A-Level Biology 2026-2028

Miss Gardener, Ms Hayward, Miss Kane

Welcome!

Dear Biology Students,

We are looking forward to welcoming you to the AQA 'A' Level Biology A-level Biology course in September, where we will explore everything from biological molecules to the evolution of new species and the reasons why humans have evolved as they have! We do not expect you to know everything, but we do expect you to work hard and to seek help with any areas you are unsure about. We will support you through this interesting and challenging course and we hope you will enjoy it.

The following tasks are things we would like you to complete before the start of the course.

1. Equipment and organisation:

Please arrive at your first **Biology** lesson with the following essential equipment:

A scientific calculator, a set of highlighters, a ruler, protractor, pens, pencils, A4 plastic wallets. We will give you an exercise book per teacher.

These are your topic headings:

Year 1

1. Specification and exam papers
2. Admin/revision material
3. Assessed work
4. Development of Practical Skills in Biology
5. **Section 1 – Biological molecules**
6. Biological Molecules
7. Nucleic acids
8. **Section 2 - Cells**
9. Cell structure
10. Transport across cell membranes
11. Cell recognition and the immune system
12. **Section 3 – Organisms exchange substances with their environment**
13. Exchange (surfaces)
14. Mass transport (in animals and plants)
15. **Section 4 – Genetic information, variation and relationships between organisms**
16. DNA, genes and protein synthesis
17. Genetic diversity
18. **Section 8 – The control of gene expression** - Recombinant DNA technology (AMGEN)

Year 2

19. **Section 5 – Energy transfer in and between organisms**
20. Photosynthesis
21. Respiration
22. Energy and ecosystems
23. **Section 6 – Organisms respond to changes in their environments**
24. Response to stimuli
25. Nervous coordination and muscles
26. Homeostasis
27. **Section 7 – genetics, populations, evolution and ecosystems**
28. Inherited change
29. Populations and evolution
30. Populations and ecosystems
31. **Section 8 – The control of gene expression**
32. Gene expression
33. ~~Recombinant DNA technology~~ (completed in Y12)

2. General Information:

Recommended Reading:

Textbooks

- Fullick, et al (2015); A-level Biology for OCR; Oxford University Press
  This is your course textbook. You will be provided with an online edition of this book, but you may wish to buy your own if you want to make notes within it.
- New A-Level Biology for OCR A: Year 1 & 2 Student Book with Online Edition; CGP.
  Another alternative textbook with well-explained examples.
- CGP Head Start to A-level Biology
  A good book to bridge the gap between GCSE and A-level Biology.
- Penny and Leftwich (2018) Maths Skills for A-level Biology (second edition)
  An excellent book to explain and practice difficult mathematical biological concepts.

We have a few copies of the textbook for borrowing during study, but not enough for the class.

Popular Science books

Reading around the subject is important and can give you a further insight into what we teach and why. It will also read well on future UCAS / apprenticeship / job applications if you are willing to invest your own time into your studies.

- Junk DNA by Nessa Carey
- The Red Queen by Matt Ridley
- A short history of nearly everything by Bill Bryson
- Hen's teeth and horses' toes by Stephan Jay Gould – also good for geography students!
- Frankenstein's cat by Emily Anthes
- The Selfish Gene by Richard Dawkins

There are, of course, many others – this is just a starting point!

Magazines

- Biological Sciences Review
- New Scientist
- How it Works

Contact details:

If you are struggling with any aspect of the summer work and you would like pointing in the right direction, or if you just want to find out more about the course, you can contact your Head of Biology: Miss Gardener.

Miss C. Gardener: cgardener@sheringhamhigh.co.uk

3. Summer research task:

The Ig Nobel Prize

The Ig Nobel Prizes celebrate scientific research that first makes people laugh and then makes people think. Although many winning studies seem unusual or humorous at first, they are genuine scientific investigations that often explore important biological questions in creative ways.

Your Task

Choose ONE Biology-related Ig Nobel Prize-winning study and investigate the original scientific paper. You will produce a GCSE-friendly summary of the research, explaining the biology behind the study for an AQA GCSE Biology audience.

Step 1: Choose a Study

Browse the official Ig Nobel Prize Winners Archive at https://improbable.com/ig/winners/

Choose a study linked to Biology. Suitable topics may include:
- Animal behaviour
- Ecology
- Evolution
- Human biology
- Physiology
- Microbiology
- Adaptation
- Genetics

Examples include:
- Does painting cows like zebras reduce fly bites?
- Which body part hurts most when stung by a bee?
- Can mammals breathe through their intestines?
- How do animals communicate?
- Why do certain organisms behave in unusual ways?

Step 2: Find the Original Research Paper

Use Google Scholar, university websites, journal websites, or references provided on the Ig Nobel website.

You must use the ORIGINAL scientific paper, not a newspaper article or science news report.

Step 3: Produce Your Summary

Write approximately 500–800 words using the following headings.

1. Title

State the title of the research paper.

2. Biological Background

What question were the researchers trying to answer? Why is this question important or interesting?

3. Methods

Explain what the scientists did, what organisms were studied, what variables were measured, and how the investigation was carried out.

4. Results

Describe what the scientists discovered. Include important observations or findings.

5. Biology Behind the Study

Explain the biology involved. Link your explanation to AQA GCSE Biology topics where possible.

6. Evaluation

What are the strengths and limitations of the study? Was the sample size suitable? Could the investigation be improved?

