AQA GCSE PHYSICS (4451)

PHYSICS



EXAM QUESTION PACK

UNIT P2 HIGHER TIER PHY2H PAPERS

STEMUP

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Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

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

General Certificate of Secondary Education
Higher Tier
June 2012

Additional Science
Unit Physics P2

PHY2H

H

Physics
Unit Physics P2

Written Paper

Wednesday 30 May 2012 1.30 pm to 2.15 pm

For this paper you must have:
- a ruler.

You may use a calculator.

Time allowed
- 45 minutes

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 45.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.

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

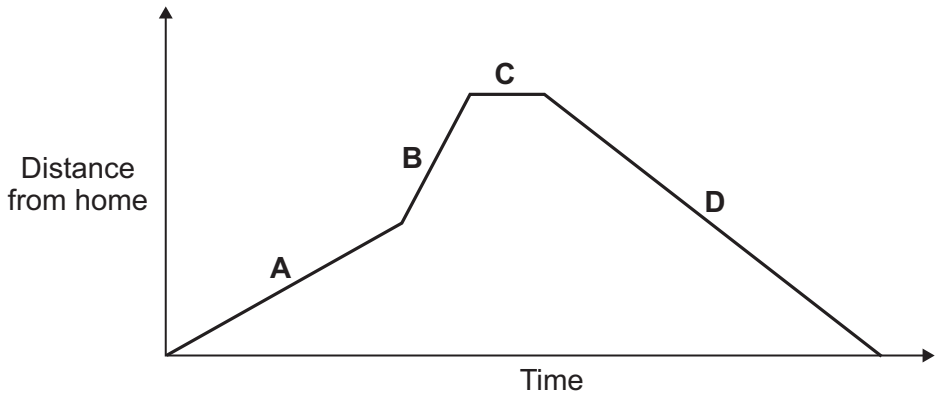
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Do not write outside the box

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

1 (a) A person takes their dog for a walk.

The graph shows how the distance from their home changes with time.



Which part of the graph, **A**, **B**, **C** or **D**, shows them walking the fastest?

Write your answer in the box. ☐

Give the reason for your answer.

.....

.....

(2 marks)

1 (b) During the walk, both the speed and the velocity of the person and the dog change.

How is *velocity* different from *speed*?

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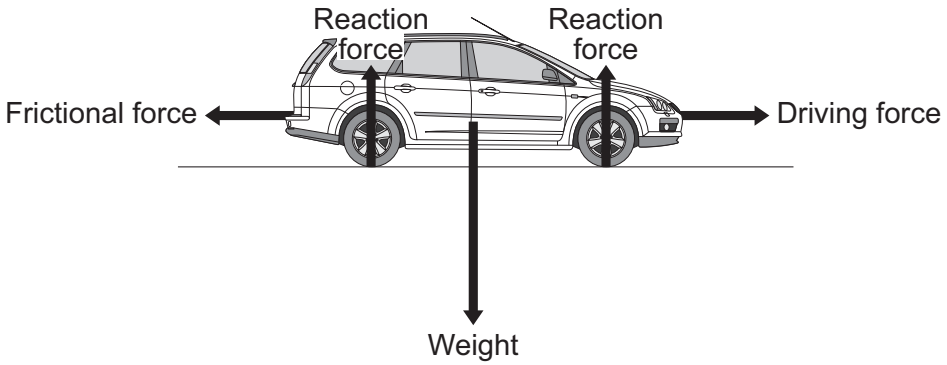
.....

(1 mark)

3

Do not write outside the box

2 The diagram shows the forces acting on a car. The car is being driven along a straight, level road at a constant speed of 12 m/s.



2 (a) The driver then accelerates the car to 23 m/s in 4 seconds.

Use the equation in the box to calculate the acceleration of the car.

$$\text{acceleration} = \frac{\text{change in velocity}}{\text{time taken for change}}$$

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

.....

.....

Acceleration = ...

(3 marks)

2 (b) Describe how the horizontal forces acting on the car change during the first **two** seconds of the acceleration.

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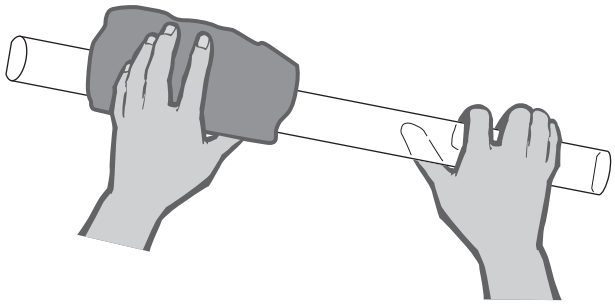
(3 marks)

6

Turn over ▶

Do not write outside the box

3 (a) The diagram shows a polythene rod being rubbed with a woollen cloth.



The polythene rod becomes negatively charged.

Explain how this happens.

.....

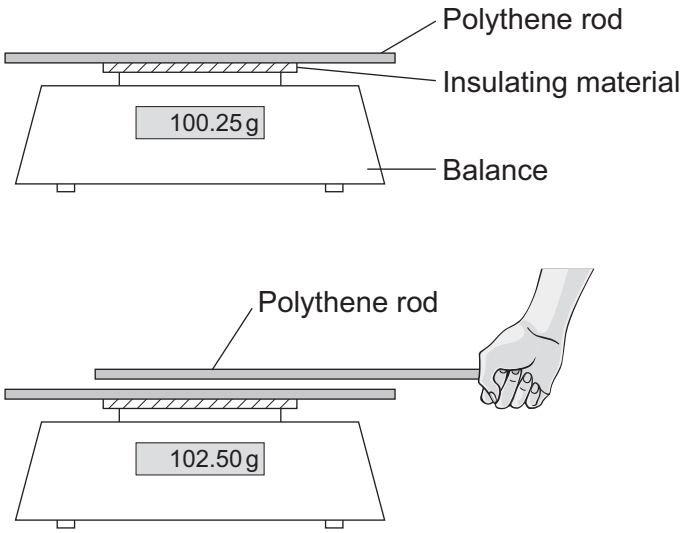
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(2 marks)

3 (b) A student put the charged polythene rod on to a balance. The rod was separated from the metal pan of the balance by a thin block of insulating material.
The student then held a second charged polythene rod above, but **not** touching, the first rod. The reading on the balance increased.



Do not write outside the box

3 (b) (i) Explain why the reading on the balance increases.

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.....

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(2 marks)

3 (b) (ii) The student observed that the nearer the two rods are to each other, the bigger the increase in the balance reading.

What should the student conclude from this observation?

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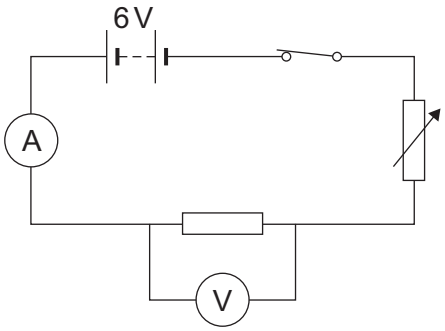
(2 marks)

6

Turn over for the next question

Do not write outside the box

4 The diagram shows the circuit set up by a student.



4 (a) The student uses the circuit to test the following hypothesis:

'The current through a resistor is directly proportional to the potential difference across the resistor.'

4 (a) (i) If the hypothesis is correct, what should the student predict will happen to the current through the resistor when the potential difference across the resistor is doubled?

.....

.....

(1 mark)

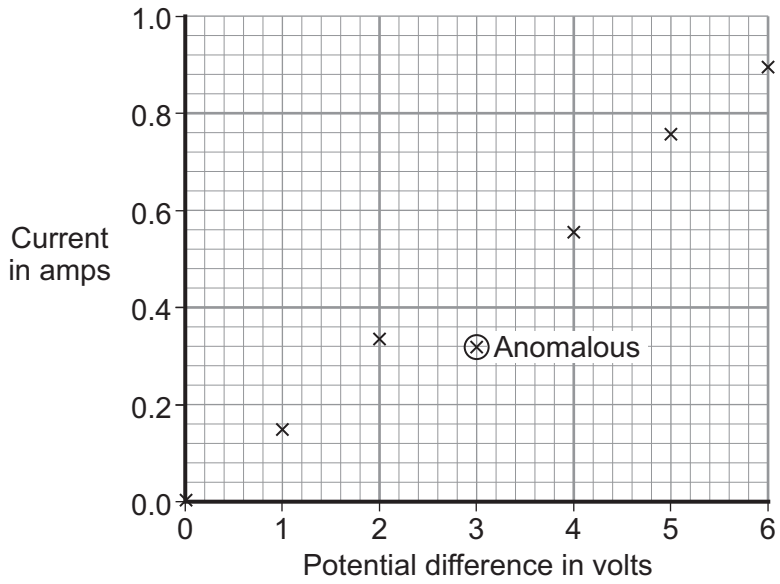
4 (a) (ii) Name the component in the circuit used to change the potential difference across the resistor.

.....

(1 mark)

Do not write outside the box

4 (b) The student used the data obtained to plot the points for a graph of current against potential difference.



4 (b) (i) Why has the student plotted the points for a line graph and not drawn a bar chart?

.....

.....

(1 mark)

4 (b) (ii) One of the points has been identified by the student as being anomalous.

What is the most likely cause for this anomalous point?

.....

.....

(1 mark)

4 (b) (iii) Draw a line of best fit for these points.

(1 mark)

4 (b) (iv) Does the data the student obtained support the hypothesis?

Give a reason for your answer.

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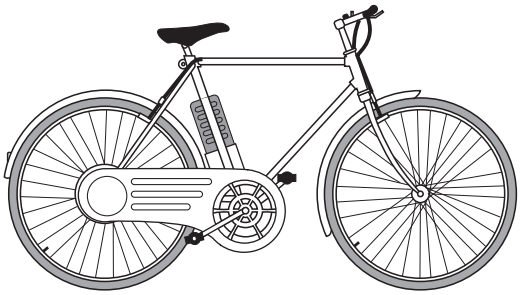
(1 mark)

6

Turn over ▶

Do not write outside the box

5 The picture shows an electric bicycle. The bicycle is usually powered using a combination of the rider pedalling and an electric motor.



5 (a) A 36 volt battery powers the electric motor. The battery is made using individual 1.2 volt cells.

5 (a) (i) Explain how a 36 volt battery can be produced using individual 1.2 volt cells.

To gain full marks, you must include a calculation in your answer.

.....

.....

.....

.....

(2 marks)

5 (a) (ii) The battery supplies a direct current (d.c.).

What is a *direct current* (*d.c.*)?

.....

.....

(1 mark)

5 (a) (iii) When fully charged, the battery can deliver a current of 5 A for 2 hours. The battery is then fully discharged.

Use the equation in the box to calculate the maximum charge that the battery stores.

charge = current × time

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

.....

.....

Charge stored = ...

(3 marks)

Do not write outside the box

5 (b) When powered only by the electric motor, the bicycle can carry a 90 kg rider at a maximum speed of 6 m/s. Under these conditions, the maximum distance that the bicycle can cover before the battery needs recharging is 32 km.

