

oestrogen inhibits FSH

allow oestrogen stimulates LH / build up of uterine <u>lining</u>

1

LH stimulates egg / ovum release / ovulation

accept LH inhibits oestrogen
accept LH controls / stimulates growth of corpus luteum
ignore production of egg

1

[6]

Q3.

(a) (bacteria and viruses produce) toxins

allow poisons
allow damage body cells

1

(b) (i) body mass

allow weight
allow ethnicity
ignore height / size

1

(ii) placebo / fake drug

allow sugar pill
allow no treatment

1

(iii) any **one** from:

- as a control group
- for comparison
- to see if the drugs worked
- to take account of psychological effect

accept placebo effect
allow to avoid bias

1

(c) (i) 1.2 (°C)

1

(ii) 3 (hours)

1

(d) (i) (Paracetamol)

any **two** from:

- ibuprofen reduces body temperature faster
- ibuprofen reduces temperature more
- ibuprofen doesn't need to be taken as often
- ibuprofen keeps body temperature lower / normal / 37 °C for longer

allow works faster

2

(ii) (Paracetamol + ibuprofen)

any **two** from:

- body temperature decreases at a similar rate

  allow ibuprofen works (almost) as fast
- ibuprofen maintained body temperature close to normal / 37 °C

  allow ibuprofen maintained normal body temperature almost as long

  allow doesn't make temperature drop below normal as long
- (better to) take fewer drugs

  allow less chance of overdose / giving too much

  allow (better to) take drugs less frequently
- easier to administer

  allow less chance of missing doses / taking at the wrong time

2

[10]

Examiner reports

Q1.

Students gained more marks on question 4 about homeostasis by correctly calculating the decrease in blood glucose and naming the disorder as diabetes. Most gained a further mark for giving exercise in some form as a way to control diabetes. A 'healthy' or a 'balanced' diet were not considered relevant, but a low carbohydrate or low sugar diet gained the mark. 'Losing weight' was credited if no other marks were awarded.

Q2.

(a) (i) Students should aim to be much more specific in their responses to direct questions. There were a number of very vague answers often using the word 'something' either 'something that does something' or a 'chemical which does something'. Many included the word 'chemical' but failed to include what this chemical did, even at the simplest level with the idea of the chemical being a 'message'. Relatively few students referred to the idea that a hormone affects a 'target organ'. Evidently some students had compared nervous communication with hormonal communication, in their revision, and gave these comparisons in their answers here. Those that included relevant descriptions of a hormone were, of course, credited, however weaker ones such as 'hormones travel at the speed of blood' were not.

(ii) A high proportion of students correctly named an appropriate gland, or simply gave 'glands'. Those glands named in the specification were of course commonly given and the examiners accepted all other endocrine glands. Of concern was the poor spelling of 'pituitary' with some attempts being barely recognisable and it is fortunate that on this occasion hormonal communication was not the subject of the QWC question.

(iii) A good proportion of students correctly gave 'blood' or 'bloodstream', however 'nerves' and 'synapses' were by no means uncommon, whilst others hedged their bets with 'blood and nerves'. Students should be made aware that answers that include both a right and wrong answer for a single marking point will never be awarded the mark, irrespective of the order they write the answers or the use of brackets or fainter / smaller writing.

(b) Many students showed excellent knowledge and had clearly prepared themselves well for this question. These students often gave all the marking ideas available and would have scored many more marks had they been available. Those students who bullet-pointed their responses ensured that they referred to all three hormones. Other students fared worse with half-learned facts that were sometimes scatter-gunned at the hormones, thus whilst they might have correctly given a function of one of the hormones in one sentence, they immediately lost that mark for attributing a wrong function to the same hormone in the next sentence. Once more, students would be better served by having some understanding of the mechanics of mark schemes, in that contradictions cost marks and it is no use hedging bets with multiple attempts. For a question with a three mark tariff asking about three hormones, it should be evident that there is one mark for each hormone and so only one role for each is required.

Q3.

(a) Only just over a third of the students knew that bacteria and viruses make us feel ill

because they produce toxins. Many students said that bacteria produce toxins, but went on to give a different reason for viruses, for example, viruses reproduce inside cells or make the cells burst. These students gained the mark as long as they had not given an incorrect statement about viruses. Several incorrect responses referred to the immune system or used poor terminology saying that the organisms attacked body cells.

(b) (i) Only a fifth of the students gained this mark. The question stated that the children in the groups were matched for age and gender; therefore a different factor that should be controlled was needed. The most common correct answers were mass or weight. Height or size did not gain the mark. Several students said “Previous illness” or “Severity of illness”, and many references to temperature were given. Very few students mentioned ethnicity.

(ii) The majority of students answered this question correctly with many mentioning the word “placebo”. Most of the other correct answers said “nothing”. Students who did not gain the mark generally said give them a different drug, for example, Calpol, or an antibiotic. Some said give them a larger dose of the drugs mentioned in the question.

(iii) There were some good responses relating to taking account of a psychological effect. Many gained the mark for saying that a placebo was used in order to see if the drug worked, but this was expressed in many different ways. Some said it was used for comparison or as a control. Only a few referred to accuracy, fair testing or to improve reliability, all of which were ignored.

(c) (i) Most students interpreted the graph correctly to gain the mark.

(ii) Only just over a fifth of students gained this mark, showing they had some difficulty in counting how many hours the body temperature was normal or below for the two groups.

(d) (i) Many students lost marks because they did not write comparative statements. Saying that ibuprofen reduced the temperature quickly was insufficient. It was necessary to say that ibuprofen reduced the temperature faster, more or for longer. Many said that ibuprofen worked better or more effectively, but this was too vague to be awarded a mark. A few students attempted to compare all three groups, rather than ibuprofen (alone) with paracetamol (alone).

(ii) Over half of the students gained 1 mark for saying that ibuprofen maintained body temperature close to normal. There was a lack of understanding that there is a range for normal body temperature, and many students thought that lowering the body temperature below 37 °C was harmful. A vague statement such as“Ibuprofen is almost as good” or “almost as effective” was not creditworthy; students had to give an example of this, for example, it decreased the temperature at a similar rate.

The human nervous system PPQs

Name: _____

Class: _____

Date: _____

Time:	**37 minutes**
Marks:	**34 marks**
Comments:	**Self-assess using the mark scheme below. You can check your marks against the Examiners comments to see if you fell into the same issues as the students who took that exam.**

Q1.

Caffeine is a drug that affects reaction time.

Coffee is a drink that contains caffeine.

Five students investigated the effect of drinking coffee on their reaction time.

Each student sat in front of a computer screen showing a reaction timer.

This is the method used.

1. Press any key on the keyboard when the colour of the screen changes to green.
2. Record the reaction time shown on the computer screen.
3. Drink coffee containing caffeine.
4. Wait 15 minutes then repeat steps 1 and 2.

(a) What is the dependent variable in the investigation?

Tick (✓) **one** box.

The coffee containing caffeine	☐
The number of students	☐
The reaction time	☐

(1)

(b) Give **two** control variables the students should have used.

1 _____

_____

2 _____

_____

(2)

(c) Why did the students wait 15 minutes after drinking the coffee before repeating the test?

_____

_____

(1)

(d) Responding to the colour change of the screen involves a receptor in the student.

Where is the receptor in the student?

Tick (✓) **one** box.

Ear ☐

Eye ☐

Skin ☐

(1)

(e) Responding to the colour change of the screen involves an effector in the student.

What is the effector in the student?

Tick (✓) **one** box.

Brain ☐

Gland ☐

Muscle ☐

Spinal cord ☐

(1)

The table below shows the results.

Student	**Reaction time in milliseconds**	
	Before drinking coffee	**After drinking coffee**
1	385	255
2	420	291
3	285	265
4	871	259
5	463	247

(f) What is the effect of drinking coffee on reaction time?

Use the table above.

_____

_____

(1)

(g) Which student had the smallest change in reaction time after drinking coffee?

Tick (✓) **one** box.

Student 1 ☐

Student 2 ☐

Student 3 ☐

Student 4 ☐

Student 5 ☐

(1)

(h) The students decided that one of the results was anomalous.

What should the students do with the anomalous result when calculating the mean change in reaction time?

_____

_____

(1)

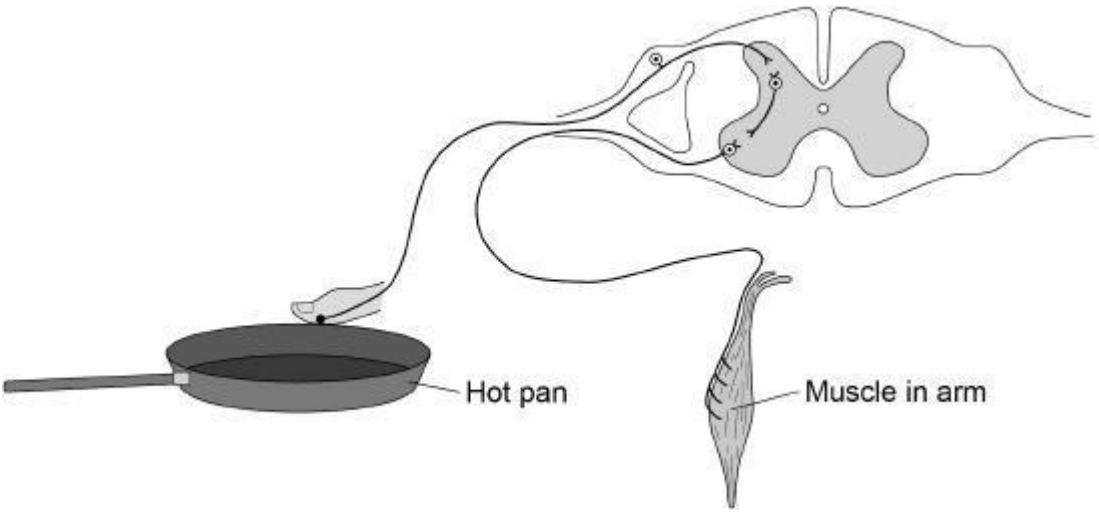
(Total 9 marks)

Q2.

Human reactions are a response to an external change.

(a) Reflex actions help to protect the body against damage.

The diagram below shows the nervous pathway for a reflex action.



A stimulus from the hot pan will cause the muscle in the arm to contract and move the finger away.

Describe how the stimulus from the hot pan reaches the muscle in the arm.

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(b) A student investigated whether using the right hand or the left hand had an effect on reaction time.

The student only tested right-handed people.

Describe a method for the student's investigation.

Include details of the test you would use for reaction time**.**

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(4)

A different student carried out an investigation to see if playing tennis improved reaction time.

The student used two groups of six people.

The table below shows the results.

Person	**Reaction time in seconds**	
	People who play tennis	People who do not play tennis
1	0.2	0.3
2	0.4	0.4
3	0.3	0.6
4	0.4	0.5
5	0.2	0.3
6	0.3	0.2
Mean	**X**	0.4

(c) Calculate mean value **X** in the table above.

_____

_____

_____

X = _____ seconds

(2)

(d) What is the dependent variable in the student's investigation?

_____

(1)

The student concluded:

‘Playing tennis improves reaction time.’

(e) Give **one** piece of evidence which supports the conclusion.

_____

_____

(1)

(f) Give **one** piece of evidence which does **not** support the conclusion.

_____

_____

(1)

(Total 13 marks)

Q3.

Caffeine is a drug that decreases reaction time.

A group of sixteen students investigated the effect of caffeine on reaction time.

The students were all 15-year-old girls.

The group was divided into 8 pairs of students.

This is the method used.

1. Student **A** starts two stopwatches at the same time.
2. Student **A** then gives one of the stopwatches to Student **B**.
3. Student **A** says “stop” at the same time as stopping her stopwatch. Student **B** stops her stopwatch as quickly as possible after Student **A** says “stop”.
4. The difference in time shown on the two stopwatches is recorded. This is the reaction time of Student **B**.
5. Student **B** drinks a caffeinated drink.
6. The students wait 15 minutes and then repeat steps 1 to 4.

(a) Suggest **one** control variable the students should have used in the investigation.

Do **not** refer to age or sex in your answer.

_____

_____

(1)

(b) Suggest **two** sources of random error when using this method to measure a person’s reaction time.

1 _____

_____

_____

2 _____

_____

_____

(2)

The table below shows the results.

Student pair	**Decrease in reaction time after drinking the caffeinated drink in seconds**
1	0.039
2	0.021
3	0.027
4	0.041
5	0.022
6	0.036
7	0.024
8	0.097

(c) Why can a mode **not** be determined for the data in the table above?

_____

_____

(1)

(d) The students decided the result from pair **8** was anomalous.

The students calculated that the mean decrease in reaction time was 0.030 seconds.

Describe how the students calculated the mean decrease in reaction time.

_____

_____

_____

(1)

(e) Caffeine causes the release of adrenaline.

Adrenaline affects heart rate.

Explain how the effect of adrenaline on heart rate might cause reaction time to decrease.

_____

_____

_____

_____

_____

_____

_____

_____

(4)

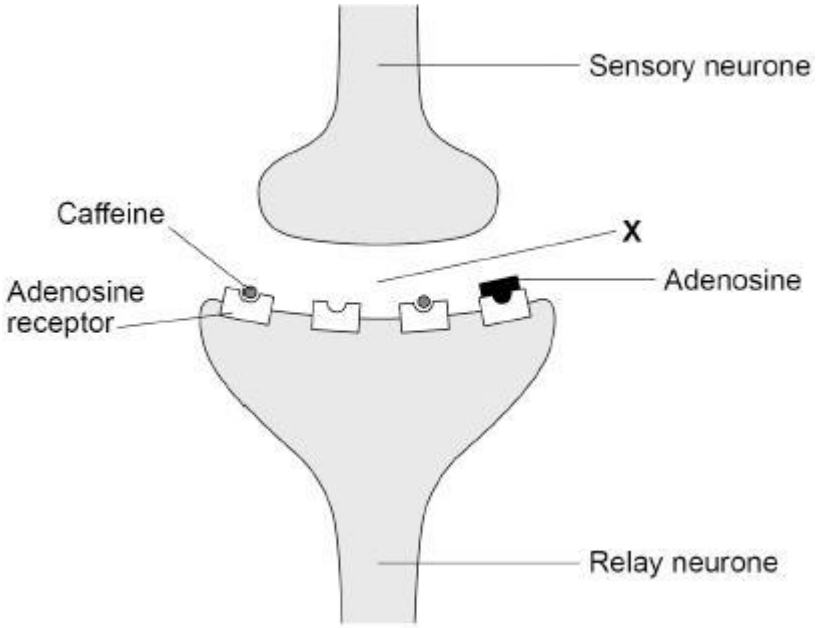
Adenosine is a different chemical made by the body.

Adenosine binds to receptors on relay neurones.

Adenosine decreases the number of impulses in relay neurones.

The figure below shows how caffeine binds to adenosine receptors on a relay neurone.

When caffeine binds to adenosine receptors it blocks the receptor so adenosine cannot bind.



(f) Label **X** shows the gap between the sensory neurone and the relay neurone.

What is the name of the gap labelled **X**?

_____

(1)

(g) Suggest why reaction time decreases when caffeine binds to adenosine receptors.

_____

_____

_____

_____

_____

_____

(2)

(Total 12 marks)

Q1.

(a) the reaction time

1

(b) any **two** from:

- age
- sex

  allow gender
- previous intake of caffeine / coffee that day
- usual intake of caffeine / coffee (on previous days)
- concentration of caffeine / coffee
- volume of caffeine / coffee

  *if neither given allow amount / mass of caffeine / drink **or** type / brand of coffee for **1** mark*
- time of day
- amount / length of sleep

  allow fatigue
- health

  allow other drugs taken
- body mass

  allow (body) weight
- same / type of reaction time program / software
- same keyboard
- prior experience with the reaction timer

2

(c) any **one** from:

- (time) for the coffee / caffeine to work
- (time) for coffee / caffeine to be absorbed

  allow (time) for the coffee / caffeine to be digested
- (time) for caffeine to reach the brain

  allow (time) for coffee to reach the brain
- (time) for coffee / caffeine to get round the body

1

(d) eye

1

(e) muscle

1

(f) (reaction time is) decreased

allow reaction time is shorter

allow reactions are faster

allow (reaction) time is quicker

1

(g) student 3

1

(h) leave it out (and divide sum of the others by 4)
or
divide the sum of the others by 4

ignore repeat the test

1

[9]

Q2.

(a) any **four** from:
- (stimulus is) detected by the receptor
- (initiates) an electrical impulse
- (impulse) travels via the neurones
- sensory, relay and motor

allow in this order only
- crosses synapses
- (crosses synapses) as a chemical

4

(b) **Level 2:** The method would lead to the production of a valid outcome. All key steps are identified and logically sequenced.

3–4

Level 1: The method would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear.

1–2

No relevant content

0

Indicative content
- select at least 3 people
- do reaction time test at least 3 times using right hand
- details on how to do test in valid manner
- find a mean
- remove anomalous readings
- repeat for each person for left hand
- select people of same age
- select people of same gender
- same time of day
- other control such as amount of coffee, sleep.

To access level 2 the right hand and left hand of each person must be compared

(c)

$$\frac{(0.2 + 0.4 + 0.3 + 0.4 + 0.2 + 0.3)}{6}$$

or

$$\frac{1.8}{6}$$

1

0.3

1

(d) reaction time

allow time

1

(e) students who play tennis (regularly) had shorter / faster (mean) reaction time(s)

1

(f) any **one** from:

- overlap in times between two groups

  allow correctly described as comparative data

- small difference in (mean) times

- small sample used

  allow students who did not play tennis may have played other (ball) games

1

[13]

Q3.

(a) any **one** from:

- previous intake of caffeine that day
- usual intake of caffeine (on previous days)
- concentration of caffeine
- volume of caffeine

  allow named caffeinated drink for caffeine

  *allow amount / mass / type of caffeine for **1** mark*

- time of day
- amount of sleep
- body mass
- previous experience of the test
- which hand (of student **B**) holds the stopwatch

  allow fatigue

  allow (body) weight / BMI

1

(b) any **two** from:

- (student **A**) does not press both start buttons simultaneously
- (student **A**) may not say stop and press button simultaneously
- student **B** could be distracted
- idea that student **B**

anticipated student **A**

stopping the stopwatch

- stopwatch malfunction

  allow (stop)watches may not be <u>accurate</u>

2

(c) no value / result / number occurs more than once

or

all the values / results / numbers are different

1

(d) add(ed) the other (7) results and divide(d) by 7

allow correctly shown calculation

ignore leave out the result for pair 8

1

(e) (adrenaline) increases heart rate

allow increases blood flow

1

(which) increases oxygen / glucose to brain / muscle (cells)

1

(which) increases rate of respiration

1

(so) releasing more energy for (faster / more) muscle <u>contraction</u>

allow (so) releasing more ATP for (faster / more) muscle <u>contraction</u>

*do **not** accept energy produced / made / created*

1

(f) synapse

allow synaptic cleft

1

(g) fewer adenosine (molecules) can bind to the receptors

or

adenosine has no / less effect on the (relay) neurone

1

therefore impulses in relay neurone are more frequent

allow impulses in relay neurone are faster

allow there are more impulses in relay neurone

allow impulses in relay neurone not delayed / reduced (in number)

ignore caffeine binds to adenosine receptors

1

[12]

Q1.

This was based on Required Practical Activity 6. It was clear that many students did not appear to understand the method given. When asked for two control variables, many students copied steps from the method that were not applicable.