7. Why Did It Win an Ig Nobel Prize?

- What makes the study unusual, surprising, or humorous?
- What important biological idea does it explore?
- Why do you think the judges selected this research for an Ig Nobel Prize?
- Do you agree with the decision? Explain your reasoning using evidence from the study.
- How does the study make people 'laugh, then think'?

Links to AQA GCSE Biology

Where possible, link your chosen study to one or more AQA GCSE Biology topics:

- Cell Biology
- Organisation
- Infection and Response
- Bioenergetics
- Homeostasis and Response
- Inheritance, Variation and Evolution
- Ecology

Step 4: Harvard Reference

You must include a Harvard-style reference for the original paper.

Example:
Mitchell, M. and Wartinger, D. (2016) 'Validation of a functional pyelocalyceal renal model for the evaluation of renal calculi passage while riding a roller coaster', Journal of the American Osteopathic Association, 116(10), pp. 647–652.

Presentation Requirements

- Word processed
- 600–800 words
- Use headings
- Include at least one image, graph, or diagram
- Include one Harvard reference
- Submit as a PDF or Word document

Success Criteria

Research	Uses the original scientific paper
Biological Understanding	Explains biological concepts accurately
Communication	Written clearly for a GCSE audience
Evaluation	Provides thoughtful analysis and judgement
AQA Links	Makes accurate links to GCSE Biology topics
Referencing	Uses Harvard referencing correctly

Extension Challenge

Compare your chosen study with a more traditional Biology investigation studying a similar topic.

Discuss:

- Which study would be easier to communicate to the public?
- Does unusual research help increase interest in science?
- Should funding be given to research that appears unusual at first glance?

Final Thought

The Ig Nobel Prizes celebrate research that makes people "laugh, then think". Your challenge is to show that behind every unusual study is real biology worth understanding.

Preparation for your assessment:

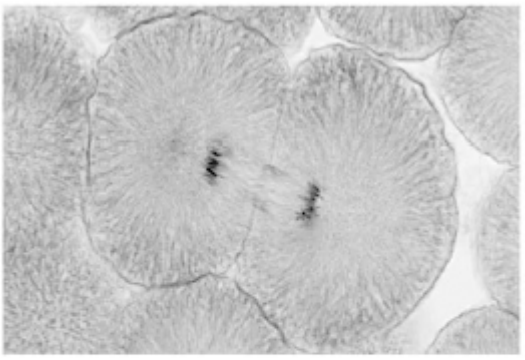
On one of your first Biology lessons, you will have a 1-hour assessment that will be comprised of higher difficulty GCSE level Biology questions. This is so that we can assess your starting level and provide you with support if needed. To prepare for this, you should **complete and mark** all of the questions below. Your teacher(s) will not be marking these.

Q1.

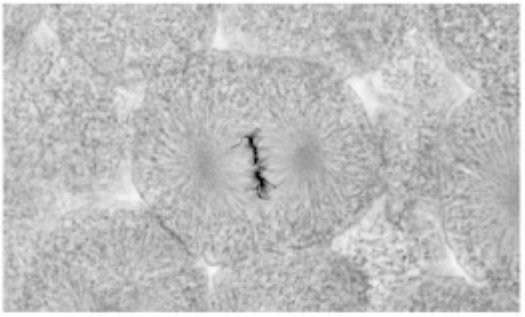
Figure 1 shows photographs of some animal cells at different stages during the cell cycle.

Figure 1

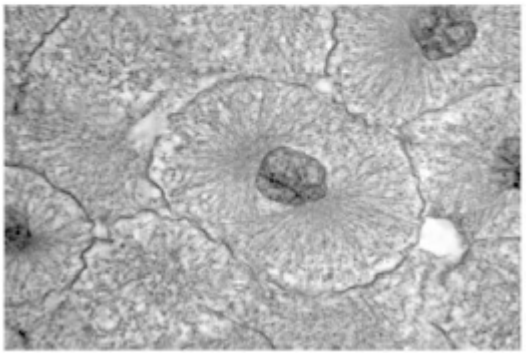
A



B



C



A © Ed Reschke/Photolibrary/Getty Images
B © Ed Reschke/Oxford Scientific/Getty Images
C © Ed Reschke/Photolibrary/Getty Images

(a) Which photograph in **Figure 1** shows a cell that is **not** going through mitosis?

Tick **one** box.

A ☐ **B** ☐ **C** ☐

(1)

(b) Describe what is happening in photograph **A**.

_____

_____

_____

_____

(2)

(c) A student wanted to find out more about the cell cycle.

The student made a slide of an onion root tip.

She counted the number of cells in each stage of the cell cycle in one field of view.

The table below shows the results.

		Stages in the cell cycle				
	Non-dividing cells	**Stage 1**	**Stage 2**	**Stage 3**	**Stage 4**	**Total**
Number of cells	20	9	4	2	1	36

Each stage of the cell cycle takes a different amount of time.

Which stage is the fastest in the cell cycle?

Give a reason for your answer.

Stage _____

Reason _____

_____

(2)

(d) The cell cycle in an onion root tip cell takes 16 hours.

Calculate the length of time **Stage 2** lasts in a typical cell.

Give your answer to 2 significant figures.

