AQA GCSE PHYSICS (4403)

PHYSICS



EXAM QUESTION PACK

UNIT P2 FOUNDATION TIER PH2FP PAPERS

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AQA

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

Surname _____

Forename(s) _____

Candidate signature _____

GCSE

ADDITIONAL SCIENCE PHYSICS

F

Foundation 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 9(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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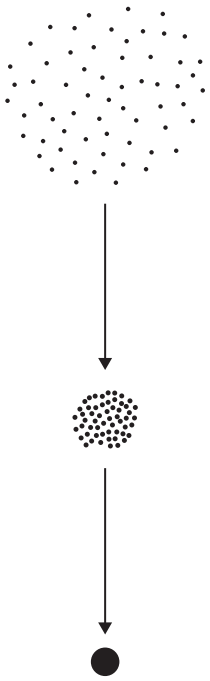
Answer **all** questions in the spaces provided.

1 (a) **Figure 1** shows how a star is formed.

Use **one** answer from each box to complete the sentences in **Figure 1**.

[3 marks]

Figure 1



gas	**rock**	**water**

A star starts as a huge cloud of dust and _____ particles in space.

friction	**fusion**	**gravity**

The force of _____ pulls the particles in the cloud closer together.

protostar	**red giant**	**white dwarf**

The compressed mass of particles

forms a _____ .

Do not write outside the box

1 (b) Elements heavier than iron are formed in a supernova.
What is a supernova?

[1 mark]

Tick (✓) **one** box.

the explosion of a massive star ☐

a very bright, hot young star ☐

a very cool super giant star ☐

1 (c) Brown dwarf stars are small stars too cool to give out visible light. They were first discovered in 1995. Scientists think that there are millions of these stars spread throughout the Universe.

Which **one** of the following is the most likely reason why brown dwarf stars were not discovered before 1995?

[1 mark]

Tick (✓) **one** box.

Brown dwarf stars did not exist before 1995. ☐

Scientists were looking in the wrong part of the Universe. ☐

The telescopes and measuring instruments were not sensitive enough. ☐

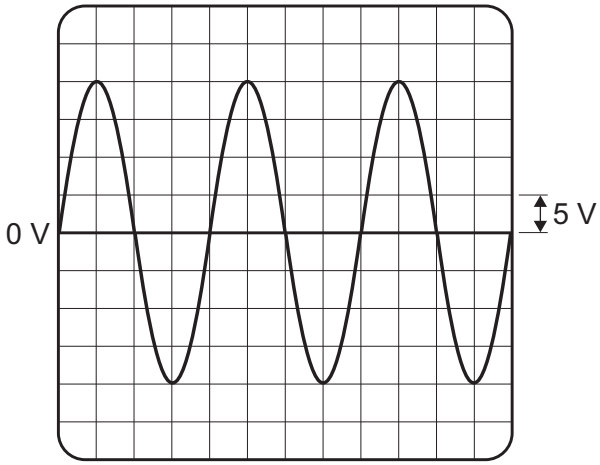
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Turn over for the next question

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2 (a) **Figure 2** shows the oscilloscope trace an alternating current (a.c.) electricity supply produces.

Figure 2



One vertical division on the oscilloscope screen represents 5 volts.

Calculate the peak potential difference of the electricity supply.

[1 mark]

Peak potential difference = _____ V

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

[1 mark]

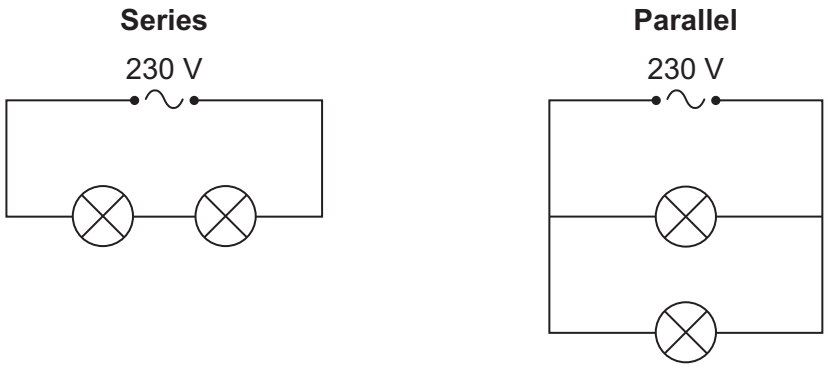
40	**50**	**60**

In the UK, the frequency of the a.c. mains electricity supply is _____ hertz.

Do not write outside the box

2 (c) **Figure 3** shows how two lamps may be connected in series or in parallel to the 230 volt mains electricity supply.

Figure 3



2 (c) (i) Calculate the potential difference across each lamp when the lamps are connected in **series**.
The lamps are identical.

[1 mark]

Potential difference when in series = _____ V

2 (c) (ii) What is the potential difference across each lamp when the lamps are connected in **parallel**?

[1 mark]

Tick (✓) **one** box.

115 V ☐ 230 V ☐ 460 V ☐

2 (c) (iii) Give **one** advantage of connecting the lamps in parallel instead of in series.

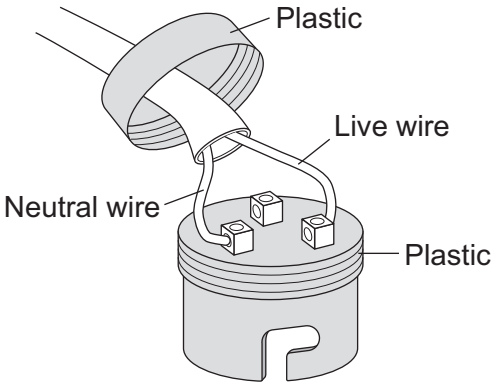
[1 mark]

Question 2 continues on the next page

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2 (d) **Figure 4** shows the light fitting used to connect a filament light bulb to the mains electricity supply.

Figure 4



The light fitting does **not** have an earth wire connected.

Explain why the light fitting is safe to use.

[2 marks]

2 (e) A fuse can be used to protect an electrical circuit.

Name a different device that can also be used to protect an electrical circuit.

[1 mark]

8

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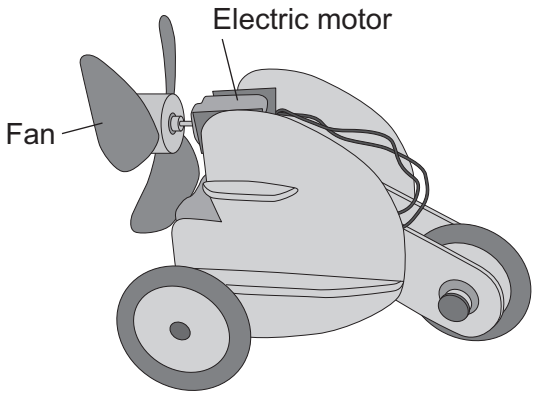
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ANSWER IN THE SPACES PROVIDED

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3 **Figure 5** shows an air-driven toy.
When the electric motor is switched on the fan rotates.
The fan pushes air backwards making the toy move forwards.

Figure 5



3 (a) (i) The toy has a mass of 0.15 kg and moves forward with a velocity of 0.08 m/s.

How is the momentum of the toy calculated?

[1 mark]

Tick (✓) **one** box.

0.15 + 0.08 = 0.230 ☐

0.15 ÷ 0.08 = 1.875 ☐

0.15 × 0.08 = 0.012 ☐

3 (a) (ii) What is the unit of momentum?

[1 mark]

Tick (✓) **one** box.

kg m/s ☐ m/s^2 ☐ kg/m/s ☐

Do not write outside the box

3 (a) (iii) Use the correct answer from the box to complete the sentence.

[1 mark]

less than	equal to	more than

The momentum of the air backwards is _____ the momentum of the toy forwards.

3 (b) The electric motor can rotate the fan at two different speeds.

Explain why the toy moves faster when the fan rotates at the higher of the two speeds.

[2 marks]

_____

_____

_____

_____

5

Turn over for the next question

Do not write outside the box

4 (a) Uranium has two natural isotopes, uranium-235 and uranium-238.

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

[1 mark]

electrons	neutrons	protons

The nucleus of a uranium-238 atom has three more _____ than the nucleus of a uranium-235 atom.

4 (b) Uranium-235 is used as a fuel inside a nuclear reactor.
Energy is released from nuclear fuels by the process of nuclear fission.

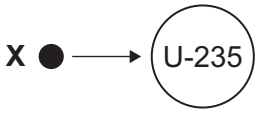
What is the energy released from nuclear fuels inside a nuclear reactor used for?

[1 mark]

_____

4 (c) **Figure 6** shows the nucleus of an atom of uranium-235 (U-235) about to undergo nuclear fission.

Figure 6



4 (c) (i) Before nuclear fission can happen the nucleus of a uranium atom has to absorb the particle labelled **X**.

What is particle **X**?

[1 mark]

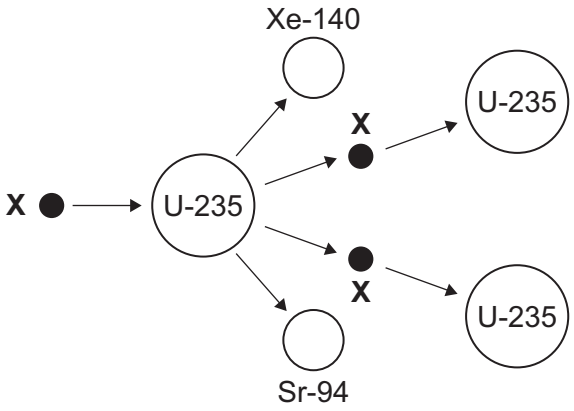
Tick (✓) **one** box.

an electron ☐ a neutron ☐ a proton ☐

Do not write outside the box

4 (c) (ii) The process of nuclear fission, shown in **Figure 7**, causes the nucleus of the uranium-235 (U-235) atom to split apart and release two of the particles **X**.

Figure 7



Complete **Figure 7** to show how the particles **X start** a chain reaction.

[2 marks]

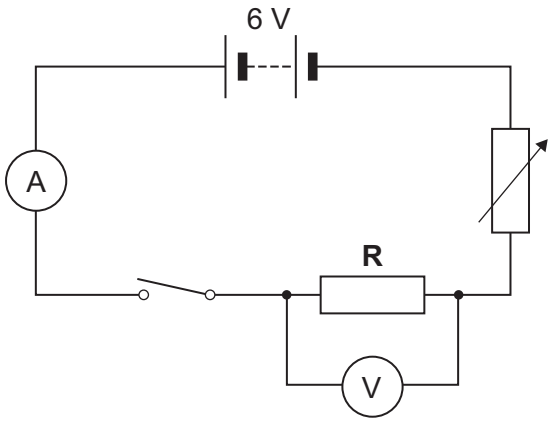
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Turn over for the next question

Do not write outside the box

5 **Figure 8** shows an electrical circuit.

Figure 8



5 (a) The 6 V battery shown in **Figure 8** is made up of a number of identical 1.5 V cells.

Calculate the minimum number of cells needed to make the battery.

[1 mark]

Number of cells = _____

5 (b) The switch in **Figure 8** is shown in the open position. Closing the switch completes the circuit.
Charge flows through the completed circuit and a reading is shown on both the ammeter and the voltmeter.

5 (b) (i) In 10 seconds, 20 coulombs of charge flows through the circuit.

Calculate the current reading shown on the ammeter.

Use the correct equation from the Physics Equations Sheet.

[2 marks]

Current = _____ A

Do not write outside the box

5 (b) (ii) For 20 coulombs of charge to flow through the resistor **R**, 100 joules of work must be done.

Calculate the potential difference reading given by the voltmeter.

Use the correct equation from the Physics Equations Sheet.

[2 marks]

_____

_____

Potential difference = _____ V

5

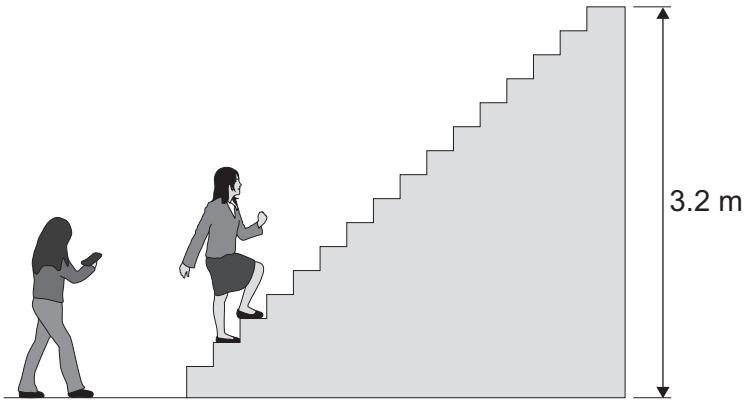
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6 A student did an experiment to calculate her power.
Figure 9 shows how she obtained the measurements needed.

The student first weighed herself and then ran up a flight of stairs. A second student timed how long it took her to go from the bottom to the top of the stairs. The height of the stairs was also measured.

Figure 9



6 (a) Complete the following sentence.

[1 mark]

To run up the stairs the student must do work against

the force of _____ .

6 (b) The student did 2240 J of work going from the bottom of the stairs to the top of the stairs.
The student took 2.8 seconds to run up the stairs.

6 (b) (i) Calculate the power the student developed when running up the stairs.

Use the correct equation from the Physics Equations Sheet.

[2 marks]

_____

_____

Power = _____ W

Do not write outside the box

6 (b) (ii) How much gravitational potential energy did the student gain in going from the bottom to the top of the stairs?

[1 mark]

Tick (✓) **one** box.

much more than 2240 J ☐

2240 J ☐

much less than 2240 J ☐

6 (c) Another four students did the same experiment.
The measurements taken and the calculated values for power are given in **Table 1**.

Table 1

Student	Weight in newtons	Time taken in seconds	Power in watts
A	285	3.8	240
B	360	2.4	480
C	600	3.4	560
D	725	4.0	580

6 (c) (i) To make a fair comparison of their powers the students kept **one** variable in the experiment constant.

What variable did the students keep constant?

[1 mark]

_____

6 (c) (ii) From the data in **Table 1** a student wrote the following conclusion.

'The greater the weight of the student the greater the power developed.'

Suggest why this conclusion may **not** be true for a larger group of students.

[1 mark]

_____

_____

6

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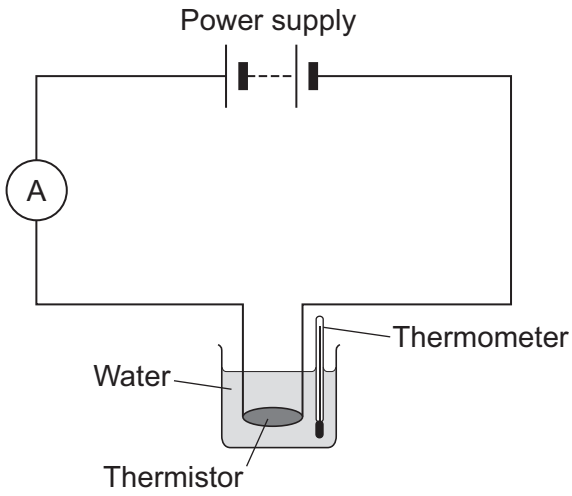
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7 **Figure 10** shows the apparatus used to investigate how the current through a thermistor depends on the temperature of the thermistor.

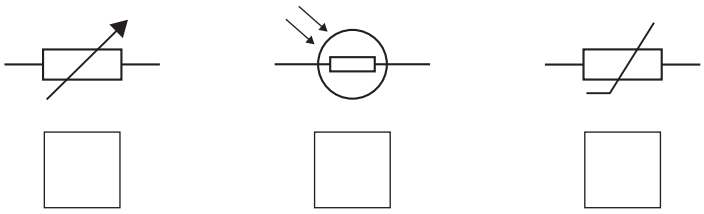
Figure 10



7 (a) Which **one** of the following is the correct circuit symbol for a thermistor?

[1 mark]

Tick (✓) **one** box.



Question 7 continues on the next page

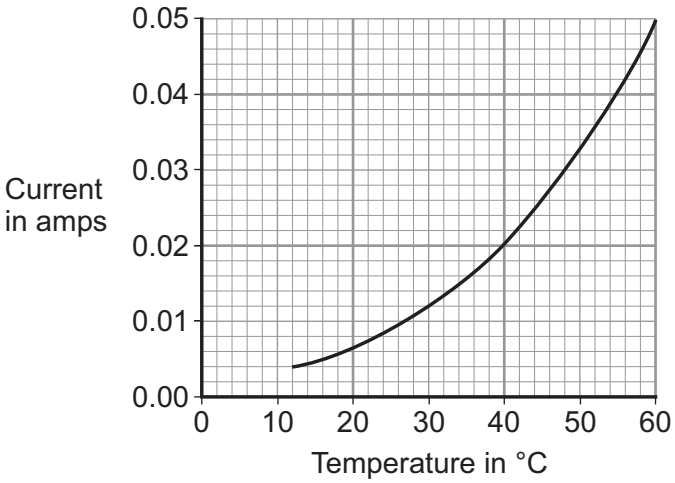
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7 (b) To get a range of results, hot water at 60 °C was poured into the beaker.
The temperature of the water and current through the thermistor were then recorded as the water cooled.

The results of the investigation are shown in **Figure 11**.

Figure 11



7 (b) (i) Suggest **one** way the investigation could have been changed to give a wider range of temperatures.

[1 mark]

_____

_____

7 (b) (ii) Describe how the current through the thermistor depends on the temperature of the thermistor.

[1 mark]

_____

_____

7 (b) (iii) Use **Figure 11** to determine the current through the thermistor at 40 °C.

[1 mark]

Current at 40 °C = _____ A

Do not write outside the box

7 (b) (iv) At 40 °C the thermistor has a resistance of 250 Ω.

Use your answer to part **(b)(iii)** and the resistance of the thermistor to calculate the potential difference across the thermistor.

Use the correct equation from the Physics Equations Sheet.

[2 marks]

Potential difference = _____ V

7 (b) (v) The potential difference across the thermistor stays the same all through the investigation.

What conclusion can be made from the results in **Figure 11** about the resistance of the thermistor as the temperature of the thermistor **decreases**?

[1 mark]

Tick (✓) **one** box.

- the resistance increases ☐
- the resistance does not change ☐
- the resistance decreases ☐

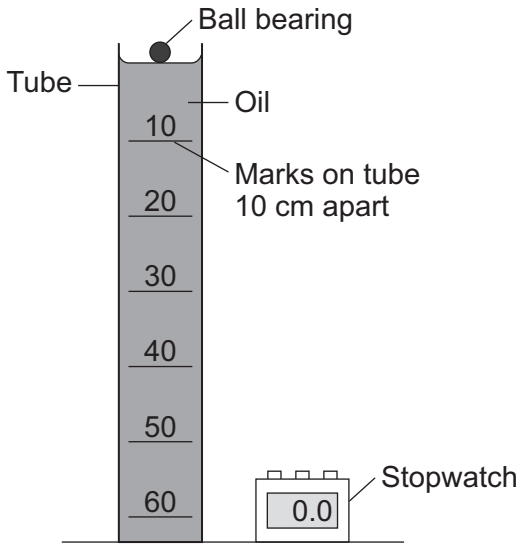
7

Turn over for the next question

Do not write outside the box

8 A student investigated how the speed of a ball bearing changes as the ball bearing falls through a tube of oil.
Figure 12 shows the equipment the student used.

Figure 12



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

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

[1 mark]

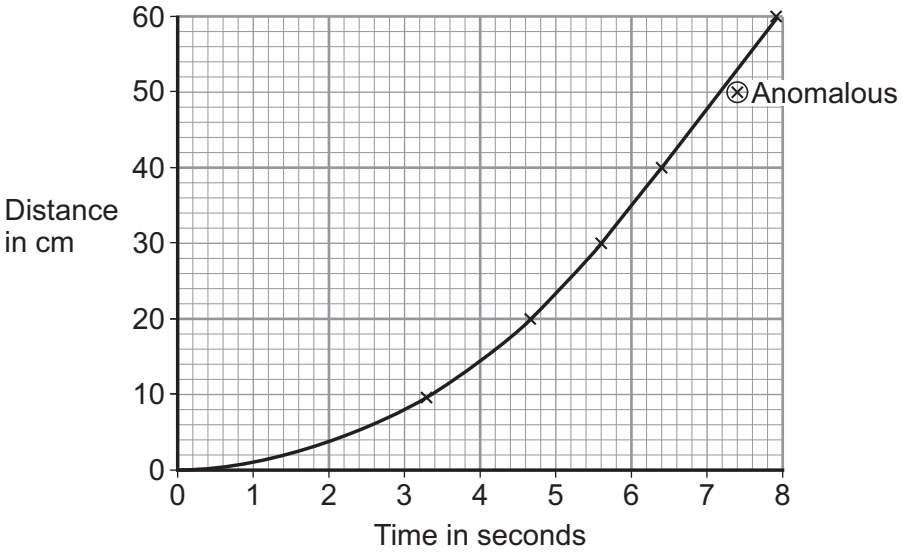
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_____

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8 (b) **Figure 13** shows the student's results plotted as a graph.