Most students could identify the receptor and effector in this situation. It was more challenging to describe the effect of drinking coffee on reaction time, with many students stating reaction time increased. (g) required students to identify the smallest change in reaction time. A common incorrect answer was student 5, who showed the lowest reaction time, but not the smallest change. Most students knew that the anomalous result should not be included when calculating the mean. Common incorrect responses referred to rounding the anomaly up or down.

Q2.

(a) required knowledge of the reflex arc pathway and on this paper very little knowledge was seen. If marks were gained it was usually for the idea that ‘messages’ travelled via neurones or the mention in passing of a synapse. A very common incorrect answer worth 0 marks was ‘the stimulus travels to the brain, and then to the muscle telling it to contract’.

In (b) students generally mentioned the ruler drop test and gained 1 mark for an incorrect or vague account or 2 marks if detail, controls or repeats were given. Very few students progressed beyond that as they either compared right-handed and left-handed people, or those taking caffeine or not.

Q3.

Some students read and understood the reaction time method provided. Some however, made assumptions that this was a ‘ruler drop’ method and then struggled to answer questions relating to control variables and possible sources of random error in the method.

In (d) students had to link their knowledge of the effect of adrenaline on the body to reaction time. A common misconception seen was that reaction time decreasing must mean slower reactions. Few students referred to oxygen or glucose supply to muscles or the brain, and fewer referred to the rate of respiration or energy released for muscle contraction. The common errors referring to energy being ‘produced’ were seen.

Students could generally recall the term ‘synapse’. Few could apply their knowledge to the scenario given in (g). Many students simply repeated the information provided, which is never awarded credit.

Hormonal control in humans PPQs

Name: _____

Class: _____

Date: _____

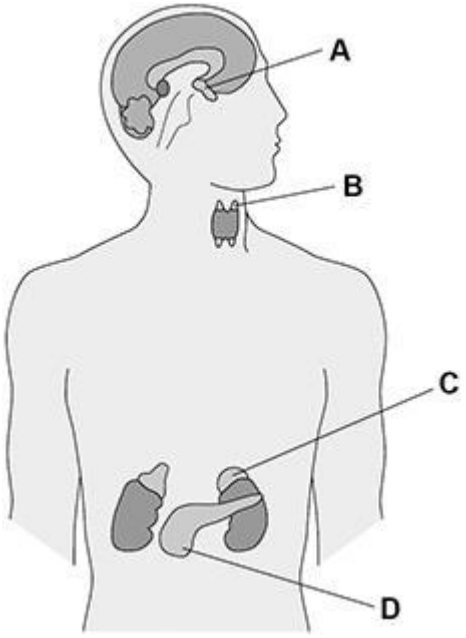
Time:	**38 minutes**
Marks:	**35 marks**
Comments:	**Self-assess using the mark scheme below. You can check your marks against the Examiners comments to see if you fell into the same issues as the students who took that exam.**

Q1.

The endocrine system is made up of glands which secrete hormones.

Figure 1 shows the position of endocrine glands in the human body.

Figure 1



(a) Which letter shows the pancreas?

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

(1)

(b) Which letter shows the thyroid gland?

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

(1)

(c) Hormones travel from the gland where they are made to the target organ where they have an effect.

How do hormones travel from the gland to the target organ?

_____

_____

(1)

When blood glucose concentration becomes too high, hormone **X** from the pancreas causes a decrease in the glucose concentration.

(d) Name hormone **X**.

_____

(1)

(e) In what **two** ways does hormone **X** cause a decrease in blood glucose concentration?

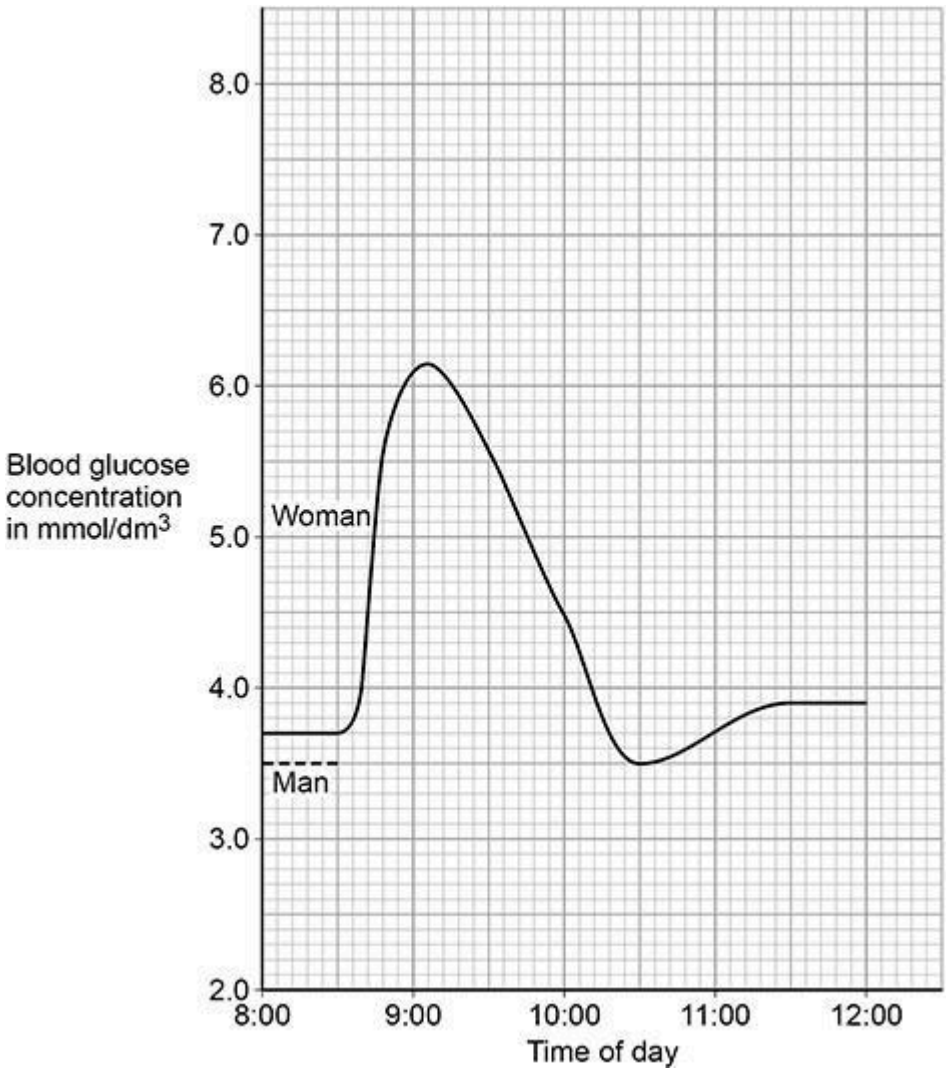
Tick (✓) **two** boxes.

- Glucose is broken down. ☐
- Glucose is converted to glycogen. ☐
- Glucose is excreted by the kidneys. ☐
- Glucose moves from the blood into the cells. ☐
- Glucose moves into the small intestine. ☐

(2)

Figure 2 shows the blood glucose concentration in a woman.

Figure 2



(f) Suggest what time of day the woman ate her breakfast of sugar-coated cereal.

Time of day = _____

(1)

The man in **Figure 2** has Type 2 diabetes but he has **not** been treated.

(g) The man ate:

- the same type and amount of breakfast cereal as the woman
- at the same time as the woman.

Suggest what his blood glucose concentration would be at 9:00

Blood glucose concentration = _____ mmol/dm^3

(1)

(h) The man:

- is an obese office worker
- does not exercise
- eats sugary snacks at his desk.

Give **two** lifestyle changes a doctor might recommend to the man to help him control his diabetes.

1 _____

_____

2 _____

_____

(2)

(i) Describe how a **low** blood glucose concentration would lead to a person feeling weak.

_____

_____

_____

_____

(2)

(Total 12 marks)

Q2.

This question is about reproduction.

(a) Describe the difference between the way hormonal and non-hormonal methods of contraception work.

Give **one** example of each method of contraception.

_____

_____

_____

_____

_____

_____

(3)

The urine of women using hormonal methods of contraception contains high levels of progesterone.

Concentrations of 1–3 ng/dm^3 of progesterone are found in the water of rivers near sewage outflow points.

Scientists investigated the effect of different concentrations of progesterone in water on fish reproduction.

This is the method used.

1. Prepare tanks of water containing different concentrations of progesterone.

2. Put a breeding pair of fish into each tank.

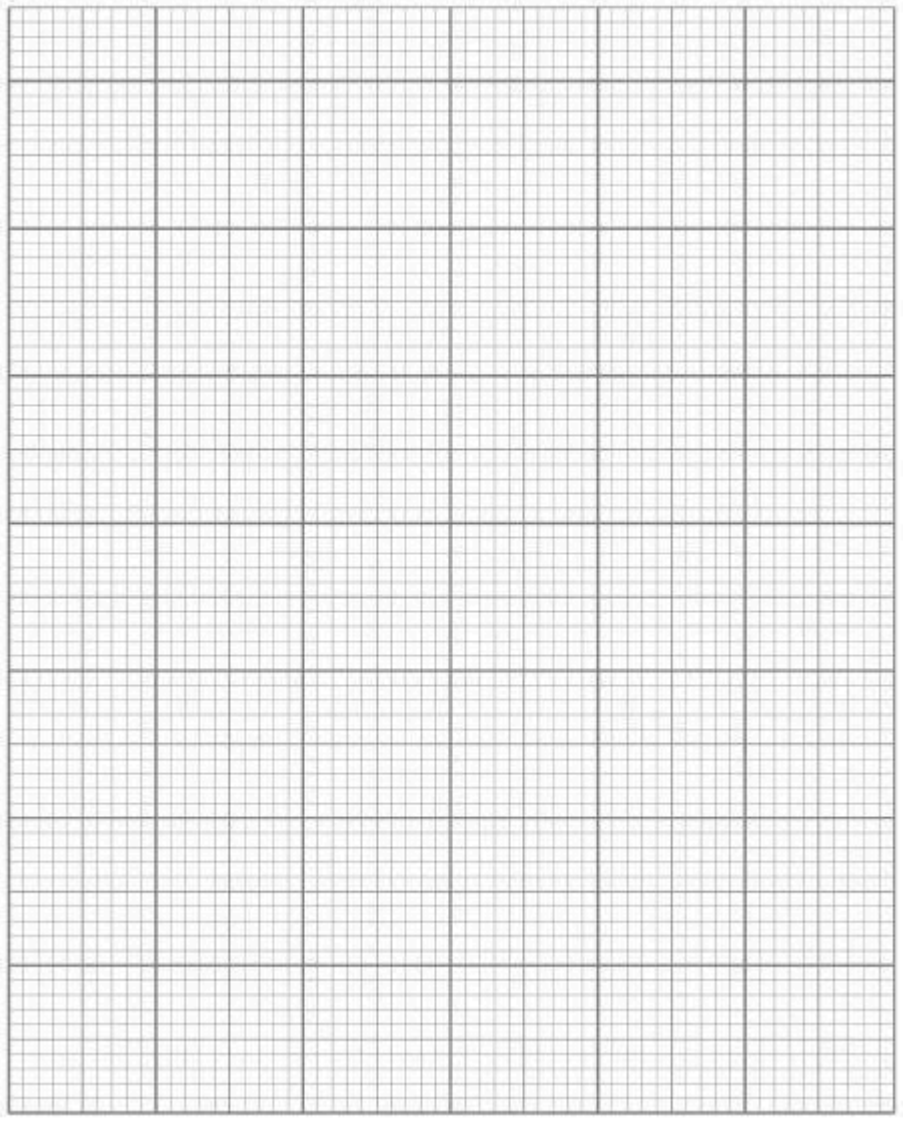
3. Record the number of eggs produced per day by the female in each tank for 14 days.

The table shows the results.

Concentration of progesterone in water in ng/dm^3	**Mean number of eggs produced per day**
0.0	28.6
0.8	4.5
1.5	3.2
3.0	2.8
10.0	1.1
20.0	0.2

(b) Plot the data from the table on the grid.

You should:
- label each axis
- use a suitable scale
- draw a line of best fit.



(4)

(c) Describe the effect on fish reproduction of the concentrations of progesterone found in rivers near sewage outflows.

Use data from your graph.

_____

_____

_____

_____

(2)

(Total 9 marks)

Q3.

This question is about homeostasis.

(a) Define the term homeostasis.

_____

_____

_____

_____

(2)

(b) Name the hormone released if the blood glucose concentration falls too low.

_____

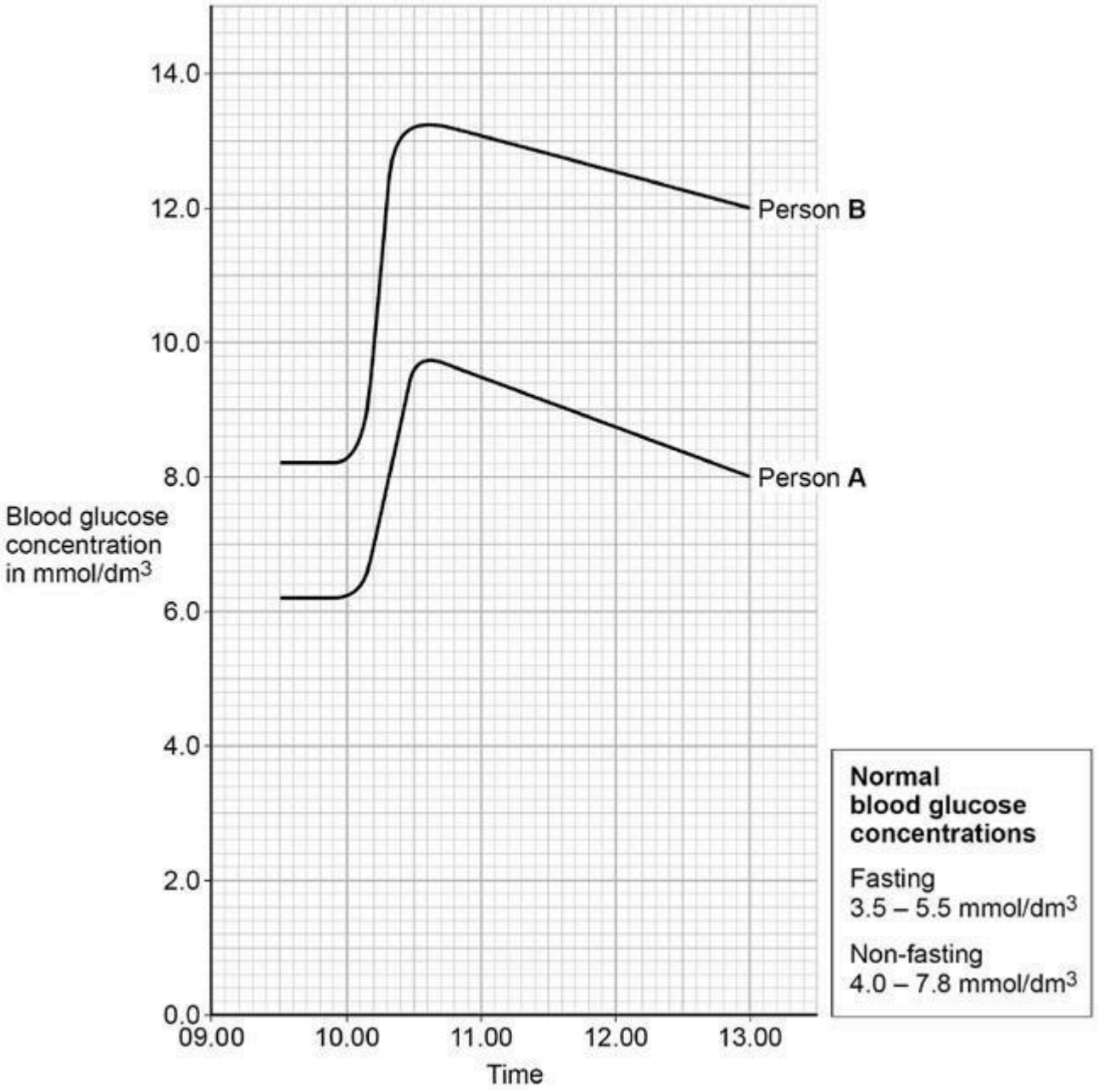
(1)

Two people were sent to a hospital to find out if they have diabetes.

This is the method used at the hospital.

- Do not eat or drink after midnight. This is called fasting.
- Measure blood glucose concentration at 9.30 am
- Drink a glucose solution at 10.00 am
- Measure blood glucose concentration for the next 3 hours.

The graph shows the results.



Person **A** and person **B** have diabetes.

(c) Describe how the graph above shows that person **B** has diabetes.

Use data from the graph.

_____

_____

_____

_____

_____

_____

(3)

(d) Person **A** and person **B** had a test to measure the concentration of insulin in their blood when they were fasting.

The table shows the results.

Person	**Fasting blood insulin concentration in arbitrary units**
A	280
B	20
Normal range	50–175

Suggest which type of diabetes person **A** and person **B** have.

Give a reason for each answer.

Person **A**

Type of diabetes _____

Reason _____

_____

Person **B**

Type of diabetes _____

Reason _____

_____

(2)

(e) Toxic hypoglycaemia syndrome (THS) has caused the deaths of hundreds of starving children in some tropical countries.

- The starving children have had nothing to eat all day.
- The starving children then eat many lychee fruits.
- The lychee fruits contain a molecule which stops an enzyme in the liver working.
- This enzyme normally converts stored fats into glucose.

Children who have eaten during the day are **not** affected by eating many lychee fruits.

Starving children may die from eating many lychee fruits but children who have eaten during the day are not affected.

Explain why.

(6)
(Total 14 marks)

Q1.

(a) D

1

(b) B

1

(c) (in / through / via) blood(stream)

allow (in / through / via) plasma
allow (in / through / via) blood vessels
allow (in / through / via) arteries / veins / capillaries

1

(d) insulin

1

(e) glucose is converted to glycogen

1

glucose moves from the blood into the cells

1

(f) 8:30 (am)

allow 8:25 – 8:35 (am)
allow time written in words

1

(g) any value in the range ≥ 6.5 to ≤ 20 ($mmol/dm^3$)

1

(h) any **two** from:

- low carbohydrate diet
  allow low calorie / fat / sugar diet
  allow eat fewer (sugary) snacks
- exercise (regime)
  allow description of exercise
- lose body mass
  allow lose weight
  allow (metformin) tablets to reduce blood glucose

2

(i) (less) respiration

1

(so) less energy released / transferred

*do **not** accept energy produced / made / created*

or
less muscle contraction

1

[12]

Q2.

(a) (hormonal uses chemicals / synthetic) hormones to prevent an egg being released

allow 'to prevent maturation of eggs'

1

(non-hormonal has a barrier which) prevents the sperm reaching an egg **or** prevents implantation

1

a correct example of each type

1

(b) suitable scales and axes labels correct

1

all points plotted accurately

*allow **1** mark for 5 accurate points*

2

line of best fit

*allow a bar chart for max **3** marks*

1

(c) decrease egg production

1

by between 6–10 times

allow ecf from their graph

1

[9]

Q3.