_____

_____

_____

_____

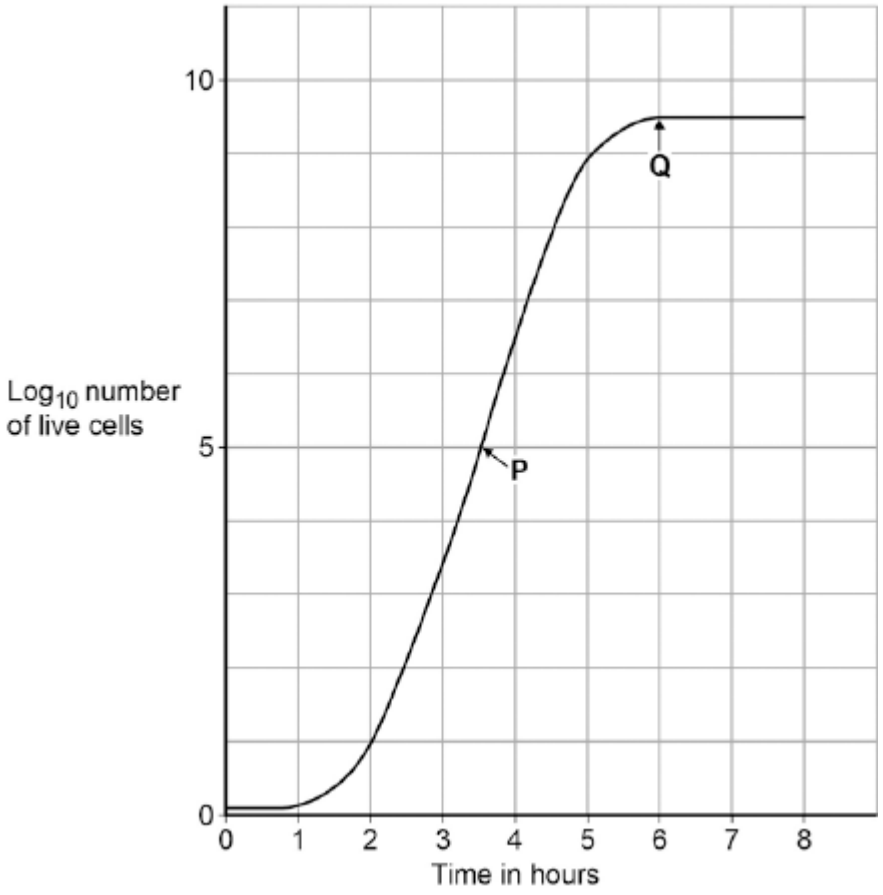
Time in **Stage 2** = _____ minutes

(3)

(e) Bacteria such as *Escherichia coli* undergo cell division similar to mitosis.

Figure 2 shows a growth curve for *E. coli* grown in a nutrient broth.

Figure 2



What type of cell division causes the change in number of *E. coli* cells at **P**?

_____

(1)

(f) Suggest why the number of cells levels out at **Q**.

_____

_____

_____

_____

_____

_____

(2)

(Total 11 marks)

Q2. A small animal called an axolotl lives in water. The axolotl has a double circulatory system.

(a) Define the term double circulatory system.

_____

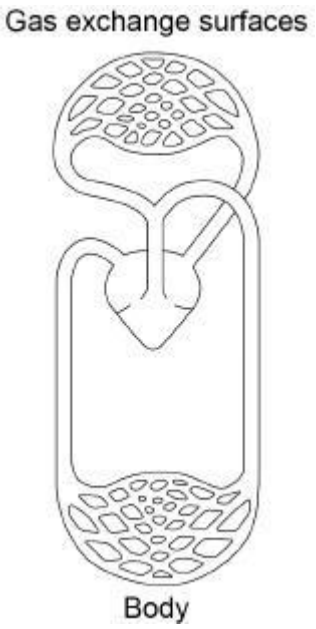
_____

_____

(1)

Figure 1 shows the double circulatory system of the axolotl.

Figure 1



(b) The heart of the axolotl has only one ventricle.

Label the ventricle on **Figure 1**.

(1)

(c) Explain why having only one ventricle makes the circulatory system less efficient than having two ventricles.

_____

_____

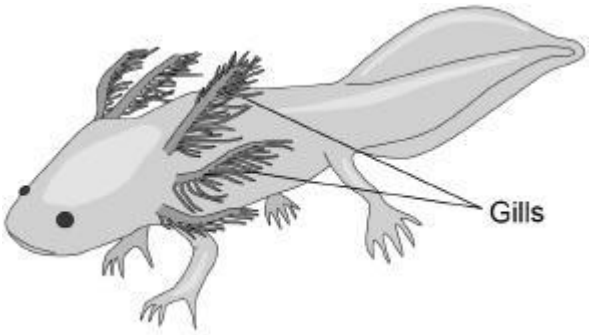
_____

_____

(2)

Figure 2 shows an axolotl.

Figure 2



(d) Explain why an axolotl may die in water with a low concentration of oxygen.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(4)

If a gill of an axolotl is removed, a new gill will grow in its place.

Scientists hope to use information on how axolotls grow new gills to help with regenerating human tissue.

(e) Name the type of cell that divides when a new gill grows.

_____

(1)

(f) Name **one** condition that could be treated using regenerated human tissue.

_____

(1)

(g) Suggest **one** reason why an axolotl is a suitable animal for research in the laboratory.

_____

_____

(1)

(h) An axolotl may **not** be a suitable animal to study when researching regeneration in human tissue.

