AQA GCSE PHYSICS (4403)

PHYSICS



EXAM QUESTION PACK

UNIT P2 HIGHER TIER PH2HP PAPERS

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AQA

Please write clearly in block capitals.

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

Surname _____

Forename(s) _____

Candidate signature _____

GCSE

ADDITIONAL SCIENCE PHYSICS

H

Higher Tier Unit Physics P2

Friday 17 June 2016 Morning Time allowed: 1 hour

Materials

For this paper you must have:
- a ruler
- a 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.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 60.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.
- Question 2(d) should be answered in continuous prose.
  In this question you will be marked on your ability to:
  – use good English
  – organise information clearly
  – use specialist vocabulary where appropriate.

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

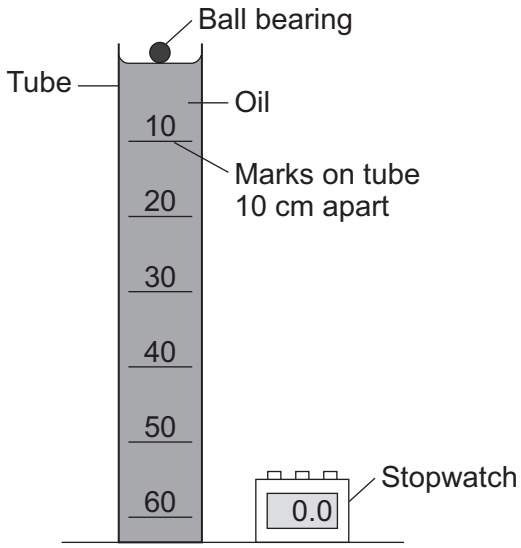
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Do not write outside the box

Answer **all** questions in the spaces provided.

1 A student investigated how the speed of a ball bearing changes as the ball bearing falls through a tube of oil.
Figure 1 shows the equipment the student used.

Figure 1



The student measured the time taken for the ball bearing to fall different distances.
Each distance was measured from the top of the oil.

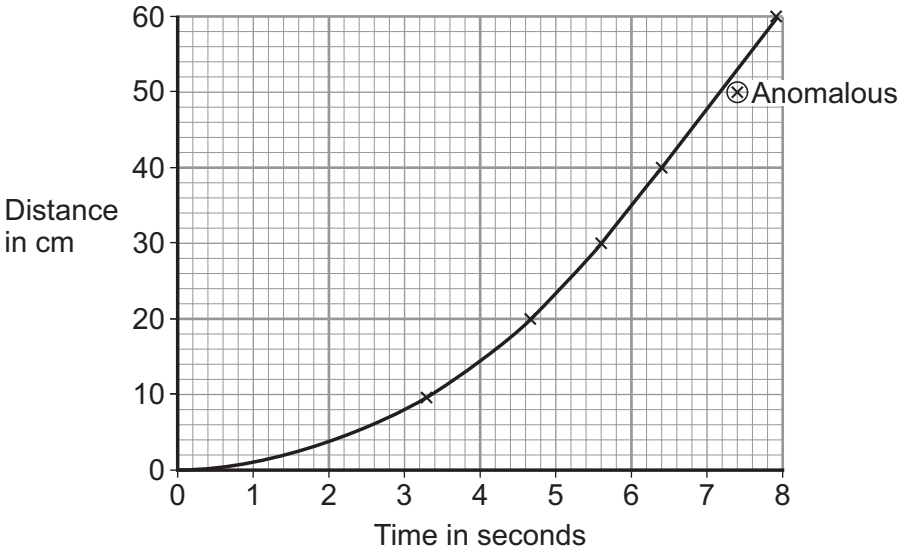
1 (a) What is likely to have been the main source of error in this investigation?

[1 mark]

Do not write outside the box

1 (b) **Figure 2** shows the student's results plotted as a graph.

Figure 2



1 (b) (i) The student has identified one of the results as being anomalous.

Use the correct answer from the box to complete the sentence.

[1 mark]

after	**as**	**before**

The anomalous result was caused by the stopwatch being started _____ the ball bearing was released.

1 (b) (ii) What can you conclude from the graph about the speed of the ball bearing during the first four seconds?

[1 mark]

_____

_____

1 (b) (iii) The graph shows that the ball bearing reached its terminal velocity.

Describe how the graph would be used to calculate the terminal velocity of the ball bearing.

[1 mark]

_____

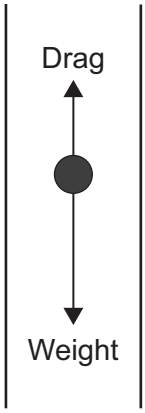
_____

Question 1 continues on the next page

Do not write outside the box

1 (b) (iv) The directions of the two forces acting on the ball bearing as it falls through the oil are shown in **Figure 3**.

Figure 3



Explain, in terms of the forces shown in **Figure 3**, why the ball bearing reaches its terminal velocity.

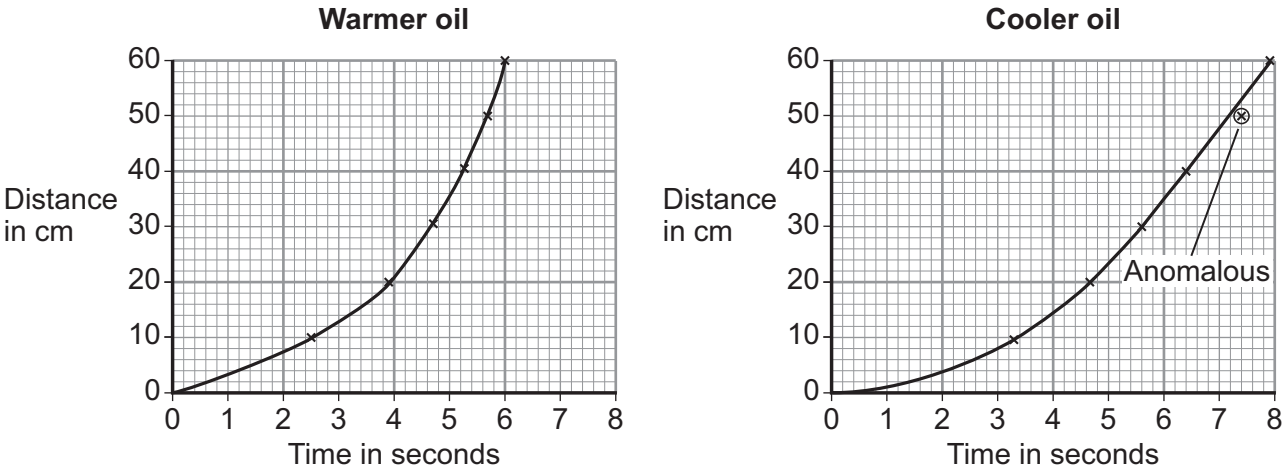
[2 marks]

Do not write outside the box

1 (c) The student repeated the investigation using warmer oil.

Figure 4 shows the set of results using the warmer oil **and** the set of results using the cooler oil.

Figure 4



Compare the two graphs in **Figure 4**.

Use the correct phrase from the box to complete the sentence.

[3 marks]

less than	**equal to**	**greater than**

After falling 40 cm, the drag force on the ball bearing in the warmer oil is

_____ the drag force on the ball bearing in the cooler oil.

Explain the reason for your answer.

_____

_____

_____

_____

9

Do not write outside the box

2 Alpha particles, beta particles and gamma rays are types of nuclear radiation.

2 (a) Describe the structure of an alpha particle.

[1 mark]

2 (b) Nuclear radiation can change atoms into ions by the process of ionisation.

2 (b) (i) Which type of nuclear radiation is the least ionising?

[1 mark]

Tick (✓) **one** box.

alpha particles ☐ beta particles ☐ gamma rays ☐

2 (b) (ii) What happens to the structure of an atom when the atom is ionised?

[1 mark]

2 (c) People working with sources of nuclear radiation risk damaging their health.

State **one** precaution these people should take to reduce the risk to their health.

[1 mark]

Do not write outside the box

2 (d) **In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.**

The type of radiation emitted from a radioactive source can be identified by comparing the properties of the radiation to the properties of alpha, beta and gamma radiation.

Describe the properties of alpha, beta and gamma radiation in terms of their:

- penetration through materials
- range in air
- deflection in a magnetic field.

[6 marks]

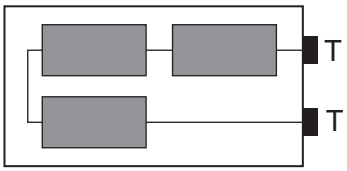
Extra space

10

Do not write outside the box

3 (a) **Figure 5** shows the inside of a battery pack designed to hold three identical 1.5 V cells.

Figure 5

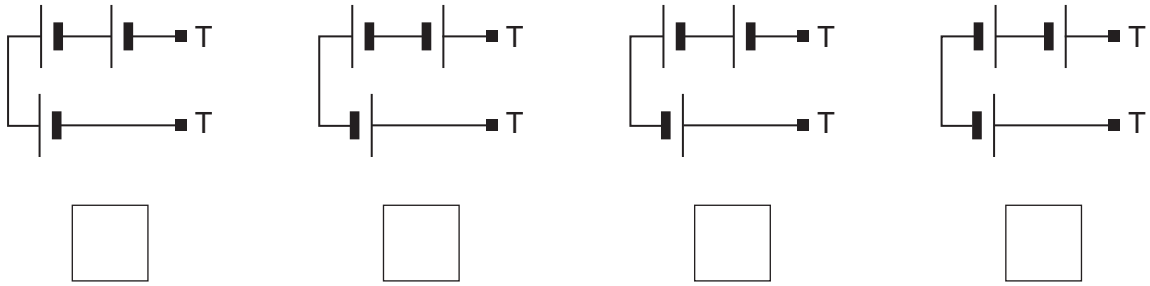


Which **one** of the arrangements shown in **Figure 6** would give a 4.5 V output across the battery pack terminals **T**?

[1 mark]

Tick (✓) **one** box.

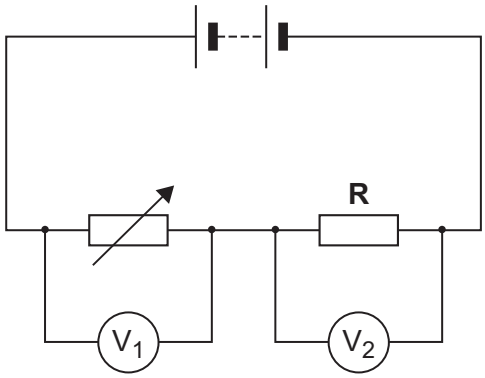
Figure 6



Do not write outside the box

3 (b) **Figure 7** shows a variable resistor and a fixed value resistor connected in series in a circuit.

Figure 7



Complete **Figure 7** to show how an ammeter would be connected to measure the current through the circuit.
Use the correct circuit symbol for an ammeter.

[1 mark]

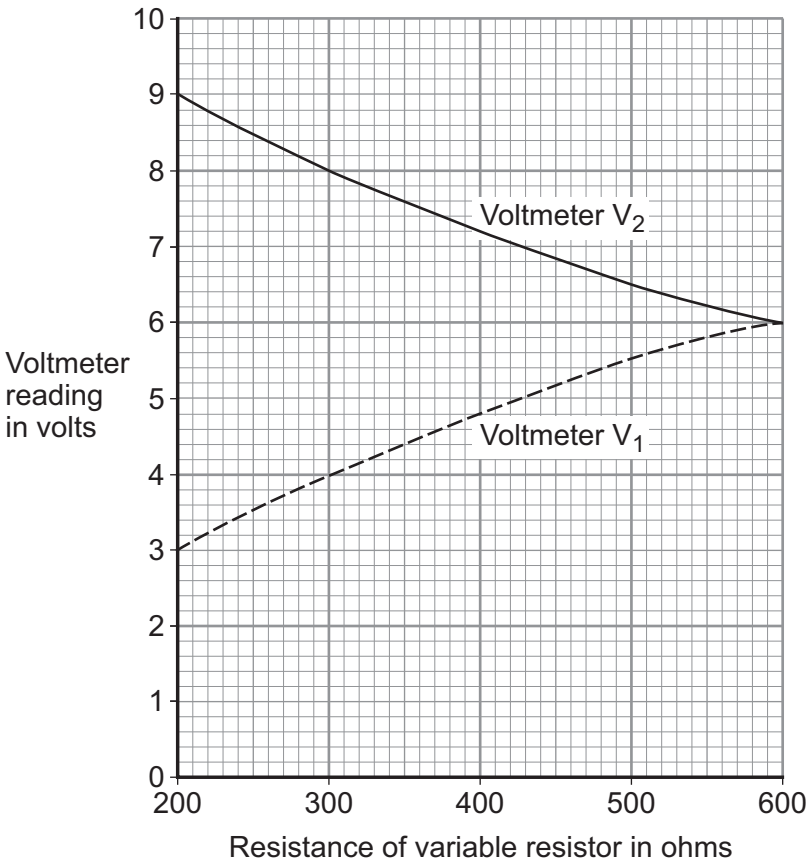
Question 3 continues on the next page

Do not write outside the box

3 (c) The variable resistor can be adjusted to have any value from 200 ohms to 600 ohms.

Figure 8 shows how the reading on voltmeter $\mathbf{V_1}$ and the reading on voltmeter $\mathbf{V_2}$ change as the resistance of the variable resistor changes.

Figure 8



3 (c) (i) How could the potential difference of the battery be calculated from **Figure 8**?

[2 marks]

Tick (✓) **one** box.

9 + 3 = 12 V ☐

9 – 3 = 6 V ☐

9 ÷ 3 = 3 V ☐

Give the reason for your answer.

_____

_____

Do not write outside the box

3 (c) (ii) Use **Figure 8** to determine the resistance of the fixed resistor, **R**.

[2 marks]

Resistance of **R** = _____ Ω

Give the reason for your answer.

_____

_____

3 (c) (iii) Calculate the current through the circuit when the resistance of the variable resistor equals 200 Ω.

Use the correct equation from the Physics Equations Sheet.

[3 marks]

_____

_____

_____

Current = _____ A

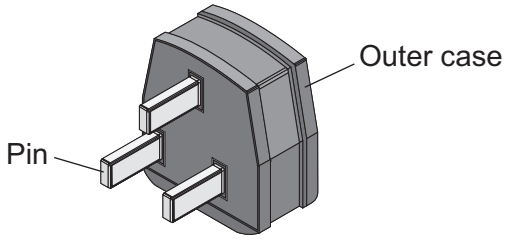
9

Turn over for the next question

Do not write outside the box

4 (a) A washing machine is connected to the mains electricity supply using a cable and three-pin plug.
Figure 9 shows a three-pin plug.

Figure 9



Name the materials used in the structure of a plug. Give the reason why each material is used.

[2 marks]

Pin _____

_____

Outer case _____

_____

4 (b) The three-pin plug contains a fuse. The fuse is connected to one of the wires inside the cable.

4 (b) (i) Which **one** of the wires inside the cable is the fuse connected to?

[1 mark]

_____

4 (b) (ii) The fuse is a thin wire inside a closed glass tube. The wire acts as a resistor.

What effect does a current through a wire have on the wire?

[1 mark]

_____

Do not write outside the box

4 (b) (iii) The power of the washing machine varies between 0.7 kW and 2 kW depending on which part of the wash cycle is operating.

Calculate the maximum current drawn from the mains electricity supply by the washing machine.

The mains electricity supply is at a potential difference of 230 V.

Use the correct equation from the Physics Equations Sheet.

[2 marks]

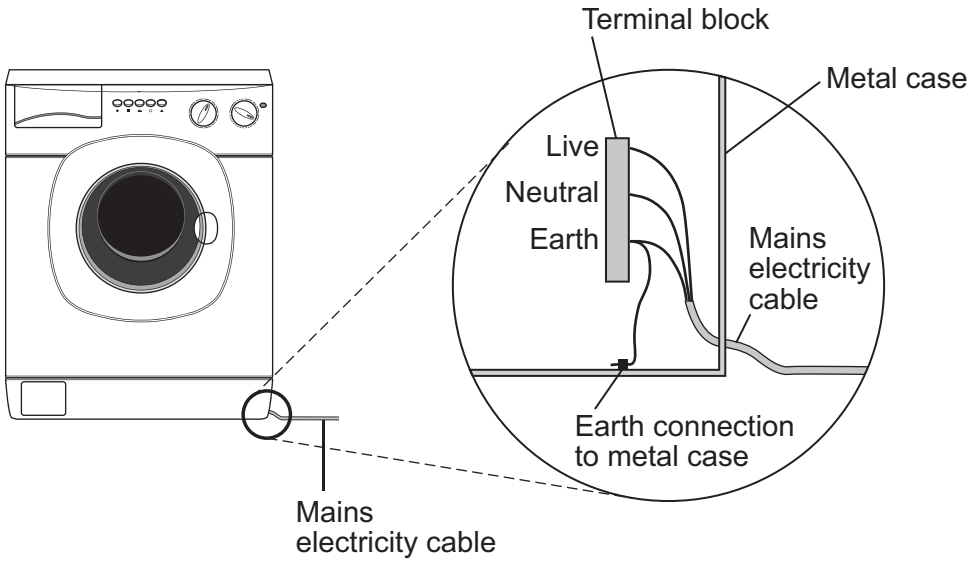
Current = _____ A

Question 4 continues on the next page

Do not write outside the box

4 (c) **Figure 10** shows how the mains electricity cable is connected to the washing machine.
The earth wire is connected to the metal case of the washing machine.

Figure 10



If a fault makes the metal case live, the earth wire and fuse inside the plug prevent the mains cable from overheating and causing a fire.

Explain how.

[2 marks]

4 (d) New research has shown that many people underestimate the hazards of using mains electricity.

It is important that people do understand the hazards of using mains electricity.
Suggest why.

[1 mark]

9

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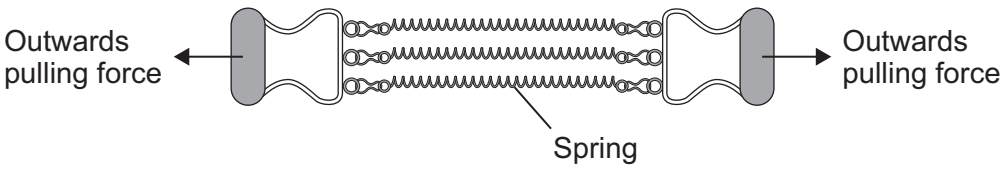
Turn over for the next question

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ANSWER IN THE SPACES PROVIDED

Do not write outside the box

5 **Figure 11** shows an exercise device called a chest expander. The three springs are identical.

Figure 11



A person pulls outwards on the handles and does work to stretch the springs.

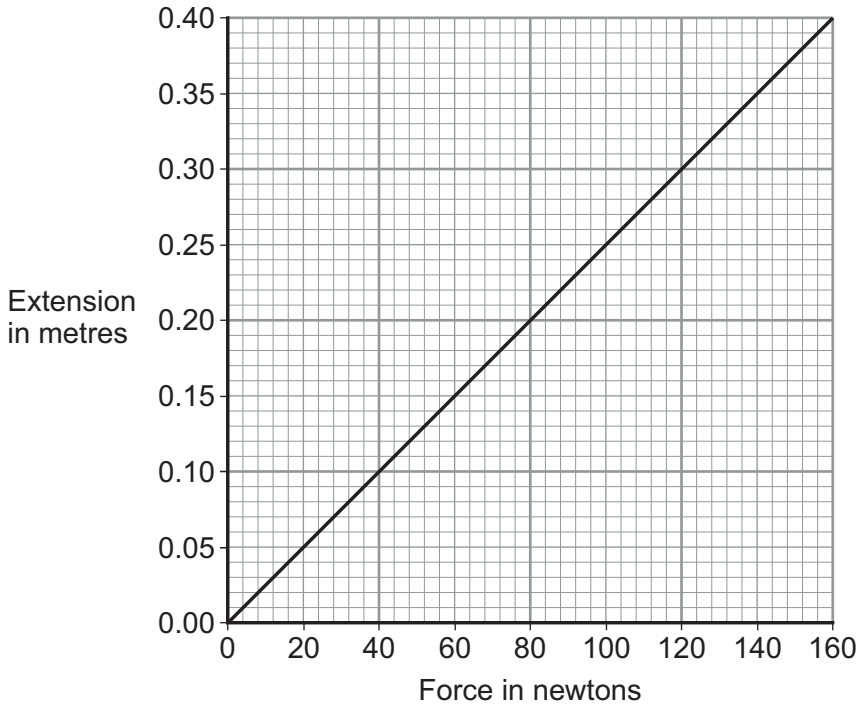
5 (a) Complete the following sentence.

[1 mark]

When the springs are stretched _____ _____ energy is stored in the springs.

5 (b) **Figure 12** shows how the extension of a single spring from the chest expander depends on the force acting on the spring.

Figure 12



Do not write outside the box

5 (b) (i) How can you tell, from **Figure 12**, that the limit of proportionality of the spring has not been exceeded?

[1 mark]

5 (b) (ii) Use data from **Figure 12** to calculate the spring constant of the spring.
Give the unit.

Use the correct equation from the Physics Equations Sheet.

[3 marks]

Spring constant = _____ Unit _____

5 (b) (iii) Three identical resistors joined in parallel in an electrical circuit share the total current in the circuit.

In a similar way, the three springs in the chest expander share the total force exerted.

By considering this similarity, use **Figure 12** to determine the total force exerted on the chest expander when each spring is stretched by 0.25 m.

[2 marks]

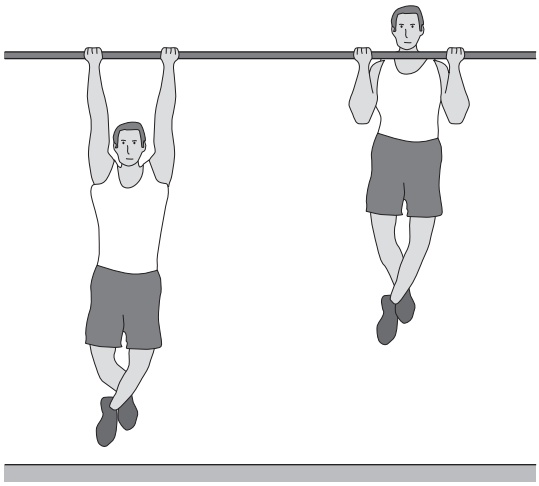
Total force = _____ N

Question 5 continues on the next page

Do not write outside the box

5 (c) The student in **Figure 13** is doing an exercise called a chin-up.

Figure 13



Each time the student does one chin-up he lifts his body 0.40 m vertically upwards.
The mass of the student is 65 kg.
The student is able to do 12 chin-ups in 60 seconds.

Calculate the power developed by the student.

Gravitational field strength = 10 N/kg

Use the correct equations from the Physics Equations Sheet.

[3 marks]

Power = _____ W

10

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

6 (a) Brown dwarf stars are thought to have been formed in the same way as other stars.
They are too small for nuclear fusion reactions to take place in them.
Brown dwarf stars emit infrared radiation but are not hot enough to emit visible light.

6 (a) (i) Describe how a star is formed.

[2 marks]

6 (a) (ii) Describe the process of nuclear fusion.

[1 mark]

6 (a) (iii) Scientists predicted that brown dwarf stars existed before the first one was discovered in 1995.

Suggest **one** reason why scientists are now able to observe and identify brown dwarf stars.

[1 mark]

Do not write outside the box

6 (b) In the 18th century some scientists suggested a theory about how the planets formed in the Solar System. The theory was that after the Sun formed, there were cool discs of matter rotating around the Sun. These cool discs of matter formed the planets. The scientists thought this must have happened around other stars too.