(a) regulation / control / maintenance of internal conditions (of a cell / body)

allow keeping the internal conditions (of a cell / body) the same

1

for optimum (cell / enzyme activity)

allow description of optimum functioning (of cell / body)

1

(b) glucagon

correct spelling only

1

(c) any **two** from:

- fasting blood glucose is higher than normal range
- reached a very high concentration after glucose drink
- did not return to normal after 3 hours
- **or**

- fell slowly after reaching peak.

use of correct data in comparison to normal ranges given for any of the above points

allow ± half a small square for values quoted from the graph

1

ignore references to person A

2

(d) (person A has Type) 2 (pancreas) producing (lots of) insulin but body cells cannot respond to it.

*allow cells becoming resistant to insulin for respond to insulin. do **not** accept the person has become resistant to insulin*

1

(person B has Type) 1 (pancreas) not producing enough insulin (to control concentration of glucose in the blood)

1

type of diabetes must be correct

(e) starving children have used up their glycogen stores

allow starving children have no / low glycogen stores

1

(so) would need (liver enzyme) to release glucose from fats

1

as enzyme is stopped from working they get low / no glucose

allow no working enzyme leads to hypoglycaemia

1

(cell) respiration is insufficient (so they die)

allow starving children use proteins to release energy (which leads to death)

1

children that are not starving have glycogen stores in liver / muscle

1

(so) glucagon will continue to release glucose (into the blood for them)

1

[14]

Q1.

(a) Two-thirds of students could identify the pancreas on Figure 1.

(b) 72% of students could identify the thyroid gland on Figure 1.

(c) 62% of students gained this mark. Blood, bloodstream and blood vessels were the most commonly seen correct answers. Named blood vessels were acceptable, as was plasma, but this was rarely seen.

Common misconceptions were seen, such as hormones travelling in blood cells, electrical impulses transporting hormones or the brain sending hormones out to the rest of the body.

(d) 45% of students gave the correct answer ‘insulin’. Phonetic spelling was allowed. Incorrect answers included a range of other hormones, diabetes and pancreas.

(e) A fifth of students could identify two ways that hormone X causes a decrease in blood glucose concentration.

(f) Students found this challenging, with fewer than 43% gaining the mark. Some students incorrectly gave the time that the graph peaked, others the trough or the start of the *x*-axis.

(g) This was another challenging question, with a third of students gaining the mark.

(h) Most students could give at least one lifestyle change. Exercise or descriptions of exercise were the most common correct response.

(i) Students found this a very challenging question. Few students made correct reference to respiration. Energy was often referred to in incorrect terms, such as glucose making energy or glucose being needed to feel energised. Some students stated that you need lots of glucose for energy which was insufficient. Other students confused the idea that low blood glucose was because of insulin in this case.

Q3.

(a) This question required a straightforward and general definition of homeostasis – the idea that internal conditions of a body or cell are regulated so that they are optimal for all functioning.

The first strand of this definition was often given correctly, although no credit was allowed for statements such as ‘control of the body’ or ‘maintenance of the body’s living conditions’ where there was no qualification of this being ‘internal’. Answers which embraced regulation of both internal and external environments were clearly incorrect but probably reflected the students’ knowledge that ‘changes’ in these environments are the triggers for homeostasis. Some students inappropriately referred to things, organs, reactions, activities, structures, functions, or systems being controlled.

The second strand of the definition, however, was seen far less frequently. Words such as regular, correct, normal, good, healthy or right were all too vague for ‘optimal’. Similarly, references to conditions being kept stable, steady or balanced,

whilst true, did not go far enough, as they may not necessarily be ‘optimal’. Some students focused on hormones or on specific examples of homeostasis, but an overarching definition of the term was required for credit.

Others were completely confused and followed the trigger of the prefix ‘hom(e)o’ by referring to ‘(homozygous) genes’ or to evolution, reflecting the generic name for a human. Some recalled ‘environment’ in their learned definition and then gave ecological responses. 41% of students earned the first mark point and 9% gained the second.

(b) 36% of students gave the correct response of glucagon as the hormone which is released if blood glucose concentration falls too low. It was expected that students could spell this scientific word and so the various combinations of glycogen, glucose and glucagon seen were not accepted.

(c) This challenging question required students to describe how the data presented in a graph showed that one individual had diabetes. Many jumped too quickly, saw a graph of blood glucose concentration in two people and immediately thought that the question was actually asking something different i.e. for a comparison to show that one individual was ‘normal’ and the other was ‘diabetic’. References to person A were ignored in the marking of the question but a student who followed this line of argument often found it difficult to gain much credit.

Although the command word in the question was ‘describe’ many students still felt the need to ‘explain’. As a result, they both wasted time and also failed to home in on the detailed descriptions of events that were required. Students should have assessed the graph and question carefully and noted – firstly, that information about normal blood glucose concentrations was given for comparison; secondly, that this information referred separately to fasting and non-fasting levels; thirdly, that the question tariff was three marks and that plotted data on the graph followed through three distinct stages; finally, that the question asked specifically for the use of data.

One mark was available for appreciating that the fasting blood glucose level in person B was higher than normal. Students did not gain credit if ‘fasting’ was omitted or if the reference to ‘high’ was not comparative.

One mark was available for noting that blood glucose reached a very high level after the drink. Students failed to get credit if the context of ‘non-fasting’ or ‘after the drink’ was not made clear. No mark was awarded, either, if ‘high’ was not qualified in some way to imply that it was ‘very’ high. Blood glucose levels would go up immediately after a glucose drink, regardless of whether the person was diabetic or not. In addition, the mark was for the blood glucose reaching this (very) high level and not for the speed at which it achieved it. Blood glucose levels would rise quickly after a glucose drink, regardless of whether the person was diabetic or not. Consequently, answers such as blood glucose levels ‘shot up’ or ‘rose rapidly’ after the drink gained no credit.

One mark was available for appreciating that blood glucose levels fell slowly or took a long time to fall after the initial rise. This point had to relate to a description of the graph and it was insufficient to say ‘it took much longer for the glucose to be converted to glycogen’.

Students could only access full marks in this question if they used correct data from the graph in support of one of the points they made. Some answers incorrectly referred to insulin, rather than to blood glucose levels, and no credit could be given.

6% of all students gained all three marks, 19% of students gained two marks and 24% gained one mark.

(d) This question required students to understand the differences between the two types of diabetes. If the incorrect types were ascribed to the two people then no marks were available for the student's reasoning. The people referred to in the question were person A and person B and the two types of diabetes are Type 1 and Type 2. The correct and unambiguous use of letters and numbers in answers here was, therefore, a priority. Some students wrongly referred to type A/B diabetes; others hurriedly wrote the numbers 1 and 2 in a way that was unclear to examiners. Where specific letters or numbers are required in answers, students are advised to think very carefully before putting pen to paper and to, possibly, consider writing numbers in words if they feel that their figures might be misconstrued. The same applies to crossings out. If changes are made to answers, they must be unambiguous if credit is to be awarded.

Full and accurate answers relating to person A were rarely seen. Students had to refer both to the fact that insulin was 'produced' and also to body 'cells' being unable to respond or being resistant to it. If the context of production was incorrect, e.g. liver, then no mark was credited. If the lack of response was linked to the body without the qualification of cells or if the student said that 'the body was insulin resistant', again, no credit could be given.

Answers relating to person B were invariably better. The mark was not awarded, however, for responses that were too vague e.g. 'cannot produce the right amount of insulin' / 'cannot produce insulin properly' or 'the body is not producing enough'. Given the data in the question, it was also clearly wrong to say that person B produced 'no insulin'. Students occasionally referred to reasons which did not fully reflect the data given e.g. due to genetic factors or obesity; others described possible ways of treating the diabetes. Such answers gained no credit on their own. A third of students explained one answer, usually Type 1 for person B but very few gave the detail needed to explain Type 2.

(e) This question required students to apply their knowledge of blood glucose control in a novel situation. Thus, a majority of students did not gain any credit. Although this was not an easy question, many students at least attempted to give reasoned and detailed answers. The context of the question was given in an order that was hoped might help understanding but, nevertheless, very few complete accounts were given.

Students were asked to explain the different possible outcomes when both starving and non-starving children ate lychee fruits. Many struggled to find appropriate biological knowledge to frame their responses and jumped at key words that they hoped would give clues. These included – 'THS', 'enzymes', 'liver', 'day (and night)', 'fat' and 'glucose'.

'THS' led some into thinking that this was an infectious disease, arguing that starving children would have very weakened immune systems that could not cope, leading to death. Enzymes' opened up several different approaches, apart from the expected one, including e.g. no amylase to break down the fruit and release glucose, no lipase to break down fats, enzymes being denatured as a result of high temperatures in the tropics, lychee fruits containing the enzyme which then attacked the liver. Others thought that an enzyme which led to the release of glucose had, in the context of the whole of question six, to be glucagon. Some answers, unfortunately, also referred to enzymes being 'killed'. 'Liver', in conjunction with 'fats', led a few students to discuss how no emulsification by bile was possible.

Others referred to THS being a liver disease. ‘The ‘day and night’ aspect led to answers which suggested that starving children would be unable to cope with many lychee fruits on ‘empty stomachs’ just before going to sleep.

The most common incorrect lines of argument, however, centred on ‘fats’. Many answers implied that a lack of food meant that the starving children would have no fats in their bodies at all meaning that no glucose could be released. The students were, therefore, paying little attention to the effects of eating lychee fruits. Other answers focused on fats not being broken down and, therefore, accumulating in the body, leading to eventual heart disease and death. Some mistakenly equated fats with ‘glycogen’.

Discussions of ‘glucose’ itself were often misplaced. Rather than lychee fruits containing a molecule preventing the release of glucose, many argued that they would, themselves, contain large amounts of the sugar. It is possible these students confused hypoglycaemia and hyperglycaemia. The children would be overloaded with glucose and unable to store it, leading to other problems (e.g. with water levels and osmosis) and, ultimately, death.

Other misconceptions that arose in answers included e.g. respiration ‘produces’ energy or energy is ‘used’ in respiration. Weak answers were always too vague, even if not incorrect, to gain credit e.g. ‘the body will not be at its optimum level’ or it will not be possible to ‘respire properly’. Few students correctly referred to glycogen stores in non-starving children, but good responses did make the link to their absence in starving children.

Students should, perhaps, be advised to marshal their ideas in a brief plan before answering questions of this sort. They should also pay heed to all information given in the stem of the question rather than to just a few aspects.

Only the most perceptive students recognised that the difference in effects on the children lay in the presence or absence of glycogen stores in the muscle or liver which could be used to restore blood glucose levels. If they did recognise this, they gained three to five marks. The most common single mark awarded was for the knowledge that without glucose respiration would stop, leading to death.

Reproduction PPQs

Name: _____

Class: _____

Date: _____

Time:	**30 minutes**
Marks:	**29 marks**
Comments:	**Self-assess using the mark scheme below. You can check your marks against the Examiners comments to see if you fell into the same issues as the students who took that exam.**

Q1.

This question is about genetics.

(a) Crop plants are genetically modified (GM) for useful characteristics.

Which useful characteristic are crops genetically modified for?

Tick (✓) **one** box.

Fewer roots ☐

Larger yields ☐

Smaller fruits ☐

(1)

(b) What is **one** concern about GM crops?

Tick (✓) **one** box.

GM crops will add to global warming. ☐

GM crops will cause air pollution. ☐

GM crops will harm wildlife. ☐

GM crops will produce too much food. ☐

(1)

Some inherited disorders are caused by a faulty piece of DNA.

(c) What is the name of a piece of DNA that codes for a characteristic?

_____

(1)

(d) DNA contains a code for making substances in the cell.

What type of substance is made using the DNA code?

Tick (✓) **one** box.

Fat ☐

Protein ☐

Starch ☐

Sugar ☐

(1)

Cystic fibrosis (CF) is an inherited disorder.

The allele for having CF is recessive (**h**).

The allele for **not** having CF is dominant (**H**).

(e) What is a recessive allele?

Tick (✓) **one** box.

An allele that is always expressed. ☐

An allele that is expressed if only one copy is present. ☐

An allele that is only expressed if two copies are present. ☐

(1)

A man and a woman do **not** have CF. The man has the alleles **Hh**.

(f) What word describes the alleles of the man?

Tick (✓) **one** box.

Heterozygous ☐

Homozygous ☐

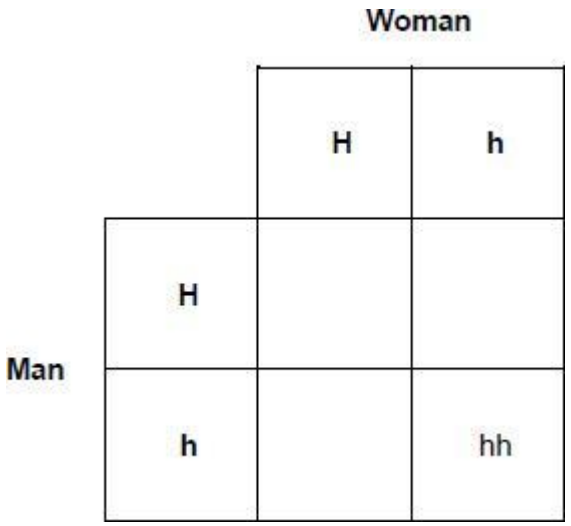
Phenotype ☐

(1)

(g) The man and the woman want to have a child.

Complete below diagram to show the possible genotypes of the child.

Draw a ring around the genotype of a child who will have CF.



(3)

(h) What is the chance that a child of the man and the woman will have CF?

Tick (✓) **one** box.

25% ☐ 50% ☐ 75% ☐ 100% ☐

(1)

(i) The woman is pregnant.

The woman can have embryo screening to find out if the child will have CF.

Suggest **one** reason why the woman might **not** want to have embryo screening.

_____

_____

_____

(1)

(Total 11 marks)

Q2.

Some genetic disorders are caused by alleles inherited from the parents.

(a) What are **alleles**?

_____

_____

(1)

(b) Polydactyly is a genetic disorder that leads to extra fingers or toes.

Polydactyly is caused by a dominant allele, **D**.

The photograph shows the hand of a person with polydactyly.

A man has polydactyly. His wife does not have polydactyly.

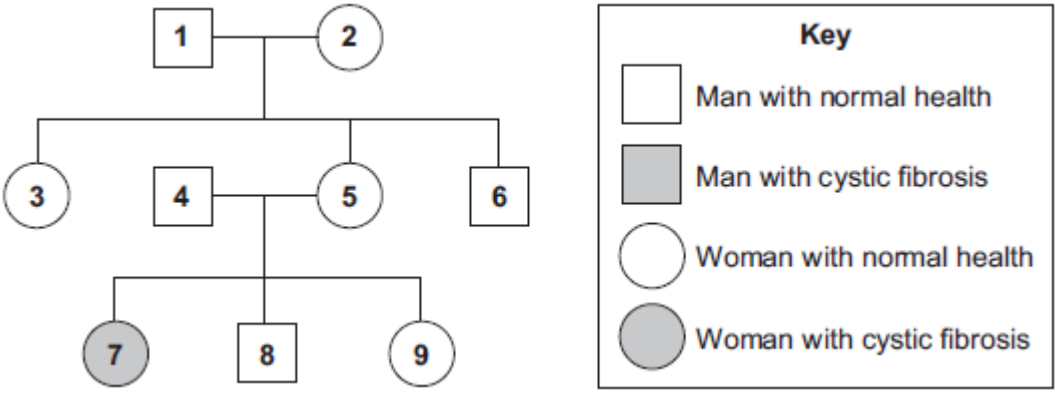
This couple's children have a 50% chance of having polydactyly.

Draw a genetic diagram to explain why.

(3)

(c) Cystic fibrosis is another genetic disorder. It is caused by a recessive allele.

The diagram shows the inheritance of cystic fibrosis in one family.



Woman **5** is pregnant with her fourth child.

What is the probability that this child will have cystic fibrosis?

Draw a genetic diagram to explain your answer.

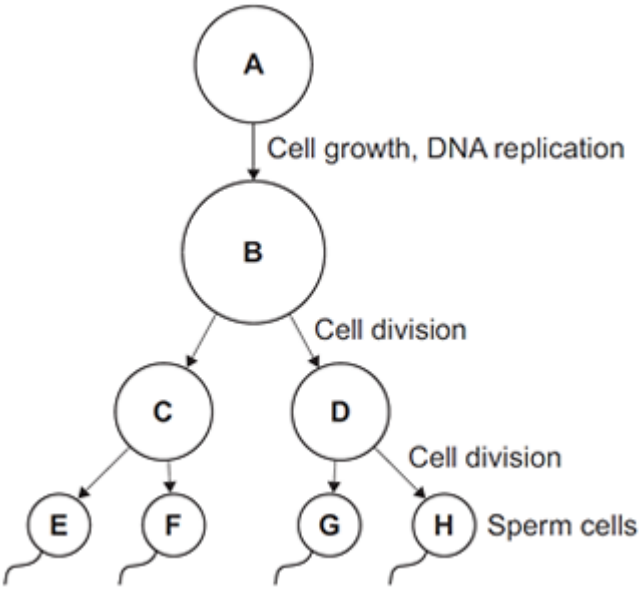
Use the following symbols.

N = allele for normal health
n = allele for cystic fibrosis

(4)
(Total 8 marks)

Q3.

The diagram below shows the production of human sperm cells.



(a) Name the organ where the processes shown in the diagram above take place.

_____

(1)

(b) (i) Not every cell in the diagram above contains the same amount of DNA.

Cell **A** contains 6.6 picograms of DNA (1 picogram = 10^{-12} grams).

How much DNA is there in each of the following cells?

Cell **B** _____ picograms

Cell **C** _____ picograms

Cell **E** _____ picograms

(2)

(ii) How much DNA would there be in a fertilised egg cell?

_____ picograms

(1)

(iii) A fertilised egg cell divides many times to form an embryo.

Name this type of cell division.

_____

(1)

(c) After a baby is born, stem cells may be collected from the umbilical cord. These can be frozen and stored for possible use in the future.

(i) What are stem cells?

_____

_____

_____

_____

(2)

(ii) Suggest why it is ethically more acceptable to take stem cells from an umbilical cord instead of using stem cells from a 4-day-old embryo produced by In Vitro Fertilisation (IVF).

_____

_____

(1)

(iii) Stem cells taken from a child's umbilical cord could be used to treat a condition later in that child's life.

Give **one** advantage of using the child's own umbilical cord stem cells instead of using stem cells donated from another person.

_____

_____

(1)

(iv) Why would it **not** be possible to treat a genetic disorder in a child using his own umbilical cord stem cells?

_____

_____

(1)

(Total 10 marks)

Q1.

(a) larger yields

1

(b) GM crops will harm wildlife

1

(c) gene(s)

allow allele(s)

1

(d) protein

1

(e) an allele is only expressed if two copies are present

1

(f) heterozygous

1

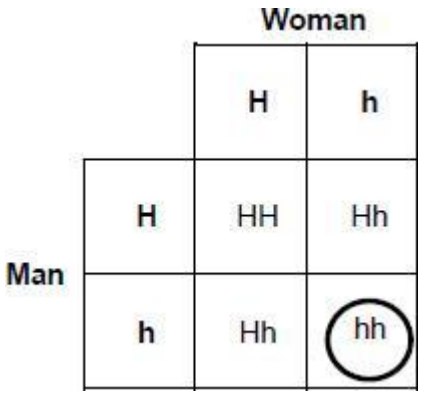
(g) **Mark with (h)**

offspring genotypes correctly derived

*allow **1** mark for 1 or for 2 correct genotypes*

2

hh circled Woman



1

(h) **Mark with (g)**

25%

*probability must match derivations (hh) in part **(g)***

1

(i) any **one** from:

- it might harm the embryo / baby / mother

  ignore harmful / dangerous unqualified

- it might cause a miscarriage
- they do not want to make a choice about having an abortion

- it is against their religious beliefs
  allow against their religion

  ignore cost

1

[11]

Q2.