The bicycle has a mass of 30 kg.

5 (b) (i) Use the equation in the box to calculate the maximum kinetic energy of the bicycle **and** rider when the rider is not pedalling.

$$\text{kinetic energy} = \frac{1}{2} \times \text{mass} \times \text{speed}^2$$

Show clearly how you work out your answer.

.....

.....

Kinetic energy = ... J

(2 marks)

5 (b) (ii) The bicycle can be fitted with panniers (bags) to carry a small amount of luggage.

What effect would fitting panniers and carrying luggage have on the distance the bicycle can cover before the battery needs recharging?

.....

Give a reason for your answer.

.....

.....

(2 marks)

10

Turn over for the next question

Do not write outside the box

6 (a) The picture shows two teenagers riding identical skateboards.
The skateboards are moving at the same speed and the teenagers have the same mass.



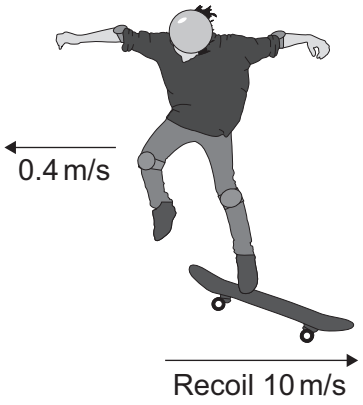
Why do the teenagers **not** have the same momentum?

.....

.....

(1 mark)

6 (b) One of the skateboards slows down and stops. The teenager then jumps off the skateboard, causing it to recoil and move in the opposite direction.



The momentum of the teenager and skateboard is conserved.

6 (b) (i) What is meant by 'momentum being conserved'?

.....

.....

(1 mark)

Do not write outside the box

6 (b) (ii) The teenager, of mass 55 kg, jumps off the skateboard at 0.4 m/s causing the skateboard to recoil at 10 m/s.

Use the equation in the box to calculate the mass of the skateboard.

momentum = mass × velocity

.....

.....

.....

Mass = ... kg

(3 marks)

6 (c) Once the skateboard starts to recoil, it soon slows down and its kinetic energy decreases.

Explain why.

.....

.....

.....

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(2 marks)

7

Turn over for the next question

Do not write outside the box

7 (a) Atoms of the isotope bismuth-212 decay by emitting either an alpha particle or a beta particle.
The equation represents what happens when an atom of bismuth-212 decays by beta emission into an atom of polonium-212.

$$^{212}_{83}\text{Bi} \longrightarrow {}^{212}_{84}\text{Po} + \text{beta particle}$$

7 (a) (i) The bismuth atom and the polonium atom have the same mass number (212).

What is the *mass number* of an atom?

.....

(1 mark)

7 (a) (ii) Beta decay does **not** cause the mass number of an atom to change.

Explain why not.

.....

.....

.....

.....

(2 marks)

7 (b) When an atom of bismuth-212 emits an alpha particle, the atom decays into an atom of thallium.

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

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

7 (b) (i) The equation below represents the alpha decay of bismuth-212.

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

$$^{212}_{83}\text{Bi} \longrightarrow \square\!\!\square \text{ Tl} + {}^{4}_{2}\text{He}$$

(2 marks)

Do not write outside the box

7 (b) (ii) It is impossible for the alpha decay of bismuth-212 to produce the same element as the beta decay of bismuth-212.

Explain why.

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(2 marks)

7

END OF QUESTIONS

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General Certificate of Secondary Education

Additional Science 4463 / Physics 4451

PHY2H **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.

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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.

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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.

PHY2H

Question 1

question	answers	extra information	mark
1(a)	**B** gradient / slope is the steepest / steeper	reason only scores if B is chosen answers must be comparative accept steepest line ignore greatest speed	1 1
1(b)	(velocity includes) direction	'it' refers to velocity	1
Total			**3**

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PHY2H

Question 2

question	answers	extra information	mark
2(a)	2.75	allow **1** mark for correct substitution, ie $\frac{11}{4}$ **or** $\frac{23 - 12}{4}$ provided no subsequent step shown	2
	m/s^2		1
2(b)	driving force increases		1
	frictional force increases	accept air resistance / drag for frictional force	1
	driving force > frictional force		1
Total			**6**

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PHY2H

Question 3

question	answers	extra information	mark
3(a)	electrons transfer / removed	do **not** accept negatively charged atoms for electrons	1
	to the rod / from the cloth	this only scores if first mark given this does not score if there is reference to any original charge on cloth or rod 'it' refers to the rod accept negative charge transfer to rod / removed from cloth for **1** mark transfer of positive charge / positive electrons scores zero	1
3(b)(i)	rods / charges repel		1
	creating downward / extra force (on the balance)	accept pushing (bottom) rod downwards do not accept increasing the weight / mass charges attracting scores zero	1

Question 3 continues on the next page

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PHY2H

Question 3 continued

question	answers	extra information	mark
3(b)(ii)	the (repulsion) force increases as the distance between the charges decreases	accept there is a negative correlation between (repulsion) force and distance between charges **or** (repulsion) force and distance between charges are inversely proportional for both marks examples of **1** mark answers force increases as distance decreases force and distance are inversely proportional negative correlation between force and distance repels more as distance decreases if given in terms of attracting or attraction force this mark does not score	2
Total			**6**

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PHY2H

Question 4

question	answers	extra information	mark
4(a)(i)	also double	increases is insufficient	1
4(a)(ii)	variable resistor	accept rheostat / potentiometer	1
4(b)(i)	the data / results / variables are continuous	accept data / results / variables are not categoric / discrete	1
4(b)(ii)	misreading the ammeter	do **not** accept misreading the meter / results do **not** accept misreading the ammeter and / or voltmeter reading / human error is insufficient	1
4(b)(iii)	straight line from the origin drawn passing close / through points at 1 V, 5 V, 6 V and ignoring anomalous point	do **not** accept line drawn 'dot-to-dot'	1
4(b)(iv)	yes supports prediction **or** (straight) line passes through the origin	mark is for the reason accept a mathematical argument, eg when p.d. went from 2 to 4 the current went from 0.3 to 0.6 it's directly proportional is insufficient	1
Total			**6**

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PHY2H

Question 5

question	answers	extra information	mark
5(a)(i)	(connect) 30 (cells) in series		1 1
5(a)(ii)	current always flows in the same direction **or** current only flows one way		1
5(a)(iii)	36 000 coulombs / C	 allow **1** mark for correctly converting 2 hours to 7200 seconds answers 10 or 600 score **1** mark do **not** accept c	2 1
5(b)(i)	2160	 allow **1** mark for correct substitution, ie ½ × 120 × 6^2 answers of 1620 or 540 score **1** mark	2

Question 5 continues on the next page

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PHY2H

Question 5 continued

question	answers	extra information	mark
5(b)(ii)	reduce it		1
	any **one** from: • draws a larger current (from battery)		1
	• motor draws greater power (from battery)	accept energy per second for power accept more energy needed to move the bicycle	
	• greater resistance force (to motion) / air resistance / drag / friction	accept less streamlined more mass to carry is insufficient	
Total			**10**

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PHY2H

Question 6

question	answers	extra information	mark
6(a)	(moving in) different / opposite directions	accept one has positive momentum the other negative momentum accept they have different velocities	1
6(b)(i)	momentum before = momentum after **or** (total) momentum stays the same	 accept no momentum is lost accept no momentum is gained	1
6(b)(ii)	2.2	 allow **1** mark for calculation of teenagers' momentum as 22 (kgm/s) and allow **1** mark for correct statement, eg momentum before = momentum after **or** allow **2** marks for a numerical expression of above, eg 55 × 0.4 = m × 10 **or** 0 = (55 × 0.4) + (m × (-10))	3
6(c)	any **two** from: • work is done • (against) friction • (transforming) (kinetic) energy into heat	 any reference to increasing friction negates this marking point	2
Total			**7**

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PHY2H

Question 7

question	answers	extra information	mark
7(a)(i)	(total) number of protons plus neutrons	accept number of nucleons accept amount for number do not accept number of particles in the nucleus	1
7(a)(ii)	number of neutrons decreases by one number of protons increases by one	 accept for both marks a neutron changes into a proton	1 1
7(b)(i)	$^{208}_{81}Th$	 correct order only	1 1
7(b)(ii)	the number of protons determines the element alpha and beta decay produce different changes to the number of protons **or** alpha and beta decay produce different atomic numbers	accept atomic number for number of protons there must be a comparison between alpha and beta which is more than a description of alpha and beta decay alone ignore correct reference to mass number	1 1
Total			**7**

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Question	Mark
1	
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AQA

General Certificate of Secondary Education
Higher Tier
January 2012

Additional Science

Unit Physics P2

PHY2H

H

Physics

Unit Physics P2

Monday 30 January 2012 1.30 pm to 2.15 pm

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- a ruler.

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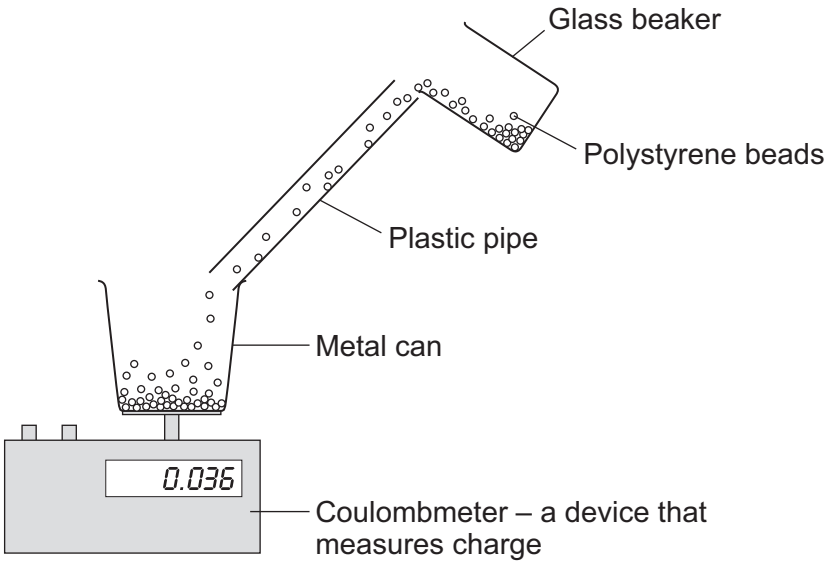
Advice
- In all calculations, show clearly how you work out your answer.

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Do not write outside the box

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

1 (a) Fine powders poured through a pipe can become charged. The diagram shows the apparatus used by a student to investigate this effect.



The student poured 75cm^3 of polystyrene beads down the pipe. The beads fell into a metal can and the charge on them was measured directly using a coulombmeter.

The student repeated this twice more, but each time used 75cm^3 of beads of a different size.

1 (a) (i) When they fell through the pipe, the polystyrene beads became negatively charged.

Explain how this happened.

.....

.....

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.....

.....

(3 marks)

Do not write outside the box

1 (a) (ii) Give **one** control variable in the student's investigation.

.....

.....

(1 mark)

1 (b) The results obtained by the student are shown in the table.

