AQA

GCSE
COMBINED SCIENCE: TRILOGY

F

Foundation Tier Paper 5: Physics 1F

Specimen 2018 Time allowed: 1 hour 15 minutes

Materials
For this paper you must have:
- a ruler
- a calculator
- the Physics Equation Sheet (enclosed).

Instructions
- Answer **all** questions in the spaces provided.
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information
- There are 70 marks available on this paper.
- The marks for questions are shown in brackets.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.
- When answering questions 05.1 and 07.5 you need to make sure that your answer:
  - is clear, logical, sensibly structured
  - fully meets the requirements of the question
  - shows that each separate point or step supports the overall answer.

Advice
- In all calculations, show clearly how you work out your answer.

Please write clearly, in block capitals.

Centre number ☐☐☐☐☐ Candidate number ☐☐☐☐

Surname

Forename(s)

Candidate signature _____

0 1 Most electrical appliances are connected to the mains electricity using three-core cables.

0 1 . 1 What is the approximate value of the potential difference of the UK mains electricity supply?

Tick **one** box.

[1 mark]

23 V ☐

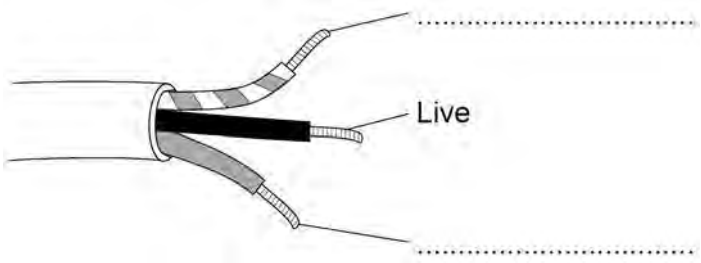
230 V ☐

300 V ☐

350 V ☐

Figure 1 shows a three-core cable.

Figure 1



0 1 . 2 Use answers from the box to label the wires and complete **Figure 1**.

[2 marks]

Earth	**Negative**	**Neutral**

0 1 . 3 In the UK the three wires in a three-core cable are always the same colours.

Why are the wires always the same colours?

Tick **one** box

[1 mark]

Each wire is made by a different company. ☐

It is easy to identify each wire. ☐

They are cheaper to manufacture. ☐

0 1 . 4 Touching the live wire is dangerous.

Use answers from the box to complete the sentences.

[2 marks]

current	**resistance**	**shock**	**force**	**voltage**

Touching the live wire causes a large potential difference to exist across the body.

This causes a _____ through the body,

which results in an electric _____

0 1 . 5 What is the approximate frequency of the UK mains electricity supply?

Tick **one** answer.

[1 mark]

50 Hz ☐

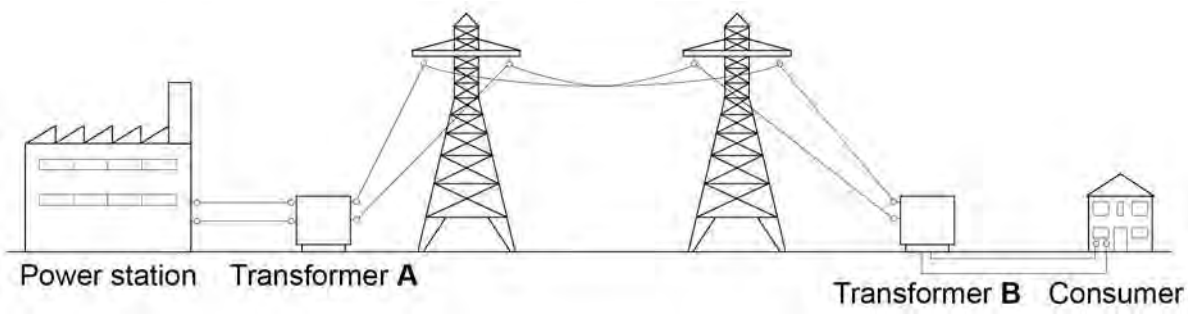
75 Hz ☐

100 Hz ☐

150 Hz ☐

Figure 2 shows how power stations transfer electrical power to consumers using the National Grid.

Figure 2



0 1 . 6 The power station generates electricity at a voltage of 25 kV.

Transformer **A** increases the voltage by a factor of 16.

What is the voltage output of transformer **A**?

[2 marks]

Output voltage = _____ kV

0 1 . 7 Why is the voltage increased by transformer **A**?

Tick **one** box.

[1 mark]

- To reduce the energy lost due to heating ☐
- To increase the power ☐
- To increase the current ☐

0 1 . 8 Why is it important that the voltage is decreased by transformer **B**?

Tick **one** box.

[1 mark]

- Less energy is used by consumers ☐
- It is safer for consumers ☐
- It reduces consumers' electricity bills ☐

Turn over for the next question

0 2 The nuclei of some isotopes are radioactive.

0 2 . 1 Which of the following statements could apply to a radioactive nucleus?

[1 mark]

Tick **one** box.

The nucleus will emit an atom. ☐

The nucleus will emit light. ☐

The nucleus will emit a neutron. ☐

The nucleus will emit sound. ☐

0 2 . 2 Potassium-40 is a radioactive isotope present in food, such as bananas.

The following equation shows how potassium-40 will decay into calcium-40

$$^{40}_{19}\text{potassium} \longrightarrow {}^{40}_{20}\text{calcium} + {}^{0}_{-1}\text{e}$$

Give one similarity and one difference between nuclei of potassium-40 and calcium-40

[2 marks]

Similarity

Difference

0 2 . 3 The activity of a sample of potassium-40 is measured 3 times.

The measurements are given below.

4906 Bq **4956 Bq** **4889 Bq**

Which of the following statements explains why the readings are different?

[1 mark]

Tick **one** box.

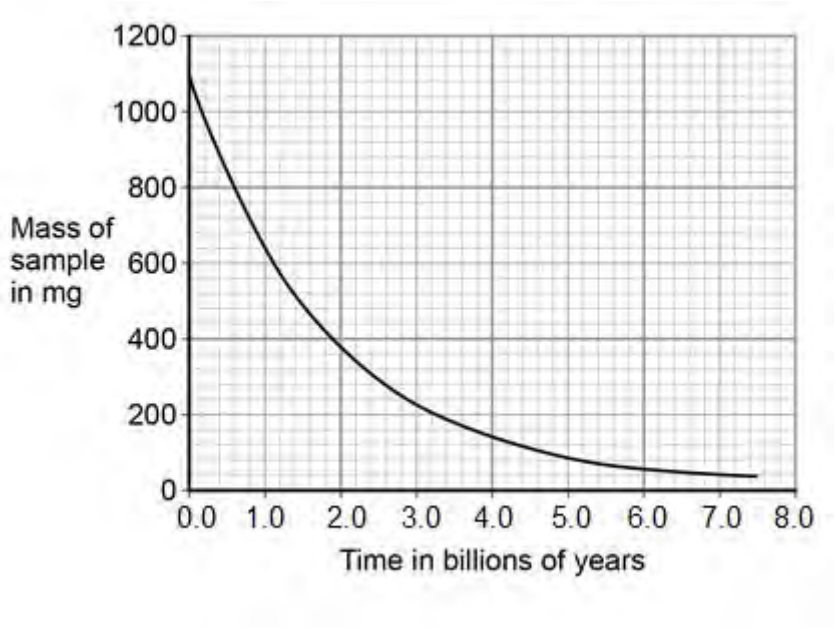
Radioactive decay is constant. ☐

Radioactive decay is hazardous. ☐

Radioactive decay is random. ☐

0 2 . 4 **Figure 3** shows how the activity of a sample of potassium-40 changes over time.

Figure 3



Use **Figure 3** to determine the half-life of potassium-40.

[2 marks]

Half-life = _____ billion years

0 2 . 5 When food is eaten, some of the radiation the food emits is detectable outside the body.

Which type of radiation would not be detectable outside the body?

Tick **one** box.

[1 mark]

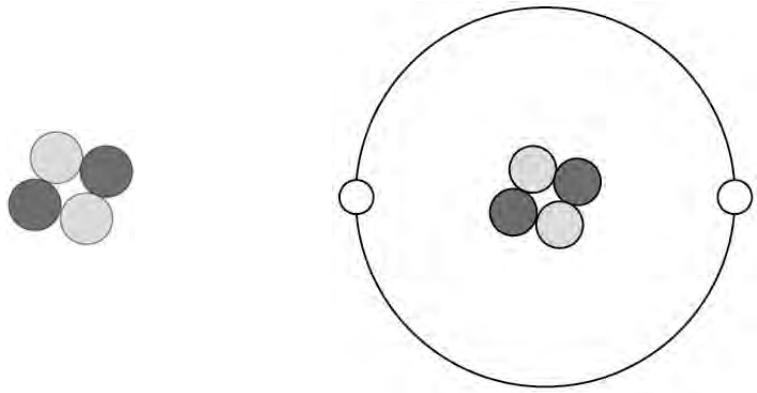
alpha ☐

beta ☐

gamma ☐

0 3 **Figure 4** is a diagram of an alpha particle and a helium atom.

Figure 4



Alpha particle Helium atom

0 3 . 1 What is the approximate size of a helium atom?

Tick **one** box.

[1 mark]

1×10^{-5} m ☐

1×10^{-10} m ☐

1×10^{-15} m ☐

1×10^{-20} m ☐

0 3 . 2 A helium atom is much larger than an alpha particle.

Give **one** other difference between a helium atom and an alpha particle.

[1 mark]

0 3 . 3 What is the atomic number of the helium atom in **Figure 4**?

Tick **one** box.

[1 mark]

2 ☐

4 ☐

6 ☐

8 ☐

0 3 . 4 What is the charge on the helium atom in **Figure 4**?

Explain your answer.

[3 marks]

0 3 . 5 Helium is a gas that occurs naturally.

There is very little helium on Earth.

Helium has important uses in medicine and is also used to inflate party balloons.

Some scientists believe that helium should **not** be used to inflate party balloons.

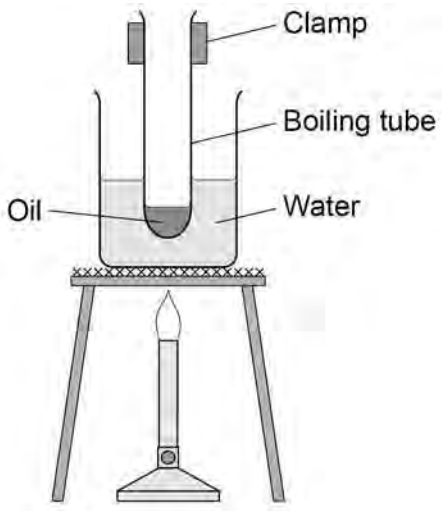
Why?

[2 marks]

0 4 A student investigated the change in temperature when oils of different specific heat capacities were heated.

She set up the apparatus shown in **Figure 5**.

Figure 5



This is the method used.

1. Put 25 g of oil into a boiling tube.
2. Pour 100 ml of water into a beaker and heat it with a Bunsen burner.
3. When the water is boiling, put the boiling tube into the beaker.
4. When the temperature of the oil reaches 30 °C, heat for a further 30 seconds and record the rise in temperature.
5. Repeat with different oils.
6. Repeat the whole investigation.

0 4 . 1 Name **two** pieces of apparatus the student used that are **not** shown in **Figure 5**.

[2 marks]

1 _____

2 _____

0 4 . 2 What are the independent and dependent variables in the student's investigation?

[2 marks]

Independent

Dependent

0 4 . 3 Give **two** safety precautions the student should have taken.

[2 marks]

1

2

0 4 . 4 Suggest **one** improvement to the student's method.

[2 marks]

Table 1 shows the student's results.

Table 1

	Temperature rise in °C			
Type of oil	**1**	**2**	**3**	**Mean**
Castor oil	20	19	21	20
Linseed oil	19	18	19	19
Mineral oil	21	21	21	21
Olive oil	17	17	18	
Sesame oil	23	23	20	22

0 4 . 5 Calculate the mean temperature rise for olive oil.

Give your answer to two significant figures.

[2 marks]

Mean temperature rise = _____ °C

0 4 . 6 The mean change in temperature of the castor oil is 20 °C

The specific heat capacity of castor oil is 1 800 J/kg °C

The mass of oil used is 0.025 kg

Calculate the change in thermal energy of the castor oil the student used.

Use the correct equation from the Physics Equations Sheet.

Select the correct unit from the box.

joule	**newton**	**volt**

[3 marks]

Change in thermal energy = _____

Unit _____

Turn over for the next question

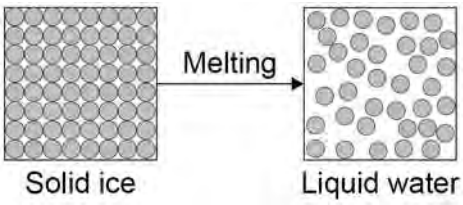
0 5 **Figure 6** shows solid ice on a car's rear window.

Figure 6

The glass window contains an electrical heating element.

0 5 . 1 Use the particle model in **Figure 7** to describe how the heating element causes the arrangement of the ice particles to change as the ice melts.

Figure 7



You should include a description of how the particles are arranged in the solid ice and in the water.

[6 marks]

0 5 . 2 A car manufacturer tests different heating elements by measuring how long it takes ice to melt.

During the test some variables must be controlled.

Identify **two** control variables in the car manufacturer's test.

[2 marks]

Tick **two** boxes.

- The colour of the car ☐
- The current in the heating element ☐
- The mass of ice ☐
- The size of the car ☐
- The time taken for the ice to melt ☐

Question 5 continues on the next page

Some of the energy supplied by the heater causes the ice to melt without the temperature of the ice increasing.

0 5 . 3 What is the name given to this energy supplied by the heater?

[1 mark]

Tick **one** box.

Latent heat of freezing ☐

Latent heat of fusion ☐

Latent heat of vaporisation ☐

0 5 . 4 When the heater is supplied with 120 J of energy each second, the internal energy of the ice increases by 45 J each second.

Use the following equation to calculate the efficiency of the heater.

$$\text{Efficiency} = \frac{\text{output energy transfer}}{\text{input energy transfer}}$$

Give your answer to two decimal places.

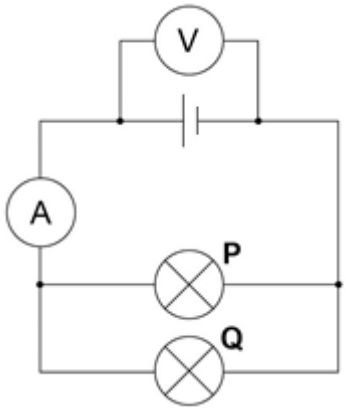
[2 marks]

Efficiency = _____

0 6 **Figure 8** shows a circuit diagram containing two identical lamps arranged in parallel.

The reading on the ammeter is 186 mA.

Figure 8



0 6 . 1 Which statement about the current through the lamps is true?

[1 mark]

Tick **one** box.

The current through both lamp **P** and lamp **Q** is **0.093 A** ☐

The current through both lamp **P** and lamp **Q** is **0.186 A** ☐

The current through both lamp **P** and lamp **Q** is **0.93 A** ☐

The current through both lamp **P** and lamp **Q** is **1.86 A** ☐

0 6 . 2 One of the lamps breaks and is not replaced.

Which statement about the current in the other lamp is true?

Tick **one** box.

[1 mark]

The current through the lamp is **0.093 A** ☐

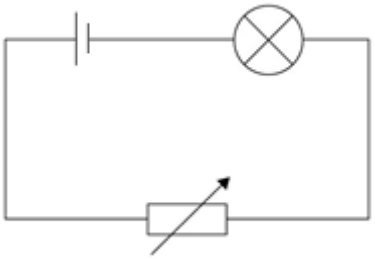
The current through the lamp is **0.186 A** ☐

The current through the lamp is **0.93 A** ☐

The current through the lamp is **1.86 A** ☐

Figure 9 shows a circuit that can be used to alter the brightness of a lamp.

Figure 9



0 6 . 3 The resistance of the variable resistor is increased.

What effect will this have on the brightness of the lamp?

Explain your answer.

[2 marks]

When the potential difference across the lamp is 3.3 V, the current is 0.15 A.

0 6 . 4 Write down the equation that links current, potential difference and resistance.

[1 mark]

Equation _____

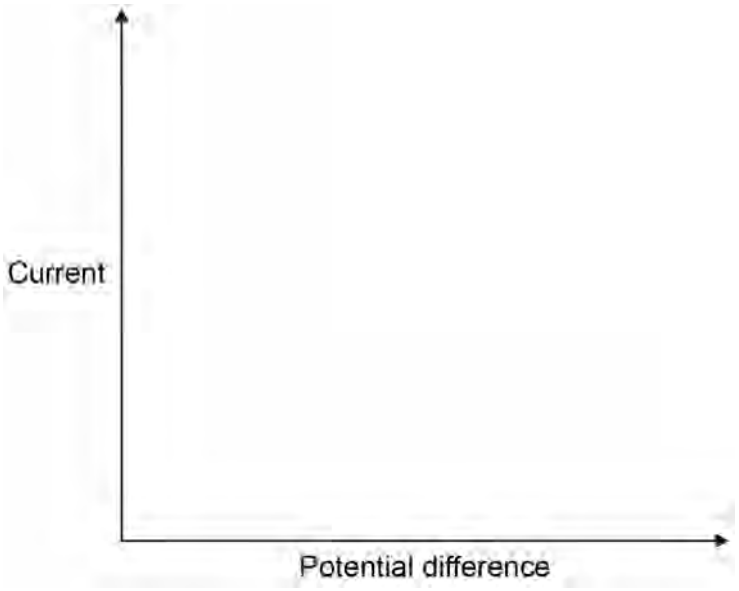
0 6 . 5 Calculate the resistance of the lamp.

[3 marks]

Resistance = _____ Ω

0 6 . 6 Sketch a current–potential difference graph for a filament lamp.

[1 mark]



Turn over for the next question

0 7 **Figure 10** shows a battery operated remote control car.

Figure 10

0 7 . 1 The car's battery contains a store of energy.

As the car moves, energy from one store is transferred to another store.

Describe how different stores of energy change as the car moves.

[2 marks]

The car has a top speed of 12 m/s and a mass of 800 g.

0 7 . 2 Write down the equation that links kinetic energy, mass and speed.

[1 mark]

Equation _____

0 7 . 3 Calculate the maximum kinetic energy of the car.

[2 marks]

Maximum kinetic energy = _____ J

0 7 . 4 Explain why having a more efficient motor increases the top speed of the car.

[2 marks]

Question 7 continues on the next page

Figure 11 shows an electric car being charged.

Figure 11

0 7 . 5 A driver wishes to buy a new car.

Table 2 gives some data about an electric car and one with a petrol engine.

Table 2

	Electric car	Petrol engine car
Cost (£)	27 000	15 000
Running cost per year (£)	250	2 000
Average lifetime (years)	12	12

Which car would be the most economic over its 12 year lifetime?

Use data from **Table 2** to support your answer.

You should include the difference in cost in your answer.

[4 marks]

END OF QUESTIONS

There are no questions printed on this page

There are no questions printed on this page

SPECIMEN MATERIAL

GCSE
COMBINED SCIENCE: TRILOGY

PAPER 6: PHYSICS 2H

Mark scheme

Specimen 2018

Version 1.0

Mark schemes are prepared by the Lead Assessment Writer and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all associates participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every associate understands and applies it in the same correct way. As preparation for standardisation each associate analyses a number of students' scripts. Alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Assessment Writer.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

Further copies of this mark scheme are available from aqa.org.uk

Information to Examiners

1. General

The mark scheme for each question shows:

- the marks available for each part of the question
- the total marks available for the question
- the typical answer or answers which are expected
- extra information to help the Examiner make his or her judgement and help to delineate what is acceptable or not worthy of credit or, in discursive answers, to give an overview of the area in which a mark or marks may be awarded
- the Assessment Objectives and specification content that each question is intended to cover.

The extra information is aligned to the appropriate answer in the left-hand part of the mark scheme and should only be applied to that item in the mark scheme.

At the beginning of a part of a question a reminder may be given, for example: where consequential marking needs to be considered in a calculation; or the answer may be on the diagram or at a different place on the script.

In general the right-hand side of the mark scheme is there to provide those extra details which confuse the main part of the mark scheme yet may be helpful in ensuring that marking is straightforward and consistent.

2. Emboldening and underlining

2.1 In a list of acceptable answers where more than one mark is available 'any **two** from' is used, with the number of marks emboldened. Each of the following bullet points is a potential mark.

2.2 A bold **and** is used to indicate that both parts of the answer are required to award the mark.

2.3 Alternative answers acceptable for a mark are indicated by the use of **or**. Different terms in the mark scheme are shown by a / ; eg allow smooth / free movement.

2.4 Any wording that is underlined is essential for the marking point to be awarded.

3. Marking points

3.1 Marking of lists

This applies to questions requiring a set number of responses, but for which students have provided extra responses. The general principle to be followed in such a situation is that 'right + wrong = wrong'.

Each error / contradiction negates each correct response. So, if the number of error / contradictions equals or exceeds the number of marks available for the question, no marks can be awarded.

However, responses considered to be neutral (indicated as * in example 1) are not penalised.

Example 1: What is the pH of an acidic solution? (1 mark)

Student	Response	Marks awarded
1	green, 5	0
2	red*, 5	1
3	red*, 8	0

Example 2: Name two planets in the solar system. (2 marks)

Student	Response	Marks awarded
1	Neptune, Mars, Moon	1
2	Neptune, Sun, Mars, Moon	0

3.2 Use of chemical symbols / formulae

If a student writes a chemical symbol / formula instead of a required chemical name, full credit can be given if the symbol / formula is correct and if, in the context of the question, such action is appropriate.

3.3 Marking procedure for calculations

Marks should be awarded for each stage of the calculation completed correctly, as students are instructed to show their working.

Full marks can however be given for a correct numerical answer, without any working shown.

3.4 Interpretation of 'it'

Answers using the word 'it' should be given credit only if it is clear that the 'it' refers to the correct subject.

3.5 Errors carried forward

Any error in the answers to a structured question should be penalised once only.

Papers should be constructed in such a way that the number of times errors can be carried forward is kept to a minimum. Allowances for errors carried forward are most likely to be restricted to calculation questions and should be shown by the abbreviation e.c.f. in the marking scheme.

3.6 Phonetic spelling

The phonetic spelling of correct scientific terminology should be credited **unless** there is a possible confusion with another technical term.

3.7 Brackets

(…..) are used to indicate information which is not essential for the mark to be awarded but is included to help the examiner identify the sense of the answer required.

3.8 Ignore / Insufficient / Do <u>not</u> allow

Ignore or insufficient are used when the information given is irrelevant to the question or not enough to gain the marking point. Any further correct amplification could gain the marking point.

Do **not** allow means that this is a wrong answer which, even if the correct answer is given as well, will still mean that the mark is not awarded.

Level of response marking instructions

Level of response mark schemes are broken down into levels, each of which has a descriptor. The descriptor for the level shows the average performance for the level. There are marks in each level.

Before you apply the mark scheme to a student's answer read through the answer and annotate it (as instructed) to show the qualities that are being looked for. You can then apply the mark scheme.

Step 1 Determine a level

Start at the lowest level of the mark scheme and use it as a ladder to see whether the answer meets the descriptor for that level. The descriptor for the level indicates the different qualities that might be seen in the student's answer for that level. If it meets the lowest level then go to the next one and decide if it meets this level, and so on, until you have a match between the level descriptor and the answer. With practice and familiarity you will find that for better answers you will be able to quickly skip through the lower levels of the mark scheme.

When assigning a level you should look at the overall quality of the answer and not look to pick holes in small and specific parts of the answer where the student has not performed quite as well as the rest. If the answer covers different aspects of different levels of the mark scheme you should use a best fit approach for defining the level and then use the variability of the response to help decide the mark within the level, ie if the response is predominantly level 3 with a small amount of level 4 material it would be placed in level 3 but be awarded a mark near the top of the level because of the level 4 content.

Step 2 Determine a mark

Once you have assigned a level you need to decide on the mark. The descriptors on how to allocate marks can help with this. The exemplar materials used during standardisation will help. There will be an answer in the standardising materials which will correspond with each level of the mark scheme. This answer will have been awarded a mark by the Lead Examiner. You can compare the student's answer with the example to determine if it is the same standard, better or worse than the example. You can then use this to allocate a mark for the answer based on the Lead Examiner's mark on the example.

You may well need to read back through the answer as you apply the mark scheme to clarify points and assure yourself that the level and the mark are appropriate.

Indicative content in the mark scheme is provided as a guide for examiners. It is not intended to be exhaustive and you must credit other valid points. Students do not have to cover all of the points mentioned in the Indicative content to reach the highest level of the mark scheme.

You should ignore any irrelevant points made. However, full marks can be awarded only if there are no incorrect statements that contradict a correct response.

An answer which contains nothing of relevance to the question must be awarded no marks.

Question 1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	the time it took from seeing the green light to pressing a key		1	AO1/1 6.5.4.3.2
01.2	he could have been distracted		1	AO3/3a 6.5.4.3.2
01.3	boys have a shorter reaction time than girls **or** reaction time improves with practice		1	AO3/2b 6.5.4.3.2 WS3.5
01.4	collect more data / larger sample size **or** take more repeat readings per person	must link to response in 1.3	1	AO3/3b 6.5.4.3.2 WS3.7
01.5	reaction time will have less effect (as distance increases) because it is a smaller proportion of the total race time		1 1	AO2/1 6.5.4.3.2

01.6	**Level 3:** A coherent description of the race, which uses data from the graph, including discussion of the meanings of the changing gradient of both of the lines.	5–6	6	AO3/1a 6.5.4.3.2 6.5.4.1.4 WS3.5
	Level 2: Multiple pieces of data taken from the graphs used to evidence a comparison between the runners. Likely to include discussion of the meaning of the (changing) gradient of one of the lines. Answer not coherently structured.	3–4		
	Level 1: Some data taken from the graph, but may be limited to one aspect or simple readings. Lack of coherence in answer.	1–2		
	No relevant content.	0		
	Indicative content • A starts at constant speed *for 440 m / 60 s* • A then slows down *from 60 s* • the gradient for B is lower at the start so B starts at a slower speed • the gradient for B increases so B accelerates • B overtook A *at 700 m /114 s* • B has a greater top speed because the maximum gradient is greater • B won the race *in 126 s* / beat A *by 34 s*			

01.7	tangent drawn at 60s data obtained using correct information 5.5(m/s)	 accept answer in range 5.3 to 5.7	1 1 1	AO2/2 6.5.4.1.4 WS 3.2, 3.3

Total			**15**

Question 2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	any **four** from: • light waves are transverse whereas sound waves are longitudinal • light waves travel faster than sound waves • light waves have a higher frequency than sound waves • light waves have a shorter wavelength than sound waves • light waves have oscillations perpendicular (to the direction of energy transfer) whereas sound waves are parallel (to the direction of energy transfer)		4	AO1/1 6.6.1.1 6.6.1.2 6.6.2.1 WS 1.4
02.2	the baby can be seen in the dark		1	AO2/1 6.6.2.4 WS1.4
02.3	wave speed = frequency × wavelength	accept $v = f \lambda$	1	AO1/1 6.6.1.2
02.4	$3 \times 10^8 = f \times 0.125$ $f = 3 \times 10^8 / 0.125$ $f = 2.4 \times 10^9$ (Hz)	allow 2.4×10^9 with no working for **3** marks	1 1 1	AO2/1 6.6.1.2 WS3.3
Total			**9**	

Question 3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	mass		1	AO1/1
	velocity		1	6.5.5.1
				WS4.1
03.2	kg m/s		1	AO1/1
				6.5.5.1
				WS4.3
03.3	momentum before = momentum after		1	AO1/1
				6.5.5.2
	and before diving in the momentum of the diver and (small) boat is zero		1	WS1.2
	after diving the diver has forwards momentum/ momentum to the right		1	
	therefore the (small) boat has equal backwards momentum/ equal momentum to the left		1	
03.4	the boat moves back more slowly		1	AO2/1
	because there is more mass (but momentum stays the same)		1	AO1/1
				6.5.5.1
03.5	as she swims there is a drag force		1	AO2/1
	as speed increases so does the drag force		1	AO2/1
	she accelerates less		1	AO2/1
	drag force = thrust force	accept resultant force = 0	1	AO1/1
	the swimmer reaches terminal velocity		1	AO1/1
				6.5.4.2.1
Total			**14**	

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	force = spring constant x extension	accept f = ke	1	AO1/1 6.5.3
04.2	extension is directly proportional to the force applied because it is straight line through the origin		1 1	AO3/2a AO1/2 6.5.3
04.3	test a greater range of load **or** test more springs		1	AO3/3b 6.5.3 WS2.5
04.4	work done is equal to elastic potential energy as long as the spring does not go past the limit of proportionality		1 1	AO1/2 6.5.3
04.5	line extending with a greater gradient than existing line a stiffer spring has a greater spring constant (*k*) *k* = F / e		1 1 1	AO3/2a AO3/2b AO3/2b 6.5.3
04.6	the spring will be deformed because it has passed the elastic limit	accept not gone back to original shape	1 1	AO1/2 6.5.3
Total			**11**	

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	arrow of equal size pointing vertically downwards	judged by eye	1	AO2/1
	labelled 'weight'		1	AO1/1 6.5.1.1/2/3
05.2	the upwards force is greater than the downwards force		1	AO2/1
	because air resistance increases		1	6.5.4.2.2
05.3	$v^2 = (2 \times 2 \times 209) + 8^2$		1	AO2/1 6.5.4.1.5
	$v = \sqrt{900}$		1	WS3.3
	v = 30 (m/s)	allow 30 (m/s) without working shown for **3** calculation marks	1	
05.4	vertical force (300 N) drawn with a suitable scale		1	AO2/1
	horizontal force (60 N) drawn to the same scale		1	6.5.1.4
	resultant force drawn in correct direction		1	
	value of resultant in the range 304 N – 308 N		1	
Total			**11**	

Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	thumb, index finger and third finger are held mutually at right angles		1	AO1/2
	index finger shows the direction of the magnetic field from North to South, third finger shows the direction of the current from positive to negative terminal		1	6.7.2.2
	the thumb then shows the direction of the force acting on the copper rod		1	
	so the copper rod will move from left to right		1	
06.2	any **one** from: use a stronger magnet increase the magnetic flux density increase the length of the copper rod in the magnetic field coil the copper rod		1	AO2/2 6.7.2.2
06.3	$W = 9.8 \times 4 \times 10^{-4} = 3.92 \times 10^{-3}$		1	AO2/2
	conversion of the length 7cm to 0.07m		1	6.5.1.3 6.7.2.2
	$3.92 \times 10^{-3} = B \times 1.12 \times 0.07$		1	WS4.5
	$B = 3.92 \times 10^{-3} / 0.0784$		1	
	B = 0.05 (T)	allow 0.05 (T) without working shown for the **5** calculation marks	1	
Total			**10**	

SPECIMEN MATERIAL

GCSE
COMBINED SCIENCE: TRILOGY

PAPER 5: PHYSICS 1H

Mark scheme

Specimen 2018

Version 1.0

Mark schemes are prepared by the Lead Assessment Writer and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all associates participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every associate understands and applies it in the same correct way. As preparation for standardisation each associate analyses a number of students' scripts. Alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Assessment Writer.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

Further copies of this mark scheme are available from aqa.org.uk

Information to Examiners

1. General

The mark scheme for each question shows:

- the marks available for each part of the question
- the total marks available for the question
- the typical answer or answers which are expected
- extra information to help the Examiner make his or her judgement and help to delineate what is acceptable or not worthy of credit or, in discursive answers, to give an overview of the area in which a mark or marks may be awarded
- the Assessment Objectives and specification content that each question is intended to cover.