(a) (different / alternative) forms of a gene
*do **not** accept types of genes*

1

(b) genotypes of parents and gametes correct (Man **D** and **d**, Wife **d** and **d**)
*allow half-size genetic diagram with only one **d** from wife*

1

offspring genotypes correct (½ = **Dd** and ½ = **dd**)
allow ecf if parental genotypes are wrong

1

offspring phenotypes correctly assigned to genotypes

1

(c) genotypes of parents and gametes correct (**N** and **n**)
allow ecf if parental genotypes are wrong

1

offspring genotypes correct (**NN**, 2 × **Nn**, and **nn**)

1

offspring phenotypes correctly assigned to genotypes;

1

correct probability = 0.25 / ¼ / 25% / 1 in 4 / 1:3, only;
*do **not** allow '3:1' / '1:4'*

1

[8]

Q3.

(a) testis / testes
allow testicle(s)

1

(b) (i) **B** = 13.2
C = 6.6
E = 3.3
all 3 correct = 2 marks
2 or 1 correct = 1 mark
*If no marks awarded allow ecf for C **and** E based on answer to B*
ie C = ½ B and E = ½ C for one mark

2

(ii) 6.6

*allow twice answer for cell **E** in part bi*

1

(iii) mitosis

correct spelling only

1

(c) (i) any **two** from:

- cells that are able to divide
- undifferentiated cells / not specialised
- can become other types of cells / tissues **or** become specialised /differentiated

allow pluripotent

2

(ii) 4-day embryo is a (potential) human life

or

destroying/damaging (potential) human life

allow cord would have been discarded anyway

ignore reference to miscarriage

allow cannot give consent

1

(iii) perfect tissue match **or** hard to find suitable donors

allow same/matching antigens

allow no danger of rejection

allow no need to take immunosuppressant drugs (for life)

*ignore genetically identical **or** same DNA*

1

(iv) stem cells have same faulty gene / allele / DNA / chromosomes

allow genetically identical

ignore cells have the same genetic disorder

1

[10]

Q1.

(a) 72% of students could identify larger yields as a useful characteristic that crops are genetically modified for.

(b) Around half of students could identify a concern about GM crops.

(c) 40% of students could name ‘gene’ or ‘allele’ as a piece of DNA that codes for a characteristic. Frequently seen incorrect answers were chromosome, genome and phenotype.

(d) Just over half of students knew that protein was made using the DNA code.

(e) 50% of students knew the definition of a recessive allele.

(f) 52% of students could identify that heterozygous was the appropriate term.

(g) A quarter of students could correctly derive the three missing possible genotypes of the child and draw a ring around hh. Many students could derive the genotypes, but did not draw a ring, or circled Hh or HH.

(h) The probability selected here needed to match the proportion of hh in their response to **(g)**. Half of students achieved this.

(i) Many students gave the first marking point, for the idea that there may be harm to the embryo. Some responses were too vague, such as ‘religion’ unqualified. ‘They might not want to know’ was considered insufficient. Despite the question context relating to cystic fibrosis, many students only referred to screening identifying the gender of the embryo. Some misconceptions were seen, such as embryo screening causing cancer and incorrect references to radiation were common.

Q3.

This question was about the DNA content of cells at various stages in meiosis and fertilisation, and the therapeutic use of stem cells

(a) It was rather surprising that only two thirds of students knew that the testes were the site of sperm production.

(b) (i) Students had to use the information that the first cell (cell **A**) in the diagram contained 6.6 picograms of DNA in order to calculate how much DNA was found in three other cells. Given that DNA replication occurred between cells **A** and **B**, it should not have been too hard to calculate the answer *13.4* for the DNA content of cell **B** and to deduce that this amount was progressively halved in the formation of cells **C** and **E**. However, only half of the students managed this, although a substantial proportion scored at least one mark for realising that the DNA content was halved from an incorrect starting figure for cell **B**. **A** not uncommon error was the use of the figures ‘46’ and ‘23’ by students who ignored the information they had been given.

(ii) Only half of the students were able to double their figure for the DNA content of cell **E** (the sperm cell) to obtain an appropriate figure for the DNA content of a fertilised egg cell.

(iii) Just over a third of students were able to name *mitosis* as the type of cell division used in the development of an embryo from a fertilised egg.

(c) This section was about stem cells and their potential use.

(i) Almost two thirds of students knew at least one fact about the nature of stem cells: either that they were unspecialised cells or that they could differentiate into any type of cell, but few gave both aspects.

(ii) Slightly more students could suggest a reason why it might be ethically more acceptable to take stem cells from an umbilical cord rather than from a 4-day-old embryo produced by IVF, usually expressed in terms of avoiding the destruction of, or damage to, a human life, although many did not seem to regard the umbilical cord as being 'alive'.

(iii) Fewer than half of students gained a mark here. The use of a patient's *own* umbilical cord stem cells (rather than stem cells from another person) related to a perfect *tissue match* / *same antigens* (or *avoidance of rejection*) rather than simply to genetic identity.

(iv) Fewer than half of students gained a mark here. Students were expected to realise that a genetic disorder could hardly be cured with one's own umbilical cord stem cells as they would have the *same* defect in the gene.

Variation and evolution PPQs

Name: _____

Class: _____

Date: _____

Time:	**30 minutes**
Marks:	**28 marks**
Comments:	**Self-assess using the mark scheme below. You can check your marks against the Examiners comments to see if you fell into the same issues as the students who took that exam.**

Q1.

Variation in individual organisms can be caused by:

- genes
- the environment
- a combination of both genes and the environment.

Figure 1 shows variations in a woman.

Figure 1

(a) What is the cause of each variation in the table below?

Tick only **one** box in each row.

Variation	Cause of variation		
	Genes only	**Environment only**	**Both genes and the environment**
Brown eyes			
Light brown skin colour			
Short hair			

(3)

(b) The allele for blue eyes is recessive (**b**).

The allele for brown eyes is dominant (**B**).

A woman has blue eyes.

What are the woman's alleles?

Tick **one** box.

BB ☐ **Bb** ☐ **bb** ☐

(1)

(c) The woman marries a man with the alleles **Bb** for eye colour.

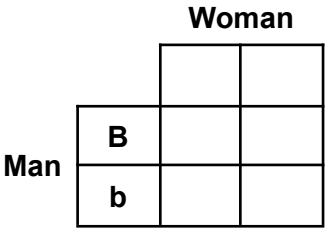
What colour eyes does the man have?

_____

(1)

(d) Complete the Punnett square diagram in **Figure 2** for this man and woman.

Figure 2



(1)

(e) What is the probability that a child of this man and woman will have brown eyes?

_____

(1)

(f) What is the scientific term used for the child's eye colour?

Tick **one** box.

Chromosome ☐

Condition ☐

Genotype ☐

Phenotype ☐

(1)

(g) What effect will a mutation have?

Tick **one** box.

Almost certainly have no effect ☐

Definitely change appearance ☐

Definitely be passed on to all children ☐

Probably cause a disease ☐

(1)

(Total 9 marks)

Q2.

This question is about DNA and genes.

(a) Which diagram represents a DNA molecule?

Tick (✓) **one** box.

☐ ☐ ☐

(1)

(b) Describe the structure of a DNA molecule.

_____

_____

(1)

(c) A gene is a small section of DNA on a chromosome.

Complete the sentences.

A gene codes for a particular sequence of _____.

This sequence makes a specific _____.

(2)

(d) What is meant by the term genome?

_____

_____

(1)

(e) The complete human genome is now known.

Which important scientific advance was made using knowledge of the human genome?

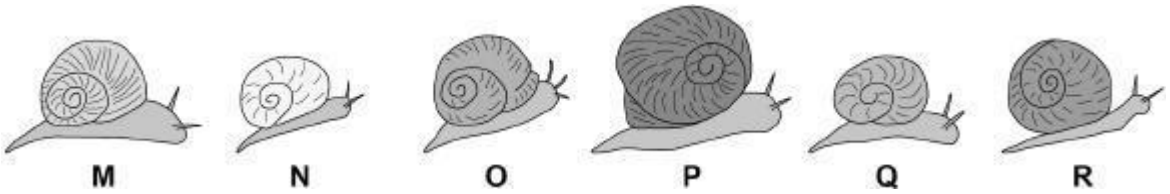
Tick (✓) **one** box.

Discovering antibiotic resistant bacteria	☐
Finding more foods to eat from tropical forests	☐
Tracing how aboriginal people spread across Australia	☐
Working out when the last ice age ended	☐

(1)

A student found six different snails of one species in his garden.

The diagram below shows the snails.



(f) All the snails are different.

What scientific term describes differences in characteristics between individuals of a species?

_____

(1)

(g) A change in DNA has caused snail **P** to be very different from the other five snails.

Suggest why there might be an increasing number of snails similar to snail **P** in each future generation.

_____

_____

_____

_____

(2)
(Total 9 marks)

Q3.

A fossil was found in rocks. The rocks were formed from mud.

The fossil is of the fungus *Ourasphaira giraldae.*

(a) What is the genus of the fungus?

_____

(1)

(b) Why was the mud important during the formation of the fossil?

Tick (✓) **one** box.

The fungus completely decayed in the mud.	☐
The mud stopped oxygen reaching the fungus.	☐
There was water in the mud around the fungus.	☐

(1)

The estimated age of the fossil is in the range from 8.9×10^8 years old to 1.1×10^9 years old.

(c) Calculate the size of the range of the estimated age of the fossil.

_____

_____

_____

Size of range = _____ years

(1)

(d) Humans did **not** exist when the fungus was alive.

Suggest **one** other reason why an accurate estimation of when this species of fungus existed is not known.

_____

_____

(1)

Carl Woese developed the three-domain system of classification.

(e) Fungi are **not** in the domain Archaea.

Which domain are fungi classified in?

_____

(1)

(f) Which **two** characteristics are features of organisms in the domain Archaea?

Tick (✓) **two** boxes.

Can only survive in light	☐
Can survive in extreme environments	☐
Cells contain chloroplasts	☐
Cells do not have a cell wall	☐
Cytoplasm contains DNA	☐

(2)

(g) Carl Linnaeus lived in the 1700s.

Carl Linnaeus classified living things into groups depending on their appearance.

Give **three** types of evidence that are used **now** to classify living things.

Do **not** refer to appearance in your answer.

1 _____

_____

2 _____

_____

3 _____

_____

(3)

(Total 10 marks)

Q1.

(a)

	Genes	Environment	Both	
Brown…	✓			1
Light…			✓	1
Short…		✓		1

(b) bb

1

(c) brown

*allow light brown **or** dark brown*

1

(d) (using bb for mother's gametes)

correct combination in all four boxes, e.g.

	(b)	*(b)*
(B)	Bb	Bb
(b)	bb	bb

allow any combination of mother's gametes as mark is for filling in boxes correctly

1

(e) 50%, 0.5, ½

*the award of this mark is consequential to the answer in part **(d)***

ignore ratios

1

(f) phenotype

1

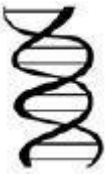
(g) almost certainly have no effect

1

[9]

Q2.

(a)



1

(b) any **one** from:
- 2 strands / chains that are twisted / coiled / spiralled
  allow cross links between 2 strands / chains
- double helix
- (long) polymer
  allow reference to nucleotides or sugars, phosphates and bases

1

(c)
in this order only

amino acids

1

protein
allow polypeptide

1

(d) all the genetic material (of an organism)
allow DNA / genes for genetic material
ignore chromosomes

1

(e) tracing how aboriginal people spread across Australia

1

(f) variation
ignore genetic/environmental

1

(g) stronger / larger (shell)

1

(so) more likely to (survive and) breed
or
(so) more likely to (survive and) pass on genes

OR

(better) camouflaged (1)

(so) less likely to be eaten and will breed more (1)

1

[9]

Q3.

(a) *Ourasphaira*

ignore italics

ignore capitalisation

*do **not** accept Ourasphaira giraldae*

1

(b) the mud stopped oxygen reaching the fungus

1

(c) any **one** from:

- 2.1×10^8 (years)
- 210 000 000 (years)

1

(d) any **one** from:

- fossil(s) of the fungus may have been destroyed (by geological activity)

  ignore some destroyed
- fossil(s) of the fungus may not have been found (yet)

  ignore some not found (yet)
- dating methods are not precise / accurate
- the time at which an organism / fungus evolves from ancestors is difficult to pinpoint

  allow point of speciation is not known

1

(e) eukaryota

allow eukaryote(s)

1

(f) can survive in extreme environments

1

cytoplasm contains DNA

1

(g) any **three** from:

- studies of internal / cell structures with <u>light</u> microscopes
- studies of internal / cell structures with <u>electron</u> microscopes

  allow organelles for internal / cell structures

  *if neither mark awarded allow studies of internal / cell structures (with microscopes) for **1** mark*

- chemical analysis
- comparison of biochemical processes
- DNA / genetic analysis
- studies of evolution(ary relationships)

3

[10]

Q1.

(a) Students were asked for the cause of three types of variation. 58% of students gave all three correctly. Many identified eye colour but less were able to correctly identify skin colour and short hair.

(b) Students were generally good at identifying the alleles for blue eyes with 82% answering correctly.

(c) 78% of students got the eye colour of the man when given the alleles. ‘Green eyes’ was also seen a fair number of times even though only brown and blue had been mentioned in the question stem.

(d) 78% of students were able to complete the Punnett square correctly. A very small number appeared to be confused about inserting the alleles for the woman and hence could not gain credit.

A large number of students used Bb or BB as their female’s gametes and gained credit for the correct derivation.

(e) When the Punnett square was completed correctly using bb, the student generally also gained this mark. However, where the student had used BB or Bb then the percentage quoted was usually incorrect.

Many students gave their response in the form of a ratio; often 2/4 was encountered, rather than 1/2. Students need to understand the difference between probability and ratios.

(f) The most common misconception for this question was that genotype, rather than phenotype, was the scientific term used for the child’s eye colour. 23% of students answered correctly.

(g) The effect of a mutation as usually having no effect was not a common response from students (14%). Most responses were ‘definitely change appearance’ or ‘probably cause a disease’.

Q2.

Students were generally able to recognise the DNA molecule and some could describe it as a double helix. In (c) very few responses related to protein synthesis with most giving some aspect of DNA, genes or chromosomes.

The section in the specification giving advantages of the human genome project seems to have been a significant challenge to students as few students could relate it to the migration of people. In (f) and (g) some students quoted ‘survival of the fittest’ but were unable to apply it to snail P. Many did gain 1 mark however, for noting the larger shell and suggesting that it was an advantage.

Q3.

Overall, there was a poor understanding of classification. Many students could not give the genus name when provided with the binomial. The calculation of the range required manipulation of figures in standard form, and was generally answered clearly. The most

common incorrect answer was 2.1×10^7. Students gained credit whether or not their correct answer was given in standard form.

In (d), many students did not move beyond the idea that had been given in the question, that humans were not alive when the fungus was alive and therefore there are no records of the fungus; this was insufficient. Some students could give the domain eukaryota, and phonetic spelling was allowed, as explained at the beginning of the mark scheme. (e) asked for recall of three types of evidence that are used now to classify living things. Despite being prompted not to refer to appearance, many responses did this, such as referring to size or external features.

Understanding genetics and evolution PPQs

Name: _____

Class: _____

Date: _____

Time:	**27 minutes**
Marks:	**24 marks**
Comments:	**Self-assess using the mark scheme below. You can check your marks against the Examiners comments to see if you fell into the same issues as the students who took that exam.**

Q1.

The theory of evolution by natural selection was suggested by Charles Darwin in 1859.

Evidence from fossils supports Darwin's theory.

(a) What evidence supports the theory of evolution by natural selection?

Tick (✓) **one** box.

Knowledge of how DNA controls inheritance ☐

Knowledge of how the dinosaurs became extinct ☐

Knowledge of how the Earth was formed ☐

Knowledge of what causes global warming ☐

(1)

(b) **Figure 1** shows a fossil fly preserved in amber.

The fossil formed when the amber solidified with the fly trapped inside.

Figure 1

Fossil fly preserved in amber © Philippe Gouveia / iStock

Why has the fly been preserved?

Tick (✓) **one** box.

The amber has been kept at a constant temperature. ☐

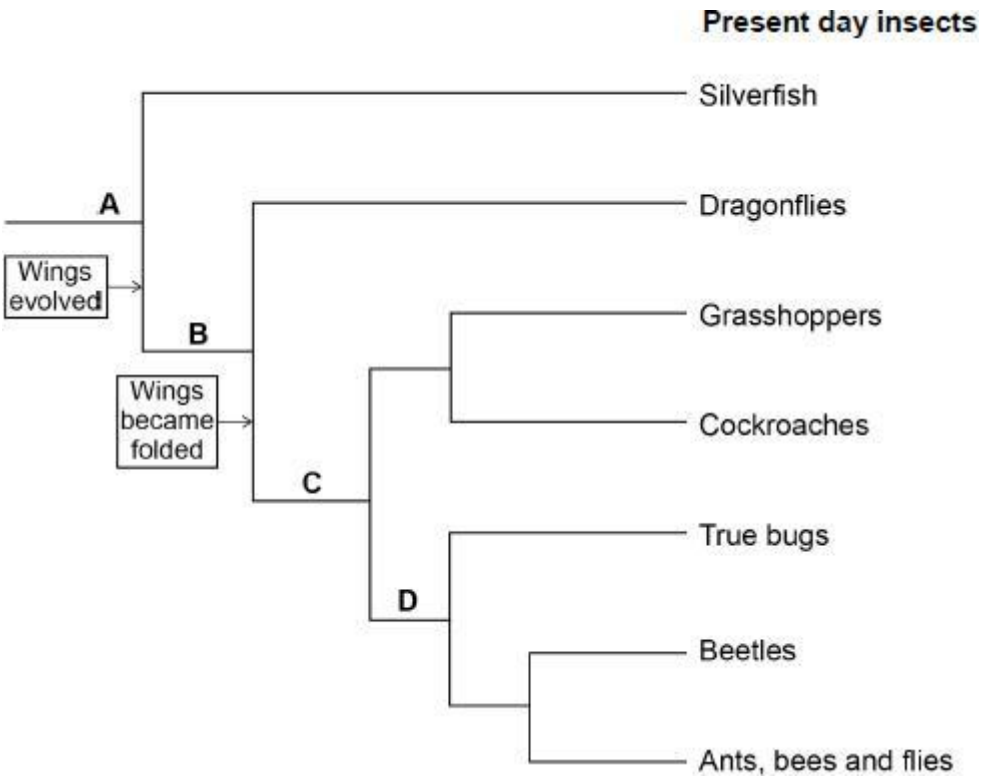
The fly was soft-bodied. ☐

There was no oxygen in the amber. ☐

(1)

Figure 2 shows a simplified evolutionary tree for the insect group of animals.

Figure 2



(c) Which present day insect evolved first?

_____

(1)

(d) Animals **A**, **B**, **C** and **D** were ancestors of present day insects.

Which animal is the most recent ancestor of both grasshoppers and beetles?

Tick (✓) **one** box.