Suggest **one** reason why.

_____

_____

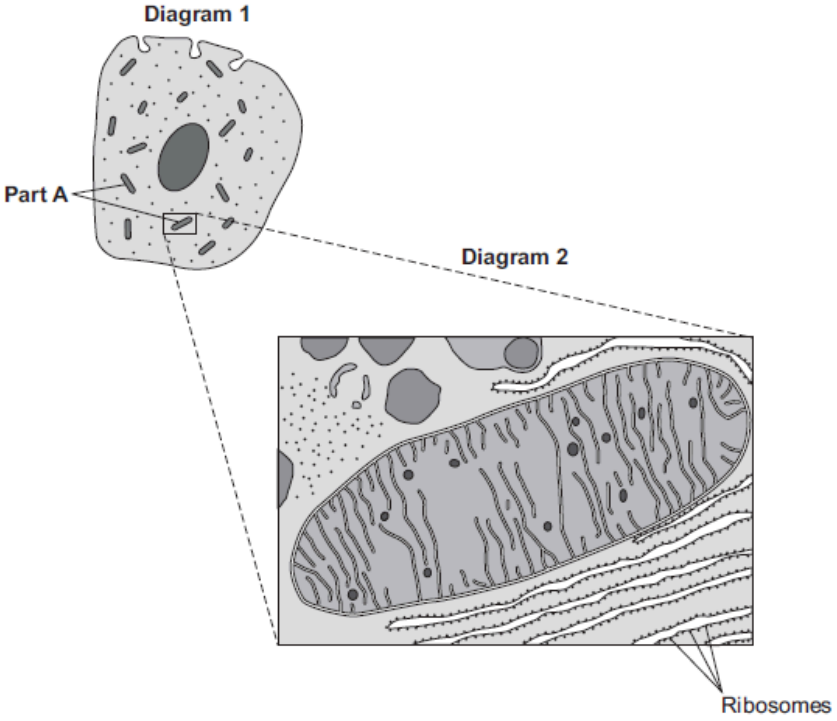
(1)

(Total 12 marks)

Q3.

Diagram 1 shows a cell from the pancreas.

Diagram 2 shows part of the cell seen under an electron microscope.



Part **A** is where most of the reactions of aerobic respiration happen.

(a) (i) Name part **A**.

_____

(1)

(ii) Complete the equation for aerobic respiration.

glucose + oxygen ⟶ _____ + _____ (+ energy) **(2)**

(iii) Part **A** uses oxygen.

Explain how oxygen passes from the blood to part **A**.

_____

_____

_____

_____

_____

_____

_____

(3)

(b) The pancreas cell makes enzymes.

Enzymes are proteins.

Describe how the ribosomes and part **A** help the cell to make enzymes.

_____

_____

_____

_____

_____

_____

_____

_____

(3)

(Total 9 marks)

Q4.

(a) Mr and Mrs Smith both have a history of cystic fibrosis in their families.
Neither of them has cystic fibrosis.
Mr and Mrs Smith are concerned that they may have a child with cystic fibrosis.

Use a genetic diagram to show how they could have a child with cystic fibrosis.

Use the symbol **A** for the dominant allele and the symbol **a** for the recessive allele.

(3)

(b) Mr and Mrs Smith decided to visit a genetic counsellor who discussed embryo screening.

Read the information which they received from the genetic counsellor.

- Five eggs will be removed from Mrs Smith's ovary while she is under an anaesthetic.
- The eggs will be fertilised in a dish using Mr Smith's sperm cells.
- The embryos will be grown in the dish until each embryo has about thirty cells.
- One cell will be removed from each embryo and tested for cystic fibrosis.
- A suitable embryo will be placed into Mrs Smith's uterus and she may become pregnant.
- Any unsuitable embryos will be destroyed.

(i) Suggest why it is helpful to take five eggs from the ovary and not just one egg.

_____

_____

(1)

(ii) Evaluate the use of embryo screening in this case.

Remember to give a conclusion to your evaluation.

_____

_____

_____

_____

_____

_____

_____

_____

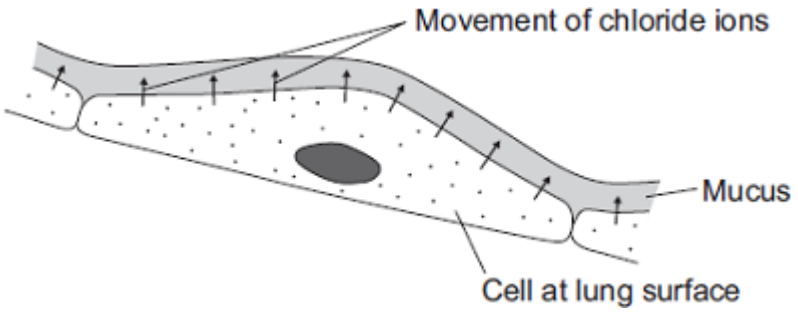
_____

_____

(4)

(c) In someone who has cystic fibrosis the person's mucus becomes thick.

The diagram shows how, in a healthy person, cells at the lung surface move chloride ions into the mucus surrounding the air passages.



The movement of chloride ions causes water to pass out of the cells into the mucus.

Explain why.

_____

_____

_____

_____

_____

_____

_____

(3)

(Total 11 marks)

Q5.