The extra information is aligned to the appropriate answer in the left-hand part of the mark scheme and should only be applied to that item in the mark scheme.

At the beginning of a part of a question a reminder may be given, for example: where consequential marking needs to be considered in a calculation; or the answer may be on the diagram or at a different place on the script.

In general the right-hand side of the mark scheme is there to provide those extra details which confuse the main part of the mark scheme yet may be helpful in ensuring that marking is straightforward and consistent.

2. Emboldening and underlining

2.1 In a list of acceptable answers where more than one mark is available 'any **two** from' is used, with the number of marks emboldened. Each of the following bullet points is a potential mark.

2.2 A bold **and** is used to indicate that both parts of the answer are required to award the mark.

2.3 Alternative answers acceptable for a mark are indicated by the use of **or**. Different terms in the mark scheme are shown by a / ; eg allow smooth / free movement.

2.4 Any wording that is underlined is essential for the marking point to be awarded.

3. Marking points

3.1 Marking of lists

This applies to questions requiring a set number of responses, but for which students have provided extra responses. The general principle to be followed in such a situation is that 'right + wrong = wrong'.

Each error / contradiction negates each correct response. So, if the number of error / contradictions equals or exceeds the number of marks available for the question, no marks can be awarded.

However, responses considered to be neutral (indicated as * in example 1) are not penalised.

Example 1: What is the pH of an acidic solution? (1 mark)

Student	Response	Marks awarded
1	green, 5	0
2	red*, 5	1
3	red*, 8	0

Example 2: Name two planets in the solar system. (2 marks)

Student	Response	Marks awarded
1	Neptune, Mars, Moon	1
2	Neptune, Sun, Mars, Moon	0

3.2 Use of chemical symbols / formulae

If a student writes a chemical symbol / formula instead of a required chemical name, full credit can be given if the symbol / formula is correct and if, in the context of the question, such action is appropriate.

3.3 Marking procedure for calculations

Marks should be awarded for each stage of the calculation completed correctly, as students are instructed to show their working.

Full marks can however be given for a correct numerical answer, without any working shown.

3.4 Interpretation of 'it'

Answers using the word 'it' should be given credit only if it is clear that the 'it' refers to the correct subject.

3.5 Errors carried forward

Any error in the answers to a structured question should be penalised once only.

Papers should be constructed in such a way that the number of times errors can be carried forward is kept to a minimum. Allowances for errors carried forward are most likely to be restricted to calculation questions and should be shown by the abbreviation e.c.f. in the marking scheme.

3.6 Phonetic spelling

The phonetic spelling of correct scientific terminology should be credited **unless** there is a possible confusion with another technical term.

3.7 Brackets

(…..) are used to indicate information which is not essential for the mark to be awarded but is included to help the examiner identify the sense of the answer required.

3.8 Ignore / Insufficient / Do <u>not</u> allow

Ignore or insufficient are used when the information given is irrelevant to the question or not enough to gain the marking point. Any further correct amplification could gain the marking point.

Do **not** allow means that this is a wrong answer which, even if the correct answer is given as well, will still mean that the mark is not awarded.

Level of response marking instructions

Level of response mark schemes are broken down into levels, each of which has a descriptor. The descriptor for the level shows the average performance for the level. There are marks in each level.

Before you apply the mark scheme to a student's answer read through the answer and annotate it (as instructed) to show the qualities that are being looked for. You can then apply the mark scheme.

Step 1 Determine a level

Start at the lowest level of the mark scheme and use it as a ladder to see whether the answer meets the descriptor for that level. The descriptor for the level indicates the different qualities that might be seen in the student's answer for that level. If it meets the lowest level then go to the next one and decide if it meets this level, and so on, until you have a match between the level descriptor and the answer. With practice and familiarity you will find that for better answers you will be able to quickly skip through the lower levels of the mark scheme.

When assigning a level you should look at the overall quality of the answer and not look to pick holes in small and specific parts of the answer where the student has not performed quite as well as the rest. If the answer covers different aspects of different levels of the mark scheme you should use a best fit approach for defining the level and then use the variability of the response to help decide the mark within the level, ie if the response is predominantly level 3 with a small amount of level 4 material it would be placed in level 3 but be awarded a mark near the top of the level because of the level 4 content.

Step 2 Determine a mark

Once you have assigned a level you need to decide on the mark. The descriptors on how to allocate marks can help with this. The exemplar materials used during standardisation will help. There will be an answer in the standardising materials which will correspond with each level of the mark scheme. This answer will have been awarded a mark by the Lead Examiner. You can compare the student's answer with the example to determine if it is the same standard, better or worse than the example. You can then use this to allocate a mark for the answer based on the Lead Examiner's mark on the example.

You may well need to read back through the answer as you apply the mark scheme to clarify points and assure yourself that the level and the mark are appropriate.

Indicative content in the mark scheme is provided as a guide for examiners. It is not intended to be exhaustive and you must credit other valid points. Students do not have to cover all of the points mentioned in the Indicative content to reach the highest level of the mark scheme.

You should ignore any irrelevant points made. However, full marks can be awarded only if there are no incorrect statements that contradict a correct response.

An answer which contains nothing of relevance to the question must be awarded no marks.

Question 1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	0.093 A		1	AO2/1 6.2.2
01.2	0.093 A		1	AO2/1 6.2.2
01.3	(increasing the resistance) decreases the current therefore (the lamp will be) dimmer		1 1	AO1/1 6.2.1.3
01.4	potential difference = current × resistance	accept correct rearrangement with R as subject	1	AO1/1 6.2.1.3
01.5	3.3 = 0.15 x R R = 3.3 / 0.15 (Ω) R = 22 (Ω)	 allow 22 (Ω) without working shown for **3** marks	1 1 1	AO2/1 6.2.1.3
01.6	line drawn from the origin with a decreasing gradient.		1	AO1/1 6.2.1.4
Total			**9**	

Question 2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	the store of chemical energy (in the battery) decreases		1	AO1/1 6.1.2.1
	the internal energy of the surrounding air increases.	accept description of energy becoming less usefully stored for **2** marks	1	
02.2	kinetic energy = ½ mass x velocity^2		1	AO1/1 6.1.1.2
02.3	$E_K = ½ \times 0.8 \times 12^2$		1	AO2/1 6.1.1.3
	$E_K = 57.6$ (J)	allow 57.6 (J) without working shown for **2** marks	1	
02.4	lower proportion of wasted energy	accept less energy is wasted	1	AO2/1 6.1.2.1
	higher proportion of energy is converted into <u>kinetic</u> energy	accept more kinetic energy	1	

Question	Answers	Mark	AO / Spec. Ref.
2.5	**Level 2:** A relevant and coherent argument which demonstrates processing and numerical analysis of the information presented and draw a conclusion which is logically consistent with the reasoning and refers to payback time for the vehicles.	3–4	AO3/2b 6.1.3
	Level 1: Simple comparisons are made which demonstrate a basic ability to numerically analyse the information presented. The conclusion, if present, may not be consistent with the calculations.	1–2	
	No relevant content	0	
	Indicative content • The electric car costs £12 000 more to buy • Running cost of electric car = £3 000 • Running cost of petrol engine car = £24 000 • Total cost of electric car = £30 000 • Total cost of petrol engine car = £39 000 • The electric car cost £1 750 less to run each year • The electric car will save £9 000 • Additional cost is covered in 6.9 years • So the electric car will be cheaper over the 12 year lifetime **or** Electric 27000 / 12 = 2250 Annual cost = 2250 + 250 = 2500 Petrol 15000 / 12 = 1250 Annual cost = 1250 + 2000 = 3250 So electric is £750 cheaper per year		
Total		**11**	

Question 3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	electromagnetic radiation from the nucleus	'electromagnetic radiation' is insufficient	1	AO1/1 6.4.2.1
03.2	(Gamma is the most penetrating) so a large proportion of the emitted radiation will leave the body more easily detected outside the body		1 1	AO1/1 6.4.2.1
03.3	(average) time it takes for the number of nuclei of the isotope in a sample to halve **or** (average) time it takes for the count rate from a sample containing the isotope to fall to half its initial level		1	AO1/1 6.4.2.3
03.4	initially there is a high level of hazard. level of hazard drops to a low level quickly (activity initially high) due to short half-life **or** (drops to safe level quickly) due to short half-life	answer must imply short period of time	1 1 1	AO1/1 AO1/1 AO2/1 6.4.2.4
3.5	it is exposed to ionising radiation		1	AO1/1 6.4.2.4
3.6	does not become radioactive		1	AO1/1 6.4.2.4
Total			**9**	

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	10 000		1	AO1/1 6.4.1.1
04.2	**Increase** absorb electromagnetic radiation **Decrease** emit electromagnetic radiation		1 1	AO1/1 6.4.1.1
04.3	atomic number is the number of protons mass number is the number of protons and neutrons		1 1	AO1/1 6.4.1.2
04.4	**Level 2:** A clear comparison, with logical structure. 3–4 **Level 1:** Fragmented points, with no logical structure. 1–2 No relevant content 0 **Indicative content** **<u>Beta decay</u>** • Atomic number increases by one • When a neutron decays into a proton **<u>Alpha decay</u>** • Atomic number decreases by two • When an alpha particle is emitted **<u>Comparison</u>** Both change number of protons (hence new element/transmutation) Beta decay increases atomic number and alpha decay decreases (explicit) NB No credit is given for different number of protons = new element.		4	AO1/1 6.4.1.1 6.4.2.2
Total			**9**	

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	water boils at the same temperature each time control starting temp by allowing enough time for water and kettle to reach room temperature		1 1	AO3/3a 6.1.1.5 WS2.2
05.2	uncertainty = (302 – 298)/2 uncertainty = ± 2 (s)	ignore missing ±	1 1	AO2/2 6.1.1.5 WS3.4
05.3	(Energy transferred = Power × time) E = 2.20 × 300 E = 660 (kJ)	allow 660 (kJ) without working shown for **2** marks allow answer calculated using incorrect value for t (298 or 302) for **1** mark	 1 1	 AO2/1 AO2/1 6.1.1.5
05.4	(mass × change in temperature) / mass 80 (°C)	allow **1** mark for any correct pair of values from the table eg 20 / 0.25 allow 80 (°C) without working shown for **2** marks	1 1	AO2/2 6.1.1.4
05.5	four points plotted correctly accurate line drawn	allow **1** mark for three correctly plotted points ecf their 5.3 allow ± 1mm line should be straight and drawn with a ruler line must not go through the origin	2 1	AO2/2 6.1.1.4 WS3.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.6	values read correctly from graph correct conversion into J correct use of $\Delta y/\Delta x$ value in range 4200 – 4800	 allow value in range 4200 – 4800 without working shown for **4** marks	1 1 1 1	AO2/2 6.1.1.4 WS3.1
05.7	some of the energy supplied does not raise the temperature of the water	some of the energy is wasted is insufficient	1	AO3/3b 6.1.1.4 WS3.5
05.8	(the power of the kettle may not be 2.2kW) (by measuring the power) the student can accurately calculate the amount of energy supplied to each mass of water		 1	AO3/3a 6.1.1.4
Total			**17**	

Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	random	accept in all directions description must be of random motion	1	AO1/1 6.3.3.1
06.2	heating increases the temperature of the gas temperature is proportional to kinetic energy if kinetic energy increases speed increases		1 1 1	AO1/1 6.3.3.1
06.3	energy is needed to change the state of the water to break the bonds		1 1	AO1/1 6.3.2.2
06.4	$1000 = m / 2.5 \times 10^{-5}$ $m = 2.5 \times 10^{-5} \times 1000$ m = 0.025 (kg) E = 0.025 × 2 260 000 E = 56 500 (J)	allow 56 500 (J) without working shown for **5** marks **0** marks awarded for E = m × L	1 1 1 1 1	AO2/1 6.3.2.3 6.2.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.5	any **four** from: • because the water is preheated) the change in temperature of the water is less • so less energy is used to heat the water ($E=mc\Delta\theta$) • therefore they (condensing boilers) are more efficient • so less energy is wasted • less gas is burned to heat the same amount of water • less waste gas (CO_2) is produced by the boiler **or** (because less gas is used) they are cheaper to run/save money		4	AO3/1b 6.1.2.2 6.1.1.3
Total			**15**	

AQA

GCSE
COMBINED SCIENCE: TRILOGY

F

Foundation Tier Paper 6: Physics 2F

Specimen 2018 Time allowed: 1 hour 15 minutes

Materials
For this paper you must have:
- a ruler
- a calculator
- the Physics Equation Sheet (enclosed).

Instructions
- Answer all questions in the spaces provided.
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information
- There are 70 marks available on this paper.
- The marks for questions are shown in brackets.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.
- When answering questions 02.3 and 06.6 you need make to sure that your answer:
  - is clear, logical, sensibly structured
  - fully meets the requirements of the question
  - shows that each separate point or step supports the overall answer.

Advice
- In all calculations, show clearly how you work out your answer.

Please write clearly, in block capitals, to allow character computer recognition.

Centre number ☐☐☐☐☐ Candidate number ☐☐☐☐

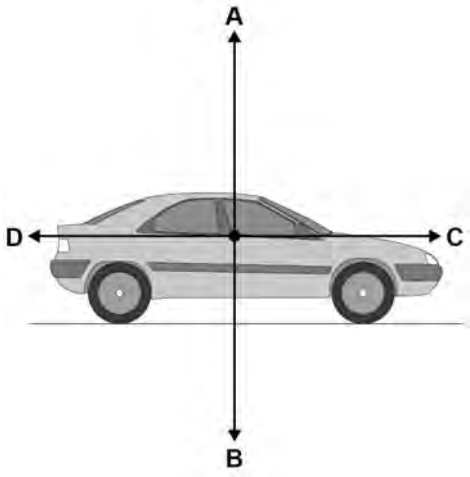
Surname

Forename(s)

Candidate signature _____

0 1 **Figure 1** shows the forces acting on a car moving at a constant speed.

Figure 1



0 1 . 1 Which force would have to increase to make the car accelerate?

[1 mark]

Tick **one** box.

A ☐

B ☐

C ☐

D ☐

0 1 . 2 The car travels a distance of 2040 metres in 2 minutes.

Use the following equation to calculate the mean speed of the car.

$$\textbf{mean speed} = \frac{\textbf{distance}}{\textbf{time}}$$

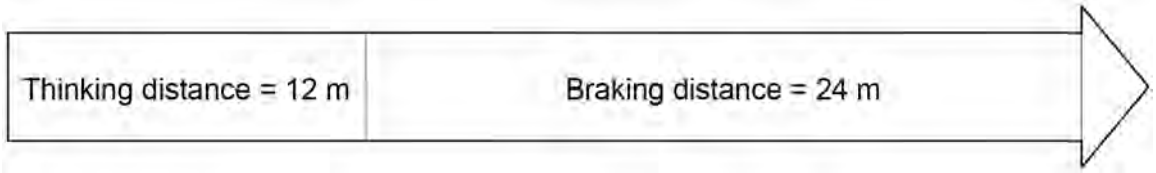
[2 marks]

Mean speed = _____ m/s

0 1 . 3 The car makes an emergency stop.

Figure 2 shows the thinking distance and braking distance of the car.

Figure 2



What is the stopping distance?

[1 mark]

0 1 . 4 The person driving the car is tired.

What effect will this have on the thinking distance and braking distance?

Tick **one** box for thinking distance.

Tick **one** box for braking distance.

[2 marks]

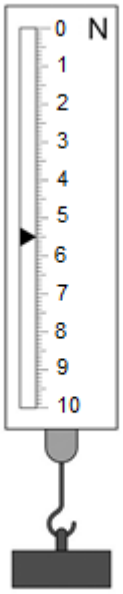
	decreases	increases	stays the same
thinking distance	☐	☐	☐
braking distance	☐	☐	☐

Turn over for the next question

0 2 A newtonmeter measures the weight of objects.

Look at **Figure 3**.

Figure 3



0 2 . 1 What is the weight of the object in **Figure 3**?

[1 mark]

Weight = _____ N

0 2 . 2 The spring inside the newtonmeter behaves elastically.

What happens to the length of the spring when the object is removed from the newtonmeter?

[1 mark]

Tick **one** box.

The spring gets longer ☐

The spring gets shorter ☐

The spring stays the same length ☐

0 2 . 3 A student carried out a practical to investigate the extension of a spring.

Write a method the student could have used.

[4 marks]

0 2 . 4 What could be done to improve the accuracy in this investigation?

[2 marks]

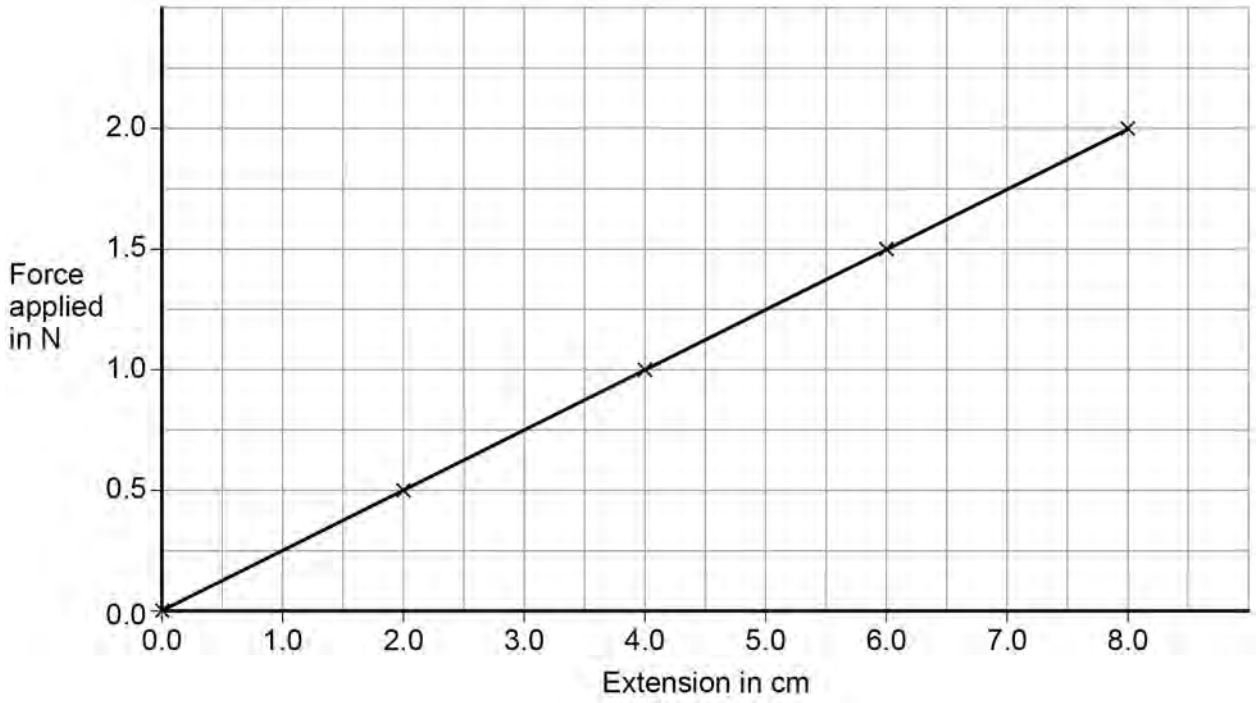
Tick **two** boxes.

- Use a pointer from the spring to measure the length. ☐
- Use a stronger spring in the practical. ☐
- Use a new spring between each reading. ☐
- Make sure the spring is stationary before measuring length. ☐
- Use a longer rule when measuring length. ☐

The student added weights to a spring and measured the extension of the spring.

Figure 4 shows his results.

Figure 4



0 2 . 5 What is the relationship between force applied and extension?

[1 mark]

Tick **one** box.

Extension is inversely proportional to force ☐

Extension increases by smaller values as force increases ☐

Extension is directly proportional to force ☐

0 2 . 6 Use **Figure 4** to determine the additional force needed to increase the extension in the spring from 5.0 cm to 7.0 cm.

[1 mark]

Force needed = _____ N

0 2 . 7 **Table 1** shows some results with a different spring.

Table 1

Force applied in N	Extension in m
0.0	0.000
0.5	0.025
1.0	0.050
1.5	0.075

What would the extension be with a force of 2.0 N?

[1 mark]

Tick **one** box.

0.080 m ☐

0.090 m ☐

0.095 m ☐

0.100 m ☐

0 2 . 8 The spring constant for the spring in **Table 1** is 20 N/m.

Calculate the work done in stretching the spring until the extension of the spring is 0.050m

Use the correct equation from the Physics Equation Sheet.

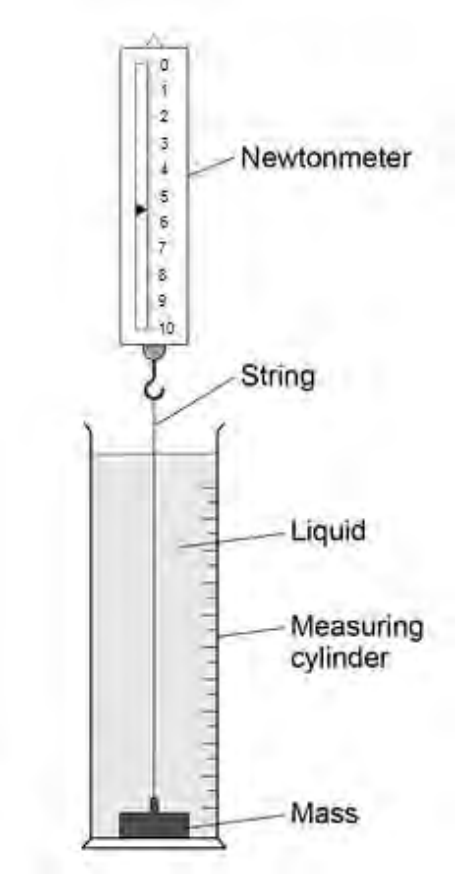
[2 marks]

Work done = _____ J

0 3 A student investigated the force needed to raise a mass through different liquids at a constant speed.

She set up the apparatus shown in **Figure 5**.

Figure 5



0 3 . 1 In the investigation there are several variables.

Draw **one** line from each variable to the correct description for this investigation.

[3 marks]

Variable	Description
Control	Distance the mass was lifted
Dependent	Value of force on the newtonmeter
Independent	Mass
	Type of liquid

Table 2 shows the student's results.

Table 2

Liquid	Force in N
Water	10.0
Washing up liquid	11.1
Glycerol	11.5
Syrup	13.8

0 3 . 2 What was the resolution of the newtonmeter?

Tick **one** box.

[1 mark]

- 0.1 N ☐
- 0.5 N ☐
- 1 N ☐
- 10 N ☐

Question 3 continues on the next page

0 3 . 3 The student wanted to display her results.

How should she display her results?

[1 mark]

Tick **one** box.

A bar chart ☐

A line graph ☐

A pie chart ☐

0 3 . 4 Give a reason for your answer to part **03.3**.

[1 mark]

0 3 . 5 A force of 13.8 N was used to lift the mass 30 cm vertically through the liquid.

Use the following equation to calculate the work done in lifting the mass.

$$\text{Work done} = \text{force} \times \text{distance}$$

Choose the correct unit from the box.

[3 marks]

J	m/s	N

Work done = _____

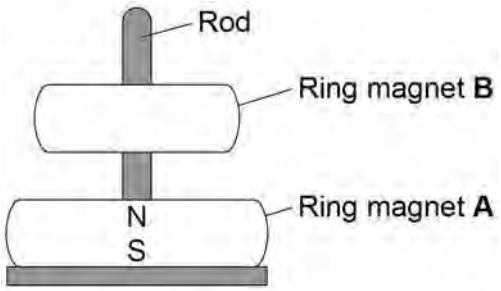
Unit = _____

0 4 A magnetic toy uses ring-shaped magnets.

Look at **Figure 6**.

The magnets can move up and down the rod. Ring magnet **B** appears to float.

Figure 6



0 4 . 1 The magnetic poles are labelled on ring magnet **A**.

Label the magnetic poles on ring magnet **B**.

[1 mark]

0 4 . 2 What would happen if ring magnet **B** was turned upside down?

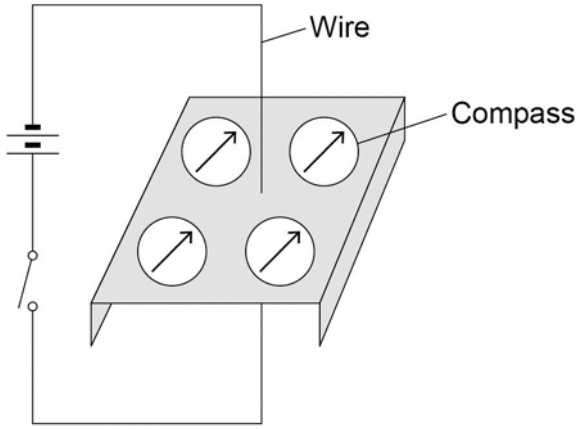
[1 mark]

Question 4 continues on the next page

Figure 7 shows four plotting compasses arranged around a wire.

The needle of a compass is a magnet.

Figure 7



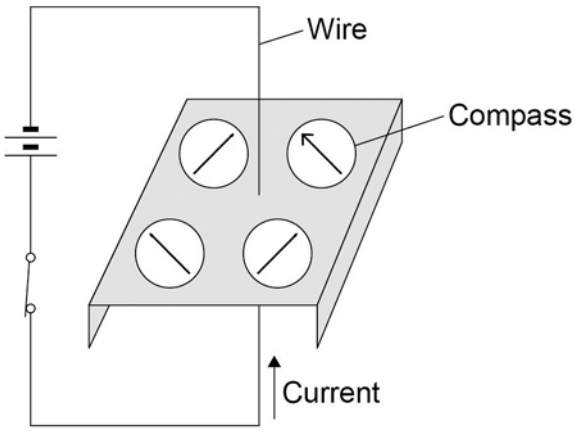
0 4 . 3 In **Figure 7** the switch is open and there is no current in the wire.

Explain why the compass needles all point in the same direction.

[2 marks]

Figure 8 shows the switch closed.

Figure 8



0 4 . 4 There is now a current in the wire.

The compass needles change direction.

On **Figure 8** draw arrowheads on the three incomplete compass needles to show their direction.

[1 mark]

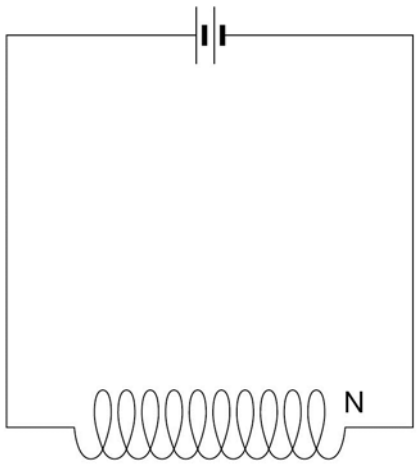
0 4 . 5 What would happen to the direction of the compass needles if the current was reversed?

[1 mark]

Question 4 continues on the next page

Figure 9 shows a coil of wire in a circuit.

Figure 9



0 4 . 6 On **Figure 9** draw the magnetic field due to the current in the coil.

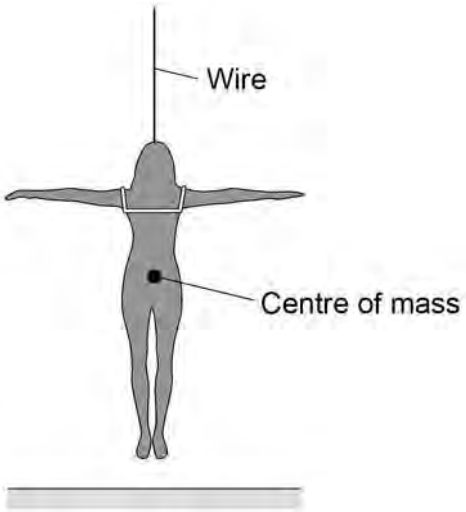
[3 marks]

Turn over for the next question

0 5 An actor is attached to a wire so that she can hang above the stage.

Look at **Figure 10.**

Figure 10



0 5 . 1 On **Figure 10** draw **two** arrows to show the forces acting on the actor.

[2 marks]

0 5 . 2 Which **two** forces are acting on the actor?

[2 marks]

Tick **two** boxes.

- Air resistance force ☐
- Electrostatic force ☐
- Gravitational force ☐
- Magnetic force ☐
- Tension force ☐

0 5 . 3 The actor hangs above the stage in a stationary position.

What is the resultant force on the actor?

[1 mark]

Resultant force = _____ N

0 5 . 4 The actor has a mass of 70 kg.

Gravitational field strength = 9.8 N/kg

Use the following equation to calculate the weight of the actor.

Weight = mass × gravitational field strength

Give your answer to 2 significant figures.

[2 marks]

Weight of actor = _____ N

0 5 . 5 A motor pulls vertically upwards on the wire with a force of 720 N.

Calculate the resultant force on the actor.

[1 mark]

Resultant force = _____ N

Question 5 continues on the next page

Another actor has a mass of 65 kg.

This actor is attached to the wire and the motor pulls her vertically upwards.

The resultant force on the actor is 25 N.

0 5 . 6 Write down the equation that links acceleration, mass and resultant force.

[1 mark]

Equation _____

0 5 . 7 Calculate the acceleration of the actor.

[3 marks]

_____

_____

_____

Acceleration of actor = _____ m/s^2

Turn over for the next question

0 6 Four students tested their reaction times using a computer program.

When a green light appeared on the screen the students had to press a key.

Table 3 shows their results.

Table 3

Student	Reaction time in s			Mean reaction time in s
	Test 1	Test 2	Test 3	
Boy 1	0.28	0.27	0.26	0.27
Boy 2	0.28	0.47	0.22	0.25
Girl 1	0.31	0.29	0.27	0.29
Girl 2	0.32	0.30	0.29	0.30

0 6 . 1 What is meant by 'reaction time' in this experiment?

[1 mark]

0 6 . 2 Boy 2 had an anomalous result in **Test 2**.

Suggest a reason why.

[1 mark]

0 6 . 3 Give **one** conclusion that can be made from the results in **Table 3**.

[1 mark]

0 6 . 4 Suggest further evidence that you could collect to support your conclusion.

[1 mark]

Reaction time is important at the start of a race.

Table 4 shows the time taken by a boy to run different distances.

Table 4

Distance in m	Time in s
100	12.74
200	25.63
800	139.46

0 6 . 5 Reaction time is more important in a 100 m race than in an 800 m race.

Explain why.