A ☐ B ☐ C ☐ D ☐

(1)

(e) Name the group of present day insects which have wings which do **not** fold.

_____

(1)

(f) The house fly has the binomial name *Musca domestica*.

The table below shows part of the classification for the house fly.

Classification group	**Name**
Kingdom	
Phylum	arthropoda
Class	
Order	diptera
Family	muscidae
Genus	
Species	

Complete the table above.

Choose answers from the box.

animalia	**domestica**	**Musca**	**insecta**

(3)

(g) Carl Woese proposed the 'three-domain system' of classification.

Which domain are insects in?

Tick (✓) **one** box.

Archaea ☐

Eukaryota ☐

Prokaryota ☐

(1)

(Total 9 marks)

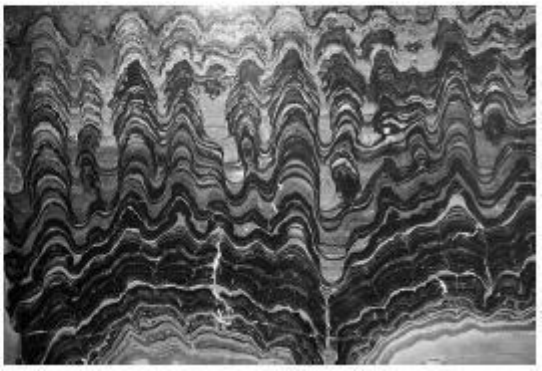
Q2.

Figure 1 shows photographs of fossils of extinct organisms.

Figure 1

Fossil A

Fossil B



(a) What is a fossil?

_____

_____

_____

_____

(2)

(b) What does extinct mean?

_____

_____

(1)

(c) **Fossil A** is a trilobite which had a shell, eyes and limbs.

Fossil B is a stromatolite formed by layers of microorganisms.

Which **two** statements suggest that the microorganisms lived at an earlier time than the trilobites?

Tick **two** boxes.

Microorganisms have a more simple structure than a trilobite.	☐
Stromatolites are found in older rock than trilobites.	☐

Stromatolites are layers of minerals left behind by millions of microorganisms. ☐

Stromatolites structures are larger than trilobite fossils. ☐

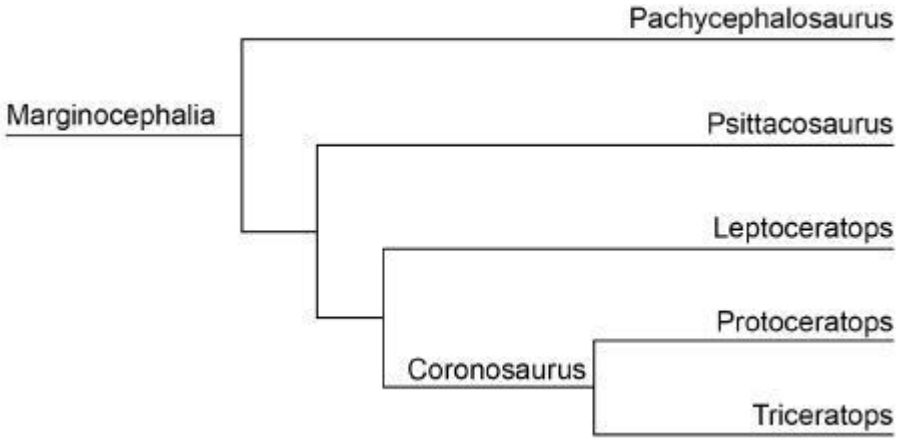
Trilobites lived in the sediment on the sea floor. ☐

(2)

Figure 2 shows an evolutionary tree drawn from the fossil record in the 1970s.

The evolutionary tree is for a group of dinosaurs.

Figure 2



(d) Scientists in the 1970s did radiocarbon dating on all the fossils.

Which fossil gave the earliest radiocarbon date?

_____

(1)

(e) Suggest which **two** types of dinosaur fossils showed the most similar features.

_____

(1)

(f) Give **one** reason why this evolutionary tree might **not** be correct.

_____

_____

(1)

(Total 8 marks)

Q3.

Scientists believe that the first life on Earth was primitive anaerobic bacteria which first appeared billions of years ago.

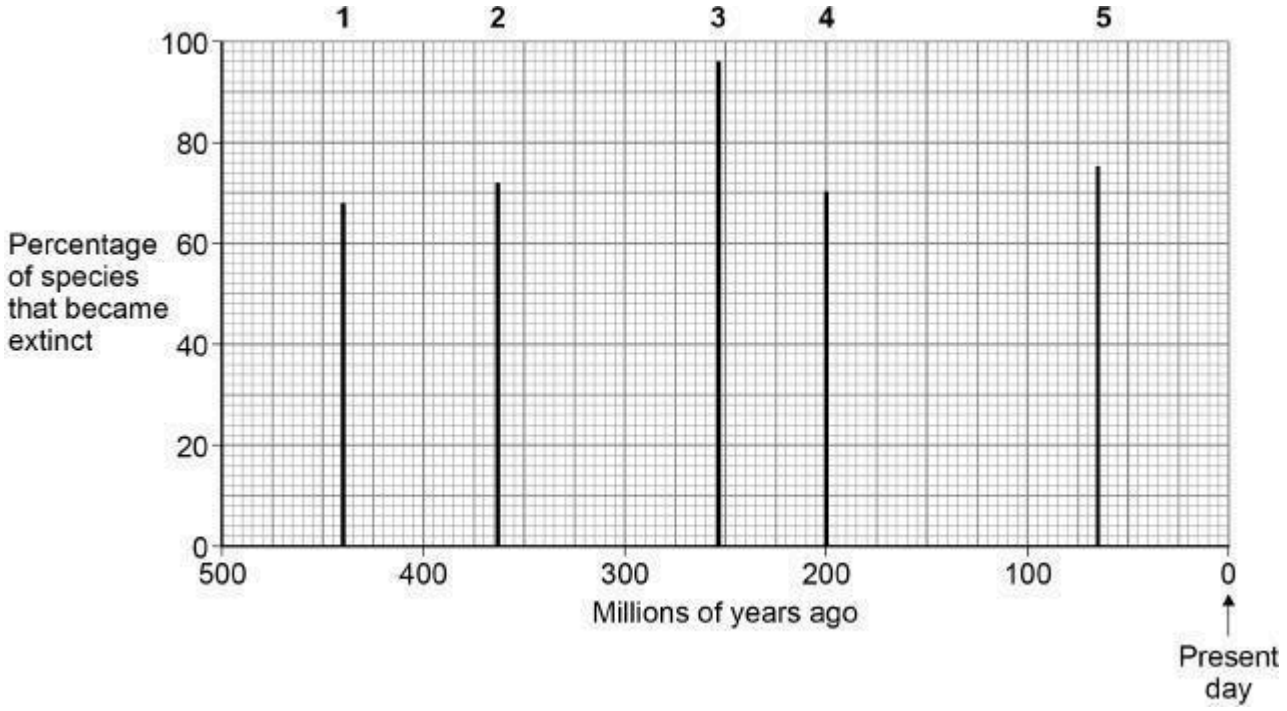
(a) Which domain of the three-domain classification system do these primitive anaerobic bacteria belong to?

_____

(1)

Scientists have identified five periods of mass extinction since the fossil record began.

The graph below shows the timeline of the five mass extinction events.



(b) Ammonites were organisms that first appeared in the oceans 415 million years ago.

Ammonites disappeared in the 5th mass extinction.

Draw a horizontal line on the graph above to show the time period that ammonites existed on Earth.

Label the line 'ammonites'.

(1)

(c) Another type of organism that existed in the oceans was called trilobites.

Trilobites existed from 544 million years ago until 278 million years ago.

How many more years did ammonites exist than trilobites?

_____

_____

_____

_____

_____ years

(2)

(d) There was an increase in the percentage of species which became extinct in the third mass extinction compared to the first mass extinction.

Calculate the percentage increase.

_____

_____

_____

_____

_____

_____

Percentage increase = _____ %

(3)

(Total 7 marks)

Q1.

(a) knowledge of how DNA controls inheritance

1

(b) there was no oxygen in the amber

1

(c) silverfish

ignore A

1

(d) C

1

(e) dragonflies

ignore A / B

1

(f)

	animalia	*allow animals*
	insecta	*allow insects*
	Musca	
	domestica	

*all correct for **3** marks*
*allow **2** marks for 2 or 3 correct*
*allow **1** mark for 1 correct*
ignore italics and upper / lower case letters

3

(f) eukaryota

1

[9]

Q2.

(a) remains / traces of organisms

1

from millions of years ago

1

(b) no individuals of a species still alive

1

(c) microorganisms have a simpler structure than a trilobite

1

stromatolites are found in older rock than trilobites

1

(d) Marginocephalia

1

(e) Protoceratops **and** Triceratops
(in either order)

allow

*Coronosaurus **and** Triceratops*

or

*Coronosaurus **and** Protoceratops*

or

*Marginocephalia **and** Pachycephalosaurus*

1

(f) any **one** from:
- the fossil record is not complete
- new fossils may have been found since 1970s
- DNA / chemical analysis may have given new information

1

[8]

Q3.

(a) archaea

allow archea or archaia as phonetic spelling

1

(b) horizontal line from –415 to –65 (labelled ammonites)

allow -410 to -420 for -415 (to -65)
allow oblique line

1

(c) ammonites = 350 (million years)
and
trilobites = 266 (million years)

allow range 345 to 355

1

84 million (years) or 84 000 000

allow correct calculation from their answer for ammonites

allow answers in standard form

1

(d) 68 and 96

allow +/- half a small square

1

[(96-68) ÷ 68] × 100

1

41.17647…
or
41.2
or
41

1

[7]

Q1.

(a) Two-thirds of students knew that knowledge of how DNA controls inheritance supports the theory of evolution by natural selection.

(b) 62% of students knew the fly had been preserved in amber because there was no oxygen in the amber.

(c) 55% of students could correctly interpret the evolutionary tree.

(d) 43% of students could identify the most recent ancestor of both grasshoppers and beetles using Figure 2.

(e) 28% of students could work out the group of present-day insects which have wings which do not fold.

(f) ;Generally, students could not correctly place the four words to demonstrate understanding of classification by Carl Linnaeus or the binomial system. 6% of students achieved all three marks. Animalia was the most common correct answer.

(g) 43% of students could identify the domain insects are in.

Q3.

Apart from not knowing the 3-domain system or how to spell ‘archaea’, the mathematically-minded student was able to score marks in question 6. Examiners noted that while some students had no difficulty, most struggled.

Classification PPQs

Name: _____

Class: _____

Date: _____

Time:	**25 minutes**
Marks:	**24 marks**
Comments:	**Self-assess using the mark scheme below. You can check your marks against the Examiners comments to see if you fell into the same issues as the students who took that exam.**

Q1.

Living things can be classified into groups.

(a) Scientists look at structures inside cells to classify living things.

Suggest **one** structure found in cells that can be used to classify living things.

_____

(1)

(b) The table below shows one system for classifying humans.

X	Animalia
Phylum	Chordata
Class	Mammalia
Order	Primates
Family	Hominidae
Genus	*Homo*
Species	*Sapiens*

Who devised this system of classification?

Tick **one** box.

Darwin ☐

Linnaeus ☐

Wallace ☐

Woese ☐

(1)

(c) Look at the table above.

X is the largest category in this classification.

Name category **X**.

_____

(1)

(d) Give the **binomial name** of humans.

Use information in the table above.

_____

(1)

(e) Suggest **one** way that classification systems are useful to scientists.

_____

(1)

(Total 5 marks)

Q2.

Scientists have removed microorganisms from inside rocks in caves in Mexico.

The microorganisms have been trapped there for between 10 000 and 50 000 years.

The caves are dark, very hot, humid and acidic.

(a) Why are these microorganisms called extremophiles?

Tick **two** boxes.

They are thousands of years old	☐
They survive in high humidity	☐
They survive in high temperatures	☐
They survive in the dark	☐
They survive inside rocks	☐
They survive where it is acidic	☐

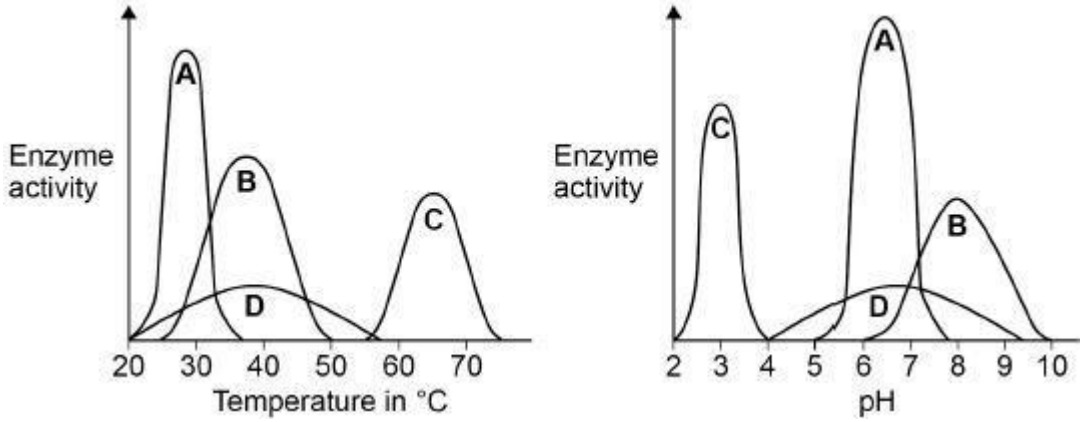
(2)

The microorganisms have been inactive for thousands of years but the scientists have reactivated them.

The diagram below shows the results of enzyme analysis on four enzymes, **A**, **B**, **C** and **D**.

Three of the enzymes were from microorganisms found in the soil near the caves.

One of the enzymes was from a reactivated microorganism from the caves.



(b) Which enzyme comes from the microorganism from the caves?

Tick **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

(1)

(c) Give the reasons for your answer to part **(b)**

_____

_____

_____

(1)

(d) Carl Woese developed the 'three-domain system' of classification.

Describe the 'three-domain system' of classification.

_____

_____

_____

_____

_____

_____

(3)

(e) Most of the microorganisms from the caves were classified as belonging to the Archaea domain of the 'three-domain system'.

Suggest why.

_____

_____

(1)

(Total 8 marks)

Q3.

The polar bear is a mammal that lives in arctic habitats.

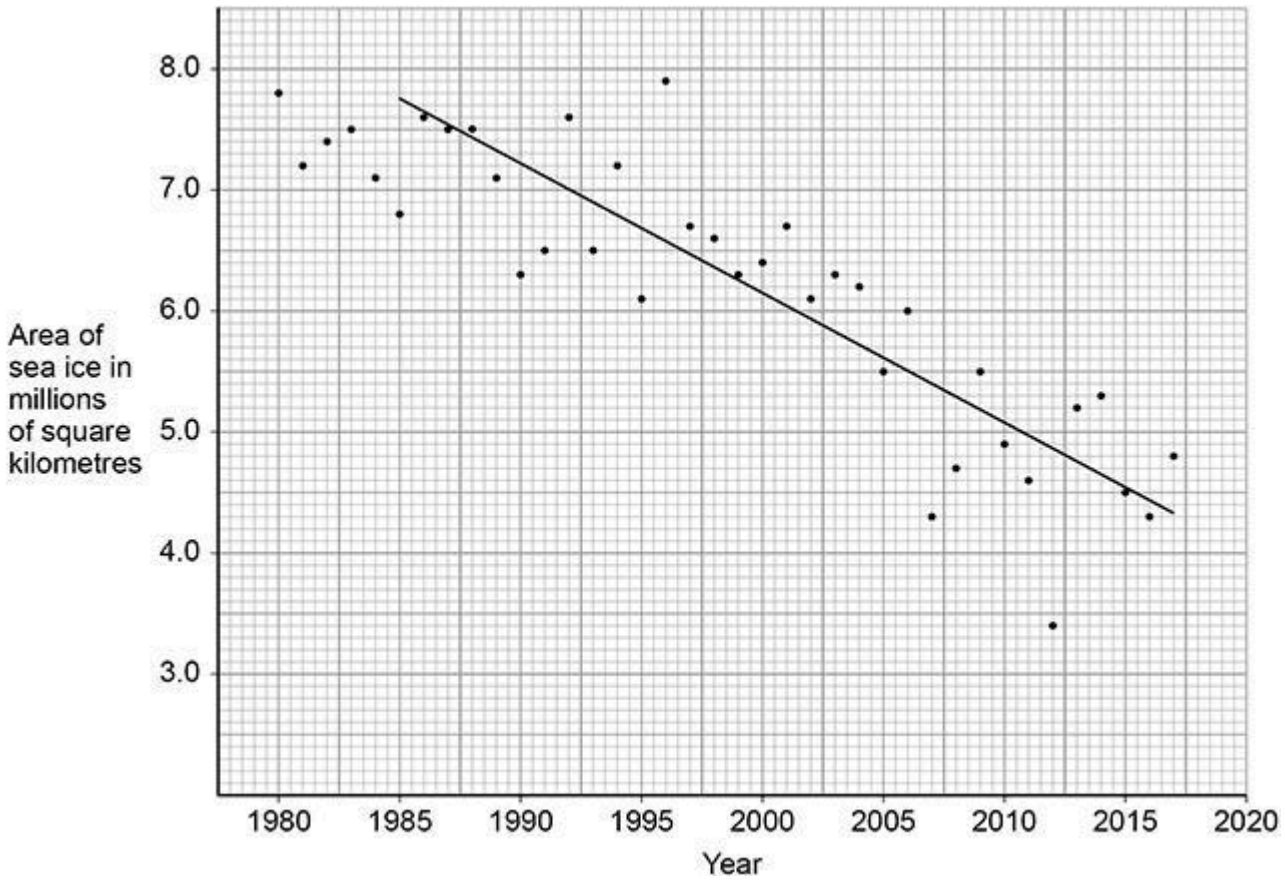
(a) Complete the table below for the classification of the polar bear, *Ursus maritimus*.

Classification group	**Name**
Domain	
Kingdom	
	chordata
Class	mammalia
Order	carnivora
	ursidae
Genus	Ursus
Species	maritimus

(2)

Scientists have been measuring the area of sea ice in the Arctic since 1980.

The figure below shows the area covered by sea ice every September.



(b) Determine the annual rate of loss of sea ice between 1985 and 2017.

A trend line has been drawn on the figure above to help you.

_____

_____

_____

_____

Rate of loss = _____ million square kilometres per year

(3)

The total number of polar bears living on the arctic ice is not known.

The hunting of polar bears has been banned or reduced in some areas.

In some populations the average mass and height of polar bears has decreased.

Polar bears eat seals. Seals live on the sea ice in winter and raise their pups there in early spring. In the summer seals live mainly in the sea catching fish to eat.

Polar bears spend much of the year hunting seals on the sea ice and in the sea nearby. The sea ice area is at its lowest each year in September at the end of summer. The polar bears feed mainly in early spring, and again in autumn to build fat stores to survive the next winter.

During the winter of 2017 scientists measured the metabolic rates of nine female polar bears and found them to be much higher than expected. Cameras attached to the female polar bears showed they had to swim long distances to find seals to eat.

(c) Suggest why polar bears find it harder to catch seals in autumn than in spring.

_____

_____

_____

_____

(2)

(d) Evaluate what might happen to the population of polar bears in the Arctic in the future.

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(Total 11 marks)

Q1.