Figure 13



8 (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.

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

[1 mark]

_____

_____

8 (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]

_____

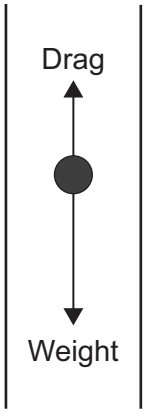
_____

Question 8 continues on the next page

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8 (b) (iv) The directions of the two forces acting on the ball bearing as it falls through the oil are shown in **Figure 14**.

Figure 14



Explain, in terms of the forces shown in **Figure 14**, why the ball bearing reaches its terminal velocity.

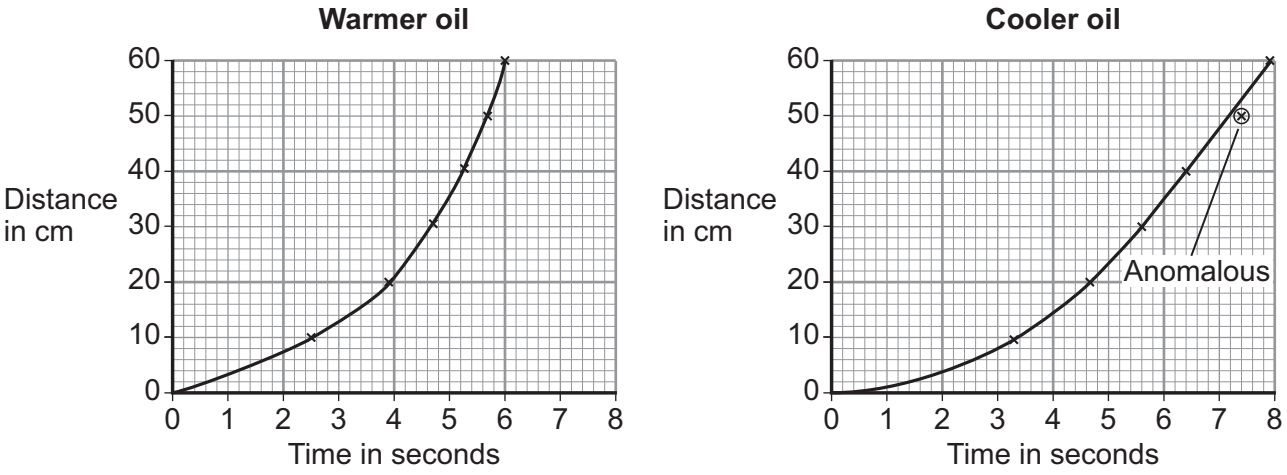
[2 marks]

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

Figure 15 shows the set of results using the warmer oil **and** the set of results using the cooler oil.

Figure 15



Compare the two graphs in **Figure 15**.

Use the correct answer 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

Turn over ▶

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

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

[1 mark]

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

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

[1 mark]

Tick (✓) **one** box.

alpha particles ☐ beta particles ☐ gamma rays ☐

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

[1 mark]

9 (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

9 (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

END OF QUESTIONS

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AQA

GCSE

Additional Science / Physics

PH2FP

Mark scheme

4408/4403

June 2016

Version: 1.0 Final Mark Scheme

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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.

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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 **9(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)	gas gravity protostar	correct order only accept correct word circled in box provided no answer given in answer space	1 1 1	AO1 2.6.2c
1(b)	the explosion of a massive star		1	AO1 2.6.2f
1(c)	The telescopes and measuring instruments were not sensitive enough.		1	AO3 2.6
Total			**5**	

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Question	Answers	Extra information	Mark	AO / Spec. Ref.
2(a)	20		1	AO2 2.4.1b
2(b)	50		1	AO1 2.4.1c
2(c)(i)	115		1	AO2 2.3.2k
2(c)(ii)	230		1	AO1 2.3.2l
2(c)(iii)	if one goes out the other still works **or** brighter	accept power (output) is greater can be switched on/off independently is insufficient	1	AO2 2.3
2(d)	the outside/casing is plastic and plastic is an insulator	there is plastic around the wires is insufficient it is plastic is insufficient an answer the light fitting is double insulated gains both marks	1 1	AO1 2.4.1j
2(e)	(residual current) circuit breaker	accept RCCB accept RCBO accept RCCD accept RCB accept miniature circuit breaker / MCB trip switch is insufficient breaker is insufficient do not accept earth wire	1	AO1 2.4.1i
Total			**8**	

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Question	Answers	Extra information	Mark	AO / Spec. Ref.
3(a)(i)	0.15 × 0.08 = 0.012		1	AO2 2.2.2a
3(a)(ii)	kg m/s		1	AO1 2.2.2a
3(a)(iii)	equal to		1	AO1 2.2.2b
3(b)	momentum of the air increases **or** force backwards increases so momentum of the toy must increase **or** the force forwards (on the toy) increases	it = toy accept air moves faster accept momentum backwards increases accept pushes more air back(wards) accept momentum forwards must increase	1 1	AO2 2.2.2b
Total			**5**	

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Question	Answers	Extra information	Mark	AO / Spec. Ref.
4(a)	neutrons		1	AO1 2.5.1e
4(b)	generate electricity	accept produce electricity accept heat water accept produce steam turns turbines is insufficient	1	AO1 2.6
4(c)(i)	a neutron		1	AO1 2.6.1c
4(c)(ii)	two particles **X** released from the uranium-235 uranium-235 shown splitting into two fragments **or** each particle **X** shown colliding with a uranium-235 and producing 2 further particles **X**	 one uranium-235 shown splitting is sufficient, provided no contradiction shown	1 1	AO1 2.6.1e
Total			**5**	

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Question	Answers	Extra information	Mark	AO / Spec. Ref.
5(a)	4		1	AO2 2.3.2j
5(b)(i)	2	allow **1** mark for correct substitution ie I = $\frac{20}{10}$ provided no subsequent step	2	AO2 2.3.2a
5(b)(ii)	5	allow **1** mark for correct substitution ie V = $\frac{100}{20}$ provided no subsequent step	2	AO2 2.3.2b
Total			**5**	

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Question	Answers	Extra information	Mark	AO / Spec. Ref.
6(a)	gravity	accept weight for gravity air resistance is insufficient	1	AO1 2.2.1f
6(b)(i)	800	allow **1** mark for correct substitution ie P = $\frac{2240}{2.8}$ provided no subsequent step	2	AO2 2.2.1e
6(b)(ii)	2240 J		1	AO1 2.2.1f
6(c)(i)	(vertical) height	accept (height of) stairs	1	AO3 2.2.1f
6(c)(ii)	a fast / short time (for a lighter student) may give the greatest power **or** a slow / long time (for a heavy student) may give the least power	accept time is a factor fitness is insufficient	1	AO3 2.2.1e
Total			**6**	

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Question	Answers	Extra information	Mark	AO / Spec. Ref.
7(a)	last box ticked 		1	AO1 2.3.2c
7(b)(i)	use hotter water (than 60 °C) **or** add ice cubes	accept use boiling water accept use water at any stated temperature above 60 °C accept add water at any stated temperature below 12 °C use different temperatures is insufficient	1	AO3 2.3.2q
7(b)(ii)	the current increases as the temperature increases		1	AO2 2.3.2q
7(b)(iii)	0.02 (A)		1	AO2 2.3.2q
7(b)(iv)	5 (V) **or** their **(b)(iii)** × 250 correctly calculated	allow **1** mark for correct substitution ie V = 0.02 × 250 **or** V = their **(b)(iii)** × 250	2	AO2 2.3.2h
7(b)(v)	the resistance increases		1	AO3 2.3.2q
Total			**7**	

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Question	Answers	Extra information	Mark	AO / Spec. Ref.
8(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
8(b)(i)	before		1	AO3 2.1
8(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
8(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
8(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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8(c)	less than ball bearing increases speed at a greater rate **or** ball bearing has a greater acceleration **or** terminal velocity has not been reached so resultant force must be greater **or** as weight is the same (the drag must be less)	 accept it travels the same distance in less time accept the ball bearing is going faster accept warmer oil has a lower density/viscosity for 1 mark if neither of the two reason marks score	1 1 1	AO3 2.1.4a/b
Total			**9**	

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Question	Answers	Extra information	Mark	AO / Spec. Ref.
9(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
9(b)(i)	gamma rays		1	AO1 2.5.2e
9(b)(ii)	loses/gains (one or more) electron(s)		1	AO1 2.5.1d
9(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.
9(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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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	
8	
TOTAL	

AQA

General Certificate of Secondary Education
Foundation Tier
June 2015

Additional Science
Unit Physics P2

PH2FP

F

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 8(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.

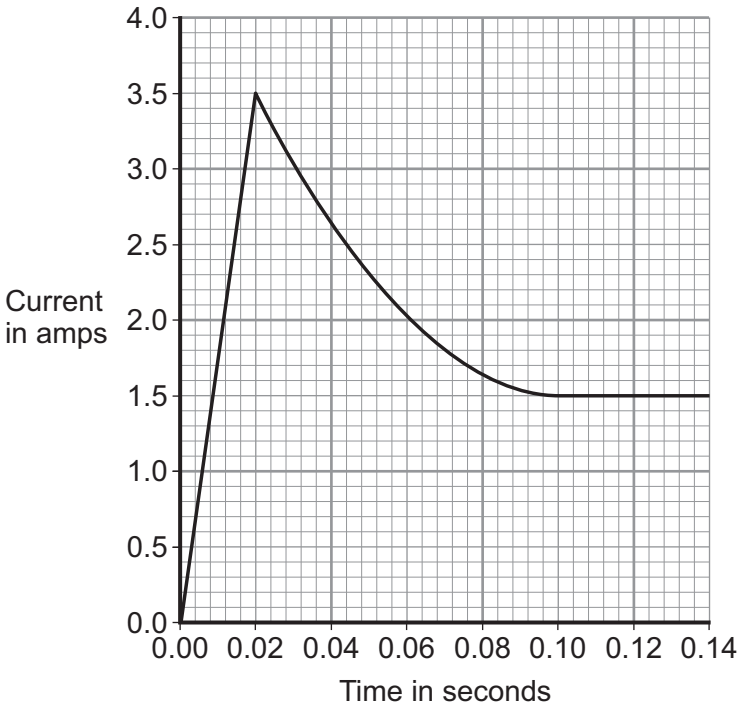
Advice
- In all calculations, show clearly how you work out your answer.

Do not write outside the box

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

1 **Figure 1** shows how the current through a filament bulb changes after the bulb is switched on.

Figure 1



1 (a) What happens to the current through the bulb in the first 0.02 seconds after the bulb is switched on?

[1 mark]

.....

1 (b) Between 0.02 seconds and 0.08 seconds the current through the bulb decreases.

1 (b) (i) What, if anything, happens to the **resistance** of the bulb between 0.02 seconds and 0.08 seconds?

[1 mark]

Draw a ring around the correct answer.

decreases **does not change** **increases**

Do not write outside the box

1 (b) (ii) What, if anything, happens to the **temperature** of the bulb between 0.02 seconds and 0.08 seconds?

[1 mark]

Draw a ring around the correct answer.

decreases **does not change** **increases**

1 (c) The bulb is connected to a 12 V power supply.

Calculate the power of the bulb when the current through the bulb is 1.5 A.

Use the correct equation from the Physics Equations Sheet.

[3 marks]

Choose the unit from the list below.

coulomb **joule** **watt**

.....

.....

Power = ... unit .....

6

Turn over for the next question

Do not write outside the box

2 The equation below shows the process by which two atomic nuclei join to form a different nucleus.

$$ {}_{1}^{1}\mathrm{H} + {}_{1}^{2}\mathrm{H} \rightarrow {}_{2}^{3}\mathrm{He} $$

2 (a) Where does the process shown by the equation above happen naturally?

[1 mark]

Tick (✓) **one** box.

Inside the Earth ☐

Inside a nuclear power station ☐

Inside the Sun ☐

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

[1 mark]

fission	**force**	**fusion**

The process of joining two atomic nuclei to form a different nucleus is called

nuclear ..... .

2 (c) What is released during this process?

[1 mark]

Draw a ring around the correct answer.

charge **energy** **force**

3

Do not write outside the box

3 (a) When a force is applied to a spring, the spring extends by 0.12 m.
The spring has a spring constant of 25 N/m.

Calculate the force applied to the spring.

Use the correct equation from the Physics Equations Sheet.

[2 marks]

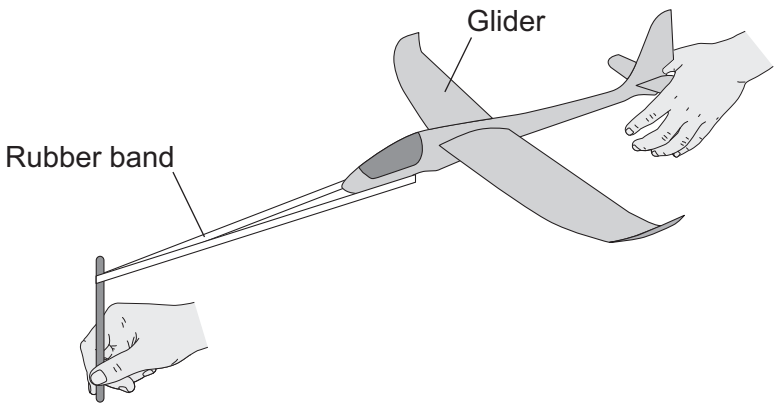
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Force = ... N

3 (b) **Figure 2** shows a toy glider. To launch the glider into the air, the rubber band and glider are pulled back and then the glider is released.

Figure 2



3 (b) (i) Use the correct answers from the box to complete the sentence.

[2 marks]

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

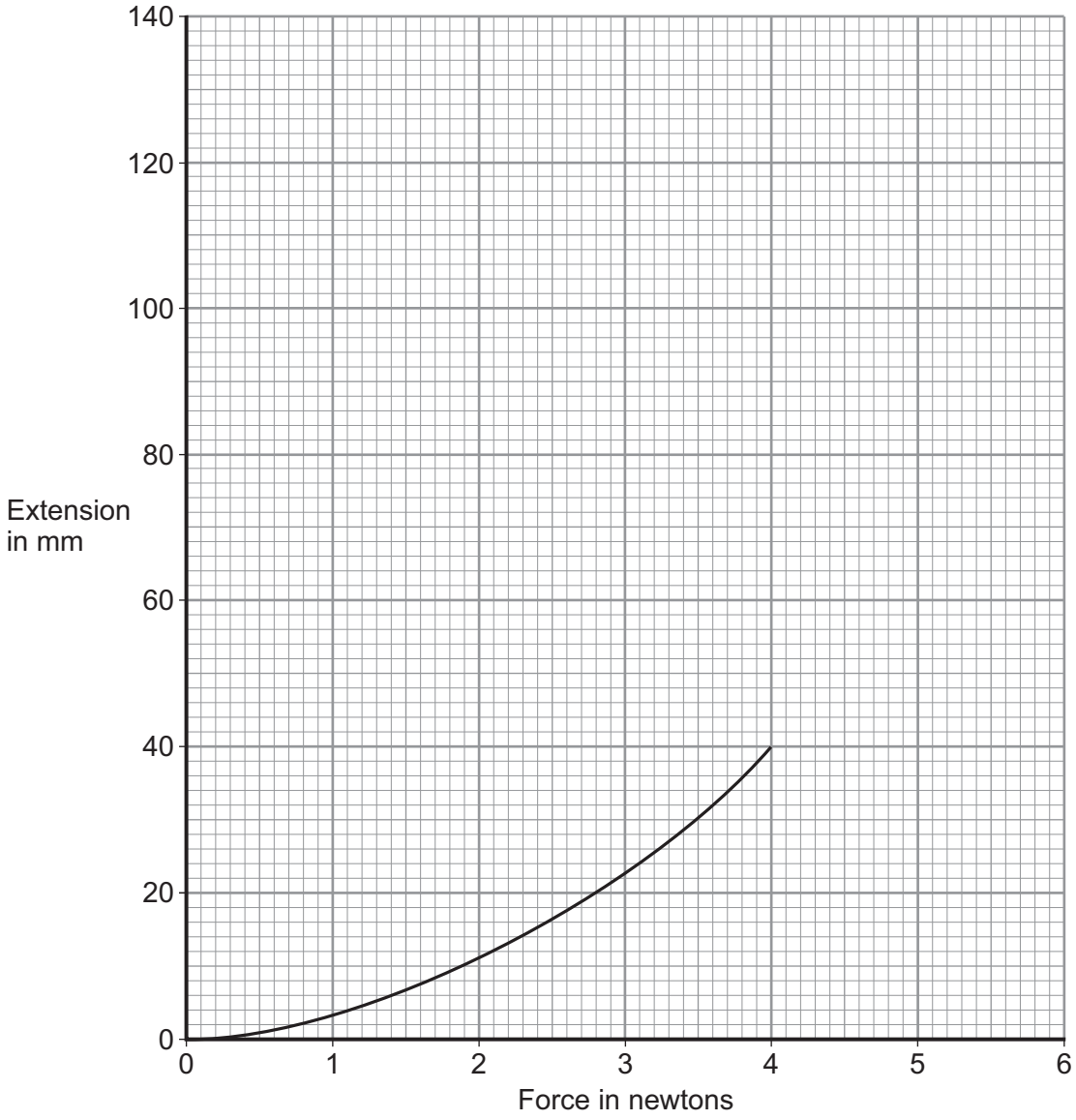
When the glider is released, the ..... energy stored in the rubber band decreases and the glider gains ..... energy.

Question 3 continues on the next page

Do not write outside the box

3 (b) (ii) **Figure 3** shows how the extension of the rubber band varies with the force applied to the rubber band.

Figure 3



What can you conclude, from **Figure 3**, would happen to the extension of the rubber band if the force applied to the rubber band was increased to 6 N?

The rubber band does **not** break.

[2 marks]

.....

.....

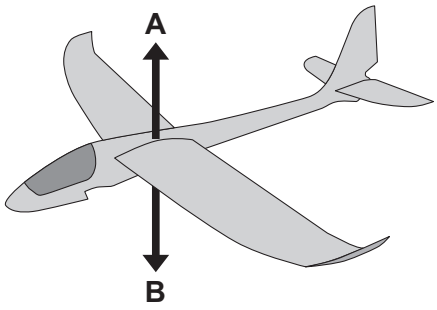
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.....

Do not write outside the box

3 (c) **Figure 4** shows the vertical forces, **A** and **B**, acting on the glider when it is flying.

Figure 4



3 (c) (i) What name is given to the force labelled **B**?

[1 mark]

Draw a ring around the correct answer.

drag **friction** **weight**

3 (c) (ii) Which **one** of the following describes the downward speed of the glider when force **B** is greater than force **A**?

[1 mark]

Tick (✓) **one** box.

Downward speed increases ☐

Downward speed is constant ☐

Downward speed decreases ☐

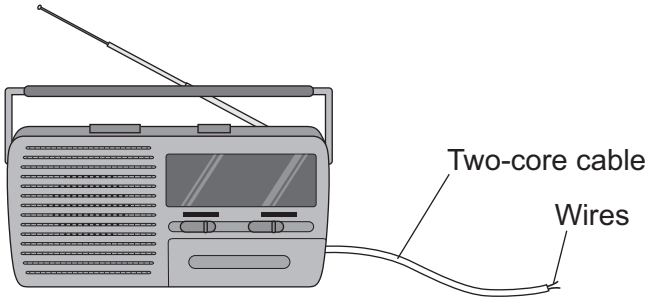
8

Turn over for the next question

Do not write outside the box

4 **Figure 5** shows a radio. The radio can be powered by connecting the two-core cable to the mains electricity supply.