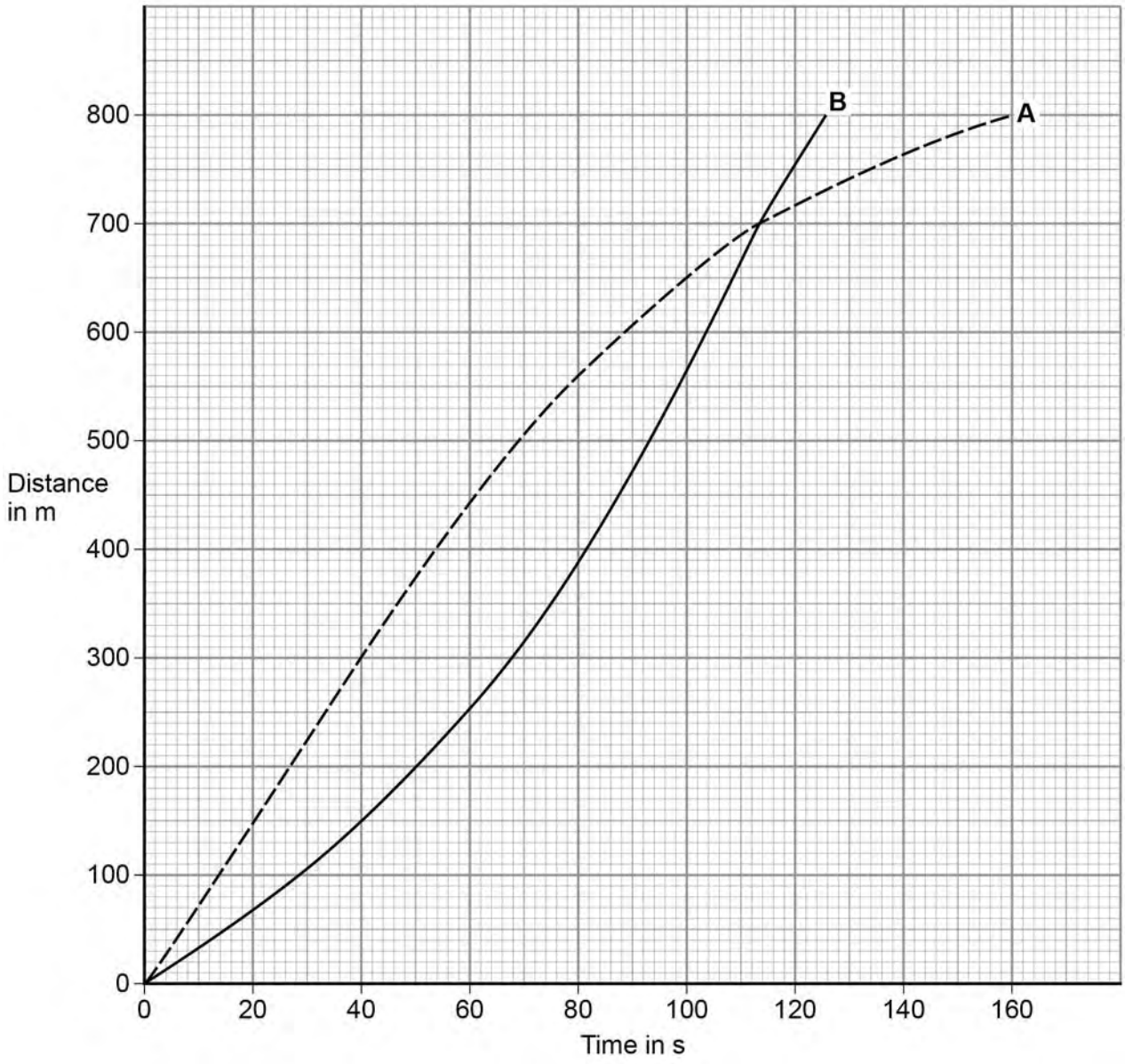
[2 marks]

Question 6 continues on the next page

Two girls, **A** and **B**, ran an 800 m race.

Figure 11 shows how the distance changed with time.

Figure 11



0 6 . 6 Compare the motion of runners **A** and **B**.

Include data from **Figure 11**.

[6 marks]

Turn over for the next question

0 7 A baby monitor has a sensor unit that transmits an image of the baby and the noises the baby makes to a monitor unit.

The monitor unit then displays an image of the baby and emits the noises the baby makes.

0 7 . 1 Compare the properties of the waves that transmit images and noises from the monitor unit.

[4 marks]

0 7 . 2 The sensor unit can detect infrared and visible light.

Suggest **one** advantage of being able to detect infrared.

[1 mark]

0 7 . 3 Write down the equation that links frequency, wave speed and wavelength.

[1 mark]

Equation

0 7 . 4 The signals for the monitor unit are transmitted as electromagnetic waves with a wavelength of 0.125 m.

Wave speed of electromagnetic waves = 3×10^8 m/s

Calculate the frequency of the signal.

[3 marks]

Frequency = Hz

END OF QUESTIONS

There are no questions printed on this page

GCSE
COMBINED SCIENCE: TRILOGY

PAPER 6: PHYSICS 2F

Mark scheme

Specimen 2018

Version 1.0

Mark schemes are prepared by the Lead Assessment Writer and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all associates participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every associate understands and applies it in the same correct way. As preparation for standardisation each associate analyses a number of students' scripts. Alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Assessment Writer.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

Further copies of this mark scheme are available from aqa.org.uk

Information to Examiners

1. General

The mark scheme for each question shows:

- the marks available for each part of the question
- the total marks available for the question
- the typical answer or answers which are expected
- extra information to help the Examiner make his or her judgement and help to delineate what is acceptable or not worthy of credit or, in discursive answers, to give an overview of the area in which a mark or marks may be awarded
- the Assessment Objectives and specification content that each question is intended to cover.

The extra information is aligned to the appropriate answer in the left-hand part of the mark scheme and should only be applied to that item in the mark scheme.

At the beginning of a part of a question a reminder may be given, for example: where consequential marking needs to be considered in a calculation; or the answer may be on the diagram or at a different place on the script.

In general the right-hand side of the mark scheme is there to provide those extra details which confuse the main part of the mark scheme yet may be helpful in ensuring that marking is straightforward and consistent.

2. Emboldening and underlining

2.1 In a list of acceptable answers where more than one mark is available 'any **two** from' is used, with the number of marks emboldened. Each of the following bullet points is a potential mark.

2.2 A bold **and** is used to indicate that both parts of the answer are required to award the mark.

2.3 Alternative answers acceptable for a mark are indicated by the use of **or**. Different terms in the mark scheme are shown by a / ; eg allow smooth / free movement.

2.4 Any wording that is underlined is essential for the marking point to be awarded.

3. Marking points

3.1 Marking of lists

This applies to questions requiring a set number of responses, but for which students have provided extra responses. The general principle to be followed in such a situation is that 'right + wrong = wrong'.

Each error / contradiction negates each correct response. So, if the number of error / contradictions equals or exceeds the number of marks available for the question, no marks can be awarded.

However, responses considered to be neutral (indicated as * in example 1) are not penalised.

Example 1: What is the pH of an acidic solution? (1 mark)

Student	Response	Marks awarded
1	green, 5	0
2	red*, 5	1
3	red*, 8	0

Example 2: Name two planets in the solar system. (2 marks)

Student	Response	Marks awarded
1	Neptune, Mars, Moon	1
2	Neptune, Sun, Mars, Moon	0

3.2 Use of chemical symbols / formulae

If a student writes a chemical symbol / formula instead of a required chemical name, full credit can be given if the symbol / formula is correct and if, in the context of the question, such action is appropriate.

3.3 Marking procedure for calculations

Marks should be awarded for each stage of the calculation completed correctly, as students are instructed to show their working.

Full marks can however be given for a correct numerical answer, without any working shown.

3.4 Interpretation of 'it'

Answers using the word 'it' should be given credit only if it is clear that the 'it' refers to the correct subject.

3.5 Errors carried forward

Any error in the answers to a structured question should be penalised once only.

Papers should be constructed in such a way that the number of times errors can be carried forward is kept to a minimum. Allowances for errors carried forward are most likely to be restricted to calculation questions and should be shown by the abbreviation e.c.f. in the marking scheme.

3.6 Phonetic spelling

The phonetic spelling of correct scientific terminology should be credited **unless** there is a possible confusion with another technical term.

3.7 Brackets

(…..) are used to indicate information which is not essential for the mark to be awarded but is included to help the examiner identify the sense of the answer required.

3.8 Ignore / Insufficient / Do <u>not</u> allow

Ignore or insufficient are used when the information given is irrelevant to the question or not enough to gain the marking point. Any further correct amplification could gain the marking point.

Do **not** allow means that this is a wrong answer which, even if the correct answer is given as well, will still mean that the mark is not awarded.

Level of response marking instructions

Level of response mark schemes are broken down into levels, each of which has a descriptor. The descriptor for the level shows the average performance for the level. There are marks in each level.

Before you apply the mark scheme to a student's answer read through the answer and annotate it (as instructed) to show the qualities that are being looked for. You can then apply the mark scheme.

Step 1 Determine a level

Start at the lowest level of the mark scheme and use it as a ladder to see whether the answer meets the descriptor for that level. The descriptor for the level indicates the different qualities that might be seen in the student's answer for that level. If it meets the lowest level then go to the next one and decide if it meets this level, and so on, until you have a match between the level descriptor and the answer. With practice and familiarity you will find that for better answers you will be able to quickly skip through the lower levels of the mark scheme.

When assigning a level you should look at the overall quality of the answer and not look to pick holes in small and specific parts of the answer where the student has not performed quite as well as the rest. If the answer covers different aspects of different levels of the mark scheme you should use a best fit approach for defining the level and then use the variability of the response to help decide the mark within the level, ie if the response is predominantly level 3 with a small amount of level 4 material it would be placed in level 3 but be awarded a mark near the top of the level because of the level 4 content.

Step 2 Determine a mark

Once you have assigned a level you need to decide on the mark. The descriptors on how to allocate marks can help with this. The exemplar materials used during standardisation will help. There will be an answer in the standardising materials which will correspond with each level of the mark scheme. This answer will have been awarded a mark by the Lead Examiner. You can compare the student's answer with the example to determine if it is the same standard, better or worse than the example. You can then use this to allocate a mark for the answer based on the Lead Examiner's mark on the example.

You may well need to read back through the answer as you apply the mark scheme to clarify points and assure yourself that the level and the mark are appropriate.

Indicative content in the mark scheme is provided as a guide for examiners. It is not intended to be exhaustive and you must credit other valid points. Students do not have to cover all of the points mentioned in the Indicative content to reach the highest level of the mark scheme.

You should ignore any irrelevant points made. However, full marks can be awarded only if there are no incorrect statements that contradict a correct response.

An answer which contains nothing of relevance to the question must be awarded no marks.

Question 1

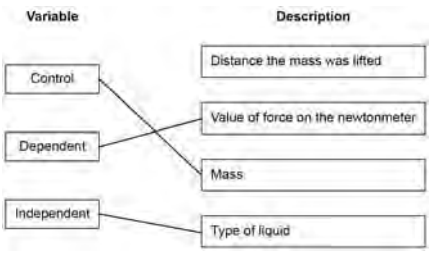
Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	C		1	AO1/1 6.5.1.2
01.2	2040 / 120 17 (m/s)	 allow 17 (m/s) with no working shown for **2** marks	1 1	AO2/1 6.5.4.1.2
01.3	the thinking distance and the braking distance combined	accept 36 m	1	AO2/1 6.5.4.3.1
01.4	thinking distance increases braking distance stays the same		1 1	AO1/1 6.5.4.3.1/2
Total			**6**	

Question 2

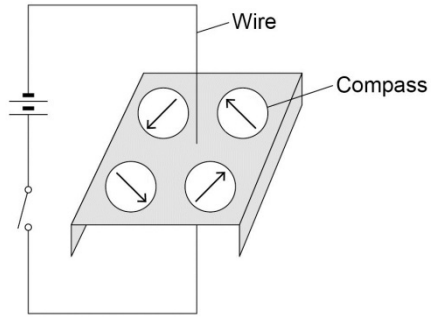
Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	5.5 (N)		1	AO2/2 6.5.3 WS2.6
02.2	The spring gets shorter		1	AO1/1 6.5.3
02.3	**Level 2:** A detailed and coherent description of the experiment. The response provides a logical sequence.	3–4	4	AO1/2 6.5.3
	Level 1: Simple description of the experiment with some steps missing. The response may not be in a logical sequence and may not lead to the collection of valid results.	1–2		
	No relevant content.	0		
	Indicative content • set up a clamp stand with a clamp and hang a spring on it • use another clamp and boss to fix a half metre rule alongside the spring • record the metre rule reading that is level with the bottom of the spring • hang a weight from the bottom of the spring • record the new reading on the rule and the extension on the spring • remove the weight and check the length of the spring • repeat by adding more weights and record the readings on the rule			

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.4	Use a pointer from the spring to measure the length. Make sure the spring is stationary before measuring length.		1 1	AO3/3b 6.5.3
02.5	Extension is directly proportional to force	if more than **one** box ticked apply list principle	1	AO3/2b 6.5.3 WS3.5
02.6	0.5 (N)		1	AO2/1 6.5.3
02.7	0.100 m	if more than **one** box ticked apply list principle	1	AO3/2a 6.5.3 WS3.5
02.8	0.5 x 20 x $(0.050)^2$ = 0.025 (J)	 allow 0.025 (J) with no working for **2** marks	1 1	AO2/1 6.5.3
Total			**13**	

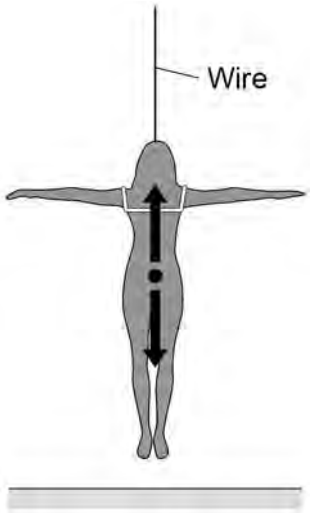
Question 3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1		allow **one** mark for each correct line if more than one line is drawn from any variable then all of those lines are wrong	1 1 1	AO3/3a AO2/2 AO2/2 6.5.1.2 WS2.2, 4.1
03.2	0.1 N	if more than **one** box ticked apply list principle	1	AO2/2 6.5.1.2 WS2.3
03.3	A bar chart	if more than **one** box ticked apply list principle	1	AO2/2 6.5.1.2 WS3.1
03.4	some of the data is categoric		1	AO2/2 6.5.1.2 WS3.1
03.5	13.8 × 0.30 4.14 J	allow 4.14 without working shown for **2** marks	1 1 1	AO2/1 AO2/1 AO1/1 6.5.2 WS4.3
Total			**9**	

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	S – top, N – bottom		1	AO1/1 6.7.1.1
04.2	touch / attracted to magnet **A**		1	AO2/1 6.7.1.1
04.3	the magnetic needles point to the north pole because The Earth has a magnetic field	 accept the needles align to the Earth's magnetic field for **2** marks	1 1	AO1/1 6.7.1.2
04.4			1	AO2/1 6.7.2.2
04.5	point in the opposite direction	change direction is insufficient	1	AO2/1 6.7.2.2
04.6	uniform field lines through the wire coil. field lines curving round the top and bottom of the wire coil. arrows indicating direction from N to S	 do **not** accept conflicting arrows	1 1 1	AO1/1 6.7.2.2
Total			**9**	

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1		arrow pointing vertically upwards arrow pointing vertically downwards	1 1	AO1/1 6.5.1.4
05.2	Gravitational force Tension force	if more than **two** boxes ticked apply list principle	1 1	AO1/1 6.5.1.2
05.3	0 (N)		1	AO1/1 6.5.4.2.1 WS1.2
05.4	weight = 70 × 9.8 (= 686) weight = 690 (N)	allow 690 (N) with no working shown for **2** marks allow 686 (N) with no working shown for **1** mark	1 1	AO2/1 6.5.1.3
05.5	34 (N) / 30 (N)	allow ecf from 05.4 correctly calculated	1	AO2/1 6.5.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.6	resultant force = mass × acceleration	accept F = ma accept equation correctly rearranged for a	1	AO1/1 6.5.4.2.2
05.7	25 = 65 × a a = 25 / 65 a = 0.38(4615…) (m/s^2)	allow 0.38 (m/s^2) with no working for **3** marks	1 1 1	AO2/1 6.5.4.2.2 WS3.3
Total			**12**	

Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	the time it took from seeing the green light to pressing a key		1	AO1/1 6.5.4.3.2
06.2	he could have been distracted		1	AO3/3a 6.5.4.3.2
06.3	boys have a shorter reaction time than girls **or** reaction time improves with practice		1	AO3/2b 6.5.4.3.2 WS3.5
06.4	collect more data / larger sample size **or** take more repeat readings per person	must link to response in 06.3	1	AO3/3b 6.5.4.3.2 WS3.7
06.5	reaction time will have less effect (as distance increases) because it is a smaller proportion of the total race time		1 1	AO2/1 6.5.4.3.2

06.6	**Level 3:** A coherent description of the race, which uses data from the graph, including discussion of the meanings of the changing gradient of both of the lines.	5–6	6	AO3/1a 6.5.4.3.2 6.5.4.1.4 WS3.5
	Level 2: Multiple pieces of data taken from the graphs used to evidence a comparison between the runners. Likely to include discussion of the meaning of the (changing) gradient of one of the lines. Answer not coherently structured.	3–4		
	Level 1: Some data taken from the graph, but may be limited to one aspect or simple readings. Lack of coherence in answer.	1–2		
	No relevant content.	0		
	Indicative content • A starts at constant speed *for 440 m / 60 s* • A then slows down *from 60 s* • the gradient for B is lower at the start so B starts at a slower speed • the gradient for B increases so B accelerates • B overtook A *at 700 m /114 s* • B has a greater top speed because the maximum gradient is greater • B won the race *in 126 s* / beat A *by 34 s*			

Total			**12**

Question 7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	any **four** from: • light waves are transverse whereas sound waves are longitudinal • light waves travel faster than sound waves • light waves have a higher frequency than sound waves • light waves have a shorter wavelength than sound waves • light waves have oscillations perpendicular (to the direction of energy transfer) whereas sound waves are parallel (to the direction of energy transfer)		4	AO1/1 6.6.1.1 6.6.1.2 6.6.2.1 WS 1.4
07.2	the baby can be seen in the dark		1	AO2/1 6.6.2.4 WS1.4
07.3	wave speed = frequency × wavelength	accept $v = f \lambda$	1	AO1/1 6.6.1.2
07.4	$3 \times 10^8 = f \times 0.125$ $f = 3 \times 10^8 / 0.125$ $f = 2.4 \times 10^9$ (Hz)	allow 2.4×10^9 with no working for **3** marks	1 1 1	AO2/1 6.6.1.2 WS3.3
Total			**9**	

AQA

Please write clearly in block capitals.

Centre number | | | | | | Candidate number | | | | |

Surname _____

Forename(s) _____

Candidate signature _____

GCSE
COMBINED SCIENCE: TRILOGY

H

Higher Tier
Physics Paper 2H

Friday 14 June 2019 Morning Time allowed: 1 hour 15 minutes

Materials

For this paper you must have:
- a protractor
- a ruler
- a scientific calculator
- the Physics Equations Sheet (enclosed).

Instructions
- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions in the spaces provided.
- Do all rough work in this book. Cross through any work you do not want to be marked.
- In all calculations, show clearly how you work out your answer.

For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
TOTAL	

Information
- The maximum mark for this paper is 70.
- The marks for questions are shown in brackets.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.

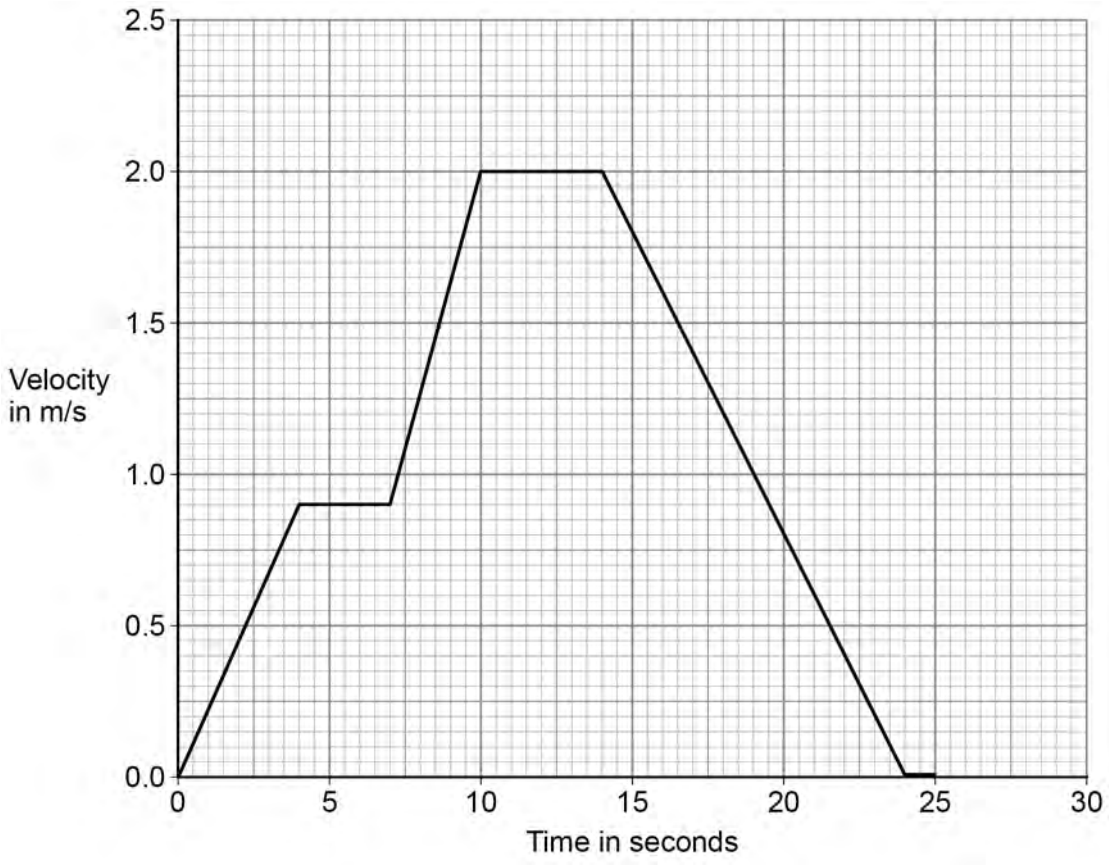
Do not write outside the box

0 1 **Figure 1** shows a runner using a smart watch and a mobile phone to monitor her run.

Figure 1

Figure 2 is a velocity–time graph for part of the runner's warm-up.

Figure 2



Do not write outside the box

0 1 . 1 Determine the total time for which the velocity of the runner was increasing.

[2 marks]

Time = _____ s

0 1 . 2 Determine the deceleration of the runner.

[2 marks]

Deceleration = _____ m/s^2

Question 1 continues on the next page

Do not write outside the box

The smart watch and mobile phone are connected to each other by a system called Bluetooth.

Bluetooth is wireless and uses electromagnetic waves for communication.

0 1 . 3 Suggest why the phone and watch being connected by a wireless system is an advantage when running.

[1 mark]

0 1 . 4 Write down the equation that links frequency, wave speed and wavelength.

[1 mark]

0 1 . 5 The electromagnetic waves have a frequency of 2 400 000 000 Hz

The speed of electromagnetic waves is 300 000 000 m/s

Calculate the wavelength of the electromagnetic waves.

[3 marks]

Wavelength = _____ m

Do not write outside the box

0 1 . 6 **Table 1** shows some information about four types of Bluetooth.

Table 1

Type	Power in milliwatts	Range in metres
1	100	100
2	2.50	10.0
3	1.00	1.00
4	0.50	0.50

Mobile phones use type **2** Bluetooth to communicate with other devices.

Suggest **two** reasons why.

[2 marks]

1 _____

_____

2 _____

_____

11

Turn over for the next question

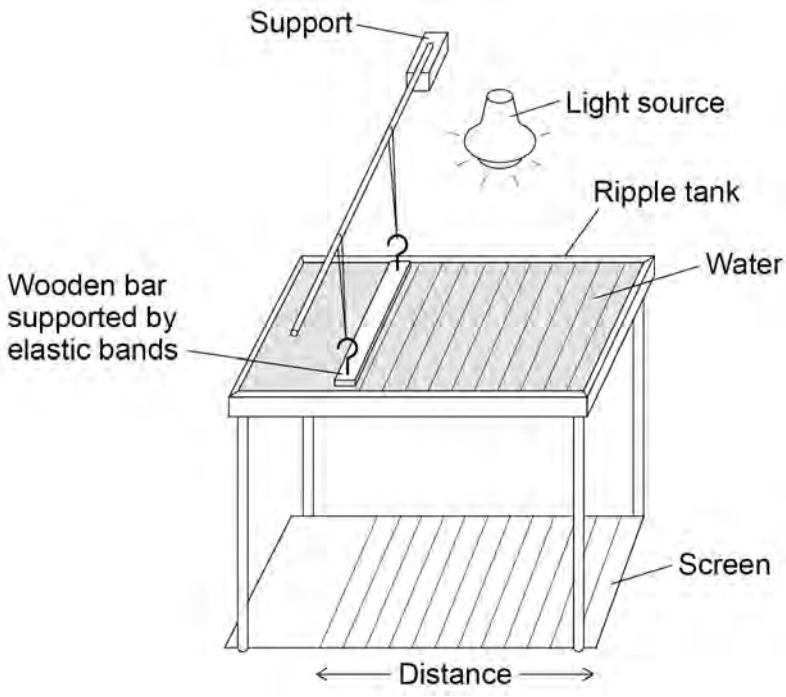
Do not write outside the box

0 2 **Figure 3** shows the equipment a teacher used to determine the speed of a water wave.

The equipment includes:

- a ripple tank filled with water
- a wooden bar that creates ripples on the surface of the water
- a light source which causes a shadow of the ripples on the screen.

Figure 3



0 2 . 1 Describe how equipment in **Figure 3** can be used to measure the wavelength, frequency and speed of a water wave.

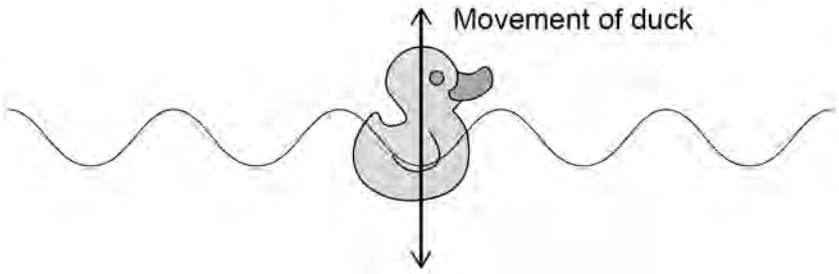
[6 marks]

Do not write outside the box

The teacher put a plastic duck in the ripple tank as shown in **Figure 4**.

The plastic duck moved up and down as the waves in the water passed.

Figure 4



0 2 . 2 How does the movement of the plastic duck in **Figure 4** demonstrate that water waves are transverse?

[1 mark]

Question 2 continues on the next page

Do not write outside the box

0 2 . 3 The teacher measured the maximum height and the minimum height of the plastic duck above the screen as the wave passed.

The teacher repeated his measurements.

Table 2 shows the teacher's measurements.

Table 2

Maximum height in mm	509	513	511
Minimum height in mm	503	498	499

Calculate the mean amplitude of the water wave.

[3 marks]

Mean amplitude = _____ mm

10

Do not write outside the box

0 3 Some quantities are scalars and some are vectors.

0 3 . 1 Which of the following quantities are scalars?

[2 marks]

Tick (✓) **two** boxes.

- Displacement ☐
- Distance ☐
- Force ☐
- Speed ☐
- Velocity ☐

0 3 . 2 Give the difference between a vector quantity and a scalar quantity.

[1 mark]

Question 3 continues on the next page

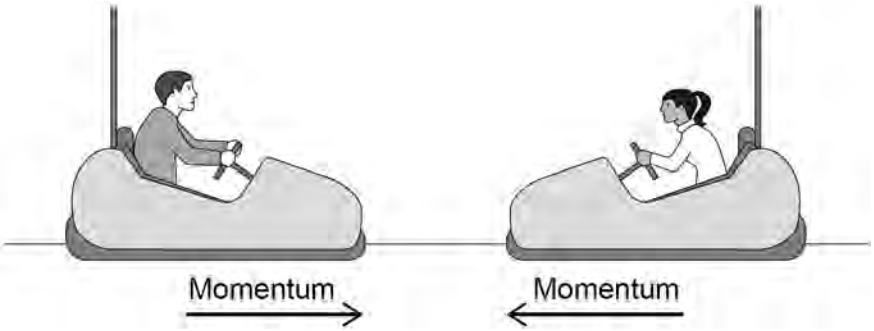
Do not write outside the box

Bumper cars are a fairground ride and are designed to bump into each other.

Figure 5 shows two bumper cars moving towards each other.

The momentum of each bumper car is shown by an arrow.

Figure 5



0 3 . 3 Give **two** factors that affect the momentum of each bumper car.

[2 marks]

1 _____

2 _____

0 3 . 4 The bumper cars crash into each other and stop.

Explain why both bumper cars stop after the crash.

[4 marks]

_____

_____

_____

_____

_____

_____

_____

_____

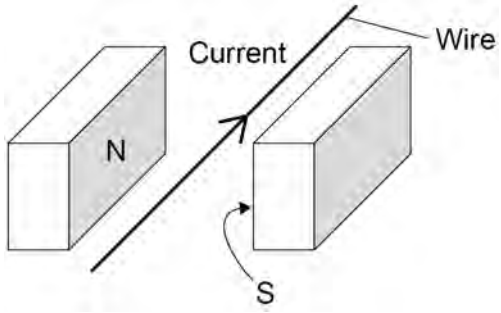
9

Do not write outside the box

0 4 **Figure 6** shows a wire in a magnetic field.

The direction of the current in the wire is shown.

Figure 6

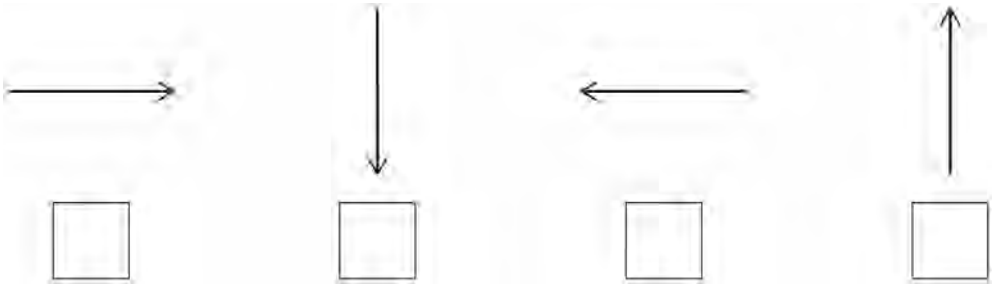


0 4 . 1 There is a force on the wire due to the current in the magnetic field.

In which direction is the force on the wire?

[1 mark]

Tick (✓) **one** box.



0 4 . 2 Give **two** ways that the direction of the force on the wire could be reversed.

[2 marks]

1 _____

2 _____

Question 4 continues on the next page

Do not write outside the box

0 4 . 3 The length of the wire in the magnetic field is 0.050 m

The force on the wire is 0.072 N

magnetic flux density = 360 mT

Calculate the current in the wire.

Use the Physics Equations Sheet.