(a) Relevant organelle found in cells such as nucleus, mitochondria

1

(b) Linnaeus

1

(c) Kingdom

1

(d) *Homo Sapiens*

ignore underlining, italics or not, capitals or not

1

(e) Any **one** from:

- to know which species are closely related
  or
  study evolution
- to monitor biodiversity
- to identify different organisms such as two different species

1

[5]

Q2.

(a) they survive in high temperatures

1

they survive where it is acidic

1

(b) C

1

(c) because it has (high / optimum) activity at high temperature or 65 °C **and / or** low pH or pH 3 or high acidity

*allow it is the only enzyme that is active between 55 °C and 75 °C **and / or** below pH4*

1

*mark dependent on C correct for part **(b)***

(d) any **three** from:

- based on DNA / chemical evidence

(the three domains are)

- (Archaea) − primitive / simple bacteria
- Prokaryota / Bacteria − true / modern bacteria
- Eukaryota − includes (protists, fungi,) plants and animals

allow Eukaryota − includes organisms with cells having a nucleus

*if no other mark awarded allow for **1** mark mention of Archaea, Prokaryota / Bacteria and*

Eukaryota
or
three correct descriptions

3

(e) (these microorganisms) live in extreme conditions

allow (most Archaea) are extremophiles

1

[8]

Q3.

(a)

	eukaryote / eukaryota
	animal(ia)
phylum / phyla	
family	

2 *marks for all 4 correct*

1 *mark for 2 or for 3 correct*

ignore italics and upper / lower case letters

2

(b) **View with the graph**

two readings from graph
7.75 **and** 4.32

allow in range of 7.7 to 7.8 ***and*** *4.3 to 4.4*

allow two readings from two identified points on the line, allowing a tolerance of ± ½ a small square

1

calculation of gradient

$\frac{3.43}{32}$

allow calculation of gradient using correct readings from graph, $\frac{dy}{dx}$

1

correct answer
0.1(071875)

allow correct answer using student's correct readings from graph

1

(c) any **two** from:
in autumn

- no / fewer seals left on ice

or
all / most seals are in the sea
ignore seals are in the sea unqualified

- seals are adults / older so swim faster
- more <u>competition</u> between polar bears

2

(d) **Level 2:** A judgement, strongly linked and logically supported by a sufficient range of correct reasons, is given.

3–4

Level 1: Some logically linked reasons are given. There may also be a simple judgement.

1–2

No relevant content

0

Indicative content

may decrease because:
- global warming is melting sea ice
- less sea ice each year so less habitat / hunting area
- as ice / habitat disappears seals will decrease in number
- having to swim longer distances to find seals, wastes energy
- increased metabolic rate means more food is required
- not building up fat stores in the autumn means fewer will survive each winter
- decrease in mass / height may reduce hunting ability / strength
- hunting in some / most areas continues
- less likely to find mates
- eventually the species may become extinct

may increase / maintain numbers if:
- more laws put in place to stop hunting **or** laws to stop hunting will allow bears to reproduce
- quotas introduced to reduce hunting
- nations / people work to reduce carbon dioxide emissions to halt global warming
- (feeding / hunting) behaviour of polar bears changes

For Level **2** both increase / maintenance **and** decrease of the polar bear population must be considered

[11]

Q2.

(a) Students were able to relate extremophiles to harsh conditions with 39% of students identifying one of the conditions and 54% identifying both.

(b) 64% of students identified enzyme C as the enzyme from bacteria in the cave.

(c) Those students who selected the incorrect enzyme in part **(b)** were unable to get any credit for their answer to this question. Some who correctly picked enzyme C then incorrectly wrote about microbes living or surviving in the conditions rather than referring to enzymes still being active in these conditions.

Other students appeared to misunderstand the graph itself and presumed that the enzymes themselves had high temperatures or were acidic rather than the activity being greatest in those conditions. The word optimum was rarely used.

Those students who got the correct answer (28%) usually referred to 'enzyme activity at high temperatures'. Whereas the students who wrote about pH did not mention that the conditions were of low pH or high acidity, simply referring to it being acidic.

(d) There were a few excellent answers from students who had a real understanding of this new aspect of the specification. However, in general students struggled with this question, with 12% not attempting it at all. 3% of students achieved three marks.

Many students did not know what the domains were. Students often wrote answers about kingdoms and phyla rather than the three domains. And there were many answers that suggested the domains were a way of classifying organisms in the environment with many references to producers, consumers, habitats, communities and abiotic and biotic factors. Many students confused the three-domain system with the Linnaeus system of classification and described that instead.

Other students described the thee-domain system as referring to the conditions of an organism's environment, referencing the previous questions' use of pH and temperature. Some students also described food chains or predator prey relationships. Students were often able to achieve two out of the three marks for their descriptions of Eukaryotes and Prokaryotes. However, they often did not describe Archaea as 'simple' or 'primitive' bacteria, but simply as extremophiles.

Not many students received credit for marking point one as they usually just referenced classification based on characteristics rather than DNA or chemical evidence. The compensation mark was the marking point most often awarded.

(e) 24% of students answered this question correctly. Some did not recognise that the extreme conditions were the focus of the question and instead commented on the microorganism being found in the caves which had matching conditions to the graphs.

Common incorrect answers included that Archaea are primitive or old or that they survived in hot or dark or humid or acidic conditions without making reference to the fact that these conditions are extreme.

Q3.

(a) Phonetic spellings were allowed throughout. Many students knew one of the four words, with animalia/animal kingdom being the most common correct response. Students who got phylum correct often also knew family. Archaea was sometimes given incorrectly as the domain.

(b) Most students could take two correct readings from the graph. Most selected data from 1985 and 2017, but that was not necessary for full marks. Any two years could be used if indicated on the figure, or in the answer space. Clear answers often included lines drawn on the graph to help students read the data points. Some students tried to use individual data points, not the trend line, which was inappropriate.

(c) Credit is never given for repeating information from the stem of the question. 16% of students could suggest a reason why polar bears find it harder to catch seals in autumn than spring.

(d) This was an 'extended response' style of question. Such questions are marked holistically. There are overall generic descriptions for the two levels of response at the top of the scheme, giving a hierarchy of response. Within each level of response there are two marks.

Credit is never given for repeating information from the stem of the question. Students were expected to evaluate what might happen to the population of polar bears in the future. To access Level 2, students needed to consider both a decrease and an increase or maintenance of the population. Few students considered reasons that would lead to an increase or maintenance of the population.

As an evaluation question, the generic level descriptors refer to judgement. Students were not required to come to an overall or final judgement. Their judgement was be taken to mean the likely effect of any part of the indicative content on the population size anywhere within their response.

Adaptions, interdependence and ecology RPA PPQs

Name: _____

Class: _____

Date: _____

Time:	**47 minutes**
Marks:	**45 marks**
Comments:	**Self-assess using the mark scheme below. You can check your marks against the Examiners comments to see if you fell into the same issues as the students who took that exam.**

Q1.

Figure 1 shows one species of bird on a bird feeder.

Figure 1

The birds use their beaks to reach nuts inside the bird feeder.

Cats sometimes eat the birds.

(a) Give the food chain for the birds, cats and nuts.

_____

(2)

(b) Which organism in the food chain you gave in part (a) is the primary consumer?

_____

(1)

(c) Cats are one biotic factor that affects the size of the bird population.

Which **two** of the following are **biotic** factors?

Tick (✓) **two** boxes.

Food ☐

Pathogens ☐

Sunlight ☐

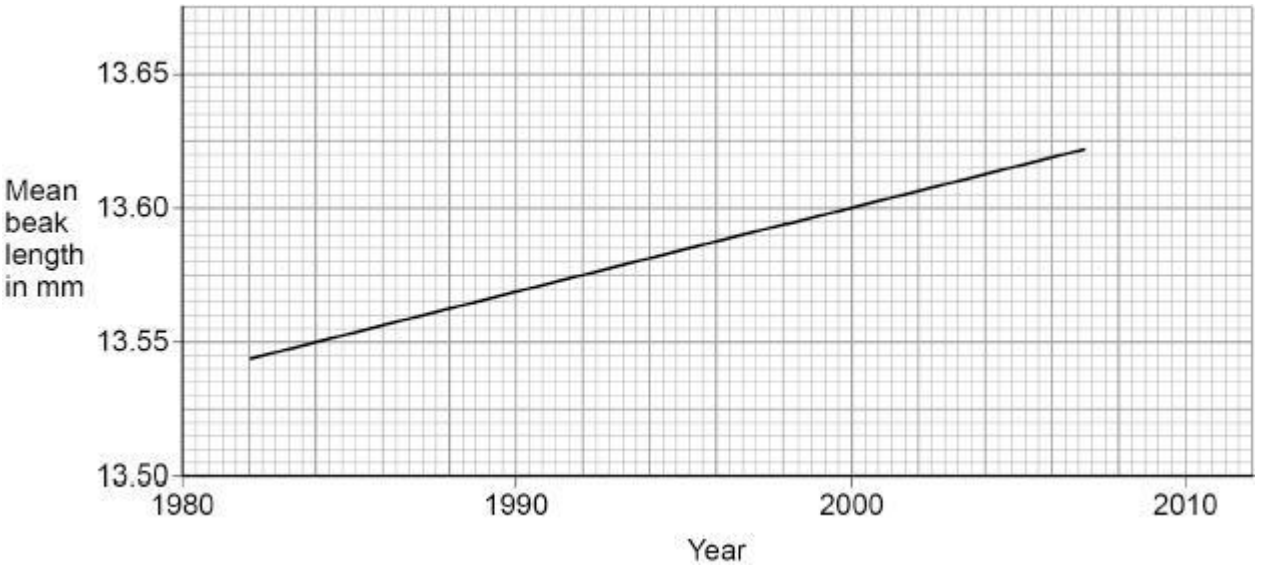
Temperature ☐

Water ☐

(2)

Figure 2 shows the mean beak length of this species of bird from 1982 to 2007.

Figure 2



(d) What was the mean beak length in 2000?

Mean beak length = _____ mm

(1)

(e) What type of adaptation is beak length?

Tick (✓) **one** box.

Behavioural ☐

Chemical ☐

Structural ☐

(1)

Figure 2 shows evidence of evolution in this species of bird.

(f) Scientists have concluded that beak length in this species of bird is increasing.

Complete the sentences about the evolution of this species of bird.

Choose answers from the box.

excretion	**generation**	**mutation**
reproduction	**respiration**	**variation**

The difference in beak length in the bird population is called _____.

A change in a gene affects the beak length.
Change in a gene is called _____.

The birds with the longest beaks get more food.
Getting more food improves a bird's chances of survival and _____.

This process of evolution takes place over more than one _____.

(4)

(g) Birds of this species:

- live for about 3 years
- produce up to 24 eggs every year.

Why is evolution easier to study in birds than in humans?

Tick (✓) **one** box.

Birds breed less frequently than humans.	☐
Birds have a shorter life cycle than humans.	☐
Birds have fewer offspring than humans.	☐

(1)

(h) Bacteria also provide evidence for evolution.

Which statement describes evidence for evolution?

Tick (✓) **one** box.

Bacteria can become resistant to antibiotics. ☐

Decomposition can be caused by bacteria. ☐

Some bacteria are pathogens. ☐

(1)

(Total 13 marks)

Q2.

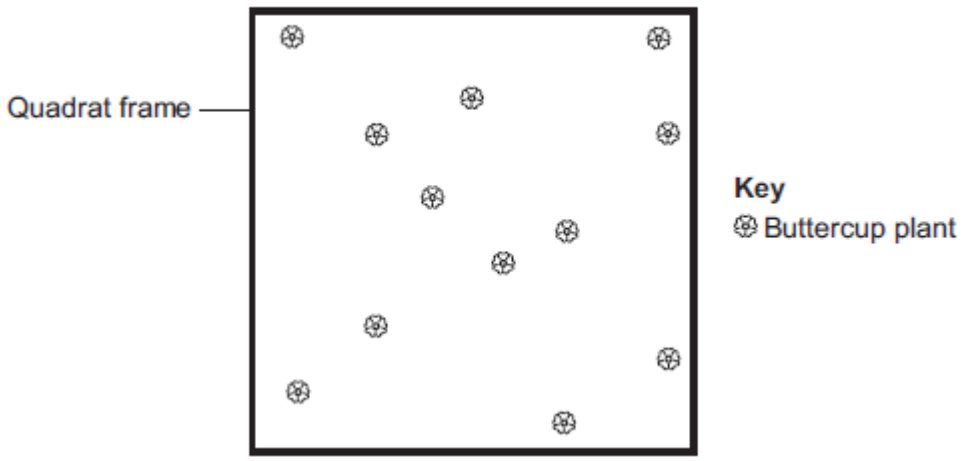
A grassy field on a farm measured 120 metres by 80 metres.

A student wanted to estimate the number of buttercup plants growing in the field.

The student found an area where buttercup plants were growing and placed a 1 m × 1 m quadrat in one position in that area.

Figure 1 shows the buttercup plants in the quadrat.

Figure 1



The student said, 'This result shows that there are 115 200 buttercup plants in the field.'

(a) (i) How did the student calculate that there were 115 200 buttercup plants in the field?

_____

_____

_____

_____

(2)

(ii) The student's estimate of the number of buttercup plants in the field is

probably not accurate. This is because the buttercup plants are not distributed evenly.

How would you improve the student's method to give a more accurate estimate?

_____

_____

_____

_____

(2)

(b) Sunlight is one environmental factor that might affect the distribution of the buttercup plants.

(i) Give **three other** environmental factors that might affect the distribution of the buttercup plants.

1. _____

2. _____

3. _____

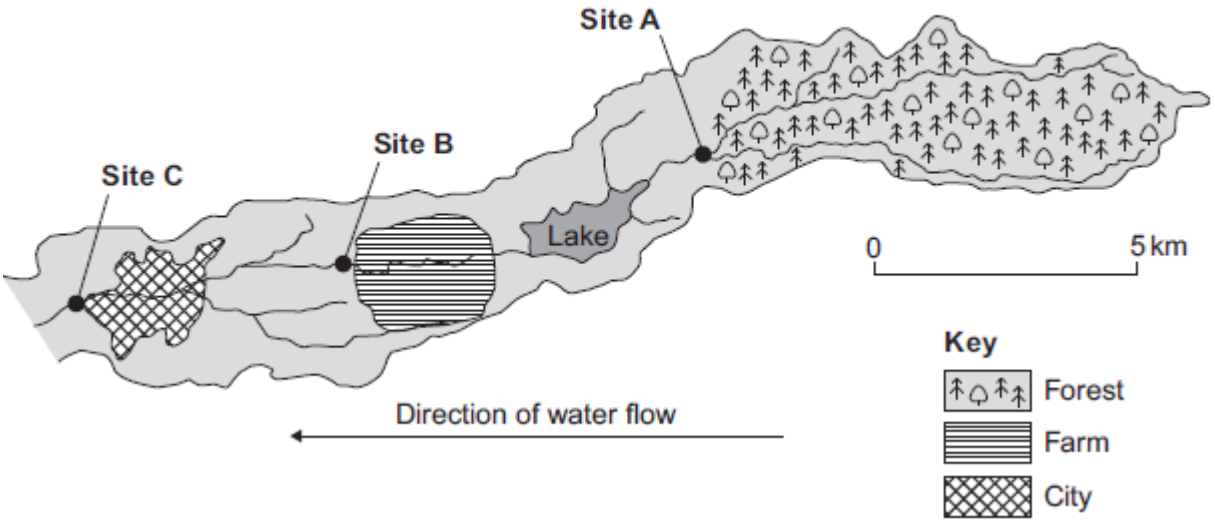
(3)

(ii) Explain how the amount of sunlight could affect the distribution of the buttercup plants.

(3)

(c) **Figure 2** is a map showing the position of the farm and a river which flows through it.

Figure 2



Every year, the farmer puts fertiliser containing mineral ions on some of his fields.When there is a lot of rain, some of the fertiliser is washed into the river.

(i) When fertiliser goes into the river, the concentration of oxygen dissolved in the water decreases.

Explain why the concentration of oxygen decreases.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(5)

(ii) There is a city 4 km downstream from the farm.

Apart from fertiliser, give **one** other form of pollution that might go into the river as it flows through the city.

_____

(1)

(d) Three sites, **A**, **B** and **C**, are shown in **Figure 2**.

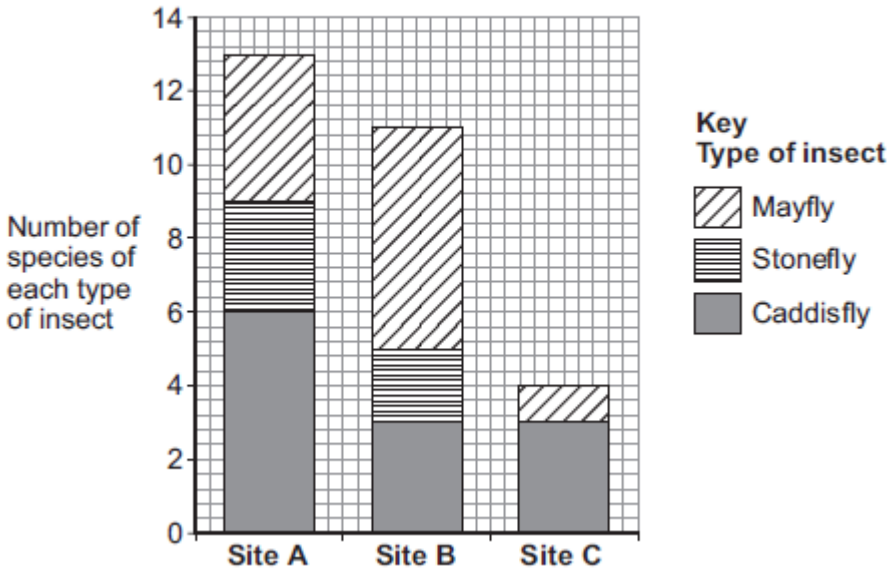
Scientists took many samples of river water from these sites.

The scientists found larvae of three types of insect in the water: mayfly, stonefly and caddisfly. For each type of insect the scientists found several different species.

The scientists counted the number of different species of the larvae of each of the three types of insect.

Figure 3 shows the scientists' results.

Figure 3



(i) How many more species of mayfly were there at Site **B** than at Site **A**?

_____

(1)

(ii) Suggest what caused this increase in the number of species of mayfly.

_____

_____

(1)

(iii) The scientists stated that the number of species of stonefly was the best indicator of the amount of oxygen dissolved in the water.

Use information from **Figure 3** to suggest why.

(1)

(Total 19 marks)

Q3.

Some students estimated the population of daisies in a school field.

This is the method used.

1. Find a place where some daisies are growing.
2. Put the quadrat down.
3. Count and record the number of daisies in the quadrat.
4. Repeat steps 1–3 at four different places in the field.
5. Calculate the mean number of daisies per quadrat.
6. Use the data to estimate the total number of daisies in the field.

(a) Which **two** improvements would increase the validity of this method?

Tick (✓) **two** boxes.