Diameter of polystyrene beads in mm	Charge in microcoulombs
1.0	0.080
2.0	0.044
3.0	0.012

(1 000 000 microcoulombs = 1 coulomb)

1 (b) (i) Describe the connection between the size of the polystyrene beads and the total charge on the beads.

.....

.....

(1 mark)

1 (b) (ii) Explain how these results might be different if the student had used a shorter pipe.

.....

.....

.....

.....

(2 marks)

Question 1 continues on the next page

Do not write outside the box

1 (c) In industry, powders are often pumped through pipes. If the static charge caused a spark, the powder could ignite and cause an explosion.

1 (c) (i) Is an explosion more likely to happen when pumping very fine powders or when pumping powders that consist of much larger particles?

.....

Give a reason for your answer.

.....

.....

(1 mark)

1 (c) (ii) Suggest **one** way that the risk of an explosion could be reduced.

.....

.....

(1 mark)

1 (d) The table gives the minimum ignition energy (MIE) value for a number of fine powders. The MIE is the minimum amount of energy required to cause a fine powder to ignite.

Type of powder	MIE in millijoules
Coal dust	60.00
Aluminium powder	10.00
Cornstarch dust	0.30
Iron powder	0.12

The MIE values for different substances are all measured in the same way and under the same conditions of pressure and temperature.

Why is this important?

.....

.....

(1 mark)

10

Do not write outside the box

2 (a) Nuclear fission is used in nuclear power stations to generate electricity. Nuclear fusion happens naturally in stars.

2 (a) (i) Explain briefly the difference between *nuclear fission* and *nuclear fusion*.

.....

.....

.....

.....

.....

(2 marks)

2 (a) (ii) What is released during both nuclear fission and nuclear fusion?

.....

(1 mark)

2 (b) Plutonium-239 is used as a fuel in some nuclear reactors.

2 (b) (i) Name another substance used as a fuel in some nuclear reactors.

.....

(1 mark)

2 (b) (ii) There are many isotopes of plutonium.

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

.....

(1 mark)

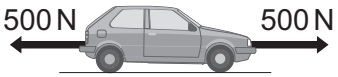
5

Turn over for the next question

Do not write outside the box

3 (a) A car is being driven along a straight road. The diagrams, **A**, **B** and **C**, show the horizontal forces acting on the moving car at three different points along the road.

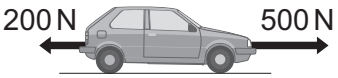
Describe the motion of the car at each of the points, **A**, **B** and **C**.



A

.....

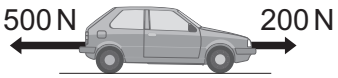
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B

.....

.....



C

.....

.....

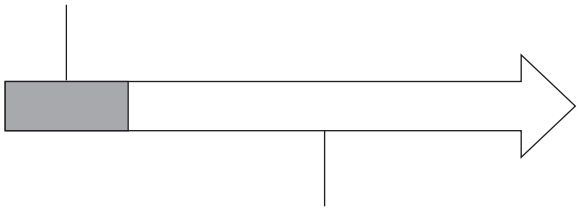
(3 marks)

3 (b) The diagram below shows the stopping distance for a family car, in good condition, driven at 22 m/s on a dry road. The stopping distance has two parts.

3 (b) (i) Complete the diagram below by adding an appropriate label to the second part of the stopping distance.

(1 mark)

The distance the car travels during the driver's reaction time



.....

.....

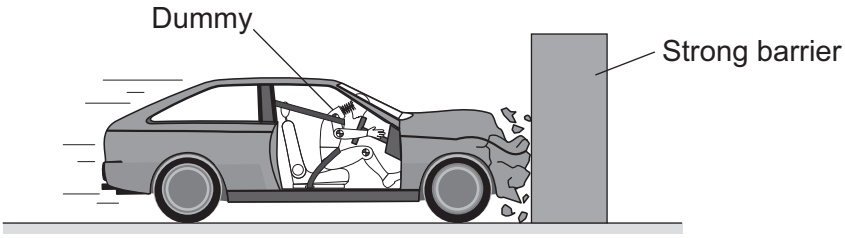
3 (b) (ii) State **one** factor that changes both the first part **and** the second part of the stopping distance.

.....

(1 mark)

Do not write outside the box

3 (c) The front crumple zone of a car is tested at a road traffic laboratory. This is done by using a remote control device to drive the car into a strong barrier. Electronic sensors are attached to the dummy inside the car.



3 (c) (i) At the point of collision, the car exerts a force of 5000 N on the barrier.

State the size and direction of the force exerted by the barrier on the car.

.....

.....

(1 mark)

3 (c) (ii) Suggest why the dummy is fitted with electronic sensors.

.....

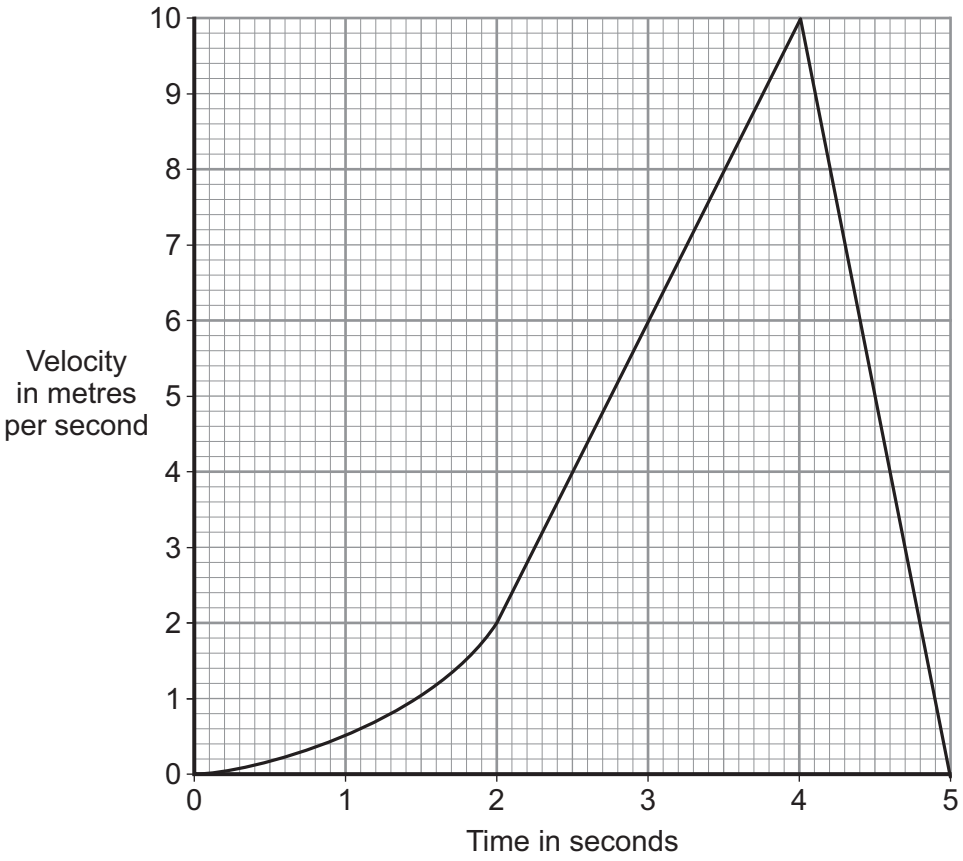
.....

(1 mark)

Question 3 continues on the next page

Do not write outside the box

3 (c) (iii) The graph shows how the velocity of the car changes during the test.



Use the graph to calculate the acceleration of the car just before the collision with the barrier.

Show clearly how you work out your answer, including how you use the graph, and give the unit.

.....

.....

.....

.....

Acceleration = ...

(3 marks)

10

Do not write outside the box

Turn over for the next question

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ANSWER IN THE SPACES PROVIDED

Do not write outside the box

4 (a) The resistance of a 24 W, 12 V filament lamp depends on the current flowing through the lamp. For currents up to 0.8 A, the resistance has a constant value of 2.5 Ω.

4 (a) (i) Use the equation in the box to calculate the potential difference across the lamp when a current of 0.8 A flows through the lamp.

potential difference = current × resistance

Show clearly how you work out your answer.

.....

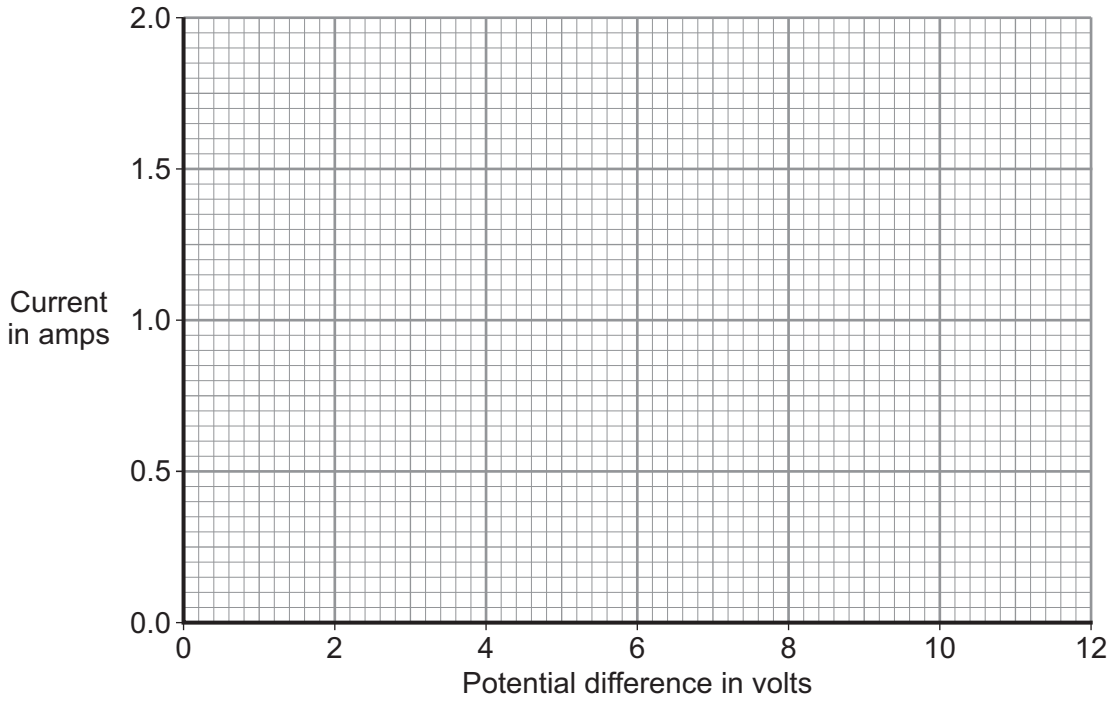
.....

Potential difference = ... V

(2 marks)

4 (a) (ii) When the potential difference across the lamp is 12 V, the current through the lamp is 2 A.

On the axes below, draw a current – potential difference graph for the filament lamp over the range of potential difference from 0 to 12 volts.