6 (b) (i) Thinking about this theory, what would the scientists have predicted to have been formed in other parts of the Universe?

[1 mark]

6 (b) (ii) Since the 1980s scientists studying young stars have shown the stars to be surrounded by cool discs of rotating matter.

What was the importance of these observations to the theory the scientists suggested in the 18th century?

[1 mark]

6 (c) The Earth contains elements heavier than iron.

Why is the presence of elements heavier than iron in the Earth evidence that the Solar System was formed from material produced after a massive star exploded?

[1 mark]

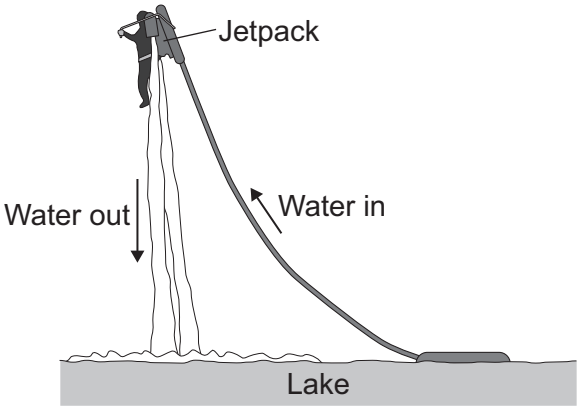
7

Turn over for the next question

Do not write outside the box

7 **Figure 14** shows a person using a device called a jetpack. Water is forced downwards from the jetpack and produces an upward force on the person.

Figure 14



7 (a) State the condition necessary for the person to be able to remain stationary in mid-air.

[1 mark]

_____

_____

7 (b) The person weighs 700 N and the jetpack weighs 140 N.

7 (b) (i) Calculate the combined mass of the person and the jetpack.

Gravitational field strength = 10 N/kg

Use the correct equation from the Physics Equations Sheet.

[2 marks]

_____

_____

_____

Combined mass = _____ kg

Do not write outside the box

7 (b) (ii) Increasing the upward force to 1850 N causes the person to accelerate upwards.

Calculate the acceleration of the person and the jetpack. Give the unit.

Use the correct equation from the Physics Equations Sheet.

[3 marks]

Acceleration = _____ Unit _____

6

END OF QUESTIONS

There are no questions printed on this page

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ANSWER IN THE SPACES PROVIDED

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GCSE

Additional Science / Physics

PH2HP

Mark scheme

4408/4403

June 2016

Version: 1.0 Final Mark Scheme

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.

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Mark Scheme

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

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 errors / 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

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

However, if the answer is incorrect, mark(s) can be gained by correct substitution / working and this is shown in the 'extra information' column or by each stage of a longer calculation.

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 Accept / allow

Accept is used to indicate an equivalent answer to that given on the left-hand side of the mark scheme. Allow is used to denote lower-level responses that just gain credit.

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

Ignore of insufficient 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.

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

4. Quality of Communication and levels marking

In Question **2(d)** students are required to produce extended written material in English, and will be assessed on the quality of their communication as well as the standard of the scientific response.

Students will be required to:
- use good English
- organise information clearly
- use specialist vocabulary where appropriate.

The following general criteria should be used to assign marks to a level:

Level 1: basic
- Knowledge of basic information
- Simple understanding
- The answer is poorly organised, with almost no specialist terms and their use demonstrating a general lack of understanding of their meaning, little or no detail
- The spelling, punctuation and grammar are very weak.

Level 2: clear
- Knowledge of accurate information
- Clear understanding
- The answer has some structure and organisation, use of specialist terms has been attempted but not always accurately, some detail is given
- There is reasonable accuracy in spelling, punctuation and grammar, although there may still be some errors.

Level 3: detailed
- Knowledge of accurate information appropriately contextualised
- Detailed understanding, supported by relevant evidence and examples
- Answer is coherent and in an organised, logical sequence, containing a wide range of appropriate or relevant specialist terms used accurately.
- The answer shows almost faultless spelling, punctuation and grammar.

Question	Answers	Extra information	Mark	AO / Spec. Ref.
1(a)	starting / stopping the stopwatch **or** timing over the smaller distances	human error is insufficient reaction time is insufficient accept not timing accurately do not accept references to measuring distance incorrectly	1	AO3 2.1
1(b)(i)	before		1	AO3 2.1
1(b)(ii)	increasing	accept accelerating it is not constant is insufficient it is less than after four seconds is insufficient it reaches a constant speed negates	1	AO3 2.1.2b
1(b)(iii)	calculate the gradient of the straight/steepest/constant section	accept gradient of any section after 5.5 seconds/30 cm	1	AO1 2.1.2b
1(b)(iv)	drag (force) increases (as the ball bearing gets faster) (until) drag (force) = weight **or** (until) resultant force is zero	accept frictional/upward force for drag accept upward force = downward force accept till forces are balanced	1 1	AO1 2.1.4b

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1(c)	less than		1	AO3 2.1.4a/b
	ball bearing increases speed at a greater rate **or** ball bearing has a greater acceleration **or** terminal velocity has not been reached	accept it travels the same distance in less time accept the ball bearing is going faster	1	
	so resultant force must be greater **or** as weight is the same (the drag must be less)	accept warmer oil has a lower density/viscosity for 1 mark if neither of the two reason marks score	1	
Total			**9**	

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Question	Answers	Extra information	Mark	AO / Spec. Ref.
2(a)	2 protons and 2 neutrons	accept 2p and 2 n accept (the same as a) helium nucleus symbol is insufficient do not accept 2 protons and neutrons	1	AO1 2.5.2c
2(b)(i)	gamma rays		1	AO1 2.5.2e
2(b)(ii)	loses/gains (one or more) electron(s)		1	AO1 2.5.1d
2(c)	any **one** from: • wear protective clothing • work behind lead/concrete/glass shielding • limit time of exposure • use remote handling	accept wear mask/gloves wear goggles is insufficient wear protective equipment/gear is insufficient accept wear a film badge accept handle with (long) tongs accept maintain a safe distance accept avoid direct contact	1	AO2 2.5

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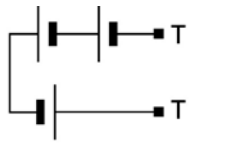
Question	Answers	Extra information	Mark	AO / Spec. Ref.
2(d)	Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information on page 4 and apply a 'best-fit' approach to the marking.		6	AO1 2.5.2e 2.5.2f

0 marks	Level 1 (1-2 marks)	Level 2 (3-4 marks)	Level 3 (5-6 marks)
No relevant information	There is a description of at least one type of radiation in terms of one or more properties.	There is a description of at least two types of radiation in terms of some properties **or** a full description of one type of radiation in terms of all three properties **or** the same property is described for all three radiations	There is a description of all three types of radiation in terms of at least two of their properties **or** a full description of two types of radiation in terms of all three properties.

examples of physics points made in the response	extra information
alpha particles	
• are least penetrating	
• are stopped by paper / card	
• have the shortest range	
• can travel (about) 5cm in air	
• are (slightly) deflected by a magnetic field	
• alpha particles are deflected in the opposite direction to beta particles by a magnetic field	
beta particles	
• (some are) stopped by (about) 2mm (or more) of aluminium/metal	accept (some are) stopped by aluminium foil
• can travel (about) 1 metre in air	
• are deflected by a magnetic field	
• beta particles are deflected in the opposite direction to alpha particles by a magnetic field	
gamma rays	
• are the most penetrating	
• are stopped by (about) 10cm of lead	
• have the longest range	
• can travel at least 1 km in air	
• are not deflected by a magnetic field	

Total			10

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Question	Answers	Extra information	Mark	AO / Spec. Ref.
3(a)	3rd box from the left ticked 		1	AO2 2.3.2j
3(b)	correct symbol drawn in series with other components	symbol must have upper case A	1	AO1 2.3.2c
3(c)(i)	9 + 3 = 12V pd of battery is shared between the variable resistor and fixed resistor	reason only scores if this mark scored accept $V_1 + V_2$ = pd of the battery accept p.d. is shared in a series circuit accept voltage for p.d.	1 1	AO2 2.3.2k AO1 2.3.2k
3(c)(ii)	600 p.d. of supply shared equally when resistors have the same value **or** ratio of the p.d. is the same as the ratio of the resistance	reason only scores if this mark scored	1 1	AO2 2.3.2k AO1

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Question	Answers	Extra information	Mark	AO / Spec. Ref.
3(c)(iii)	0.015 **or** their (c)(i) ÷ (their (c)(ii) + 200) correctly calculated	allow **2** marks for correct substitution ie 12 = I × 800 **or** their (c)(i) = I × (their (c)(ii) +200) allow **1** mark for total resistance = 800 (Ω) or their (c)(ii) + 200 **or** allow **1** mark for a substitution of 12 = I × 200 **or** their (c)(i) = I × 200 **or** alternative method using the graph V = 3 V (1) 3 = I × 200 (1)	3	AO2 2.3.2k 2.3.2h
Total			**9**	

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Question	Answers	Extra information	Mark	AO / Spec. Ref.
4(a)	pin made from brass because it is (hard and) a (good electrical) conductor outer case plastic/rubber because it is a (good electrical) insulator	 accept copper for brass metal is insufficient heat conductor on its own negates heat insulator on its own negates	 1 1	AO1 2.4.1f
4(b)(i)	live		1	AO1 2.4.1g
4(b)(ii)	makes it hot/warm	melts is insufficient	1	AO1 2.4.2a
4(b)(iii)	8.7	accept an answer that rounds to 8.7 allow **1** mark for correct substitution ie 2000 = 230 × I an answer of 0.0087**or** 0.009 **or** 3.0(4) **or** 5.65 **or** 5.7 gains **1** mark	2	AO2 2.4.2c
4(c)	a (large) current goes from the live wire to the earth wire (which causes) the fuse to (overheat and) melt	accept metal case for live wire accept a current goes from live to earth do not accept electricity for current accept blow for melt break is insufficient do not accept snap / blow up for melt	1 1	AO1 2.4.1k

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Question	Answers	Extra information	Mark	AO / Spec. Ref.
4(d)	reduce chance of an electric shock	accept to reduce the risk of an accident accept prevent electric shock accept prevent electrocution accept prevent or reduce the risk of an (electrical) fire accept an electric shock can kill you accept it can kill you accept so you can use it safely	1	AO3 2.4
Total			**9**	

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Question	Answers	Extra information	Mark	AO / Spec. Ref.
5(a)	elastic potential		1	AO1 2.1.5b 2.2.1c
5(b)(i)	line is straight	accept line does not curve	1	AO1 2.1.5c
5(b)(ii)	400 newtons per metre **or** N/m	allow **1** mark for correct substitution of any pair of numbers correctly taken from the graph e.g.160 = k × 0.40 if symbols are used they must be correct	2 1	AO2 2.1.5d AO1 2.1.5d
5(b)(iii)	300	allow **1** mark for correctly obtaining force on 1 spring = 100N	2	AO3 2.3.2l
5(c)	52	allow **2** marks for calculating change in gpe for 1 chin-up as 260 (J) or for 12 chin-ups as 3120 (J) an answer 4.3 gains **2** marks allow **1** mark for correct substitution into gpe equation ie gpe = 65 × 10 × 0.4 (×12) **or** correct use of power equation with an incorrect value for energy transferred	3	AO2 2.2.1e
Total			**10**	

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Question	Answers	Extra information	Mark	AO / Spec. Ref.
6(a)(i)	(enough) dust and gas (from space) is pulled together by: gravitational attraction **or** gravitational forces **or** gravity	accept nebula for dust and gas accept hydrogen for gas accept gas on its own dust on its own is insufficient mention of air negates this mark ignore any (correct) stages beyond this	1 1	AO1 2.6.2c
6(a)(ii)	joining of two (atomic) nuclei (to form a larger one)	do not accept atoms for nuclei	1	AO1 2.6.2a
6(a)(iii)	more sensitive astronomical instruments / telescopes **or** infrared telescopes developed	accept better technology more knowledge is insufficient	1	AO3 2.6
6(b)(i)	(other) planets / solar systems	do not accept galaxy moons is insufficient	1	AO3 2.6
6(b)(ii)	provided evidence to support theory	accept proves the theory	1	AO1 2.6
6(c)	elements heavier than iron are formed only when a (massive) star explodes	accept materials for elements accept supernova for star explodes accept stars can only fuse elements up to (and including) iron	1	AO1 2.6.2f
Total			**7**	

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Question	Answers	Extra information	Mark	AO / Spec. Ref.
7(a)	resultant force = zero **or** upward force = downward force	 accept forces are balanced accept weight for downward force	1	AO1 2.1.1d
7(b)(i)	84	allow **1** mark for correct substitution ie 840 = m × 10	2	AO2 2.1.4d
7(b)(ii)	12 **or** 1010 ÷ their (b)(i) correctly calculated m/s^2	accept 12.02 for both marks a resultant force of 1010 (N) gains **1** mark an answer 22(.02) gains 1 mark accept m/s/s	2 1	AO2 2.1.2a AO1 2.1.2a
Total			**6**	

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Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

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

AQA

General Certificate of Secondary Education
Higher Tier
June 2015

Additional Science
Unit Physics P2

PH2HP

H

Physics
Unit Physics P2

Wednesday 20 May 2015 1.30 pm to 2.30 pm

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

A

Time allowed
- 1 hour

Instructions
- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 60.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.
- Question 2(c) should be answered in continuous prose.
  In this question you will be marked on your ability to:
  – use good English
  – organise information clearly
  – use specialist vocabulary where appropriate.

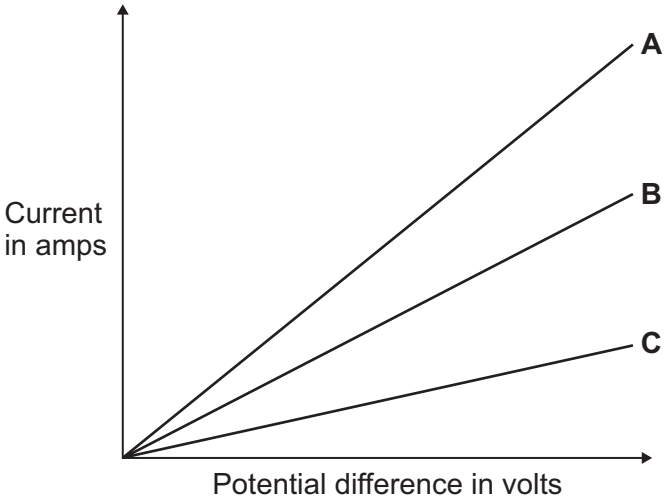
Advice
- In all calculations, show clearly how you work out your answer.

Do not write outside the box

Answer **all** questions in the spaces provided.

1 (a) **Figure 1** shows the current–potential difference graph for three wires, **A**, **B** and **C**.

Figure 1



1 (a) (i) Using **Figure 1**, how can you tell that the temperature of each wire is constant?

[1 mark]

.....

.....

1 (a) (ii) Which **one** of the wires, **A**, **B** or **C**, has the greatest resistance?

[2 marks]

Write the correct answer in the box. ☐

Give a reason for your answer.

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Do not write outside the box

1 (b) A student measured the resistance of four wires.

Table 1 shows the resistance of, and other data about, each of the four wires, **J**, **K**, **L** and **M**.

Table 1

Wire	Type of metal	Length in cm	Diameter in mm	Resistance in …….
J	copper	50	0.17	0.36
K	copper	50	0.30	0.12
L	copper	100	0.30	0.24
M	constantan	100	0.30	7.00

1 (b) (i) The last column of **Table 1** should include the unit of resistance.

[1 mark]

What is the unit of resistance?

.....

1 (b) (ii) The resistance of a wire depends on many factors.

Look at **Table 1**. Which **two** wires from **J**, **K**, **L** and **M** show that the resistance of a wire depends on the **length** of the wire?

[2 marks]

Wire ☐ and wire ☐

Give a reason for your answer.

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Question 1 continues on the next page

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1 (b) (iii) A student looked at the data in **Table 1** and wrote this conclusion:

'The resistance of a wire depends on the type of metal from which the wire is made.'

The student could **not** be certain that her conclusion is true for **all** types of metal.

Suggest what extra data is needed for the student to be more certain that the conclusion is correct.

[1 mark]

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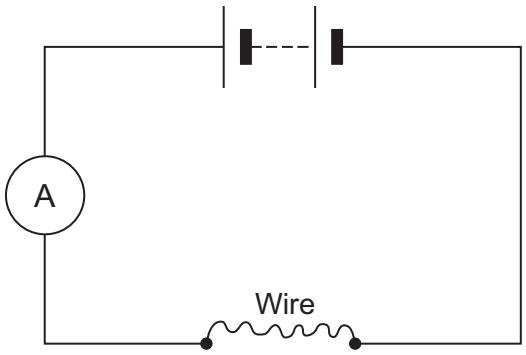
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1 (c) The resistance of a wire can be calculated using the readings from an ammeter and a voltmeter.

1 (c) (i) Complete **Figure 2** by drawing a voltmeter in the correct position in the circuit. Use the correct circuit symbol for a voltmeter.

[1 mark]

Figure 2

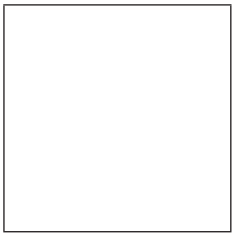


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1 (c) (ii) In a circuit diagram, a wire can be represented by the symbol for a resistor.

In the box below, draw the circuit symbol for a resistor.

[1 mark]



9

Turn over for the next question

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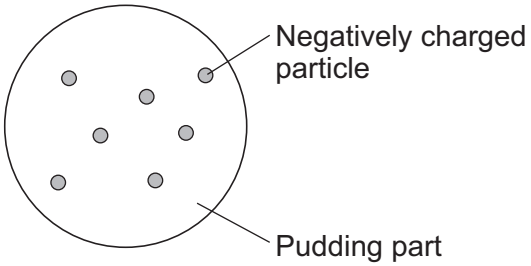
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ANSWER IN THE SPACES PROVIDED

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2 (a) Over 100 years ago, scientists thought the atom was like a 'plum pudding'.
Figure 3 shows the plum pudding model of the atom.

Figure 3



The scientists knew that an atom has negatively charged particles. They also knew that an atom has no overall charge.

What did the scientists conclude about the **charge** on the 'pudding part' of the atom?
[1 mark]

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Question 2 continues on the next page

Do not write outside the box

2 (b) Two scientists named Rutherford and Marsden devised an experiment to investigate the plum pudding model of the atom. The experiment involved firing alpha particles at a thin sheet of gold. The scientists measured how many of the alpha particles were scattered.

Using the plum pudding model, the scientists predicted that only a few of the alpha particles would be scattered by more than 4°.

Over several months, more than 100 000 measurements were made.

2 (b) (i) The results from this experiment caused the plum pudding model to be replaced by a new model of the atom.

Explain why.

[2 marks]

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2 (b) (ii) Suggest **one** reason why other scientists thought this experiment provided valid evidence for a new model of the atom.

[1 mark]

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Do not write outside the box

2 (c) **In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.**

Describe the model now used for the structure of an atom.

In your answer you should:
- give details of the individual particles that make up an atom
- include the relative masses and relative charges of these particles.

Do **not** include a diagram in your answer.

[6 marks]

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Extra space .....

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3 Many countries use nuclear power stations to generate electricity.
Nuclear power stations use the process of nuclear fission to release energy.

3 (a) (i) What is nuclear fission?

[1 mark]

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3 (a) (ii) Plutonium-239 is one substance used as a fuel in a nuclear reactor. For nuclear fission to happen, the nucleus must absorb a particle.

What type of particle must be absorbed?

[1 mark]

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3 (b) Nuclear **fusion** also releases energy.
Nuclear fusion happens at very high temperatures. A high temperature is needed to overcome the repulsion force between the nuclei.

3 (b) (i) Why is there a repulsion force between the nuclei of atoms?

[1 mark]

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3 (b) (ii) Where does nuclear fusion happen naturally?

[1 mark]

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Do not write outside the box

3 (c) In 1991, scientists produced the first controlled release of energy from an experimental nuclear **fusion** reactor. This was achieved by fusing the hydrogen isotopes, deuterium and tritium.

Deuterium is naturally occurring and can easily be extracted from seawater. Tritium can be produced from lithium. Lithium is also found in seawater.

Table 2 gives the energy released from 1 kg of fusion fuel and from 1 kg of fission fuel.

Table 2

Type of fuel	Energy released from 1 kg of fuel in joules
Fusion fuel	3.4×10^{14}
Fission fuel	8.8×10^{13}

3 (c) (i) Suggest **two** advantages of the fuel used in a fusion reactor compared with plutonium and the other substances used as fuel in a fission reactor.

[2 marks]

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2 .....

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3 (c) (ii) Some scientists think that by the year 2050 a nuclear fusion power station capable of generating electricity on a large scale will have been developed.

Suggest **one** important consequence of developing nuclear fusion power stations to generate electricity.

[1 mark]

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Question 3 continues on the next page

Do not write outside the box

3 (d) Tritium is radioactive.

After 36 years, only 10 g of tritium remains from an original sample of 80 g.

Calculate the half-life of tritium.

Show clearly how you work out your answer.

[2 marks]

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Half-life = ... years

9

Do not write outside the box

4 (a) A car driver sees the traffic in front is not moving and brakes to stop his car.

The stopping distance of a car is the thinking distance plus the braking distance.

4 (a) (i) What is meant by the 'braking distance'?

[1 mark]

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4 (a) (ii) The braking distance of a car depends on the speed of the car and the braking force.

State **one** other factor that affects braking distance.

[1 mark]

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4 (a) (iii) How does the braking force needed to stop a car in a particular distance depend on the speed of the car?

[1 mark]

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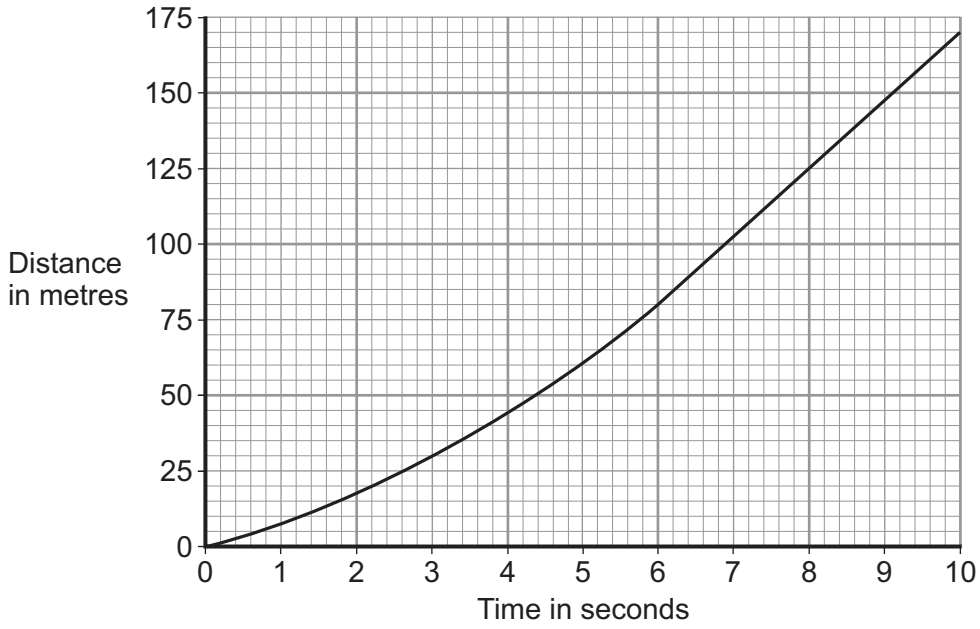
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Question 4 continues on the next page

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4 (b) **Figure 4** shows the distance–time graph for the car in the 10 seconds before the driver applied the brakes.