Do not put any quadrats near trees. ☐

Repeat for another ten quadrats. ☐

Use a long tape measure. ☐

Use a random method to place the quadrats. ☐

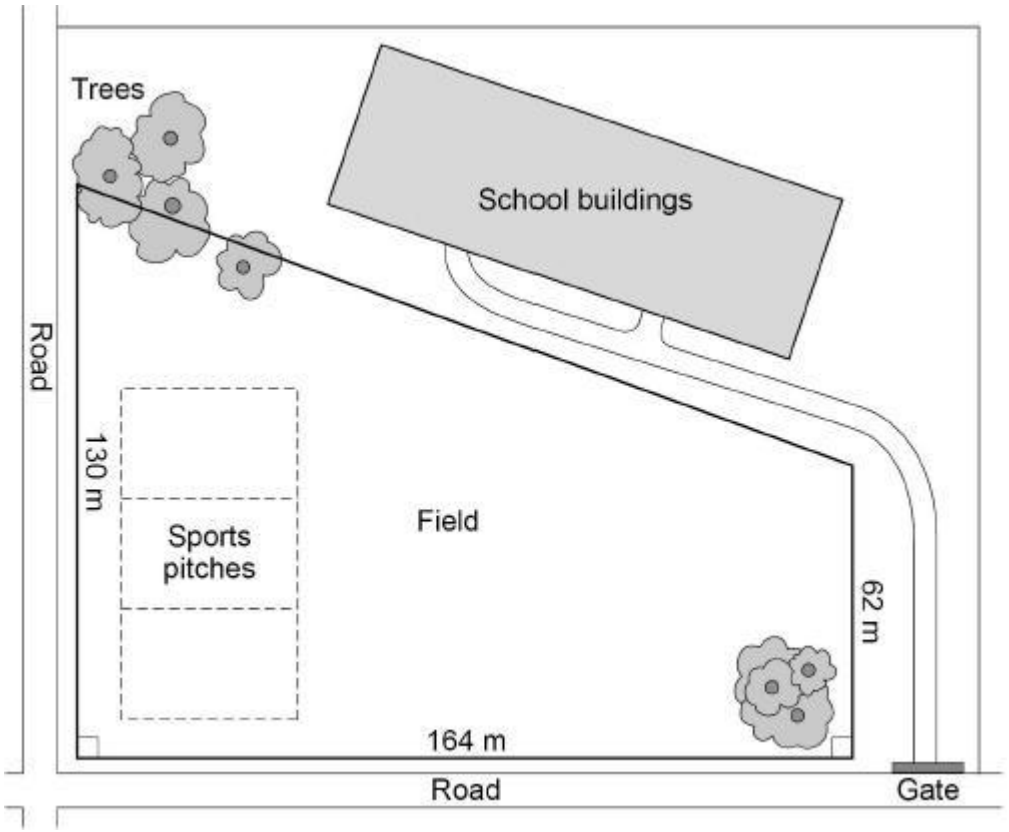
Use the same person to place all the quadrats. ☐

(2)

(b) With an improved method the students calculated the mean number of daisy plants to be 7.65 per quadrat.

The students used a quadrat measuring 50 cm × 50 cm

The diagram shows the school site and the dimensions of the school field.



Calculate the population of daisy plants on the school field.

Give your answer in standard form to 2 significant figures.

Population of daisy plants = _____

(5)

(c) The students noticed a very uneven distribution of daisy plants in the field.

Explain how different biotic factors **and** abiotic factors could have caused an uneven distribution of daisy plants.

Use the diagram above.

(6)

(Total 13 marks)

Q1.

(a) nut(s) → bird(s) → cat(s)

*allow **1** mark for organisms in correct order (left to right) but arrows incorrect or missing*

*allow **2** marks for cat(s) ← bird(s) ← nut(s)*

*do **not** accept cat(s)bird(s) nut(s)*

*do **not** accept cat(s) →bird(s) →nut(s)*

2

(b) <u>birds</u>

*answer must be consistent with food chain given in question **(a)***

*if no answer to question **(a)***

allow bird(s)

1

(c) food

1

pathogens

1

(d) 13.60 (mm)

allow 13.6 (mm)

1

(e) structural

1

(f) variation

1

mutation

1

reproduction

1

generation

must be in this order

1

(g) birds have a shorter life cycle than humans

1

(h) bacteria can become resistant to antibiotics

1

[13]

Q2.

(a) (i) counts / 12

1

× 120 × 80 / × 9600
or
× area of field

1

(ii) (more) quadrats / repeats

1

placed randomly

ignore method of achieving randomness

1

(b) (i) any **three** from:

- temperature / warmth / heat
- water / rain
- minerals / ions / salts (in soil)

allow nutrients / fertiliser / soil fertility

ignore food

- pH (of soil)
- trampling
- herbivores

ignore predators

- competition (with other species)
- pollution qualified e.g. SO_2 / herbicide
- wind (related to seed dispersal).

ignore space / oxygen / CO_2 / soil unqualified

3

(ii) light needed for photosynthesis

1

for making food / sugar / etc.

1

effect on buttercup distribution eg more plants in sunny areas / fewer plants in shady areas

1

(c) (i) fertiliser / ions / salts cause growth of algae / plants

1

(algae / plants) block light

1

(low light) causes algae / plants to die

1

microorganisms / bacteria feed on / break down / cause decay of organic matter / of dead plants

*do **not** allow germs / viruses*

1

(aerobic) <u>respiration</u> (by microbes) uses O_2

*do **not** allow anaerobic*

1

(ii) sewage / toxic chemicals / correct named example eg metals / bleach /

disinfectant / detergent etc

allow suitable named examples eg metals such as Pb / Zn / Cr / oil / SO_2 / acid rain / pesticides / litter

ignore chemicals unqualified

ignore waste unqualified

ignore human waste / domestic waste / industrial waste unqualified

1

(d) (i) 2

1

(ii) more food

allow other sensible suggestion eg more species colonise from tributary streams after forest

1

(iii) number of stonefly species decreases (from **A** to **B** / **B** to **C** / **A** to **C**) as more pollution enters river / less oxygen

allow fewer species in more polluted water

ignore none are found at site C

1

[19]

Q3.

(a) repeat for another ten quadrats

1

use a random method to place the quadrats

1

(b)

*an answer of 4.8 x 10^5 scores **5** marks*

*an answer of 481 766.4 **or** 481 766 **or** 480 000 scores **4** marks*

*an answer of 15 744 × 4 × 7.65 scores **3** marks*

*an answer of 15 744 (m^2) scores **2** marks*

(area of field =) 62 × 164 + 164 × 68 ÷ 2 **or** equivalent

1

15 744 (m^2)

1

15 744 × 4 × 7.65

allow use of incorrect area

allow $\frac{7.65}{0.25} \times 15744$

1

- 481 766.4

*allow 481 766 **or** 480 000*

1

- 4.8×10^5

  allow incorrect calculation expressed correctly

1

(c) **Level 3:** Relevant points (reasons / causes) are identified, given in detail and logically linked to form a clear account.

5–6

Level 2: Relevant points (reasons / causes) are identified, and there are attempts at logical linking. The resulting account is not fully clear.

3–4

Level 1: Points are identified and stated simply, but their relevance is not clear and there is no attempt at logical linking.

1–2

No relevant content

0

Indicative content

- trees over / in field
- (which) reduce light for photosynthesis
- (so) fewer daisies there

- trees over / in field
- (which) take water / nitrates / ions from the soil
- (so) fewer daisies there

- trampling on sports pitches
- (will) kill plants
- (so) fewer daisies there

- competition from plants / grasses on field
- (will) use up water / nitrates / ions / space
- (so) fewer daisies there

- gardener may water / fertilise / mow field
- (which provides) more water / nitrates / ions
- (so) more / fewer daises grow there

- more insects / disease / animals in some areas
- (may) eat / kill plants
- (so) fewer daisies there

- school buildings
- (which) reduce light for photosynthesis
- (so) fewer daisies near school

- pollution / toxins from vehicles on roads
- (which will) reduce growth
- (so) fewer daisies near roads

- wrong pH **or** lack of ions **or** poor drainage **or** poor / wet / dry soil in some areas
- (which will) slow growth
- (so) fewer daisies there

Level 3 answers must refer to several factors in accurate detail

[13]

Q1.

Many students could not give the food chain. Some students obtained one mark out of two for having the organisms in the correct order, but used dashes or commas instead of arrows. More students could give the primary consumer in the food chain. Reading from the graph was generally answered well. Fewer students could complete the sentences about evolution.

Q2.

(a) Nearly all students were able to explain how the student had calculated the population of buttercup plants in the field and, while most could suggest one improvement the student could have made to give a more accurate estimate − usually the use of more quadrats, less than half were also able to make the point that these should have been placed randomly throughout the field.

(b) Only one-third of students were able to suggest three environmental factors, in addition to sunlight, that would have affected the distribution of buttercup plants in the field, such as temperature, water, mineral ions, pH of the soil, trampling, herbivores, competition with other species. Many students made suggestions that were inappropriate to the situation or were inadequate, such as carbon dioxide or oxygen concentrations, 'food' or 'pollution'. In part (ii), explanations of how the amount of sunlight might affect the distribution of the buttercup plants generally included a reference to photosynthesis, but this was not always related to the actual distribution − e.g. more plants being found in sunny areas, and the production of glucose (or even 'food') for the buttercup plants was rarely mentioned. Hence, while nearly three quarters of students were able to make 2 points, only one-fifth scored all 3 marks.

(c) Accounts of eutrophication in part (i) were often excellent, with nearly one-third of students scoring all 5 marks and almost half scoring at least 4 marks. Nearly all students knew that fertiliser from farmland washing into a river would stimulate the growth of plants and algae and this would reduce the amount of light reaching plants deeper in the river which would die. The better students explained how respiration of microorganisms that caused decay of the dead plants would consume oxygen. In (ii), suggestions of a type of pollution that would enter the river as it flowed through the city were often too general, such as 'domestic waste' or 'industrial waste'. A more specific answer was required, such as sewage, toxic chemicals or a named example such as metals or bleach or detergent. Over three quarters of students were able to give a suitable example, with sewage being the most common.

(d) This section was about indicator species, with data about the numbers of mayfly, stonefly and caddisfly larvae from three different sites on the river being presented in the form of a stacked bar graph. In part (i), students had to find how many more species of mayfly larvae there were at the site after the farm compared to the site after the upstream forest. The correct answer, 2, was successfully determined by the vast majority of students. However, most were unsuccessful in part (ii) when suggesting what might have caused the increase. The most common suitable suggestion was that more food, or types of food, may have been available after the river had flowed through the farm. In part (iii), students had to use the data from the bar graph to explain why scientists considered stonefly larvae to be the best indicator of the amount of oxygen in the river. Less than half the students were able to relate the progressive decrease in the number of stonefly species as the river

flowed downstream with increasing levels of pollution (from the farm and from the city) and hence decreasing levels of oxygen. Many simply stated that there were no stonefly at the site downstream from the city.

Q3.

(a) Most students were able to identify one way to improve the method given for the RPA of measuring a population of organisms; in this case, daisies in a school field. 57% of students gave both improvements correctly.

(b) Most students made a good attempt at this tough multistep calculation. A third gained two marks for correctly calculating the area of the school field. A further 12% of students gained a further one mark, most usually for converting the incorrect answer they derived into standard form with two significant figures. 10% correctly calculated the result but failed to express it in the required format, while 7% calculated a totally correct answer.

(c) This extended response question asking about factors which would affect the distribution of daisy plants on the school field was intended to be challenging. To give answers reaching Level 2 or 3 the student needed to include a high degree of accurate detail to explain each factor. Students who identified only factors, or who discussed only one factor, would be unlikely to get a mark awarded above Level 1. To gain a mark in Level 3 quite a lot of strong linking with accurate detail was needed for several factors and a clear understanding of how each one affected the distribution. It was not required to label each factor as biotic or abiotic but if the student chose to do so it needed to be correct.

11% of students gave enough accurate detail to be awarded five or six marks (Level 3). 57% of students gained three or four marks (Level 2) and 26% achieved one or two marks (Level 1). Very few students gained no credit or did not attempt a response. This question differentiated well throughout the ability range of students.

Organising an ecosystem PPQs

Name: _____

Class: _____

Date: _____

Time:	**33 minutes**
Marks:	**31 marks**
Comments:	**Self-assess using the mark scheme below. You can check your marks against the Examiners comments to see if you fell into the same issues as the students who took that exam.**

Q1.

Figure 1 shows a food chain in a garden.

Figure 1

bean plant → blackfly → spider → blackbird

(a) Which term describes the spider in this food chain?

Tick (✓) **one** box.

- Primary consumer ☐
- Producer ☐
- Secondary consumer ☐
- Tertiary consumer ☐

(1)

(b) Many of the spiders in the garden died.

What is likely to happen to the number of blackflies in the garden?

Tick (✓) **one** box.

- Decrease ☐
- Increase ☐
- Stay the same ☐

(1)

(c) Give a reason for your answer to part **(b)**.

_____

_____

(1)

The table shows the estimated biomass of organisms in the garden.

Organism	**Biomass in g**
Bean plants	225
Blackflies	115
Spiders	65
Blackbirds	10

(d) What conclusion can be made about biomass in food chains?

_____

_____

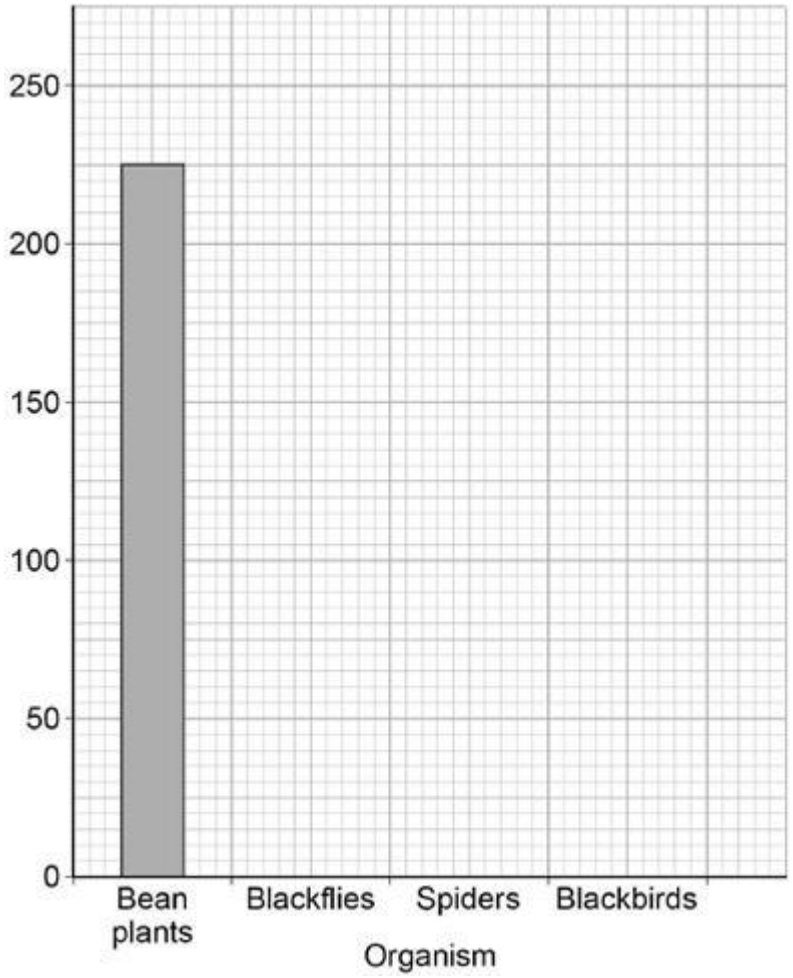
(1)

(e) Complete **Figure 2**.

You should:

- label the y-axis
- plot the data from the table above.

Figure 2



(3)

(f) Explain why a garden is **not** a stable community.

_____

_____

_____

_____

(2)

(Total 9 marks)

Q2.

This question is about the cycling of water and carbon in ecosystems.

(a) Which reaction produces water?

Tick (✓) **one** box.

Aerobic respiration ☐

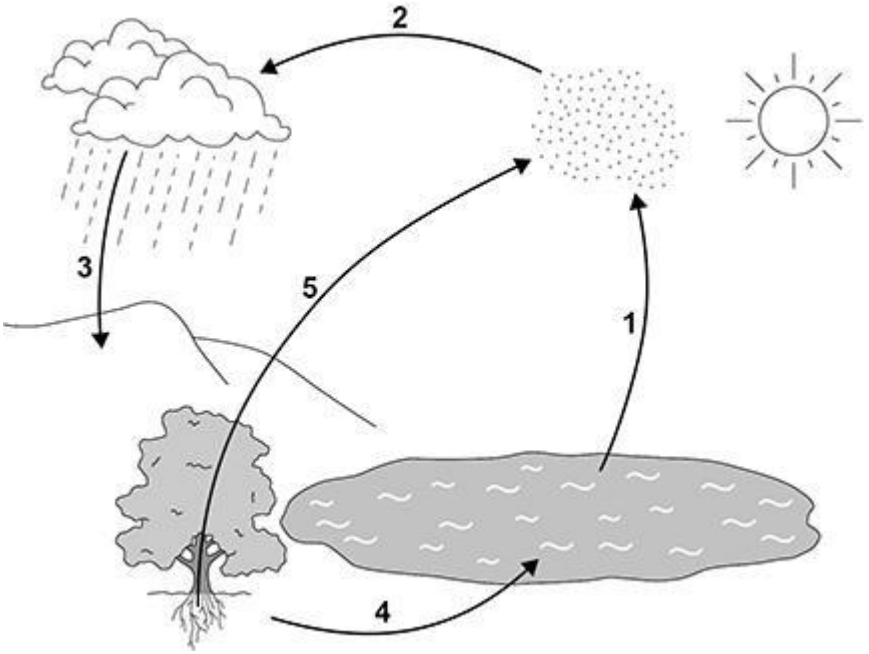
Anaerobic respiration ☐

Photosynthesis ☐

(1)

The water cycle provides water for plants and animals on land before the water goes into lakes and seas.

The diagram below represents the water cycle.



(b) Name the processes **1** to **5** shown on above diagram.

1. _____

2. _____

3. _____

4. _____

5. _____

(5)

(c) In 2007 the population of the world was 6 000 000 000

A study found that 4.5% of the population had severe water shortage.

Calculate how many people had severe water shortage.

Give your answer in standard form.

_____

_____

_____

_____

_____

Number of people (in standard form) = _____

(3)

(d) Why do more people have severe water shortage now than in 2007?

Tick (✓) **two** boxes.

Climate change has increased the area of deserts.	☐
Each person drinks less water.	☐
More water is used to grow crops.	☐
Sea levels have risen because the ice caps are melting.	☐
Some countries have built de-salting factories for seawater.	☐

(2)

Leaves on a tree contain carbon compounds.

In autumn the leaves fall to the ground.

(e) Microorganisms in the soil recycle carbon from the leaves so that the carbon is used for new plant growth.

Explain how.

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(f) What is **one** benefit of fallen leaves for living plants?

Tick (✓) **one** box.

Energy is released for living plants. ☐

Insect pests in the soil are killed. ☐

Nitrates are released into the soil. ☐

Oxygen is supplied to root cells. ☐

(1)

(Total 16 marks)

Q3.

The UK contains large areas of peat bogs that have been present for thousands of years.

(a) Peat is removed from peat bogs.

The peat can be mixed with air and added to garden compost.

The release of carbon dioxide from peat is a problem.

Give **two other** reasons why gardeners should use less peat-based compost in the future.

1. _____

_____

2. _____

_____

(2)

(b) Explain why mixing peat with air leads to the release of carbon dioxide.

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(Total 6 marks)

Q1.