Data from 'The Million Women' survey in the UK was collected for over 15 years.

Scientists analysed the data to study the effect of consuming alcohol on liver disease.

The scientists:

- included 400 000 women who regularly consumed alcohol
- included 400 000 women who did **not** consume alcohol
- excluded women who already had a liver disease.

(a) Age and gender were two factors controlled in this analysis.

Many other factors were also controlled.

Suggest **two** other factors which the scientists would have controlled.

1 _____

_____

2 _____

_____

(2)

The data was analysed for:

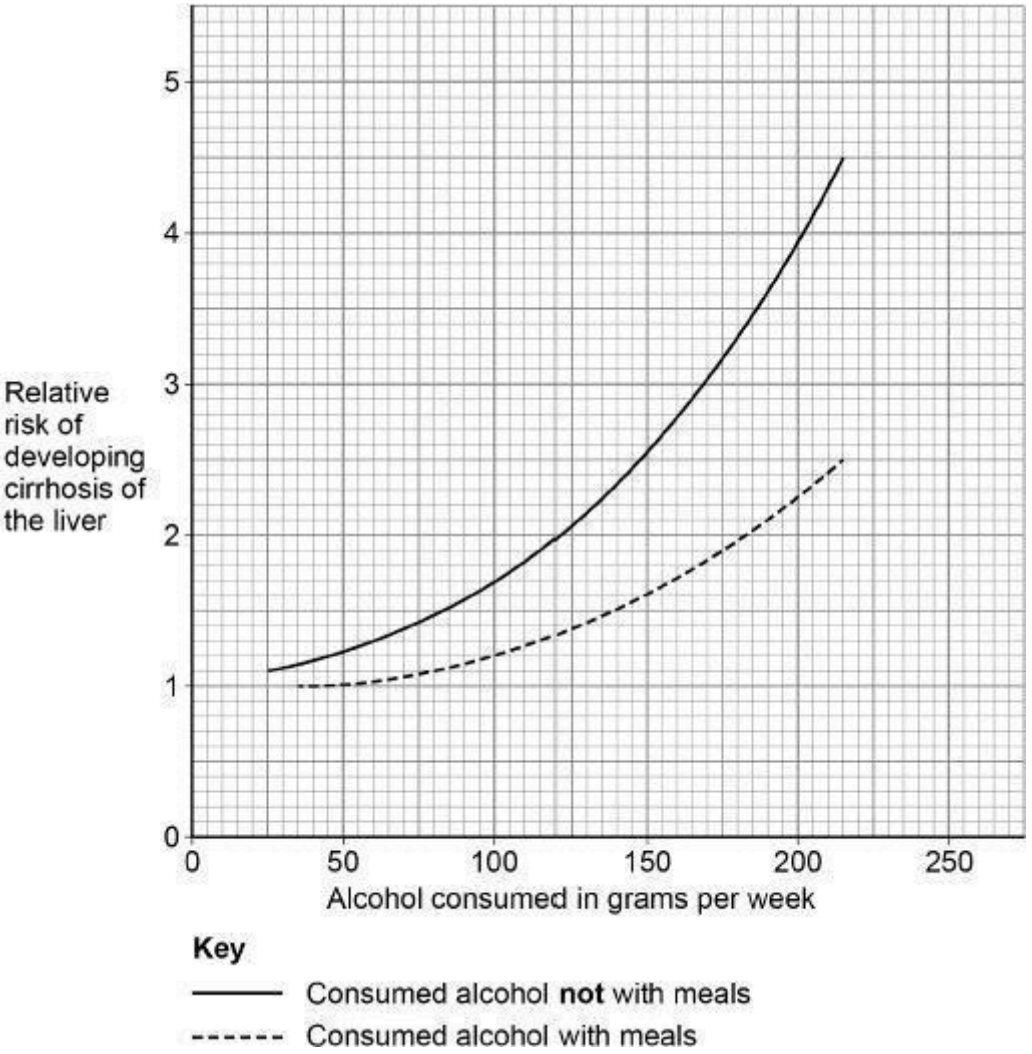
- women who drank alcohol with meals
- women who drank alcohol **not** with meals
- women who did **not** drink alcohol.

During the survey approximately 1500 women developed a liver disease called cirrhosis of the liver.

Scientists calculated the relative risk of developing cirrhosis of the liver for each group who consumed alcohol.

A relative risk of 1.0 means there was no statistical difference between the groups who did consume alcohol and the group who did **not** consume alcohol.

The below graph shows a summary of the results.



(b) A woman drinks 150 g of alcohol per week **not** with meals.

The woman decides to change to drinking 150 g of alcohol per week with meals.

Calculate the percentage decrease in relative risk of developing cirrhosis of the liver for this woman.

_____

_____

_____

_____

Percentage decrease = _____ %

(2)

(c) One glass of wine contains 12 g of alcohol.

A different woman drinks two glasses of wine each day with her meals.

Calculate the relative risk of developing cirrhosis of the liver for this woman.