Figure 4



Use **Figure 4** to calculate the maximum speed the car was travelling at.
Show clearly how you work out your answer.

[2 marks]

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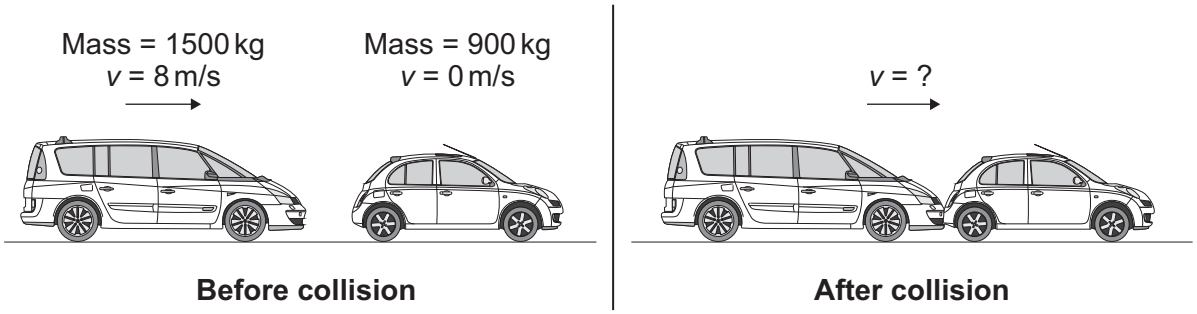
Maximum speed = ... m/s

Do not write outside the box

4 (c) The car did not stop in time. It collided with the stationary car in front, joining the two cars together.

Figure 5 shows both cars, just before and just after the collision.

Figure 5



4 (c) (i) The momentum of the two cars was conserved.

What is meant by the statement 'momentum is conserved'?

[1 mark]

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4 (c) (ii) Calculate the velocity of the two joined cars immediately after the collision.

Use the correct equation from the Physics Equations Sheet.

[3 marks]

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Velocity = ... m/s

Question 4 continues on the next page

Turn over ▶

Do not write outside the box

4 (d) Since 1965, all cars manufactured for use in the UK must have seat belts.

It is safer for a car driver to be wearing a seat belt, compared with not wearing a seat belt, if the car is involved in a collision.

Explain why.

[4 marks]

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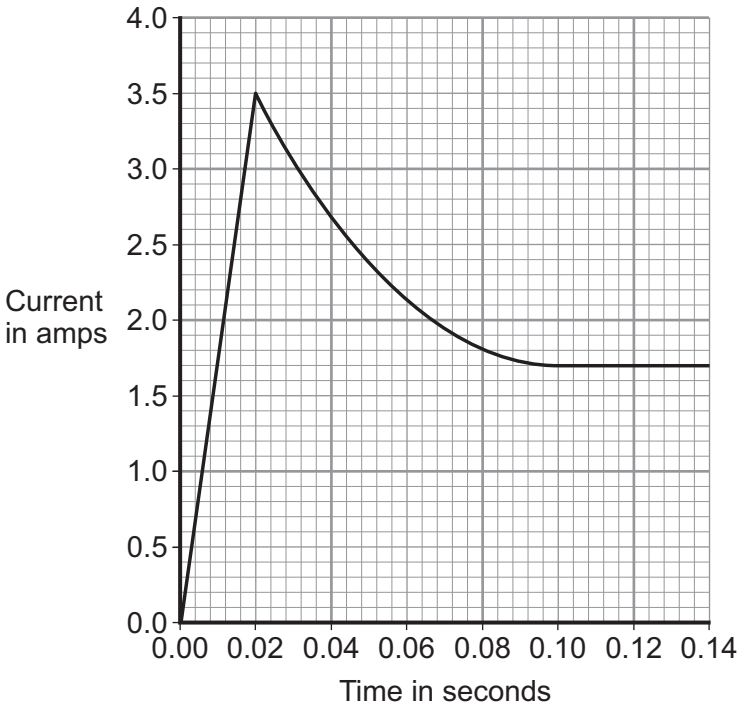
Turn over for the next question

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ANSWER IN THE SPACES PROVIDED

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5 A 12 V filament bulb is connected to a 12 V power supply.
Figure 6 shows how the current changes after the bulb is switched on.

Figure 6



5 (a) (i) After 0.10 seconds, the bulb works at its normal brightness.

What is the current through the bulb when it is working at normal brightness?

[1 mark]

Current = ... A

5 (a) (ii) The bulb works at normal brightness for 30 seconds before it is switched off.

Calculate the charge that flows through the bulb in the 30 seconds before it is switched off. Give the unit.

Use the correct equation from the Physics Equations Sheet.

[3 marks]

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Charge = ... unit .....

Do not write outside the box

5 (a) (iii) Calculate the energy transferred by the 12 V bulb when it is working at normal brightness for 30 seconds.

Use the correct equation from the Physics Equations Sheet.

[2 marks]

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Energy transferred = ... J

5 (b) Between 0.02 seconds and 0.08 seconds, there is an increase in both the resistance and the temperature of the metal filament inside the bulb.

Explain, in terms of the electrons and ions inside the filament, why both the temperature and the resistance increase.

[2 marks]

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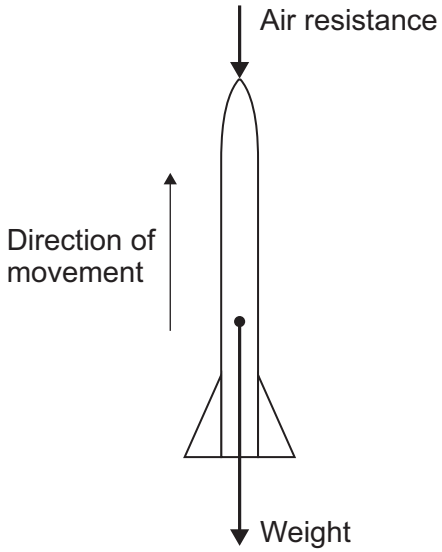
8

Turn over for the next question

Do not write outside the box

6 (a) **Figure 7** shows the forces acting on a model air-powered rocket just after it has been launched vertically upwards.

Figure 7



6 (a) (i) How does the velocity of the rocket change as the rocket moves **upwards**?

[2 marks]

.....

Give a reason for your answer.

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6 (a) (ii) The velocity of the rocket is not the same as the speed of the rocket.

What is the difference between the velocity of an object and the speed of an object?

[1 mark]

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Do not write outside the box

6 (b) The speed of the rocket just after being launched is 12 m/s.
The mass of the rocket is 0.05 kg.

6 (b) (i) Calculate the kinetic energy of the rocket just after being launched.

Use the correct equation from the Physics Equations Sheet.

[2 marks]

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Kinetic energy = ... J

6 (b) (ii) As the rocket moves upwards, it gains gravitational potential energy.

State the maximum gravitational potential energy gained by the rocket.

Ignore the effect of air resistance.

[1 mark]

Maximum gravitational potential energy = ... J

6 (b) (iii) Calculate the maximum height the rocket will reach.

Ignore the effect of air resistance.

Gravitational field strength = 10 N/kg.

Use the correct equation from the Physics Equations Sheet.

[2 marks]

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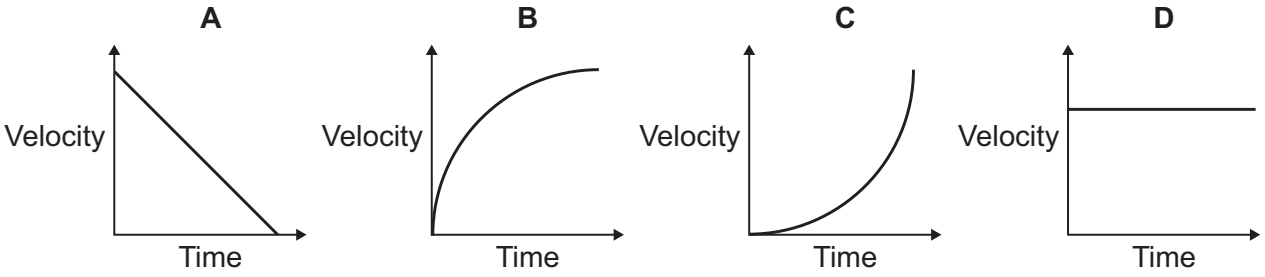
Maximum height = ... m

Question 6 continues on the next page

Do not write outside the box

6 (b) (iv) **Figure 8** shows four velocity–time graphs.

Figure 8



Taking air resistance into account, which graph, **A**, **B**, **C** or **D**, shows how the velocity of the rocket changes as it **falls** from the maximum height it reached until it just hits the ground?

[1 mark]

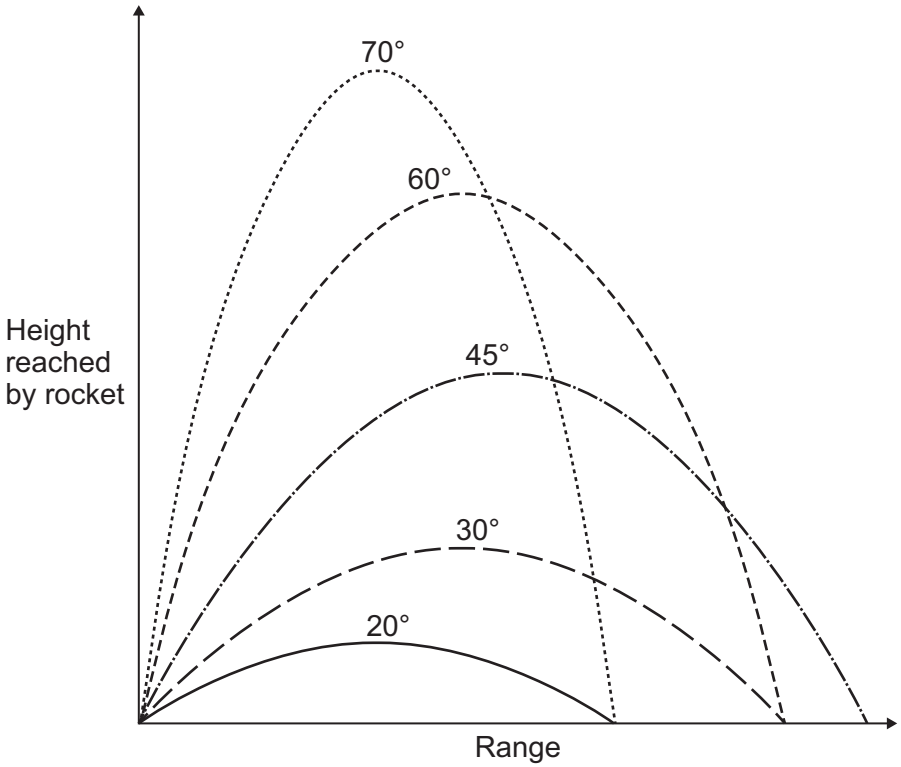
Write the correct answer in the box.

Do not write outside the box

6 (c) The rocket can be launched at different angles to the horizontal.
The horizontal distance the rocket travels is called the range.

Figure 9 shows the paths taken by the rocket when launched at different angles.
Air resistance has been ignored.

Figure 9



What pattern links the angle at which the rocket is launched and the range of the rocket?

[2 marks]

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11

END OF QUESTIONS

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GCSE

Additional Science / Physics

PH2HP

Mark scheme

4408/4403
June 2015

Version/Stage: 1.0 Final

STEMUP.CO.UK

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

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Mark Scheme

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

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 errors / 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

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

However, if the answer is incorrect, mark(s) can be gained by correct substitution / working and this is shown in the 'extra information' column or by each stage of a longer calculation.

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.

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3.8 Accept / allow

Accept is used to indicate an equivalent answer to that given on the left-hand side of the mark scheme. Allow is used to denote lower-level responses that just gain credit.

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

Ignore of insufficient 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.

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

4. Quality of Communication and levels marking

In Question **2c** students are required to produce extended written material in English, and will be assessed on the quality of their communication as well as the standard of the scientific response.

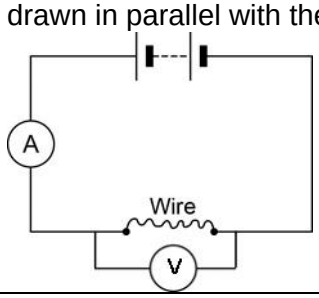
Students will be required to:
- use good English
- organise information clearly
- use specialist vocabulary where appropriate.

The following general criteria should be used to assign marks to a level:

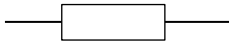
Level 1: basic
- Knowledge of basic information
- Simple understanding
- The answer is poorly organised, with almost no specialist terms and their use demonstrating a general lack of understanding of their meaning, little or no detail
- The spelling, punctuation and grammar are very weak.

Level 2: clear
- Knowledge of accurate information
- Clear understanding
- The answer has some structure and organisation, use of specialist terms has been attempted but not always accurately, some detail is given
- There is reasonable accuracy in spelling, punctuation and grammar, although there may still be some errors.

Level 3: detailed
- Knowledge of accurate information appropriately contextualised
- Detailed understanding, supported by relevant evidence and examples
- Answer is coherent and in an organised, logical sequence, containing a wide range of appropriate or relevant specialist terms used accurately.
- The answer shows almost faultless spelling, punctuation and grammar.

Question	Answers	Extra information	Mark	AO / Spec. ref.	ID
1(a)(i)	p.d. is (directly) proportional to current **or** gradient/slope is constant ***or*** the lines show constant resistance	accept lines are straight / diagonal	1	AO2 2.3.2d/e/g	**E**
1(a)(ii)	C for the same p.d. the current is the smallest	reason only scores if C is chosen accept lowest gradient **and** the gradient = 1/R	1 1	AO2 2.3.2i	**E**
1(b)(i) clip with table in (b)	ohm	accept correct symbol Ω accept an answer written in Table 1 if not given in answer space	1	AO1 2.3.2h	**E**
1(b)(ii)	K and L only length varies	reason only scores if both K and L are chosen accept type of metal **and** the diameter are the same	1 1	AO3 2.3.2	**E**
1(b)(iii)	measure the resistance of more wires made from different metals	accept test more (types of) metals measure the resistance of more wires is insufficient they only use two metals is insufficient	1	AO3 2.3.2	**E**
1(c)(i)	voltmeter symbol correct and drawn in parallel with the wire  	accept voltmeter symbol correct and drawn in parallel with the battery	1	AO1 2.3.2c/f	**E**

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1(c)(ii)	correct symbol drawn 	symbol must be rectangular	1	AO1 2.3.2c	**E**
Total			**9**		

Question	Answers	Extra information	Mark	AO / Spec. ref.	ID
2(a)	(an equal amount of) positive (charge)	do **not** accept charge on the atom / nucleus is positive	1	AO3 2.5.1	**E**
2(b)(i)	a (significant) number of alpha particles were scattered by more than 4^{o} **or** alpha particles deflected backwards	accept (some) measurements / results were unexpected	1	AO1 2.5	**E**
	measurements / results could not be explained by 'plum pudding' model **or** measurements / results did not support predictions	can be explained by the nuclear model is insufficient accept measurements / results did not support hypothesis	1		
2(b)(ii)	many/(over)100 000 measurements/results taken	accept Rutherford(and Marsden) were respected scientists **or** scientists were respected accept measurements / results taken over several months the experiment was repeated many times is insufficient	1	AO3 2.5	**E**

Question 2 continues on the next page . . .

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<table>
<tr><th>Question</th><th colspan="3">Answers</th><th>Extra information</th><th>Mark</th><th>AO / Spec. Ref.</th><th>ID</th></tr>
<tr><td>2(c)</td><td colspan="3"></td><td></td><td>6</td><td rowspan="3">AO1
2.5.1a/b/c</td><td rowspan="3">E</td></tr>
<tr><td colspan="5">Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information on page 4 and apply a ‘best-fit’ approach to the marking.</td></tr>
<tr><td>0 marks</td><td>Level 1 (1–2 marks)</td><td>Level 2 (3–4 marks)</td><td colspan="2">Level 3 (5–6 marks)</td></tr>
<tr><td>no relevant content</td><td>A brief description is given with some particles correctly named</td><td>A description is given with all three particles named
and either
the polarity of charge associated with the three particles
or
the relative mass of the three particles
or
the relative mass for one particle and the relative charge for one particle given</td><td colspan="2">A more detailed description is given, naming the particles and polarity of charge
and either
the relative mass is given for at least two particles
or
the relative charge is given for at least two particles</td><td></td><td></td></tr>
</table>

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examples of the points made in the response	extra information		
brief description contains protons, neutrons and electrons protons are positive electrons are negative neutrons are uncharged has a nucleus **relative charge** proton +1 electron – 1 neutron 0 **relative mass** proton 1 neutron 1 electron (about) 1/2000 **more detailed description** protons and neutrons make up the nucleus electrons orbit the nucleus electrons are in shells most of the atom is empty space nucleus occupies a very small fraction of the volume of the atom electrons orbit at a relatively large distance from the nucleus most of the mass of the atom is contained in the nucleus the nucleus as a whole is positively charged total number of protons in the nucleus equals the total number of electrons orbitting it in an atom	accept protons and neutrons have the same mass accept electrons have tiny / negligible mass zero mass is neutral		

Total		**10**

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Question	Answers	Extra information	Mark	AO / Spec. ref.	ID
3(a)(i)	splitting of a(n atomic) nucleus	do not accept splitting an atom	1	AO1 2.6.1b	**E**
3(a)(ii)	Neutron		1	AO1 2.6.1c	**E**
3(b)(i)	nuclei have the same charge **or** nuclei are positive	accept protons have the same charge	1	AO1 2.3.1d	**E**
3(b)(ii)	(main sequence) star	accept Sun or any correctly named star accept red (super) giant	1	AO1 2.6.2b	**E**
3(c)(i)	any **two** from: • easy to obtain / extract • available in (very) large amounts • releases more energy (per kg) • produces little/no radioactive waste	do **not** accept figures *only* naturally occurring is insufficient seawater is renewable is insufficient less cost is insufficient	2	AO2/3 2.6	**E**
3(c)(ii)	any **one** from: • makes another source of energy available • increases supply of electricity • able to meet global demand • less environmental damage • reduces amount of other fuels used	accept any sensible suggestion accept a specific example accept a specific example	1	AO3 2.6	**E**
3(d)	12	allow **1** mark for obtaining 3 half-lives	2	AO2 2.5.2h	**E**

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Total			**9**

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Question	Answers	Extra information	Mark	AO / Spec. ref.	ID
4(a)(i)	distance travelled under the braking force	accept distance travelled between applying the brakes and stopping	1	AO1 2.1.3c	**E**
4(a)(ii)	any **one** from: • icy/wet roads • (worn) tyres • road surface • mass (of car and passengers) • (efficiency/condition of the) brakes	accept weather (conditions) accept gradient of road accept number of passengers friction/traction is insufficient	1	AO1 2.1.3f	**E**
4(a)(iii)	greater the speed the greater the braking force (required)	must mention both speed and force	1	AO1 2.1.3b	**E**
4(b)	22.5	allow **1** mark for showing correct use of the graph with misread figures **or** for showing e.g. 90÷4 an answer 17 gains **1** mark any answer such as 17.4 or 17.5 scores 0	2	AO2 2.1.2b/c	**E**
4(c)(i)	momentum before = momentum after **or** (total) momentum stays the same	accept no momentum is lost accept no momentum is gained ignore statements referring to energy	1	AO1 2.2.2b	**E**

Question 4 continues on the next page . . .

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Question 4 continued . . .

Question	Answers	Extra information	Mark	AO / Spec. ref.	ID
4(c)(ii)	5	allow **2** marks for correctly obtaining momentum before as 12 000 **or** allow **2** marks for 1500 x 8 = 2400 x v **or** allow **1** mark for a relevant statement re conservation of momentum **or** allow **1** mark for momentum before = 1500 x 8	3	AO2 2.2.2a/b	**E**
4(d)	the seat belt stretches driver takes a longer *(impact)* time to slow down and stop (than a driver hitting a hard surface/windscreen/ steering wheel) for the (same) change of momentum a smaller force is exerted (so driver less likely to have serious injury than driver without seat belt) **or** the seat belt stretches ***(1)*** driver travels a greater distance while slowing down and stopping (than a driver hitting a hard surface/windscreen/ steering wheel) ***(1)*** for (same) amount of work done (**1**) a smaller force is exerted (so driver less likely to have serious injury than driver without seat belt) ***(1)***	 accept so smaller deceleration/negative acceleration do not accept impact for force accept for (same) change of KE do not accept impact for force	1 1 1 1	AO1/3 2.2	**E**

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Total			**13**

Question	Answers	Extra information	Mark	AO / Spec. ref.	ID
5(a)(i) mark with 5aii 5aiii	1.7		1	AO2 2.3.2	**E**
5(a)(ii) mark with 5ai 5aiii	51 **or** 30 x their (a)(i) correctly calculated	allow **1** mark for correct substitution i.e. 1.7 = Q/30 or their (a)(i) = Q/30	2	AO1/AO2 2.3.2a	**E**
	coulomb / C	do **not** accept c	1		
5(a)(iii) mark with 5ai 5aii	612 **or** their(a)(ii)x 12 correctly calculated ***or*** their (a)(i) x 360 correctly calculated	allow **1** mark for correct substitution i.e. E = 12 x 51 or 12 x their (a)(ii) or their (a)(i) x 360	2	AO2 2.4.2d	**E**
5(b)	ions vibrate faster **or** ions vibrate with a bigger amplitude	accept atoms for ions throughout accept ions gain energy accept ions vibrate more ions start to vibrate is insufficient	1	AO1 2.3.2m	**E**
	electrons collide more (frequently) with the ions **or** (drift) velocity of electrons decreases	electrons start to collide is insufficient there are more collisions is insufficient, unless both electrons and ions are implied	1		
Total			**8**		

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Question	Answers	Extra information	Mark	AO / Spec. ref.	ID
6(a)(i)	decreases (to zero) resultant force acts in opposite direction to motion	 accept air resistance and weight for resultant force accept resultant force acts downwards do **not** accept air resistance increases	1 1	AO1 2.1.1c/e	**E**
6(a)(ii)	velocity includes direction **or** velocity is a vector (quantity)		1	AO1 2.1.2d	**E**
6(b)(i) mark with 6bii 6biii	3.6	allow **1** mark for correct substitution i.e. ½ x 0.05 x 12^2 provided no subsequent step	2	AO2 2.2.1g	**E**
6(b)(ii) mark with 6bi, 6biii	3.6 **or** their (b)(i)		1	AO1 2.2	**E**
6(b)(iii) mark with 6bi, 6bii	7.2 **or** their (b)(ii) ÷ 0.5 correctly calculated	allow **1** mark for correct substitution i.e. 3.6 or their (b)(ii) = 0.05 x 10 x h	2	AO2 2.2.1f	**E**
6(b)(iv)	**B**		1	AO3 2.1	**A**
6(c)	range increases up to 45^o range decreases from 45^o	 the range is a maximum at 45^o gains both marks for any two angles that add up	1 1	AO3 2.1	**E**

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		to 90^{o} the range is the same gains both marks the range increases then decreases gains **1** mark			
Total			**11**		

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Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

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

AQA

General Certificate of Secondary Education
Higher Tier
June 2014

Additional Science
Unit Physics P2

PH2HP

H

Physics
Unit Physics P2

Monday 19 May 2014 1.30 pm to 2.30 pm

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

A

Time allowed
- 1 hour

Instructions
- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 60.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.
- Question 3(a)(iii) should be answered in continuous prose.
  In this question you will be marked on your ability to:
  – use good English
  – organise information clearly
  – use specialist vocabulary where appropriate.