(a) secondary consumer

1

(b) increase

1

(c)

view with part (b)

(because) the blackflies are not being eaten

*allow idea of other predators (of blackflies) if 'stay the same' selected in part **(b)***

1

(d) biomass decreases as you go up / along the food chain

allow converse

1

(e) label biomass in g(rams)

1

three bars plotted correctly

allow ± half small square

*allow **1** mark for 2 bars correct*

ignore width and spacing of bars

2

(f) organisms / species are always being added / removed

allow example of an environmental change e.g. gardener did not water for a month

1

so population sizes not (fairly) constant

1

[9]

Q2.

(a) aerobic respiration

1

(b) 1. evaporation

allow evaporate(s) / evaporating

1

2. condensation

allow condense(s) / condensing

1

3. precipitation

allow rain(ing) / rainfall
allow named precipitation
ignore precipitates

1

4. draining / drainage
allow run-off / percolation / infiltration
allow groundwater / underground flow

1

5. transpiration

1

(c) $6\,000\,000\,000 \times \frac{4.5}{100}$
allow 6 000 000 000 × 0.045

1

270 000 000

1

2.7×10^8
allow an incorrectly calculated number of people given in correct standard form

1

(d) climate change has increased the area of deserts

1

more water is used to grow crops

1

(e) decay / decomposition of leaves
allow leaves are broken down

1

respiration (by microorganisms / decomposers)
ignore aerobic / anaerobic
ignore respiration by worms / detritivores / insects / leaves

1

respiration releases carbon dioxide
or
microorganisms release carbon dioxide

1

carbon dioxide is used in photosynthesis (for new plant growth)
*do **not** accept carbon dioxide absorbed in the roots*

1

(f) nitrates are released into the soil

1

[16]

Q3.

(a) reduces biodiversity

1

peat is being used faster than it forms

allow peat is non-renewable

1

(b) decay / decomposition / rotting of peat

1

by microorganisms / bacteria / microbes / fungi / decomposers introduced when peat is mixed with air

1

that respire using substances in peat as reactant

1

and using oxygen that is introduced when peat is mixed with air

1

[6]

Q1.

(a) 79% of students correctly identified the spider as the secondary consumer in the food chain.

(b) 82% of students also knew that the blackfly would increase if the spiders died.

(c) Most students who identified an increase in part (b) knew that this was because blackfly are no longer being eaten. Those that did not gain credit gave answers relating to the blackbirds rather than the blackflies and others clearly had the misconception that the blackflies were eating the spiders.

(d) 21% of students were able to correctly give the relationship for biomass as you go up the food chain, although many more may have had the right idea if they had been able to express it clearly. Answers relating to larger or named animals having the largest biomass were insufficient to gain credit. Other students made comparisons between the size of an animal and its biomass.

(e) The bar chart was generally well constructed with a third of students gaining full credit and 41% gaining two of the three marks. The mark most often missed was for labelling the y-axis as many students did not do this, or simply labelled it ‘y’.

(f) Students found this question difficult. 14% of students were able to refer to the constant adding and removing of organisms or give a change that would lead to this such as mowing the grass. A small minority of students gained a second mark for reference to constant population sizes needed in a stable community.

Q2.

Foundation

(a) 40% of students knew that aerobic respiration produces water.

(b) Many students could only name one or two parts of the water cycle shown on the figure. The most common marks awarded were for evaporation and precipitation. Very few students gave correct answers for processes 4 or 5. Some students gave descriptions rather than the name of each process, which did not gain the mark unless the process was named within the description.

(c) Some students only got as far as the second marking point and stopped, or then made errors in writing the answer in standard form. Two marks were awarded in either instance.

The third marking point was not awarded for incorrect use of standard form, so 27×10^7 was frequently seen and was incorrect. Note the ‘allow’ statement in the extra information column for this marking point. Students gained one mark for only if they attempted an incorrect calculation using numbers from the question, and then gave that answer in standard form.

(d) A third of students could identify two reasons why more people have severe water shortage now than in 2007.

(e) Students found this aspect of the carbon cycle challenging to explain. Many students repeated information given in the stem of the question, which is never creditworthy.

The most common mark awarded was for the idea of leaves decaying. Some students incorrectly suggested microorganisms eat the leaves. References to respiration were rare, and often incorrect, such as trees using carbon dioxide for respiration. The third and fourth marking points both required reference to carbon dioxide, not simply carbon, which was far more frequently seen. Although chemical formulae are generally acceptable as alternatives to the names of substances, they need to be correct, for example CO_2 is an acceptable alternative to carbon dioxide but CO2 and CO^2 are not.

(f) 38% of students could identify that nitrates released into the soil is a benefit of fallen leaves for living plants.

Higher

(a) 57% of students knew that aerobic respiration produces water.

(b) Many students could name three/four of the five parts of the water cycle shown on the figure. The most common marks awarded were for evaporation, condensation and precipitation. Fewer students gave correct answers for processes 4 or 5. Some students gave descriptions rather than the name of each process, which did not gain the mark unless the process was named within the description. Some confusion was seen between transpiration and translocation.

(c) Some students only got as far as the second marking point and stopped, or then made errors in writing the answer in standard form. Two marks were awarded in either instance.

The third marking point was not awarded for incorrect use of standard form, so 27×10^7 was frequently seen and was incorrect. Note the allow statement in the extra information column for this marking point. Students gained one mark only if they attempted an incorrect calculation using numbers from the question, and then gave that answer in standard form.

(d) 62% of students could identify two reasons why more people have severe water shortage now than in 2007.

(e) Students found this aspect of the carbon cycle challenging to explain. Many students repeated information given in the stem of the question, which is never creditworthy.

The most common mark awarded was for the idea of leaves decaying. Some students incorrectly suggested microorganisms eat the leaves. References to respiration were rare, and often incorrect, such as trees using carbon dioxide for respiration. The third and fourth marking points both required reference to carbon dioxide, not simply carbon, which was far more frequently seen. Although chemical formulae are generally acceptable as alternatives to the names of substances, they need to be correct, for example CO_2 is an acceptable alternative to carbon dioxide but CO2 and CO^2 are not.

(f) 64% of students could identify that nitrates released into the soil is a benefit of fallen leaves for living plants.

Biodiversity PPQs

Name: _____

Class: _____

Date: _____

Time:	**29 minutes**
Marks:	**28 marks**
Comments:	**Self-assess using the mark scheme below. You can check your marks against the Examiners comments to see if you fell into the same issues as the students who took that exam.**

Q1.

Global warming may reduce biodiversity in some areas.

(a) What is biodiversity?

Tick **one** box.

The different habitats in an ecosystem	☐
The interaction of living and non-living factors in a habitat	☐
The interdependence of organisms on Earth	☐
The total number of organisms in an ecosystem	☐
The variety of different species on Earth	☐

(1)

(b) What gases cause global warming?

Tick **two** boxes.

Carbon dioxide	☐
Methane	☐
Nitrogen	☐
Oxygen	☐
Water vapour	☐

(2)

(c) Give **two** effects of global warming that could reduce biodiversity in an area.

1. _____

_____

2. _____

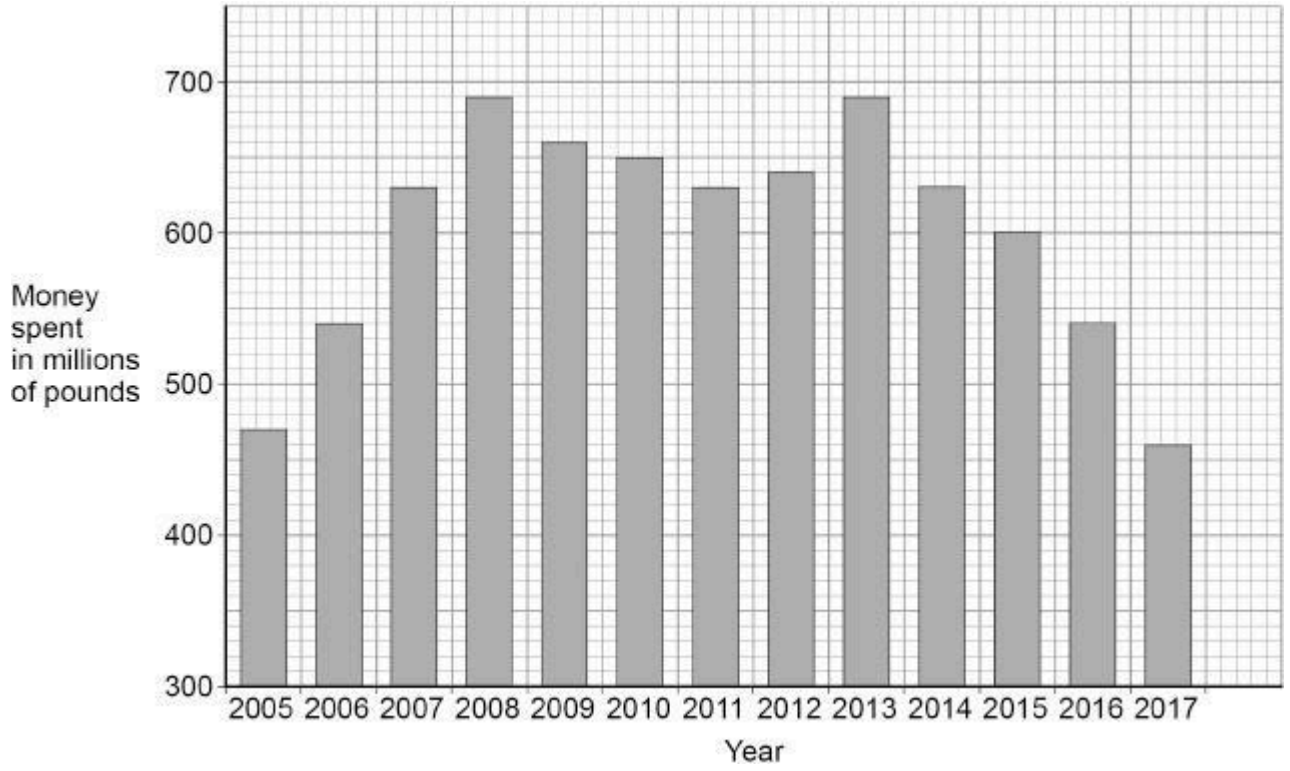
_____

(2)

(Total 5 marks)

Q2.

The graph below shows the money spent on conserving biodiversity in the UK by the government.



(a) Describe the trends in the money spent on conserving biodiversity from 2005 to 2011.

Use data from the graph above in your answer.

_____

_____

_____

_____

(2)

(b) Calculate the percentage decrease in the money spent on conserving biodiversity from 2013 to 2017.

Use the equation:

$$\text{percentage decrease} = \frac{\text{change in money spent from 2013 to 2017}}{\text{money spent in 2013}} \times 100$$

Give your answer to 2 significant figures.

_____

_____

_____

_____

_____

Percentage decrease (2 significant figures) = _____ %

(3)

(c) Conservation of peat bogs can help maintain biodiversity.

Give **two** uses of peat taken from peat bogs.

1 _____

_____

2 _____

(2)

(d) Describe **two** ways to **increase** biodiversity in the UK.

Do **not** refer to money spent or to peat in your answer.

1 _____

_____

2 _____

_____

(2)

(Total 9 marks)

Q3.

The figures below show the levels of carbon dioxide in air from 150 000 years ago.

TIME	CARBON DIOXIDE CONCENTRATION
1500 years ago	270 parts per million
1800 AD	290 parts per million
1957	315 parts per million
1983	340 parts per million

(a) Explain why carbon dioxide levels in the atmosphere are changing.

_____

_____

_____

_____

_____

(3)

(b) It is suggested that the increased level of carbon dioxide in the air is causing the atmosphere to warm up (the “Greenhouse Effect”).

Describe, as fully as you can, **two** major effects of global warming and how these may affect the human population.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(6)

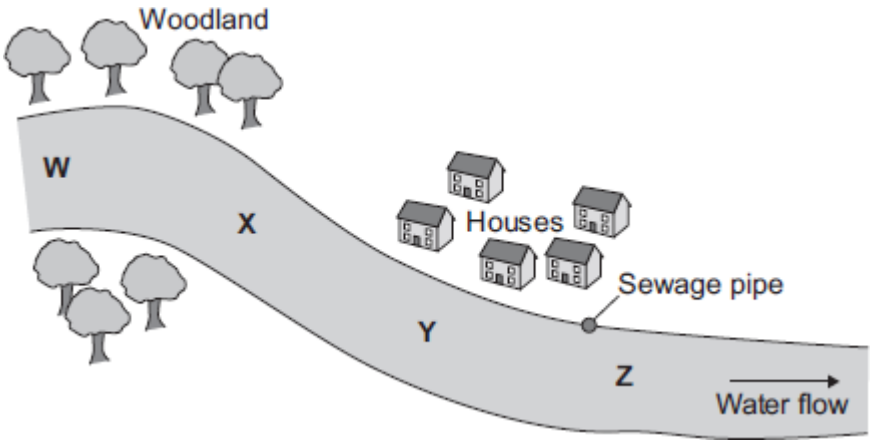
(Total 9 marks)

Q4.

Two groups of students, **Group 1** and **Group 2**, were monitoring the oxygen concentration in a river.

They measured the oxygen concentration of the water at points **W**, **X**, **Y** and **Z**. The measurements were taken on the same day, but the two groups used different oxygen sensors.

The sensors for both groups were working properly.



The results for the two groups are shown in the table.

	Concentration of oxygen in arbitrary units			
Sampling position	**W**	**X**	**Y**	**Z**
Group 1	9.4	9.3	9.4	8.5
Group 2	9	9	9	9

(a) The results of **Group 2** did not show any difference in the concentration of oxygen at the four different sampling positions. The results of **Group 1** did show differences.

Suggest why.

_____

_____

(1)

(b) The results of **Group 1** show the lowest concentration of oxygen was at sampling position **Z**.

Suggest why.

_____

_____

_____

_____

_____

_____

(3)

(c) The students also counted the number of different invertebrates living in the river at points **W**, **X**, **Y** and **Z**.

The results are shown in the table.

Invertebrate	Sampling position			
	W	**X**	**Y**	**Z**
Stonefly larva	4	5	4	0
Water snail	16	15	16	10
Bloodworm	0	0	0	25
Freshwater louse	6	5	7	5

From these results, which invertebrate is **not** suitable as an indicator of oxygen concentration in water?

_____

Give a reason for your choice.

_____

_____

(1)

(Total 5 marks)

Q1.

(a) the variety of different species on Earth

1

(b) carbon dioxide

1

methane

1

(c) any **two** from:

- drought
- flooding
- temperature change

  allow temperature increase or decrease
- rainfall change

  allow rainfall increase or decrease

2

[5]

Q2.

(a) increases (from 2005) to 690 million **or** increases to 2008

allow peak in 2008

allow peak at 690 million

1

decreases (from 2008) to 630 million

if no other mark awarded, allow overall increase from 470 million

or

overall increase to 630 million

or

(overall) increase of 160 million

or

*increases to 690 and decreases to 630 (without units) for **1** mark*

1

(b) $\frac{690(\text{million}) - 460(\text{million})}{690(\text{million})} \times 100$

allow

$\frac{230(\text{million})}{690(\text{million})} \times 100$

1

33.3 (%)

ignore number of decimal places allow calculated

value from incorrect graph readings

1

33 (%)

allow calculated answer correctly given to 2 significant figures

1

(c) compost

allow improving soil (texture / drainage / quality)
ignore farming unqualified ignore as fertiliser

1

burning
or
as a fuel

1

(d) any **two** from:

- reduce pollution

  ignore references to carbon dioxide, greenhouse gases or global warming

  *allow reduce named example of pollution, eg smoke **or** acidic gases **or** sewage **or** fertiliser*
  allow reduce toxic waste dumping

- plant trees

  allow afforestation

  allow reforestation

  ignore reduce / stop deforestation

- breeding programmes (for endangered species)

- rewilding / regeneration of habitats / hedgerows / meadows

  allow planting wild flower seeds

- (reintroducing) wider field margins

- plant a variety of crops

  allow reduce monoculture

- reduce use of pesticide / herbicide / insecticide

  ignore recycling

  ignore protect / conserve habitat(s) / areas

2

[9]

Q3.

(a) *idea:*
more (fossil) fuel burned (do not credit simply more people/cars/industry)
deforestation = less photosynthesis
deforestation = more respiration/burning

each for 1 mark

3

(b) *idea*:
climate change
for 1 mark

warmer/colder/drier/wetter
food production affected/starvation
mayor ecosystems destroyed/damaged
any two for 1 mark each

6

sea level rise
for 1 mark

low land flooded
less food grown/starvation
homes/factories flooded
any two for 1 mark each

Allow
polar ice caps melt
sea water expands

[9]

Q4.

(a) (sensor used by Group 2) had lower resolution
accept converse answers
allow poor / worse resolution
allow (sensor used by Group 2) only measured to whole numbers
ignore reference to sensitivity / precision / accuracy

1

(b) microorganisms / bacteria (in water / from sewage)
ignore references to plants

1

used up oxygen
must be linked to microorganisms

1

during respiration

1

(c) freshwater louse
*correct organism **and** reason needed for mark*
allow louse / lice

number of organisms changes little

1

[5]

Q2.

This question was common with Combined Science: Trilogy Biology Paper 1 Higher Tier.

Generally, students could interpret the graph and describe the trends between 2008 and 2011 in terms of years, such as ‘it increases to 2008’ however, fewer could correctly extract relevant data, such as the money spent in millions of pounds in 2008 or 2011. References to trends beyond 2011 were ignored. Some students tried to give economic or ‘levels of concern’ reasons for the trends which did not answer the question. When ‘describe’ is used as a command word the answer does not require an explanation.

In (b) students were asked to calculate the percentage change, and given the equation. Some students did not appear to read the appropriate figures from the graph. The most common error was not giving the answer to two significant figures. This is prompted in the question and on the answer line. There were indications that some students are confused between decimal places and significant figures.

Knowledge about uses of peat was very limited, with most students not being able to give one use of peat taken from peat bogs. The most common correct answer related to peat in compost. Misconceptions of the term biodiversity were frequently seen in (d), with answers referring to diversity in the human population or vague answers relating to recycling or climate change that would not directly increase biodiversity. Suggestions that would maintain, or decrease the rate of biodiversity decline, such as ‘stop hunting’ may maintain, but not increase biodiversity, and therefore were considered to be insufficient at this level.

Q3.

(a) Generally well answered with most candidates gaining two marks and a significant minority all three available marks.

(b) Also well answered, many candidates gaining most or all of the available marks. A minority of candidates, however, described the causes and/or consequences of the depletion of the ozone layer, either as well as or instead of global warming.

Q4.

(a) Many students had not read the question carefully and said the differences in the readings were either due to different sensors being used, or because one of them was faulty. Both of these ideas were mentioned in the question. Responses mentioning the resolution of the meters were rarely seen, although precision, accuracy and sensitivity were often mentioned, but these were ignored. Students should be made aware of the definitions given in the glossary. Students who answered correctly usually said Group 2’s sensor rounded the reading to a whole number

(b) Although most students said that point Z was just below a sewage pipe, they did not go on to say the sewage would contain microorganisms. Many thought chemicals in the sewage would reduce the oxygen levels. Some students said point Z was furthest from the trees which produce oxygen and therefore there would be less oxygen at point Z.

(c) The concept of indicator organisms appears to be poorly understood. The most

common response was bloodworm, which is the most suitable indicator of oxygen concentration. Many of those who gave freshwater louse as their choice did not clearly explain why so did not gain a mark.