Figure 5



4 (a) (i) What must be fitted to the cable before it can be connected to the mains electricity supply?

[1 mark]

.....

4 (a) (ii) There are only two wires inside the cable.
What are the names of the two wires inside the cable?

[1 mark]

Tick (✓) **one** box.

Earth and live ☐

Earth and neutral ☐

Live and neutral ☐

4 (a) (iii) Use the correct answer from the box to complete the sentence.

[1 mark]

double	**extra**	**fully**

It is safe to connect the radio to the mains electricity supply using a two-core cable because the radio is ..... insulated.

Do not write outside the box

4 (b) The radio can also be powered by a battery.

What type of current does a battery supply?

[1 mark]

Tick (✓) **one** box.

Alternating current (a.c.) only ☐

Direct current (d.c.) only ☐

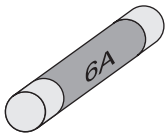
Both a.c. and d.c. ☐

4 (c) **Figure 6** shows a fuse and a circuit breaker.

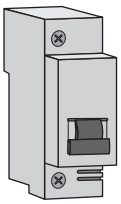
Fuses and circuit breakers are able to disconnect and switch off circuits.

Figure 6

Fuse



Circuit breaker



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

[1 mark]

earth	**live**	**neutral**

A fuse or a circuit breaker is connected to the ..... wire in a circuit.

4 (c) (ii) What happens to cause a fuse or circuit breaker to disconnect a circuit?

[1 mark]

.....

.....

Question 4 continues on the next page

Turn over ▶

Do not write outside the box

4 (c) (iii) Suggest **two** advantages of using a circuit breaker to disconnect a circuit compared with using a fuse.

[2 marks]

1 .....

.....

2 .....

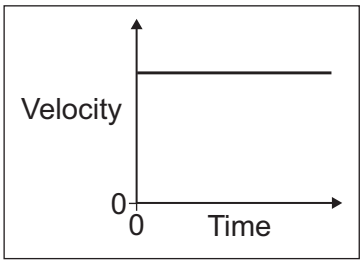
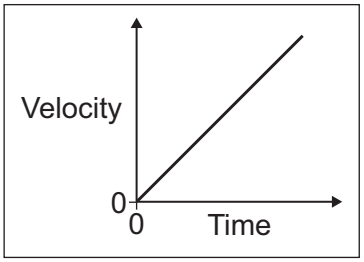
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8

Do not write outside the box

5 (a) Draw **one** line from each velocity–time graph to the statement describing the motion shown by the graph.

[2 marks]

Velocity–time graph	Motion shown by graph
	Constant acceleration
	Not moving
	Constant deceleration
	Constant velocity

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

[1 mark]

energy	**momentum**	**speed**

The velocity of an object includes both the ..... of the object and the direction the object is moving.

Question 5 continues on the next page

Do not write outside the box

5 (c) At the start of a race, a horse accelerates from a velocity of 0 m/s to a velocity of 9 m/s in 4 seconds.

5 (c) (i) Calculate the acceleration of the horse.

Use the correct equation from the Physics Equations Sheet.

[2 marks]

.....

.....

Acceleration = ... m/s^2

5 (c) (ii) When the horse accelerates, what, if anything, happens to the air resistance acting against the horse?

[1 mark]

Tick (✓) **one** box.

The air resistance decreases. ☐

The air resistance is constant. ☐

The air resistance increases. ☐

5 (d) A horse and a pony walk across a field at the same constant speed.

The horse has 4000 joules of kinetic energy.

The pony is **half** the mass of the horse.

What is the kinetic energy of the pony?

[2 marks]

Draw a ring around the correct answer.

2000 J **4000 J** **8000 J**

Give a reason for your answer.

.....

.....

8

Do not write outside the box

6 (a) Radioactive sources that emit alpha, beta or gamma radiation can be dangerous.

What is a possible risk to health caused by using a radioactive source?

[1 mark]

.....

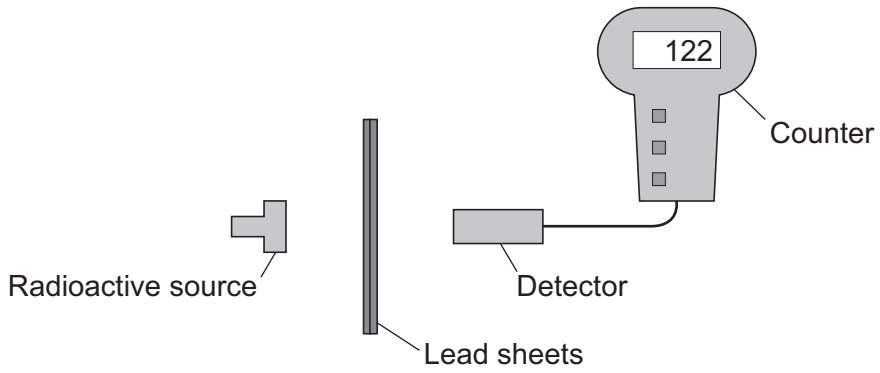
.....

6 (b) In an experiment, a teacher put a 2 mm thick lead sheet in front of a radioactive source. She used a detector and counter to measure the radiation passing through the lead sheet in one minute.

She then put different numbers of lead sheets, each 2 mm thick, in front of the radioactive source and measured the radiation passing through in one minute.

The apparatus the teacher used is shown in **Figure 7**.

Figure 7



6 (b) (i) When using a radioactive source in an experiment, how could the teacher reduce the risk to her health?

Suggest **one** way.

[1 mark]

.....

.....

Question 6 continues on the next page

Do not write outside the box

6 (b) (ii) The number recorded on the counter is actually higher than the amount of radiation detected from the source.

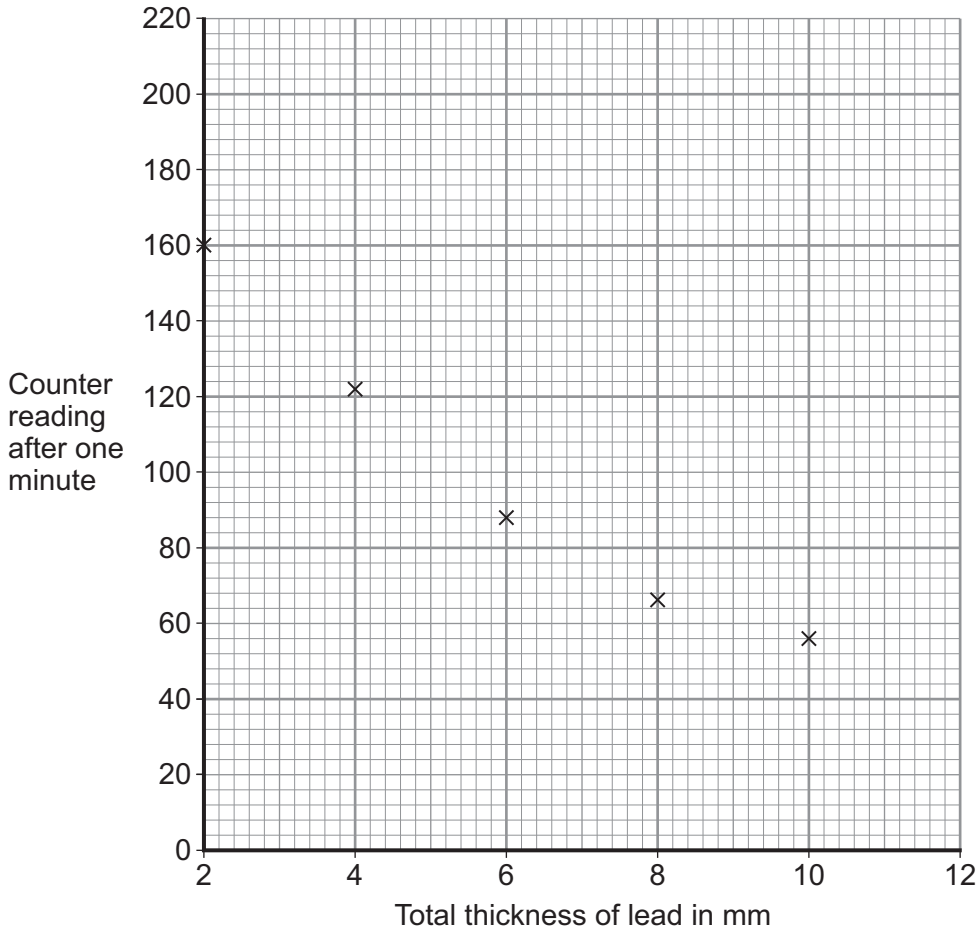
Complete the following word equation.

[1 mark]

The number recorded on the counter	=	The amount of radiation detected from the source	+	..... radiation

6 (c) The readings taken by the teacher are plotted in **Figure 8**.

Figure 8



6 (c) (i) Draw a line of best fit to complete **Figure 8**.

[1 mark]

Do not write outside the box

6 (c) (ii) How does the amount of radiation **absorbed** by the lead change as the total thickness of the lead is increased?

[1 mark]

.....

.....

6 (c) (iii) Use **Figure 8** to estimate the reading on the counter when the total thickness of the lead is increased to 12 mm.

[1 mark]

Estimated counter reading = ...

6 (d) What type of radiation was emitted from the radioactive source?

[2 marks]

Draw a ring around the correct answer.

alpha **beta** **gamma**

Give a reason for your answer.

.....

.....

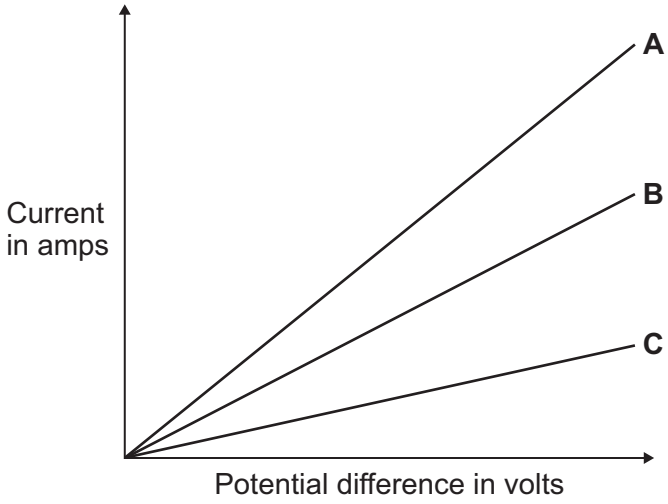
8

Turn over for the next question

Do not write outside the box

7 (a) **Figure 9** shows the current–potential difference graph for three wires, **A**, **B** and **C**.

Figure 9



7 (a) (i) Using **Figure 9**, how can you tell that the temperature of each wire is constant?

[1 mark]

.....

.....

7 (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.

.....

.....

.....

Do not write outside the box

7 (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

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

[1 mark]

What is the unit of resistance?

.....

7 (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.

.....

.....

.....

Question 7 continues on the next page

Do not write outside the box

7 (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]

.....

.....

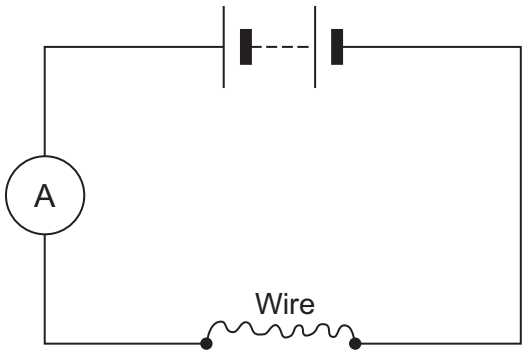
.....

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

7 (c) (i) Complete **Figure 10** by drawing a voltmeter in the correct position in the circuit. Use the correct circuit symbol for a voltmeter.

[1 mark]

Figure 10

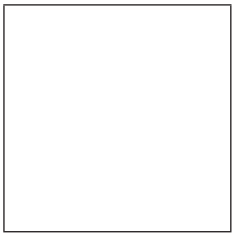


Do not write outside the box

7 (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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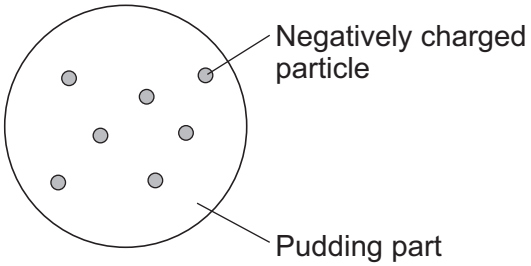
There are no questions printed on this page

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

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8 (a) Over 100 years ago, scientists thought the atom was like a 'plum pudding'.
Figure 11 shows the plum pudding model of the atom.

Figure 11



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]

.....

.....

Question 8 continues on the next page

Do not write outside the box

8 (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.

8 (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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8 (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

8 (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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10

END OF QUESTIONS

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ANSWER IN THE SPACES PROVIDED

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GCSE

Additional Science / Physics

PH2FP

Mark scheme

4408/4403
June 2015

Version/Stage: 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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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 **8c** 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)	increases	accept reaches highest value do **not** accept increases and decreases	1	AO2 2.3.2	**E**
1(b)(i)	increases		1	AO1 2.3.2m	**A**
1(b)(ii)	increases		1	AO1 2.3.2m	**A**
1(c)	18 watt	allow **1** mark for correct substitution i.e. 12 x 1.5 provided no subsequent step accept W answer may be indicated in the list	2 1	AO2 2.4.2c AO1 2.4.2c	**E**
Total			**6**		

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Question	Answers	Extra information	Mark	AO / Spec. ref.	ID
2(a)	inside the Sun		1	AO1 2.6.2b	**A**
2(b)	fusion		1	AO1 2.6.2a	**G**
2(c)	energy		1	AO1 2.6.2f	**A**
Total			**3**		

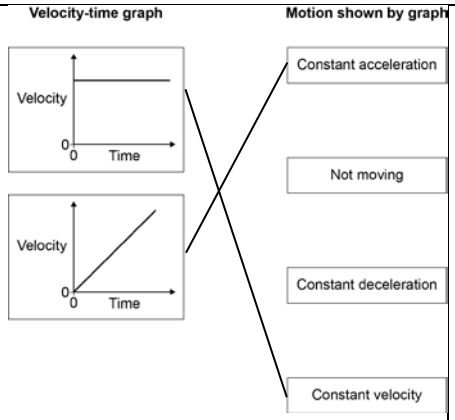
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Question	Answers	Extra information	Mark	AO / Spec. ref.	ID
3(a)	3 (.0)	allow **1** mark for correct substitution i.e. 25 x 0.12 provided no subsequent step	2	AO2 2.1.5d	**E**
3(b)(i)	elastic potential kinetic	correct order only	1 1	AO1 2.1.5c 2.2	**G**
3(b)(ii)	increases to 80(mm) (or more)	 accept any number greater than 75 an answer 'it (more than) doubles' gains both marks	1 1	AO3 2.1.5a	**E**
3(c)(i)	weight		1	AO1 2.1	**A**
3(c)(ii)	Downward speed increases		1	AO1 2.1.1e	**A**
Total			**8**		

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Question	Answers	Extra information	Mark	AO / Spec. ref.	ID
4(a)(i)	(3-pin) plug	do **not** accept plug socket	1	AO1 2.4.1d	**E**
4(a)(ii)	live and neutral		1	AO1 2.4.1e	**A**
4(a)(iii)	double		1	AO1 2.4.1j	**G**
4(b)	Direct current (d.c.) only		1	AO1 2.4.1a	**A**
4(c)(i)	live		1	AO1 2.4.1g	**G**
4(c)(ii)	too great a current flows	accept a surge of current accept too great a power accept an electrical fault do **not** accept voltage / energy / electricity too high	1	AO1 2.4.1g	**E**
4(c)(iii)	can be reset (disconnects circuit) faster	accept does not need replacing cheaper is insufficient does not melt is insufficient quicker to fix / replace is insufficient	1 1	AO2 2.4	**E**
Total			**8**		

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Question	Answers	Extra information	Mark	AO / Spec. ref.	ID
5(a)		if more than one line is drawn from a graph then all those lines are wrong allow **1** mark for 1 correct line	2	AO1 2.1.2f	**G**
5(b)	speed		1	AO1 2.1.2d	**G**
5(c)(i)	2.25	allow **1** mark for correct substitution i.e. $a = \frac{9 - 0}{4}$ or $a = \frac{9}{4}$ provided no subsequent step	2	AO2 2.1.2e	**E**
5(c)(ii)	The air resistance increases		1	AO1 2.1.4a	**A**
5(d)	2000 J mass is half **or** kinetic energy depends on mass	 do **not** accept weight for mass	1 1	AO2 2.2.1g	**E**
Total			**8**		

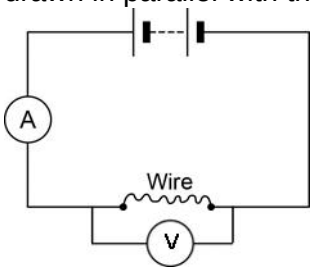
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Question	Answers	Extra information	Mark	AO / Spec. ref.	ID
6(a)	cell damage *or* cancer	accept kills/mutates cells radiation poisoning is insufficient ionising is insufficient	1	AO3 2.5.2g	**E**
6(b)(i)	any **one** from: • use tongs to pick up source • wear gloves • use (lead) shielding • minimise time (of exposure) • maximise distance (between source and teacher)	accept any other sensible and practical suggestion ignore reference to increasing / decreasing the number / thickness of lead sheets	1	AO3 2.5	**E**
6(b)(ii)	<u>background</u>		1	AO1 2.5.2b	**E**
6(c)(i)	curve drawn *from point 2,160*	do **not** accept straight lines drawn from dot to dot	1	AO2 2.5	**E**
6(c)(ii)	(also) increases	less radiation passes through is insufficient	1	AO3 2.5	**E**
6(c)(iii)	50	accept any value from 40 to 56 inclusive	1	AO3 2.5	**E**
6(d)	gamma only gamma (radiation) can pass through lead	 accept alpha **and** beta cannot pass through lead a general property of gamma radiation is insufficient	1 1	AO2 2.5.2e	**E**
Total			**8**		

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Question	Answers	Extra information	Mark	AO / Spec. ref.	ID
7(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**
7(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**
7(b)(i) clip with table 1	ohm	accept correct symbol Ω accept an answer written in Table 1 if not given in answer space	1	AO1 2.3.2h	**E**
7(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**
7(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**

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7(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**
7(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**
8(a)	(an equal amount of) positive charge	do **not** accept charge on the atom / nucleus is positive	1	AO3 2.5.1	**E**
8(b)(i)	a (significant) number of alpha particles were scattered by more than 4^{o} **or** alpha particles deflected backwards measurements / results could not be explained by 'plum pudding' model **or** measurements / results did not support predictions	accept (some) measurements / results were unexpected can be explained by the nuclear model is insufficient accept measurements / results did not support hypothesis	1 1	AO1 2.5 AO1	**E**
8(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**

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Question 8 continues on the next page . . .

Question	Answers	Extra information	Mark	AO / Spec. Ref.	ID
8(c)			6	AO1 2.5.1a/b/c	**E**

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.

0 marks	Level 1 (1–2 marks)	Level 2 (3–4 marks)	Level 3 (5–6 marks)
no relevant content	A brief description is given with some particles correctly named	A description is given with all three particles named **plus 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	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

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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 orbiting 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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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	
8	
TOTAL	

AQA

General Certificate of Secondary Education
Foundation Tier
June 2014

Additional Science
Unit Physics P2

PH2FP

F

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 8(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.

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

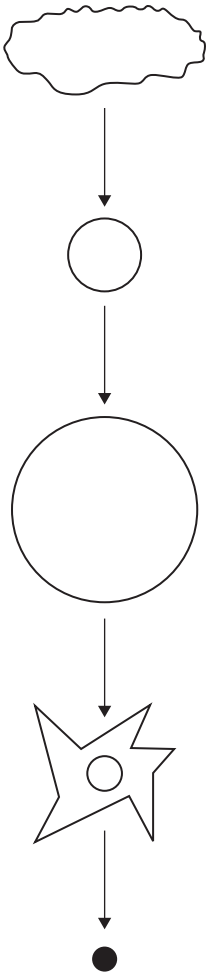
1 (a) **Figure 1** shows the life cycle of a very large star.

Use the correct answers from the box to complete the sentences in **Figure 1**.