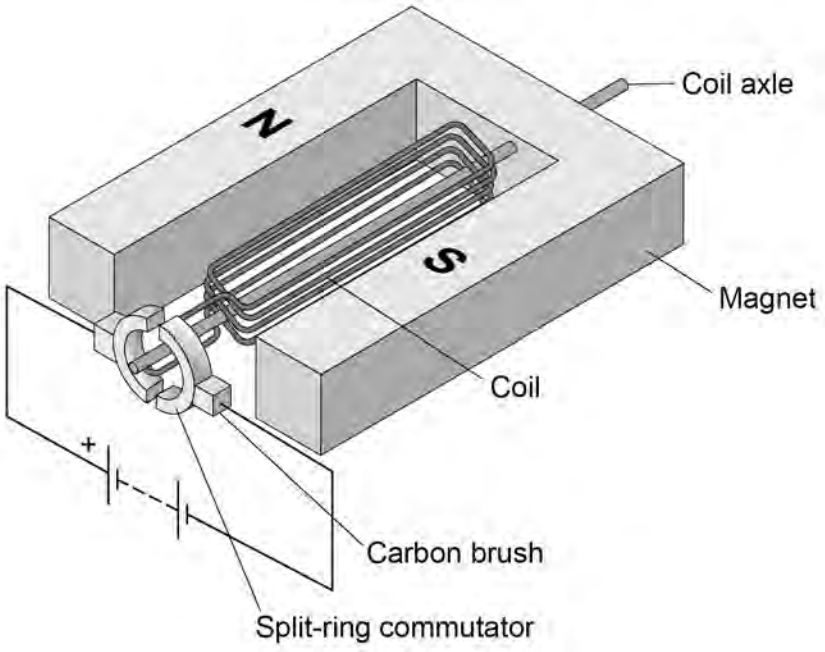
[4 marks]

Current = _____ A

Do not write outside the box

0 4 . 4 **Figure 7** shows a simple motor.

Figure 7



Explain why the coil rotates when there is a current in the coil.

[4 marks]

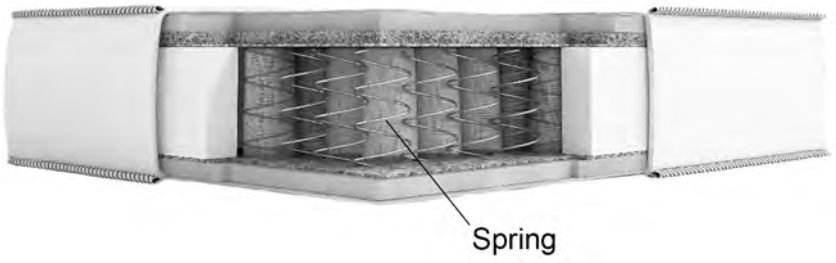
11

Turn over for the next question

Do not write outside the box

0 5 **Figure 8** shows some springs inside a mattress.

Figure 8



0 5 . 1 Which proportionality is true when a force is applied to a spring?

[1 mark]

Tick (✓) **one** box.

Force ∝ energy stored ☐

Force ∝ extension ☐

Force ∝ length ☐

Force ∝ spring constant ☐

Do not write outside the box

A mattress contains 1200 identical springs.

A person lies on the mattress and the springs compress.

The mean force on each spring in the mattress is 0.49 N

0 5 . 2 Calculate the mass of the person.

gravitational field strength = 9.8 N/kg

[4 marks]

Mass = _____ kg

Question 5 continues on the next page

Do not write outside the box

0 5 . 3 The mean compression of each spring is 3.5×10^{-3} m

Calculate the spring constant of each spring in the mattress.

Give the unit.

[4 marks]

Spring constant = _____

Unit = _____

0 5 . 4 For a given force, different springs compress by different amounts.

Explain what property of the springs would make the mattress soft.

[2 marks]

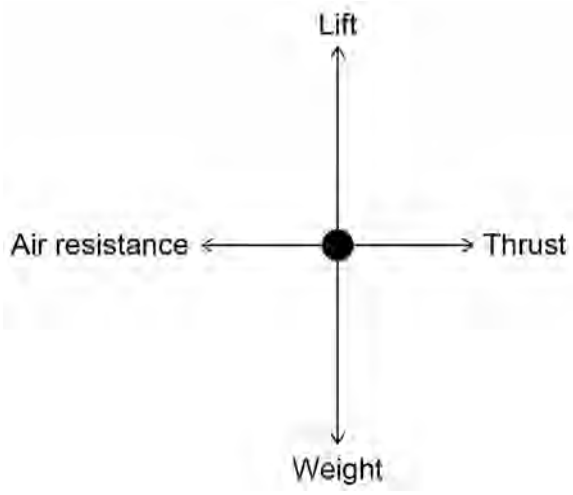
11

Do not write outside the box

0 6 **Figure 9** shows a free body diagram for an aeroplane flying at a constant speed and at a constant height.

The speed of the aeroplane is much greater than the speed at which the aeroplane lands.

Figure 9



0 6 . 1 Explain how the forces need to change so the aeroplane can land.

[4 marks]

Question 6 continues on the next page

Do not write outside the box

0 6 . 2 The aeroplane lands at a speed of 80 m/s

After landing, the aeroplane takes 28 s to decelerate to a speed of 10 m/s

The mean resultant force on the aeroplane as it decelerates is 750 000 N

Calculate the mass of the aeroplane.

[5 marks]

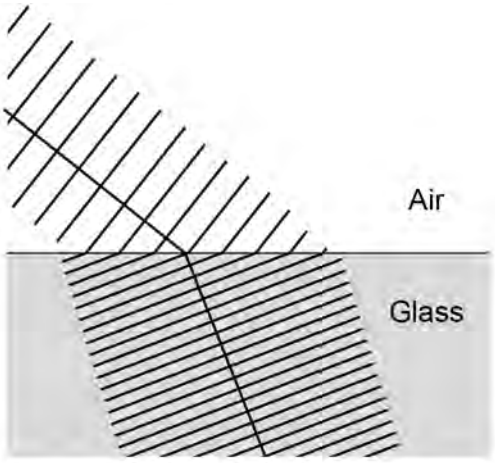
Mass = _____ kg

9

Do not write outside the box

0 7 Wave front diagrams are used to explain why light refracts when it passes from air into glass.

Figure 10



0 7 . 1 Explain why the light refracts as it passes from air into glass.

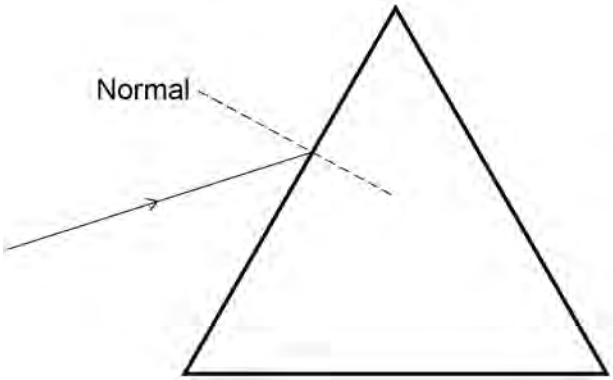
[3 marks]

Question 7 continues on the next page

Do not write outside the box

0 7 . 2 **Figure 11** shows a ray of red light entering a glass prism.

Figure 11



Complete the ray diagram to show the ray emerging from the glass prism.

[3 marks]

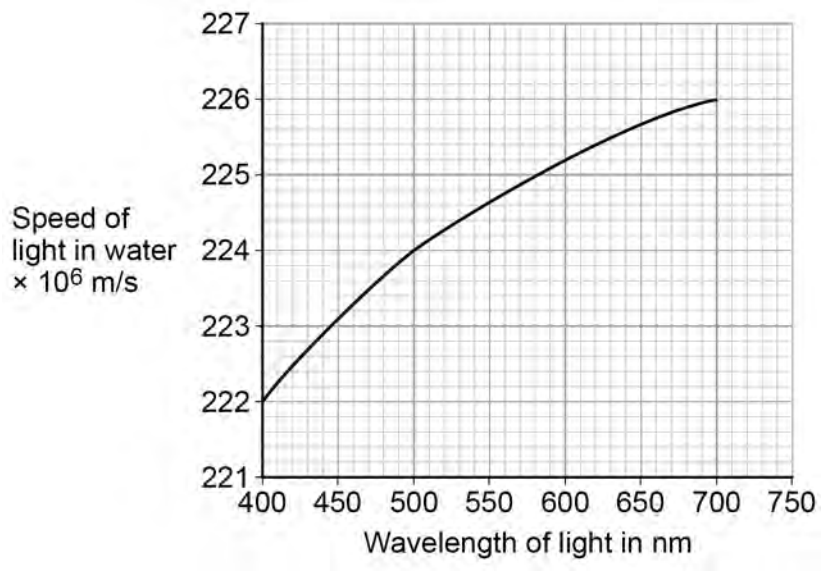
Do not write outside the box

0 7 . 3 White light is made up of a continuous spectrum of different wavelengths that all travel at 3×10^8 m/s in air.

Rainbows are produced because different wavelengths of light travel at different speeds in water.

Figure 12 shows the speed of different wavelengths of light in water.

Figure 12



Explain why violet light is refracted the most as it enters water.

[3 marks]

9

END OF QUESTIONS

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ANSWER IN THE SPACES PROVIDED

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ANSWER IN THE SPACES PROVIDED

SPECIMEN MATERIAL

GCSE
COMBINED SCIENCE: TRILOGY

PAPER 5: PHYSICS 1F

Mark scheme

Specimen 2018

Version 1.0

Mark schemes are prepared by the Lead Assessment Writer and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all associates participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every associate understands and applies it in the same correct way. As preparation for standardisation each associate analyses a number of students' scripts. Alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Assessment Writer.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

Further copies of this mark scheme are available from aqa.org.uk

Information to Examiners

1. General

The mark scheme for each question shows:

- the marks available for each part of the question
- the total marks available for the question
- the typical answer or answers which are expected
- extra information to help the Examiner make his or her judgement and help to delineate what is acceptable or not worthy of credit or, in discursive answers, to give an overview of the area in which a mark or marks may be awarded
- the Assessment Objectives and specification content that each question is intended to cover.

The extra information is aligned to the appropriate answer in the left-hand part of the mark scheme and should only be applied to that item in the mark scheme.

At the beginning of a part of a question a reminder may be given, for example: where consequential marking needs to be considered in a calculation; or the answer may be on the diagram or at a different place on the script.

In general the right-hand side of the mark scheme is there to provide those extra details which confuse the main part of the mark scheme yet may be helpful in ensuring that marking is straightforward and consistent.

2. Emboldening and underlining

2.1 In a list of acceptable answers where more than one mark is available 'any **two** from' is used, with the number of marks emboldened. Each of the following bullet points is a potential mark.

2.2 A bold **and** is used to indicate that both parts of the answer are required to award the mark.

2.3 Alternative answers acceptable for a mark are indicated by the use of **or**. Different terms in the mark scheme are shown by a / ; eg allow smooth / free movement.

2.4 Any wording that is underlined is essential for the marking point to be awarded.

3. Marking points

3.1 Marking of lists

This applies to questions requiring a set number of responses, but for which students have provided extra responses. The general principle to be followed in such a situation is that 'right + wrong = wrong'.

Each error / contradiction negates each correct response. So, if the number of error / contradictions equals or exceeds the number of marks available for the question, no marks can be awarded.

However, responses considered to be neutral (indicated as * in example 1) are not penalised.

Example 1: What is the pH of an acidic solution? (1 mark)

Student	Response	Marks awarded
1	green, 5	0
2	red*, 5	1
3	red*, 8	0

Example 2: Name two planets in the solar system. (2 marks)

Student	Response	Marks awarded
1	Neptune, Mars, Moon	1
2	Neptune, Sun, Mars, Moon	0

3.2 Use of chemical symbols / formulae

If a student writes a chemical symbol / formula instead of a required chemical name, full credit can be given if the symbol / formula is correct and if, in the context of the question, such action is appropriate.

3.3 Marking procedure for calculations

Marks should be awarded for each stage of the calculation completed correctly, as students are instructed to show their working.

Full marks can however be given for a correct numerical answer, without any working shown.

3.4 Interpretation of 'it'

Answers using the word 'it' should be given credit only if it is clear that the 'it' refers to the correct subject.

3.5 Errors carried forward

Any error in the answers to a structured question should be penalised once only.

Papers should be constructed in such a way that the number of times errors can be carried forward is kept to a minimum. Allowances for errors carried forward are most likely to be restricted to calculation questions and should be shown by the abbreviation e.c.f. in the marking scheme.

3.6 Phonetic spelling

The phonetic spelling of correct scientific terminology should be credited **unless** there is a possible confusion with another technical term.

3.7 Brackets

(…..) are used to indicate information which is not essential for the mark to be awarded but is included to help the examiner identify the sense of the answer required.

3.8 Ignore / Insufficient / Do <u>not</u> allow

Ignore or insufficient are used when the information given is irrelevant to the question or not enough to gain the marking point. Any further correct amplification could gain the marking point.

Do **not** allow means that this is a wrong answer which, even if the correct answer is given as well, will still mean that the mark is not awarded.

Level of response marking instructions

Level of response mark schemes are broken down into levels, each of which has a descriptor. The descriptor for the level shows the average performance for the level. There are marks in each level.

Before you apply the mark scheme to a student's answer read through the answer and annotate it (as instructed) to show the qualities that are being looked for. You can then apply the mark scheme.

Step 1 Determine a level

Start at the lowest level of the mark scheme and use it as a ladder to see whether the answer meets the descriptor for that level. The descriptor for the level indicates the different qualities that might be seen in the student's answer for that level. If it meets the lowest level then go to the next one and decide if it meets this level, and so on, until you have a match between the level descriptor and the answer. With practice and familiarity you will find that for better answers you will be able to quickly skip through the lower levels of the mark scheme.

When assigning a level you should look at the overall quality of the answer and not look to pick holes in small and specific parts of the answer where the student has not performed quite as well as the rest. If the answer covers different aspects of different levels of the mark scheme you should use a best fit approach for defining the level and then use the variability of the response to help decide the mark within the level, ie if the response is predominantly level 3 with a small amount of level 4 material it would be placed in level 3 but be awarded a mark near the top of the level because of the level 4 content.

Step 2 Determine a mark

Once you have assigned a level you need to decide on the mark. The descriptors on how to allocate marks can help with this. The exemplar materials used during standardisation will help. There will be an answer in the standardising materials which will correspond with each level of the mark scheme. This answer will have been awarded a mark by the Lead Examiner. You can compare the student's answer with the example to determine if it is the same standard, better or worse than the example. You can then use this to allocate a mark for the answer based on the Lead Examiner's mark on the example.

You may well need to read back through the answer as you apply the mark scheme to clarify points and assure yourself that the level and the mark are appropriate.

Indicative content in the mark scheme is provided as a guide for examiners. It is not intended to be exhaustive and you must credit other valid points. Students do not have to cover all of the points mentioned in the Indicative content to reach the highest level of the mark scheme.

You should ignore any irrelevant points made. However, full marks can be awarded only if there are no incorrect statements that contradict a correct response.

An answer which contains nothing of relevance to the question must be awarded no marks.

Question 1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	230 V		1	AO1/1 6.2.3.1
01.2	Earth Neutral	must be in the correct order	1 1	AO1/1 6.2.3.2
01.3	It is easy to identify each wire.		1	AO3/1a 6.2.3.2
01.4	current shock	must be in the correct order	1 1	AO1/1 6.2.3.2
01.5	50 Hz		1	AO1/1 6.2.3.1
01.6	output = 25 x 16 400 (kV)	 allow 400 (kV) with no working shown for **2** marks	1 1	AO2/1 6.2.4.3
01.7	It reduces the energy lost due to heating		1	AO2/1 6.2.4.3
01.8	It is safer for consumers		1	AO2/1 6.2.4.3
Total			**11**	

Question 2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	The nucleus will emit a neutron.		1	AO1/1 6.4.2.1
02.2	**<u>Similarity</u>** same mass number **<u>difference</u>** different atomic number	 allow same number of nucleons (protons + neutrons) allow different number of protons	 1 1	AO1/1 6.4.2.2
02.3	Radioactive decay is random.		1	AO1/1 6.4.2.3
02.4	1.3 (billion years)	allow 1.2-1.4 (billion years) allow **1** mark for horizontal line drawn from ~ 550	2	AO2/1 6.4.2.3
02.5	alpha		1	AO1/1 6.4.2.1
Total			**7**	

Question 3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	1 x 10^{-10} m		1	AO1/1 6.4.1.1
03.2	(a helium atom) has 2 <u>electrons</u>	accept it has more mass allow it is not charged	1	AO2/1 6.4.1.1
03.3	2		1	AO2/1 6.4.1.2
03.4	neutral (because) protons have positive charge and electrons have negative charge (and) there are equal numbers of protons and electrons	accept 0 or 'no charge'	1 1 1	AO2/1 6.4.1.2
03.5	helium will one day run out there will be none left for medical uses so balloons waste helium		1 1	AO3/1b 6.4.1.2
Total			**8**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	thermometer stopclock/stopwatch	 accept measuring cylinder accept top pan balance	1 1	AO1/2 6.1.1.4 WS2.3
04.2	independent: type of oil dependent: temperature rise in °C		1 1	AO1/2 6.1.1.4 WS2.4
04.3	wear safety goggles oil not heated directly	 accept any reasonable comment about not handling hot apparatus.	1 1	AO1/2 6.1.1.4 WS2.4
04.4	repeat the experiment and calculate the mean temperature rise **OR** heat the oil for a longer period of time (1) to get a wider range of temperatures (1)		1 1	AO3/3b 6.1.1.4 WS2.7
04.5	(17 + 17 + 18) / 3 (= 17.33) temperature rise = 17 (°C)	 accept 17 (°C) with no working shown for **2** marks allow 17.33 with no working shown for **1** mark	1 1	AO3/1a 6.1.1.4
04.6	E = 0.025 x 1800 x 20 (J) E = 900 (J) Joule	 allow 900 without working shown for the **2** calculation marks	1 1 1	AO2/1 AO2/1 AO1/1 6.1.1.3
Total			**13**	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	**Level 3:** A clear, logical explanation containing accurate ideas presented in the correct order with links between ideas.	5–6	6	2 AO2/1
	Level 2: Key ideas presented with some linked together to form a partial explanation.	3–4		2 AO2/1
	Level 1: Fragmented ideas, some may be relevant, insufficient links to form an explanation.	1–2		2 AO1/1 6.3.1.1 6.2.4.2
	No relevant content.	0		
	Indicative content • current in the wire causes heating • increases temperature of the metal wires / ice <u>Solid</u> • arrangement of particles is regular • particles vibrate about a fixed position <u>Melting</u> • internal energy of the ice increases, increasing the temperature to melting point • so (as the temperature increases) particles vibrate faster • eventually particles vibrate fast enough to break free from the (strong) bonds • therefore the arrangement of particles becomes irregular <u>Liquid</u> • arrangement of particles is irregular • particles movement (translational) is random			
05.2	The current in the heating element The mass of ice		1 1	AO3/3a 6.3.1.1
05.3	latent heat of fusion		1	AO1/1 6.3.2.3
05.4	45 / 120 = 0.375 0.38	allow 0.38 with no working shown for **2** marks allow 0.375 with no working shown for **1** mark	1 1	AO2/1 AO2/1 6.1.2.2
Total			**11**	

Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	0.093 A		1	AO2/1 6.2.2
06.2	0.093 A		1	AO2/1 6.2.2
06.3	(increasing the resistance) decreases the current therefore (the lamp will be) dimmer		1 1	AO1/1 6.2.1.3
06.4	potential difference = current × resistance	accept correct rearrangement with R as subject	1	AO1/1 6.2.1.3
06.5	3.3 = 0.15 x R R = 3.3 / 0.15 (Ω) R = 22 (Ω)	 allow 22 (Ω) without working shown for **3** marks	1 1 1	AO2/1 6.2.1.3
06.6	line drawn from the origin with a decreasing gradient.		1	AO1/1 6.2.1.4
Total			**9**	

Question 7

Question	Answers	Extra information	Mark	AO / Spec. Ref.
07.1	the store of chemical energy (in the battery) decreases		1	AO1/1 6.1.2.1
	the internal energy of the surrounding air increases.	accept description of energy becoming less usefully stored for **2** marks	1	
07.2	kinetic energy = ½ mass x velocity^2		1	AO1/1 6.1.1.2
07.3	$E_K = ½ \times 0.8 \times 12^2$		1	AO2/1 6.1.1.3
	$E_K = 57.6$ (J)	allow 57.6 (J) without working shown for **2** marks	1	
07.4	lower proportion of wasted energy	accept less energy is wasted	1	AO2/1 6.1.2.1
	higher proportion of energy is converted into <u>kinetic</u> energy	accept more kinetic energy	1	

Question	Answers	Mark	AO / Spec. Ref.
7.5	**Level 2:** A relevant and coherent argument which demonstrates processing and numerical analysis of the information presented and draw a conclusion which is logically consistent with the reasoning and refers to payback time for the vehicles.	3–4	AO3/2b 6.1.3
	Level 1: Simple comparisons are made which demonstrate a basic ability to numerically analyse the information presented. The conclusion, if present, may not be consistent with the calculations.	1–2	
	No relevant content	0	
	Indicative content • The electric car costs £12 000 more to buy • Running cost of electric car = £3 000 • Running cost of petrol engine car = £24 000 • Total cost of electric car = £30 000 • Total cost of petrol engine car = £39 000 • The electric car cost £1 750 less to run each year • The electric car will save £9 000 • Additional cost is covered in 6.9 years • So the electric car will be cheaper over the 12 year lifetime **or** Electric 27000 / 12 = 2250 Annual cost = 2250 + 250 = 2500 Petrol 15000 / 12 = 1250 Annual cost = 1250 + 2000 = 3250 So electric is £750 cheaper per year		
Total		**11**	

AQA

Please write clearly in block capitals.

Centre number | | | | | | Candidate number | | | | |

Surname _____

Forename(s) _____

Candidate signature _____

GCSE
COMBINED SCIENCE: TRILOGY

H

Higher Tier
Physics Paper 1H

Wednesday 22 May 2019 Afternoon Time allowed: 1 hour 15 minutes

Materials

For this paper you must have:
- a ruler
- a scientific calculator
- the Physics Equations Sheet (enclosed).

Instructions
- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions in the spaces provided.
- Do all rough work in this book. Cross through any work you do not want to be marked.
- In all calculations, show clearly how you work out your answer.

For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
6	
TOTAL	

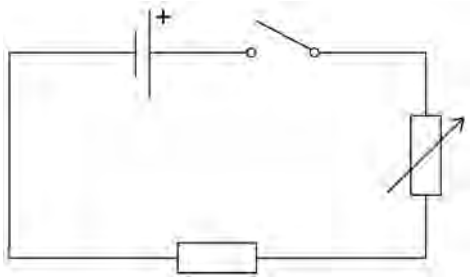
Information
- The maximum mark for this paper is 70.
- The marks for questions are shown in brackets.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.

Do not write outside the box

0 1 A student investigated how the current in a resistor varies with the potential difference across the resistor.

Figure 1 shows part of the circuit used.

Figure 1



0 1 . 1 The student connected an ammeter and a voltmeter into the circuit.

What is the correct way to connect the ammeter and the voltmeter into the circuit?

[1 mark]

Tick (✓) **one** box.

Ammeter	**Voltmeter**	
In parallel with the resistor	In series with the resistor	
In parallel with the cell	In series with the resistor	
In series with the resistor	In parallel with the resistor	
In series with the resistor	In parallel with the cell	

0 1 . 2 The student increased the resistance of the variable resistor.

How did increasing the resistance affect the current in the circuit?

[1 mark]

Do not write outside the box

0 1 . 3 How should the student change the circuit to give negative values for current and potential difference?

[1 mark]

0 1 . 4 Name the type of relationship between current and potential difference for a resistor at constant temperature.

[1 mark]

0 1 . 5 Write the equation which links current, potential difference and resistance.

[1 mark]

0 1 . 6 The current in the resistor was 0.12 A when the potential difference across the resistor was 3.0 V

Calculate the resistance of the resistor.

[3 marks]

Resistance = _____ Ω

8

Do not write outside the box

0 2 A scientist cooled the air inside a container.

0 2 . 1 The temperature of the air changed from 20 °C to 0 °C

The volume of the container of air stayed the same.

Explain how the motion of the air molecules caused the pressure in the container to change as the temperature decreased.

[3 marks]

0 2 . 2 The air contained water that froze at 0 °C

The change in internal energy of the water as it froze was 0.70 kJ

The specific latent heat of fusion of water is 330 kJ/kg

Calculate the mass of ice produced.

Use the Physics Equations Sheet.

[3 marks]

Mass of ice = _____ kg

Do not write outside the box

0 2 . 3 The air also contained oxygen, nitrogen and carbon dioxide.

Oxygen boils at –183 °C and freezes at –218 °C
Nitrogen boils at –195 °C and freezes at –210 °C
Carbon dioxide sublimates at –78 °C

The scientist continued to cool the air to a temperature of –190 °C

What is the state of each substance at –190 °C?

[2 marks]

Tick (✓) **one** box for **each** row of the table.

Substance	**Solid**	**Liquid**	**Gas**
Oxygen			
Nitrogen			
Carbon dioxide			

Question 2 continues on the next page

Do not write outside the box

0 2 . 4 The air also contained a small amount of argon.

As the temperature of the air decreased from 20 °C to –190 °C the argon changed from a gas to a liquid to a solid.

Explain the changes in the arrangement and movement of the particles of the argon as the temperature of the air decreased.

[6 marks]

14

Do not write outside the box

0 3 A hybrid car has an electric motor and a petrol engine.

0 3 . 1 Petrol is a non-renewable energy resource.

What is meant by a non-renewable energy resource?

[1 mark]

0 3 . 2 The electric motor in the car is powered by a battery.

To charge the battery, the car is plugged into the mains supply at 230 V

The power used to charge the battery is 6.9 kW

Calculate the current used to charge the battery.

[4 marks]

Current = _____ A

0 3 . 3 Mains electricity is an ac supply.

Explain the difference between direct and alternating potential difference.

[2 marks]

Do not write outside the box

0 3 . 4 The cable used to connect the car to the mains electricity supply has a low resistance.

Explain why it is better to use a cable with a low resistance than to use a cable with a high resistance.

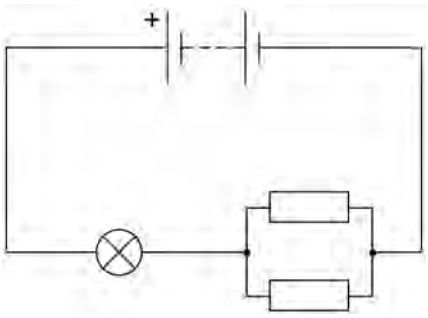
[2 marks]

9

Do not write outside the box

0 4 **Figure 2** shows a circuit that a student built.

Figure 2



0 4 . 1 The lamp has a resistance of 10 Ω

Each resistor has a resistance of 10 Ω

What is the total resistance of the circuit?

[1 mark]

Tick (✓) **one** box.

Between 20 and 30 Ω ☐

Exactly 20 Ω ☐

Exactly 30 Ω ☐

Less than 20 Ω ☐

0 4 . 2 Explain your answer to Question **04.1**

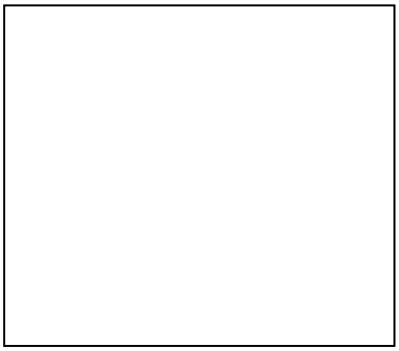
[2 marks]

Do not write outside the box

The student replaced one of the resistors with a thermistor.

0 4 . 3 Draw the circuit symbol for a thermistor in the box below.

[1 mark]



0 4 . 4 The student increased the temperature of the thermistor.

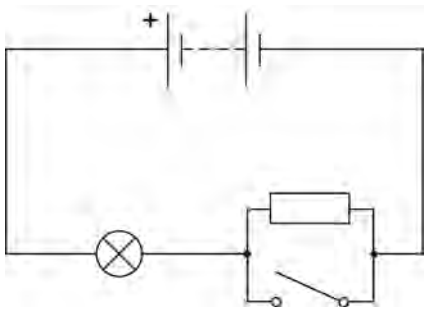
Explain how the current in the thermistor changed.

[2 marks]

Do not write outside the box

0 4 . 5 **Figure 3** shows another circuit the student built.

Figure 3



Explain how the potential difference across the resistor and the lamp will change when the switch is closed.

[4 marks]

The resistor _____

_____

_____

_____

The lamp _____

_____

_____

_____

10

Turn over for the next question

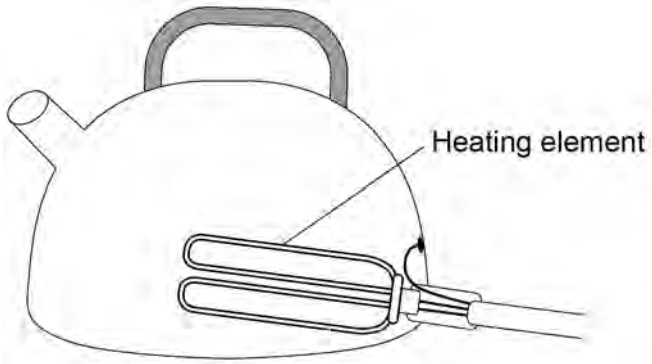
Do not write outside the box

0 5 A student investigated how the mass of water in an electric kettle affected the time taken for the water to reach boiling point.

The kettle switched off when the water reached boiling point.

Figure 4 shows the kettle.

Figure 4



0 5 . 1 The heating element of the kettle was connected to the mains supply.

Explain why the temperature of the heating element increased.

[2 marks]

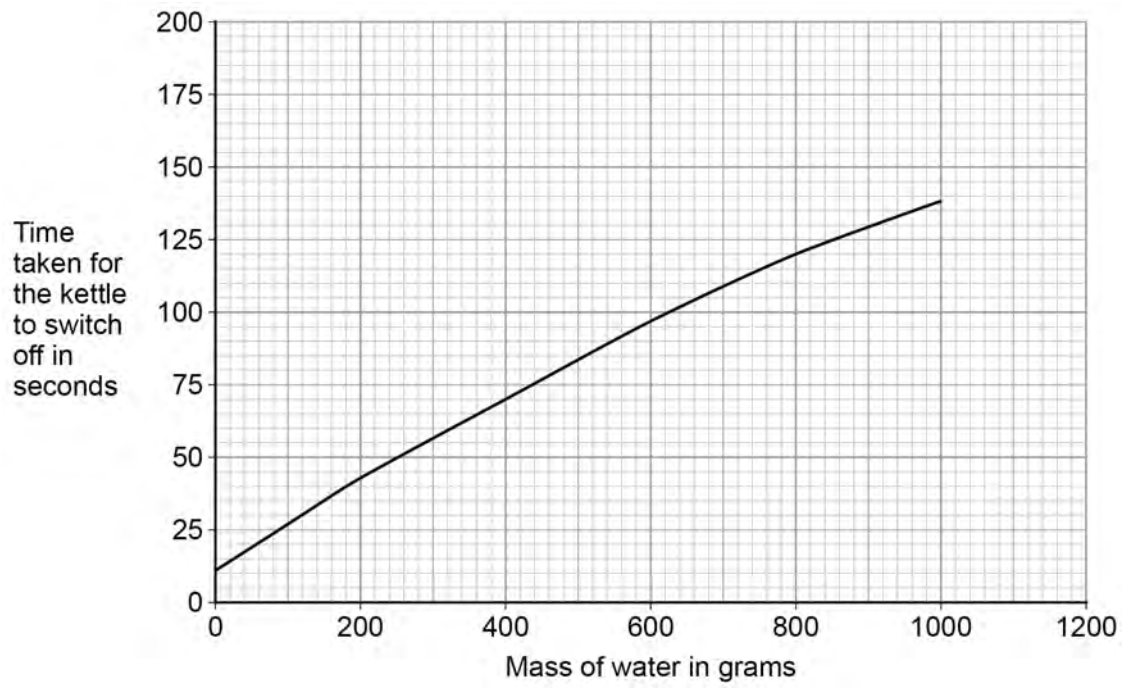
0 5 . 2 Give **one** variable that the student should have controlled.