(2 marks)

Do not write outside the box

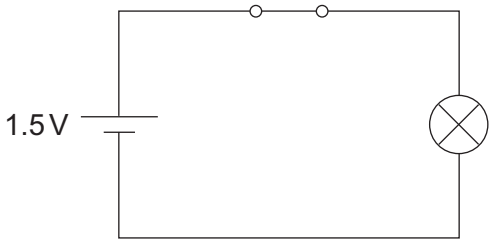
4 (a) (iii) Why does the resistance of the lamp change when the current through the lamp exceeds 0.8 A?

.....

.....

(1 mark)

4 (b) The lamp is now included in a circuit. The circuit is switched on for 2 minutes. During this time, 72 coulombs of charge pass through the lamp.



Use the equation in the box to calculate the energy transformed by the lamp while the circuit is switched on.

energy transformed = potential difference × charge

Show clearly how you work out your answer.

.....

.....

Energy transformed = ... J

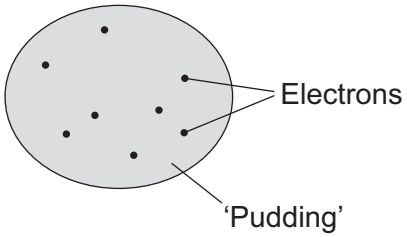
(2 marks)

7

Turn over for the next question

Do not write outside the box

5 The 'plum pudding' model of the atom was used by scientists in the early part of the 20th century to explain atomic structure.



5 (a) Those scientists knew that atoms contained electrons and that the electrons had a negative charge. They also knew that an atom was electrically neutral overall.

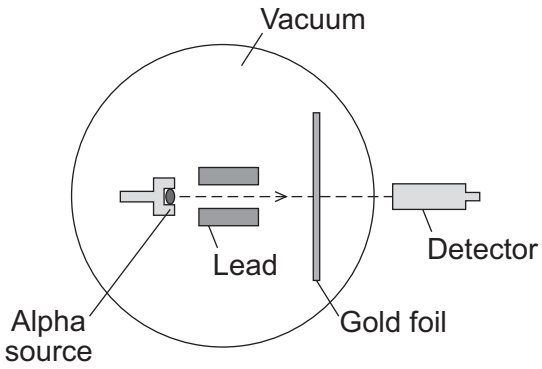
What did this allow the scientists to deduce about the 'pudding' part of the atom?

.....

.....

(1 mark)

5 (b) An experiment, designed to investigate the 'plum pudding' model, involved firing alpha particles at a thin gold foil.



If the 'plum pudding' model was correct, then most of the alpha particles would go straight through the gold foil. A few would be deflected, but by less than 4°.

The results of the experiment were unexpected. Although most of the alpha particles did go straight through the gold foil, about 1 in every 8 000 was deflected by more than 90°.

Why did this experiment lead to a new model of the atom, called the nuclear model, replacing the 'plum pudding' model?

.....

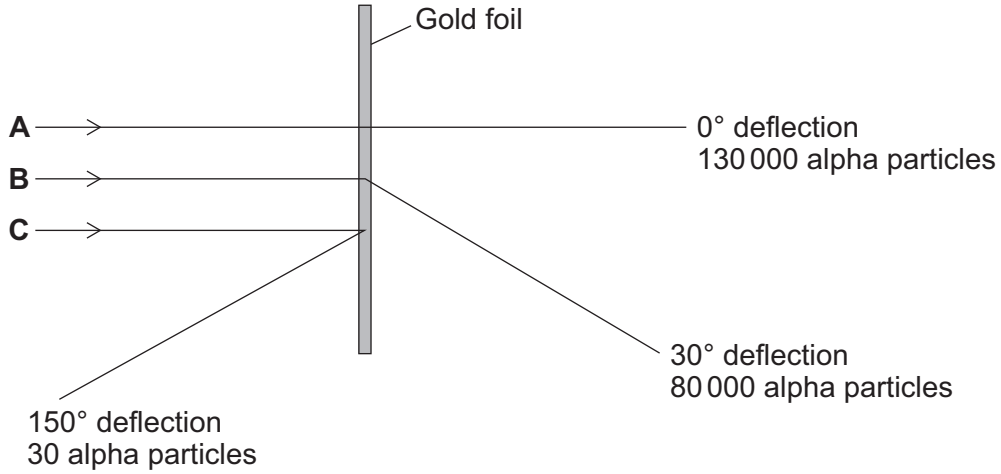
.....

.....

(1 mark)

Do not write outside the box

5 (c) The diagram shows the paths, **A**, **B** and **C**, of three alpha particles. The total number of alpha particles deflected through each angle is also given.



5 (c) (i) Using the nuclear model of the atom, explain the three paths, **A**, **B** and **C**.

A .....

.....

B .....

.....

C .....

.....

(3 marks)

5 (c) (ii) Using the nuclear model, the scientist E. Rutherford devised an equation to predict the proportion of alpha particles that would be deflected through various angles.

The results of the experiment were the same as the predictions made by Rutherford.

What was the importance of the experimental results and the predictions being the same?

.....

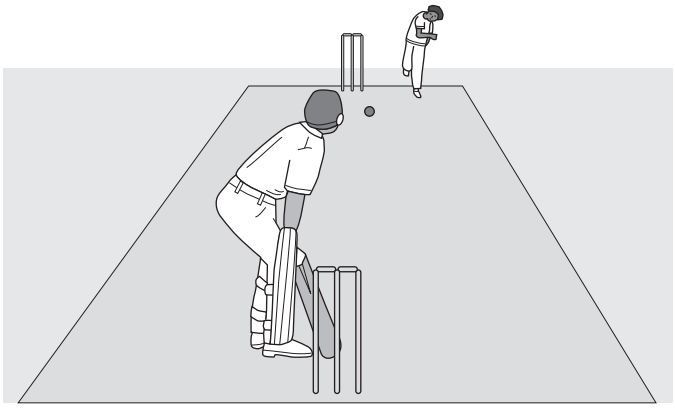
.....

(1 mark)

6

Do not write outside the box

6 The picture shows players in a cricket match.



6 (a) A fast bowler bowls the ball at 35 m/s. The ball has a mass of 0.16 kg.

Use the equation in the box to calculate the kinetic energy of the cricket ball as it leaves the bowler's hand.

$$\text{kinetic energy} = \tfrac{1}{2} \times \text{mass} \times \text{speed}^2$$

Show clearly how you work out your answer.

.....

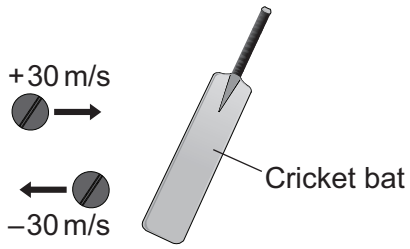
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.....

Kinetic energy = ... J

(2 marks)

6 (b) When the ball reaches the batsman it is travelling at 30 m/s. The batsman strikes the ball which moves off at 30 m/s in the opposite direction.



Do not write outside the box

6 (b) (i) Use the equation in the box to calculate the change in momentum of the ball.

momentum = mass × velocity

Show clearly how you work out your answer.

.....

.....

Change in momentum = ... kg m/s

(2 marks)

6 (b) (ii) The ball is in contact with the bat for 0.001 s.

Use the equation in the box to calculate the force exerted by the bat on the ball.

$$\text{force} = \frac{\text{change in momentum}}{\text{time taken for the change}}$$

Show clearly how you work out your answer.

.....

.....

Force = ... N

(1 mark)

6 (c) A fielder, as he catches a cricket ball, pulls his hands backwards.

Explain why this action reduces the force on his hands.

.....

.....

.....

.....

.....

(2 marks)

7

END OF QUESTIONS

There are no questions printed on this page

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Version1.0: 29/02/2012

General Certificate of Secondary Education

Additional Science 4463 / Physics 4451

PHY2H Unit Physics 2

Mark Scheme

2012 Examination – January Series

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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.

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Marking Guidance for Examiners

GCSE Science Papers

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.

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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	Pluto, Mars, Moon	1
2	Pluto, 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.

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PHY2H

Question 1

question	answers	extra information	mark
1(a)(i) (E)	friction between the beads and pipe	accept beads rub against the pipe	1
	(cause) <u>electrons</u> to transfer	accept electrons are lost/gained do **not** accept negatively charged atoms for electrons	1
	from the pipe **or** to the beads	3rd mark point only scores if 2nd mark scores do **not** accept from the (negatively) charged pipe do **not** accept to the (positively) charged beads accept negative charge transfer to the beads for **1** mark provided 2nd or 3rd marking point not awarded mention of positive charge transfer negates last 2 marking points	1
1(a)(ii) (E)	<u>volume</u> (of beads) **or** <u>length</u> of pipe **or** speed the beads are poured **or** angle of pipe	accept (75)cm^3 accept use the same pipe poured the same way is insufficient	1
1(b)(i) (E)	the larger the beads the less charge	do **not** accept inversely proportional negative correlation is insufficient	1

Question 1 continues on the next page . . .

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PHY2H

Question 1 continued . . .

1(b)(ii) (E)	(total) charge decrease beads in contact with pipe (walls) for less time OR smaller surface area (to rub against)	results would be lower/smaller would be insufficient accept less contact (between beads and pipe) accept beads in pipe for less time accept less pipe to rub against less friction is insufficient	1 1
1(c)(i) (E)	(pumping very) fine powders greater charge (build up) **or** higher pd/voltage **or** greater energy	reason only scores if (very)fine powders given accept more static (electricity) accept an answer that correctly relates back to the experimental data accept larger surface area to volume (ratio)	 1
1(c)(ii) (E)	idea of earthing (the pipe)	accept use metal pipes do **not** accept use larger particles	1
1(d) (E)	to compare (the relative risks) **or** different conditions change the MIE value	fair test is insufficient you can only have one independent variable is insufficient accept different conditions change the results do **not** accept avoid bias	1
Total			**10**

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PHY2H

Question 2

question	answers	extra information	mark
2(a)(i) (E)	(nuclear) fission is the splitting of a (large atomic) nucleus (nuclear) fusion is the joining of (two atomic) nuclei (to form a larger one)	do **not** accept particle/atom for nucleus do not accept particles/atoms for nuclei	1 1
2(a)(ii) (E)	energy	accept heat/radiation/nuclear energy accept gamma (radiation) do not accept neutrons/neutrinos	1
2(b)(i) (E)	uranium (-235)	accept U (-235) ignore any numbers given with uranium accept thorium accept MOX (mixed oxide) do **not** accept hydrogen	1
2(b)(ii) (E)	(same) number of protons	accept (same) atomic number accept (same) positive charge ignore reference to number of electrons	1
Total			**5**

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PHY2H

Question 3

question	answers	extra information	mark
3(a) (E)	**A** constant speed / velocity	accept steady pace do **not** accept terminal velocity do **not** accept stationary	1
	B acceleration	accept speeding up	1
	C deceleration	accept slowing down accept accelerating backwards accept accelerating in reverse do **not** accept decelerating backwards	1
3(b)(i) (E)	the distance the car travels under the braking force	accept braking <u>distance</u>	1
3(b)(ii) (E)	speed/velocity/momentum		1
3(c)(i) (E)	5000 (N) to the left	**both** required accept 5000(N) with the direction indicated by an arrow drawn pointing to the left accept 5000(N) in the opposite direction to the force of the car (on the barrier) accept 5000(N) towards the car	1
3(c)(ii) (E)	to measure/detect forces exerted (on dummy / driver during the collision)		1
3(c)(iii) (E)	4	allow **1** mark for showing a triangle drawn on the straight part of the graph **or** correct use of two pairs of coordinates	2
	m/s^2	do **not** accept mps^2	1
Total			**10**