[2 marks]

main sequence star	**neutron star**	**supernova**	**white dwarf**

Figure 1



Gas and dust join together to become a protostar.

The star is stable as a ..... .

The star expands to become a red super giant.

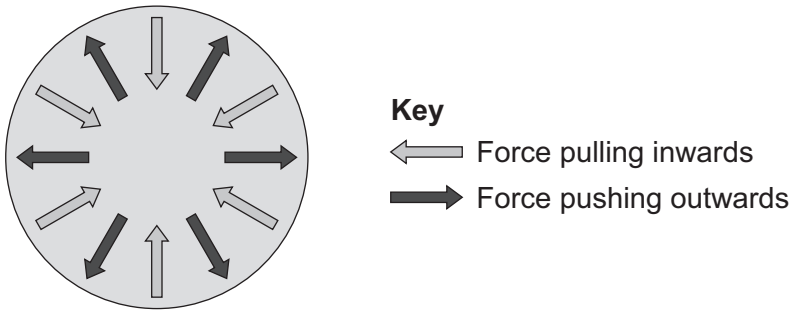
The outer layers of the star explode as a ..... .

The core of the star shrinks and a black hole is formed.

Do not write outside the box

1 (b) **Figure 2** shows the forces acting on a star when the star is stable.

Figure 2



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

[1 mark]

When a star is stable, the forces pushing outwards are

bigger than

smaller than

balanced by

the forces pulling inwards.

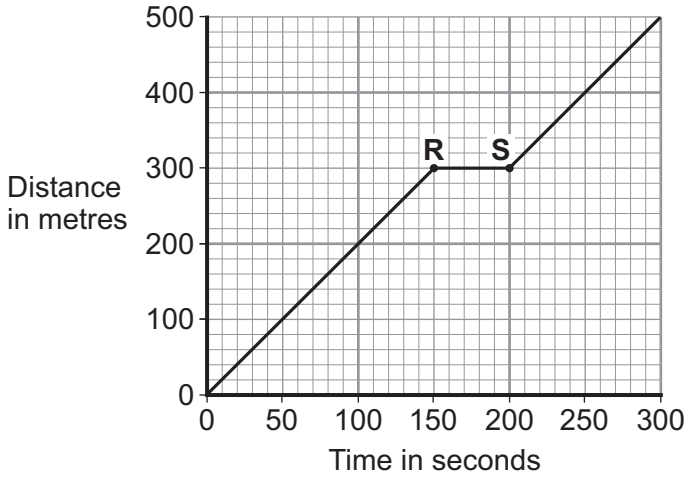
3

Turn over for the next question

Do not write outside the box

2 (a) **Figure 3** shows the distance–time graph for a person walking to a bus stop.

Figure 3



2 (a) (i) Which **one** of the following statements describes the motion of the person between points **R** and **S** on the graph?

Tick (✓) **one** box.

[1 mark]

Not moving ☐

Moving at constant speed ☐

Moving with increasing speed ☐

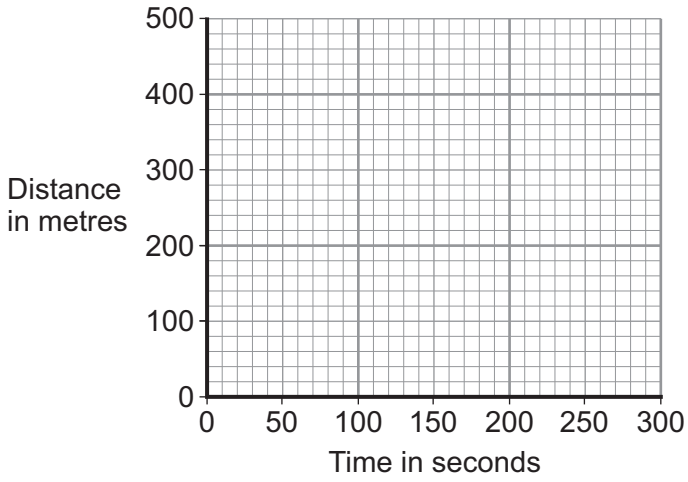
Do not write outside the box

2 (a) (ii) Another person, walking at constant speed, travels the same distance to the bus stop in 200 seconds.

Complete **Figure 4** to show a distance–time graph for this person.

[1 mark]

Figure 4



2 (b) A bus accelerates away from the bus stop at 2.5 m/s^2.

The total mass of the bus and passengers is 14 000 kg.

Calculate the resultant force needed to accelerate the bus and passengers.

Use the correct equation from the Physics Equations Sheet.

[2 marks]

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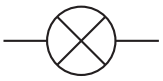
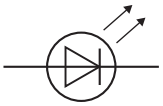
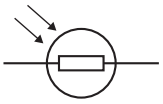
Resultant force = ... N

4

Do not write outside the box

3 (a) Draw **one** line from each circuit symbol to its correct name.

[3 marks]

Circuit symbol	Name
	Diode
	Light-dependent resistor (LDR)
	Lamp
	Light-emitting diode (LED)

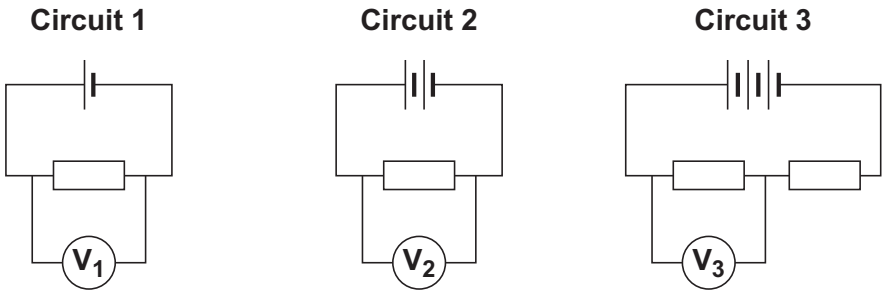
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3 (b) **Figure 5** shows three circuits.

The resistors in the circuits are identical.

Each of the cells has a potential difference of 1.5 volts.

Figure 5



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

[1 mark]

half	twice	the same as

The resistance of **circuit 1** is ..... the resistance of **circuit 3**.

3 (b) (ii) Calculate the reading on voltmeter $\mathbf{V_2}$.

[1 mark]

.....

Voltmeter reading $\mathbf{V_2}$ = ... V

3 (b) (iii) Which voltmeter, $\mathbf{V_1}$, $\mathbf{V_2}$ or $\mathbf{V_3}$, will give the lowest reading?

Draw a ring around the correct answer.

[1 mark]

$\mathbf{V_1}$ $\mathbf{V_2}$ $\mathbf{V_3}$

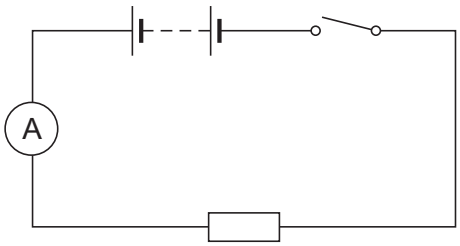
Question 3 continues on the next page

Do not write outside the box

3 (c) A student wanted to find out how the number of resistors affects the current in a series circuit.

Figure 6 shows the circuit used by the student.

Figure 6



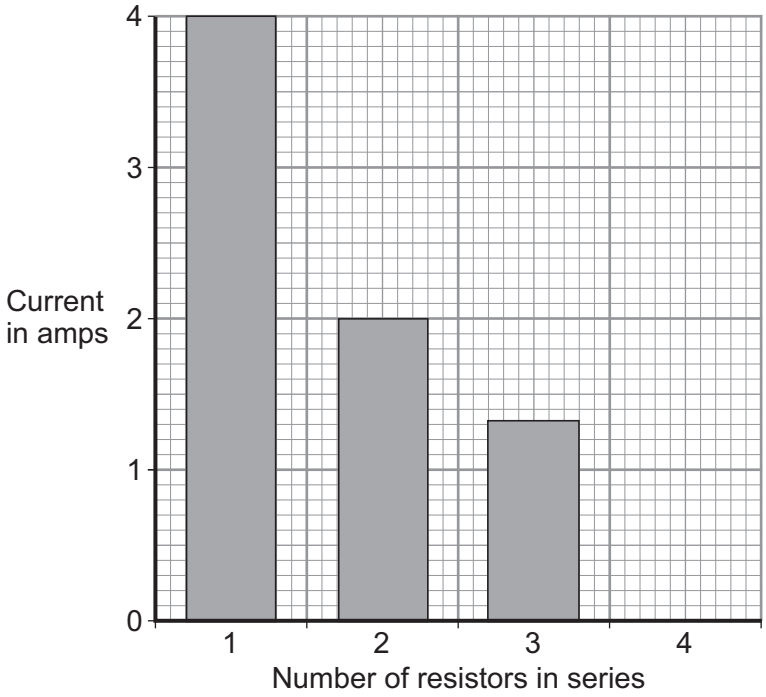
The student started with one resistor and then added more identical resistors to the circuit.

Each time a resistor was added, the student closed the switch and took the ammeter reading.

The student used a total of 4 resistors.

Figure 7 shows three of the results obtained by the student.

Figure 7



Do not write outside the box

3 (c) (i) To get valid results, the student kept one variable the same throughout the experiment.

Which variable did the student keep the same?

[1 mark]

.....

3 (c) (ii) The bar chart in **Figure 7** is not complete. The result using 4 resistors is not shown.

Complete the bar chart to show the current in the circuit when 4 resistors were used.

[2 marks]

3 (c) (iii) What conclusion should the student make from the bar chart?

[1 mark]

.....

.....

10

Turn over for the next question

Do not write outside the box

4 A paintball gun is used to fire a small ball of paint, called a paintball, at a target.

Figure 8 shows someone just about to fire a paintball gun.

The paintball is inside the gun.

Figure 8



4 (a) What is the momentum of the paintball before the gun is fired?

[2 marks]

.....

Give a reason for your answer.

.....

.....

4 (b) The gun fires the paintball forwards at a velocity of 90 m/s.

The paintball has a mass of 0.0030 kg.

Calculate the momentum of the paintball just after the gun is fired.

Use the correct equation from the Physics Equations Sheet.

[2 marks]

.....

.....

.....

Momentum = ... kg m/s

Do not write outside the box

4 (c) The momentum of the gun and paintball is conserved.

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

[1 mark]

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

The total momentum of the gun and paintball just after the gun is fired

will be ..... the total momentum of the gun and paintball

before the gun is fired.

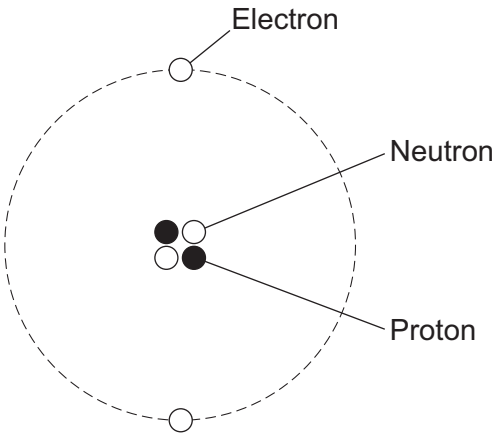
5

Turn over for the next question

Do not write outside the box

5 (a) **Figure 9** shows a helium atom.

Figure 9



5 (a) (i) Which **one** of the particles in the atom is **not** charged?

Draw a ring around the correct answer.

[1 mark]

electron **neutron** **proton**

5 (a) (ii) Which **two** types of particle in the atom have the same mass?

[1 mark]

..... and .....

5 (a) (iii) What is the atomic number of a helium atom?

Draw a ring around the correct answer.

[2 marks]

2 **4** **6**

Give a reason for your answer.

.....

.....

Do not write outside the box

5 (b) Alpha particles are one type of nuclear radiation.

5 (b) (i) Name **one** other type of nuclear radiation.

[1 mark]

.....

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

[1 mark]

electrons	**neutrons**	**protons**

The difference between an alpha particle and a helium atom is that the alpha particle does **not** have any ..... .

5 (b) (iii) Which **one** of the following is a property of alpha particles?

Tick (✓) **one** box.

[1 mark]

Have a long range in air ☐

Are highly ionising ☐

Will pass through metals ☐

Question 5 continues on the next page

Do not write outside the box

5 (c) Doctors may use nuclear radiation to treat certain types of illness.

Treating an illness with radiation may also harm a patient.

5 (c) (i) Complete the following sentence.

[1 mark]

The risk from treating a patient with radiation is that the radiation may

..... healthy body cells.

5 (c) (ii) Draw a ring around the correct answer to complete the sentence.

[1 mark]

Radiation may be used to treat a patient if the risk from the

radiation is

- much bigger than
- about the same as
- much smaller than

the possible benefit of having the treatment.

9

Do not write outside the box

Turn over for the next question

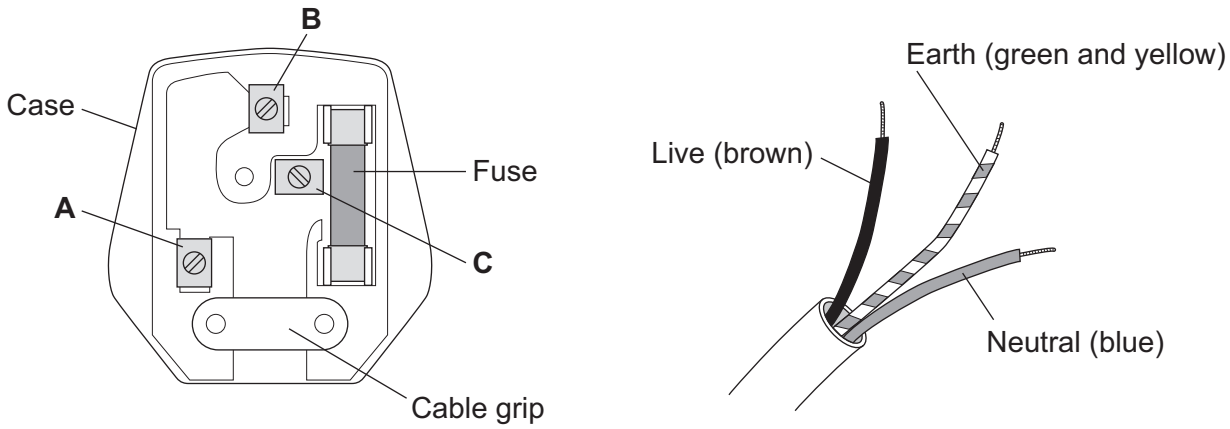
DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

Do not write outside the box

6 (a) **Figure 10** shows the inside of a three-pin plug and a length of three-core cable.

The cable is to be connected to the plug.

Figure 10



6 (a) (i) Complete **Table 1** to show which plug terminal, **A**, **B** or **C**, connects to each of the wires inside the cable.

[2 marks]

Table 1

Wire	Plug terminal
Live	
Neutral	
Earth	

6 (a) (ii) Name a material that could be used to make the case of the plug.

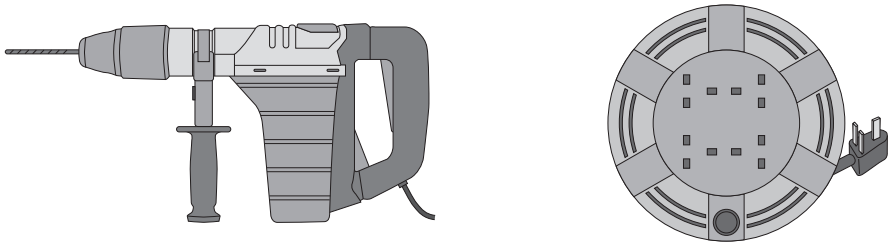
[1 mark]

.....

Do not write outside the box

6 (b) **Figure 11** shows an electric drill and an extension lead. The drill is used with the extension lead.

Figure 11



Electric drill

Extension lead

6 (b) (i) The drill is used for 50 seconds.

In this time, 30 000 joules of energy are transferred from the mains electricity supply to the drill.

Calculate the power of the drill.

Use the correct equation from the Physics Equations Sheet.

[2 marks]

.....

.....

.....

Power = ... W

Question 6 continues on the next page

Do not write outside the box

6 (b) (ii) A second drill is used with the extension lead. The power of this drill is 1200 W.

The instructions for using the extension lead include the following information.

> **When in use the lead may get hot:**
>
> **DO NOT go over the maximum power**
>
> - lead wound inside the case: 820 watts
> - lead fully unwound outside the case: 3100 watts

It would **not** be safe to use this drill with the extension lead if the lead was left wound inside the plastic case.

Explain why.

[3 marks]

.....

.....

.....

.....

.....

.....

Do not write outside the box

6 (c) **Table 2** gives information about three different electric drills.

Table 2

Drill	Power input in watts	Power output in watts
X	640	500
Y	710	500
Z	800	500

A person is going to buy **one** of the drills, **X**, **Y** or **Z**. The drills cost the same to buy.

Use only the information in the table to decide which **one** of the drills, **X**, **Y** or **Z**, the person should buy.

Write your answer in the box. ☐

Give a reason for your answer.

[1 mark]

.....

.....

.....

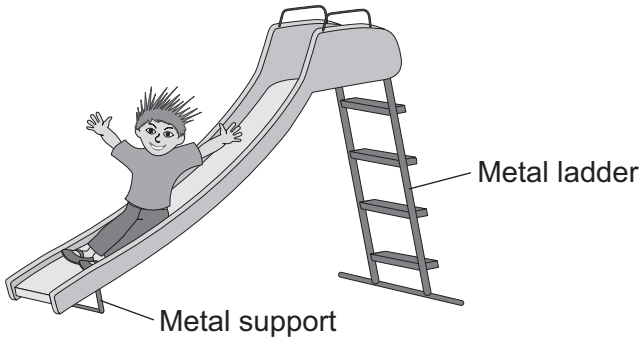
9

Turn over for the next question

Do not write outside the box

7 **Figure 12** shows a slide in a children's playground.

Figure 12



7 (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

7 (b) The slide is made of plastic.

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

Explain why.

[2 marks]

.....

.....

.....

.....

7 (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.

.....

.....

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

[1 mark]

.....

.....

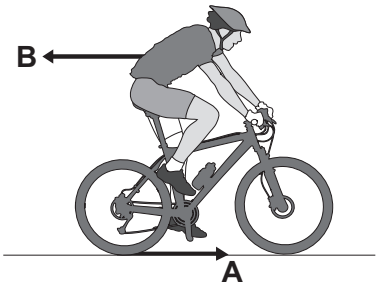
7

Turn over for the next question

Do not write outside the box

8 (a) **Figure 13** shows the horizontal forces acting on a moving bicycle and cyclist.

Figure 13



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

Draw a ring around the correct answer.

[1 mark]

friction **gravity** **weight**

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

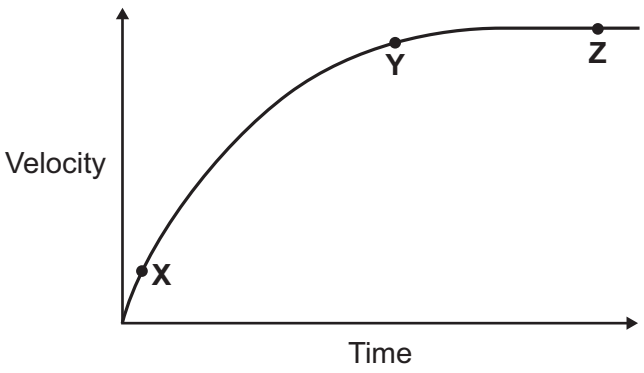
[1 mark]

.....

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

Figure 14 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 14



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 14**.

[6 marks]

Extra space .....

Question 8 continues on the next page

Do not write outside the box

8 (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 = ...