[1 mark]

Do not write outside the box

Figure 5 shows how the mass of water in the kettle affected the time taken for the kettle to switch off.

Figure 5



0 5 . 3 Suggest why the line on **Figure 5** does **not** go through the origin.

[1 mark]

0 5 . 4 Suggest why the results give a non-linear pattern.

[1 mark]

Question 5 continues on the next page

Do not write outside the box

0 5 . 5 The power of the kettle was 2.6 kW

The kettle took 120 seconds to heat 0.80 kg of water from 18 °C to 100 °C

Calculate the specific heat capacity of water using this information.

Give your answer to 2 significant figures.

[6 marks]

Specific heat capacity = _____ J/kg °C

11

Do not write outside the box

0 6 Lanthanum-140 is a radioactive isotope.

0 6 . 1 A nucleus of lanthanum-140 emits gamma radiation.

What happens to the mass number and the charge of the nucleus when gamma radiation is emitted?

[1 mark]

Tick (✓) **one** box.

Mass number	**Charge**	
Decreases	Decreases	☐
Decreases	Stays the same	☐
Stays the same	Decreases	☐
Stays the same	Stays the same	☐

0 6 . 2 Why is it difficult to detect gamma radiation?

[1 mark]

Question 6 continues on the next page

Do not write outside the box

0 6 . 3 Activity is the rate at which a radioactive source decays.

A teacher measured the count-rate from a sample of lanthanum-140 using a Geiger-Muller (G-M) tube.

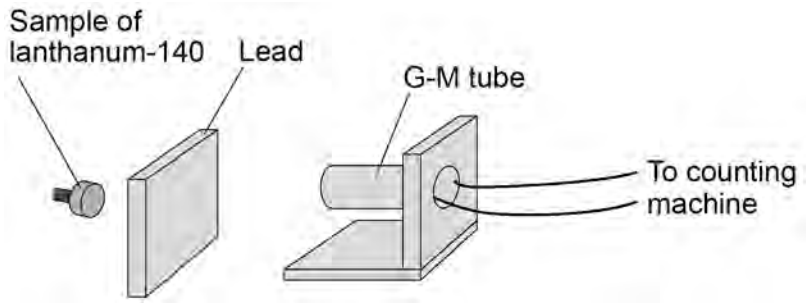
Explain why the count rate was less than the activity of the sample of lanthanum-140

[2 marks]

The teacher investigated how the thickness of lead affected the amount of gamma radiation that could pass through it.

Figure 6 shows the apparatus.

Figure 6



0 6 . 4 Explain why the teacher stood as far away from the apparatus as possible.

[2 marks]

Do not write outside the box

Table 1 shows the results.

Table 1

Thickness of lead in cm	Count rate in counts per second
0.5	110
1.0	60
1.5	33
2.0	18
2.5	10

0 6 . 5 The teacher concluded that the count rate was **not** inversely proportional to the thickness of lead.

Explain why the teacher was correct.

Use the data in **Table 1**.

[3 marks]

0 6 . 6 Lanthanum-140 can also emit beta radiation and change into cerium.

Complete the equation showing the decay of lanthanum (La) 140 into cerium (Ce).

[2 marks]

$$^{140}_{57}\text{La} \longrightarrow \ ^{\ \ }_{\ \ }\text{e} + \ ^{\ \ }_{\ \ }\text{Ce}$$

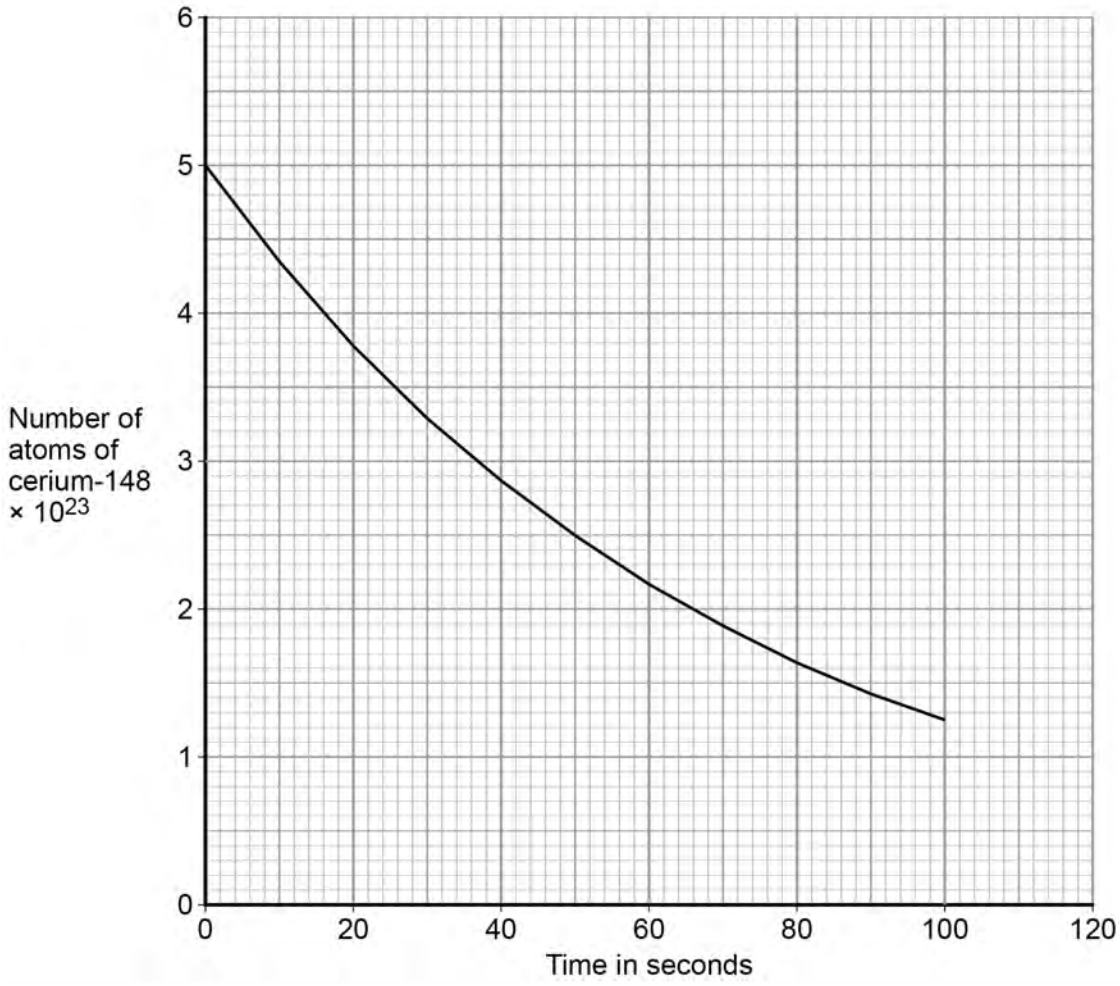
There are other isotopes of cerium which are radioactive.

Different isotopes of cerium have different half-lives.

The half-life of an isotope can be found by studying how the number of atoms changes over time.

Figure 7 shows how the number of atoms of cerium-148 in a 120 g sample changes over time.

Figure 7



Do not write outside the box

0 6 . 7 Determine the ratio of the number of cerium atoms in the sample when it was 100 seconds old compared with when the sample was 350 seconds old.

Use data from **Figure 7**.

[4 marks]

Ratio = _____

0 6 . 8 Determine the activity of the sample of cerium when the sample was 20 seconds old.

Use **Figure 7**.

[3 marks]

Activity = _____ Bq

18

END OF QUESTIONS

Do not write outside the box

There are no questions printed on this page

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

GCSE
COMBINED SCIENCE: TRILOGY
8464/P/2H

Physics Paper 2H

Mark scheme

June 2019

Version: 1.0 Final

196G8464P2H/MS

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Each error / contradiction negates each correct response. So, if the number of error / contradictions equals or exceeds the number of marks available for the question, no marks can be awarded.

However, responses considered to be neutral (indicated as * in example 1) are not penalised.

Example 1: What is the pH of an acidic solution?

[1 mark]

Student	Response	Marks awarded
1	green, 5	0
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3	red*, 8	0

Example 2: Name two planets in the solar system.

[2 marks]

Student	Response	Marks awarded
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The phonetic spelling of correct scientific terminology should be credited **unless** there is a possible confusion with another technical term.

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You may well need to read back through the answer as you apply the mark scheme to clarify points and assure yourself that the level and the mark are appropriate.

Indicative content in the mark scheme is provided as a guide for examiners. It is not intended to be exhaustive and you must credit other valid points. Students do **not** have to cover all of the points mentioned in the indicative content to reach the highest level of the mark scheme.

You should ignore any irrelevant points made. However, full marks can be awarded only if there are no incorrect statements that contradict a correct response.

An answer which contains nothing of relevance to the question must be awarded no marks.

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
01.1	(4 - 0) + (10 - 7) **or** 4 + 3 **or** 10 - 3 7 (s)	an answer of 7 (s) gains **2** marks	1 1	AO2 6.5.4.1.5	E
01.2	gradient = $\frac{0-2}{24-14}$ (-)0.2 (m/s^2)	an answer of 0.2 (m/s^2) gains **2** marks allow readings from any two points correctly substituted allow correct use of $a = \frac{\Delta v}{t}$	1 1	AO2 6.5.4.1.5	E
01.3	(there are no wires) to get tangled / disconnected	allow easier to move arms allow wires are inconvenient allow easier to transfer data	1	AO3 6.6.2.4	E
01.4	wave speed = frequency × wavelength	allow v = f λ allow any correct re-arrangement	1	AO1 6.6.1.2	E
01.5	300 000 000 = 2 400 000 000 × λ λ = $\frac{300\,000\,000}{2\,400\,000\,000}$ λ = 0.125 (m)	an answer of 0.125 (m) or 0.13 (m) scores **3** marks allow λ = 0.13 (m)	1 1 1	AO2 6.6.1.2	E
01.6	range is far enough (for most uses) power is not too great so the battery will not drain quickly	allow power not too great so the phone will not overheat allow the range per milliwatt is greatest or 4 metres	1 1	AO3 6.6.2.4	E

Total			**11**		

Question	Answers	Mark	AO / Spec. Ref.	ID
02.1	**Level 3:** The design/plan would lead to the production of a valid outcome. All key steps are identified and logically sequenced.	5–6	AO1 6.6.1.2	E
	Level 2: The design/plan would not necessarily lead to a valid outcome. Most steps are identified, but the plan is not fully logically sequenced.	3–4		
	Level 1: The design/plan 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 • If two quantities have been determined, $v = f \lambda$ can be used to find the third. **Frequency** • use a stopclock • count the number of waves passing a point in a fixed time period • divide the time by the number of waves to determine the time for one wave, T • $f = 1/T$ • read the frequency off the oscillator **Wavelength** • use a camera to freeze the image • use a metre rule to measure the distance between two wavefronts • count the number of waves between the wavefronts • divide distance by the number of waves to determine λ **Velocity** • determine a mean value of frequency • determine a mean value of wavelength • measure the time it takes one wavefront to travel the length of the screen • measure the length of the screen • speed = distance / time to access Level 3 there must be a description of how frequency, wavelength and velocity can be determined			

02.2	(the duck) moves perpendicular to the direction of wave travel	duck moves up and down is insufficient	1	AO2 6.6.1.1	E

02.3		an answer of 5.5 gains **3** (mm) marks		AO2 6.6.1.2	E
	mean maximum height = 511 **and** mean minimum height = 500		1		
	511 – 500 = 11	allow a calculated difference from incorrect means	1		
	11 / 2 = 5.5 (mm)	allow their difference divided by 2 any correct method of determining the mean amplitude can score **3** marks	1		

Total			**10**		

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
03.1	distance speed		1 1	AO1 6.5.4.1.3	A
03.2	(both have magnitude) only a vector has direction	allow scalar does not have a direction	1	AO1 6.5.1.1	E
03.3	any **two** from: • mass • velocity • friction • power of the motor	 allow weight allow speed or direction allow air resistance or drag	2	AO1 6.5.5.2	E

03.4	total momentum is zero after the collision (because the bumper cars are stationary) because the momentum of each car before the collision was equal (in magnitude) and opposite (in direction) so the total momentum of the bumper cars was zero before the collision and momentum is conserved **OR** total momentum is zero after the collision (because the bumper cars are stationary) (1) because the momentum of each car before the collision was equal (in magnitude) and opposite (in direction) (1) both cars exert an equal and opposite force on each other (for equal periods of time) (1) so the cars accelerate (in opposite directions) (1)		1 1 1 1	AO3 5.5.5.2	E
Total			**9**		

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
04.1			1	AO1 6.7.2.2	A
04.2	reverse the direction of the current reverse the direction of the magnetic field		1 1	AO1 6.7.2.2	E
04.3	 B = 0.360 (T) 0.072 = 0.360 × I × 0.050 $I = \frac{0.072}{(0.360 \times 0.050)}$ I = 4.0 (A)	an answer of 4.0 (A) scores **4** marks allow a correct substitution using an incorrectly / not converted value of B allow a correct rearrangement using an incorrectly / not converted value of B allow a correct calculation using an incorrectly / not converted value of B	 1 1 1 1	AO2 6.7.2.2	E

04.4	there is a magnetic field (due to the permanent magnet) **and** current in a wire causes a magnetic field current is in opposite directions in each side of the coil so forces act in opposite directions on either side of the coil (the split ring ensures that) the current in the left / right side of the coil is always in the same direction	 allow (the split ring ensures that) the force in the left / right side of the coil is always in the same direction allow the current reverses each half rotation	1 1 1 1	AO1 6.7.2.3	E
Total			**11**		

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
05.1	force ∝ extension		1	AO1 6.5.3	A
05.2	F = 0.49 × 1 200 **or** F = 588 (N) 588 = m × 9.8 $m = \frac{588}{9.8}$ m = 60 (kg) **OR** 0.49 = mean mass per spring × 9.8 (1) mean mass per spring = $\frac{0.49}{9.8}$ (1) mean mass per spring = 0.050 (1) m = 0.050 × 1200 = 60 (kg) (1)	an answer of 60 (kg) scores **4** marks allow a correct substitution using an incorrectly calculated value of F allow a correct rearrangement using an incorrectly calculated value of F allow a correct calculation using an incorrectly calculated value of F	1 1 1 1	AO2 6.5.1.3	E
05.3	$0.49 = k \times 3.5 \times 10^{-3}$ $k = \frac{0.49}{3.5 \times 10^{-3}}$ 140 N/m	an answer of 140 scores **3** calculation marks	1 1 1 1	3 x AO2 1 x AO1 6.5.3	E

05.4	springs with a low spring constant because they can compress by a larger amount (for a given force)	 allow they can compress by the same amount for a smaller force allow low stiffness	1 1	AO3 6.5.3	E
Total			**11**		

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
06.1	thrust decreases	allow air resistance or drag increases ignore air resistance decreases as speed decreases	1	1xAO1 1xAO2 2xAO3 6.5.4.2.1	E
	so there is a resultant force in opposite direction	allow so air resistance or drag is greater than thrust	1		
	lift must decrease (because weight stays the same)		1		
	so there is a resultant downwards force	allow so weight is greater than lift the last two marking points cannot be awarded if there is a reference to the weight increasing	1		
06.2		an answer of 300 000 (kg) scores **5** marks		AO2 6.5.4.1.5 6.5.4.2.2	E
	$a = \frac{(10-80)}{28}$	allow $a = \frac{(80-10)}{28}$	1		
	$a = (–)2.5\ (m/s^2)$	a valid equation must have been used to calculate a to score subsequent marks	1		
	$(–)\ 750\ 000 = m \times (–)2.5$	allow a correct substitution using their calculated value of a	1		
	$m = \frac{(-)750\ 000}{(-)2.5}$	allow a correct rearrangement using their calculated value of a	1		
	m = 300 000 (kg)	allow a correct calculation using their calculated value of a	1		
Total			**9**		

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
7.1	speed / velocity in the glass is lower	speed / velocity changes is insufficient allow the refractive index of glass is higher than that of air allow glass has a higher optical density than air	1	AO1 6.6.2.2	E
	so the edge of the wave(front) entering the glass slows down		1		
	but the part of the wave(front) in the air continues at the higher speed / velocity (causing a change in direction)		1		
7.2	correct ray in the prism bent towards the normal		1	AO1 6.2.2.2	E
	second normal at 90° at the point the ray emerges		1		
	correct emergent ray bent away from the normal	this mark can be awarded without a normal line drawn	1		
7.3	violet has the shortest wavelength (400 nm)		1	AO3 6.2.2.2	E
	violet light travels the slowest in water		1		
	violet light undergoes the greatest change in speed (and direction)		1		
Total			**9**		

GCSE
COMBINED SCIENCE: TRILOGY
8464/P/1H

Physics Paper 1H

Mark scheme

June 2019

Version: 1.0 Final

I96G8464pIh/MS

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The exemplar materials used during standardisation will help. There will be an answer in the standardising materials which will correspond with each level of the mark scheme. This answer will have been awarded a mark by the Lead Examiner. You can compare the student's answer with the example to determine if it is the same standard, better or worse than the example. You can then use this to allocate a mark for the answer based on the Lead Examiner's mark on the example.

You may well need to read back through the answer as you apply the mark scheme to clarify points and assure yourself that the level and the mark are appropriate.

Indicative content in the mark scheme is provided as a guide for examiners. It is not intended to be exhaustive and you must credit other valid points. Students do **not** have to cover all of the points mentioned in the indicative content to reach the highest level of the mark scheme.

You should ignore any irrelevant points made. However, full marks can be awarded only if there are no incorrect statements that contradict a correct response.

An answer which contains nothing of relevance to the question must be awarded no marks.

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
01.1	ammeter in series with the resistor, voltmeter in parallel with the resistor		1	AO1/1 6.2.1.4 RP 16 WS 2.4	A
01.2	current decreased	ignore slows down	1	AO1/1 6.2.1.3 RP 16 WS 3.6	E
01.3	reverse the connections to the cell	allow battery for cell allow reverse the cell	1	AO1/2 6.2.1.3 RP 16 WS 2.2	E
01.4	(directly) proportional	do not allow inversely proportional do not allow indirectly proportional	1	AO1/2 6.2.1.3 RP 16 WS 3.5	G
01.5	potential difference = current × resistance **or** V=IR	allow voltage for potential difference allow any correct re-arrangement	1	AO1/1 6.2.1.3 RP 16 WS 3.3	E
01.6	 3.0 = 0.12 × R R = $\frac{3.0}{0.12}$ R = 25 (Ω)	an answer of 25 (Ω) scores **3** marks	 1 1 1	AO2/1 6.2.1.3 RP 16 WS 3.3	E
Total			**8**		

<table>
<tr><th>Question</th><th>Answers</th><th>Extra information</th><th>Mark</th><th>AO / Spec. Ref.</th><th>ID</th></tr>
<tr><td>02.1</td><td>pressure decreased

because molecules have less (kinetic) energy

so fewer collisions (with the wall/container each second)</td><td>

allow less speed/velocity

allow collide with less force

allow less force on the walls</td><td>1

1

1</td><td>AO2.1

6.3.3.1</td><td>E</td></tr>
<tr><td>02.2</td><td>

0.70 = m × 330
or
700 = m × 330 000

$m = \frac{0.70}{330}$
or
$m = \frac{700}{330\,000}$

m = 0.0021 (kg)</td><td>an answer of 0.0021(212121…) scores 3 marks

allow correct rearrangement using converted value(s) of E to J and/or L to J/kg

allow 0.0021(212121…)
allow correct calculation using converted value(s) of E and/or L

3 marks can only be awarded for m = 0.0021(212121…) (kg)</td><td>

1

1

1</td><td>AO2.1

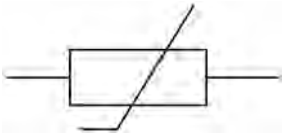
6.3.2.2
6.1.1.3</td><td>E</td></tr>
<tr><td>02.3</td><td><table><tr><th>Substance</th><th>Solid</th><th>Liquid</th><th>Gas</th></tr><tr><td>Oxygen</td><td></td><td>✓</td><td></td></tr><tr><td>Nitrogen</td><td></td><td></td><td>✓</td></tr><tr><td>Carbon dioxide</td><td>✓</td><td></td><td></td></tr></table>2 correct answers scores 1 mark.
if more than one tick in a row, neither tick can score a mark</td><td></td><td>2</td><td>AO3/2b

6.3.1.1</td><td>E</td></tr>
</table>

02.4	**Level 3:** Relevant points (reasons/causes) are identified, given in detail and logically linked to form a clear account.	5–6	AO1.1 6.3.1.2	E
	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 cooling • as the argon cools the particles slow down • particles in a liquid move slower than particles in a gas • particles in a solid move slower than particles in a liquid • as the liquid/solid cools the particles get closer together • as the liquid/solid cools the density increases gas to liquid • particles change from being spread apart to touching each other • particles will (collide with other particles more often and) change direction more often liquid to solid • particles change from a random arrangement to a regular pattern • particles change from moving freely to fixed positions • particles change from moving freely/randomly to vibrating explanation • (internal) energy (of the argon) decreases • (kinetic) energy (of the particles) decreases with temperature • (potential) energy (of the particles) changes with change of state (of the argon) • forces between particles in a gas are negligible/zero • attractive forces act between atoms when they are close to each other • attractive forces between particles are stronger in a solid than in a liquid to access level 3 there must be an explanation of changes to arrangement and movement of particles during either cooling or a change of state			

Total			**14**

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
03.1	an energy resource that cannot be replenished as it is used	allow an energy resource that will run out ignore cannot be re-used	1	AO1.1 AO1 in isolation 6.1.3	E
03.2	6.9 k(W) = 6900 (W) 6900 = 230 × I $I = \frac{6900}{230}$ I = 30 (A)	an answer of 30 (A) scores **4** marks allow correct substitution of an incorrectly/not converted value for power allow a correct transformation using an incorrectly/not converted value for power allow a correct calculation using an incorrectly/not converted value for power	1 1 1 1	AO2.1 6.2.4.1	E
03.3	direct potential difference is always in the same direction alternating potential difference changes direction	allow direct current is always in the same direction allow alternating current changes direction	1 1	AO1.1 6.2.3.1	E
03.4	lower potential difference across the cable it is more efficient **OR** (lower resistance gives) a greater current (for the same potential difference) (1) so the car battery can charge faster (1)	allow lower power/energy dissipation allow it won't get as hot	1 1	AO1.1 6.1.2.2 6.2.4.1	E
Total			**9**		

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
04.1	less than 20 Ω		1	AO2/1 6.2.2	A
04.2	the resistance of the lamp is added to the total resistance of the resistors in parallel the resistors in parallel have a total resistance of less than 10 ohms	allow resistors in series add up allow resistors in parallel have a smaller resistance than the lowest value resistor	1 1	AO3/1a 6.2.2	E E
04.3			1	AO1.1 AO1 in isolation 6.2.1.1	E
04.4	the current increased (because) the resistance (of the thermistor) decreased	 allow because the resistance of the circuit decreased	1 1	AO1.1 AO1 in isolation 6.2.1.4 6.2.1.3	E

04.5	**the resistor** the potential difference across the resistor becomes 0V because there is a short circuit across the resistor **the lamp** the potential difference across the lamp increases because the current increases	 allow because there is no current in the resistor allow switch has no resistance If neither of the first two marking points awarded, allow **1** mark for p.d. decreases because there is less current in the resistor **or** p.d. decreases because components in parallel have less resistance **or** p.d. decreases because there is an alternative route for the current allow the potential difference across the lamp will be the same as the battery allow because the resistance of the circuit decreases allow because there is less p.d. across the resistor	 1 1 1 1	AO2.2 6.2.2 6.2.1.1 6.2.1.3 WS 3.6	E
Total			**10**		

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
05.1	electrons collide with particles in the heating element which increases the (kinetic) energy of the particles (in the heating element)	allow there is a current in the heating element allow internal store of energy increases allow the particles (in the heating element) vibrate more rapidly	1 1	AO1.1 6.2.4.2 6.3.2.1 WS 1.2	E
05.2	the starting temperature of the water	allow the starting temperature of the kettle	1	AO3.3a 6.2.4.2 WS 2.2	E
05.3	(the heating element of) the kettle took time to heat up		1	AO3.1a 6.2.4.2 WS 3.7	E
05.4	the (rate of) energy transfer (per kg of water) to the surroundings decreases as the mass of water increases **or** the efficiency of the kettle increases as the mass of water increases	allow the (rate of) energy transfer (per kg of water) to the surroundings changes as the mass of water changes allow the efficiency of the kettle changes as the mass of water changes	1	AO3.1b 6.2.4.2 WS 3.7	E

05.5		an answer of 4800 (J/kg °C) scores **6** marks a correct answer given to more than 2 s.f. scores **5** marks		AO2.1 6.3.2.2 6.1.1.3 6.1.1.4 WS 3.3	E
	E = 2600 × 120	allow a correct substitution of an incorrectly/not converted value of P and/or t.	1		
	E = 312 000 (J)	this answer only the equation E=Pt must have been used to score subsequent marks.	1		
	312 000 = 0.80 × c × (100-18) **or** 312 000 = 0.80 × c × (82)	allow use of their value of E calculated using E =Pt for this and subsequent steps	1		
	$c = \frac{312\,000}{0.80 \times 82}$		1		
	c = 4 756		1		
	c = 4 800 (J/kg °C) (2 s.f.)	this mark can only be scored for a correct rounding of a value of c calculated using correct equations	1		

Total			**11**

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
06.1	mass number stays the same, charge stays the same		1	AO1.1 6.4.2.2	A
06.2	gamma radiation is only weakly ionising **or** most gamma radiation will pass through any detector	 allow gamma radiation is very penetrating	1	AO1.1 6.4.2.1	E
06.3	any two from • the radiation spreads out in all directions • only some of the radiation goes into the G-M tube • only some of the radiation passing into the GM tube is detected	allow **2** marks for only some of the radiation passing into the GM tube is detected because gamma is weakly ionising	2	AO1.1 6.4.2.4	E
06.4	to reduce the amount of radiation received because radiation increases the risk of cancer or (genetic) mutation	allow to reduce irradiation (of the teacher) allow causes cancer or (genetic) mutation ignore references to contamination	1 1	AO1.1 6.4.2.1 WS 1.4	E

06.5	a calculation of the product of thickness and count rate a second calculation of the product of thickness and count rate a comparison of the calculated values and a recognition that they are different **OR** A calculation of half the count rate (1) A comparison with the count rate for double that thickness (1) A recognition that the values are different (1)	examples of calculations 0.5 × 110 = 55 1.0 × 60 = 60 1.5 × 33 = 50 2.0 × 18 = 36 2.5 × 10 = 25 e.g. $\frac{110}{2} = 55$ the first two marks may be scored for a count rate divided by 3, 4 or 5 compared with the corresponding count rate for 3, 4 or 5 times the thickness e.g. 55 ≠ 60	1 1 1	AO3.1b 6.4.2.1	E
06.6	$^{140}_{57}La \longrightarrow {}^{0}_{-1}e + {}^{140}_{58}Ce$	allow **1** mark for correct numbers on electron allow **1** mark for correct numbers on Ce	2	AO1.1 AO1 in isolation AO1.2 6.4.2.2	E

06.7		an answer of $\frac{1}{32}$ or equivalent scores **4** marks		AO3.1a 6.4.2.3	E
	half-life = 50 seconds	this may be indicated on Figure 7	1		
	250 seconds difference in age = 5 half lives	allow 100 seconds = 2 half lives **and** 350 seconds = 7 half lives	1		
	ratio = $\left(\frac{1}{2}\right)^5$ **or** ratio = $\frac{1}{2}\times\frac{1}{2}\times\frac{1}{2}\times\frac{1}{2}\times\frac{1}{2}$	allow this mark if they have halved $1.25(\times 10^{23})$ five times to get $0.0390625(\times 10^{23})$ for example $1.25(\times 10^{23}) \rightarrow 0.625(\times 10^{23}) \rightarrow 0.3125(\times 10^{23}) \rightarrow 0.15625(\times 10^{23}) \rightarrow 0.078125(\times 10^{23}) \rightarrow 0.0390625(\times 10^{23})$	1		
	ratio = $\frac{1}{32}$ **or** ratio = 1:32	allow ratio = 0.031 allow 32:1 **or** 32	1		
06.8	tangent drawn on graph	do not allow a line drawn that crosses the graph line	1	AO2.2 6.4.2.1	E
	use of gradient = $\frac{(\Delta \text{ no. of atoms})}{\Delta \text{ time}}$	values must be taken from their tangent drawn at 20 seconds	1		
	gradient = 5.3 $(\times 10^{21})$ (Bq)	allow gradient = 0.053 $(\times 10^{23})$ (Bq) allow a range between 4.7 $(\times 10^{21})$ (Bq) and 5.9 $(\times 10^{21})$ (Bq)	1		

Total			**18**

AQA

Please write clearly in block capitals.

Centre number | | | | | | Candidate number | | | | |

Surname _____

Forename(s) _____

Candidate signature _____

GCSE
COMBINED SCIENCE: TRILOGY

F

Foundation Tier
Physics Paper 2F

Friday 14 June 2019 Morning Time allowed: 1 hour 15 minutes

Materials

For this paper you must have:
- a protractor
- a ruler
- a scientific calculator
- the Physics Equations Sheet (enclosed).

Instructions
- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions in the spaces provided.
- Do all rough work in this book. Cross through any work you do not want to be marked.
- In all calculations, show clearly how you work out your answer.

For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
TOTAL	

Information
- The maximum mark for this paper is 70.
- The marks for questions are shown in brackets.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.

Do not write outside the box

0 1 Magnetic force is a non-contact force.

0 1 . 1 Which **two** of these are also non-contact forces?

[2 marks]

Tick (✓) **two** boxes.

Air resistance ☐

Electrostatic ☐

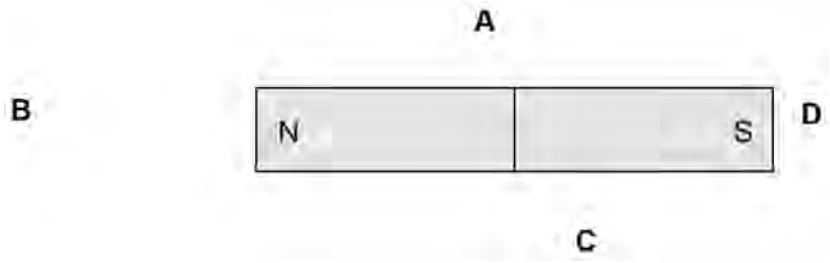
Friction ☐

Gravitational ☐

Tension ☐

0 1 . 2 **Figure 1** shows a bar magnet.

Figure 1



Which letter shows the position where the magnetic field around the bar magnet is strongest?

[1 mark]

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

Do not write outside the box

0 1 . 3 When two magnets are brought close to each other they exert a force on each other.

Describe how two bar magnets can be used to demonstrate a force of attraction and a force of repulsion.