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PHY2H

Question 4

question	answers	extra information	mark
4(a)(i) (E)	2	allow **1** mark for correct substitution i.e. 0.8 × 2.5 provided no further step shown	2
4(a)(ii) (E)	straight line drawn from origin to 2, 0.8 **or** their (a)(i), 0.8 curve from 2, 0.8 to 12,2 **or** their (a)(i) 0.8 to 12,2	 accept curve from 2, 0.9 to 12,2 **or** their (a)(i) 0.9 to 12,2 'convex' curve required accept a curve that flattens between 10 and 12V	1 1
4(a)(iii) (E)	filament / lamp gets hot	accept temperature increases	1
4(b) (E)	108	allow **1** mark for correct substitution i.e. 1.5 × 72 provided no further step shown	2
Total			**7**

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PHY2H

Question 5

question	answers	extra information	mark
5(a) (E)	has an equal amount of positive charge	accept pudding/it is positive	1
5(b) (E)	(experimental) results could not be explained using 'plum pudding' model **or** (experimental) results did not support plum pudding model	 accept (experimental) results disproved plum pudding model	1
5(c)(i) (E)	**A** – most of atom is empty space **or** most of atom concentrated at the centre **B** – nucleus is positive (so repels alpha particles) **C** – nucleus is very small **or** nucleus is a concentrated mass	 accept nucleus has the same charge as alpha accept nucleus is positive if not scored for B accept nucleus has a very concentrated charge	1 1 1
5(c)(ii) (E)	(if predictions correct, this) supports the new model	answers should be in terms of the nuclear model accept supports his/new/nuclear theory accept proves for supports accept shows predictions/ Rutherford was correct	1
Total			**6**

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PHY2H

Question 6

question	answers	extra information	mark
6(a) (E)	98	allow **1** mark for correct substitution ie ½ × 0.16 × 35 × 35 provided no subsequent step shown an answer of 98 000 scores 0	2
6(b)(i) (E)	9.6	allow **1** mark for (change in velocity =) 60 ignore negative sign	2
6(b)(ii) (E)	9600 **or** their (b)(i) ÷ 0.001 correctly calculated, unless (b) (i) equals 0	ignore negative sign	1
6(c) (E)	increases the time to reduce/change momentum (to zero)	only scores if 1st mark scored decreases rate of change of momentum scores both marks provided there are no contradictions accept decreased acceleration/deceleration equations on their own are insufficient	1 1
Total			**7**

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Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

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

General Certificate of Secondary Education
Higher Tier
June 2011

Additional Science
Unit Physics P2

PHY2H

H

Physics
Unit Physics P2

Written Paper

Friday 27 May 2011 9.00 am to 9.45 am

For this paper you must have:
- a ruler.

You may use a calculator.

Time allowed
- 45 minutes

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 45.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.

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 **Diagram 1** shows a hairdryer.
Diagram 2 shows how the heaters and fan of the hairdryer are connected to a 3-pin plug.
The hairdryer does not have an earth wire.

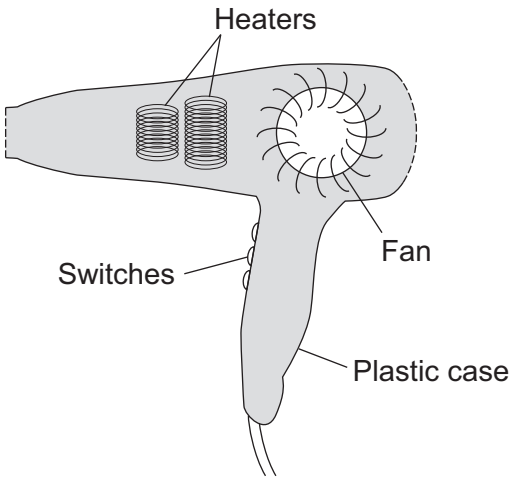


Diagram 1

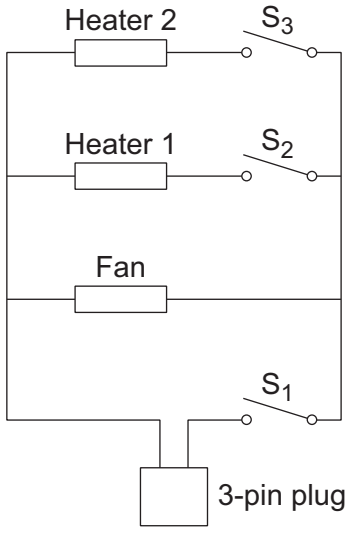


Diagram 2

1 (a) What colour is the insulation around the wire connected to the live pin inside the plug?

.....
(1 mark)

1 (b) Why does the hairdryer **not** need an earth wire?

.....

.....
(1 mark)

1 (c) All the switches are shown in the OFF position.

1 (c) (i) Which switch or switches have to be ON to make:

(1) only the fan work; .....

(2) heater 2 work? .....
(2 marks)

Do not write outside the box

1 (c) (ii) The heaters can only be switched on when the fan is also switched on.

Explain why.

.....

.....

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(2 marks)

1 (d) The table shows the current drawn from the 230 volt mains electricity supply when different parts of the hairdryer are switched on.

	Current in amps
Fan only	1.0
Fan and heater 1	4.4
Fan and both heaters	6.5

Use the equation in the box to calculate the maximum power of the hairdryer.

power = current × potential difference

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

.....

.....

Maximum power = ...

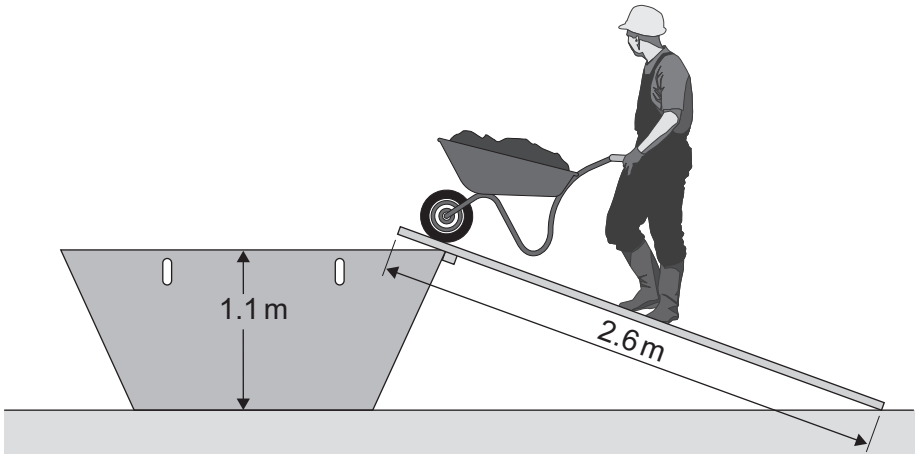
(3 marks)

9

Turn over for the next question

Do not write outside the box

2 (a) The diagram shows a builder using a plank to help load rubble into a skip.



The builder uses a force of 220 N to push the wheelbarrow up the plank.

Use information from the diagram and the equation in the box to calculate the work done to push the wheelbarrow up the plank to the skip.

work done = force applied × distance moved in the direction of force

Show clearly how you work out your answer.

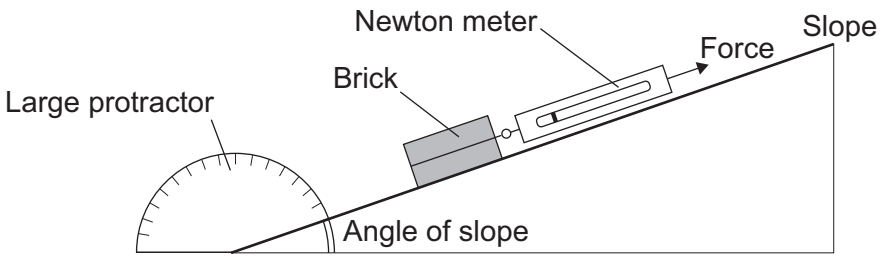
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Work done = ... J

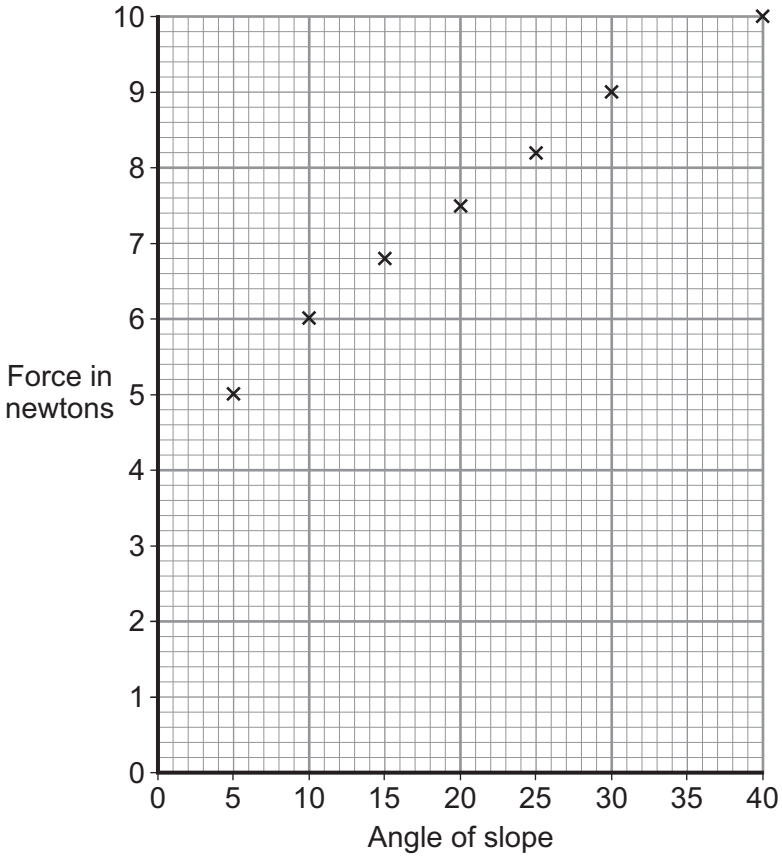
(2 marks)

2 (b) A student investigated how the force needed to pull a brick up a slope, at a steady speed, depends on the angle of the slope.
The apparatus used by the student is shown in the diagram.



The student used the results from the investigation to plot the points for a graph of force used against the angle of the slope.

Do not write outside the box



2 (b) (i) Draw a line of best fit for these points. *(1 mark)*

2 (b) (ii) How does the force used to pull the brick up the slope change as the angle of the slope increases?

.....

.....