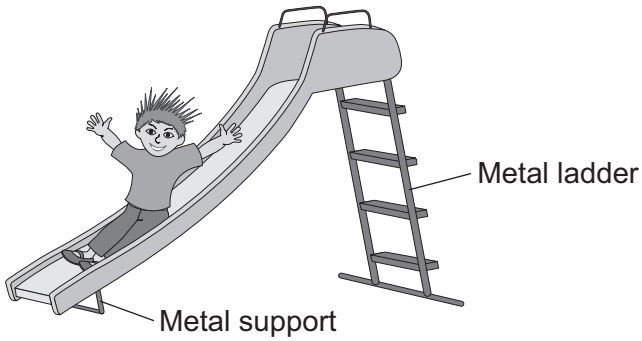
Advice
- In all calculations, show clearly how you work out your answer.

Do not write outside the box

Answer **all** questions in the spaces provided.

1 **Figure 1** shows a slide in a children's playground.

Figure 1



1 (a) A child of mass 18 kilograms goes down the slide.

The vertical distance from the top to the bottom of the slide is 2.5 metres.

Calculate the decrease in gravitational potential energy of the child sliding from the top to the bottom of the slide.

Gravitational field strength = 10 N/kg

Use the correct equation from the Physics Equations Sheet.

[2 marks]

.....

.....

.....

Decrease in gravitational potential energy = ... J

Do not write outside the box

1 (b) The slide is made of plastic.

1 (b) (i) The child becomes electrically charged when he goes down the slide.

Explain why.

[2 marks]

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.....

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.....

1 (b) (ii) Going down the slide causes the child's hair to stand on end.

What conclusion about the electrical charge on the child's hair can be made from this observation?

[2 marks]

.....

.....

Give a reason for your answer.

.....

.....

1 (b) (iii) Why would the child **not** become electrically charged if the slide was made from metal?

[1 mark]

.....

.....

7

Turn over for the next question

Do not write outside the box

2 Stars go through a life cycle.

Some stars will finish their life cycle as a black dwarf and other stars as a black hole.

2 (a) **Table 1** gives the mass, relative to the Sun, of three stars, **J**, **K** and **L**.

Table 1

Star	Mass of the star relative to the Sun
J	0.5
K	14.5
L	20.0

Which **one** of the stars, **J**, **K** or **L**, will become a black dwarf? .....

[2 marks]

Give a reason for your answer.

.....

.....

2 (b) Scientists can take the measurements needed to calculate the mass of many stars.

Scientists cannot calculate the mass of the star Betelgeuse.

They estimate that the star has a mass between 8 and 20 times the mass of the Sun.

2 (b) (i) Betelgeuse is in the red super giant stage of its life cycle.

What will happen to Betelgeuse at the end of the red super giant stage?

[1 mark]

.....

.....

Do not write outside the box

2 (b) (ii) Suggest **one** reason why scientists can only estimate and **not** calculate the mass of Betelgeuse.

[1 mark]

.....

.....

.....

2 (b) (iii) In the future, it may become possible for scientists to calculate the mass of Betelgeuse.

Suggest **one** reason why.

[1 mark]

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.....

2 (c) Describe what happens to a star, after the main sequence period, for the star to eventually become a **black dwarf**.

[5 marks]

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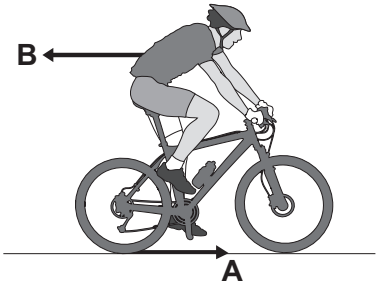
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10

Do not write outside the box

3 (a) **Figure 2** shows the horizontal forces acting on a moving bicycle and cyclist.

Figure 2



3 (a) (i) What causes force **A**?

Draw a ring around the correct answer.

[1 mark]

friction **gravity** **weight**

3 (a) (ii) What causes force **B**?

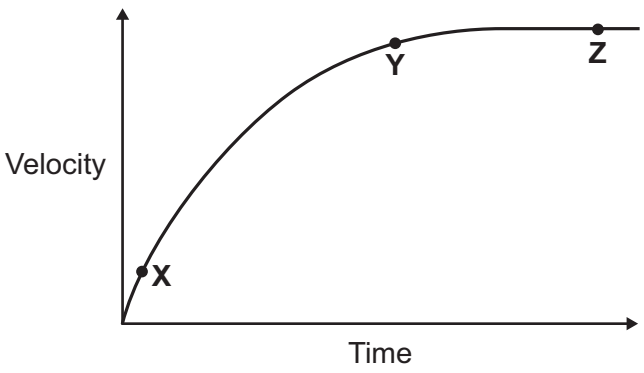
[1 mark]

.....

3 (a) (iii) **In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.**

Figure 3 shows how the velocity of the cyclist changes during the first part of a journey along a straight and level road. During this part of the journey the force applied by the cyclist to the bicycle pedals is constant.

Figure 3



Do not write outside the box

Describe how **and** explain, in terms of the forces **A** and **B**, why the velocity of the cyclist changes:

- between the points **X** and **Y**
- and between the points **Y** and **Z**, marked on the graph in **Figure 3**.

[6 marks]

Extra space .....

Do not write outside the box

3 (b) (i) The cyclist used the brakes to slow down and stop the bicycle.

A constant braking force of 140 N stopped the bicycle in a distance of 24 m.

Calculate the work done by the braking force to stop the bicycle. Give the unit.

Use the correct equation from the Physics Equations Sheet.

[3 marks]

.....

.....

.....

Work done = ...

3 (b) (ii) Complete the following sentences.

[2 marks]

When the brakes are used, the bicycle slows down. The kinetic energy of the bicycle ..... .

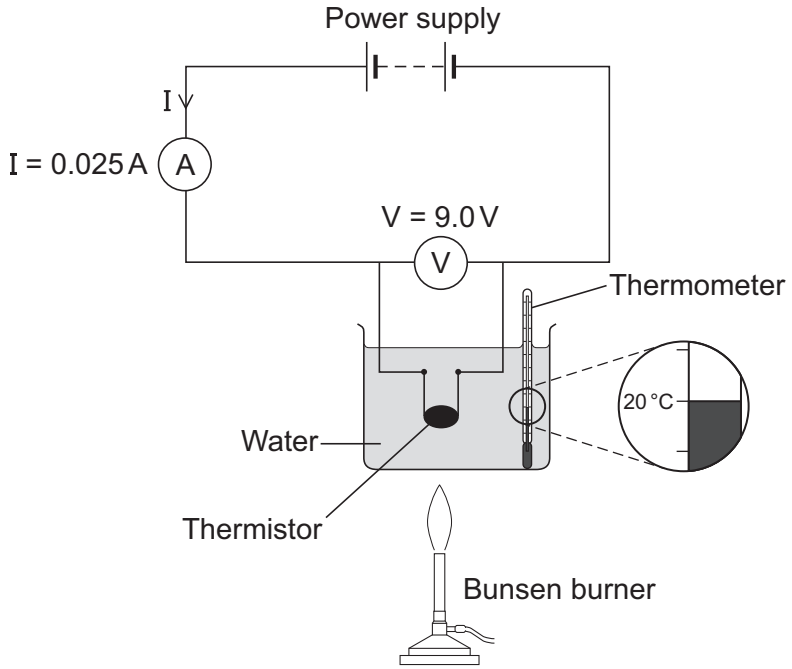
At the same time, the ..... of the brakes increases.

13

Do not write outside the box

4 (a) **Figure 4** shows the apparatus used to obtain the data needed to calculate the resistance of a thermistor at different temperatures.

Figure 4



4 (a) (i) In the box below, draw the circuit symbol for a thermistor.

[1 mark]

4 (a) (ii) Use the data given in **Figure 4** to calculate the resistance of the thermistor at 20 °C.

Use the correct equation from the Physics Equations Sheet.

[2 marks]

.....

.....

.....

Resistance = ... ohms

Question 4 continues on the next page

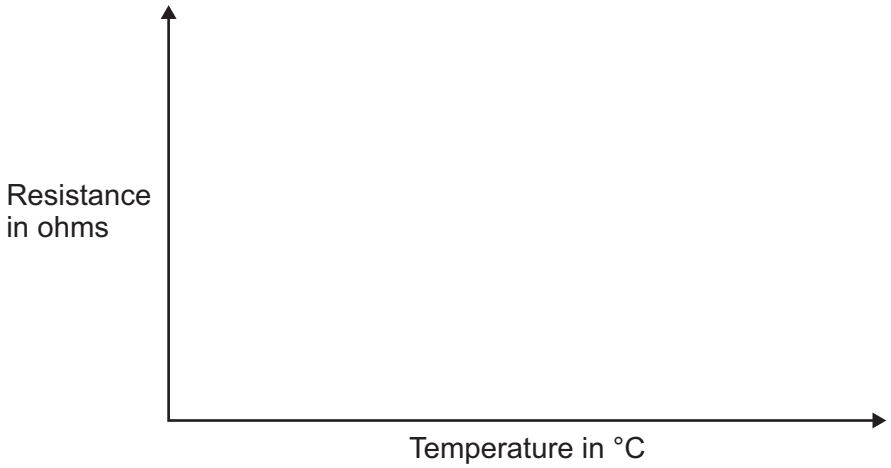
Do not write outside the box

4 (a) (iii) **Figure 5** shows the axes for a sketch graph.

Complete **Figure 5** to show how the resistance of the thermistor will change as the temperature of the thermistor increases from 20 °C to 100 °C.

[1 mark]

Figure 5



4 (a) (iv) Which **one** of the following is most likely to include a thermistor?

Tick (✓) **one** box.

[1 mark]

An automatic circuit to switch a plant watering system on and off. ☐

An automatic circuit to switch an outside light on when it gets dark. ☐

An automatic circuit to switch a heating system on and off. ☐

4 (b) The ammeter used in the circuit has a very low resistance.

Why is it important that ammeters have a very low resistance?

[1 mark]

.....

.....

Do not write outside the box

4 (c) **Table 2** gives the temperature of boiling water using three different temperature scales.

Table 2

Temperature	Scale
100	Celsius (°C)
212	Fahrenheit (°F)
80	Réaumur (°Re)

Scientists in different countries use the same temperature scale to measure temperature.

Suggest **one** advantage of doing this.

[1 mark]

.....

.....

.....

4 (d) A student plans to investigate how the resistance of a light-dependent resistor (LDR) changes with light intensity.

The student starts with the apparatus shown in **Figure 4** but makes three changes to the apparatus.

One of the changes the student makes is to replace the thermistor with an LDR.

Describe what other changes the student should make to the apparatus.

[2 marks]

.....

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9

Do not write outside the box

5 **Figure 6** shows a skateboarder jumping forwards off his skateboard.

The skateboard is stationary at the moment the skateboarder jumps.

Figure 6



5 (a) The skateboard moves backwards as the skateboarder jumps forwards.

Explain, using the idea of momentum, why the skateboard moves backwards.

[3 marks]

.....

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Do not write outside the box

5 (b) The mass of the skateboard is 1.8 kg and the mass of the skateboarder is 42 kg.

Calculate the velocity at which the skateboard moves backwards if the skateboarder jumps forwards at a velocity of 0.3 m/s.

Use the correct equation from the Physics Equations Sheet.

[3 marks]

.....

.....

.....

.....

.....

.....

Velocity of skateboard = ... m/s

6

Turn over for the next question

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

Do not write outside the box

6 (a) There are many isotopes of the element molybdenum (Mo).

What do the nuclei of different molybdenum isotopes have in common?

[1 mark]

.....

6 (b) The isotope molybdenum-99 is produced inside some nuclear power stations from the nuclear fission of uranium-235.

6 (b) (i) What happens during the process of nuclear fission?

[1 mark]

.....

.....

6 (b) (ii) Inside which part of a nuclear power station would molybdenum be produced?

[1 mark]

.....

6 (c) When the nucleus of a molybdenum-99 atom decays, it emits radiation and changes into a nucleus of technetium-99.

$$^{99}_{42}\text{Mo} \longrightarrow {}^{99}_{43}\text{Tc} + \text{Radiation}$$

What type of radiation is emitted by molybdenum-99?

[2 marks]

.....

Give a reason for your answer.

.....

.....

Question 6 continues on the next page

Do not write outside the box

6 (d) Technetium-99 has a short half-life and emits gamma radiation.

What is meant by the term 'half-life'?

[1 mark]

.....

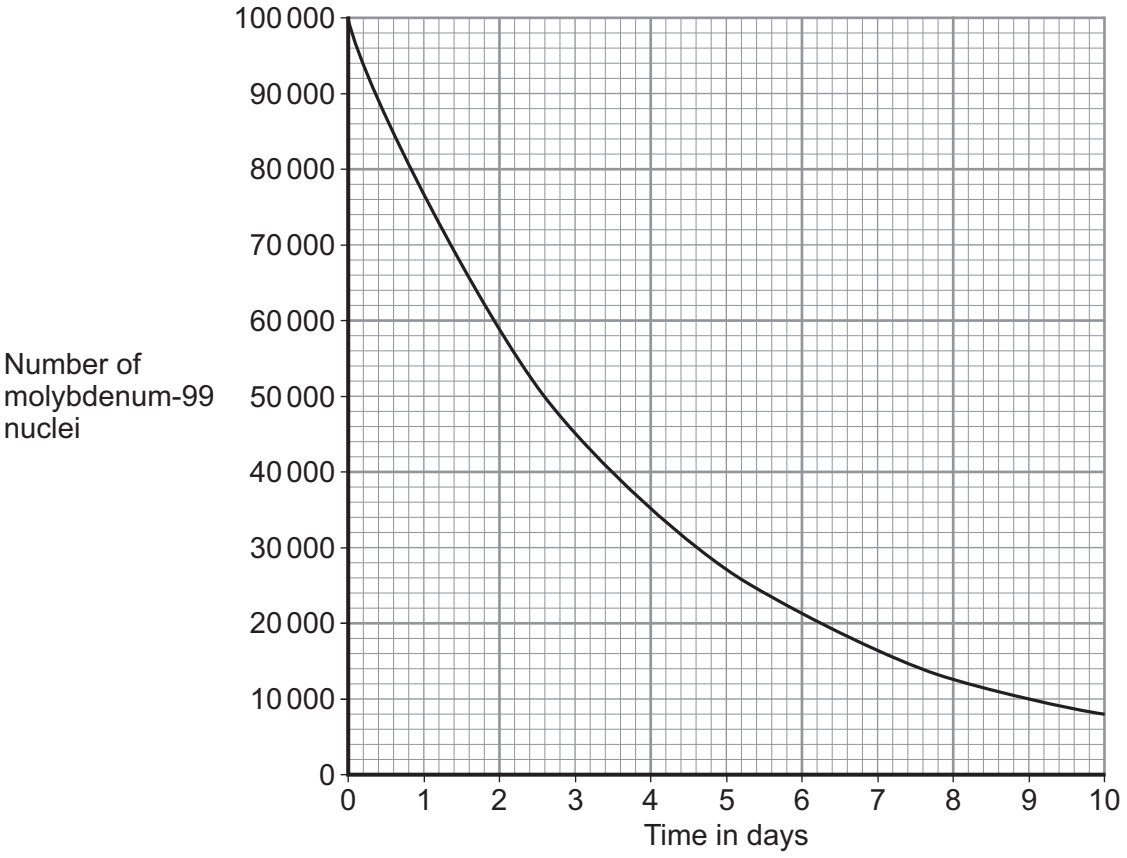
.....

.....

6 (e) Technetium-99 is used by doctors as a medical tracer. In hospitals it is produced inside a technetium generator by the decay of molybdenum-99 nuclei.

6 (e) (i) **Figure 7** shows how the number of nuclei in a sample of molybdenum-99 changes with time as the nuclei decay.

Figure 7



Do not write outside the box

A technetium generator will continue to produce sufficient technetium-99 until 80% of the original molybdenum nuclei have decayed.

After how many days will a source of molybdenum-99 inside a technetium-99 generator need replacing?

Show clearly your calculation and how you use the graph to obtain your answer.

[2 marks]

.....

.....

.....

Number of days = ...

6 (e) (ii) Medical tracers are injected into a patient's body; this involves some risk to the patient's health.

Explain the risk to the patient of using a radioactive substance as a medical tracer.

[2 marks]

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.....

6 (e) (iii) Even though there may be a risk, doctors frequently use radioactive substances for medical diagnosis and treatments.

Suggest why.

[1 mark]

.....

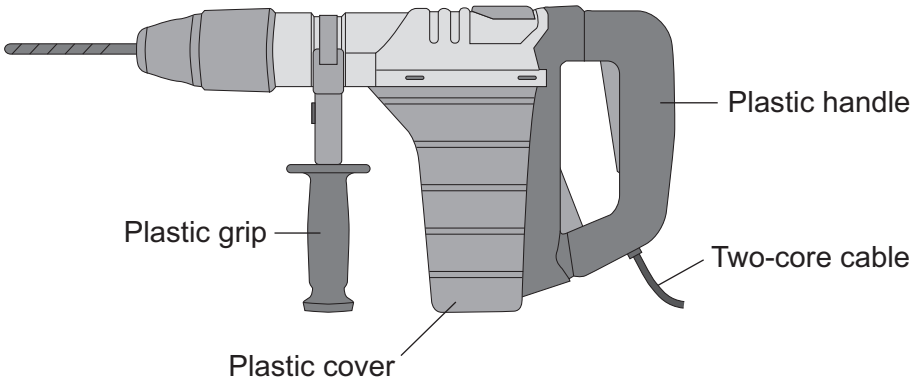
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7 **Figure 8** shows an electric drill.

Figure 8



The information in the box is taken from the booklet supplied with the drill.

- This drill is fitted with a two-core cable
- Power supply: 230 V a.c. 50 Hz
- Power input: 1012 W
- Mass: 6 kg

7 (a) Why is it safe for this drill to be fitted with a two-core cable rather than a three-core cable?

[1 mark]

.....

.....

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7 (b) Calculate the current drawn from the mains electricity supply by the drill.

Use the correct equation from the Physics Equations Sheet.

[2 marks]

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Current = ... A

Do not write outside the box

7 (c) It is advisable to use all 230 V power tools with a residual current circuit breaker (RCCB).

How does an RCCB operate?

[1 mark]

.....

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.....

4

END OF QUESTIONS

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GCSE

ADDITIONAL SCIENCE / PHYSICS

PH2HP

Mark scheme

4408/4403

June 2014

Version: 1.0 Final

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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

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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

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.

3. Marking points

3.1 Marking of lists

This applies to questions requiring a set number of responses, but for which candidates 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)

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

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

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

3.2 Use of chemical symbols / formulae

If a candidate 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

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

However, if the answer is incorrect, mark(s) can be gained by correct substitution / working and this is shown in the 'extra information' column or by each stage of a longer calculation.

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 are 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 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.

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

Quality of Written Communication and levels marking

In Question 3(a)(iii) candidates are required to produce extended written material in English, and will be assessed on the quality of their written communication as well as the standard of the scientific response.

Candidates will be required to:

- use good English
- organise information clearly
- use specialist vocabulary where appropriate.

The following general criteria should be used to assign marks to a level:

Level 1: basic

- Knowledge of basic information
- Simple understanding
- The answer is poorly organised, with almost no specialist terms and their use demonstrating a general lack of understanding of their meaning, little or no detail
- The spelling, punctuation and grammar are very weak.

Level 2: clear

- Knowledge of accurate information
- Clear understanding
- The answer has some structure and organisation, use of specialist terms has been attempted but not always accurately, some detail is given
- There is reasonable accuracy in spelling, punctuation and grammar, although there may still be some errors.

Level 3: detailed

- Knowledge of accurate information appropriately contextualised
- Detailed understanding, supported by relevant evidence and examples
- Answer is coherent and in an organised, logical sequence, containing a wide range of appropriate or relevant specialist terms used accurately.
- The answer shows almost faultless spelling, punctuation and grammar.

Question	Answers	Extra information	Mark	AO spec ref
1(a)	450	allow **1** mark for correct substitution, ie 18 × 10 × 2.5 provided no subsequent step	2	AO2 2.2.1f
1(b)(i)	friction between child ('s clothing) and slide	accept friction between two insulators accept child rubs against the slide accept when two insulators rub (together)	1	AO1 2.3.1a
	causes electron / charge transfer (between child and slide)	accept specific reference, eg electrons move onto / off the child / slide reference to positive electrons / protons / positive charge / atoms transfer negates this mark answers in terms of the slide being initially charged score zero	1	
1(b)(ii)	all the charges (on the hair) are the same (polarity)	accept (all) the charge/hair is negative / positive accept it is positive/negative	1	AO3 2.3.1d
	charges / hairs are repelling	both parts should be marked together	1	
1(b)(iii)	charge would pass through the metal (to earth)	accept metal is a conductor accept metal is not an insulator accept there is no charge / electron transfer accept the slide is earthed accept metals contain free electrons	1	AO1 2.3.1e
Total			**7**	

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Question	Answers	Extra information	Mark	AO spec ref
2(a)	J (only) stars (about) the same/smaller size/mass as the Sun become black dwarfs	reason only scores if J is chosen accept smaller than the Sun accept it is the smallest accept (only) small stars become black dwarfs	1 1	AO1 AO2 2.6.2e
2(b)(i)	become a supernova **or** it will explode	ignore subsequent correct stages	1	AO1 2.6.2e
2(b)(ii)	cannot take measurements needed **or** do not have the technology	do **not** accept cannot measure mass	1	AO3 2.6.2e
2(b)(iii)	advances in (measuring) techniques / technology / knowledge		1	AO3 2.6.2e

Question 2 continues on the next page . . .

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Question 2 continued . . .

Question	Answers	Extra information	Mark	AO spec ref
2(c)	any **five** from: • star expands (to become) • a red giant • heavier elements are formed (by fusion) • star shrinks (to become) • a white dwarf • star cools / fades • star stops emitting energy / radiation	ignore any information up to the end of the main sequence Apply the list rule if more than 5 points are made red supergiant is incorrect elements heavier than iron are formed is incorrect supernova, neutron star, black hole are incorrect star loses all energy is insufficient	5	AO1 2.6.2 b, d, e
Total			**10**	

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Question	Answers	Extra information	Mark	AO spec ref
3(a)(i)	friction		1	AO1 2.1.3a
3(a)(ii)	air resistance	accept drag friction is insufficient	1	AO1 2.1.3a

3(a)(iii)	Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information on page 5, and apply a 'best-fit' approach to the marking.		**Mark** **6**	**AO spec ref**
0 marks	**Level 1 (1–2 marks)**	**Level 2 (3–4 marks)**	**Level 3 (5–6 marks)**	AO2 AO3 2.1.4c
No relevant content.	There is an attempt to explain in terms of forces A and B why the velocity of the cyclist changes between any two points **or** a description of how the velocity changes between any two points.	There is an explanation in terms of forces A and B of how the velocity changes between X and Y and between Y and Z **or** a complete description of how the velocity changes from X to Z. **or** an explanation and description of velocity change for either X to Y or Y to Z	There is a clear explanation in terms of forces A and B of how the velocity changes between X and Z **and** a description of the change in velocity between X and Z.	