[2 marks]

Force of attraction _____

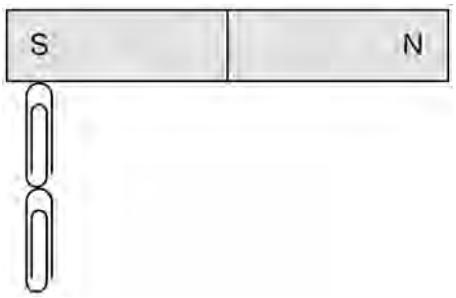
_____

Force of repulsion _____

_____

Figure 2 shows some paper clips that are attracted to a permanent magnet.

Figure 2



0 1 . 4 The paperclips become magnetised when they are close to the permanent magnet.

What is the name of this type of magnetism?

[1 mark]

Tick (✓) **one** box.

Forced magnetism ☐

Induced magnetism ☐

Strong magnetism ☐

0 1 . 5 Label the north and south poles of the two magnetised paper clips in **Figure 2**.

[2 marks]

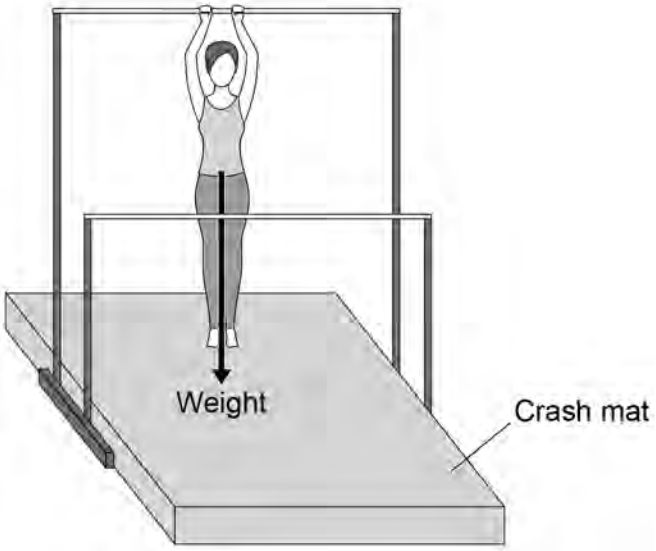
8

Do not write outside the box

0 2 **Figure 3** shows a gymnast on a piece of gymnastic equipment.

The equipment consists of two bars at different heights.

Figure 3



0 2 . 1 The gymnast exerts a downward force on the bar.

What is the size of the upward force acting on the gymnast from the bar?

[1 mark]

Tick (✓) **one** box.

It is greater than the downward force. ☐

It is less than the downward force. ☐

It is the same size as the downward force. ☐

Do not write outside the box

0 2 . 2 Why is the weight of the gymnast represented by an arrow?

[1 mark]

Tick (✓) **one** box.

Weight is a constant. ☐

Weight is a scalar. ☐

Weight is a unit. ☐

Weight is a vector. ☐

0 2 . 3 **Figure 3** shows the weight of the gymnast acting from a point.

What name is given to this point?

[1 mark]

Tick (✓) **one** box.

Centre of force ☐

Centre of mass ☐

Centre of tension ☐

Centre of weight ☐

Question 2 continues on the next page

Do not write outside the box

0 2 . 4 The gymnast has a mass of 45 kg

gravitational field strength = 9.8 N/kg

Calculate the weight of the gymnast.

Use the equation:

weight = mass × gravitational field strength

[2 marks]

Weight = _____ N

0 2 . 5 The gymnast swings from one bar to the other bar several times.

Describe how the gravitational potential energy store and the kinetic energy store of the gymnast change as she moves between the bars.

[4 marks]

Do not write outside the box

0 2 . 6 Falling on the crash mat reduces the average deceleration of the gymnast compared with falling on a hard surface.

Explain why reducing the deceleration is important to the gymnast.

[2 marks]

11

Turn over for the next question

Do not write outside the box

0 3 **Figure 4** shows two children playing table tennis.

The boy hits the ball from one end of the table.

Figure 4

0 3 . 1 Why does the velocity of the ball change when the boy hits it?

[1 mark]

Tick (✓) **one** box.

The direction of the ball does not change. ☐

There is a resultant force on the ball. ☐

The mass of the ball increases. ☐

The speed of the ball is constant. ☐

Do not write outside the box

0 3 . 2 The ball has an average speed of 11 m/s

The ball takes 0.25 s to travel the same distance as the length of the table.

Calculate the length of the table.

Use the equation:

distance travelled = speed × time

[2 marks]

Length of table = _____ m

Question 3 continues on the next page

Do not write outside the box

0 3 . 3 A table tennis ball should only be used if it bounces to at least 75% of the height it was dropped from.

A manufacturer tested a table tennis ball.

Table 1 shows the results.

Table 1

Height ball was dropped from in cm	Height of bounce in cm
30.0	25.1

Determine whether the ball can be used.

Use the data from **Table 1**.

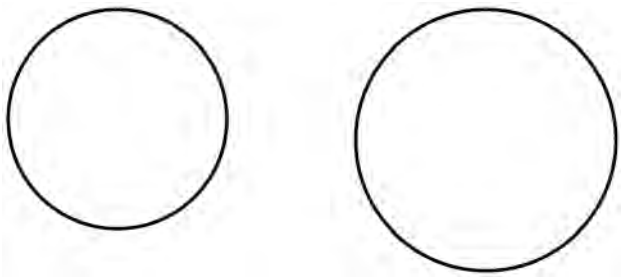
[3 marks]

Do not write outside the box

0 3 . 4 **Figure 5** shows two table tennis balls.

The balls are different sizes but have the same mass.

Figure 5



Both balls were dropped onto the table from the same height.

After they were dropped, the resultant force on the smaller ball was greater than the resultant force on the larger ball.

Explain why.

[2 marks]

8

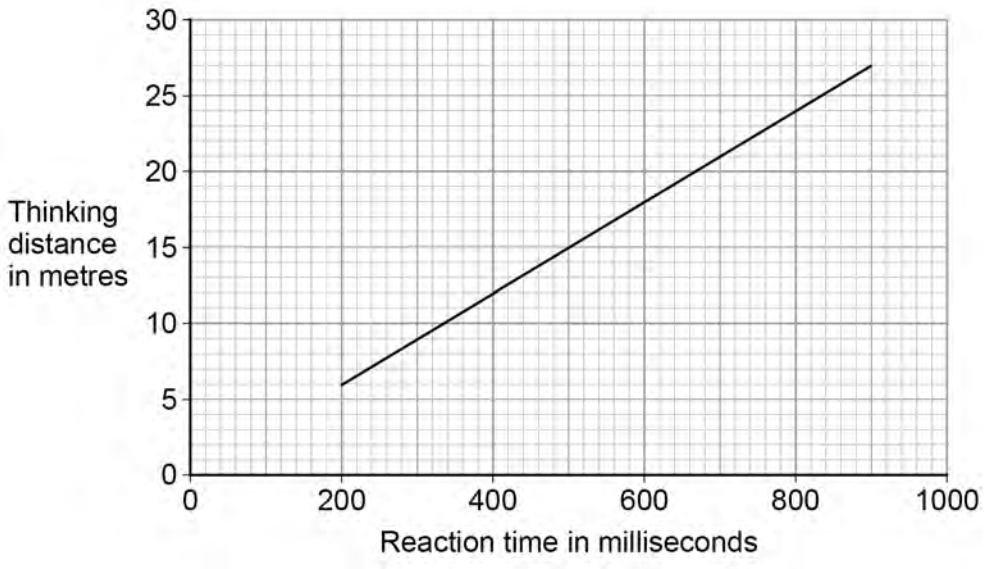
Turn over for the next question

Do not write outside the box

0 4 The thinking distance of a car depends on the reaction time of the driver.

Figure 6 shows how thinking distance varies with reaction time for a car travelling at 30 m/s

Figure 6



0 4 . 1 The reaction time of a driver can double if the driver is distracted.

Explain the effect doubling the reaction time has on the thinking distance.

Use data from **Figure 6**.

[2 marks]

0 4 . 2 Give the reason why there are no values of thinking distance for reaction times less than 200 milliseconds.

[1 mark]

Do not write outside the box

A driver measured her reaction time using an online test. She did the test five times.

Table 2 shows the results.

Table 2

Reaction time in milliseconds				
258	265	302	248	327

0 4 . 3 How does the data in **Table 2** show that it was important that the driver did the test five times?

[1 mark]

0 4 . 4 Calculate the mean reaction time of the driver.

[2 marks]

Mean reaction time = _____ ms

0 4 . 5 The driver is driving her car at 30 m/s

Determine the thinking distance.

Use **Figure 6** and your answer from Question **04.4**

[1 mark]

Thinking distance = _____ m

Do not write outside the box

0 4 . 6 The driver applies the brakes and the car comes to a stop.

The force exerted by the brakes affects the braking distance.

Give **two** other factors that affect the braking distance.

[2 marks]

1 _____

2 _____

0 4 . 7 Write down the equation that links distance, force and work done.

[1 mark]

_____

0 4 . 8 When the driver applies the brakes, there is a constant resultant force of 6.0 kN on the car.

The car travels a distance of 75 m before stopping.

Calculate the work done in stopping the car.

[3 marks]

_____

_____

_____

_____

_____

_____

Work done = _____ J

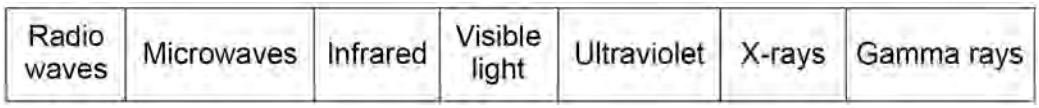
13

Do not write outside the box

0 5 The Sun emits all types of electromagnetic waves.

Figure 7 shows the electromagnetic spectrum.

Figure 7



0 5 . 1 Complete the sentences.

Choose answers from the box.

[3 marks]

frequency	**mass**	**power**
velocity		**wavelength**

In a vacuum, all electromagnetic waves travel at the same _____ .

Gamma waves have the greatest _____ .

Radio waves have the greatest _____ .

0 5 . 2 Explain why it is important that the Earth's atmosphere absorbs gamma rays emitted by the Sun.

[2 marks]

_____

_____

_____

_____

0 5 . 3 Some microwaves are **not** absorbed by the Earth's atmosphere.

Why is this useful?

[1 mark]

_____

Turn over ►

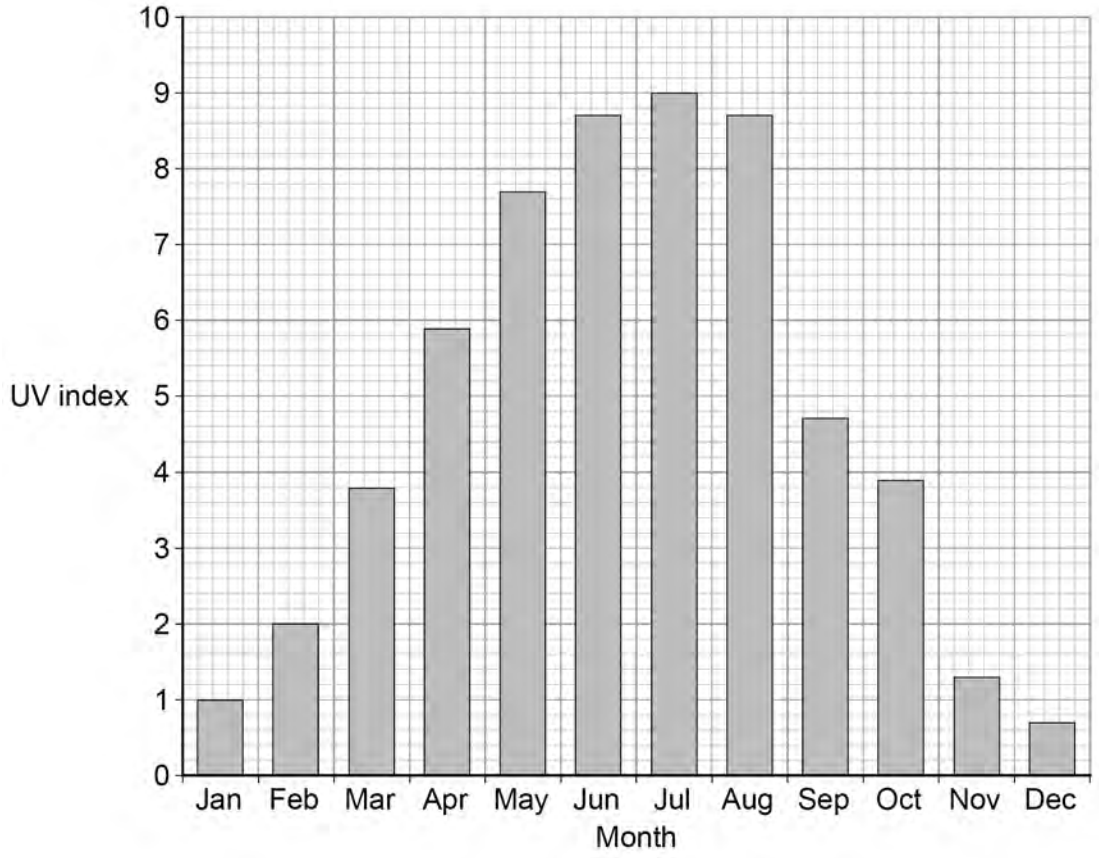
Do not write outside the box

Some ultraviolet (UV) radiation from the Sun passes through the atmosphere and reaches the surface of the Earth.

The amount of UV radiation that reaches the surface of the Earth can be measured on a scale called the UV index.

Figure 8 shows the average midday UV index in the UK for 1 year.

Figure 8



0 5 . 4 Why is exposure to UV radiation harmful to humans?

[1 mark]

Do not write outside the box

0 5 . 5 Compare the risk from UV radiation at different times of year in the UK.

Use data from **Figure 8**.

[2 marks]

9

Turn over for the next question

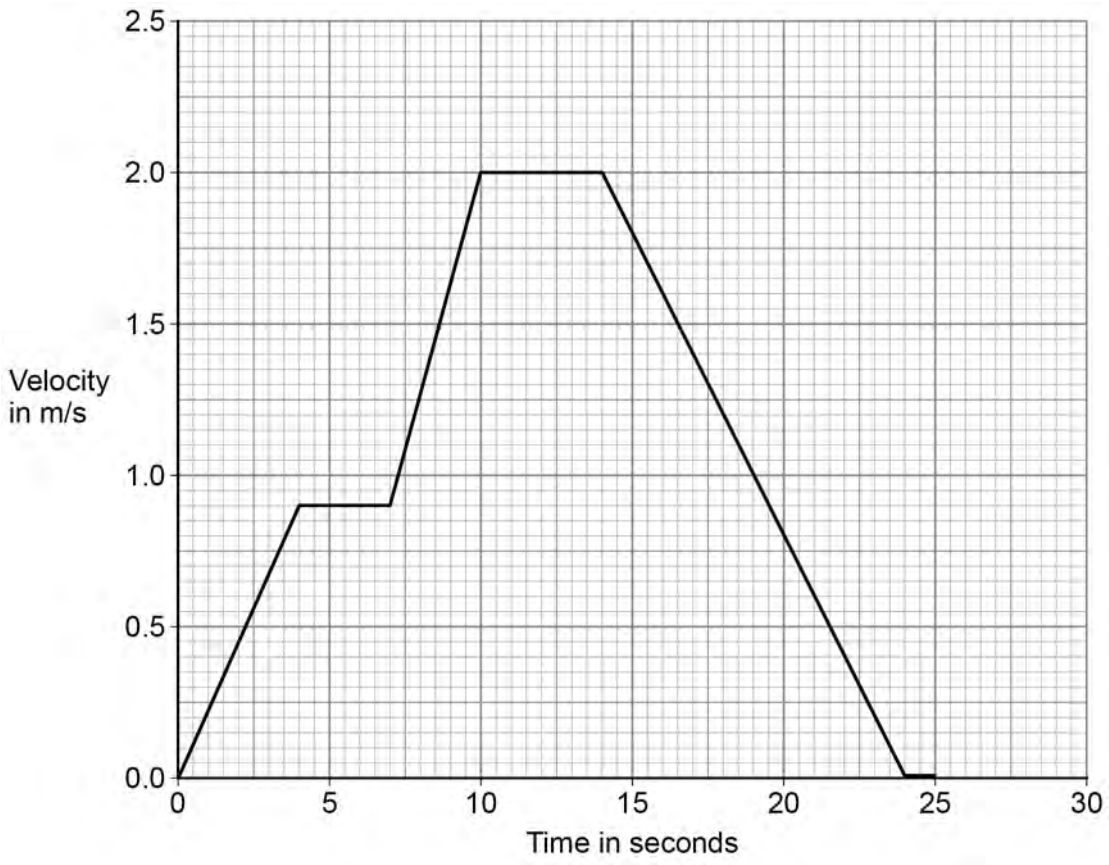
Do not write outside the box

0 6 **Figure 9** shows a runner using a smart watch and a mobile phone to monitor her run.

Figure 9

Figure 10 is a velocity–time graph for part of the runner's warm-up.

Figure 10



Do not write outside the box

0 6 . 1 Determine the total time for which the velocity of the runner was increasing.

[2 marks]

Time = _____ s

0 6 . 2 Determine the deceleration of the runner.

[2 marks]

Deceleration = _____ m/s^2

Question 6 continues on the next page

Do not write outside the box

The smart watch and mobile phone are connected to each other by a system called Bluetooth.

Bluetooth is wireless and uses electromagnetic waves for communication.

0 6 . 3 Suggest why the phone and watch being connected by a wireless system is an advantage when running.

[1 mark]

0 6 . 4 Write down the equation that links frequency, wave speed and wavelength.

[1 mark]

0 6 . 5 The electromagnetic waves have a frequency of 2 400 000 000 Hz

The speed of electromagnetic waves is 300 000 000 m/s

Calculate the wavelength of the electromagnetic waves.

[3 marks]

Wavelength = _____ m

Do not write outside the box

0 6 . 6 **Table 3** shows some information about four types of Bluetooth.

Table 3

Type	Power in milliwatts	Range in metres
1	100	100
2	2.50	10.0
3	1.00	1.00
4	0.50	0.50

Mobile phones use type **2** Bluetooth to communicate with other devices.

Suggest **two** reasons why.

[2 marks]

1 _____

_____

2 _____

_____

11

Turn over for the next question

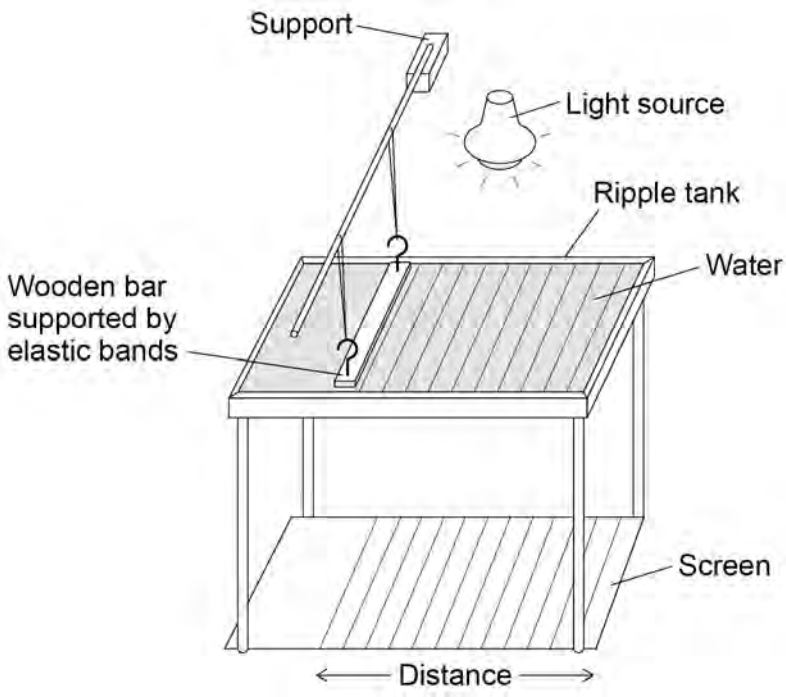
Do not write outside the box

0 7 **Figure 11** shows the equipment a teacher used to determine the speed of a water wave.

The equipment includes:

- a ripple tank filled with water
- a wooden bar that creates ripples on the surface of the water
- a light source which causes a shadow of the ripples on the screen.

Figure 11



0 7 . 1 Describe how equipment in **Figure 11** can be used to measure the wavelength, frequency and speed of a water wave.

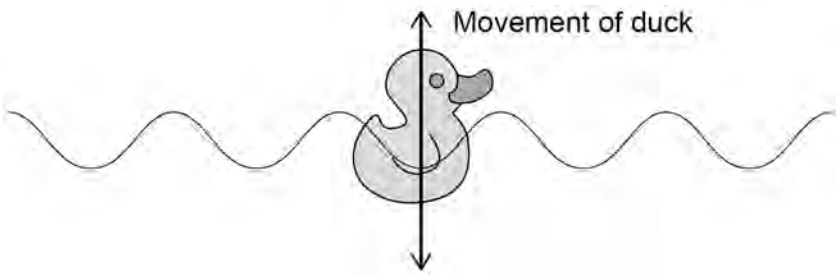
[6 marks]

Do not write outside the box

The teacher put a plastic duck in the ripple tank as shown in **Figure 12**.

The plastic duck moved up and down as the waves in the water passed.

Figure 12



0 7 . 2 How does the movement of the plastic duck in **Figure 12** demonstrate that water waves are transverse?

[1 mark]

Question 7 continues on the next page

Do not write outside the box

0 7 . 3 The teacher measured the maximum height and the minimum height of the plastic duck above the screen as the wave passed.

The teacher repeated his measurements.

Table 4 shows the teacher's measurements.

Table 4

Maximum height in mm	509	513	511
Minimum height in mm	503	498	499

Calculate the mean amplitude of the water wave.

[3 marks]

Mean amplitude = _____ mm

10

END OF QUESTIONS

AQA

Please write clearly in block capitals.

Centre number | | | | | | Candidate number | | | | |

Surname _____

Forename(s) _____

Candidate signature _____

GCSE
COMBINED SCIENCE: TRILOGY

F

Foundation Tier
Physics Paper 1F

Wednesday 22 May 2019 Afternoon Time allowed: 1 hour 15 minutes

Materials

For this paper you must have:
- a ruler
- a scientific calculator
- the Physics Equations Sheet (enclosed).

Instructions
- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions in the spaces provided.
- Do all rough work in this book. Cross through any work you do not want to be marked.
- In all calculations, show clearly how you work out your answer.

For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
TOTAL	

Information
- The maximum mark for this paper is 70.
- The marks for questions are shown in brackets.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.

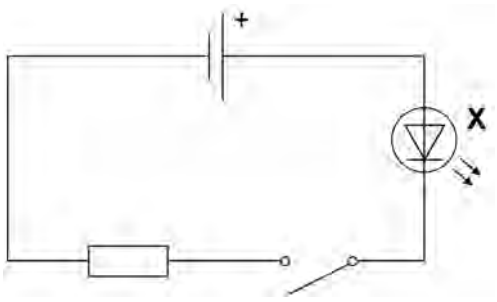
Do not write outside the box

0 1 A designer made some shoes that have lights in them.

Each shoe has a switch which closes when a person puts their foot on the floor.

Figure 1 shows the circuit.

Figure 1



0 1 . 1 What is component **X**?

[1 mark]

Tick (✓) **one** box.

Lamp ☐

LDR ☐

LED ☐

0 1 . 2 Complete the sentence.

Choose the answer from the box.

[1 mark]

greater than	**less than**	**the same as**

When the switch was closed, the current in component **X** was

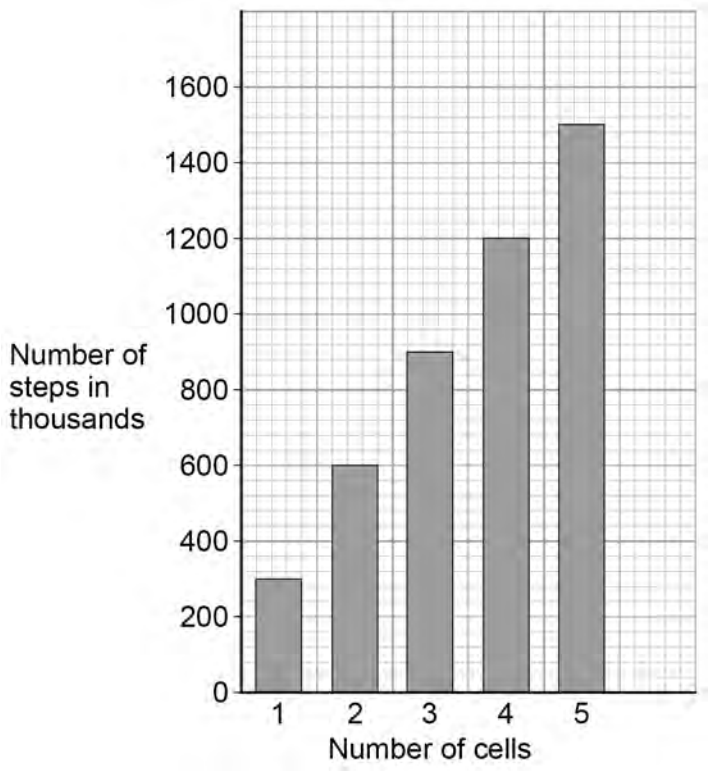
_____ the current in the resistor.

Do not write outside the box

The designer tested how the number of cells affected the number of steps that could be taken before the lights stopped working.

Figure 2 shows the results.

Figure 2



0 1 . 3 Determine how many more steps could be taken when the number of cells was increased from 3 to 5

[2 marks]

Number of steps = _____ thousand

Question 1 continues on the next page

Do not write outside the box

0 1 . 4 How could the designer check the repeatability of the results?

[1 mark]

Tick (✓) **one** box.

Repeat the experiment with a different resistor in the circuit. ☐

Repeat the experiment using exactly the same method. ☐

Repeat the experiment with different types of shoe. ☐

0 1 . 5 When the potential difference across the resistor was 0.80 V, the current in the resistor was 0.020 A

Calculate the power dissipated by the resistor.

Use the equation:

power = potential difference × current

[2 marks]

Power = _____ W

0 1 . 6 Which other equation can be used to calculate the power dissipated by a resistor?

[1 mark]

Tick (✓) **one** box.

Power = (current)^2 × resistance ☐

Power = $\frac{\text{current}}{(\text{resistance})^2}$ ☐

Power = current × (resistance)^2 ☐

Do not write outside the box

0 1 . 7 What happens to the temperature of the resistor when there is a current in it?

[1 mark]

0 1 . 8 There was a current of 0.020 A in the resistor for 180 seconds.

Calculate the charge flow through the resistor.

Use the equation:

charge flow = current × time

[2 marks]

Charge flow = _____ C

11

Turn over for the next question

Do not write outside the box

0 2 A student investigated how the area of a solar panel affected the output potential difference of the solar panel.

The student placed different sized solar panels under a lamp.

Figure 3 shows a solar panel under a lamp.

Figure 3

0 2 . 1 Which variable should be controlled?

[1 mark]

Tick (✓) **one** box.

The area of the solar panels ☐

The brightness of the lamp ☐

The output potential difference of the solar panels ☐

Do not write outside the box

0 2 . 2 The student measured the output potential difference using a voltmeter.

When the voltmeter was **not** connected, the reading on the voltmeter was 0.7 V

What name is given to this type of error?

[1 mark]

Tick (✓) **one** box.

Zero error ☐

Random error ☐

Measurement error ☐

Question 2 continues on the next page

Do not write outside the box

Table 1 shows the results of the investigation.

Table 1

Solar panel	Area of solar panel in cm^2	Output potential difference in volts			
		Test 1	Test 2	Test 3	Mean
A	10	2.5	2.4	2.6	2.5
B	20	5.0	5.0	4.9	5.0
C	30	7.5	11.9	7.5	7.5
D	50	12.4	12.6	12.5	12.5

0 2 . 3 The readings for which solar panel show an anomalous result?

[1 mark]

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

0 2 . 4 The student did **not** have a solar panel with an area of 40 cm^2

Determine the most likely value for the mean output potential difference of a 40 cm^2 solar cell.

[1 mark]

Mean output potential difference = _____ V

Do not write outside the box

0 2 . 5 The total input energy transfer to one of the solar panels was 8.0 joules.

The useful output energy transfer was 0.96 joules.

Calculate the efficiency of the solar panel.

Use the equation:

$$\text{efficiency} = \frac{\text{useful output energy transfer}}{\text{total input energy transfer}}$$

[2 marks]

Efficiency = _____

0 2 . 6 Solar power is a renewable energy resource.

Complete the sentence.

Choose the answer from the box.

[1 mark]

burned	**replenished**	**consumed**

A renewable energy resource is one that is _____ as it is used.

Question 2 continues on the next page

Do not write outside the box

0 2 . 7 Some homes have solar panels which generate electricity.

On a sunny day the potential difference across a solar panel is 31 volts.

A charge of 490 coulombs flows through the solar panel.

Calculate the energy transferred by the solar panel.

Use the equation:

energy transferred = charge flow × potential difference

Give your answer to 2 significant figures.

[3 marks]

Energy transferred = _____ J

0 2 . 8 Why do solar panels on homes help reduce the environmental impact of using electrical devices?

[1 mark]

Tick (✓) **one** box.

Less electricity is used in the home. ☐

Less fossil fuel is burned. ☐

The electricity from the solar panels is cheaper. ☐

11

Do not write outside the box

Turn over for the next question

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

Do not write outside the box

0 3 In an experiment, a beam of alpha particles was directed at a thin sheet of gold foil.

0 3 . 1 Most of the alpha particles passed straight through the gold foil.

Alpha particles which passed close to the nucleus of a gold atom did **not** pass straight through.

What happened to the alpha particles which passed close to the nucleus of a gold atom?

[1 mark]

0 3 . 2 The results suggested that the diameter of the nucleus of a gold atom is $\frac{1}{6000}$ of the diameter of the atom.

The diameter of a gold atom is 0.18 nm

Calculate the diameter of a gold nucleus in nm

[2 marks]

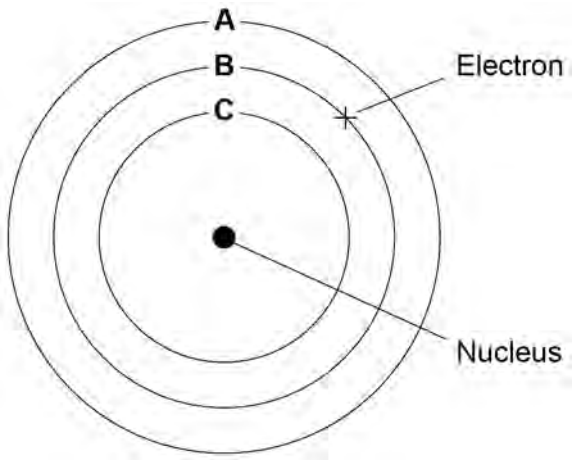
Diameter = _____ nm

Do not write outside the box

0 3 . 3 Further experiments showed that gold nuclei are surrounded by electrons in different energy levels.

Figure 4 shows three of the energy levels around the nucleus of a gold atom.

Figure 4



The electron in energy level **B** absorbs electromagnetic radiation.

Which energy level will the electron be in after it has absorbed the electromagnetic radiation?

[1 mark]

Tick (✓) **one** box.