(1 mark)

2 (b) (iii) Consider the results from this experiment.
Should the student recommend that the builder use a long plank or a short plank to help load the skip?

Draw a ring around your answer.

long plank **short plank**

Explain the reason for your answer.

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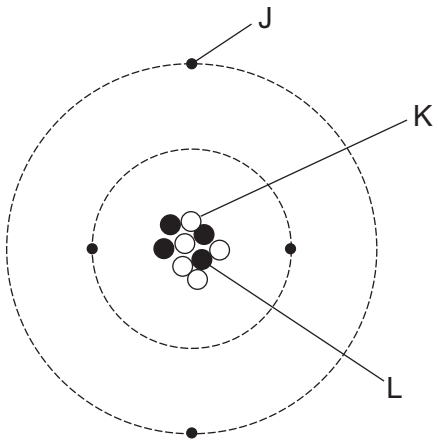
(2 marks)

6

Turn over ▶

Do not write outside the box

3 The diagram represents an atom of beryllium.



3 (a) Complete the following statements by writing one of the letters, **J**, **K** or **L**, in each box.

Each letter should be used only **once**.

The particle with a positive charge is ☐

The particle with the smallest mass is ☐

The particle with no charge is ☐

(2 marks)

3 (b) Give the reason why all atoms have a total charge of zero.

.....

.....

(1 mark)

3 (c) Complete the following sentence.

There are several isotopes of beryllium. Atoms of different beryllium

isotopes will have different numbers of ..... .

(1 mark)

3 (d) What happens to the structure of an atom to change it into an ion?

.....

.....

(1 mark)

5

Do not write outside the box

4 When the nucleus of a radium-225 atom decays, it changes into a nucleus of actinium-225.

$$^{225}_{88}\text{Ra} \longrightarrow {}^{225}_{89}\text{Ac} + \boxed{\text{Radiation}}$$

What type of radiation is emitted by radium-225?

Draw a ring around your answer.

alpha **beta** **gamma**

Explain the reason for your answer.

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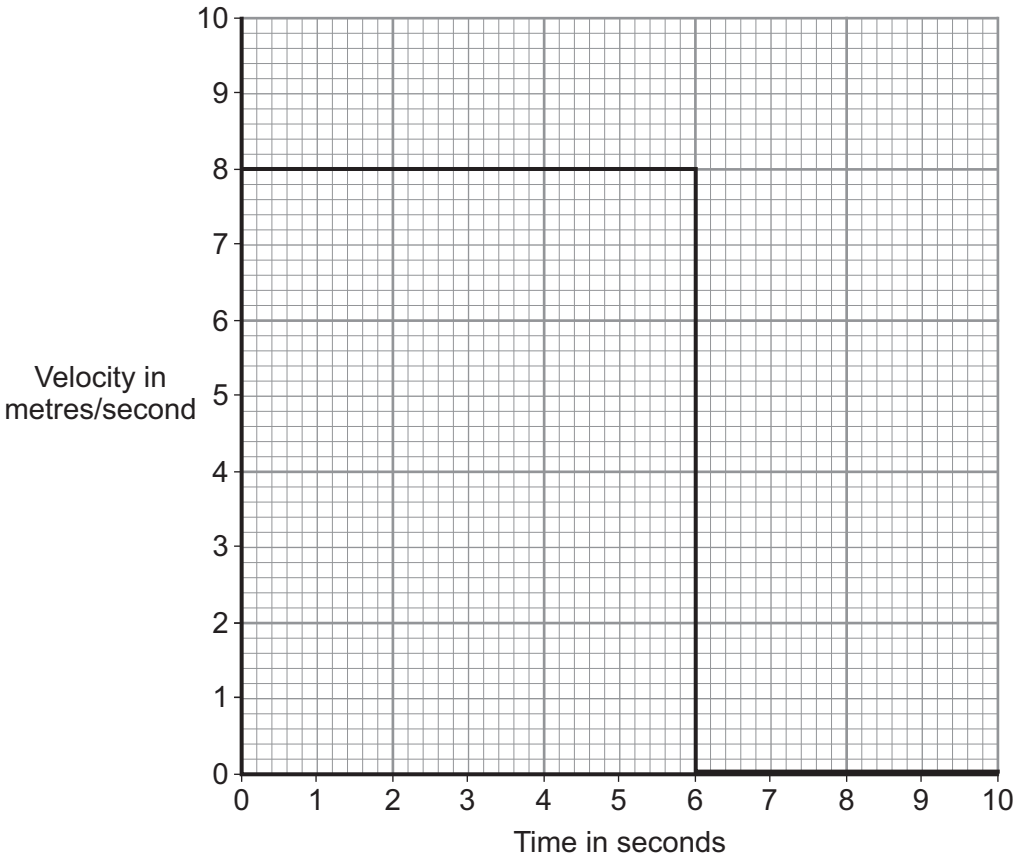
(3 marks)

3

Turn over for the next question

Do not write outside the box

5 The diagram shows the velocity-time graph for an object over a 10 second period.



5 (a) Use the graph to calculate the distance travelled by the object in 10 seconds.

Show clearly how you work out your answer.

.....

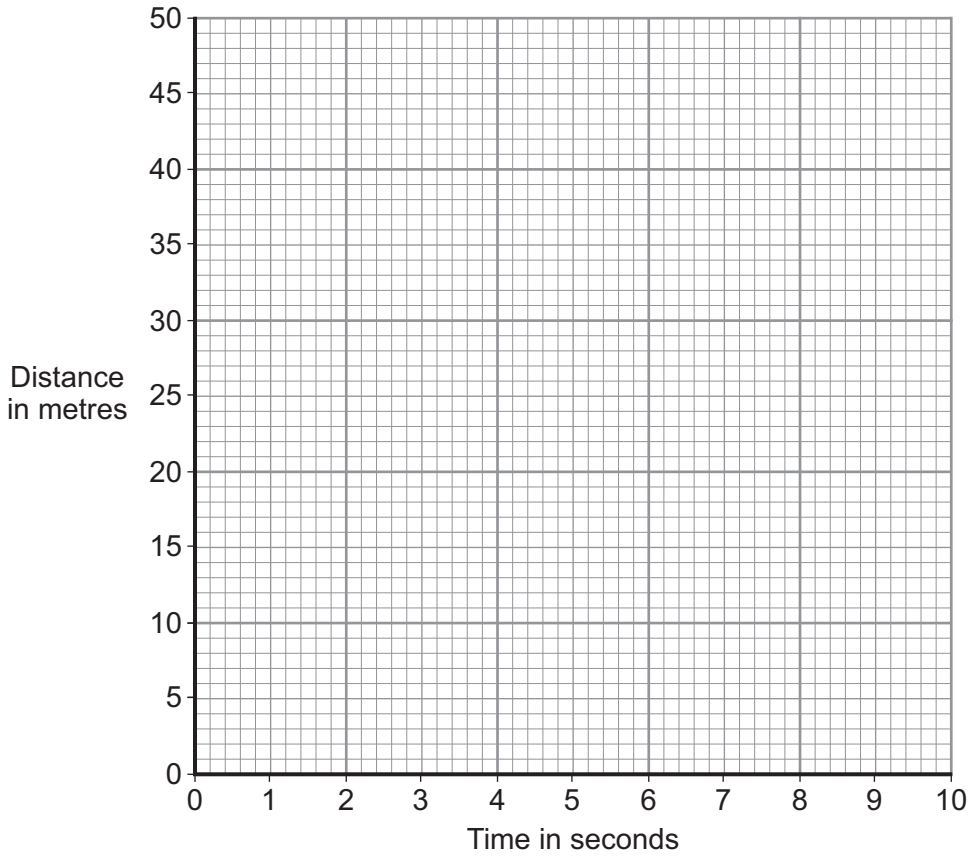
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Distance = ... m

(2 marks)

Do not write outside the box

5 (b) Complete the distance-time graph for the object over the same 10 seconds.



(2 marks)

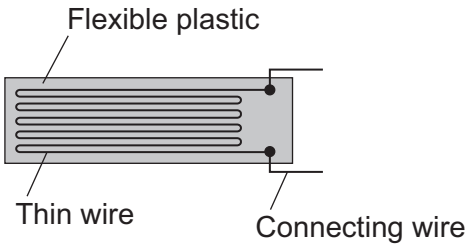
4

Turn over for the next question

Do not write outside the box

6 The diagram shows a strain gauge, which is an electrical device used to monitor a changing force.

Applying a force to the gauge causes it to stretch.
This makes the electrical resistance of the wire change.



6 (a) (i) Using the correct symbols, **add** to the diagram to show how a battery, an ammeter and a voltmeter can be used to find the resistance of the strain gauge drawn above.

(2 marks)

6 (a) (ii) When in use, the strain gauge is always connected to a d.c. power supply, such as a battery.

How is a d.c. (direct current) power supply different from an a.c. (alternating current) power supply?

.....

.....

.....

(1 mark)

Do not write outside the box

6 (b) Before any force is applied, the unstretched gauge, correctly connected to a 3.0 V battery, has a current of 0.040 A flowing through it.

6 (b) (i) Use the equation in the box to calculate the resistance of the unstretched gauge.

potential difference = current × resistance

Show clearly how you work out your answer.

.....

.....

Resistance = ... Ω

(2 marks)

6 (b) (ii) Stretching the gauge causes the current flowing through the gauge to decrease.

What happens to the resistance of the gauge when it is stretched?

.....

.....

(1 mark)

6 (b) (iii) What form of energy is stored in the gauge when a force is applied and the gauge stretches?

.....

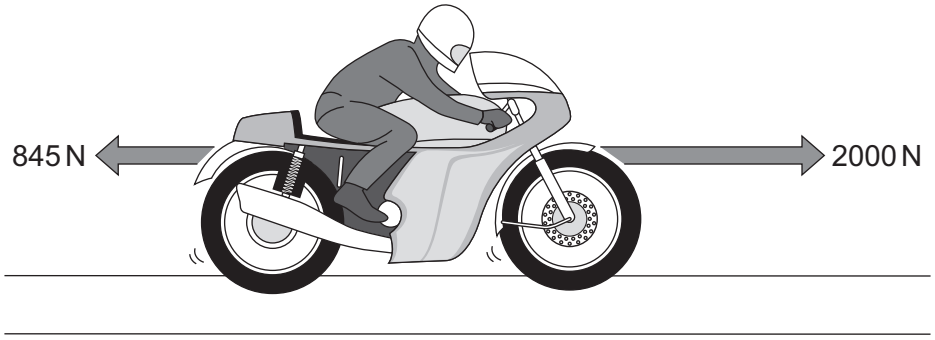
(1 mark)

7

Turn over for the next question

Do not write outside the box

7 The arrows in the diagram represent the horizontal forces acting on a motorbike at one moment in time.



7 (a) The mass of the motorbike and rider is 275 kg.

Use the equation in the box to calculate the acceleration of the motorbike at this moment in time.

resultant force = mass × acceleration

Show clearly how you work out your answer.

.....

.....

.....

.....

.....

Acceleration = ... m/s ^{2}

(3 marks)

Do not write outside the box

7 (b) A road safety organisation has investigated the causes of motorbike accidents.