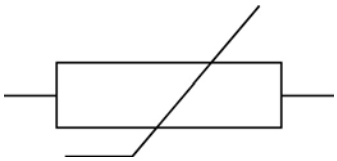
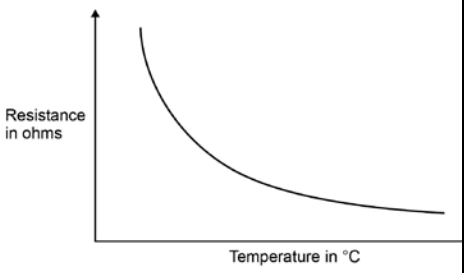
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examples of the points made in the response	extra information
X to Y • at X force A is greater than force B • cyclist accelerates • and velocity increases • as cyclist moves toward Y, force B (air resistance) increases (with increasing velocity) • resultant force decreases • cyclist continues to accelerate but at a smaller value • so velocity continues to increase but at a lower rate **Y to Z** • from Y to Z force B (air resistance) increases • acceleration decreases • force B becomes equal to force A • resultant force is now zero • acceleration becomes zero • velocity increases until… • cyclist travels at constant / terminal velocity	accept speed for velocity throughout

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Question	Answers	Extra information	Mark	AO spec ref
3(b)(i)	3360	allow **1** mark for correct substitution, ie 140 × 24 provided no subsequent step accept 3400 for **2** marks if correct substitution is shown	2	AO1 AO2 2.2.1b
	joule / J	do **not** accept j do **not** accept Nm	1	
3(b)(ii)	decreases	accept an alternative word / description for decrease do not accept slows down	1	AO1 2.1.3e
	temperature	accept thermal energy accept heat	1	
Total			**13**	

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Question	Answers	Extra information	Mark	AO spec ref
4(a)(i)			1	AO1 2.3.2c
4(a)(ii)	360	allow **1** mark for correct substitution, ie 9 = 0.025 × R	2	AO2 2.3.2h
4(a)(iii)	sketch graph of correct shape, ie 		1	AO1 2.3.2g
4(a)(iv)	An automatic circuit to switch a heating system on and off.		1	AO1 2.3.2c

Question 4 continues on the next page . . .

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Question 4 continued . . .

Question	Answers	Extra information	Mark	AO spec ref
4(b)	so ammeter reduces / affects current as little as possible	accept so does not reduce / change the current (it is measuring) accurate reading is insufficient not change the resistance is insufficient	1	AO1 2.3.2c
4(c)	gives a common understanding	accept is easier to share results accept can compare results do not need to be converted is insufficient prevent errors is insufficient	1	AO3 2.3.2k
4(d)	replace Bunsen (and water) with a lamp replace thermometer with light sensor	accept any way of changing light level accept any way of measuring a change in light level datalogger alone is insufficient	1 1	AO2 2.3.2p
Total			**9**	

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Question	Answers	Extra information	Mark	AO spec ref
5(a)	momentum before (jumping) = momentum after (jumping)	accept momentum (of the skateboard and skateboarder) is conserved	1	AO1 2.2.2b
	before (jumping) momentum of skateboard and skateboarder is zero	accept before (jumping) momentum of skateboard is zero accept before (jumping) total momentum is zero	1	
	after (jumping) skateboarder has momentum (forwards) so skateboard must have (equal) momentum (backwards)	answers only in terms of equal and opposite forces are insufficient	1	
5(b)	7	accept –7 for **3** marks allow **2** marks for momentum of skateboarder equals 12.6 **or** 0 = 42 × 0.3 + (1.8 × –v) **or** allow **1** mark for stating use of conservation of momentum	3	AO2 2.2.2b
Total			**6**	

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Question	Answers	Extra information	Mark	AO spec ref
6(a)	(same) number of protons	same atomic number is insufficient	1	AO1 2.5.1e
6(b)(i)	nuclei split	do **not** accept atom for nuclei / nucleus	1	AO1 2.6.1b
6(b)(ii)	(nuclear) reactor		1	AO1 2.6.1a
6(c)	beta any **one** from: • atomic / proton number increases (by 1) • number of neutrons decreases / changes by 1 • mass number does not change • a neutron becomes a proton	 accept atomic / proton number changes by 1 (total) number of protons and neutrons does not change	1 1	AO2 2.5.2d
6(d)	(average) time taken for number of nuclei to halve **or** (average) time taken for count-rate / activity to halve		1	AO1 2.5.2h

Question 6 continues on the next page . . .

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Question 6 continued . . .

Question	Answers	Extra information	Mark	AO spec ref
6(e)(i)	6.2 (days)	Accept 6.2 to 6.3 inclusive allow **1** mark for correctly calculating number remaining as 20 000 **or** allow **1** mark for number of 80 000 plus correct use of the graph (gives an answer of 0.8 days)	2	AO2 2.5.2h
6(e)(ii)	radiation causes ionisation that may then harm / kill healthy cells	allow radiation can be ionising accept specific examples of harm, eg alter DNA / cause cancer	1 1	AO3 2.5.2g
6(e)(iii)	benefit (of diagnosis / treatment) greater than risk (of radiation)	accept may be the only procedure available	1	AO3 2.5.2g
Total			**11**	

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Question	Answers	Extra information	Mark	AO spec ref
7(a)	drill is double insulated	accept no exposed metal parts accept the outside is an insulator accept plastic is an insulator	1	AO1 2.4.1j
7(b)	4.4	allow **1** mark for correct substitution, ie 1012 = I × 230 provided no subsequent incorrect numerical step	2	AO2 2.4.2c
7(c)	detects a (very small) difference between the current in the live wire and the current in the neutral wire		1	AO1 2.4.1i
Total			**4**	

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Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

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

General Certificate of Secondary Education
Higher Tier
June 2013

Additional Science
Unit Physics P2

PH2HP

H

Physics
Unit Physics P2

Thursday 23 May 2013 9.00 am to 10.00 am

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

Time allowed
- 1 hour

Instructions
- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- Do all rough work in this book. Cross through any work you do not want to be marked.

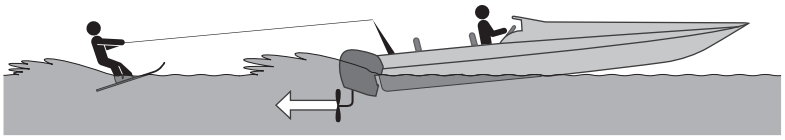
Information
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 60.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.
- Question 2 (b) should be answered in continuous prose. In this question you will be marked on your ability to:
  – use good English
  – organise information clearly
  – use specialist vocabulary where appropriate.

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

Do not write outside the box

Answer **all** questions in the spaces provided.

1 The diagram shows a boat pulling a water skier.



1 (a) The arrow represents the force on the water produced by the engine propeller. This force causes the boat to move.

Explain why.

.....

.....

.....

.....

(2 marks)

1 (b) The boat accelerates at a constant rate in a straight line. This causes the velocity of the water skier to increase from 4.0 m/s to 16.0 m/s in 8.0 seconds.

1 (b) (i) Calculate the acceleration of the water skier and give the unit.

Use the correct equation from the Physics Equations Sheet.

.....

.....

.....

Acceleration = ...

(3 marks)

Do not write outside the box

1 (b) (ii) The water skier has a mass of 68 kg.

Calculate the resultant force acting on the water skier while accelerating.

Use the correct equation from the Physics Equations Sheet.

.....

.....

.....

Resultant force = ... N

(2 marks)

1 (b) (iii) Draw a ring around the correct answer to complete the sentence.

The force from the boat pulling the water skier forwards

will be | less than / the same as / greater than | the answer to part **(b)(ii)**.

Give the reason for your answer.

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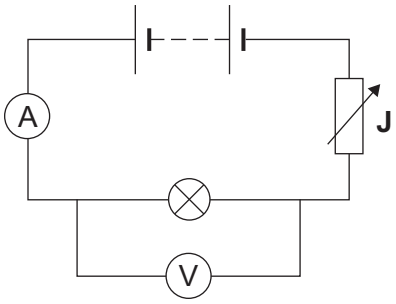
(2 marks)

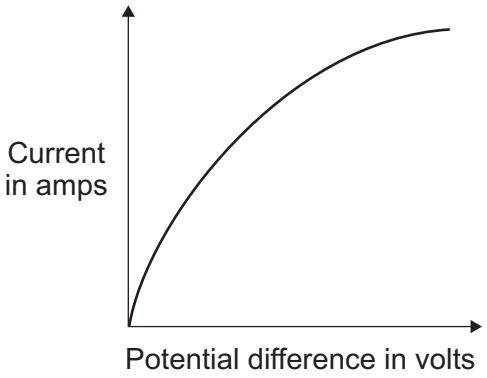
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Turn over for the next question

Do not write outside the box

2 (a) The diagram shows the circuit used to obtain the data needed to plot the current–potential difference graph for a filament bulb.





2 (a) (i) Why is the component labelled '**J**' included in the circuit?

.....

.....

(1 mark)

2 (a) (ii) The resistance of the bulb increases as the potential difference across the bulb increases. Why?

.....

.....

(1 mark)

2 (a) (iii) The bulb is at full brightness when the potential difference across the bulb is 12 V. The current through the bulb is then 3 A.

Calculate the power of the bulb when it is at full brightness and give the unit.

Use the correct equation from the Physics Equations Sheet.

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.....

Power = ...

(3 marks)

Do not write outside the box

2 (b) *In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.*

The table gives data about two types of light bulb people may use in their homes.

Type of light bulb	Energy efficiency	Cost of one light bulb	Average lifetime in hours
Halogen	10 %	£1.95	2 000
Light Emitting Diode (LED)	32 %	£11.70	36 000

Both types of light bulb produce the same amount of light.

Evaluate, in terms of cost and energy efficiency, the use of the two types of light bulb.

To gain full marks you must compare both types of light bulb and conclude which light bulb would be the best to use.

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(6 marks)

11

Do not write outside the box

3 (a) Nuclear power stations generate about 14% of the world's electricity.

3 (a) (i) Uranium-235 is used as a fuel in some nuclear reactors.

Name **one** other substance used as a fuel in some nuclear reactors.

.....

(1 mark)

3 (a) (ii) Energy is released from nuclear fuels by the process of nuclear fission. This energy is used to generate electricity.

Describe how this energy is used to generate electricity.

Do **not** explain the nuclear fission process.

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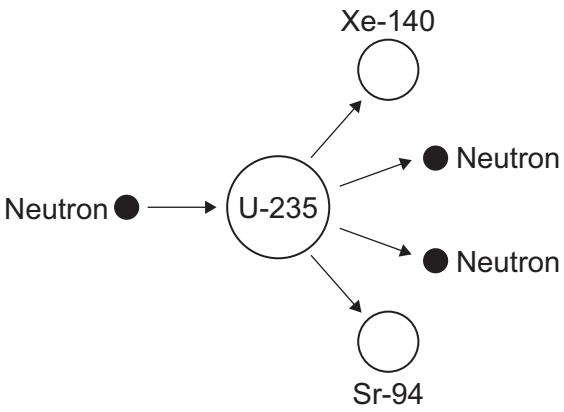
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(3 marks)

3 (b) The diagram shows the nuclear fission process for an atom of uranium-235.

Complete the diagram to show how the fission process starts a chain reaction.

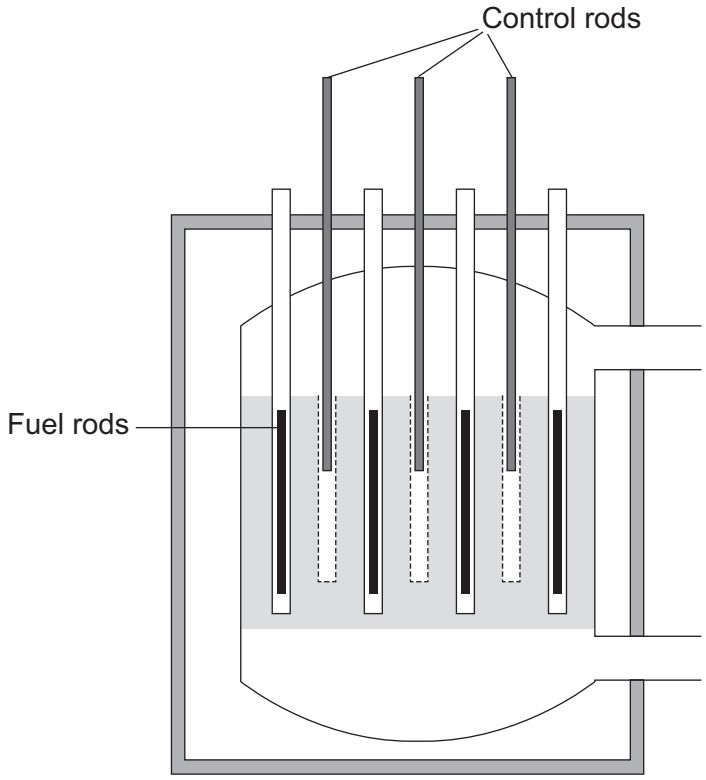


(2 marks)

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Do not write outside the box

3 (c) The diagram shows the cross-section through a nuclear reactor.



The control rods, made from boron, are used to control the chain reaction. Boron atoms absorb neutrons without undergoing nuclear fission.

Why does lowering the control rods reduce the amount of energy released each second from the nuclear fuel?

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(2 marks)

8

Turn over ▶

Do not write outside the box

4 (a) The stopping distance of a vehicle is made up of two parts, the thinking distance and the braking distance.

4 (a) (i) What is meant by *thinking distance*?

.....

.....

(1 mark)

4 (a) (ii) State **two** factors that affect thinking distance.

1 .....

.....

2 .....

.....

(2 marks)

4 (b) A car is travelling at a speed of 20 m/s when the driver applies the brakes. The car decelerates at a constant rate and stops.

4 (b) (i) The mass of the car and driver is 1600 kg.

Calculate the kinetic energy of the car and driver before the brakes are applied.

Use the correct equation from the Physics Equations Sheet.

.....

.....

.....

Kinetic energy = ... J

(2 marks)

4 (b) (ii) How much work is done by the braking force to stop the car and driver?

Work done = ... J

(1 mark)

Do not write outside the box

4 (b) (iii) The braking force used to stop the car and driver was 8000 N.

Calculate the braking distance of the car.

Use the correct equation from the Physics Equations Sheet.

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Braking distance = ... m

(2 marks)

4 (b) (iv) The braking distance of a car depends on the speed of the car and the braking force applied.

State **one** other factor that affects braking distance.

.....

.....

(1 mark)

4 (b) (v) Applying the brakes of the car causes the temperature of the brakes to increase.

Explain why.

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(2 marks)

Question 4 continues on the next page

Do not write outside the box

4 (c) Hybrid cars have an electric engine and a petrol engine. This type of car is often fitted with a regenerative braking system. A regenerative braking system not only slows a car down but at the same time causes a generator to charge the car's battery.

State and explain the benefit of a hybrid car being fitted with a regenerative braking system.

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(3 marks)

14

Do not write outside the box

5 In 2011 an earthquake caused severe damage to a nuclear power station in Japan. The damage led to the release of large amounts of radioactive iodine-131($^{131}_{53}I$) into the atmosphere.

5 (a) The table gives some information about an atom of iodine-131($^{131}_{53}I$).

Complete the table.

mass number	131
number of protons	53
number of neutrons	

(1 mark)

5 (b) Complete the sentence.

The number of protons in an atom is called the proton number or

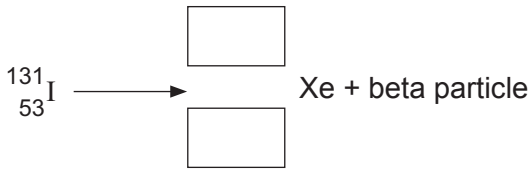
the ..... number.

(1 mark)

5 (c) An atom of iodine-131 decays into an atom of xenon (Xe) by emitting a beta particle.

5 (c) (i) The decay of iodine-131 can be represented by the equation below.

Complete the equation by writing the correct number in each of the **two** boxes.



(2 marks)

Question 5 continues on the next page

Do not write outside the box

5 (c) (ii) A sample of rainwater contaminated with iodine-131 gives a count rate of 1200 counts per second.

Calculate how many days it will take for the count rate from the sample of rainwater to fall to 75 counts per second.

Half-life of iodine-131 = 8 days

Show clearly how you work out your answer.

.....

.....

..... days
(2 marks)

5 (c) (iii) If people drink water contaminated with iodine-131, the iodine-131 builds up in the thyroid gland. This continues until the thyroid is saturated with iodine-131 and cannot absorb any more. The radiation emitted from the iodine-131 could cause cancer of the thyroid.

In Japan, people likely to be drinking water contaminated with iodine-131 were advised to take tablets containing a non-radioactive isotope of iodine.

Suggest why this advice was given.

.....

.....

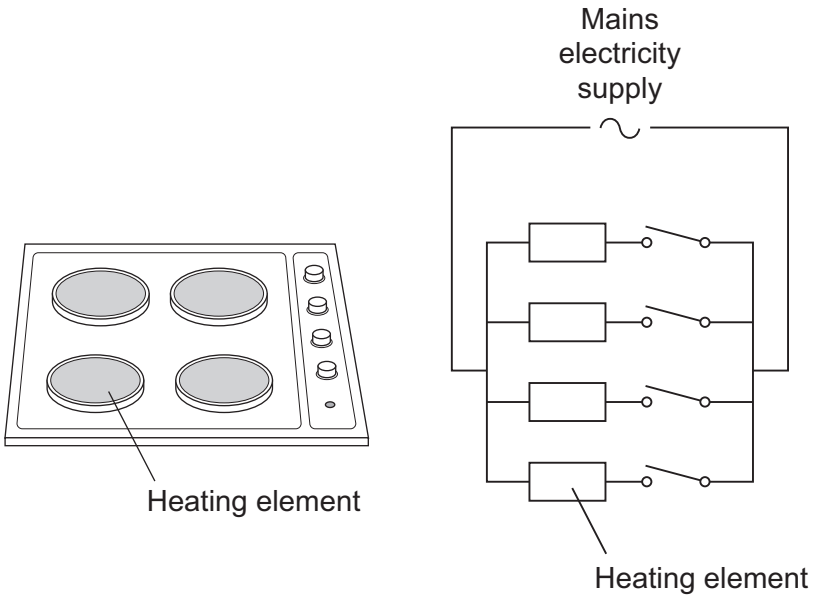
.....

.....
(2 marks)

8

Do not write outside the box

6 The picture shows an electric cooker hob. The simplified circuit diagram shows how the four heating elements connect to the mains electricity supply. The heating elements are identical.



When all four heating elements are switched on at full power the hob draws a current of 26 A from the 230 V mains electricity supply.

6 (a) Calculate the resistance of one heating element when the hob is switched on at full power.

Use the correct equation from the Physics Equations Sheet.

Give your answer to 2 significant figures.

.....

.....

.....

Resistance = ... Ω

(3 marks)

Question 6 continues on the next page

Turn over ▶

Do not write outside the box

6 (b) The table gives the maximum current that can safely pass through copper wires of different cross-sectional area.

Cross-sectional area in mm^2	Maximum safe current in amps
1.0	11.5
2.5	20.0
4.0	27.0
6.0	34.0

6 (b) (i) The power sockets in a home are wired to the mains electricity supply using cables containing 2.5 mm^2 copper wires. Most electrical appliances are connected to the mains electricity supply by plugging them into a standard power socket.

It would **not** be safe to connect the electric cooker hob to the mains electricity supply by plugging it into a standard power socket.

Why?

.....

.....

.....

.....

(2 marks)

6 (b) (ii) Describe the structure of the cable that should be used to connect the electric cooker hob to the mains electricity supply.

.....

.....

.....

.....

.....

.....

.....

.....

(3 marks)

Do not write outside the box

6 (c) Mains electricity is an alternating current supply. Batteries supply a direct current.

What is the difference between an alternating current and a direct current?

.....

.....

.....

.....

(2 marks)

10

END OF QUESTIONS

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There are no questions printed on this page

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Version 1.0



General Certificate of Secondary Education
June 2013

Additional Science / Physics PH2HP

(Specification 4408 / 4403)

Unit: Physics 2

Final

Mark Scheme

Mark schemes are prepared by the Principal Examiner 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 examiners 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 examiner understands and applies it in the same correct way. As preparation for standardisation each examiner 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, examiners encounter unusual answers which have not been raised they are required to refer these to the Principal Examiner.

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

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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 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

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.

3. Marking points

3.1 Marking of lists

This applies to questions requiring a set number of responses, but for which candidates 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)

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

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

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

3.2 Use of chemical symbols / formulae

If a candidate 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

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

However, if the answer is incorrect, mark(s) can be gained by correct substitution / working and this is shown in the 'extra information' column or by each stage of a longer calculation.

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 are 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 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.

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

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Quality of Written Communication and levels marking

In Question 2(b) candidates are required to produce extended written material in English, and will be assessed on the quality of their written communication as well as the standard of the scientific response.

Candidates will be required to:

- use good English
- organise information clearly
- use specialist vocabulary where appropriate.

The following general criteria should be used to assign marks to a level:

Level 1: basic

- Knowledge of basic information
- Simple understanding
- The answer is poorly organised, with almost no specialist terms and their use demonstrating a general lack of understanding of their meaning, little or no detail
- The spelling, punctuation and grammar are very weak.

Level 2: clear

- Knowledge of accurate information
- Clear understanding
- The answer has some structure and organisation, use of specialist terms has been attempted but not always accurately, some detail is given
- There is reasonable accuracy in spelling, punctuation and grammar, although there may still be some errors.

Level 3: detailed

- Knowledge of accurate information appropriately contextualised
- Detailed understanding, supported by relevant evidence and examples
- Answer is coherent and in an organised, logical sequence, containing a wide range of appropriate or relevant specialist terms used accurately.
- The answer shows almost faultless spelling, punctuation and grammar.

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Question 1

question	answers	extra information	mark
1(a)	(produces) a force from water on the boat		1
	in the forward direction	accept in the opposite direction this must refer to the direction of the force not simply the boat moves forwards an answer produces an (equal and) opposite force gains **1** mark	1
1(b)(i)	1.5	allow **1** mark for correct substitution, ie $\frac{16-4}{8}$ **or** $\frac{12}{8}$ provided no subsequent step shown ignore sign	2
	m/s^2		1
1(b)(ii)	102 **or** their (b)(i) × 68 correctly calculated	allow **1** mark for correct substitution, ie 1.5 × 68 **or** their (b)(i) × 68 provided no subsequent step shown	2
1(b)(iii)	greater than	reason only scores if greater than chosen	1
	need to overcome resistance forces	accept named resistance force accept resistance forces act (on the water skier) do **not** accept gravity	1
Total			**9**

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Question 2

question	answers	extra information	mark
2(a)(i)	to obtain a range of p.d. values	accept increase / decrease current / p.d. / voltage / resistance accept to change / control the current / p.d. / voltage / resistance to provide resistance is insufficient a variable resistor is insufficient do **not** accept electricity for current	1
2(a)(ii)	temperature of the bulb increases	accept bulb gets hot(ter) accept answers correctly expressed in terms of collisions between (free) electrons and ions / atoms bulb gets brighter is insufficient	1
2(a)(iii)	36 watt(s) / W	allow **1** mark for correct substitution, ie 12 × 3 provided no subsequent step shown accept joules per second / J/s do **not** accept w	2 1

Question 2 continues on the next page . . .