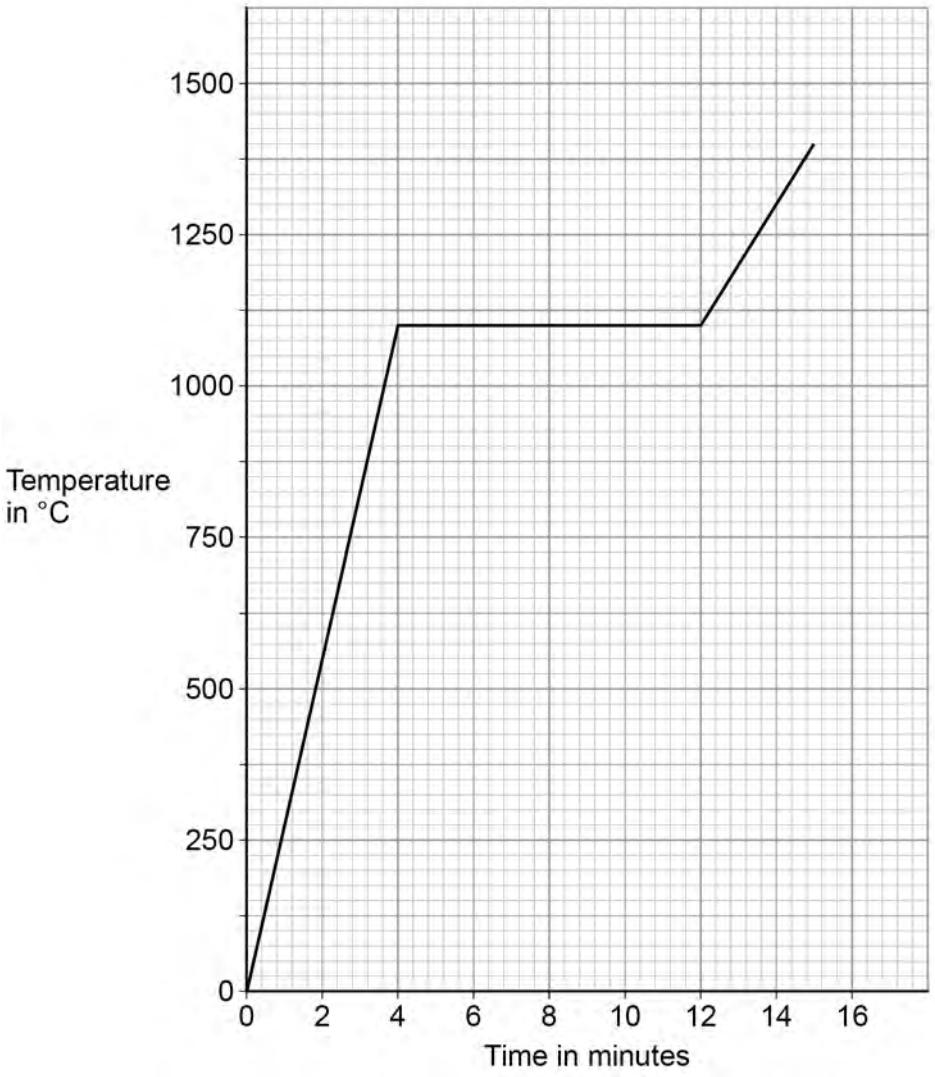
A ☐ **B** ☐ **C** ☐

Question 3 continues on the next page

Do not write outside the box

Figure 5 shows how the temperature of a small sample of gold changes as it is heated from a solid to a liquid.

Figure 5



0 3 . 4 What is the melting point of the gold?

[1 mark]

Melting point = _____ °C

0 3 . 5 How many minutes did it take for all of the gold in the sample to change from solid to liquid?

[1 mark]

Time taken = _____ minutes

Do not write outside the box

0 3 . 6 What does the gradient of the graph in **Figure 5** represent?

[1 mark]

Tick (✓) **one** box.

The internal energy of the gold ☐

The rate of change of temperature of the gold ☐

The specific heat capacity of the gold ☐

7

Turn over for the next question

Do not write outside the box

0 4 Protactinium (Pa) is radioactive.

0 4 . 1 An atom of one isotope of protactinium contains 91 protons and 143 neutrons.

What is the correct symbol for this atom?

[1 mark]

Tick (✓) **one** box.

$^{143}_{91}Pa$ ☐ $^{234}_{91}Pa$ ☐ $^{234}_{143}Pa$ ☐ $^{91}_{52}Pa$ ☐

A teacher investigated how the count rate from a sample of protactinium changed over time.

Table 2 shows the results.

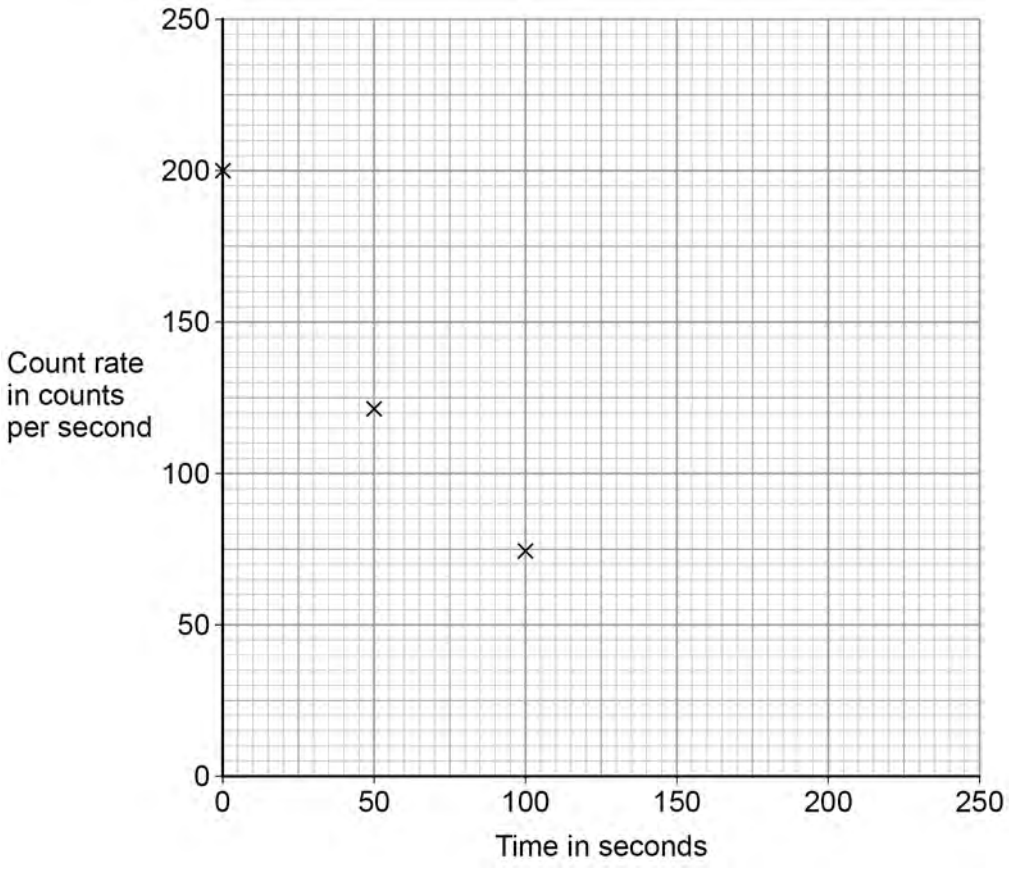
Table 2

Time in seconds	Count rate in counts per second
0	200
50	122
100	74
150	45
200	27

Do not write outside the box

Figure 6 shows some of the teacher's results.

Figure 6



0 4 . 2 Complete the graph in **Figure 6**.

Use data from **Table 2**.

Draw the line of best fit.

[2 marks]

0 4 . 3 How much time did it take for the count rate to change from 200 counts per second to 100 counts per second?

[1 mark]

Time taken = _____ s

0 4 . 4 What is the half-life of protactinium?

[1 mark]

Half-life = _____ s

Turn over ►

Do not write outside the box

0 4 . 5 The nuclear radiation from the protactinium can pass through paper.

This radiation can only be detected up to 1 metre away from the protactinium.

What type of radiation is emitted by the protactinium?

[1 mark]

Tick (✓) **one** box.

Alpha ☐

Beta ☐

Gamma ☐

Neutron ☐

0 4 . 6 The teacher read an article about the effects of radiation on the human body.

Why are articles in scientific journals generally more trustworthy than articles in newspapers?

[1 mark]

_____

_____

7

Do not write outside the box

0 5 **Figure 7** shows a toaster.

Figure 7

The toaster is connected to the mains supply using a three-core cable.

0 5 . 1 What is the function of the earth wire inside the cable?

[1 mark]

Tick (✓) **one** box.

To carry the current from the supply to the toaster ☐

To complete the circuit in the toaster ☐

To melt if a fault occurs inside the toaster ☐

To stop the metal case of the toaster becoming live if a fault occurs ☐

0 5 . 2 Complete the sentences.

Choose answers from the box.

[3 marks]

blue	**brown**	**orange**	**white**	**yellow**

The insulation around the earth wire is green and _____ .

The insulation around the live wire is _____ .

The insulation around the neutral wire is _____ .

Turn over ►

Do not write outside the box

0 5 . 3 The toaster is switched on for 120 seconds.

The power of the toaster is 850 watts.

Calculate the energy transferred by the toaster.

Use the equation:

energy transferred = power × time

[2 marks]

Energy transferred = _____ J

0 5 . 4 Complete the sentences.

Choose answers from the box.

[2 marks]

chemical	**elastic potential**	**kinetic**	**thermal**

When bread is lowered into the toaster, a spring is stretched. The stretched spring stores _____ energy.

After the bread is toasted, the spring makes the toast move upwards. As the speed of the toast increases, the _____ energy of the toast increases.

Do not write outside the box

0 5 . 5 Write the equation which links gravitational field strength, gravitational potential energy, height and mass.

[1 mark]

0 5 . 6 The toast was moved upwards by the spring.

The change in gravitational potential energy of the toast was 0.049 J

The mass of the toast was 0.050 kg

gravitational field strength = 9.8 N/kg

Calculate the change in height of the toast.

[3 marks]

Change in height = _____ m

12

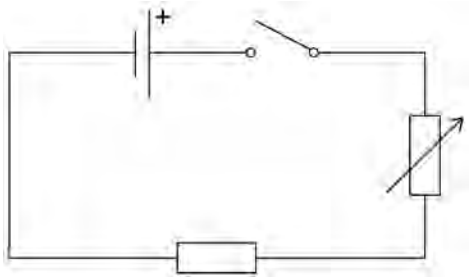
Turn over for the next question

Do not write outside the box

0 6 A student investigated how the current in a resistor varies with the potential difference across the resistor.

Figure 8 shows part of the circuit used.

Figure 8



0 6 . 1 The student connected an ammeter and a voltmeter into the circuit.

What is the correct way to connect the ammeter and the voltmeter into the circuit?

[1 mark]

Tick (✓) **one** box.

Ammeter	**Voltmeter**	
In parallel with the resistor	In series with the resistor	
In parallel with the cell	In series with the resistor	
In series with the resistor	In parallel with the resistor	
In series with the resistor	In parallel with the cell	

0 6 . 2 The student increased the resistance of the variable resistor.

How did increasing the resistance affect the current in the circuit?

[1 mark]

Do not write outside the box

0 6 . 3 How should the student change the circuit to give negative values for current and potential difference?

[1 mark]

0 6 . 4 Name the type of relationship between current and potential difference for a resistor at constant temperature.

[1 mark]

0 6 . 5 Write the equation which links current, potential difference and resistance.

[1 mark]

0 6 . 6 The current in the resistor was 0.12 A when the potential difference across the resistor was 3.0 V

Calculate the resistance of the resistor.

[3 marks]

Resistance = _____ Ω

8

Do not write outside the box

0 7 A scientist cooled the air inside a container.

0 7 . 1 The temperature of the air changed from 20 °C to 0 °C

The volume of the container of air stayed the same.

Explain how the motion of the air molecules caused the pressure in the container to change as the temperature decreased.

[3 marks]

0 7 . 2 The air contained water that froze at 0 °C

The change in internal energy of the water as it froze was 0.70 kJ

The specific latent heat of fusion of water is 330 kJ/kg

Calculate the mass of ice produced.

Use the Physics Equations Sheet.

[3 marks]

Mass of ice = _____ kg

Do not write outside the box

0 7 . 3 The air also contained oxygen, nitrogen and carbon dioxide.

Oxygen boils at –183 °C and freezes at –218 °C
Nitrogen boils at –195 °C and freezes at –210 °C
Carbon dioxide sublimates at –78 °C

The scientist continued to cool the air to a temperature of –190 °C

What is the state of each substance at –190 °C?

[2 marks]

Tick (✓) **one** box for **each** row of the table.

Substance	**Solid**	**Liquid**	**Gas**
Oxygen			
Nitrogen			
Carbon dioxide			

Question 7 continues on the next page

Do not write outside the box

0 7 . 4 The air also contained a small amount of argon.

As the temperature of the air decreased from 20 °C to –190 °C the argon changed from a gas to a liquid to a solid.

Explain the changes in the arrangement and movement of the particles of the argon as the temperature of the air decreased.

[6 marks]

14

END OF QUESTIONS

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GCSE
COMBINED SCIENCE: TRILOGY
8464/P/2F

Physics Paper 2F

Mark scheme

June 2019

Version: 1.0 Final

1 9 6 G 8 4 6 4 P 2 F / M S

Mark schemes are prepared by the Lead Assessment Writer and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all associates participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every associate understands and applies it in the same correct way. As preparation for standardisation each associate analyses a number of students' scripts. Alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Assessment Writer.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

Further copies of this mark scheme are available from aqa.org.uk

Information to Examiners

1. General

The mark scheme for each question shows:

- the marks available for each part of the question
- the total marks available for the question
- the typical answer or answers which are expected
- extra information to help the Examiner make his or her judgement
- the Assessment Objectives, level of demand and specification content that each question is intended to cover.

The extra information is aligned to the appropriate answer in the left-hand part of the mark scheme and should only be applied to that item in the mark scheme.

At the beginning of a part of a question a reminder may be given, for example: where consequential marking needs to be considered in a calculation; or the answer may be on the diagram or at a different place on the script.

In general the right-hand side of the mark scheme is there to provide those extra details which confuse the main part of the mark scheme yet may be helpful in ensuring that marking is straightforward and consistent.

2. Emboldening and underlining

2.1 In a list of acceptable answers where more than one mark is available 'any **two** from' is used, with the number of marks emboldened. Each of the following bullet points is a potential mark.

2.2 A bold **and** is used to indicate that both parts of the answer are required to award the mark.

2.3 Alternative answers acceptable for a mark are indicated by the use of **or**. Different terms in the mark scheme are shown by a / ; eg allow smooth / free movement.

2.4 Any wording that is underlined is essential for the marking point to be awarded.

3. Marking points

3.1 Marking of lists

This applies to questions requiring a set number of responses, but for which students have provided extra responses. The general principle to be followed in such a situation is that 'right + wrong = wrong'.

Each error / contradiction negates each correct response. So, if the number of error / contradictions equals or exceeds the number of marks available for the question, no marks can be awarded.

However, responses considered to be neutral (indicated as * in example 1) are not penalised.

Example 1: What is the pH of an acidic solution?

[1 mark]

Student	Response	Marks awarded
1	green, 5	0
2	red*, 5	1
3	red*, 8	0

Example 2: Name two planets in the solar system.

[2 marks]

Student	Response	Marks awarded
1	Neptune, Mars, Moon	1
2	Neptune, Sun, Mars, Moon	0

3.2 Use of chemical symbols / formulae

If a student writes a chemical symbol / formula instead of a required chemical name, full credit can be given if the symbol / formula is correct and if, in the context of the question, such action is appropriate.

3.3 Marking procedure for calculations

Marks should be awarded for each stage of the calculation completed correctly, as students are instructed to show their working. Full marks can, however, be given for a correct numerical answer, without any working shown.

3.4 Interpretation of 'it'

Answers using the word 'it' should be given credit only if it is clear that the 'it' refers to the correct subject.

3.5 Errors carried forward

Any error in the answers to a structured question should be penalised once only.

Papers should be constructed in such a way that the number of times errors can be carried forward is kept to a minimum. Allowances for errors carried forward are most likely to be restricted to calculation questions and should be shown by the abbreviation ecf in the marking scheme.

3.6 Phonetic spelling

The phonetic spelling of correct scientific terminology should be credited **unless** there is a possible confusion with another technical term.

3.7 Brackets

(…..) are used to indicate information which is not essential for the mark to be awarded but is included to help the examiner identify the sense of the answer required.

3.8 Allow

In the mark scheme additional information, 'allow' is used to indicate creditworthy alternative answers.

3.9 Ignore

Ignore is used when the information given is irrelevant to the question or not enough to gain the marking point. Any further correct amplification could gain the marking point.

3.10 Do <u>not</u> accept

Do **not** accept means that this is a wrong answer which, even if the correct answer is given as well, will still mean that the mark is not awarded.

4. Level of response marking instructions

Extended response questions are marked on level of response mark schemes.

- Level of response mark schemes are broken down into levels, each of which has a descriptor.
- The descriptor for the level shows the average performance for the level.
- There are two marks in each level.

Before you apply the mark scheme to a student's answer, read through the answer and annotate it (as instructed) to show the qualities that are being looked for. You can then apply the mark scheme.

Step 1: Determine a level

Start at the lowest level of the mark scheme and use it as a ladder to see whether the answer meets the descriptor for that level. The descriptor for the level indicates the different qualities that might be seen in the student's answer for that level. If it meets the lowest level then go to the next one and decide if it meets this level, and so on, until you have a match between the level descriptor and the answer.

When assigning a level you should look at the overall quality of the answer. Do **not** look to penalise small and specific parts of the answer where the student has not performed quite as well as the rest. If the answer covers different aspects of different levels of the mark scheme you should use a best fit approach for defining the level.

Use the variability of the response to help decide the mark within the level, ie if the response is predominantly level 2 with a small amount of level 3 material it would be placed in level 2 but be awarded a mark near the top of the level because of the level 3 content.

Step 2: Determine a mark

Once you have assigned a level you need to decide on the mark. The descriptors on how to allocate marks can help with this.

The exemplar materials used during standardisation will help. There will be an answer in the standardising materials which will correspond with each level of the mark scheme. This answer will have been awarded a mark by the Lead Examiner. You can compare the student's answer with the example to determine if it is the same standard, better or worse than the example. You can then use this to allocate a mark for the answer based on the Lead Examiner's mark on the example.

You may well need to read back through the answer as you apply the mark scheme to clarify points and assure yourself that the level and the mark are appropriate.

Indicative content in the mark scheme is provided as a guide for examiners. It is not intended to be exhaustive and you must credit other valid points. Students do **not** have to cover all of the points mentioned in the indicative content to reach the highest level of the mark scheme.

You should ignore any irrelevant points made. However, full marks can be awarded only if there are no incorrect statements that contradict a correct response.

An answer which contains nothing of relevance to the question must be awarded no marks.

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
01.1	electrostatic gravitational		1 1	AO1 6.5.1.2	A
01.2	D		1	AO2 6.7.1.1	A
01.3	bring two unlike poles close together bring two like poles close together	allow north and south poles allow opposite poles allow two north / south poles allow N for north and S for south	1 1	AO1 6.7.1.1	E
01.4	induced magnetism		1	AO1 6.7.1.1	A
01.5	all 4 poles correctly labelled north and south	allow N for north and S for south allow 1 mark for 2 or 3 correctly labelled poles	2	AO3 6.7.1.1	E
Total			**8**		

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
02.1	it is the same size as the downward force		1	AO2 6.5.4.3.2	A
02.2	weight is a vector		1	AO1 6.5.1.1	A
02.3	centre of mass		1	AO2 6.5.1.3	A
02.4	W = 45 × 9.8 W = 441 (N)	an answer of 441 (N) scores **2** marks allow 440 (N)	1 1	AO2 6.5.1.3	E
02.5	**Level 2:** Scientifically relevant facts, events or processes are identified and given in detail to form an accurate account.		3–4	AO1 6.1.1.1	E
	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 • as height changes gravitational potential energy changes • gravitational potential energy decreases when moving to the lower bar • as speed changes kinetic energy changes • kinetic energy increases when moving to the lower bar • transfer from gravitational potential energy to kinetic energy as height decreases • the sum of the kinetic energy and gravitational potential energy is constant				
02.6	reduces the force exerted the risk of injury to gymnast is reduced	ignore impact allow so the gymnast does not get injured	1 1	AO3 6.5.4.2.2	E
Total			**11**		

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
03.1	there is a resultant force on the ball		1	AO1 6.5.4.2.1	A
03.2	s = 11 × 0.25 s = 2.75 (m)	an answer of 2.75 scores **2** marks allow 2.8 (m)	1 1	AO2 6.5.4.1.2	E
03.3	$\frac{75}{100} \times 30.0$ 22.5 (cm) (25.1 > 22.5) therefore the ball can be used OR $\frac{25.1}{30.0}$ ×100 (1) 84 % (1) (84% > 75%) therefore the ball can be used (1)	allow any correct method of determining 75% of 30 this mark can only be awarded if a supporting calculation has been done allow any correct supported conclusion allow a conclusion consistent with an incorrect percentage calculation this mark can only be awarded if a supporting calculation has been done allow any correct supported conclusion allow a conclusion consistent with an incorrect percentage calculation	1 1 1	AO3 6.5.4.1.2	E
03.4	the smaller ball has a smaller area (so) air resistance is less (on the smaller ball)		1 1	AO2 6.5.4.2.1	E
Total			**8**		

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
04.1	(thinking distance) will double any correct pair of points from graph eg (200,6) and (400,12)	 allow graph shows direct proportionality (after 200 ms) allow **1** mark for thinking distance increases with supporting data.	1 1	AO3 6.5.4.3.2	E
04.2	(most) people cannot react any quicker than 200 ms		1	AO1 6.5.4.3.2	E
04.3	there is variation in the measurements	allow the data is not very precise allow lots of random error ignore references to accuracy / reliability / average	1	AO3 6.5.4.3.2	E
04.4	(258+265+302+248+327) / 5 280 (ms)	an answer of 280 gains **2** marks	1 1	AO2 6.5.4.3.2	E
04.5	8.4 (m)	allow 7.9 (m) to 8.9 (m) allow ecf from **04.4**	1	AO2 6.5.4.3.2	E
04.6	any **two** from: • (material of) road surface • condition of the tyres • speed of the car • wet / icy road surface • gradient of road • mass / weight of the car	 Ignore any reference to brakes	2	AO1 6.5.4.3.3	
04.7	work done = force × distance (along the line of action of the force)	allow W = F s allow any correct re-arrangement	1	AO1 6.5.2	

04.8	F = 6000 N	an answer of 450 000 scores 3 marks	1	AO2 6.5.2	
	W = 6000 × 75	allow a correct substitution using an incorrectly / not converted value of F	1		
	W = 450 000 (J)	allow a correct calculation using an incorrectly / not converted value of F	1		
Total			**13**		

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
05.1	velocity frequency wavelength		1 1 1	AO1 6.6.2.3	G
05.2	so people are not exposed to (as much) gamma radiation because gamma radiation can damage human tissue	allow less gamma radiation reaches the Earth's surface allow increases the risk of cancer or (cell) mutation allow gamma rays are ionising ignore any reference to temperature / heating of the atmosphere	1 1	AO1 6.6.2.3	E
05.3	(microwaves) are used in (satellite) communications	ignore any reference to temperature / heating of the atmosphere	1	AO2 6.6.2.4	E
05.4	can cause skin cancer / premature ageing	allow sunburn allow eye / skin damage cancer on its own is insufficient	1	AO1 6.6.2.3	E
05.5	risk from UV radiation is highest in July / summer two correct readings from the bar chart which support their comparison	allow any sensible comparison of named months / seasons if no other mark scored, two correct readings from the graph scores **1** mark	1 1	AO3 6.6.2.3	E
Total			**9**		

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
06.1	(4 - 0) + (10 - 7) **or** 4 + 3 **or** 10 - 3 7 (s)	an answer of 7 (s) gains **2** marks	1 1	AO2 6.5.4.1.5	E
06.2	gradient = $\frac{0-2}{24-14}$ (-) 0.2 (m/s^2)	an answer of 0.2 (m/s^2) gains **2** marks allow readings from any two points correctly substituted allow correct use of $a = \frac{\Delta v}{t}$	1 1	AO2 6.5.4.1.5	E
06.3	(there are no wires) to get tangled / disconnected	allow easier to move arms allow wires are inconvenient allow easier to transfer data	1	AO3 6.6.2.4	E
06.4	wave speed = frequency × wavelength	allow v = f λ allow any correct re-arrangement	1	AO1 6.6.1.2	E
06.5	300 000 000 = 2 400 000 000 × λ λ = $\frac{300\,000\,000}{2\,400\,000\,000}$ λ = 0.125 (m)	an answer of 0.125 (m) or 0.13 (m) scores **3** marks allow λ = 0.13 (m)	1 1 1	AO2 6.6.1.2	E
06.6	range is far enough (for most uses) power is not too great so the battery will not drain quickly	allow power not too great so the phone will not overheat allow the range per milliwatt is greatest or 4 metres	1 1	AO3 6.6.2.4	E

Total			**11**		

Question	Answers	Mark	AO / Spec. Ref.	ID
07.1	**Level 3:** The design/plan would lead to the production of a valid outcome. All key steps are identified and logically sequenced.	5–6	AO1 6.6.1.2	E
	Level 2: The design/plan would not necessarily lead to a valid outcome. Most steps are identified, but the plan is not fully logically sequenced.	3–4		
	Level 1: The design/plan 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 • if two quantities have been determined, $v = f \lambda$ can be used to find the third. **Frequency** • use a stopclock • count the number of waves passing a point in a fixed time period • divide the time by the number of waves to determine the time for one wave, T • $f = 1/T$ • read the frequency off the oscillator **Wavelength** • use a camera to freeze the image • use a metre rule to measure the distance between two wavefronts • count the number of waves between the wavefronts • divide distance by the number of waves to determine λ **Velocity** • determine a mean value of frequency • determine a mean value of wavelength • measure the time it takes one wavefront to travel the length of the screen • measure the length of the screen • speed = distance / time To access Level 3 there must be a description of how frequency, wavelength and velocity can be determined			

07.2	(the duck) moves perpendicular to the direction of wave travel	duck moves up and down is insufficient	1	AO2 6.6.1.1	E
07.3	mean maximum height = 511 **and** mean minimum height = 500 511 – 500 = 11 11 / 2 = 5.5 (mm)	an answer of 5.5 (mm) gains **3** marks allow a calculated difference from incorrect means allow their difference divided by 2 any correct method of determining the mean amplitude can score 3 marks	1 1 1	AO2 6.6.1.2	E
Total			**10**		

GCSE
COMBINED SCIENCE: TRILOGY
8464/P/1F

Physics Paper 1F

Mark scheme

June 2019

Version: 1.0 Final

I96G8464pIf/MS

Mark schemes are prepared by the Lead Assessment Writer and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all associates participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every associate understands and applies it in the same correct way. As preparation for standardisation each associate analyses a number of students' scripts. Alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Assessment Writer.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

Further copies of this mark scheme are available from aqa.org.uk

Information to Examiners

1. General

The mark scheme for each question shows:

- the marks available for each part of the question
- the total marks available for the question
- the typical answer or answers which are expected
- extra information to help the Examiner make his or her judgement
- the Assessment Objectives, level of demand and specification content that each question is intended to cover.

The extra information is aligned to the appropriate answer in the left-hand part of the mark scheme and should only be applied to that item in the mark scheme.

At the beginning of a part of a question a reminder may be given, for example: where consequential marking needs to be considered in a calculation; or the answer may be on the diagram or at a different place on the script.

In general the right-hand side of the mark scheme is there to provide those extra details which confuse the main part of the mark scheme yet may be helpful in ensuring that marking is straightforward and consistent.

2. Emboldening and underlining

2.1 In a list of acceptable answers where more than one mark is available 'any **two** from' is used, with the number of marks emboldened. Each of the following bullet points is a potential mark.

2.2 A bold **and** is used to indicate that both parts of the answer are required to award the mark.

2.3 Alternative answers acceptable for a mark are indicated by the use of **or**. Different terms in the mark scheme are shown by a / ; e.g. allow smooth / free movement.

2.4 Any wording that is underlined is essential for the marking point to be awarded.

3. Marking points

3.1 Marking of lists

This applies to questions requiring a set number of responses, but for which students have provided extra responses. The general principle to be followed in such a situation is that 'right + wrong = wrong'.

Each error / contradiction negates each correct response. So, if the number of error / contradictions equals or exceeds the number of marks available for the question, no marks can be awarded.

However, responses considered to be neutral (indicated as * in examples 1 and 2) are not penalised.

Example 1: What is the pH of an acidic solution?

[1 mark]

Student	Response	Marks awarded
1	green, 5	0
2	red*, 5	1
3	red*, 8	0

Example 2: Name two planets in the solar system.

[2 marks]

Student	Response	Marks awarded
1	Neptune, Mars, Moon*	1
2	Neptune, Sun, Mars	0

3.2 Use of chemical symbols / formulae

If a student writes a chemical symbol / formula instead of a required chemical name, full credit can be given if the symbol / formula is correct and if, in the context of the question, such action is appropriate.

3.3 Marking procedure for calculations

Marks should be awarded for each stage of the calculation completed correctly, as students are instructed to show their working. Full marks can, however, be given for a correct numerical answer, without any working shown.

3.4 Interpretation of 'it'

Answers using the word 'it' should be given credit only if it is clear that the 'it' refers to the correct subject.

3.5 Errors carried forward

Any error in the answers to a structured question should be penalised once only.

Papers should be constructed in such a way that the number of times errors can be carried forward is kept to a minimum. Allowances for errors carried forward are most likely to be restricted to calculation questions and should be shown by the abbreviation ecf in the marking scheme.

3.6 Phonetic spelling

The phonetic spelling of correct scientific terminology should be credited **unless** there is a possible confusion with another technical term.

3.7 Brackets

(…..) are used to indicate information which is not essential for the mark to be awarded but is included to help the examiner identify the sense of the answer required.

3.8 Allow

In the mark scheme additional information, 'allow' is used to indicate creditworthy alternative answers.

3.9 Ignore

Ignore is used when the information given is irrelevant to the question or not enough to gain the marking point. Any further correct amplification could gain the marking point.

3.10 Do <u>not</u> accept

Do **not** accept means that this is a wrong answer which, even if the correct answer is given as well, will still mean that the mark is not awarded.

4. Level of response marking instructions

Extended response questions are marked on level of response mark schemes.

- Level of response mark schemes are broken down into levels, each of which has a descriptor.
- The descriptor for the level shows the average performance for the level.
- There are two marks in each level.

Before you apply the mark scheme to a student's answer, read through the answer and annotate it (as instructed) to show the qualities that are being looked for. You can then apply the mark scheme.

Step 1: Determine a level

Start at the lowest level of the mark scheme and use it as a ladder to see whether the answer meets the descriptor for that level. The descriptor for the level indicates the different qualities that might be seen in the student's answer for that level. If it meets the lowest level then go to the next one and decide if it meets this level, and so on, until you have a match between the level descriptor and the answer.

When assigning a level you should look at the overall quality of the answer. Do **not** look to penalise small and specific parts of the answer where the student has not performed quite as well as the rest. If the answer covers different aspects of different levels of the mark scheme you should use a best fit approach for defining the level.

Use the variability of the response to help decide the mark within the level, i.e. if the response is predominantly level 2 with a small amount of level 3 material it would be placed in level 2 but be awarded a mark near the top of the level because of the level 3 content.