8 (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

END OF QUESTIONS

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GCSE
ADDITIONAL SCIENCE / PHYSICS

PH2FP
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 8(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

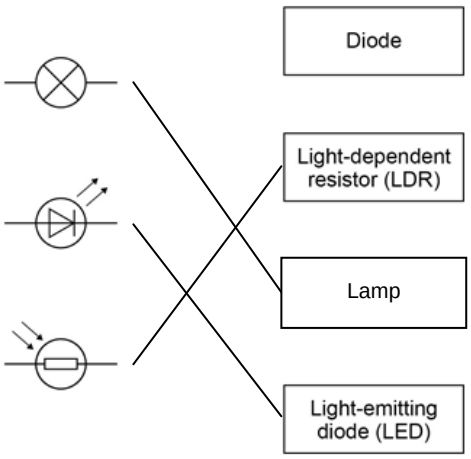
- Knowledge of accurate information appropriately contextualised
- Detailed understanding, supported by relevant evidence and examples
- Answer is coherent and in an organised, logical sequence, containing a wide range of appropriate or relevant specialist terms used accurately.
- The answer shows almost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

Question	Answers	Extra information	Mark	AO spec ref
1(a)	main sequence star supernova	correct order only	1 1	AO1 2.6.2e
1(b)	balanced by		1	AO1 2.6.2d
Total			**3**	

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Question	Answers	Extra information	Mark	AO spec ref
2(a)(i)	not moving		1	AO2 2.1.2b
2(a)(ii)	straight line from origin to (200,500)	ignore a horizontal line after (200,500)	1	AO2 2.1.2b
2(b)	35 000	allow **1** mark for correct substitution, ie 14 000 × 2.5 provided no subsequent step an answer of 87 500 indicates acceleration (2.5) has been squared and so scores zero	2	AO2 2.1.2a
Total			**4**	

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Question	Answers	Extra information	Mark	AO spec ref
3(a)		allow **1** mark for each correct line if more than one line is drawn from any symbol then all of those lines are wrong	3	AO1 2.3.2
3(b)(i)	half		1	AO1 2.3.2k
3(b)(ii)	3(V)		1	AO2 2.3.2k
3(b)(iii)	V_1		1	AO2 2.3.2k

Question 3 continues on the next page . . .

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Question 3 continued . . .

Question	Answers	Extra information	Mark	AO spec ref
3(c)(i)	potential difference / voltage of the power supply	accept the power supply accept the voltage / volts accept number of cells / batteries accept (same) cells / batteries do not accept same ammeter / switch / wires	1	AO3 2.3.2i
3(c)(ii)	bar drawn – height 1.(00)A	ignore width of bar allow **1** mark for bar shorter than 3rd bar	2	AO2 2.3.2i
3(c)(iii)	as the number of resistors increases the current decreases		1	AO3 2.3.2i
Total			**10**	

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Question	Answers	Extra information	Mark	AO spec ref
4(a)	Zero / 0 velocity / speed = 0	Accept none Nothing is insufficent accept it is not moving paintball has not been fired is insufficient	1 1	AO1 2.2.2a
4(b)	0.27	allow **1** mark for correct substitution, ie p = 0.003(0) × 90 provided no subsequent step	2	AO2 2.2.2a
4(c)	equal to		1	AO1 2.2.2b
Total			**5**	

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Question	Answers	Extra information	Mark	AO spec ref
5(a)(i)	neutron		1	AO1 2.5.1a, b
5(a)(ii)	neutron proton	both required, either order	1	AO1 2.5.1b
5(a)(iii)	2 number of <u>protons</u>	 do not accept number of electrons	1 1	AO1 2.5.1e
5(b)(i)	any **one** from: • beta • gamma	accept correct symbols accept positron / neutrino / neutron cosmic rays is insufficient	1	AO1 2.5.2
5(b)(ii)	electrons		1	AO1 2.5.2c
5(b)(iii)	are highly ionising		1	AO1 2.5.2e
5(c)(i)	mutate / destroy / kill / damage / change / ionise	Harm is insufficient	1	AO3 2.5
5(c)(ii)	much smaller than		1	AO3 2.5

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<table>
<tr><td>Total</td><td></td><td></td><td>9</td><td></td></tr>
<tr><td>Question</td><td>Answers</td><td>Extra information</td><td>Mark</td><td>AO spec ref</td></tr>
<tr><td>6(a)(i)</td><td><table><tr><th>Wire</th><th>Plug terminal</th></tr><tr><td>Live</td><td>C</td></tr><tr><td>Neutral</td><td>A</td></tr><tr><td>Earth</td><td>B</td></tr></table></td><td>all 3 correct for 2 marks

allow 1 mark for 1 correct</td><td>2</td><td>AO1

2.4.1f</td></tr>
<tr><td>6(a)(ii)</td><td>plastic
or
rubber</td><td>accept:
ABS
UF/urea formaldehyde
nylon
PVC</td><td>1</td><td>AO1

2.4.1f</td></tr>
<tr><td>6(b)(i)</td><td>600</td><td>

allow 1 mark for correct substitution,
ie P = <u>30 000</u>
50
provided no subsequent step</td><td>2</td><td>AO2

2.4.2b</td></tr>
<tr><td>6(b)(ii)</td><td>power is greater than 820 (W)

the lead /cable / wire <u>will</u> overheat / get (too) hot

so there is a risk of fire</td><td>power is 1200 W is insufficient

accept lead / cable will melt
may overheat / get hot is insufficient

accept causing a fire</td><td>1

1

1</td><td>AO3

2.4.2a</td></tr>
<tr><td>6(c)</td><td>X

any one from:
• most / more efficient

• smallest energy input (per second)

• cheapest to operate</td><td>mark only scores if X is chosen

mark is for the reason

accept smallest input (power) for same output (power)
accept wastes least energy
smallest (power) input is insufficient
uses least electricity is insufficient</td><td>

1</td><td>AO3

2.4.2a</td></tr>
</table>

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Total			**9**

Question	Answers	Extra information	Mark	AO spec ref
7(a)	450	allow **1** mark for correct substitution, ie 18 × 10 × 2.5 provided no subsequent step shown	2	AO2 2.2.1f
7(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	
7(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	
7(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
8(a)(i)	friction		1	AO1 2.1.3a
8(a)(ii)	air resistance	accept drag friction is insufficient	1	AO1 2.1.3a

8(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

Question	Answers	Extra information	Mark	AO spec ref
8(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	
8(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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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	
8	
TOTAL	

General Certificate of Secondary Education
Foundation Tier
June 2013

Additional Science PH2FP
Unit Physics P2

Physics F
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 8 (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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Answer **all** questions in the spaces provided.

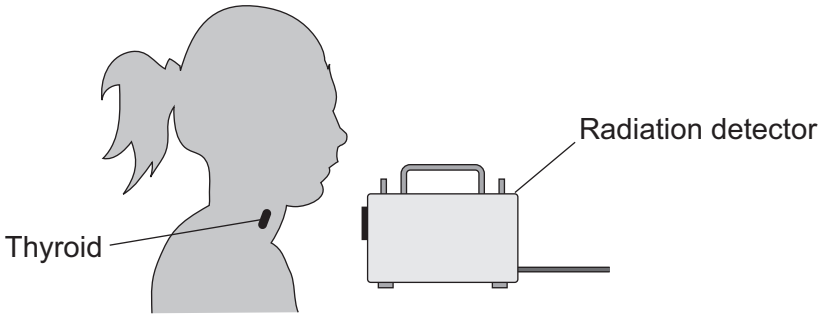
1 (a) The names of three types of radiation are given in **List A**. Some properties of these three types of radiation are given in **List B.**

Draw **one** line from each type of radiation in **List A** to its correct property in **List B**.

List A **Type of radiation**	**List B** **Property of radiation**
	will pass through paper but is stopped by thin metal
alpha	
	has the shortest range in air
beta	
	will not harm human cells
gamma	
	is very weakly ionising

(3 marks)

1 (b) The radioactive isotope iodine-123 can be used by a doctor to examine the thyroid gland of a patient. The iodine, taken as a tablet, is absorbed by the thyroid gland. The gamma radiation emitted as the iodine atoms decay is detected outside the body.



The doctor uses an isotope emitting gamma radiation to examine the thyroid gland rather than an isotope emitting alpha or beta radiation.

Which **one** of the following gives a reason why gamma radiation is used?

Tick (✓) **one** box.

Gamma radiation will pass through the body. ☐

Gamma radiation is not deflected by a magnet. ☐

Gamma radiation has a long range in air. ☐

(1 mark)

Do not write outside the box

1 (c) Iodine-123 has a half-life of 13 hours.

Use a word from the box to complete the sentence.

all	half	most

After 13 hours ..... of the iodine-123 atoms the thyroid absorbed have decayed.

(1 mark)

1 (d) Iodine-123 and iodine-131 are two of the isotopes of iodine.

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

The nucleus of an iodine-123 atom has the same number of | electrons | neutrons | protons | as the

nucleus of an iodine-131 atom.

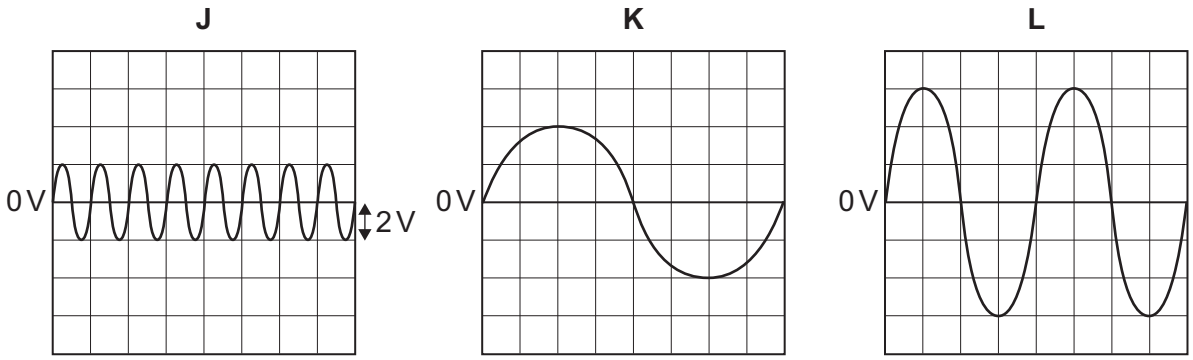
(1 mark)

6

Turn over for the next question

Do not write outside the box

2 The diagrams show oscilloscope traces. Three different alternating current (a.c.) electricity supplies, **J**, **K** and **L**, produce these traces.



In each diagram, one vertical division on the oscilloscope screen represents 2 volts.

2 (a) Which **one** of the electricity supplies, **J**, **K** or **L**, has the largest peak potential difference?

Write your answer, **J**, **K** or **L**, in the box. ☐

(1 mark)

2 (b) Calculate the value of the largest peak potential difference.

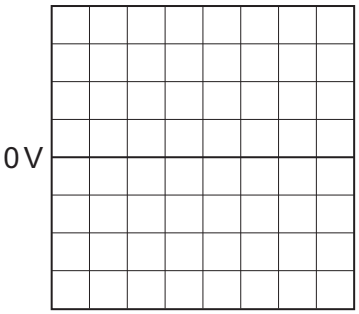
.....

Largest peak potential difference = ... V

(1 mark)

2 (c) The oscilloscope is now connected across a 3 V battery. The battery supplies direct current (d.c.). The settings on the oscilloscope are **not** changed.

On the diagram below draw the trace you would see on the oscilloscope screen.

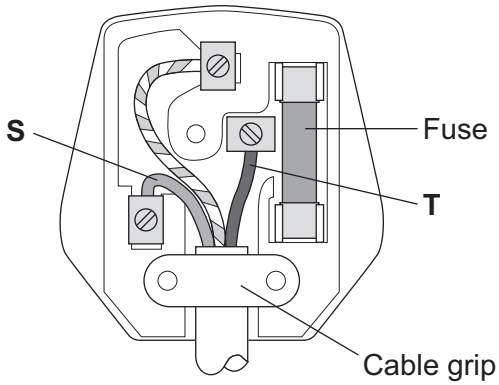


(2 marks)

4

Do not write outside the box

3 (a) The diagram shows the inside of a three-pin plug.



3 (a) (i) What name is given to the wire labelled **S**?

Draw a ring around the correct answer.

earth **live** **neutral**

(1 mark)

3 (a) (ii) What is the colour of the insulation around the wire labelled **T**?

Draw a ring around the correct answer.

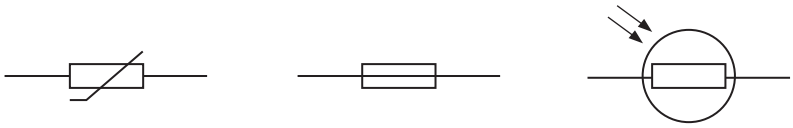
blue **brown** **green and yellow**

(1 mark)

3 (b) The plug contains a 13 amp fuse.

3 (b) (i) Which **one** of the following is the correct circuit symbol for a fuse?

Draw a ring around the correct answer.

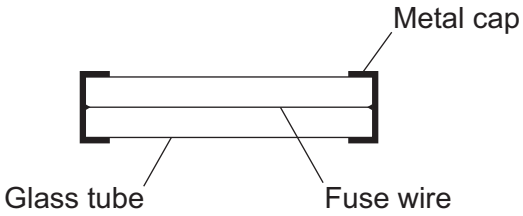


(1 mark)

Question 3 continues on the next page

Do not write outside the box

3 (b) (ii) The diagram shows the parts of the fuse.



What would happen if a current of 20 amps passed through the 13 amp fuse?

.....

.....

(1 mark)

3 (c) Not all electrical appliances are earthed.

3 (c) (i) Which **one** of the following appliances must be earthed?

Tick (✓) **one** box.

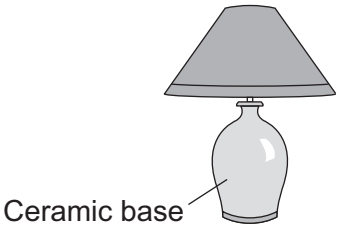
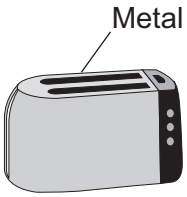
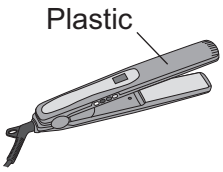


Table lamp ☐



Toaster ☐



Hair straighteners ☐

Give a reason for your answer.

.....

.....

(2 marks)

3 (c) (ii) Earthing an appliance helps to protect a person against a possible risk.

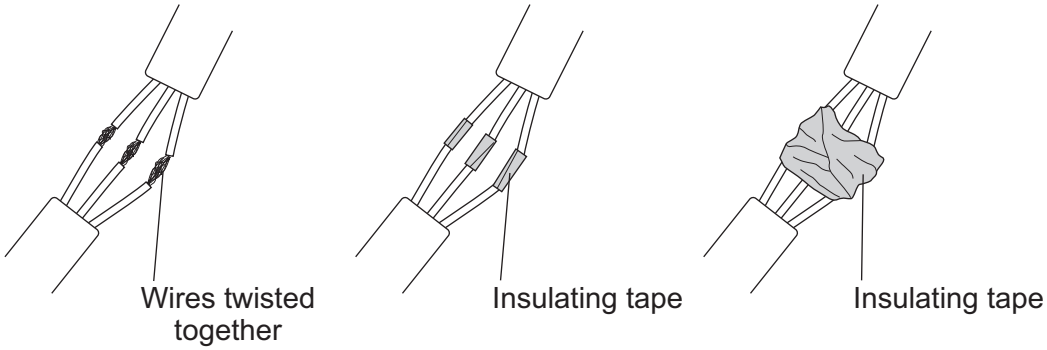
What is the risk?

.....

(1 mark)

Do not write outside the box

3 (d) The diagrams show how two lengths of mains electrical cable were joined. The individual wires have been twisted together and covered with insulating tape. This is not a safe way to join the cables.



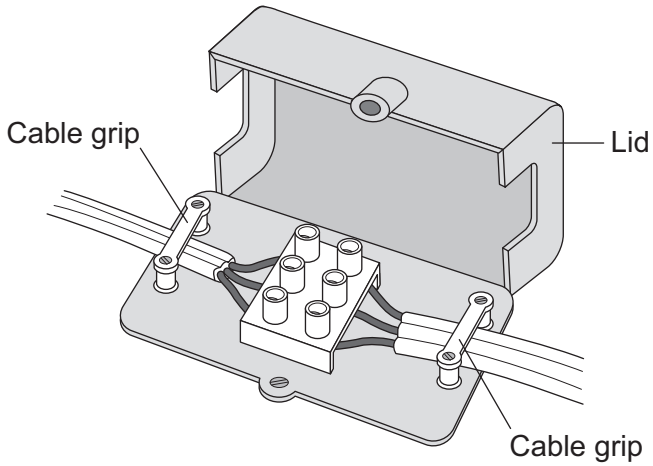
What is the possible risk from joining the two lengths of mains electrical cable in this way?

.....

.....

(1 mark)

3 (e) The diagram below shows a connecting box being used to join two lengths of electrical cable. This is a safe way to join the cables.



The cable grips are important parts of the connecting box.

Explain why.

.....

.....

.....

.....

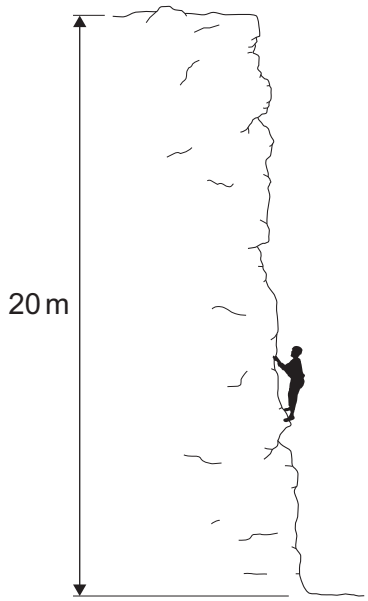
(2 marks)

10

Turn over ▶

Do not write outside the box

4 The diagram shows a climber part way up a cliff.



4 (a) Complete the sentence.

When the climber moves up the cliff, the climber

gains gravitational ..... energy.

(1 mark)

4 (b) The climber weighs 660 N.

4 (b) (i) Calculate the work the climber must do against gravity, to climb to the top of the cliff.

Use the correct equation from the Physics Equations Sheet.

.....

.....

Work done = ... J

(2 marks)

4 (b) (ii) It takes the climber 800 seconds to climb to the top of the cliff. During this time the energy transferred to the climber equals the work done by the climber.

Calculate the power of the climber during the climb.

Use the correct equation from the Physics Equations Sheet.

.....

.....

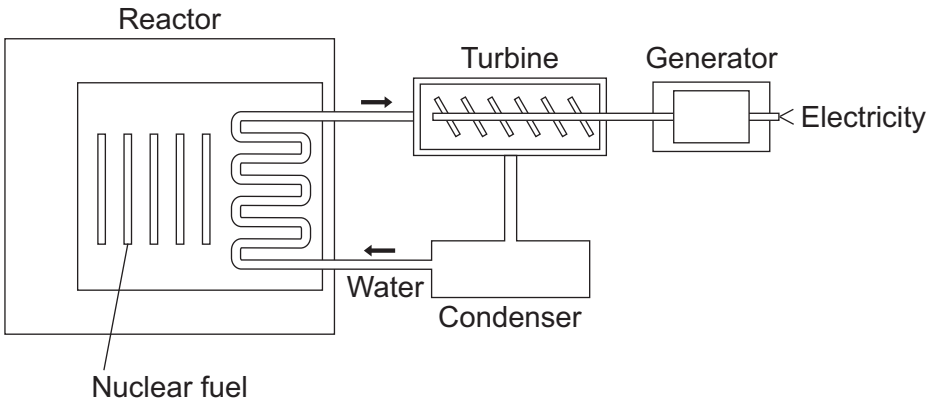
Power = ... W

(2 marks)

5

Do not write outside the box

5 Nuclear power stations use the energy released from nuclear fuels to generate electricity.



5 (a) Which substance do the majority of nuclear reactors use as fuel?

Draw a ring around your answer.

plutonium-239 **thorium-232** **uranium-235**

(1 mark)

5 (b) Energy is released from nuclear fuels by the process of nuclear fission.

Describe what happens to the nucleus of an atom during nuclear fission.

.....

.....

.....

.....

(2 marks)

5 (c) Use words from the box to complete each sentence.

condenser	**gas**	**generator**	**reactor**	**steam**	**turbine**

The energy released from the nuclear fuel is used to heat water. The water turns into

..... and this is used to drive a ..... .

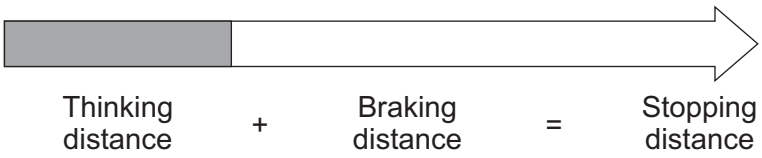
This turns a ..... to produce electricity.