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Question 2 continued . . .

question	answers	extra information	mark
2(b)	Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information on page 5, and apply a 'best-fit' approach to the marking.		6

0 marks	**Level 1 (1–2 marks)**	**Level 2 (3–4 marks)**	**Level 3 (5–6 marks)**
No relevant content.	There is a basic comparison of either a cost aspect or an energy efficiency aspect.	There is a clear comparison of either the cost aspect or energy efficiency aspect **OR** a basic comparison of both cost and energy efficiency aspects.	There is a detailed comparison of both the cost aspect and the energy efficiency aspect. For full marks the comparisons made should support a conclusion as to which type of bulb is preferable.

Examples of the points made in the response:

cost
- halogen are cheaper to buy
- 6 halogen lamps cost the same as one LED
- LEDs last longer
- need to buy 18 / more halogen lamps to last the same time as one LED
- 18 halogens cost £35.10
- costs more to run a halogen than LED
- LED has lower maintenance cost (where many used, eg large departmental store lighting)

energy efficiency
- LED works using a smaller current
- LED wastes less energy
- LEDs are more efficient
- LED is 22% more energy efficient
- LED produces less heat
- LED requires smaller input (power) for same output (power)

simply giving cost figures is insufficient

Total			**11**

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Question 3

question	answers	extra information	mark
3(a)(i)	plutonium (239)	accept Pu / Thorium / MOX (mixed oxide) do **not** accept uranium-238 **or** hydrogen	1
3(a)(ii)	(energy) used to heat water and produce (high pressure) steam the steam drives a turbine (which turns a generator)		1 1 1
3(b)	Neutron(s) shown 'hitting' other U-235 nuclei U-235 nuclei (splitting) producing 2 or more neutrons	one uranium nucleus is sufficient	1 1
3(c)	any **two** from: • neutrons are absorbed (by boron / control rods) • there are fewer neutrons • chain reaction slows down / stops	accept fewer reactions occur	2
Total			**8**

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Question 4

question	answers	extra information	mark
4(a)(i)	distance vehicle travels during driver's reaction time	accept distance vehicle travels while driver reacts	1
4(a)(ii)	any **two** from: • tiredness • (drinking) alcohol • (taking) drugs • speed • age	accept as an alternative factor distractions, eg using a mobile phone	2
4(b)(i)	320 000	allow **1** mark for correct substitution, ie $\frac{1}{2} \times 1600 \times 20^2$ provided no subsequent step shown	2
4(b)(ii)	320 000 **or** their (b)(i)		1
4(b)(iii)	40 **or** $\frac{\text{their (b)(ii)}}{8000}$ correctly calculated	allow **1** mark for statement work done = KE lost **or** allow **1** mark for correct substitution, ie 8000 × distance = 320 000 **or** their (b)(ii)	2
4(b)(iv)	any **one** from: • icy / wet roads • (worn) tyres • road surface • mass (of car and passengers) • (efficiency / condition of the) brakes	accept weather conditions accept number of passengers	1

Question 4 continues on the next page . . .

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Question 4 continued . . .

question	answers	extra information	mark
4(b)(v)	(work done by) friction (between brakes and wheel)	do **not** accept friction between road and tyres / wheels	1
	(causes) decrease in KE and increase in thermal energy	accept heat for thermal energy accept KE transferred to thermal energy	1
4(c)	the battery needs recharging less often **or** increases the range of the car	accept car for battery accept less demand for other fuels **or** lower emissions **or** lower fuel costs environmentally friendly is insufficient	1
	as the efficiency of the car is increased	accept it is energy efficient	1
	the decrease in (kinetic) energy / work done charges the battery (up)	accept because not all work done / (kinetic) energy is wasted	1
Total			**14**

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Question 5

question	answers	extra information	mark
5(a)	78		1
5(b)	atomic		1
5(c)(i)	131 54	correct order only	1 1
5(c)(ii)	32 (days)	allow **1** mark for showing 4 half-lives provided no subsequent step	2
5(c)(iii)	limits amount of iodine-131 / radioactive iodine that can be absorbed so reducing risk of cancer (of the thyroid)	accept increases level of non-radioactive iodine in thyroid do **not** accept cancels out iodine-131 accept stops risk of cancer (of the thyroid)	1 1
Total			**8**

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PH2HP

Question 6

question	answers	extra information	mark
6(a)	35	an answer with more than 2 sig figs that rounds to 35 gains **2** marks allow **2** marks for correct method, ie $\frac{230}{6.5}$ allow **1** mark for I = 6.5 (A) **or** R = $\frac{230}{26}$ an answer 8.8 gains **2** marks an answer with more than 2 sig figs that rounds to 8.8 gains **1** mark	3
6(b)(i)	(maximum) current exceeds maximum safe current for a 2.5 mm^2 wire **or** (maximum) current exceeds 20 (A)	accept power exceeds maximum safe power for a 2.5 mm^2 wire (maximum) current = 26 (A) is insufficient	1
	a 2.5 mm^2 wire would overheat / melt	accept socket for wire do **not** accept plug for wire	1
6(b)(ii)	(contains) live, neutral and earth wires	accept is a three-core cable	1
	cross-sectional area of (live and neutral) wire(s) (minimum of) 4 mm^2	accept 6 mm^2 for 4 mm^2	1
	wire / cable should be insulated	accept a suitable named insulator, eg PVC / rubber / plastic	1

Question 6 continues on the next page . . .

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PH2HP

Question 6 continued . . .

question	answers	extra information	mark
6(c)	a.c. is constantly changing direction	accept a.c. flows in two directions accept a.c. changes direction a.c. travels in different directions is insufficient	1
	d.c. flows in one direction only		1
Total			**10**

UMS Conversion Calculator: www.aqa.org.uk/umsconversion

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Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

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

General Certificate of Secondary Education
Higher Tier
January 2013

Additional Science

Unit Physics P2

PH2HP

H

Physics

Unit Physics P2

Friday 25 January 2013 1.30 pm to 2.30 pm

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

Time allowed
- 1 hour

Instructions
- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 60.
- You are expected to use a calculator where appropriate.
- Question 3 (c) should be answered in continuous prose. In this question you will be marked on your ability to:
  – use good English
  – organise information clearly
  – use specialist vocabulary where appropriate.

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

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Do not write outside the box

Answer **all** questions in the spaces provided.

1 A car has an oil leak. Every 5 seconds an oil drop falls from the bottom of the car onto the road.

1 (a) What force causes the oil drop to fall towards the road?

.....

(1 mark)

1 (b) The diagram shows the spacing of the oil drops left on the road during part of a journey from A to B.



Describe the motion of the car as it moves from **A** to **B**.

.....

Explain the reason for your answer.

.....

.....

.....

.....

(3 marks)

1 (c) When the brakes are applied, a braking force slows down and stops the car.

1 (c) (i) The size of the braking force affects the braking distance of the car.

State **one** other factor that affects the braking distance of the car.

.....

(1 mark)

Do not write outside the box

1 (c) (ii) A braking force of 3 kN is used to slow down and stop the car in a distance of 25 m.

Calculate the work done by the brakes to stop the car and give the unit.

Use the correct equation from the Physics Equations Sheet.

.....

.....

.....

Work done =.....

(3 marks)

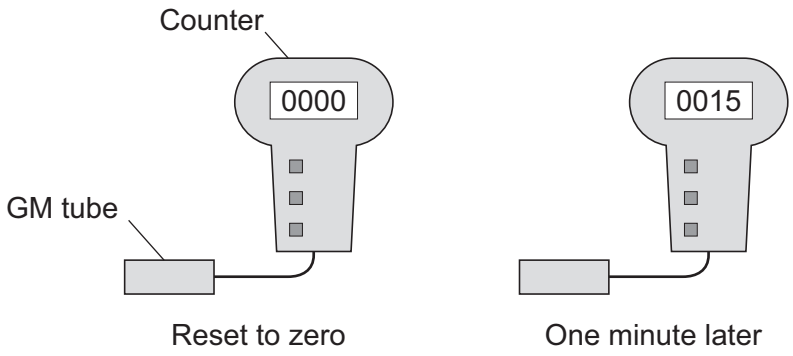
8

Turn over for the next question

Do not write outside the box

2 (a) A teacher used a Geiger-Műller (GM) tube and counter to measure the *background radiation* in her laboratory.

The teacher reset the counter to zero, waited one minute and then took the count reading. The teacher repeated the procedure two more times.



2 (a) (i) Background radiation can be either from natural sources or from man-made sources.

Name **one man-made** source of background radiation.

.....

(1 mark)

2 (a) (ii) The three readings taken by the teacher are given in the table.

Count after one minute
15
24
18

The readings given in the table are correct.

Why are the readings different?

.....

.....

(1 mark)

Do not write outside the box

2 (b) Some scientists say they have found evidence to show that people living in areas of high natural background radiation are less likely to develop cancer than people living in similar areas with lower background radiation.

The evidence these scientists found does not definitely mean that the level of background radiation determines whether a person will develop cancer.

Suggest a reason why.

.....

.....

(1 mark)

2 (c) An atom of the isotope radon-222 emits an alpha particle and decays into an atom of polonium.

An alpha particle is the same as a helium nucleus. The symbol below represents an alpha particle.

$$^{4}_{2}\text{He}$$

2 (c) (i) How many protons and how many neutrons are there in an alpha particle?

Number of protons = ...

Number of neutrons = ...

(2 marks)

2 (c) (ii) The decay of radon-222 can be represented by the equation below.

Complete the equation by writing the correct number in each of the **two** boxes.

$$^{222}_{86}\text{Rn} \longrightarrow \square \quad \square + \text{Po} + \text{alpha particle}$$

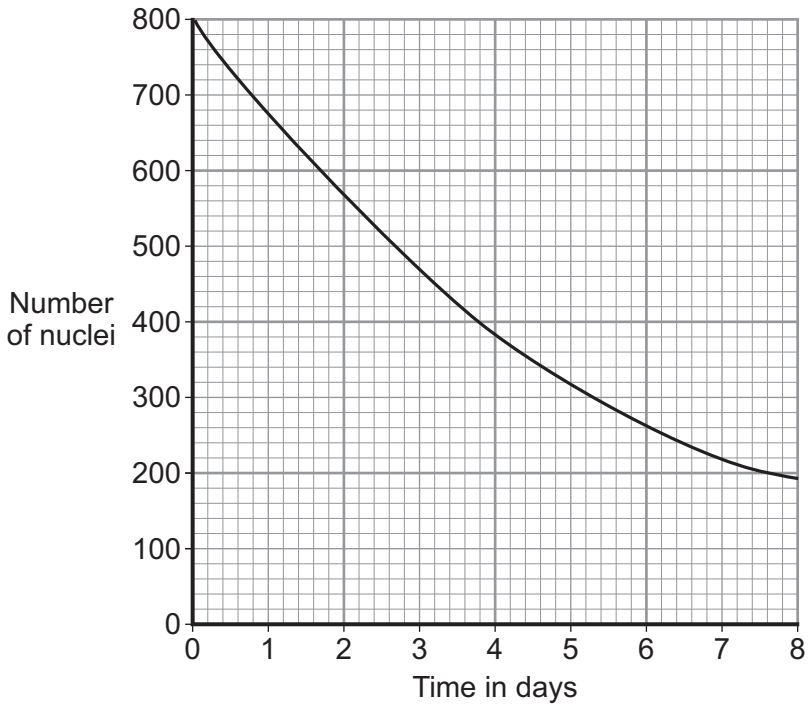
(2 marks)

Question 2 continues on the next page

Turn over ▶

Do not write outside the box

2 (d) The graph shows how, in a sample of air, the number of radon-222 nuclei changes with time.



Use the graph to find the half-life of radon-222.

Show clearly on the graph how you obtain your answer.

Half-life = ... days
(2 marks)

9

Do not write outside the box

3 Stars go through a life cycle. About 90 % of all stars are in the 'main sequence' period of the life cycle.

3 (a) Stars are stable during the 'main sequence' period of the life cycle.

Why?

.....

.....

(1 mark)

3 (b) The table gives an estimated time for the number of years that three stars, **X**, **Y** and **Z**, will be in the 'main sequence' period of their life cycle.

Star	Relative mass of the star compared to the Sun	Estimated 'main sequence' period in millions of years
X	0.1	4 000 000
Y	1.0	9 000
Z	40.0	200

3 (b) (i) This data suggests that there is a pattern linking the mass of a star and the number of years the star is in the 'main sequence' period of its life cycle.

What is the pattern suggested by the data?

.....

.....

(1 mark)

3 (b) (ii) Scientists cannot give the exact number of years a star will be in the 'main sequence' period.

Suggest why.

.....

.....

(1 mark)

Question 3 continues on the next page

Do not write outside the box

3 (b) (iii) Nuclear fusion is the process by which energy is released in stars.

Which **one** of the following can be concluded from the data in the table?

Draw a ring around the correct answer in the box to complete the sentence.

The rate of nuclear fusion in a large star is

faster than
the same as
slower than

in a small star.

Explain the reason for your answer.

.....

.....

.....

.....

(3 marks)

Do not write outside the box

3 (c) *In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.*

Describe what happens to a star **much bigger** than the Sun, once the star reaches the end of the 'main sequence' period of its life cycle.

Your answer should include the names of the stages the star passes through.

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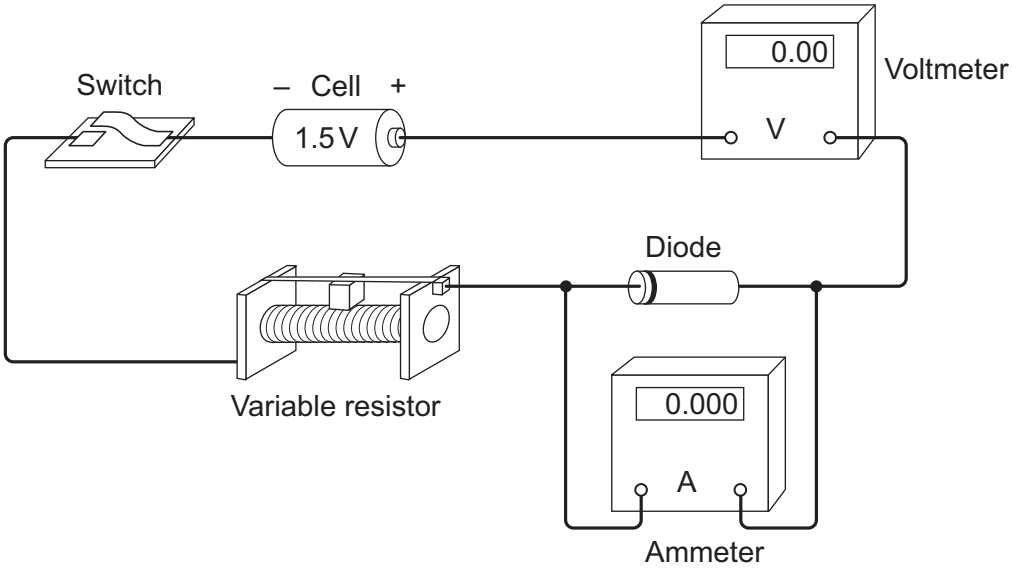
.....

(6 marks)

12

Do not write outside the box

4 (a) A student set up the circuit shown in the diagram. The student uses the circuit to obtain the data needed to plot a current - potential difference graph for a diode.



4 (a) (i) Draw, in the boxes, the circuit symbol for a diode and the circuit symbol for a variable resistor.

Diode	**Variable resistor**

(2 marks)

4 (a) (ii) The student made two mistakes when setting up the circuit.

What **two** mistakes did the student make?

1 .....

.....

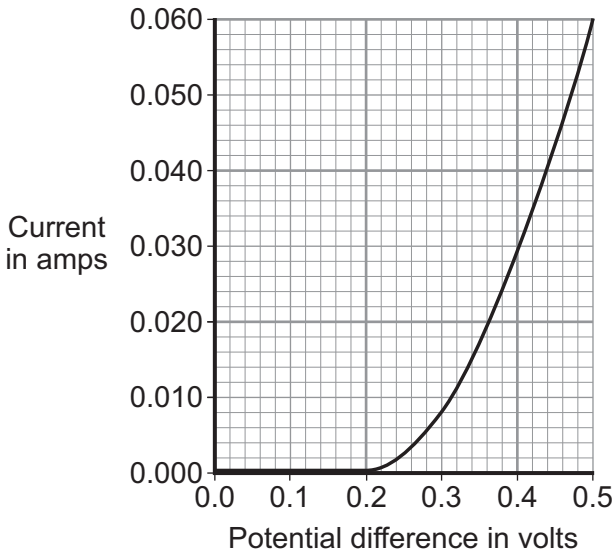
2 .....

.....

(2 marks)

Do not write outside the box

4 (b) After correcting the circuit, the student obtained a set of data and plotted the graph below.



4 (b) (i) At what potential difference did the diode start to conduct an electric current?

..... V
(1 mark)

4 (b) (ii) Use data from the graph to calculate the resistance of the diode when the potential difference across the diode is 0.3 V.

Use the correct equation from the Physics Equations Sheet.

.....

.....

.....

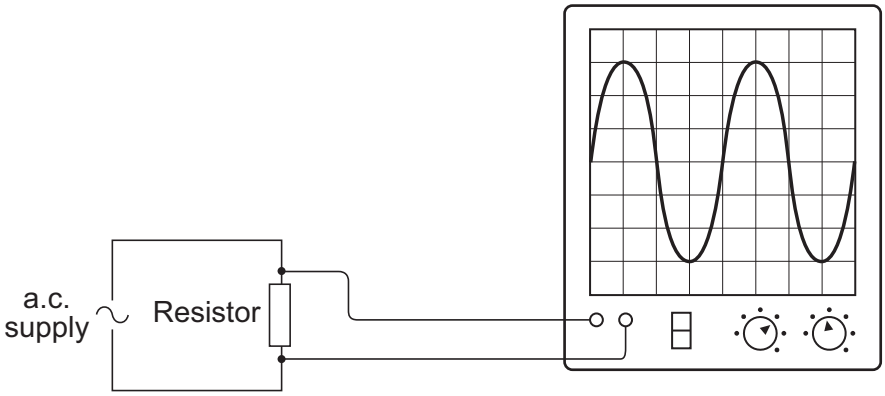
Resistance = ... ohms
(3 marks)

Question 4 continues on the next page

Turn over ▶

Do not write outside the box

4 (c) The diagram shows the trace produced by an alternating current (a.c.) supply on an oscilloscope.



Each horizontal division on the oscilloscope screen represents a time of 0.01s.

4 (c) (i) Calculate the frequency of the a.c. supply.

.....

.....

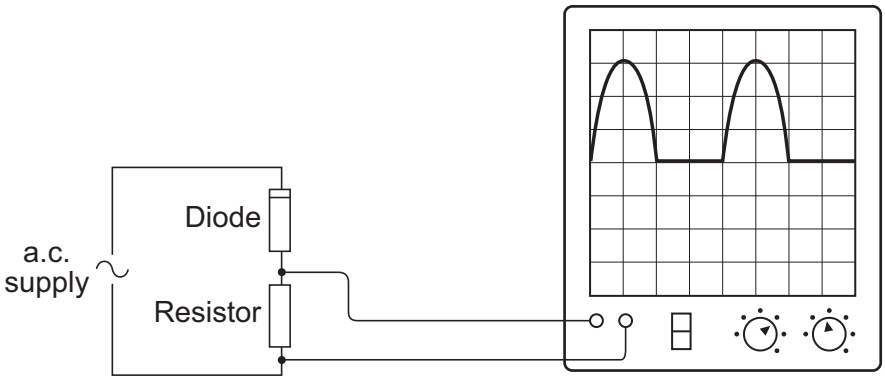
.....

Frequency = ... hertz

(2 marks)

Do not write outside the box

4 (c) (ii) A diode is now connected in series with the a.c. power supply.



Why does the diode cause the trace on the oscilloscope screen to change?

.....

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.....

.....

(2 marks)

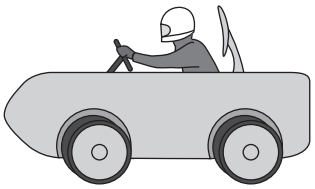
12

Turn over for the next question

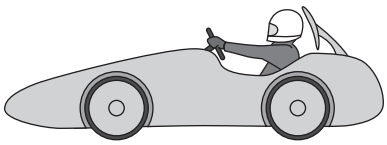
Do not write outside the box

5 (a) Some students have designed and built an electric-powered go-kart. After testing, the students decided to make changes to the design of their go-kart.

First design **X**



Final design **Y**



The go-kart always had the same mass and used the same motor.

The change in shape from the first design (**X**) to the final design (**Y**) will affect the top speed of the go-kart.

Explain why.

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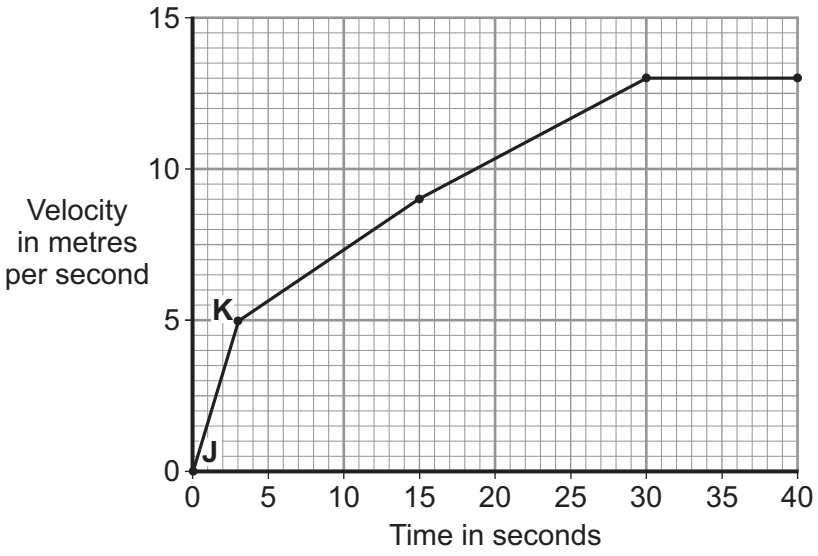
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(3 marks)

5 (b) The final design go-kart, **Y**, is entered into a race.

The graph shows how the velocity of the go-kart changes during the first 40 seconds of the race.



Do not write outside the box

5 (b) (i) Use the graph to calculate the acceleration of the go-kart between points **J** and **K**.

Give your answer to **two** significant figures.

.....

.....

.....

Acceleration = ... m/s^2

(2 marks)

5 (b) (ii) Use the graph to calculate the distance the go-kart travels between points **J** and **K**.

.....

.....

.....

Distance = ... m

(2 marks)

5 (b) (iii) What causes most of the resistive forces acting on the go-kart?

.....

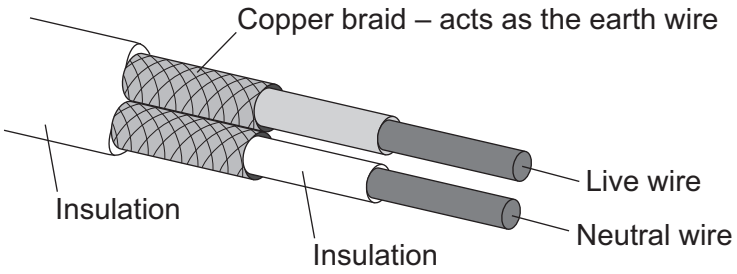
(1 mark)

8

Turn over for the next question

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6 The diagram shows the structure of a cable. The cable is part of an undersoil heating circuit inside a large greenhouse.