_____

_____

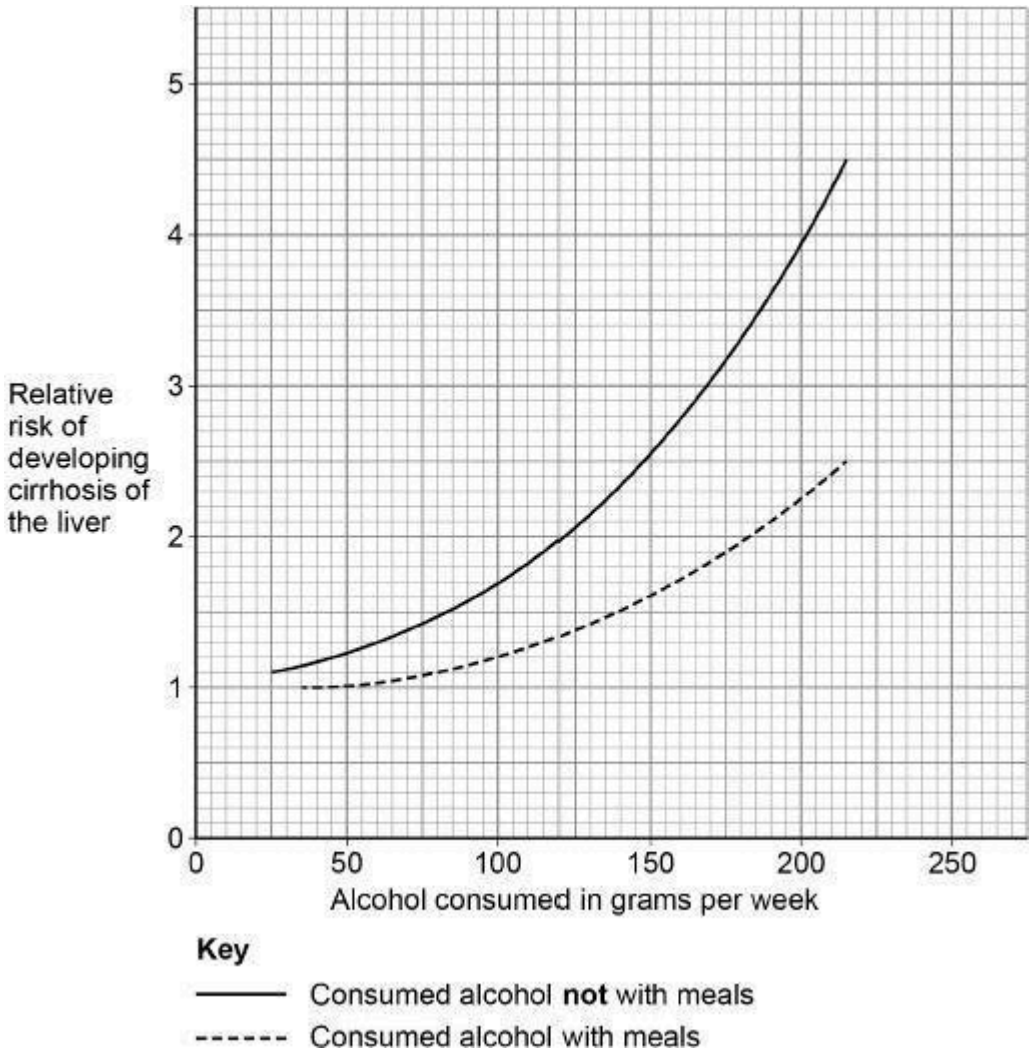
_____

_____

Relative risk = _____

(2)

The graph is repeated below.



(d) Consuming alcohol with meals instead of not with meals decreases the relative risk of developing cirrhosis of the liver.

Give **two** other conclusions about the relative risk of developing cirrhosis of the liver related to alcohol consumption.

Use data from the graph in your answer.

1 _____

_____

_____

2 _____

_____

_____

(2)

(e) Suggest **two** reasons why the data is considered to be valid.

1 _____

_____

2 _____

_____

(2)

(f) Suggest **one** aspect of the survey which might reduce validity.

_____

_____

(1)

(g) Cirrhosis of the liver leads to liver failure.

Describe the effects of liver failure on the human body.

_____

_____

_____

_____

_____

_____

_____

_____

(4)

Q6.

Some students investigated the effect of pH on the growth of one species of bacterium.
They transferred samples of bacteria from a culture of this species to each of eight flasks.
Each flask contained a solution of nutrients but at a different pH.
After 24 hours, the students measured the amount of bacterial growth.

(a) It was important that the flasks in which the bacteria grew were not contaminated with other microorganisms. Describe **two** precautions the students should have taken to prevent this contamination.

1. _____

2. _____

(2)

(b) To see the effect of pH on the growth of the bacteria, other conditions should be kept constant.

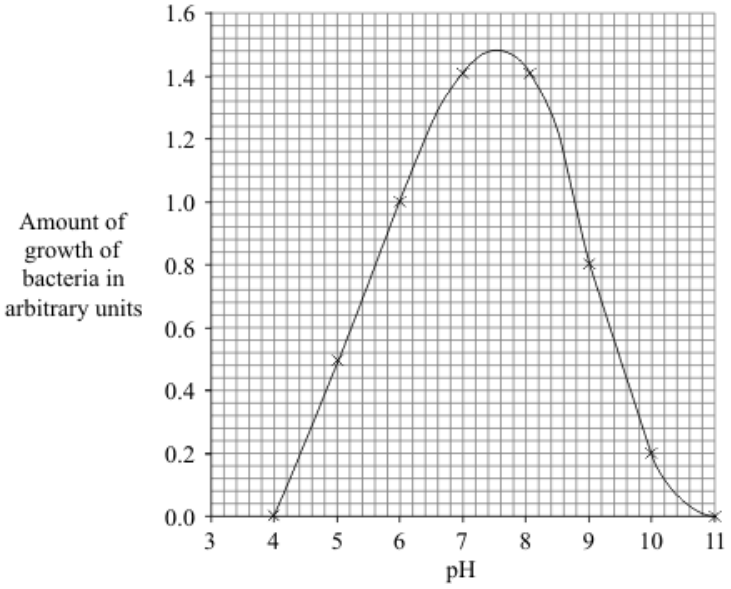
Suggest **two** conditions which should have been kept constant for all eight flasks.