The main aim of the investigation was to find out whether there was any evidence that young, inexperienced riders were more likely to be involved in an accident than older, experienced riders.

Data obtained by the organisation from a sample of 1800 police files involving motorbike accidents, is summarised in the table.

Size of motorbike engine	Percentage of all motorbikes sold	Total number in the sample of 1800 accident files
up to 125cc	36	774
126 to 350cc	7	126
351 to 500cc	7	162
over 500cc	50	738

Most of the motorbikes with engines up to 125 cc were ridden by young people. The motorbikes with engines over 500 cc were ridden by older, more experienced riders.

7 (b) (i) In terms of the main aim of the investigation, is this data valid?

Draw a ring around your answer. **NO** **YES**

Explain the reason for your answer.

.....

.....

.....

.....

(2 marks)

Question 7 continues on the next page

Turn over ▶

Do not write outside the box

7 (b) (ii) The organisation concluded that:

"Young, inexperienced riders are more likely to be involved in a motorbike accident than older, experienced riders".

Explain how the data supports this conclusion.

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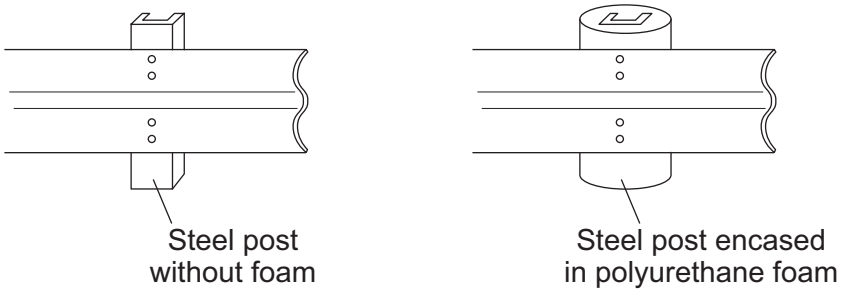
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(2 marks)

7 (c) Of particular concern to motorbike riders is the design of steel crash barriers. Riders falling off and sliding at high speed into a steel support post are often seriously injured.

One way to reduce the risk of serious injury is to cover the post in a thick layer of high impact polyurethane foam.



7 (c) (i) Use the ideas of momentum to explain how the layer of foam reduces the risk of serious injury to a motorbike rider sliding at high speed into the support post.

.....

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.....

.....

(3 marks)

Do not write outside the box

7 (c) (ii) Crash barrier tests use dummies that collide at 17 m/s with the barrier. Each test costs about £12 000. New safety devices for crash barriers are tested many times to make sure that they will improve safety.

Do you think that the cost of developing the new safety devices is justified?

Draw a ring around your answer. **NO** **YES**

Give a reason for your answer.

.....

.....

(1 mark)

11

END OF QUESTIONS

There are no questions printed on this page

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Version1.0: 29/07/2011

General Certificate of Secondary Education

Additional Science 4463 / Physics 4451

PHY2H Unit Physics 2

Mark Scheme

2011 Examination – June Series

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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 candidates' 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 candidates' 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 candidates' 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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Marking Guidance for Examiners

GCSE Science Papers

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 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.

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

Candidate	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)

Candidate	Response	Marks awarded
1	Pluto, Mars, Moon	1
2	Pluto, 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, 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.

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PHY2H

Question 1

question	answers	extra information	mark
1(a)	brown		1
1(b)	outside/case is plastic / an insulator	accept is double insulated accept non-conductor for plastic do **not** accept it / hairdryer is plastic	1
1(c)(i)	(1) S_1 (2) S_1 and S_3	and no other both required, either order	1 1
1(c)(ii)	S_1 must be ON (for either heater to work) S_1 switches the fan on	do **not** accept reference to 'fan' switch	1 1
1(d)	1495 watt(s) or W	allow **1** mark for correct substitution, ie 6.5 × 230 an answer of 1.495 kW gains **3** marks although the unit is an independent mark for full credit the unit and numerical value must be consistent accept joules per second or J/s	2 1
Total			**9**

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PHY2H

Question 2

question	answers	extra information	mark
2(a)	572	allow **1** mark for correct substitution, ie 220 × 2.6 allow **1** mark for 220 x 260 = 57 200 **or** 220 x 2600 = 572 000 but to score this mark the entire calculation must be shown	2
2(b)(i)	smooth curve drawn	accept a line that is extrapolated back to 0 degrees, but not through the origin accept a straight line of best fit (point at 40 degrees can be treated as anomalous and line may stop at 30 degrees) do **not** accept straight lines drawn 'dot to dot' or directly from first to last point or a line going through the origin	1
2(b)(ii)	increases	accept a positive correlation do **not** accept proportional	1

Question 2 continues on the next page

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PHY2H

Question 2 continued

question	answers	extra information	mark
2(b)(iii)	long plank	no mark for this, the marks are for the explanation	
	makes the angle small(er) (than a short plank)	accept increases the distance accept small(er) slope	1
	a small(er) force is needed		1
	or		
	short plank	no mark for this, the marks are for the explanation	
	a large(r) force is used over a short(er) distance (1)		
	less work done (1)	accept less energy transfer	
Total			**6**

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PHY2H

Question 3

question	answers	extra information	mark
3(a)	**L** **J** **K**	all 3 in correct order allow **1** mark for 1 correct	2
3(b)	number of electrons = number of protons	accept amount for number	1
3(c)	neutrons	this answer only	1
3(d)	loses / gains electron(s)		1
Total			**5**

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PHY2H

Question 4

question	answers	extra information	mark
4	beta	reason may score even if alpha or gamma given	1
	any **two** from: • mass number does not change **or** total number of protons and neutrons does not change • atomic / proton number increases by 1 **or** number of protons increases by 1 • number of neutrons goes down by 1	allow for **2** marks a neutron splits / changes into a proton and electron / beta candidates that answer correctly in terms of why alpha **and** gamma are not possible, gain both marks	2
Total			**3**

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PHY2H

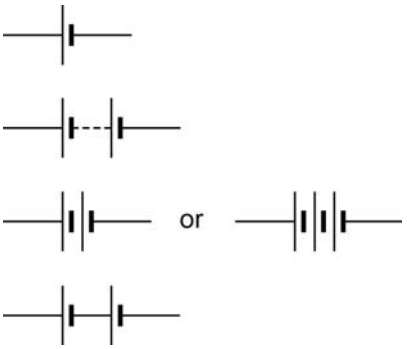
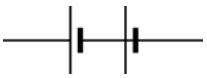
Question 5

question	answers	extra information	mark
5(a)	48	allow for **1** mark correct method shown, ie 6 × 8 **or** correct area indicated on the graph	2
5(b)	diagonal line from (0,0) to (6,48) / (6, their (a))	if answer to (a) is greater than 50, scale must be changed to gain this mark	1
	horizontal line at 48m between 6 and 10 seconds	accept horizontal line drawn at their (a) between 6 and 10 seconds	1
Total			**4**

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PHY2H

Question 6

question	answers	extra information	mark
6(a)(i)	ammeter and battery **in series** with the **gauge**	symbols must be correct ignore a voltmeter drawn in series	1
		accept  **not**  or cells reversed to cancel out	1
	voltmeter in parallel with the gauge	symbol must be correct accept a freestanding circuit diagram provided strain gauge is labelled or a resistor symbol used for the strain gauge	
6(a)(ii)	d.c. flows only in one direction	a.c. changes direction is insufficient	1
6(b)(i)	75	this answer only allow **1** mark for correct substitution **and** transformation, ie resistance = $\frac{3.0}{0.040}$	2

Question 6 continues on the next page

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PHY2H

Question 6 continued

question	answers	extra information	mark
6(b)(ii)	increases		1
6(b)(iii)	elastic / strain <u>potential</u>	do **not** accept potential	1
Total			**7**

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PHY2H

Question 7

question	answers	extra information	mark
7(a)	4.2	2 marks for correct substitution **and** transformation, ie 1155/275 allow **1** mark for correct resultant force with a subsequent incorrect method, ie 1155 allow **1** mark for an incorrect resultant force with a subsequent correct method, eg answers of 7.27 or 10.34 gain **1** mark	3
7(b)(i)	YES any **two** from: • data (from police files) can be trusted • data answers the question asked • large sample used NO any **two** from: • the sample is not representative • the sample size is too small • accident files do not indicate age / experience of riders	marks are for the explanation allow a conclusion can be made from the data an answer YES and NO can score **1** mark from each set of mark points	2

Question 7 continues on the next page

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PHY2H

Question 7 continued

question	answers	extra information	mark
7(b)(ii)	more accidents with motorbikes up to 125 cc	accept for **2** marks an answer in terms of number of under 125 cc to accidents ratio compared correctly with number of over 500 cc to accidents ratio	1
	even though there are fewer of these bikes than bikes over 500 cc		1
7(c)(i)	increases the time taken to stop	accept increases collision time	1
	decreases rate of change in momentum	accept reduces acceleration / deceleration accept $F = \frac{\Delta mv}{\Delta t}$ reduces momentum is insufficient	1
	reduces the force (on the rider)		1
7(c)(ii)	YES any sensible reason, eg: • cannot put a price on life / injury • fewer (serious) injuries • reduces cost of health care / compensation NO any sensible suggestion, eg: • money better spent on … • total number of riders involved is small	the mark is for the reason accept may save lives accept reduces risk of injury needs to be specific	1
Total			**11**

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Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

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

General Certificate of Secondary Education
Higher Tier
January 2011

Additional Science
Unit Physics P2

PHY2H

H

Physics
Unit Physics P2

Wednesday 19 January 2011 9.00 am to 9.45 am

For this paper you must have:
- a ruler.

You may use a calculator.

Time allowed
- 45 minutes

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 45.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.

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

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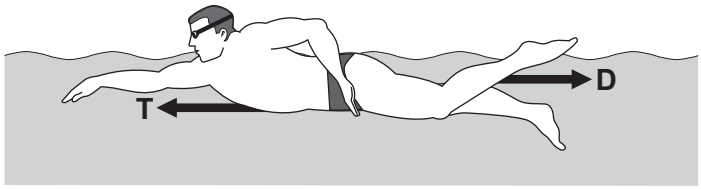
There are no questions printed on this page

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

Do not write outside the box

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

1 (a) The diagram shows the horizontal forces acting on a swimmer.



1 (a) (i) The swimmer is moving at constant speed.
Force **T** is 120 N.

What is the size of force **D**?

..... N
(1 mark)

1 (a) (ii) By increasing force **T** to 140 N, the swimmer accelerates to a higher speed.

Calculate the size of the initial resultant force acting on the swimmer.

.....

.....

Initial resultant force = ... N
(1 mark)

1 (a) (iii) Even though the swimmer keeps the force **T** constant at 140 N, the resultant force on the swimmer decreases to zero.

Explain why.

.....

.....

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.....