(3 marks)

6

Do not write outside the box

6 The diagram shows how the thinking distance and braking distance of a car add together to give the stopping distance of the car.



6 (a) Use words from the box to complete the sentence.

distance	**energy**	**force**	**time**

The stopping distance is found by adding the distance the car travels during the driver's reaction ..... and the distance the car travels under the braking ..... . *(2 marks)*

6 (b) Which **one** of the following would **not** increase the thinking distance?

Tick (✓) **one** box.

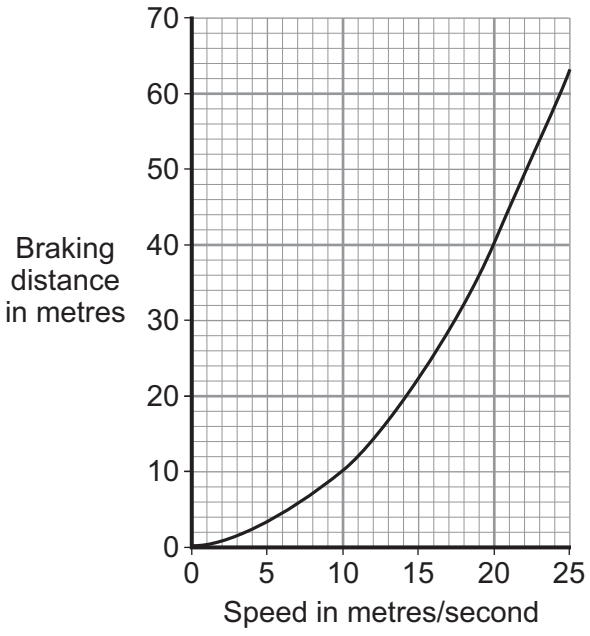
The car driver being tired. ☐

The car tyres being badly worn. ☐

The car being driven faster. ☐

(1 mark)

6 (c) The graph shows how the braking distance of a car changes with the speed of the car. The force applied to the car brakes does not change.



Do not write outside the box

6 (c) (i) What conclusion about braking distance can be made from the graph?

.....

.....

.....

.....

(2 marks)

6 (c) (ii) The graph is for a car driven on a dry road.

Draw a line on the graph to show what is likely to happen to the braking distance at different speeds if the same car was driven on an icy road.

(1 mark)

6 (d) A local council has reduced the speed limit from 30 miles per hour to 20 miles per hour on a few roads. The reason for reducing the speed limit was to reduce the number of accidents.

6 (d) (i) A local newspaper reported that a councillor said:

"It will be much safer because drivers can react much faster when driving at 20 miles per hour than when driving at 30 miles per hour."

This statement is wrong. Why?

.....

.....

(1 mark)

6 (d) (ii) The local council must decide whether to introduce the lower speed limit on a lot more roads.

What evidence should the local council collect to help make this decision?

.....

.....

.....

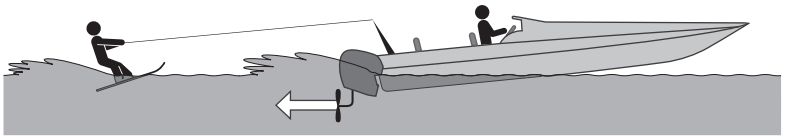
.....

(2 marks)

9

Do not write outside the box

7 The diagram shows a boat pulling a water skier.



7 (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)

7 (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.

7 (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

7 (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)

7 (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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.....

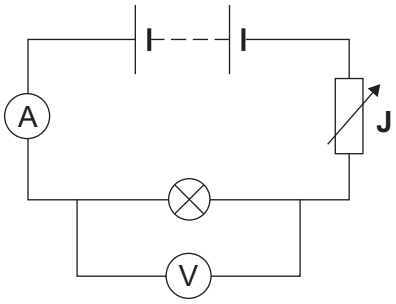
(2 marks)

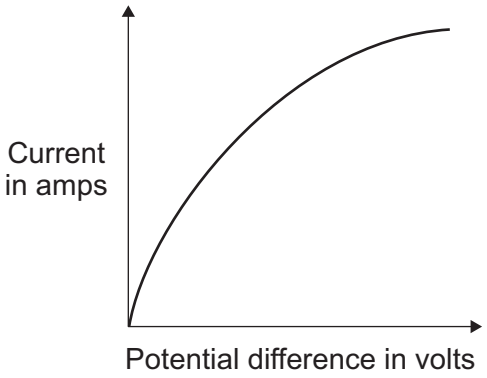
9

Turn over for the next question

Do not write outside the box

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





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

.....

.....

(1 mark)

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

.....

.....

(1 mark)

8 (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.

.....

.....

.....

Power = ...

(3 marks)

Do not write outside the box

8 (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

END OF QUESTIONS

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Version 1.0



General Certificate of Secondary Education
June 2013

Additional Science / Physics PH2FP

(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.

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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 / ; 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.

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Quality of Written Communication and levels marking

In Question 8(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

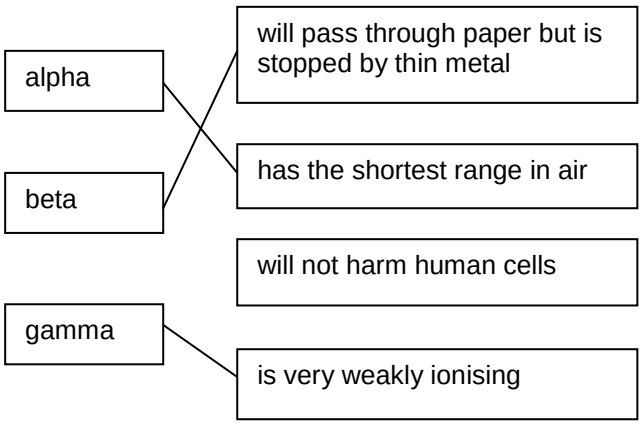
- Knowledge of accurate information
- Clear understanding
- The answer has some structure and organisation, use of specialist terms has been attempted but not always accurately, some detail is given
- There is reasonable accuracy in spelling, punctuation and grammar, although there may still be some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

PH2FP

Question 1

question	answers	extra information	mark
1(a)	3 lines correct  	allow **1** mark for each correct line if more than one line is drawn from any type of radiation box then all of those lines are wrong	3
1(b)	Gamma radiation will pass through the body		1
1(c)	half		1
1(d)	protons		1
Total			**6**

PH2FP

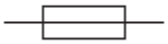
Question 2

question	answers	extra information	mark
2(a)	L		1
2(b)	6 (V)		1
2(c)	horizontal line drawn drawn in correct position	 judge by eye	1 1
Total			**4**

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Question 3

question	answers	extra information	mark
3(a)(i)	neutral		1
3(a)(ii)	brown		1
3(b)(i)	centre symbol ringed 	accept any correct indication	1
3(b)(ii)	fuse (wire) melts	accept fuse blows accept fuse breaks / snaps accept burns out appliance doesn't work is insufficient overheat is insufficient do **not** accept blows up	1
3(c)(i)	Toaster (only one with) a metal case / outside	 reason only scores if toaster chosen accept it is metal accept outside / case / metal conducts (electricity) do **not** accept it conducts electricity	1 1
3(c)(ii)	electric shock / electrocution	do **not** accept explosion	1

Question 3 continues on the next page . . .

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PH2FP

Question 3 continued . . .

question	answers	extra information	mark
3(d)	overheating of cables **or** fire	it refers to the electric cable accept short circuit / sparking overheating of tape is insufficient do **not** accept electrocution / shock	1
3(e)	stop cable(s) being pulled loose / free and so breaking the circuit **or** and shorting (one wire to another) **or** and causing a fire risk / sparking	accept wire(s) for cable(s) accept to hold cables in place accept appliance / plug would not work	1 1
Total			**10**

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Question 4

question	answers	extra information	mark
4(a)	potential		1
4(b)(i)	13 200	allow **1** mark for correct substitution, ie 660 × 20 provided no subsequent step shown	2
4(b)(ii)	16.5 **or** $\frac{\text{their (b)(i)}}{800}$ correctly calculated	allow **1** mark for correct substitution, ie $\frac{13\,200}{800}$ **or** $\frac{\text{their (b)(i)}}{800}$ provided no subsequent step shown	2
Total			**5**

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Question 5

question	answers	extra information	mark
5(a)	uranium-235	accept any correct indication	1
5(b)	splits / breaks (into two smaller parts) and (two / three) neutrons	nucleus is separated is insufficient do **not** accept atom splits – on its own	1 1
5(c)	steam turbine generator	correct order only	1 1 1
Total			**6**

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Question 6

question	answers	extra information	mark
6(a)	time force	correct order only	1 1
6(b)	The car tyres being badly worn		1
6(c)(i)	braking distance increases with speed relevant further details, eg • but not in direct proportion • and increases more rapidly after 15 m/s • double the speed, braking distance increases × 4	accept positive correlation do **not** accept stopping distance for braking distance accept any speed between 10 and 20 accept numerical example	1 1
6(c)(ii)	line drawn above existing line starting at the origin	as speed increases braking distance must increase each speed must have a single braking distance	1
6(d)(i)	reaction time / reaction (of driver) does not depend on speed (of car)		1

Question 6 continues on the next page . . .

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Question 6 continued . . .

question	answers	extra information	mark
6(d)(ii)	(on the reduced speed limit roads) over the same period of time monitor number of accidents before and after (speed limit reduced)	accept a specific time, eg 1 year allow **1** mark only for record number of vehicles / cars using the (20 mph) roads **or** collect data on accidents on the (20 mph) roads to score both marks the answer must refer to the roads with the reduced speed limit	1 1
Total			**9**

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Question 7

question	answers	extra information	mark
7(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
7(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
7(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
7(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 8

question	answers	extra information	mark
8(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
8(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
8(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 8 continues on the next page . . .

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Question 8 continued . . .

question	answers	extra information	mark
8(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**

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

STEMUP.CO.UK

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	
8	
9	
TOTAL	

General Certificate of Secondary Education
Foundation Tier
January 2013

Additional Science PH2FP

Unit Physics P2

F

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 9 (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.

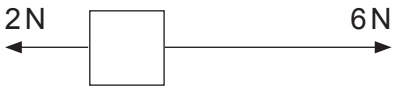
Advice
- In all calculations, show clearly how you work out your answer.

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Do not write outside the box

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

1 (a) The diagram shows two forces acting on an object.



What is the resultant force acting on the object?

Tick (✓) **one** box.

8 N to the right ☐

8 N to the left ☐

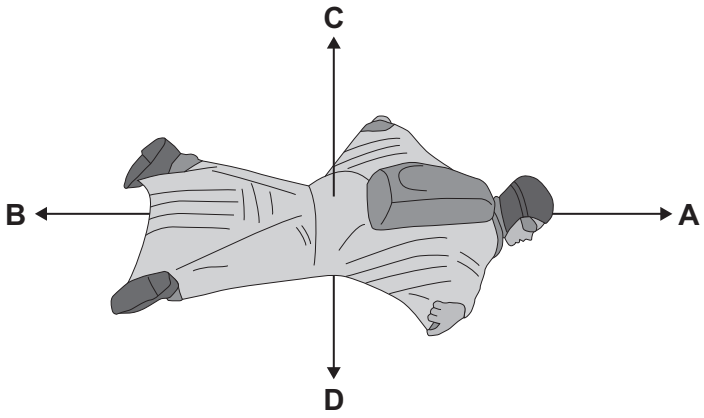
4 N to the right ☐

4 N to the left ☐

(1 mark)

1 (b) BASE jumpers jump from very high buildings and mountains for sport.

The diagram shows the forces acting on a BASE jumper in flight.
The BASE jumper is wearing a wingsuit.



Do not write outside the box

1 (b) (i) Draw a ring around the correct answer in the box to complete each sentence.

The BASE jumper accelerates forwards when force **A** is

smaller than
equal to
bigger than

force **B**.

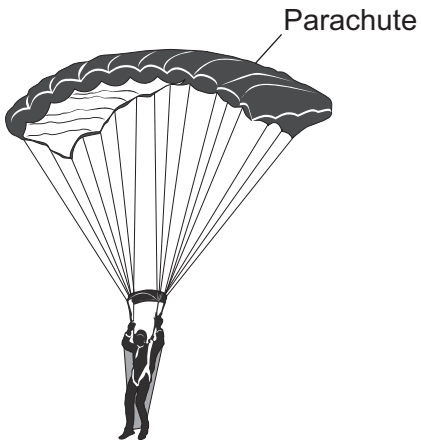
The BASE jumper falls with a constant speed when force **C** is

smaller than
equal to
bigger than

force **D**.

(2 marks)

1 (b) (ii) To land safely the BASE jumper opens a parachute.



What effect does opening the parachute have on the speed of the falling BASE jumper?

.....

Give a reason for your answer.

.....

.....

(2 marks)

5

Turn over ▶

Do not write outside the box

2 (a) Sources of background radiation are either natural or man-made.

Which **two** of the sources listed in the box are *natural* sources of background radiation?

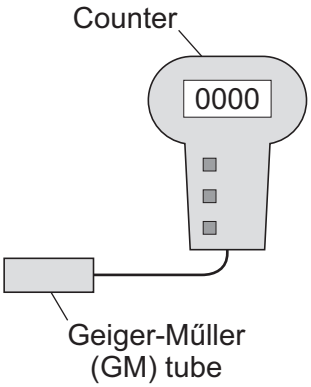
Draw a ring around each of your answers.

cosmic rays	**nuclear accidents**	**X-rays**	**radon gas**

(2 marks)

2 (b) 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 this two more times.

The three readings taken by the teacher are given in the table.



Count
17
21
19

2 (b) (i) The three readings are different.

What is the most likely reason for this?

Tick (✓) **one** box.

The teacher did not reset the counter to zero. ☐

Radioactive decay is a random process. ☐

The temperature in the laboratory changed. ☐

(1 mark)

2 (b) (ii) Calculate the mean (average) value of the three readings given in the table.

.....

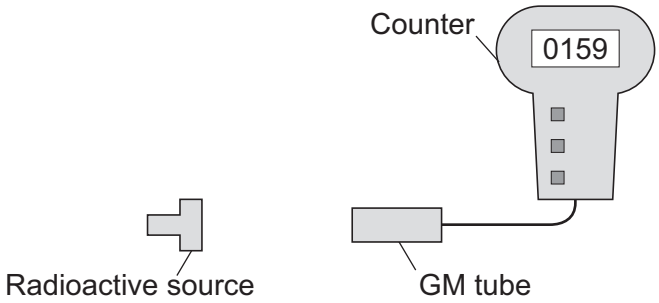
Mean (average) value = ... counts

(1 mark)

Do not write outside the box

2 (b) (iii) The diagram shows how the teacher used the GM tube and counter to measure the radiation emitted from a radioactive source.

The counter was reset to zero. The count after one minute was 159.



Calculate how many counts were due to the radiation from the radioactive source.

.....

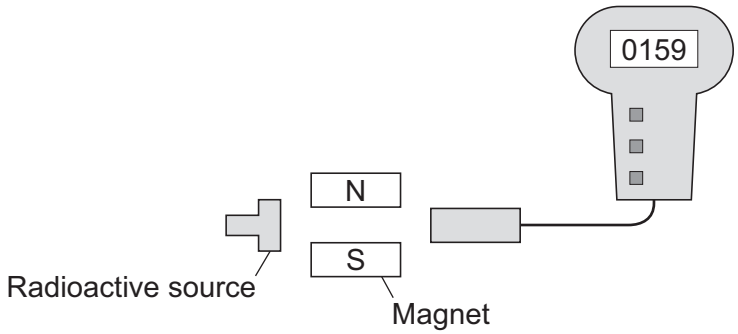
.....

Counts due to the radiation from the radioactive source = ...

(1 mark)

2 (b) (iv) The teacher then put a powerful magnet between the radioactive source and the GM tube.

The counter was reset to zero. The number on the counter shows the count after one minute.



What type of radiation was being emitted from the radioactive source?

Draw a ring around your answer.

alpha **beta** **gamma**

Explain the reason for your answer.

.....

.....

.....

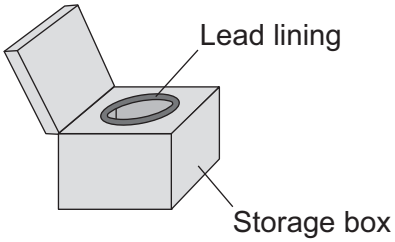
.....

(3 marks)

Turn over ▶

Do not write outside the box

2 (c) At the end of the lesson the teacher put the radioactive source back inside its storage box.



Why is the inside of the box lined with lead?

.....

.....

(1 mark)

2 (d) Which **one** of the following questions **cannot** be answered by scientific study?

Tick (✓) **one** box.

Where does background radiation come from? ☐

What is meant by the half-life of a radioactive source? ☐

Should radioactive waste be dumped in the oceans? ☐

(1 mark)

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

3 (a) Electrical circuits often contain resistors.
The diagram shows **two** resistors joined in series.

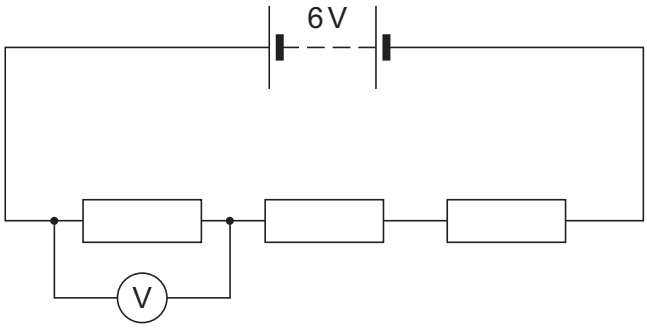


Calculate the total resistance of the **two** resistors.

.....

Total resistance = ... Ω
(1 mark)

3 (b) A circuit was set up as shown in the diagram. The three resistors are identical.



3 (b) (i) Calculate the reading on the voltmeter.

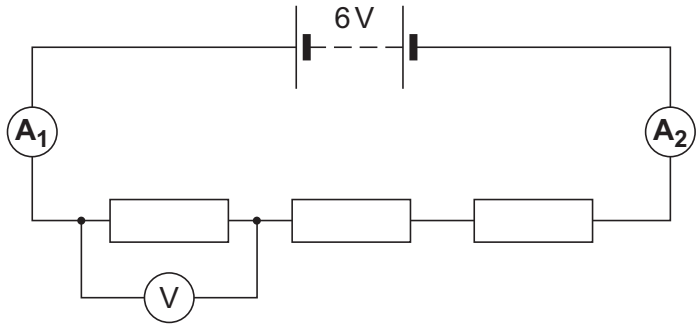
.....

.....

Reading on voltmeter = ... V
(2 marks)

Do not write outside the box

3 (b) (ii) The same circuit has now been set up with two ammeters.



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

The reading on ammeter $\mathbf{A_2}$ will be

smaller than
equal to
greater than

the reading on ammeter $\mathbf{A_1}$.

(1 mark)

4

Turn over for the next question

Do not write outside the box

4 (a) The diagram shows the information plate on an electric kettle. The kettle is plugged into the a.c. mains electricity supply.

230 V	**2760 W**
50 Hz	

Use the information from the plate to answer the following questions.

4 (a) (i) What is the frequency of the a.c. mains electricity supply?

.....

(1 mark)

4 (a) (ii) What is the power of the electric kettle?

.....

(1 mark)

4 (b) To boil the water in the kettle, 2400 coulombs of charge pass through the heating element in 200 seconds.

Calculate the current flowing through the heating element and give the unit.

Use the correct equation from the Physics Equations Sheet.

Choose the unit from the list below.

amps **volts** **watts**

.....

.....