6 (a) The cable is connected to the mains electricity supply through a residual current circuit breaker (RCCB). If the cable is accidentally cut the RCCB automatically switches the circuit off.

6 (a) (i) What is the frequency of the mains electricity supply in the UK?

.....

(1 mark)

6 (a) (ii) What happens, as the cable is cut, to cause the RCCB to switch the circuit off?

.....

.....

.....

.....

(2 marks)

6 (a) (iii) A circuit can also be switched off by the action of a fuse.

Give **one** advantage of using a RCCB to switch off a circuit rather than a fuse.

.....

.....

(1 mark)

Do not write outside the box

6 (b) The 230 volt mains electricity supply causes a current of 11 amps to flow through the cable.

6 (b) (i) Calculate the amount of charge that flows through the cable when the cable is switched on for 2 hours and give the unit.

Use the correct equation from the Physics Equations Sheet.

.....

.....

.....

Charge = ...

(3 marks)

6 (b) (ii) Calculate the energy transferred from the cable to the soil in 2 hours.

Use the correct equation from the Physics Equations Sheet.

.....

.....

Energy transferred =..... J

(2 marks)

6 (c) The heating circuit includes a thermistor. The thermistor is buried in the soil and acts as a thermostat to control the increase in the temperature of the soil.

Describe how an **increase** in the temperature of the soil affects the thermistor.

.....

.....

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(2 marks)

11

END OF QUESTIONS

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Version 1.0



General Certificate of Secondary Education
January 2013

Additional Science / Physics (Specification 4408 / 4403) PH2HP

Unit: Physics 2

Final

Mark Scheme

Mark schemes are prepared by the Principal Examiner 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 examiners 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 examiner understands and applies it in the same correct way. As preparation for standardisation each examiner 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, examiners encounter unusual answers which have not been raised they are required to refer these to the Principal Examiner.

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

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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 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

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.

3. Marking points

3.1 Marking of lists

This applies to questions requiring a set number of responses, but for which candidates 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)

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

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

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

3.2 Use of chemical symbols / formulae

If a candidate 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

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

However, if the answer is incorrect, mark(s) can be gained by correct substitution / working and this is shown in the 'extra information' column or by each stage of a longer calculation.

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 are 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 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.

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

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Quality of Written Communication and levels marking

In Question 3(c) candidates are required to produce extended written material in English, and will be assessed on the quality of their written communication as well as the standard of the scientific response.

Candidates will be required to:

- use good English
- organise information clearly
- use specialist vocabulary where appropriate.

The following general criteria should be used to assign marks to a level:

Level 1: basic

- Knowledge of basic information
- Simple understanding
- The answer is poorly organised, with almost no specialist terms and their use demonstrating a general lack of understanding of their meaning, little or no detail
- The spelling, punctuation and grammar are very weak.

Level 2: clear

- Knowledge of accurate information
- Clear understanding
- The answer has some structure and organisation, use of specialist terms has been attempted but not always accurately, some detail is given
- There is reasonable accuracy in spelling, punctuation and grammar, although there may still be some errors.

Level 3: detailed

- Knowledge of accurate information appropriately contextualised
- Detailed understanding, supported by relevant evidence and examples
- Answer is coherent and in an organised, logical sequence, containing a wide range of appropriate or relevant specialist terms used accurately.
- The answer shows almost faultless spelling, punctuation and grammar.

PH2HP

Question 1

question	answers	extra information	mark
1(a)	gravitational / gravity / weight	do **not** accept gravitational potential	1
1(b)	accelerating the distance between the drops increases but the time between the drops is the same	accept speed / velocity increases accept the time between drops is (always) 5 seconds accept the drops fall at the same rate	1 1 1
1(c)(i)	any **one** from: • speed / velocity • (condition of) brakes / road surface / tyres • weather (conditions)	 accept specific examples, eg wet / icy roads accept mass / weight of car friction is insufficient reference to any factor affecting thinking distance negates this answer	1

Question 1 continues on the next page . . .

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Question 1 continued . . .

question	answers	extra information	mark
1(c)(ii)	75 000	allow **1** mark for correct substitution, ie 3000 × 25 provided no subsequent step shown **or** allow **1** mark for an answer 75 **or** allow **2** marks for 75 k(+ incorrect unit), eg 75 kN	2
	joules / J	do **not** accept j an answer 75 kJ gains **3** marks for full marks the unit and numerical answer must be consistent	1
Total			**8**

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Question 2

question	answers	extra information	mark
2(a)(i)	any **one** from: • nuclear power (stations) • nuclear weapons (testing) • nuclear accidents	accept nuclear waste accept coal power stations accept nuclear bombs / fallout accept named accident, eg Chernobyl or Fukushima accept named medical procedure which involves a radioactive source accept radiotherapy accept X-rays accept specific industrial examples that involve a radioactive source nuclear activity / radiation is insufficient smoke detectors is insufficient	1
2(a)(ii)	(radioactive decay) is a random process	accept an answer in terms of background / radiation varies (from one point in time to another)	1
2(b)	any **one** from: • (maybe) other factors involved • evidence may not be valid • may not have (a complete) understanding of the process (involved)	accept a named 'sensible' factor, eg smoking accept not enough data	1

Question 2 continues on the next page . . .

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PH2HP

Question 2 continued . . .

question	answers	extra information	mark
2(c)(i)	2 2		1 1
2(c)(ii)	218 84	correct order only	1 1
2(d)	3.8 (days)	allow **1** mark for showing correct method using the graph provided no subsequent steps correct answers obtained using numbers other than 800 and 400 gain **2** marks provided the method is shown	2
Total			**9**

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PH2HP

Question 3

question	answers	extra information	mark
3(a)	forces (within the star) are balanced	if specific forces are mentioned they must be appropriate	1
3(b)(i)	bigger the mass (of the star) the shorter the 'main sequence' period	accept bigger the star the shorter the time	1
3(b)(ii)	any **one** from: • insufficient evidence • do not know (exact) amount of hydrogen in star • time too long (to measure directly) • may be other factors (not yet known) that determine length of 'main sequence' period • values are based on theory / calculation	accept do not know (exact) mass of star	1
3(b)(iii)	faster than		1
	larger stars have a shorter 'main sequence' period so they must have the faster (rate of) nuclear fusion	there must be a link between shorter 'main sequence' and nuclear fusion, this may be implied from the first marking point	1
	the end of 'main sequence' happens as the hydrogen in (the core of) a star is used up **or** (since) they use up hydrogen at a faster (rate)	accept more massive stars (are brighter so) release energy faster	1

Question 3 continues on the next page . . .

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question	answers	extra information	mark
3(c)	Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information on page 5, and apply a 'best-fit' approach to the marking.		6

0 marks	**Level 1 (1–2 marks)**	**Level 2 (3–4 marks)**	**Level 3 (5–6 marks)**
No relevant content.	There is a basic description of what happens to a star much larger than the Sun after the 'main sequence' period. **OR** Two stages are correctly named and are in the correct sequence.	There is a clear description of what happens to a star much larger than the Sun after the 'main sequence' period. **AND** At least two stages are correctly named and are in the correct sequence.	There is a detailed description of what happens to a star much larger than the Sun after the 'main sequence' period. **AND** At least three stages are named, in the correct sequence. There are no additional incorrect stages given.

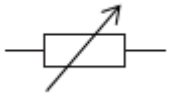
Examples of the points made in the response:	**extra information**
• (the core of the) star runs out of hydrogen • (the star) expands (to form) • (the star) cools (to form)	• the core shrinks • helium starts to fuse to form other elements
• a red supergiant	accept super red giant do **not** accept red giant
• (outer layers) explode	• fusion of lighter elements to form heavier elements (up to iron)
• as a supernova	
• elements heavier than iron are formed • core shrinks	accept heaviest elements are formed
• becoming a neutron star	
• if mass large enough (core collapses)	
• (to form) a black hole	if a correct description and sequence for a star the same size as the Sun and much bigger than the Sun given without clearly indicating which is which is limited to Level 2

Total			**12**

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Question 4

question	answers	extra information	mark
4(a)(i)	symbol for a diode 	accept 	1
	symbol for a variable resistor 		1
4(a)(ii)	voltmeter is in series **or** voltmeter is not in parallel		1
	ammeter is in parallel **or** ammeter is not in series	accept an answer in terms of how the circuit should be corrected voltmeter and ammeter are wrong way around is insufficient	1
4(b)(i)	0.2 (V)	accept any value between 0.20 and 0.21 inclusive	1
4(b)(ii)	37.5	allow **1** mark for I = 0.008 **or** allow **2** marks for correct substitution, ie 0.3 = 0.008 × R **or** allow **1** mark for a correct substitution using I = 0.8 **or** I = 0.08 **or** I = 0.009 **or** allow **2** marks for answers of 0.375 **or** 3.75 **or** 33(.3)	3

Question 4 continues on the next page . . .

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Question 4 continued . . .

question	answers	extra information	mark
4(c)(i)	25	allow **1** mark for obtaining period = 0.04(s)	2
4(c)(ii)	diode has large resistance in reverse / one direction		1
	so stops current flow in that / one direction	allow diodes only let current flow one way / direction allow **1** mark for the diode has half-rectified the (a.c. power) supply	1
Total			**12**

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PH2HP

Question 5

question	answers	extra information	mark
5(a)	more streamlined air resistance is smaller (for same speed) so reaches a higher speed (before resultant force is 0)	accept decrease surface area accept drag for air resistance friction is insufficient ignore reference to mass	1 1 1
5(b)(i)	1.7	allow **1** mark for correct method, ie $\frac{5}{3}$ **or** allow **1** mark for an answer with more than 2 sig figs that rounds to 1.7 **or** allow **1** mark for an answer of 17	2
5(b)(ii)	7.5	allow **1** mark for correct use of graph, eg $\frac{1}{2} \times 5 \times 3$	2
5(b)(iii)	air (resistance)	accept wind (resistance) drag is insufficient friction is insufficient	1
Total			**8**

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PH2HP

Question 6

question	answers	extra information	mark
6(a)(i)	50(Hz)	ignore any unit given	1
6(a)(ii)	any **two** from: • (some) current flows to Earth • current flows through copper braid • RCCB detects difference between current in live and neutral wire	 accept ground for Earth accept current flows through the earth wire accept electricity for current in either the first or second marking point but not both	2
6(a)(iii)	can be reset **or** faster acting	accept does not need replacing accept switches circuit off faster	1
6(b)(i)	79 200 coulombs / C	allow **1** mark for correct substitution, ie $11 = \frac{Q}{2 \times 3600}$ an answer 22 gains **1** mark do **not** accept c	2 1
6(b)(ii)	18 216 000 **or** 230 × their (b)(i) correctly calculated	accept for **2** marks 18 216 kJ **or** 18.216 MJ allow **1** mark for correct substitution, ie 230 × their (b)(i) **or** allow **1** mark for power calculated as 2530(W)	2

Question 6 continues on the next page . . .

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PH2HP

Question 6 continued . . .

question	answers	extra information	mark
6(c)	increases temperature of thermistor changes resistance (of thermistor)	 do **not** accept increases resistance (of thermistor) an answer decreases resistance (of thermistor) gains **2** marks	1 1
Total			**11**

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Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

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

General Certificate of Secondary Education
Higher Tier
June 2012

Additional Science
Unit Physics P2

PH2HP

H

Physics
Unit Physics P2

Wednesday 30 May 2012 1.30 pm to 2.30 pm

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

You may use a calculator.

Time allowed
- 1 hour

Instructions
- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 60.
- You are expected to use a calculator where appropriate.
- Question 3 (b) should be answered in continuous prose. In this question you will be marked on your ability to:
  – use good English
  – organise information clearly
  – use specialist vocabulary where appropriate.

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

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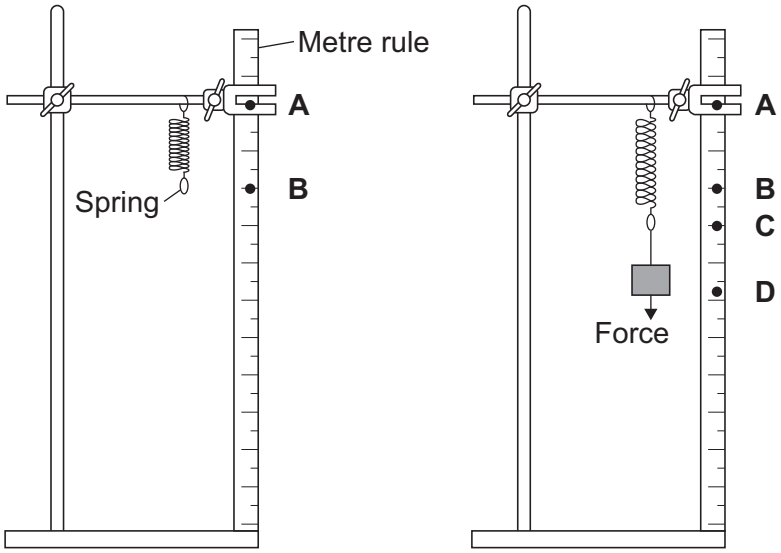
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ANSWER IN THE SPACES PROVIDED

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Answer **all** questions in the spaces provided.

1 A student investigated how the extension of a spring depends on the force applied to the spring.

The diagram shows the spring before and after a force had been applied.



1 (a) (i) Complete the following sentence using letters, **A**, **B**, **C** or **D**, from the diagram.

The extension of the spring is the distance between the positions labelled .....

and ..... on the metre rule.

(1 mark)

1 (a) (ii) What form of energy is stored in the stretched spring?

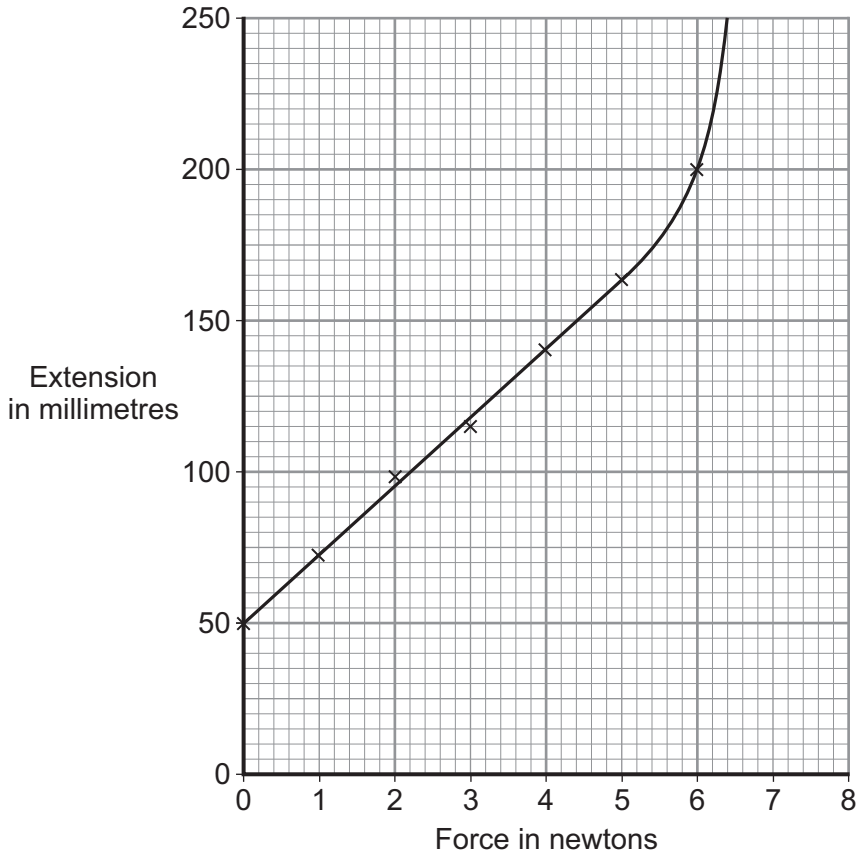
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(1 mark)

Question 1 continues on the next page

Do not write outside the box

1 (b) The results from the investigation are plotted on the following graph.



1 (b) (i) The graph shows that the student has made an error throughout the investigation.

What error has the student made?

.....

.....

Give the reason for your answer.

.....

.....

(2 marks)

Do not write outside the box

1 (b) (ii) The student has loaded the spring beyond its *limit of proportionality*.

Mark on the graph line the *limit of proportionality* of the spring. Label the point **P**.

Give the reason for choosing your point **P**.

.....

.....

.....

(2 marks)

1 (c) The student uses a different spring as a spring balance. When the student hangs a stone from this spring, its extension is 72 mm.

The spring does not go past the limit of proportionality.

Calculate the force exerted by the stone on the spring.

spring constant = 25 N/m

Use the correct equation from the Physics Equations Sheet.

Show clearly how you work out your answer.

.....

.....

Force = ... N

(2 marks)

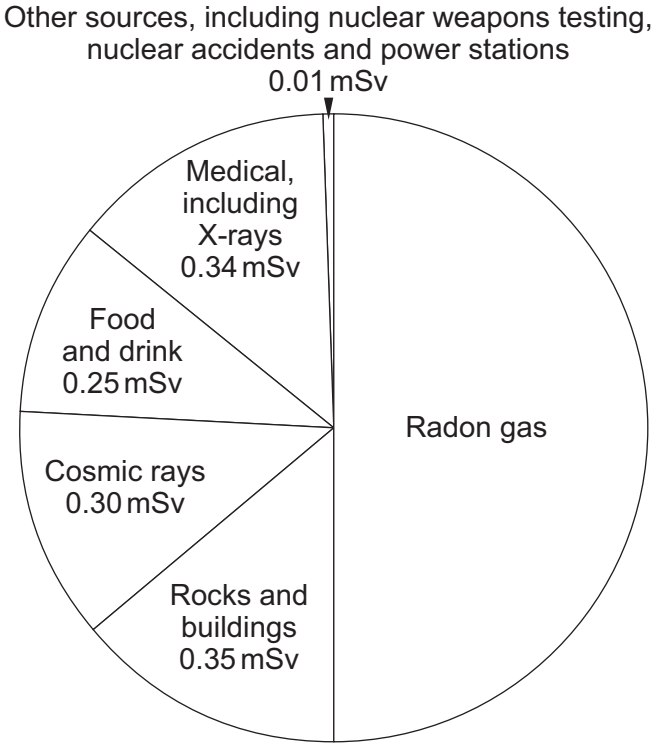
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Turn over for the next question

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2 The pie chart shows the sources of the background radiation and the radiation doses that the average person in the UK is exposed to in one year.

Radiation dose is measured in millisieverts (mSv).



2 (a) (i) What is the radiation dose that the average person in the UK receives from radon gas?

.....

.....

Radiation dose from radon gas = ... mSv

(1 mark)

2 (a) (ii) A person may receive a higher than average dose of radiation from background sources.

Suggest **two** reasons why.

1 .....

.....

2 .....

.....

(2 marks)

Do not write outside the box

2 (b) Exposure to radon gas can cause lung cancer.
A recent study has compared the risk of getting lung cancer, by the age of 75 years, for cigarette smokers and non-smokers.
The people in the study had been exposed throughout their lives to different levels of radon gas.
A summary of the data produced from the study is given in the table.

Exposure to radon gas	**Risk of lung cancer by age of 75**	
	Non-smoker	**Smoker**
No exposure	0.4 %	10 %
Moderate exposure	1.0 %	14 %
Very high exposure	1.5 %	32 %

2 (b) (i) Why were people that have had **no exposure** to radon gas included in the study?

.....

.....

(1 mark)

2 (b) (ii) Using information from the table, what conclusions can be made about exposure to radon gas and the risk of getting lung cancer?

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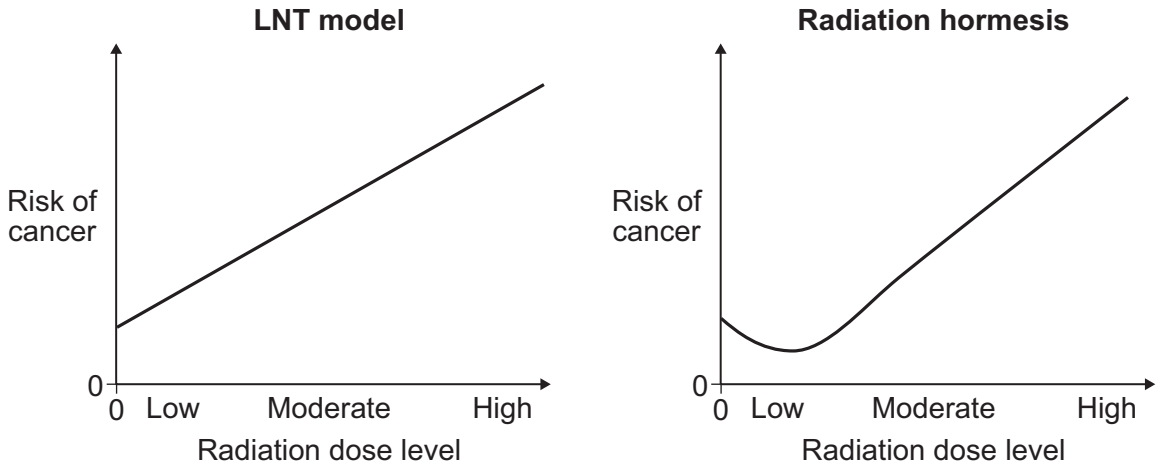
(2 marks)

Question 2 continues on the next page

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2 (c) At the moment, the regulations designed to protect people from over-exposure to radiation are based on a model called the 'linear no-threshold' (LNT) model.
Some scientists believe that the LNT model is too simple. These scientists believe that at low radiation levels a process called 'radiation hormesis' happens.

The graphs show that each model suggests a link between the risk of developing a cancer and exposure to low levels of radiation.



The link between the risk of developing cancer and exposure to low levels of radiation suggested by each of the models is different.

Describe how.

.....

.....

.....

.....

.....

(2 marks)

Do not write outside the box

2 (d) Scientists have conducted experiments in which mice have been exposed to different levels of radiation. The number of mice developing a cancer has then been measured.

Discuss whether it is ethical to use animals in scientific experiments.

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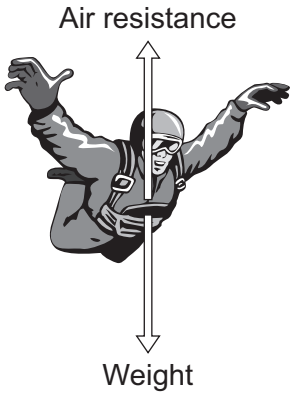
(2 marks)

10

Turn over for the next question

Do not write outside the box

3 (a) The diagram shows the forces acting on a parachutist in free fall.



The parachutist has a mass of 75 kg.

Calculate the weight of the parachutist.

gravitational field strength = 10 N/kg

Use the correct equation from the Physics Equations Sheet.

Show clearly how you work out your answer and give the unit.