1. _____

2. _____

(2)

(c) The graph shows the results of the investigation.



The students wanted to find the best pH for the growth of this species of bacterium.

(i) Use the graph to estimate the pH at which the bacteria would grow best.

pH _____

(1)

(ii) What could the students do to find a more accurate value for the best pH for growth of the bacteria?

_____

_____ **(1)**

Mark schemes

Q1.

(a) **C**

1

(b) cytoplasm **and** cell membrane dividing

*accept cytokinesis for **1** mark*

1

to form two identical daughter cells

1

(c) stage 4

1

only one cell seen in this stage

1

(d) (4 / 36) × 16 × 60

1

107 / 106.7

1

110 (minutes)

*allow 110 (minutes) with no working shown for **3** marks*

1

(e) binary fission

*do **not** accept mitosis*

1

(f) shortage of nutrients / oxygen

1

so cells die
or
death rate = rate of cell division

1

[11]

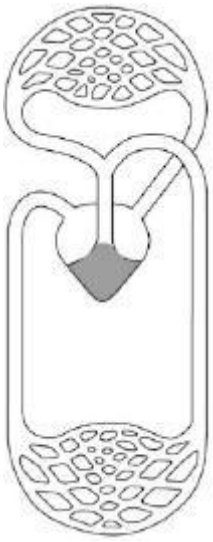
Q2.

(a) blood is pumped to the lungs by one / right side of the heart
and
blood is pumped to the body by the other / left side of the heart

allow blood enters the heart twice for every (one) circuit around the body

1

(b) ventricle correctly identified as any part of grey area below:



1

(c) oxygenated and deoxygenated blood mixes

allow some deoxygenated blood is sent to the body / tissues / cells

1

(so) less oxygen reaches the body / tissues / cells

allow named tissues / organs

1

(d) concentration gradient (of oxygen) is shallow(er) / less steep

1

(therefore) less oxygen diffuses into blood / cells / gills

1

allow idea that concentration gradient is negative (i.e. out of axolotl) (1)
so oxygen diffuses out of axolotl's blood / cells / gills (1)

(so) less (aerobic) respiration occurs so less energy is released / available
or
(so more) anaerobic respiration occurs so less energy is released / available

*do **not** accept no respiration occurs*

*do **not** accept energy production*

1

(so) less metabolism

ignore reduced living processes unqualified

*allow reduction of building larger molecules **or** movement / muscle contraction **or** keeping warm **or** urea formation **or** chemical reactions*

or
(so when) anaerobic respiration occurs, lactic acid is produced (and is toxic)

1

(e) stem (cells)

*do **not** accept embryonic stem cell*

1

(f) any **one** from:

- paralysis

- diabetes

allow other examples such as Parkinson's / heart disease / stroke / cystic fibrosis / cancer / burns

*do **not** accept infectious diseases*

1

(g) any **one** from:

- easy to breed

allow reproduce quickly

- easy / cheap to keep / rear (as are small)
- don't take up much space

allow reference to not being dangerous (to the scientist)

allow they are not endangered

allow removal of gill will not kill the axolotl

1

(h) any **one** from:

- it's not a mammal **or** it is an amphibian
- regeneration in gills may be different to that in other organs
- metabolism / body processes are too different to humans

allow humans do not have gills

*allow it's an endangered species **or** species need to be protected from extinction*

*ignore reference to genetic differences **or** ethics*

1

[12]

Q3.

(a) (i) mitochondrion / mitochondria

must be phonetically correct

1

(ii) carbon dioxide / CO_2

1

water / H_2O

1

in either order

*accept CO2 but **not** CO^2*

*accept H2O **or** HOH but not H^2O*

(iii) diffusion

1

high to low concentration

allow down a concentration gradient

1

through (cell) membrane **or** through cytoplasm

*do **not** accept cell wall*

1

(b) ribosomes make proteins / enzymes

1

using amino acids

1

part A / mitochondria provide the energy for the process

allow ATP

*do **not** accept produce or make energy*

1

[9]

Q4.