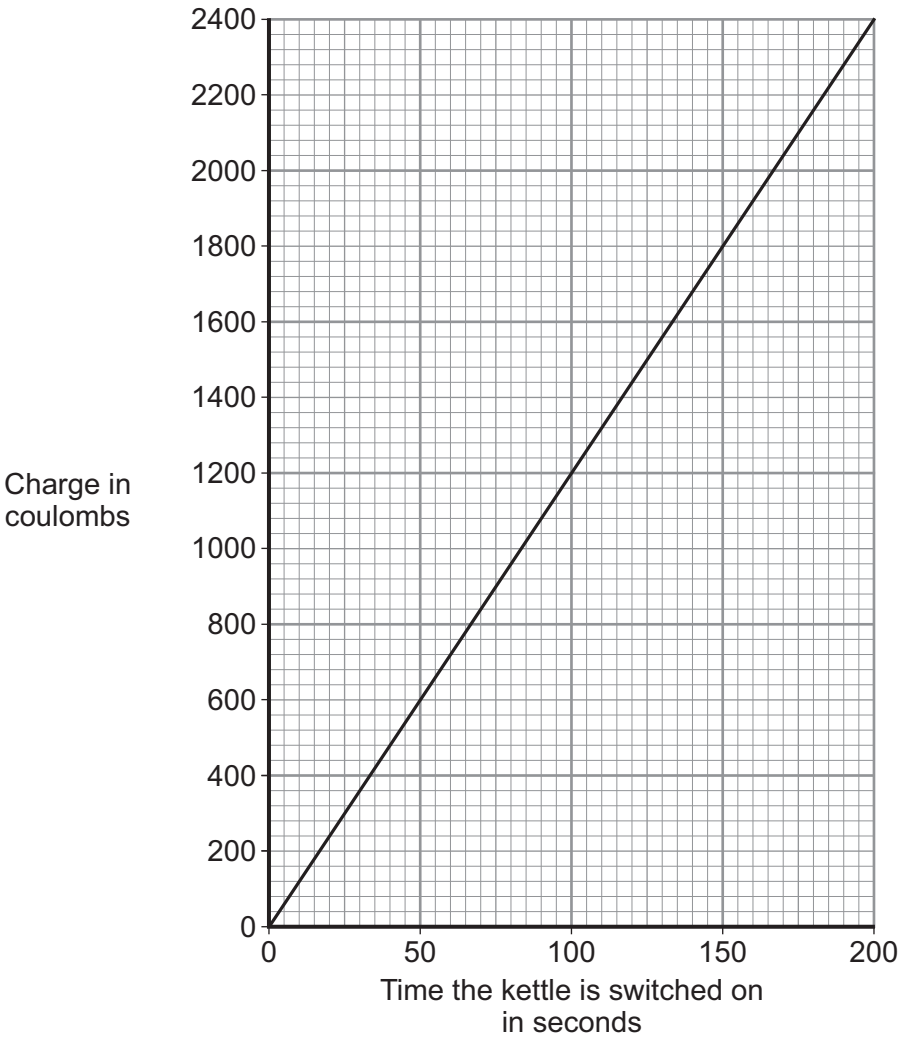
.....

Current = ...

(3 marks)

Do not write outside the box

4 (c) The amount of charge passing through the heating element of an electric kettle depends on the time the kettle is switched on.



What pattern links the amount of charge passing through the heating element and the time the kettle is switched on?

.....

.....

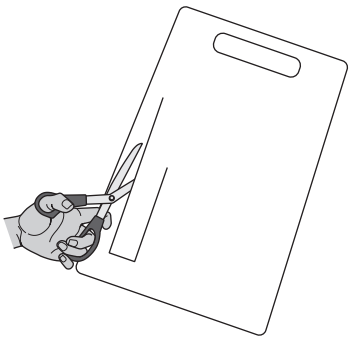
(2 marks)

7

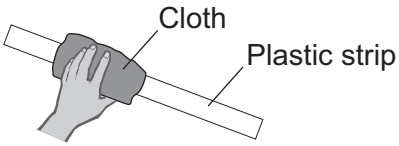
Turn over ▶

Do not write outside the box

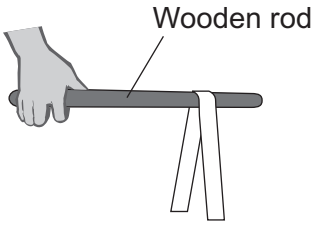
5 (a) A student uses some everyday items to investigate static electricity.



1 A strip of plastic is cut from a plastic carrier bag



2 The plastic strip is rubbed with a cloth



3 The plastic strip is hung over a wooden rod

5 (a) (i) Draw a ring around the correct answer in the box to complete each sentence.

Rubbing the plastic strip with a cloth causes the strip to become negatively charged.

This happens because

electrons
neutrons
protons

move from the cloth onto the plastic strip.

The cloth is left with

a negative
a positive
zero

charge.

(2 marks)

5 (a) (ii) When the plastic strip is hung over the wooden rod, the two halves of the strip move equally away from each other.

What **two** conclusions should the student make about the forces acting on the two halves of the plastic strip?

1 .....

.....

2 .....

.....

(2 marks)

Do not write outside the box

5 (b) Electrical charges move more easily through some materials than through other materials.

Through which **one** of the following materials would an electrical charge move most easily?

Draw a ring around your answer.

aluminium **glass** **rubber**

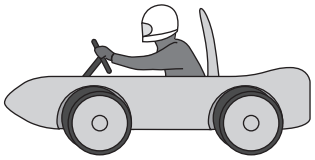
(1 mark)

5

Turn over for the next question

Do not write outside the box

6 Some students designed and built an electric-powered go-kart.
The go-kart is shown below.



6 (a) Suggest **two** changes that could be made to the design of the go-kart to increase its top speed.

1 .....

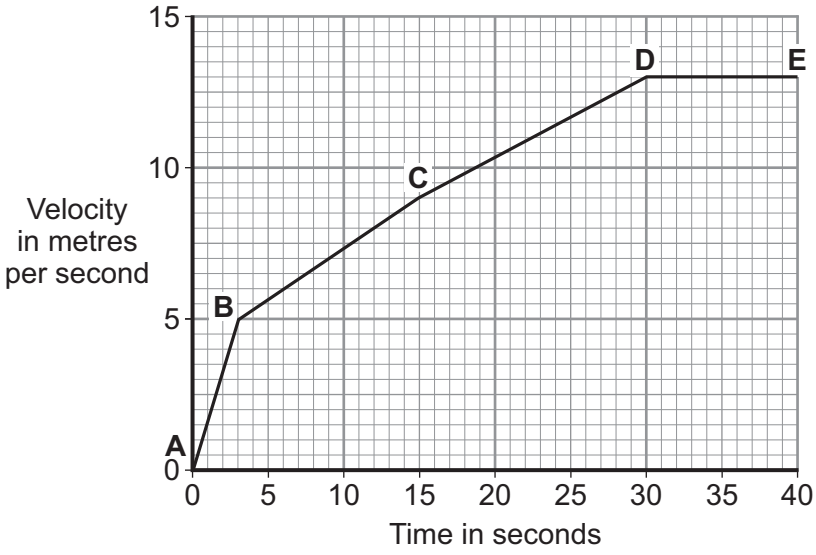
.....

2 .....

.....

(2 marks)

6 (b) A go-kart with a new design is entered into a race.
The velocity-time graph for the go-kart, during the first 40 seconds of the race, is shown below.



Do not write outside the box

6 (b) (i) Between which **two** points did the go-kart have the greatest acceleration?

Tick (✓) **one** box.

A–B ☐

B–C ☐

C–D ☐

Give a reason for your answer.

.....

.....

(2 marks)

6 (b) (ii) The go-kart travels at a speed of 13 m/s between points **D** and **E**.
The total mass of the go-kart and driver is 140 kg.

Calculate the momentum of the go-kart and driver between points **D** and **E**.

Use the correct equation from the Physics Equations Sheet.

.....

.....

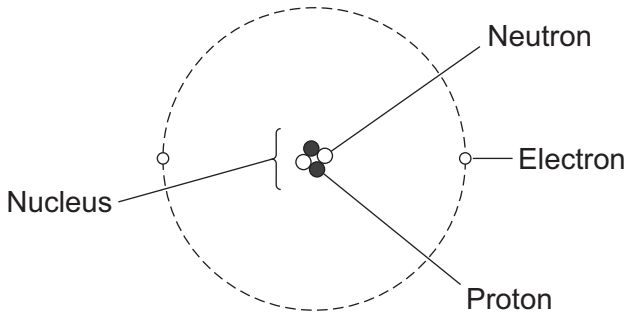
Momentum = ... kg m/s
(2 marks)

6

Turn over for the next question

Do not write outside the box

7 The diagram shows the structure of an atom.



Not drawn to scale

7 (a) In 1931 scientists thought that atoms contained **only** protons and electrons.

Suggest what happened in 1932 to change the idea that atoms contained only protons and electrons.

.....

.....

(1 mark)

7 (b) The table gives information about the particles in an atom.

Complete the table by adding the names of the particles.

Particle	Relative Mass	Relative Charge
	1	0
	very small	–1
	1	+1

(2 marks)

3

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

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

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

.....

(1 mark)

8 (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)

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

8 (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

8 (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

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

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

Why?

.....

.....

(1 mark)

9 (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

9 (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)

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

Suggest why.

.....

.....

(1 mark)

Do not write outside the box

9 (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)

Question 9 continues on the next page

Do not write outside the box

9 (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

END OF QUESTIONS

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DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

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

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Version 1.0



General Certificate of Secondary Education
January 2013

Additional Science / Physics (Specification 4408 / 4403) PH2FP

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 not 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 9(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.

PH2FP

Question 1

question	answers	extra information	mark
1(a)	4 N to the right		1
1(b)(i)	bigger than equal to		1 1
1(b)(ii)	reduces it increases air resistance / drag / force C	 accept parachute has large(r) (surface) area	1 1
Total			**5**

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PH2FP

Question 2

question	answers	extra information	mark
2(a)	cosmic rays radon gas		1 1
2(b)(i)	Radioactive decay is a random process		1
2(b)(ii)	19		1
2(b)(iii)	140	accept 159 – their (b)(i) correctly calculated	1
2(b)(iv)	gamma the count stayed the same **or** gamma does not have a charge (so) gamma is not deflected / affected by the magnetic field	 accept gamma is an electromagnetic wave accept magnet for magnetic field do **not** accept is not attracted to the magnet last two marks may be scored for an answer in terms of why it cannot be alpha or beta only answer simply in terms of general properties of gamma are insufficient	1 1 1

Question 2 continues on the next page . . .

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PH2FP

Question 2 continued . . .

question	answers	extra information	mark
2(c)	lead absorbs (some of the) radiation **or** less radiation emitted into the (storage) room	accept radiation cannot pass through (the lead)	1
2(d)	Should radioactive waste be dumped in the oceans		1
Total			**10**

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PH2FP

Question 3

question	answers	extra information	mark
3(a)	25(Ω)		1
3(b)(i)	2(V)	allow **1** mark for showing a correct method, ie 6/3	2
3(b)(ii)	equal to		1
Total			**4**

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PH2FP

Question 4

question	answers	extra information	mark
4(a)(i)	50 (Hz)		1
4(a)(ii)	2760 (W)		1
4(b)	12 amps	allow **1** mark for correct substitution, ie 2400/200 **or** allow **1** mark for 2760/230 provided no subsequent step shown	2 1
4(c)	the charge is <u>directly</u> proportional to the time switched on for	accept for **1** mark the longer time (to boil), the greater amount of charge **or** positive correlation **or** they are proportional	2
Total			**7**

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PH2FP

Question 5

question	answers	extra information	mark
5(a)(i)	electrons a positive		1 1
5(a)(ii)	(forces are) equal (forces act in) opposite directions	accept (forces are)the same forces are balanced is insufficient accept (forces) repel both sides have the same charge is insufficient	1 1
5(b)	aluminium		1
Total			**5**

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PH2FP

Question 6

question	answers	extra information	mark
6(a)	any **two** from: • (make shape / body) more streamlined • increase power of engine • reduce mass / weight (of go-kart)	accept a correct description accept lower the seating position of the driver faster engine is insufficient change wheel size is insufficient	2
6(b)(i)	A–B steepest / steeper gradient / slope	reason only scores if A–B is chosen	1 1
6(b)(ii)	1820	allow **1** mark for correct substitution, ie 140 × 13 provided no subsequent step shown	2
Total			**6**

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PH2FP

Question 7

question	answers	extra information	mark
7(a)	neutron discovered		1
7(b)	neutron electron proton	all 3 in correct order allow **1** mark for 1 correct	2
Total			**3**

PH2FP

Question 8

question	answers	extra information	mark
8(a)	gravitational / gravity / weight	do **not** accept gravitational potential	1
8(b)	accelerating	accept speed / velocity increases	1
	the distance between the drops increases		1
	but the time between the drops is the same	accept the time between drops is (always) 5 seconds accept the drops fall at the same rate	1
8(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 8 continues on the next page . . .

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PH2FP

Question 8 continued . . .

question	answers	extra information	mark
8(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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PH2FP

Question 9

question	answers	extra information	mark
9(a)	forces (within the star) are balanced	if specific forces are mentioned they must be appropriate	1
9(b)(i)	bigger the mass (of the star) the shorter the 'main sequence' period	accept bigger the star the shorter the time	1
9(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
9(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 9 continues on the next page . . .

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question	answers	extra information	mark
9(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 • (outer layers) explode	accept super red giant do **not** accept red giant • 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**

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	
7	
8	
TOTAL	

General Certificate of Secondary Education
Foundation Tier
June 2012

Additional Science PH2FP

Unit Physics P2

F

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 8 (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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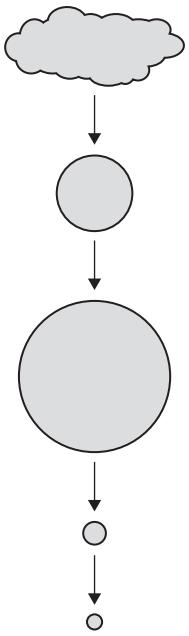
Do not write outside the box

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

1 (a) The diagram shows the lifecycle of a star.

1 (a) (i) Use words or phrases from the box to complete the sentences contained in the diagram.

black dwarf	**black hole**	**protostar**	**red giant**



Gas and dust are pulled together to form a

..... .

The star gives out energy as a main sequence star.

The star expands forming a ..... .

The star shrinks to form a white dwarf.

The star fades away as a ..... .

(3 marks)

Do not write outside the box

1 (a) (ii) The table compares the approximate size of three stars with the size of the Sun.

Star	Size
Alpha Centauri A	the same as the Sun
Betelgeuse	1120 times bigger than the Sun
Cephei	1520 times bigger than the Sun

Which **one** of these three stars has the lifecycle shown in part **(a)(i)**?

.....

Give a reason for your answer.

.....

.....

(2 marks)

1 (b) Which **one** of the following describes the process by which energy is given out in stars?

Tick (✓) **one** box.

Atomic nuclei inside the star join together. ☐

Atomic nuclei inside the star split apart. ☐

Gases inside the star burn. ☐

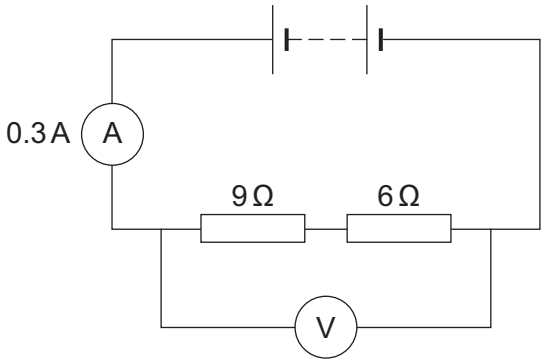
(1 mark)

6

Turn over for the next question

Do not write outside the box

2 (a) The diagram shows a simple circuit.



2 (a) (i) Calculate the total resistance of the two resistors in the circuit.

.....

Total resistance = ... Ω

(1 mark)

2 (a) (ii) Calculate the reading on the voltmeter.

Use the correct equation from the Physics Equations Sheet.

Show clearly how you work out your answer.

.....

.....

Voltmeter reading = ... V

(2 marks)

2 (a) (iii) Draw a ring around the correct answer in the box to complete the sentence.

Replacing one of the resistors with a resistor of higher value will

decrease
not change
increase

the reading on the ammeter.

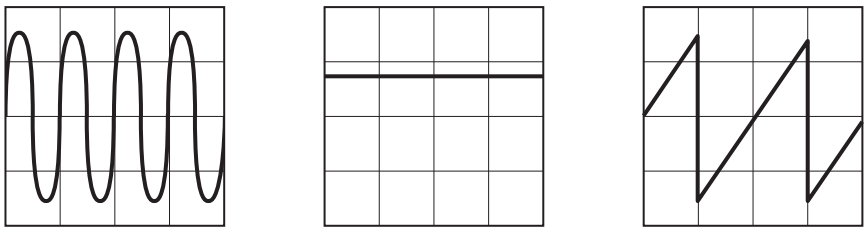
(1 mark)

Do not write outside the box

2 (b) The voltmeter in the circuit is replaced with an oscilloscope.

Which one of the diagrams, **X**, **Y** or **Z**, shows the trace that would be seen on the oscilloscope?

Write your answer, **X**, **Y** or **Z**, in the box.



X **Y** **Z**

Diagram ☐

Give a reason for your answer.

.....

.....

.....

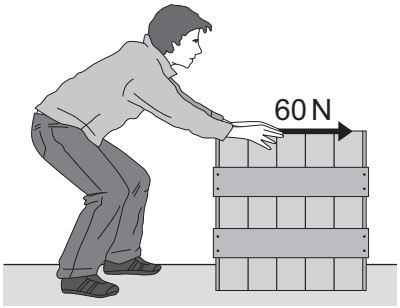
(2 marks)

6

Turn over for the next question

Do not write outside the box

3 The diagram shows a worker using a constant force of 60 N to push a crate across the floor.



3 (a) The crate moves at a constant speed in a straight line.

3 (a) (i) Draw an arrow on the diagram to show the direction of the friction force acting on the moving crate.

(1 mark)

3 (a) (ii) State the size of the friction force acting on the moving crate.

..... N

Give the reason for your answer.

.....

.....

(2 marks)

3 (b) Calculate the work done by the worker to push the crate 28 metres.

Use the correct equation from the Physics Equations Sheet.

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

Choose the unit from the list below.

joule **newton** **watt**

.....

.....

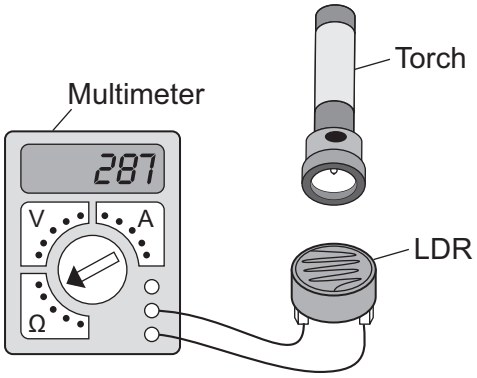
Work done = ...

(3 marks)

6

Do not write outside the box

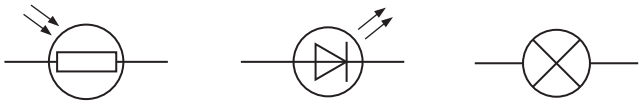
4 A student used the apparatus below to find out how the resistance of a light-dependent resistor (LDR) depends on light intensity.



The resistance of the LDR was measured directly using a multimeter.

4 (a) (i) Which **one** of the following is the correct circuit symbol for a LDR?

Draw a ring around your answer.



(1 mark)

4 (a) (ii) Name **one** factor that will affect the intensity of the light hitting the LDR.

.....

.....

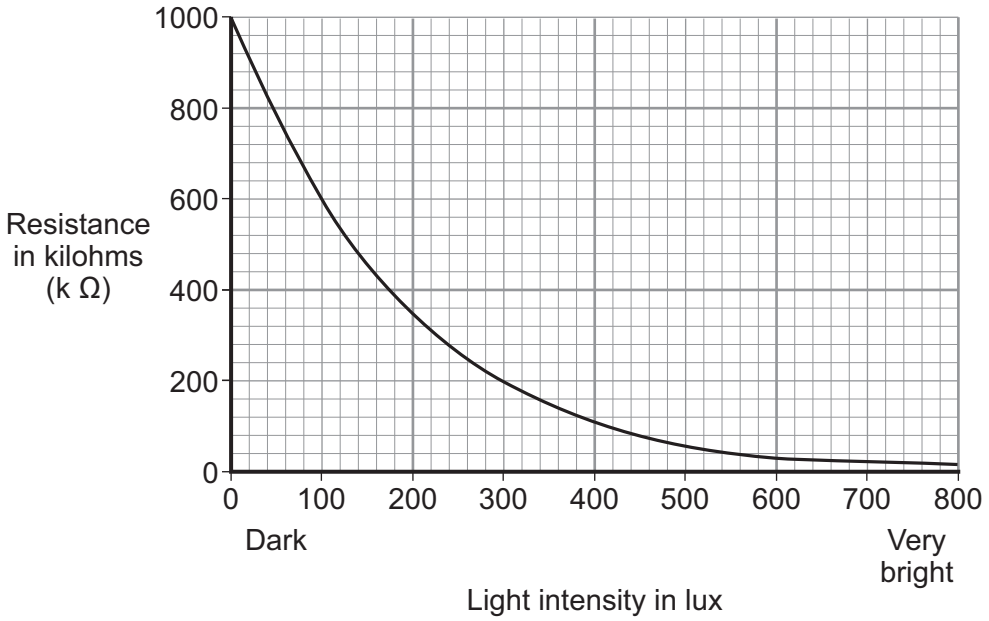
(1 mark)

Question 4 continues on the next page

Turn over ▶

Do not write outside the box

4 (b) The manufacturer of the LDR provides data for the LDR in the form of a graph.