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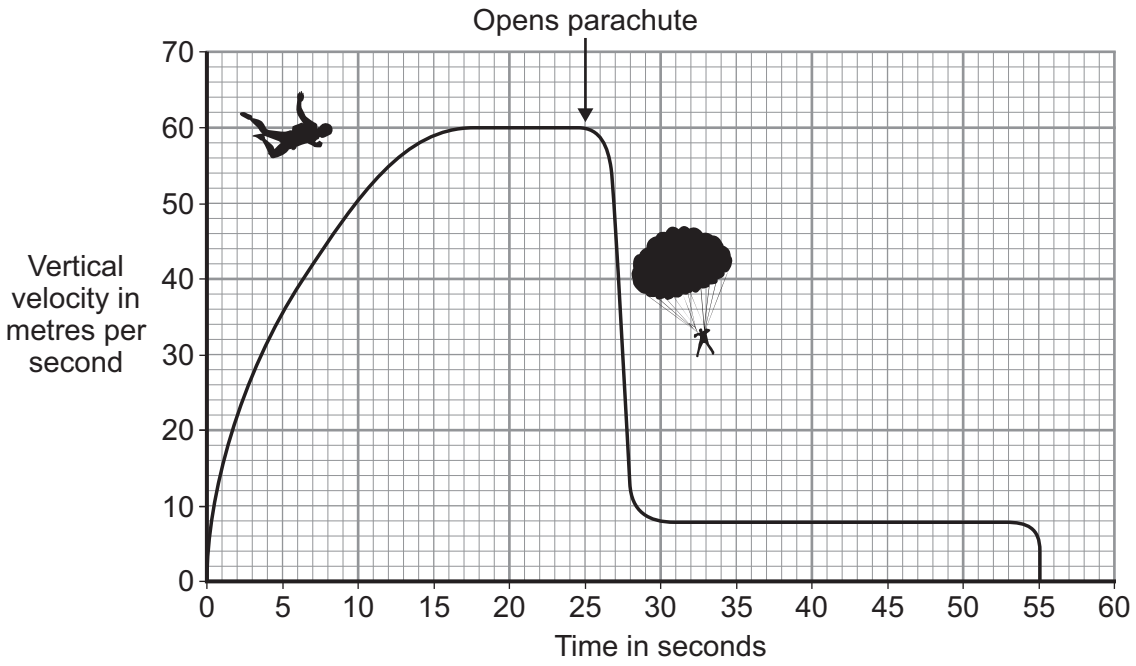
Weight = ...

(3 marks)

Do not write outside the box

3 (b) *In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.*

The graph shows how the vertical velocity of a parachutist changes from the moment the parachutist jumps from the aircraft until landing on the ground.



Using the idea of forces, explain why the parachutist reaches a terminal velocity and why opening the parachute reduces the terminal velocity.

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(6 marks)

Question 3 continues on the next page

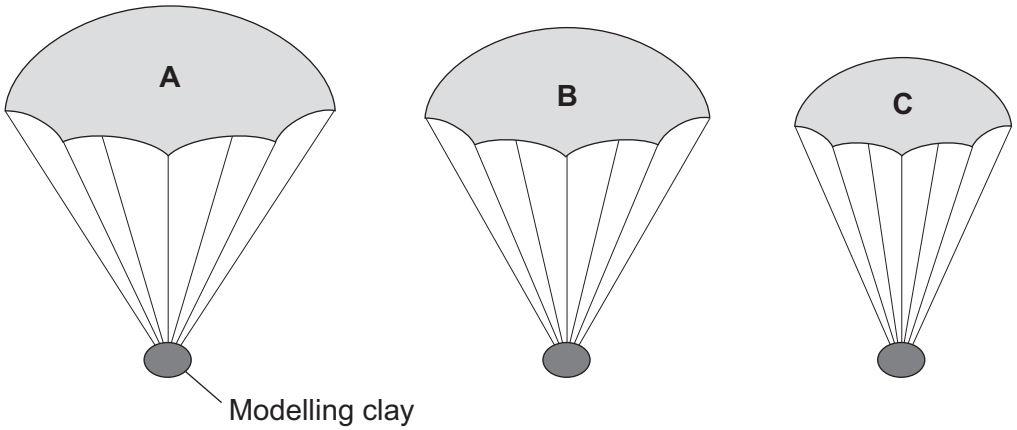
Turn over ▶

Do not write outside the box

3 (c) A student wrote the following hypothesis.

'The larger the area of a parachute, the slower a parachutist falls.'

To test this hypothesis the student made three model parachutes, **A**, **B** and **C**, from one large plastic bag. The student dropped each parachute from the same height and timed how long each parachute took to fall to the ground.



3 (c) (i) The height that the student dropped the parachute from was a control variable.

Name **one** other control variable in this experiment.

.....

(1 mark)

3 (c) (ii) Use the student's hypothesis to predict which parachute, **A**, **B** or **C**, will hit the ground first.

Write your answer in the box. ☐

Give a reason for your answer.

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(2 marks)

12

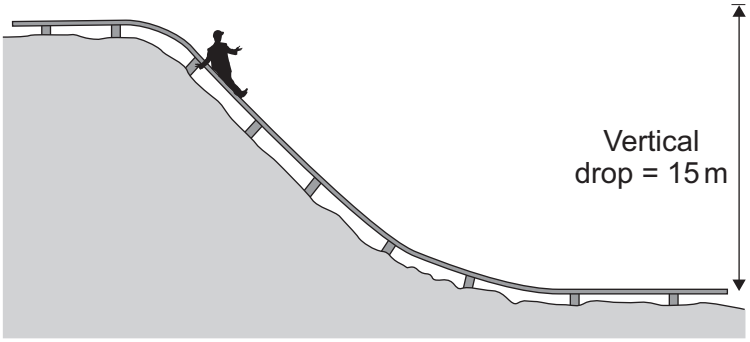
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ANSWER IN THE SPACES PROVIDED

Do not write outside the box

4 The miners working in a salt mine use smooth wooden slides to move quickly from one level to another.



4 (a) A miner of mass 90 kg travels down the slide.

Calculate the change in gravitational potential energy of the miner when he moves 15m vertically downwards.

gravitational field strength = 10 N/kg

Use the correct equation from the Physics Equations Sheet.

Show clearly how you work out your answer.

.....

.....

Change in gravitational potential energy = ... J

(2 marks)

Do not write outside the box

4 (b) Calculate the **maximum** possible speed that the miner could reach at the bottom of the slide.

Use the correct equation from the Physics Equations Sheet.

Show clearly how you work out your answer.

Give your answer to an appropriate number of significant figures.

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Maximum possible speed = ... m/s

(3 marks)

4 (c) The speed of the miner at the bottom of the slide is much less than the calculated maximum possible speed.

Explain why.

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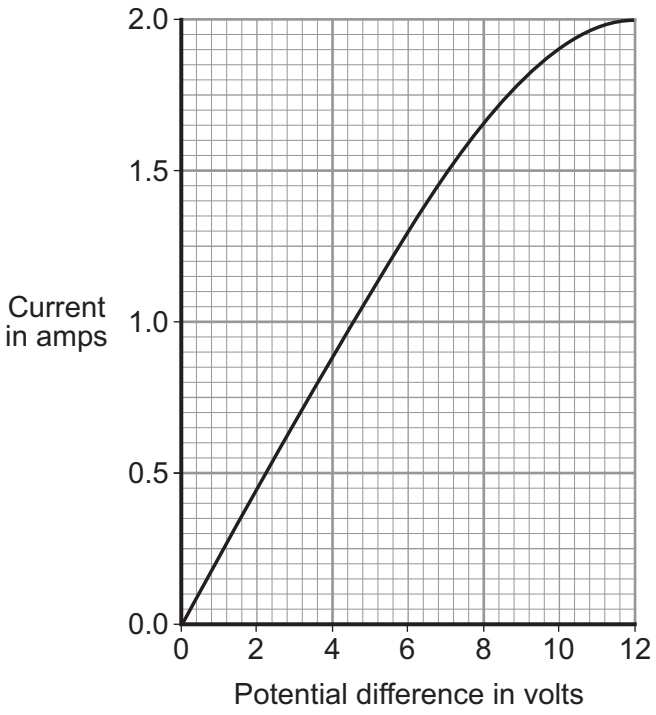
(3 marks)

8

Turn over for the next question

Do not write outside the box

5 The graph shows how the electric current through a 12 V filament bulb varies with the potential difference across the bulb.



5 (a) What is the meaning of the following terms?

electric current

.....

.....

potential difference

.....

.....

(2 marks)

Do not write outside the box

5 (b) The resistance of the metal filament inside the bulb increases as the potential difference across the bulb increases.

Explain why.

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(3 marks)

5 (c) Use data from the graph to calculate the rate at which the filament bulb transfers energy, when the potential difference across the bulb is 6 V.

Use the correct equation from the Physics Equations Sheet.

Show clearly how you work out your answer.

.....

.....

Rate of energy transfer = ... W

(2 marks)

7

Turn over for the next question

Do not write outside the box

There are no questions printed on this page

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ANSWER IN THE SPACES PROVIDED

Do not write outside the box

6 (a) As part of its life cycle, a star changes from being a protostar to a main sequence star.

Explain the difference between a protostar and a main sequence star.

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(2 marks)

6 (b) The early Universe contained only atoms of hydrogen. The Universe now contains atoms of over one hundred different elements.

Explain how the different elements now contained in the Universe were formed.

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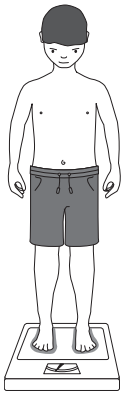
(3 marks)

5

Turn over for the next question

Do not write outside the box

7 (a) The picture shows a person using a set of electronic 'Body Fat Scales'. When the person stands on the scales, a small, harmless, electric current passes through the person's body. The scales then calculate the resistance of the person's body and convert the resistance into a *prediction* of body fat content.



7 (a) (i) The scales contain two 3 V cells joined in series.

Calculate the resistance of a person's body, if when he stands on the scales, a current of 0.12 mA passes through his body.

1000 mA = 1 A

Use the correct equation from the Physics Equations Sheet.

Show clearly how you work out your answer and give the unit.

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Resistance = ...

(3 marks)

Do not write outside the box

7 (a) (ii) The scales can only produce a *prediction* of body fat content and not an accurate measurement.

Suggest why.

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(1 mark)

7 (a) (iii) It is recommended that the scales are **not** used immediately after a person has drunk a large amount of water.

Suggest why.

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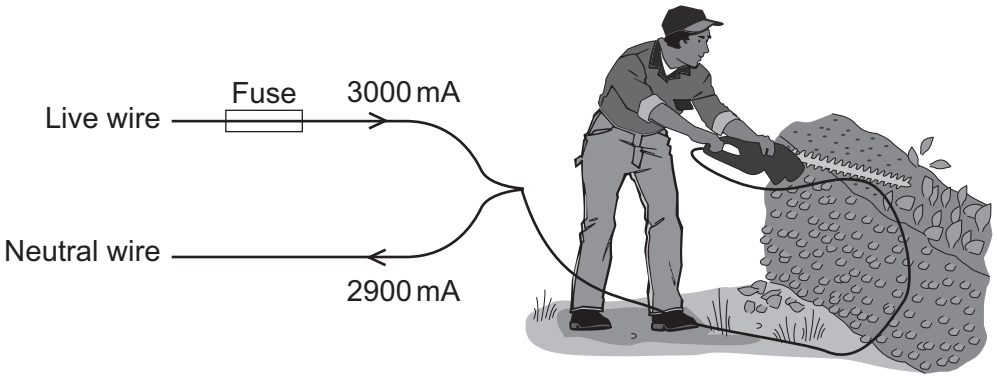
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(2 marks)

Question 7 continues on the next page

Do not write outside the box

7 (b) The diagram shows how someone could get an electric shock from accidentally cutting into an electric cable. If this happens, and a Residual Current Circuit Breaker (RCCB) is being used, the circuit will switch off automatically.



7 (b) (i) A faulty appliance or circuit can be switched off by a RCCB or a fuse.

Compare the action of a RCCB with the action of a fuse.

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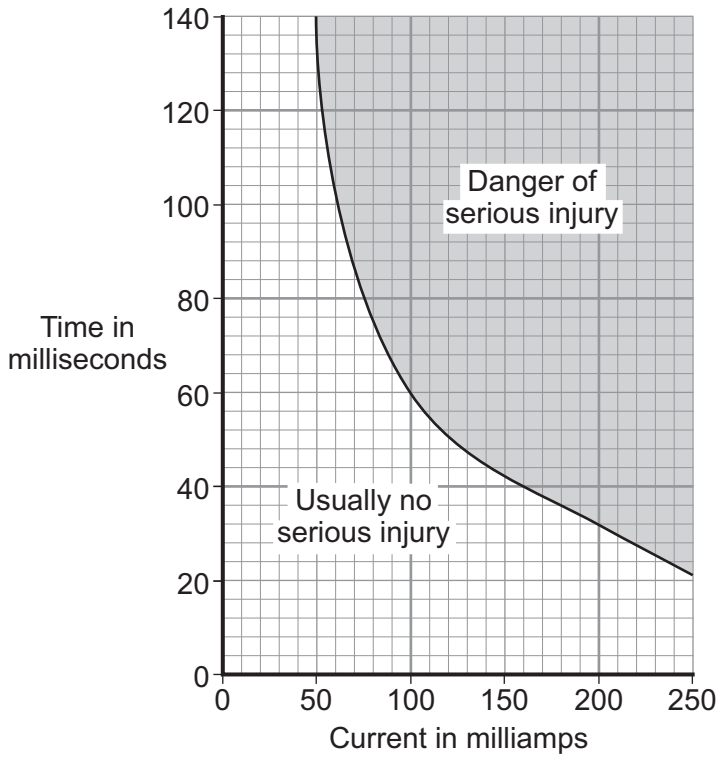
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(2 marks)

Do not write outside the box

7 (b) (ii) The graph shows how the severity of an electric shock depends on the size of the current and the time that the current flows through the body.



Using the RCCB helps prevent an electric shock seriously injuring the person using the hedge trimmers.

Using information from both the diagram and the graph explain how.

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(2 marks)

10

END OF QUESTIONS

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There are no questions printed on this page

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General Certificate of Secondary Education

Additional Science 4408 / Physics 4403

PH2HP **Unit Physics 2**

Mark Scheme

2012 examination – June series

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

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 to download from the AQA Website: www.aqa.org.uk

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MARK SCHEME

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 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

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 lines 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.)

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	4,8	0
2	green, 5	0
3	red*, 5	1
4	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

Full marks can be given for a correct numerical answer, as shown in the column 'answers', without any working shown.

However if the answer is incorrect, mark(s) can be gained by correct substitution / working and this is shown in the 'extra information' column;

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 are 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.

Quality of Written Communication and levels marking

In Question 8 students are required to produce extended written material in English, and will be assessed on the quality of their written communication as well as the standard of the scientific response.

Students will be required to:

- use good English
- organise information clearly
- use specialist vocabulary where appropriate.

The following general criteria should be used to assign marks to a level:

Level 1: Basic

- Knowledge of basic information
- Simple understanding
- The answer is poorly organised, with almost no specialist terms and their use demonstrating a general lack of understanding of their meaning, little or no detail
- The spelling, punctuation and grammar are very weak.

Level 2: Clear

- Knowledge of accurate information
- Clear understanding
- The answer has some structure and organisation, use of specialist terms has been attempted but not always accurately, some detail is given
- There is reasonable accuracy in spelling, punctuation and grammar, although there may still be some errors.

Level 3: Detailed

- Knowledge of accurate information appropriately contextualised
- Detailed understanding, supported by relevant evidence and examples
- Answer is coherent and in an organised, logical sequence, containing a wide range of appropriate or relevant specialist terms used accurately.
- The answer shows almost faultless spelling, punctuation and grammar.

PH2HP

Question 1

question	answers	extra information	mark
1(a)(i)	**B C**	either order	1
1(a)(ii)	elastic potential (energy)	accept strain for elastic	1
1(b)(i)	measured / recorded the length of the spring (and not extension) extension does not equal zero when force = 0	mark both parts together accept measured **A**–**C** (and not **B**–**C**) accept did not work out/measure the extension accept line should pass through the origin	1 1
1(b)(ii)	point marked at 5.5 (N) up to that point force and extension are (directly) proportional	accept anywhere between 5.0 and 5.6 inclusive accept at the end of the straight part (of the graph line) accept past that point force and extension are no longer (directly) proportional accept the line starts to curve	1 1
1(c)	1.8	allow **1** mark for correct substitution, ie 25 x 0.072 provided no subsequent step shown an answer 1800 gains **1** mark an incorrect conversion from mm to m with a subsequent correct calculation gains **1** mark	2
Total			**8**

PH2HP

Question 2

question	answers	extra information	mark
2(a)(i)	1.25 (mSv)		1
2(a)(ii)	any **two** from: • (frequent) flying • living at altitude • living in areas with high radon concentrations • living in a building made from granite (blocks) • having more than the average number of X-rays or having a CT scan • working in a nuclear power station	accept stated occupation that involves flying accept a specific area, eg Cornwall accept more medical treatments accept any suggestion that could reasonably increase the level from a specific source	2
2(b)(i)	to be able to see the effect of exposure (to radon gas) **or** as a control	accept to compare (the effect of) exposure (with no exposure)	1
2(b)(ii)	increased levels of exposure increases the risk (of developing cancer) smoking increases the (harmful) effect of radon	accept exposure (to radon gas) increases the risk answers that simply reproduce statistics are insufficient	1 1
2(c)	LNT model – risk increases with increasing radiation (dose) level Radiation hormesis – low radiation (dose) levels reduce the risk	accept in (direct) proportion accept low doses increase the risk	1 1

Question 2 continues on the next page . . .

PH2HP

Question 2 continued

question	answers	extra information	mark
2(d)	two valid points made – examples: • animals have no choice and so should not be used • should not make animals suffer • better to experiment on animals than humans • experiments lead to a better understanding / new knowledge • experiments may lead to health improvement / cures for humans	results for animals may not apply to humans is insufficient	2
Total			**10**

PH2HP

Question 3

question	answers	extra information	mark
3(a)	750	allow **1** mark for correct substitution, ie 75 x 10 provided no subsequent steps shown	2
	newton(s) / N	do **not** accept n	1

3(b)			6
Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information on page 2, and apply a 'best-fit' approach to the marking.			
0 marks	**Level 1 (1-2 marks)**	**Level 2 (3-4 marks)**	**Level 3 (5-6 marks)**
No relevant content.	There is a brief attempt to explain why the velocity / speed of the parachutist changes. **or** the effect of opening the parachute on velocity/speed is given.	The change in velocity/ speed is clearly explained in terms of force(s) **or** a reasoned argument for the open parachute producing a lower speed.	There is a clear and detailed explanation as to why the parachutist reaches terminal velocity **and** a reasoned argument for the open parachute producing a lower speed

Question 3 continues on the next page . . .

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Question 3 continued

question	answers	extra information	mark
3(b) (cont)	**examples of the physics points made in the response to explain first terminal velocity** • on leaving the plane the only force acting is weight (downwards) • as parachutist falls air resistance acts (upwards) • weight greater than air resistance **or** resultant force downwards • (resultant force downwards) so parachutist accelerates • as velocity / speed increases so does air resistance • terminal velocity reached when air resistance = weight **to explain second lower terminal velocity** • opening parachute increases surface area • opening parachute increases air resistance • air resistance is greater than weight • resultant force acts upwards / opposite direction to motion • parachutist decelerates / slows down • the lower velocity means a reduced air resistance • air resistance and weight become equal but at a lower (terminal) velocity	accept gravity for weight throughout accept drag / friction for air resistance accept terminal velocity reached when forces are balanced	

Question 3 continues on the next page . . .

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Question 3 continued

question	answers	extra information	mark
3(c)(i)	any **one** from: • mass/weight of the (modelling) clay • material parachute made from • number / length of strings	 accept size/amount/volume/ shape of clay accept plasticine for (modelling) clay accept same (plastic) bag	1
3(c)(ii)	**C** smallest (area) so falls fastest (so taking least time)	reason only scores if **C** is chosen accept quickest/quicker for fastest if **A** is chosen with the reason given as 'the largest area so falls slowest' this gains **1** mark	1 1
Total			**12**

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Question 4

question	answers	extra information	mark
4(a)	13 500 (J)	allow **1** mark for correct substitution, ie 90 x 10 x 15 provided no subsequent step shown	2
4(b)	17 **or** $\sqrt{\frac{their\ (a)}{45}}$ correctly calculated and answer given to 2 or 3 significant figures	accept 17.3 allow **2** marks for an answer with 4 or more significant figures, ie 17.32 **or** allow **2** marks for correct substitution, ie 13 500/ their (a) = ½ x 90 x v^2 **or** allow **1** mark for a statement or figures showing KE = GPE	3
4(c)	work is done (against) friction (between the miner and slide) (due to the) slide not (being perfectly) smooth **or** causing (kinetic) energy to be transferred as heat/internal energy of surroundings	accept 'air resistance' **or** 'drag' for friction accept miners clothing is rough accept lost/transformed for transferred accept air for internal energy of surroundings	1 1 1
Total			**8**

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Question 5

question	answers	extra information	mark
5(a)	electric current (rate of) flow of (electric) charge / electrons	accept $I = \frac{Q}{t}$ with Q and t correctly named	1
	potential difference work done / energy transferred per coulomb of charge (that passes between two points in a circuit)	accept $V = \frac{W}{Q}$ with W and Q correctly named	1
5(b)	metals contain free electrons (and ions)	accept mobile for free	1
	as temperature of filament increases ions vibrate faster / with a bigger amplitude	accept atoms for ions accept ions/atoms gain energy accept vibrate more for vibrate faster do not accept start to vibrate	1
	electrons collide more (frequently) with the ions **or** (drift) velocity of electrons decreases	do not accept start to collide accept increasing the p.d. increases the temperature (**1** mark) **and** (and) resistance increases with temperature (**1** mark) if no other marks scored	1
5(c)	7.8	allow **1** mark for obtaining value 1.3 from graph **or** allow **1** mark for a correct calculation using an incorrect current in the range 1.2-1.6 inclusive	2
Total			**7**

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PH2HP

Question 6

question	answers	extra information	mark
6(a)	a protostar is at a lower temperature **or** a protostar does not emit radiation / energy	accept heat or light for energy	1
	as (nuclear) fusion reactions have not started		1
6(b)	by (nuclear) fusion	accept nuclei fuse (together) nuclear fusion and fission negates this mark	1
	of hydrogen to helium		1
	elements heavier than <u>iron</u> are formed in a <u>supernova</u>	accept a specific example e.g. heavier elements such as gold are formed in a supernova accept heavier elements (up to iron) formed in red giant/red super giant reference to burning (hydrogen) negates the first 2 marks	1
Total			**5**

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Question 7

question	answers	extra information	mark
7(a)(i)	50 000 ohm / Ω	allow **1** mark for correct substitution, ie 6 = 0.00012 x R **or** 6 = 0.12 x R **or** answers of 25 000 or 50 gain **1** mark **or** allow 1 mark for an incorrect answer caused by one error only ie using 3V or an incorrect conversion of current an answer 50kΩ gains **3** marks	2 1
7(a)(ii)	(body) resistance changes **or** body fat/resistance affected by (many) factors	 accept named factor, eg age, gender, height, fitness, bone structure, muscle, drinking water related to body fat/resistance	1
7(a)(iii)	gives misleading / wrong/inaccurate value (because) high water content changes body resistance	 do not credit if specifically linked to a change in mass/weight accept a specific change to resistance water changes body mass is insufficient	1 1
7(b)(i)	RCCB – detects difference between current in live and neutral (wires) fuse – (overheats and) melts	accept RCCB can be reset accept blows for melts	1 1

Question 7 continues on the next page

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PH2HP

Question 7 continued

question	answers	extra information	mark
7(b)(ii)	switches the circuit / hedge trimmers off within 60 milliseconds	allow for **1** mark the RCCB/it is (very) fast. do not accept the bigger the current the faster the RCCB switches off	2
Total			**10**

UMS Conversion Calculator www.aqa.org.uk/umsconversion

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