Step 2: Determine a mark

Once you have assigned a level you need to decide on the mark. The descriptors on how to allocate marks can help with this.

The exemplar materials used during standardisation will help. There will be an answer in the standardising materials which will correspond with each level of the mark scheme. This answer will have been awarded a mark by the Lead Examiner. You can compare the student's answer with the example to determine if it is the same standard, better or worse than the example. You can then use this to allocate a mark for the answer based on the Lead Examiner's mark on the example.

You may well need to read back through the answer as you apply the mark scheme to clarify points and assure yourself that the level and the mark are appropriate.

Indicative content in the mark scheme is provided as a guide for examiners. It is not intended to be exhaustive and you must credit other valid points. Students do **not** have to cover all of the points mentioned in the indicative content to reach the highest level of the mark scheme.

You should ignore any irrelevant points made. However, full marks can be awarded only if there are no incorrect statements that contradict a correct response.

An answer which contains nothing of relevance to the question must be awarded no marks.

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
01.1	LED		1	AO1.1 AO1 in isolation 6.2.1.1	A
01.2	the same as		1	AO1.1 6.2.1.2	G
01.3	 1500 – 900 600 (thousand)	an answer of 600 (thousand) or 600 000 scores **2** marks two correct readings from the graph scores **1** mark allow a range of 1480 to 1520 and a range of 880 to 920 allow an answer in the range of 560 (thousand) to 640 (thousand) consistent with their allowed readings	 1 1	AO2.2 6.2.1.2 WS 3.2	G
01.4	repeat the experiment using exactly the same method		1	AO3.3a 6.2.1.2	A
01.5	 power = 0.80 × 0.020 power = 0.016 (W)	an answer of 0.016 (W) scores **2** marks	 1 1	AO2.1 6.2.4.1 WS 3.3	E
01.6	power = (current)^2 × resistance		1	AO1.1 AO1 in isolation 6.2.4.1	A
01.7	temperature increases		1	AO1.1 6.1.1.1	E

01.8	Q = 0.020 × 180 Q = 3.6 (C)	an answer of 3.6 (C) scores **2** marks	1 1	AO2.1 6.2.1.2 WS 3.3	E

Total			**11**

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
02.1	the brightness of the lamp		1	AO3/3a 6.1.3c WS 2.2	A
02.2	zero error		1	AO3/3b 6.1.3c WS 3.7	A
02.3	C		1	AO3/1b 6.1.3c WS 3.7	A
02.4	10.0	allow 10	1	AO3/1a 6.1.3c WS 3.5	G
02.5	$\frac{0.96}{8.0}$ = 0.12	an answer of 0.12 or 12% scores **2** marks allow 12%	1 1	AO2.1 6.1.2.2	E
02.6	replenished		1	AO1.1 in isolation 6.1.3b	G
02.7	E = 490 × 31 E = 15 190 E = 15 000 (J)	an answer of 15 000 (J) scores **3** marks allow 15 200 if correct substitution is seen allow an answer to 2 s.f. consistent with their calculated value of E using E=QV	1 1 1	AO2.1 6.2.4.2	E

02.8	less fossil fuel is burned		1	AO3.2a 6.1.3e	A
Total			**11**		

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
03.1	they changed direction	allow deflected/reflected/repelled	1	AO 1/1 6.4.1.3	E
03.2	diameter = $\frac{0.18}{6000}$ = 0.000 030 (nm)	an answer of 0.000 03 (nm) or 3.0×10^{-5} (nm) scores **2** marks allow 3.0×10^{-5} (nm)	1 1	AO2/2 6.4.1.1	E
03.3	A		1	AO 1/1 6.4.1.1	A
03.4	1100 (°C)		1	AO3/2b 6.3.2.3	G
03.5	8 (minutes)	allow 12 (minutes)	1	AO3/2b 6.3.2.3	G
03.6	the rate of change of temperature of the gold		1	AO3/1a 6.1.1.3, 6.3.2.2	A
Total			**7**		

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
04.1	$^{234}_{91}Pa$		1	AO1/1 6.4.1.2	A
04.2	points correctly plotted to within 1 mm a curved line of best fit passing within 1 mm of all 5 points	 ignore any line beyond 200 seconds	1 1	AO2.2 6.4.2.3 WS 3.2	E
04.3	70 (s)	allow an answer between 65 and 75 (s) allow an answer consistent with their drawn line	1	AO2/2 6.4.2.3 WS 3.5	E
04.4	70 (s)	allow an answer between 65 and 75 (s) allow their answer to question **04.3**	1	AO3/2b 6.4.2.3	E
04.5	beta		1	AO1.1 6.4.2.1	A
04.6	articles in scientific journals are peer reviewed	allow articles in scientific journals are based on evidence/data allow newspaper articles may be oversimplified/inaccurate/biased	1	AO1.1 6.4.2.4 WS 1.6	E
Total			**7**		

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
05.1	to stop the metal case of the toaster becoming live if a fault occurs		1	AO1.1 6.2.3.2	A
05.2	yellow brown blue		1 1 1	AO1.1 AO1 in isolation 6.2.3.2	G
05.3	E = 850 ×120 E = 102 000 (J)	an answer of 102 000 (J) scores **2** marks	1 1	AO2.1 6.2.4.2 6.1.1.4 WS 3.3	E
05.4	elastic potential kinetic		1 1	AO1.1 6.1.1.1	G
05.5	gravitational potential energy = mass × gravitational field strength × height or $E_p = m\ g\ h$	allow gpe allow any correct re-arrangement	1	AO1.1 AO1 in isolation 6.1.1.2	E
05.6	$0.049 = 0.050 \times 9.8 \times h$ $h = \frac{0.049}{0.050 \times 9.8}$ h = 0.10 (m)	an answer of 0.10 (m) scores **3** marks	1 1 1	AO2.1 6.1.1.2 WS 3.3	E
Total			**12**		

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
06.1	ammeter in series with the resistor, voltmeter in parallel with the resistor		1	AO1/1 6.2.1.4 RP 16 WS 2.4	A
06.2	current decreased	ignore slows down	1	AO1/1 6.2.1.3 RP 16 WS 3.6	E
06.3	reverse the connections to the cell	allow battery for cell allow reverse the cell	1	AO1/2 6.2.1.3 RP 16 WS 2.2	E
06.4	(directly) proportional	do not allow inversely proportional do not allow indirectly proportional	1	AO1/2 6.2.1.3 RP 16 WS 3.5	G
06.5	potential difference = current × resistance **or** V=IR	allow voltage for potential difference allow any correct re-arrangement	1	AO1/1 6.2.1.3 RP 16 WS 3.3	E
06.6	 3.0 = 0.12 × R $R = \frac{3.0}{0.12}$ R = 25 (Ω)	an answer of 25 (Ω) scores **3** marks	 1 1 1	AO2/1 6.2.1.3 RP 16 WS 3.3	E
Total			**8**		

<table>
<tr><th>Question</th><th>Answers</th><th>Extra information</th><th>Mark</th><th>AO / Spec. Ref.</th><th>ID</th></tr>
<tr><td>07.1</td><td>pressure decreased

because molecules have less (kinetic) energy

so fewer collisions (with the wall/container each second)</td><td>

allow less speed/velocity

allow collide with less force

allow less force on the walls</td><td>1

1

1</td><td>AO2.1

6.3.3.1</td><td>E</td></tr>
<tr><td>07.2</td><td>

0.70 = m × 330
or
700 = m × 330 000

$m = \frac{0.70}{330}$
or
$m = \frac{700}{330\ 000}$

m = 0.0021 (kg)</td><td>an answer of 0.0021(212121…) scores 3 marks

allow correct rearrangement using converted value(s) of E to J and/or L to J/kg

allow 0.0021(212121…)
allow correct calculation using converted value(s) of E and/or L

3 marks can only be awarded for m = 0.0021(212121…) (kg)</td><td>

1

1

1</td><td>AO2.1

6.3.2.2
6.1.1.3</td><td>E</td></tr>
<tr><td>07.3</td><td><table><tr><th>Substance</th><th>Solid</th><th>Liquid</th><th>Gas</th></tr><tr><td>Oxygen</td><td></td><td>✓</td><td></td></tr><tr><td>Nitrogen</td><td></td><td></td><td>✓</td></tr><tr><td>Carbon dioxide</td><td>✓</td><td></td><td></td></tr></table>2 correct answers scores 1 mark.
if more than one tick in a row, neither can score a mark</td><td></td><td>2</td><td>AO3/2b

6.3.1.1</td><td>E</td></tr>
</table>

07.4	**Level 3:** Relevant points (reasons/causes) are identified, given in detail and logically linked to form a clear account.	5–6	AO1.1 6.3.1.2	E
	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 cooling • as the argon cools the particles slow down • particles in a liquid move slower than particles in a gas • particles in a solid move slower than particles in a liquid • as the liquid/solid cools the particles get closer together • as the liquid/solid cools the density increases gas to liquid • particles change from being spread apart to touching each other • particles will (collide with other particles more often and) change direction more often liquid to solid • particles change from a random arrangement to a regular pattern • particles change from moving freely to fixed positions • particles change from moving freely/randomly to vibrating explanation • (internal) energy (of the argon) decreases • (kinetic) energy (of the particles) decreases with temperature • (potential) energy (of the particles) changes with change of state (of the argon) • forces between particles in a gas are negligible/zero • attractive forces act between atoms when they are close to each other • attractive forces between particles are stronger in a solid than in a liquid to access level 3 there must be an explanation of changes to arrangement and movement of particles during either cooling or a change of state			

Total			**14**

SPECIMEN MATERIAL

GCSE
COMBINED SCIENCE: TRILOGY

PAPER 5: PHYSICS 1H

Mark scheme

Specimen 2018

Version 1.0

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The mark scheme for each question shows:

- the marks available for each part of the question
- the total marks available for the question
- the typical answer or answers which are expected
- extra information to help the Examiner make his or her judgement and help to delineate what is acceptable or not worthy of credit or, in discursive answers, to give an overview of the area in which a mark or marks may be awarded
- the Assessment Objectives and specification content that each question is intended to cover.

The extra information is aligned to the appropriate answer in the left-hand part of the mark scheme and should only be applied to that item in the mark scheme.

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2. Emboldening and underlining

2.1 In a list of acceptable answers where more than one mark is available 'any **two** from' is used, with the number of marks emboldened. Each of the following bullet points is a potential mark.

2.2 A bold **and** is used to indicate that both parts of the answer are required to award the mark.

2.3 Alternative answers acceptable for a mark are indicated by the use of **or**. Different terms in the mark scheme are shown by a / ; eg allow smooth / free movement.

2.4 Any wording that is underlined is essential for the marking point to be awarded.

3. Marking points

3.1 Marking of lists

This applies to questions requiring a set number of responses, but for which students have provided extra responses. The general principle to be followed in such a situation is that 'right + wrong = wrong'.

Each error / contradiction negates each correct response. So, if the number of error / contradictions equals or exceeds the number of marks available for the question, no marks can be awarded.

However, responses considered to be neutral (indicated as * in example 1) are not penalised.

Example 1: What is the pH of an acidic solution? (1 mark)

Student	Response	Marks awarded
1	green, 5	0
2	red*, 5	1
3	red*, 8	0

Example 2: Name two planets in the solar system. (2 marks)

Student	Response	Marks awarded
1	Neptune, Mars, Moon	1
2	Neptune, Sun, Mars, Moon	0

3.2 Use of chemical symbols / formulae

If a student writes a chemical symbol / formula instead of a required chemical name, full credit can be given if the symbol / formula is correct and if, in the context of the question, such action is appropriate.

3.3 Marking procedure for calculations

Marks should be awarded for each stage of the calculation completed correctly, as students are instructed to show their working.

Full marks can however be given for a correct numerical answer, without any working shown.

3.4 Interpretation of 'it'

Answers using the word 'it' should be given credit only if it is clear that the 'it' refers to the correct subject.

3.5 Errors carried forward

Any error in the answers to a structured question should be penalised once only.

Papers should be constructed in such a way that the number of times errors can be carried forward is kept to a minimum. Allowances for errors carried forward are most likely to be restricted to calculation questions and should be shown by the abbreviation e.c.f. in the marking scheme.

3.6 Phonetic spelling

The phonetic spelling of correct scientific terminology should be credited **unless** there is a possible confusion with another technical term.

3.7 Brackets

(…..) are used to indicate information which is not essential for the mark to be awarded but is included to help the examiner identify the sense of the answer required.

3.8 Ignore / Insufficient / Do <u>not</u> allow

Ignore or insufficient are used when the information given is irrelevant to the question or not enough to gain the marking point. Any further correct amplification could gain the marking point.

Do **not** allow means that this is a wrong answer which, even if the correct answer is given as well, will still mean that the mark is not awarded.

Level of response marking instructions

Level of response mark schemes are broken down into levels, each of which has a descriptor. The descriptor for the level shows the average performance for the level. There are marks in each level.

Before you apply the mark scheme to a student's answer read through the answer and annotate it (as instructed) to show the qualities that are being looked for. You can then apply the mark scheme.

Step 1 Determine a level

Start at the lowest level of the mark scheme and use it as a ladder to see whether the answer meets the descriptor for that level. The descriptor for the level indicates the different qualities that might be seen in the student's answer for that level. If it meets the lowest level then go to the next one and decide if it meets this level, and so on, until you have a match between the level descriptor and the answer. With practice and familiarity you will find that for better answers you will be able to quickly skip through the lower levels of the mark scheme.

When assigning a level you should look at the overall quality of the answer and not look to pick holes in small and specific parts of the answer where the student has not performed quite as well as the rest. If the answer covers different aspects of different levels of the mark scheme you should use a best fit approach for defining the level and then use the variability of the response to help decide the mark within the level, ie if the response is predominantly level 3 with a small amount of level 4 material it would be placed in level 3 but be awarded a mark near the top of the level because of the level 4 content.

Step 2 Determine a mark

Once you have assigned a level you need to decide on the mark. The descriptors on how to allocate marks can help with this. The exemplar materials used during standardisation will help. There will be an answer in the standardising materials which will correspond with each level of the mark scheme. This answer will have been awarded a mark by the Lead Examiner. You can compare the student's answer with the example to determine if it is the same standard, better or worse than the example. You can then use this to allocate a mark for the answer based on the Lead Examiner's mark on the example.

You may well need to read back through the answer as you apply the mark scheme to clarify points and assure yourself that the level and the mark are appropriate.

Indicative content in the mark scheme is provided as a guide for examiners. It is not intended to be exhaustive and you must credit other valid points. Students do not have to cover all of the points mentioned in the Indicative content to reach the highest level of the mark scheme.

You should ignore any irrelevant points made. However, full marks can be awarded only if there are no incorrect statements that contradict a correct response.

An answer which contains nothing of relevance to the question must be awarded no marks.

Question 1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	0.093 A		1	AO2/1 6.2.2
01.2	0.093 A		1	AO2/1 6.2.2
01.3	(increasing the resistance) decreases the current therefore (the lamp will be) dimmer		1 1	AO1/1 6.2.1.3
01.4	potential difference = current × resistance	accept correct rearrangement with R as subject	1	AO1/1 6.2.1.3
01.5	3.3 = 0.15 x R R = 3.3 / 0.15 (Ω) R = 22 (Ω)	 allow 22 (Ω) without working shown for **3** marks	1 1 1	AO2/1 6.2.1.3
01.6	line drawn from the origin with a decreasing gradient.		1	AO1/1 6.2.1.4
Total			**9**	

Question 2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	the store of chemical energy (in the battery) decreases		1	AO1/1 6.1.2.1
	the internal energy of the surrounding air increases.	accept description of energy becoming less usefully stored for **2** marks	1	
02.2	kinetic energy = ½ mass x velocity^2		1	AO1/1 6.1.1.2
02.3	$E_K = ½ \times 0.8 \times 12^2$		1	AO2/1 6.1.1.3
	$E_K = 57.6$ (J)	allow 57.6 (J) without working shown for **2** marks	1	
02.4	lower proportion of wasted energy	accept less energy is wasted	1	AO2/1 6.1.2.1
	higher proportion of energy is converted into <u>kinetic</u> energy	accept more kinetic energy	1	

Question	Answers	Mark	AO / Spec. Ref.
2.5	**Level 2:** A relevant and coherent argument which demonstrates processing and numerical analysis of the information presented and draw a conclusion which is logically consistent with the reasoning and refers to payback time for the vehicles.	3–4	AO3/2b 6.1.3
	Level 1: Simple comparisons are made which demonstrate a basic ability to numerically analyse the information presented. The conclusion, if present, may not be consistent with the calculations.	1–2	
	No relevant content	0	
	Indicative content • The electric car costs £12 000 more to buy • Running cost of electric car = £3 000 • Running cost of petrol engine car = £24 000 • Total cost of electric car = £30 000 • Total cost of petrol engine car = £39 000 • The electric car cost £1 750 less to run each year • The electric car will save £9 000 • Additional cost is covered in 6.9 years • So the electric car will be cheaper over the 12 year lifetime **or** Electric 27000 / 12 = 2250 Annual cost = 2250 + 250 = 2500 Petrol 15000 / 12 = 1250 Annual cost = 1250 + 2000 = 3250 So electric is £750 cheaper per year		
Total		**11**	

Question 3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	electromagnetic radiation from the nucleus	'electromagnetic radiation' is insufficient	1	AO1/1 6.4.2.1
03.2	(Gamma is the most penetrating) so a large proportion of the emitted radiation will leave the body more easily detected outside the body		1 1	AO1/1 6.4.2.1
03.3	(average) time it takes for the number of nuclei of the isotope in a sample to halve **or** (average) time it takes for the count rate from a sample containing the isotope to fall to half its initial level		1	AO1/1 6.4.2.3
03.4	initially there is a high level of hazard. level of hazard drops to a low level quickly (activity initially high) due to short half-life **or** (drops to safe level quickly) due to short half-life	answer must imply short period of time	1 1 1	AO1/1 AO1/1 AO2/1 6.4.2.4
3.5	it is exposed to ionising radiation		1	AO1/1 6.4.2.4
3.6	does not become radioactive		1	AO1/1 6.4.2.4
Total			**9**	

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	10 000		1	AO1/1 6.4.1.1
04.2	**Increase** absorb electromagnetic radiation **Decrease** emit electromagnetic radiation		1 1	AO1/1 6.4.1.1
04.3	atomic number is the number of protons mass number is the number of protons and neutrons		1 1	AO1/1 6.4.1.2
04.4	**Level 2:** A clear comparison, with logical structure. 3–4 **Level 1:** Fragmented points, with no logical structure. 1–2 No relevant content 0 **Indicative content** **<u>Beta decay</u>** • Atomic number increases by one • When a neutron decays into a proton **<u>Alpha decay</u>** • Atomic number decreases by two • When an alpha particle is emitted **<u>Comparison</u>** Both change number of protons (hence new element/transmutation) Beta decay increases atomic number and alpha decay decreases (explicit) NB No credit is given for different number of protons = new element.		4	AO1/1 6.4.1.1 6.4.2.2
Total			**9**	

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	water boils at the same temperature each time control starting temp by allowing enough time for water and kettle to reach room temperature		1 1	AO3/3a 6.1.1.5 WS2.2
05.2	uncertainty = (302 – 298)/2 uncertainty = ± 2 (s)	ignore missing ±	1 1	AO2/2 6.1.1.5 WS3.4
05.3	(Energy transferred = Power × time) E = 2.20 × 300 E = 660 (kJ)	allow 660 (kJ) without working shown for **2** marks allow answer calculated using incorrect value for t (298 or 302) for **1** mark	 1 1	 AO2/1 AO2/1 6.1.1.5
05.4	(mass × change in temperature) / mass 80 (°C)	allow **1** mark for any correct pair of values from the table eg 20 / 0.25 allow 80 (°C) without working shown for **2** marks	1 1	AO2/2 6.1.1.4
05.5	four points plotted correctly accurate line drawn	allow **1** mark for three correctly plotted points ecf their 5.3 allow ± 1mm line should be straight and drawn with a ruler line must not go through the origin	2 1	AO2/2 6.1.1.4 WS3.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.6	values read correctly from graph correct conversion into J correct use of $\Delta y/\Delta x$ value in range 4200 – 4800	 allow value in range 4200 – 4800 without working shown for **4** marks	1 1 1 1	AO2/2 6.1.1.4 WS3.1
05.7	some of the energy supplied does not raise the temperature of the water	some of the energy is wasted is insufficient	1	AO3/3b 6.1.1.4 WS3.5
05.8	(the power of the kettle may not be 2.2kW) (by measuring the power) the student can accurately calculate the amount of energy supplied to each mass of water		 1	AO3/3a 6.1.1.4
Total			**17**	

Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	random	accept in all directions description must be of random motion	1	AO1/1 6.3.3.1
06.2	heating increases the temperature of the gas temperature is proportional to kinetic energy if kinetic energy increases speed increases		1 1 1	AO1/1 6.3.3.1
06.3	energy is needed to change the state of the water to break the bonds		1 1	AO1/1 6.3.2.2
06.4	$1000 = m / 2.5 \times 10^{-5}$ $m = 2.5 \times 10^{-5} \times 1000$ m = 0.025 (kg) E = 0.025 × 2 260 000 E = 56 500 (J)	allow 56 500 (J) without working shown for **5** marks **0** marks awarded for E = m × L	1 1 1 1 1	AO2/1 6.3.2.3 6.2.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.5	any **four** from: • because the water is preheated) the change in temperature of the water is less • so less energy is used to heat the water ($E=mc\Delta\theta$) • therefore they (condensing boilers) are more efficient • so less energy is wasted • less gas is burned to heat the same amount of water • less waste gas (CO_2) is produced by the boiler **or** (because less gas is used) they are cheaper to run/save money		4	AO3/1b 6.1.2.2 6.1.1.3
Total			**15**	

SPECIMEN MATERIAL

GCSE
COMBINED SCIENCE: TRILOGY

PAPER 6: PHYSICS 2H

Mark scheme

Specimen 2018

Version 1.0

Mark schemes are prepared by the Lead Assessment Writer and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all associates participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every associate understands and applies it in the same correct way. As preparation for standardisation each associate analyses a number of students' scripts. Alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Assessment Writer.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

Further copies of this mark scheme are available from aqa.org.uk

Information to Examiners

1. General

The mark scheme for each question shows:

- the marks available for each part of the question
- the total marks available for the question
- the typical answer or answers which are expected
- extra information to help the Examiner make his or her judgement and help to delineate what is acceptable or not worthy of credit or, in discursive answers, to give an overview of the area in which a mark or marks may be awarded
- the Assessment Objectives and specification content that each question is intended to cover.

The extra information is aligned to the appropriate answer in the left-hand part of the mark scheme and should only be applied to that item in the mark scheme.

At the beginning of a part of a question a reminder may be given, for example: where consequential marking needs to be considered in a calculation; or the answer may be on the diagram or at a different place on the script.

In general the right-hand side of the mark scheme is there to provide those extra details which confuse the main part of the mark scheme yet may be helpful in ensuring that marking is straightforward and consistent.

2. Emboldening and underlining

2.1 In a list of acceptable answers where more than one mark is available 'any **two** from' is used, with the number of marks emboldened. Each of the following bullet points is a potential mark.

2.2 A bold **and** is used to indicate that both parts of the answer are required to award the mark.

2.3 Alternative answers acceptable for a mark are indicated by the use of **or**. Different terms in the mark scheme are shown by a / ; eg allow smooth / free movement.

2.4 Any wording that is underlined is essential for the marking point to be awarded.

3. Marking points

3.1 Marking of lists

This applies to questions requiring a set number of responses, but for which students have provided extra responses. The general principle to be followed in such a situation is that 'right + wrong = wrong'.

Each error / contradiction negates each correct response. So, if the number of error / contradictions equals or exceeds the number of marks available for the question, no marks can be awarded.

However, responses considered to be neutral (indicated as * in example 1) are not penalised.

Example 1: What is the pH of an acidic solution? (1 mark)

Student	Response	Marks awarded
1	green, 5	0
2	red*, 5	1
3	red*, 8	0

Example 2: Name two planets in the solar system. (2 marks)

Student	Response	Marks awarded
1	Neptune, Mars, Moon	1
2	Neptune, Sun, Mars, Moon	0

3.2 Use of chemical symbols / formulae

If a student writes a chemical symbol / formula instead of a required chemical name, full credit can be given if the symbol / formula is correct and if, in the context of the question, such action is appropriate.

3.3 Marking procedure for calculations

Marks should be awarded for each stage of the calculation completed correctly, as students are instructed to show their working.

Full marks can however be given for a correct numerical answer, without any working shown.

3.4 Interpretation of 'it'

Answers using the word 'it' should be given credit only if it is clear that the 'it' refers to the correct subject.

3.5 Errors carried forward

Any error in the answers to a structured question should be penalised once only.

Papers should be constructed in such a way that the number of times errors can be carried forward is kept to a minimum. Allowances for errors carried forward are most likely to be restricted to calculation questions and should be shown by the abbreviation e.c.f. in the marking scheme.

3.6 Phonetic spelling

The phonetic spelling of correct scientific terminology should be credited **unless** there is a possible confusion with another technical term.

3.7 Brackets

(…..) are used to indicate information which is not essential for the mark to be awarded but is included to help the examiner identify the sense of the answer required.

3.8 Ignore / Insufficient / Do <u>not</u> allow

Ignore or insufficient are used when the information given is irrelevant to the question or not enough to gain the marking point. Any further correct amplification could gain the marking point.

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Question 1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	the time it took from seeing the green light to pressing a key		1	AO1/1 6.5.4.3.2
01.2	he could have been distracted		1	AO3/3a 6.5.4.3.2
01.3	boys have a shorter reaction time than girls **or** reaction time improves with practice		1	AO3/2b 6.5.4.3.2 WS3.5
01.4	collect more data / larger sample size **or** take more repeat readings per person	must link to response in 1.3	1	AO3/3b 6.5.4.3.2 WS3.7
01.5	reaction time will have less effect (as distance increases) because it is a smaller proportion of the total race time		1 1	AO2/1 6.5.4.3.2

01.6	**Level 3:** A coherent description of the race, which uses data from the graph, including discussion of the meanings of the changing gradient of both of the lines.	5–6	6	AO3/1a 6.5.4.3.2 6.5.4.1.4 WS3.5
	Level 2: Multiple pieces of data taken from the graphs used to evidence a comparison between the runners. Likely to include discussion of the meaning of the (changing) gradient of one of the lines. Answer not coherently structured.	3–4		
	Level 1: Some data taken from the graph, but may be limited to one aspect or simple readings. Lack of coherence in answer.	1–2		
	No relevant content.	0		
	Indicative content • A starts at constant speed *for 440 m / 60 s* • A then slows down *from 60 s* • the gradient for B is lower at the start so B starts at a slower speed • the gradient for B increases so B accelerates • B overtook A *at 700 m /114 s* • B has a greater top speed because the maximum gradient is greater • B won the race *in 126 s* / beat A *by 34 s*			

01.7	tangent drawn at 60s data obtained using correct information 5.5(m/s)	 accept answer in range 5.3 to 5.7	1 1 1	AO2/2 6.5.4.1.4 WS 3.2, 3.3

Total			**15**

Question 2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	any **four** from: • light waves are transverse whereas sound waves are longitudinal • light waves travel faster than sound waves • light waves have a higher frequency than sound waves • light waves have a shorter wavelength than sound waves • light waves have oscillations perpendicular (to the direction of energy transfer) whereas sound waves are parallel (to the direction of energy transfer)		4	AO1/1 6.6.1.1 6.6.1.2 6.6.2.1 WS 1.4
02.2	the baby can be seen in the dark		1	AO2/1 6.6.2.4 WS1.4
02.3	wave speed = frequency × wavelength	accept $v = f \lambda$	1	AO1/1 6.6.1.2
02.4	$3 \times 10^8 = f \times 0.125$ $f = 3 \times 10^8 / 0.125$ $f = 2.4 \times 10^9$ (Hz)	allow 2.4×10^9 with no working for **3** marks	1 1 1	AO2/1 6.6.1.2 WS3.3
Total			**9**	

Question 3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	mass		1	AO1/1
	velocity		1	6.5.5.1
				WS4.1
03.2	kg m/s		1	AO1/1
				6.5.5.1
				WS4.3
03.3	momentum before = momentum after		1	AO1/1
				6.5.5.2
	and before diving in the momentum of the diver and (small) boat is zero		1	WS1.2
	after diving the diver has forwards momentum/ momentum to the right		1	
	therefore the (small) boat has equal backwards momentum/ equal momentum to the left		1	
03.4	the boat moves back more slowly		1	AO2/1
	because there is more mass (but momentum stays the same)		1	AO1/1
				6.5.5.1
03.5	as she swims there is a drag force		1	AO2/1
	as speed increases so does the drag force		1	AO2/1
	she accelerates less		1	AO2/1
	drag force = thrust force	accept resultant force = 0	1	AO1/1
	the swimmer reaches terminal velocity		1	AO1/1
				6.5.4.2.1
Total			**14**	

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	force = spring constant x extension	accept f = ke	1	AO1/1 6.5.3
04.2	extension is directly proportional to the force applied because it is straight line through the origin		1 1	AO3/2a AO1/2 6.5.3
04.3	test a greater range of load **or** test more springs		1	AO3/3b 6.5.3 WS2.5
04.4	work done is equal to elastic potential energy as long as the spring does not go past the limit of proportionality		1 1	AO1/2 6.5.3
04.5	line extending with a greater gradient than existing line a stiffer spring has a greater spring constant (*k*) *k* = F / e		1 1 1	AO3/2a AO3/2b AO3/2b 6.5.3
04.6	the spring will be deformed because it has passed the elastic limit	accept not gone back to original shape	1 1	AO1/2 6.5.3
Total			**11**	

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	arrow of equal size pointing vertically downwards	judged by eye	1	AO2/1
	labelled 'weight'		1	AO1/1 6.5.1.1/2/3
05.2	the upwards force is greater than the downwards force		1	AO2/1
	because air resistance increases		1	6.5.4.2.2
05.3	$v^2 = (2 \times 2 \times 209) + 8^2$		1	AO2/1 6.5.4.1.5
	$v = \sqrt{900}$		1	WS3.3
	v = 30 (m/s)	allow 30 (m/s) without working shown for **3** calculation marks	1	
05.4	vertical force (300 N) drawn with a suitable scale		1	AO2/1
	horizontal force (60 N) drawn to the same scale		1	6.5.1.4
	resultant force drawn in correct direction		1	
	value of resultant in the range 304 N – 308 N		1	
Total			**11**	

Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	thumb, index finger and third finger are held mutually at right angles		1	AO1/2
	index finger shows the direction of the magnetic field from North to South, third finger shows the direction of the current from positive to negative terminal		1	6.7.2.2
	the thumb then shows the direction of the force acting on the copper rod		1	
	so the copper rod will move from left to right		1	
06.2	any **one** from: use a stronger magnet increase the magnetic flux density increase the length of the copper rod in the magnetic field coil the copper rod		1	AO2/2 6.7.2.2
06.3	$W = 9.8 \times 4 \times 10^{-4} = 3.92 \times 10^{-3}$		1	AO2/2
	conversion of the length 7cm to 0.07m		1	6.5.1.3 6.7.2.2
	$3.92 \times 10^{-3} = B \times 1.12 \times 0.07$		1	WS4.5
	$B = 3.92 \times 10^{-3} / 0.0784$		1	
	B = 0.05 (T)	allow 0.05 (T) without working shown for the **5** calculation marks	1	
Total			**10**	