Describe how the resistance of the LDR changes when the light intensity increases from 100 lux to 300 lux.

.....

.....

.....

(2 marks)

Do not write outside the box

4 (c) The student only obtained three results. These are given in the table.

Light intensity	Resistance in kilohms
Dark	750
Bright	100
Very bright	1

4 (c) (i) The student could **not** use the results to draw a line graph.
Why not?

.....

.....

(1 mark)

4 (c) (ii) Do the student's results agree with the data the manufacturer provided?

Draw a ring around your answer. YES NO

Give a reason for your answer.

.....

.....

.....

(1 mark)

4 (d) Which **one** of the following circuits probably includes a LDR?

Tick (✓) **one** box.

A circuit that automatically switches outside lights on when it gets dark. ☐

A circuit that automatically switches central heating on and off. ☐

A circuit that automatically turns lights off when no one is in the room. ☐

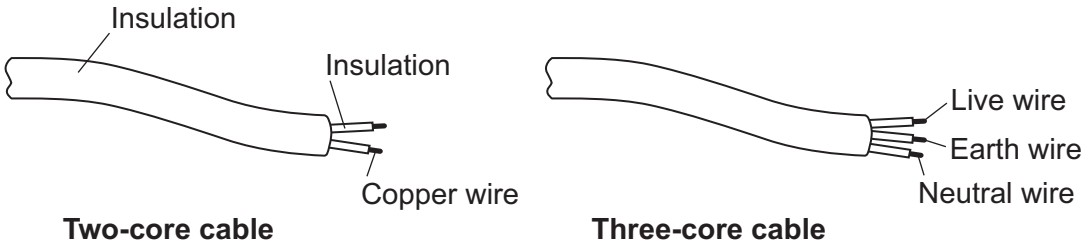
(1 mark)

7

Turn over for the next question

Do not write outside the box

5 (a) The diagram shows a piece of two-core cable and a piece of three-core cable.



Two-core cable **Three-core cable**

5 (a) (i) Which **one** of the wires inside a three-core cable is missing from a two-core cable?

Draw a ring around your answer.

earth wire **live wire** **neutral wire**

(1 mark)

5 (a) (ii) Use a word from the box to complete the following sentence.

double	**extra**	**totally**

A pottery table lamp fitted with a two-core cable is safe to use because it is

..... insulated.

(1 mark)

5 (b) The cables connecting the power sockets in a building contain wires 1.8 mm thick.
The maximum current that can safely pass through these wires is 20 amps.
A fuse is included in the circuit to protect the wiring.

Explain how a fuse protects the wiring of a circuit.

.....

.....

.....

.....

.....

.....

.....

(3 marks)

5

Do not write outside the box

6 The table shows the average background radiation dose from various sources that a person living in the UK receives in one year.

Source of background radiation	Average radiation dose received each year in dose units
Cosmic rays (from space)	300
Food and drink	250
Medical treatments (including X-rays)	350
Radon gas	1250
Rocks	350
TOTAL	2500

6 (a) (i) A student looked at the data in the table and then wrote down four statements.

Only **two** of the statements are true.

Put a tick (✓) in the boxes next to the **two** true statements.

More than half of the average radiation dose comes from radon gas. ☐

On average, cosmic rays produce less background radiation than rocks. ☐

Everyone living in the UK receives the same background radiation dose. ☐

Having no X-rays reduces a person's radiation dose. ☐

(2 marks)

6 (a) (ii) Each time a chest X-ray is taken, the patient receives about 100 units of radiation.

How many chest X-rays would just exceed the yearly average dose for medical treatments?

.....

Number of chest X-rays = ...

(2 marks)

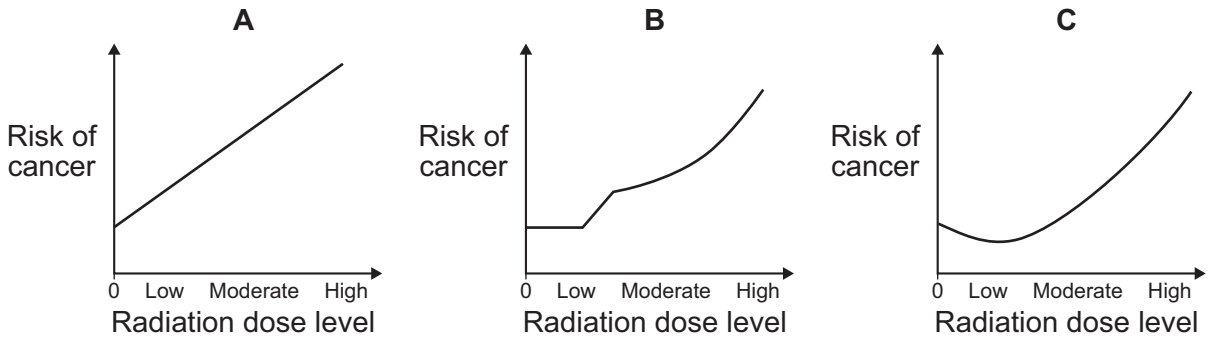
Question 6 continues on the next page

Turn over ▶

Do not write outside the box

6 (b) Exposure to radiation can cause cancer.

The graphs, **A**, **B** and **C**, show three different ways that the exposure to radiation and the risk of getting cancer could be linked.



6 (b) (i) What do all three of these graphs suggest happens to the risk of getting cancer when the radiation dose goes from moderate to high?

.....

.....

(1 mark)

6 (b) (ii) Some scientists believe that exposure to **low** radiation doses reduces the chance that a person will get cancer. This effect is called 'radiation hormesis'.

Which **one** of the graphs, **A**, **B** or **C**, shows 'radiation hormesis'?

Write your answer in the box. ☐

Give a reason for your answer.

.....

.....

.....

(2 marks)

Do not write outside the box

6 (c) Scientists did an experiment in which mice were exposed to different doses of radiation.

The results from the experiment are given in the table.

Description of exposure	Percentage of mice getting cancer
Mice exposed to a low dose of radiation and then a high dose of radiation.	16%
Mice exposed to a high dose of radiation only.	46%

6 (c) (i) Do the results from this experiment provide evidence to support 'radiation hormesis'?

Draw a ring around your answer. NO YES

Explain the reason for your answer.

.....

.....

.....

.....

.....

(2 marks)

6 (c) (ii) Complete the following sentence by drawing a ring around the correct word in the box.

Using animals in scientific experiments raises | environmental / ethical / social | issues.

(1 mark)

10

Turn over for the next question

Do not write outside the box

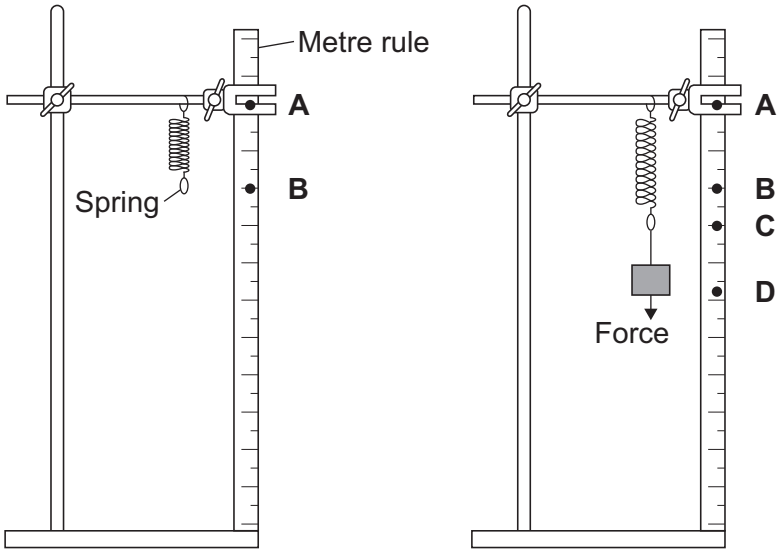
There are no questions printed on this page

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

Do not write outside the box

7 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.



7 (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)

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

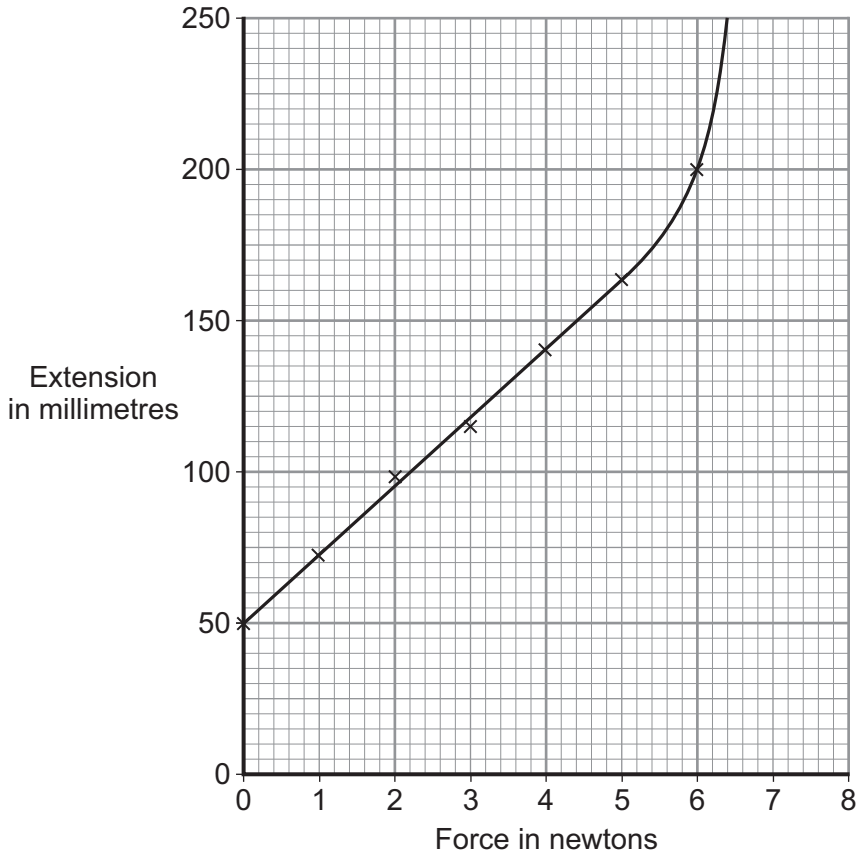
.....

(1 mark)

Question 7 continues on the next page

Do not write outside the box

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



7 (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

7 (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)

7 (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

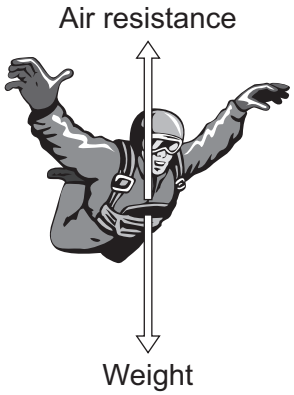
(2 marks)

8

Turn over for the next question

Do not write outside the box

8 (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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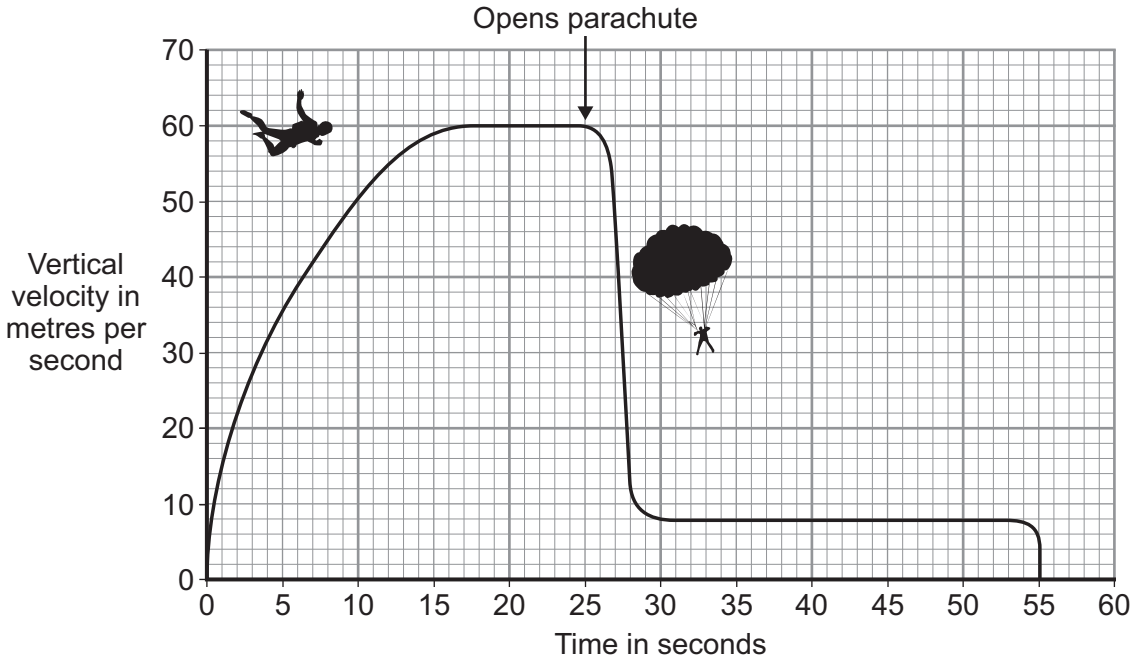
Weight = ...

(3 marks)

Do not write outside the box

8 (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 8 continues on the next page

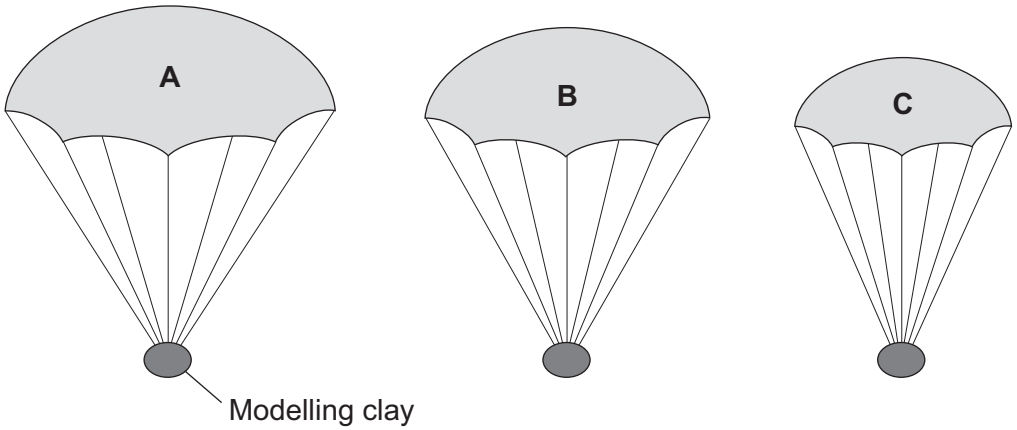
Turn over ▶

Do not write outside the box

8 (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.



8 (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)

8 (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.

.....

.....

.....

(2 marks)

12

END OF QUESTIONS

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General Certificate of Secondary Education

Additional Science 4408 / Physics 4403

PH2FP **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.

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Question 1

question	answers	extra information	mark
1(a)(i)	protostar red giant black dwarf	correct order only	1 1 1
1(a)(ii)	Alpha Centauri A stars (about) same size as Sun form white/black dwarfs **or** very large stars form red super giants / supernova/black hole	accept any correct indication, eg alpha, centauri, A reason only scores if Alpha Centauri A is chosen it is the same size as the Sun is insufficient same life cycle as the Sun is insufficient	1 1
1(b)	Atomic nuclei inside the star join together.		1
Total			**6**

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Question 2

question	answers	extra information	mark
2(a)(i)	15		1
2(a)(ii)	4.5 or their (a)(i) x 0.3 correctly calculated	allow **1** mark for correct substitution, ie 0.3 x 15/their (a)(i), provided no subsequent step	2
2(a)(iii)	decrease		1
2(b)	**Y** (only one that) shows a direct current / p.d. **or** a battery / cell gives a direct current **or** a battery/cell gives a constant current/p.d.	accept any correct indication reason only scores if **Y** is chosen accept voltage for p.d. accept both **X** and **Z** are a.c. accept it's a constant current/p.d. it is not changing is insufficient	1 1
Total			**6**

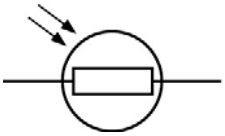
PH2FP

Question 3

question	answers	extra information	mark
3(a)(i)	horizontal arrow pointing to the left	judge by eye drawn anywhere on the diagram	1
3(a)(ii)	60 (N) (at steady speed) resultant force must be zero	 accept forces must balance/are equal accept no acceleration do **not** accept constant speed	1 1
3(b)	1680 joule	 allow **1** mark for correct substitution, ie 60 x 28 provided no subsequent step shown accept J do not accept j	2 1
Total			**6**

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Question 4

question	answers	extra information	mark
4(a)(i)	correct symbol ringed 		1
4(a)(ii)	accept any suggestion that would change light intensity, eg: • torch on or off • distance between torch and LDR • lights in room on or off • shadow over the LDR	accept power of torch do **not** accept watts/wattage of torch	1
4(b)	resistance decreases from 600 kΩ to 200 kΩ	accept by 400 kΩ	1 1
4(c)(i)	no numbers for light intensity **or** light intensity is categoric / a description/not continuous	not enough results is insufficient	1
4(c)(ii)	YES both show that resistance increases with decreasing (light) intensity / brightness	mark is for the reason accept they both get the same results/pattern	1
4(d)	A circuit that automatically switches outside lights on when it gets dark.		1
Total			**7**

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Question 5

question	answers	extra information	mark
5(a)(i)	earth wire		1
5(a)(ii)	double		1
5(b)	if too much current flows through the wire	accept power for current do **not** accept electricity for current accept if more than 20 amps flows through the wire	1
	the fuse (overheats and) melts	accept 'blows' for melts do not accept explodes/ breaks/snaps etc	1
	breaking the circuit	accept stopping the current flow	1
Total			**5**

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Question 6

question	answers	extra information	mark
6(a)(i)	on average, cosmic rays produce less background radiation than rocks. having no X-rays reduces a person's radiation dose.		1 1
6(a)(ii)	4	allow **1** mark for 350 / 4 allow **1** mark for an answer 3.5	2
6(b)(i)	(risk) increases		1
6(b)(ii)	C shows a lower risk for low doses (than for zero exposure)	reason only scores if **C** chosen accept risk reduces when you go from low to moderate (doses)	1 1
6(c)(i)	YES fewer mice exposed first to a low dose get cancer (than those only exposed to a high dose) NO the results are for mice (1) and may not be applicable to people (1)	no mark for YES or NO, marks are for the explanation only scores if first marking point scores	 1 1
6(c)(ii)	ethical		1
Total			**10**

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Question 7

question	answers	extra information	mark
7(a)(i)	**B C**	either order	1
7(a)(ii)	elastic <u>potential</u> (energy)	accept strain for elastic	1
7(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
7(b)(ii)	point marked at 5.5 (N) up to that point force and extension are (directly) proportional	accept any point between 5.0 and 5.6 inclusive accept it's 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
7(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**

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Question 8

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

8(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 8 continues on the next page . . .

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Question 8 continued

question	answers	extra information	mark
8(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	
8(c)(i)	any **one** from: • mass of the (modelling) clay • material parachute made from • number / length of strings	accept size/shape of clay size/amount/volume/shape of clay accept plasticine for (modelling)clay accept same (plastic) bag	1

Question 8 continues on the next page

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Question 8 continued

question	answers	extra information	mark
8(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**

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

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