(a) both parents **Aa**

*accept other upper and lower case letter without key **or** symbols with a key*

allow as gametes shown in Punnett square

1

aa in offspring correctly derived from parents
or
aa correctly derived from the parents given

ignore other offspring / gametes

for this mark parents do not have to be correct

1

offspring **aa** identified as having cystic fibrosis

*may be the only offspring shown **or** circled / highlighted / described*

1

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

accept converse if clear, eg if you (only) took one it might have cystic fibrosis / might not be fertilised

- (more) sure / greater chance of healthy / non-cystic fibrosis egg / embryo / child

  accept some may have the allele

  reference to 'suitable / good embryo' is insufficient

- greater chance of fertilisation

1

(ii) **advantages**

to gain 3 marks both advantage(s) <u>and</u> disadvantage(s) must be given

max 3

any **two** from:

ignore references to abortion unless qualified by later screening

- greater / certain chance of having child / embryo without cystic fibrosis / healthy
- child with cystic fibrosis difficult / expensive to bring up
- cystic fibrosis (gene / allele) not passed on to future generations

disadvantages

any **two** from:

- operation dangers / named eg infection
  ignore risk unqualified

- ethical or religious issues linked with killing embryos
  accept wrong / cruel to embryos accept right to life argument
  ignore embryos are destroyed

- (high) cost of procedure

- possible damage to embryo (during testing for cystic fibrosis / operation)

plus

conclusion

a statement that implies a qualified value judgement
eg it is right because the child will (probably) not have cystic fibrosis even though it is expensive
or
eg it is wrong because embryos are killed despite a greater chance of having a healthy baby

***note**: the conclusion mark cannot be given unless a reasonable attempt to give both an advantage and a disadvantage is made*

*do **not** award the mark if the conclusion only states that advantages outweigh the disadvantages*

1

(c) any **three** from:

- osmosis / diffusion
  *do **not** accept movement of ions / solution by osmosis / diffusion*

- more concentrated solution outside cell / in mucus
  assume concentration is concentration of solute unless answer indicates otherwise or accept correct description of 'water concentration'

- water moves from dilute to more concentrated solution
  allow correct references to movement of water in relation to concentration gradient

- partially permeable membrane (of cell)
  allow semi / selectively permeable

3

[11]

Q5.

(a) any **two** from:

ignore genetic factors

- BMI / morphology / obesity level
  *allow mass / weight **and** height*
- smoking habits

- diet

  allow previous drinking habits
- medication

  allow medical conditions

  allow drug use
- family history of liver disease
- fitness levels

  allow level of exercise
- ethnicity

  allow race
- area of UK they live in

2

(b) 2.55 – 1.60 (= 0.95)

allow 1.60 − 2.55 (= −0.95)

allow value for with meals in range 1.60 to 1.65 (for 1.60)

1

$\left(\frac{0.95}{2.55} \times 100 = \right)$

37 (.2549019608…) (%)

allow answer correctly calculated from values in ranges 1.60 to 1.65 and 2.50 to 2.60

allow – 37(.2549019608...)(%)

1

(c) 12 × 2 × 7 = 168 (g/week)

1

1.8

allow in range 1.8-1.9

*allow correct reading from a calculation that omits the 2 **or** the 7*

*do **not** accept if a unit is given*

1

(d) any **two** from:

- consuming alcohol increases the RR (with / without meals) **and** supporting data

  allow risk for RR throughout

  allow data in terms of number of glasses of wine

  allow increasing alcohol consumption increases the RR at an increasing rate

- consuming less than 50 g/week of alcohol with meals does not increase the RR

  allow any value between 35 and 60 g / week

- even (small amounts of alcohol at) 25 g / week increases the RR if not with meals

2

(e) any **two** from:

- large number in survey

- long term / 15 year survey

  allow 800 000 in survey

  if neither mark awarded allow large study
- well controlled

  allow many controls

2

(f) any **one** from:
- people underestimate / overestimate alcohol consumption

  allow people lie about alcohol consumption
  ***or** people lie about other named control variables*
- people may change (lifestyle / drinking) habits over time
- some people may drink all their weekly alcohol at once

  ignore survey only tested women

1

(g) **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

Responses may refer to either total or partial liver failure

- no bile made (in the liver)
  - fats / lipids are not emulsified
  - surface area of fats / lipids not increased
  - pH of small intestine will not be alkaline / neutralised
  - enzymes (in small intestine) will not work effectively **or** (named) food not digested / absorbed
  - so may lose weight

- lactic acid not broken down / oxidised
  - accumulation of lactic acid in blood / body
  - lactic acid is toxic **or** body will be poisoned
  - oxygen debt higher / prolonged
  - so muscle pain / fatigue

- proteins / amino acids will not be broken down (in liver)
  - (amino acids) not deaminated
  - amino acids not made into urea **or** will not form ammonia
  - (however) any ammonia formed is toxic
  - so accumulation of amino acids in blood / body

- liver does not break down / remove other toxins (like alcohol)
  - toxins accumulate in blood / body
  - body will be poisoned
  - so pain **or** jaundice **or** swollen liver **or** portal hypertension occurs

- glycogen stores will not be formed
  - cannot control blood glucose
  - so hyperglycaemia / hypoglycaemia / diabetes / coma may occur

[15]

Q6.

(a) any **two** from:

- sterilise / kill microorganisms
  ignore 'cleaning' / 'disinfect'
  ignore 'germs'
- method of sterilisation eg apparatus / media sterilised in oven / autoclave
  allow pressure cooker / boiling water
- pass flask mouth / pipette tip / loop / test tube mouth through flame
- work near a flame
- minimise opening of flask / test tube **or** hold non-vertical
  *allow idea of sealing / covering **or** prevent entry of air*

2

(b) any **two** from:

- temperature
  ignore references to time / type of bacterium
- concentration / amount of nutrients / ions
- type of nutrient
- volume / amount of solution
- amount of bacteria added
- agitation **or** amount of oxygen

2

(c) (i) 7.5
accept in range 7.4 – 7.6

1

(ii) use more pH values around / close to pH 7.5 / between 7 and 8

1

[6]