.....
(3 marks)

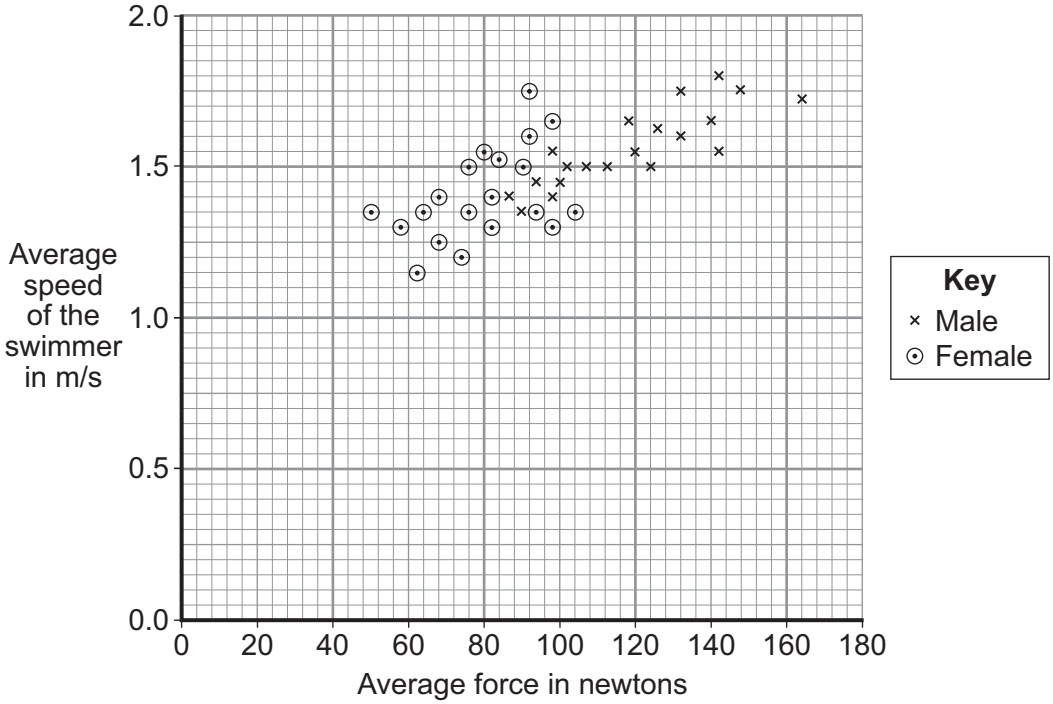
Question 1 continues on the next page

Turn over ▶

Do not write outside the box

1 (b) A sports scientist investigated how the force exerted by a swimmer's hands against the water affects the swimmer's speed.
The investigation involved 20 males and 20 females swimming a fixed distance.
Sensors placed on each swimmer's hands measured the force 85 times every second over the last 10 metres of the swim.
The measurements were used to calculate an average force.
The average speed of each swimmer over the last 10 metres of the swim was also measured.

The data from the investigation is displayed in the graph.



1 (b) (i) What was the dependent variable in this investigation?

.....

(1 mark)

1 (b) (ii) Explain **one** advantage of measuring the force 85 times every second rather than just once or twice every second.

.....

.....

.....

.....

(2 marks)

Do not write outside the box

1 (b) (iii) Give **one** way in which the data for the male swimmers is different from the data for the female swimmers.

.....

.....

(1 mark)

1 (b) (iv) Considering only the data from this investigation, what advice should a swimming coach give to swimmers who want to increase their average speed?

.....

.....

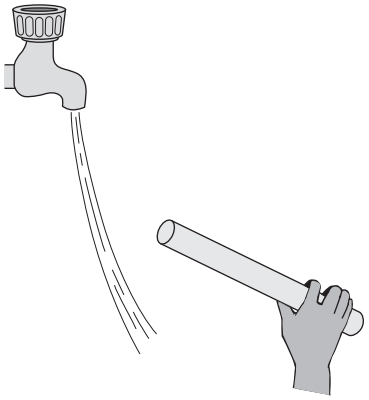
(1 mark)

10

Turn over for the next question

Do not write outside the box

2 (a) The diagram shows a negatively charged plastic rod held close to a thin stream of water. The water is attracted towards the rod.



Which **one** of the following statements explains what is happening to the charge in the water?

Tick (✓) **one** box.

The positive and the negative charges in the water are attracted to the rod. ☐

The positive and the negative charges in the water are repelled by the rod. ☐

The negative charge in the water is repelled by the rod and the positive charge is attracted. ☐

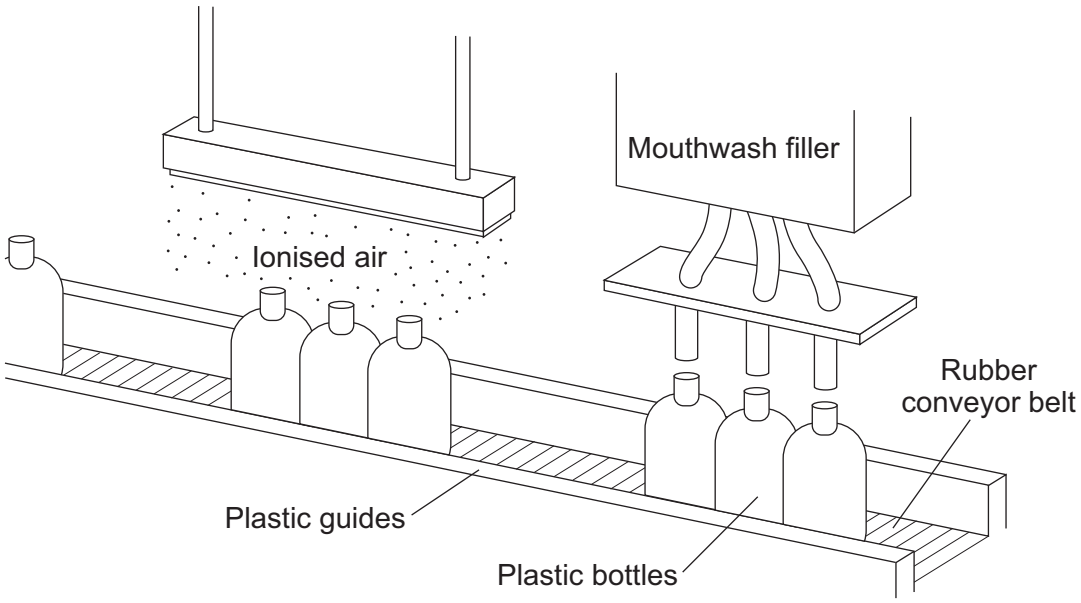
The negative charge in the water is attracted by the rod and the positive charge is repelled. ☐

(1 mark)

Do not write outside the box

2 (b) A company that produces bottles of mouthwash found a problem with the automatic filling system.

As the bottles go towards the filler, they move around on the conveyer belt and become electrostatically charged. This causes the stream of mouthwash to move sideways, missing the open top of the bottle.



The company came up with a solution to the problem. Before the bottles reach the filler, they pass through a stream of ionised air. The ions in the air neutralise the charge on the bottles.

2 (b) (i) Explain why the plastic bottles become charged.

.....

.....

.....

.....

(2 marks)

Question 2 continues on the next page

Turn over ▶

Do not write outside the box

2 (b) (ii) What is an ion?

.....

.....

(1 mark)

2 (b) (iii) Earthing the conveyor belt with a conducting wire would not have solved this problem.

Give a reason why.

.....

.....

(1 mark)

5

Do not write outside the box

3 (a) Background radiation is all around us all the time.

3 (a) (i) Radon is a natural source of background radiation.

Name another natural source of background radiation.

.....

(1 mark)

3 (a) (ii) X-rays are an artificial source of background radiation.

Name another artificial source of background radiation.

.....

(1 mark)

3 (a) (iii) An atom of radon-222 decays by emitting an alpha particle.
The equation representing the decay is shown below.

$$^{222}_{86}\text{Rn} \longrightarrow {}^{218}_{84}\text{X} + \text{alpha particle}$$

How can you tell from the equation that 'X' is not an atom of radon?

.....

.....

(1 mark)

Question 3 continues on the next page

Turn over ▶

Do not write outside the box

3 (b) Having an X-ray taken increases your exposure to radiation.

The table gives:

- the radiation doses received for 6 different medical X-rays;
- the number of days' of exposure to natural background radiation each dose is equivalent to.

Medical X-ray	Radiation dose received (in arbitrary units)	Equivalent number of days of exposure to natural background radiation
Chest	2	2.4
Skull	7	8.4
Pelvis	22	26.4
Hip	44	52.8
Spine	140	
CT head scan	200	240

A hospital patient has an X-ray of the spine taken.
Calculate the number of days of exposure to natural background radiation that an X-ray of the spine is equivalent to.

Show how you work out your answer.

.....

.....

.....

Equivalent number of days = ...

(2 marks)

Do not write outside the box

3 (c) Scientists have shown that X-rays increase the risk of developing cancer.
The scientists came to this conclusion by studying the medical history of people placed in one of two groups, **A** or **B**.
The group into which people were put depended on their X-ray record.

3 (c) (i) Person **J** has been placed into group **A**.
Place each of the people, **K**, **L**, **M**, **N** and **O**, into the appropriate group, **A** or **B**.

Person	**J** 	**K** 	**L** 	**M** 	**N** 	**O** 
Medical X-ray record	3 arm	None	None	2 skull	None	4 leg

Group A	**Group B**
J	

(1 mark)

3 (c) (ii) To be able to make a fair comparison, what is important about the number of people in each of the two groups studied by the scientists?

.....

.....

(1 mark)

3 (c) (iii) What data would the scientists have compared in order to come to the conclusion that X-rays increase the risk of developing cancer?

.....

.....

(1 mark)

Question 3 continues on the next page

Do not write outside the box

3 (c) (iv) The chance of developing cancer due to a CT head scan is about 1 in 10 000.
The chance of developing cancer naturally is about 1 in 4.

A hospital patient is advised by a doctor that she needs to have a CT head scan.
The doctor explains to the patient the risks involved.

Do you think that the patient should give her permission for the CT scan to be taken?

Draw a ring around your answer.

Yes **No**

Give a reason for your answer.

.....

.....

(1 mark)

9

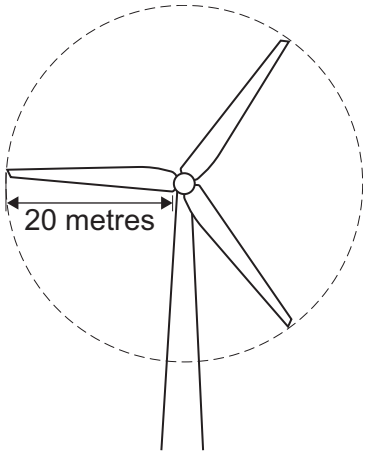
Do not write outside the box

Turn over for the next question

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

Do not write outside the box

4 The diagram shows a wind turbine.



4 (a) The blades of the turbine are 20 metres long. On average, 15 000 kg of air, moving at a speed of 12 m/s, hit the blades every second.

Use the equation in the box to calculate the kinetic energy of the air hitting the blades every second.

$$\text{kinetic energy} = \frac{1}{2} \times \text{mass} \times \text{speed}^2$$

Show clearly how you work out your answer.

.....

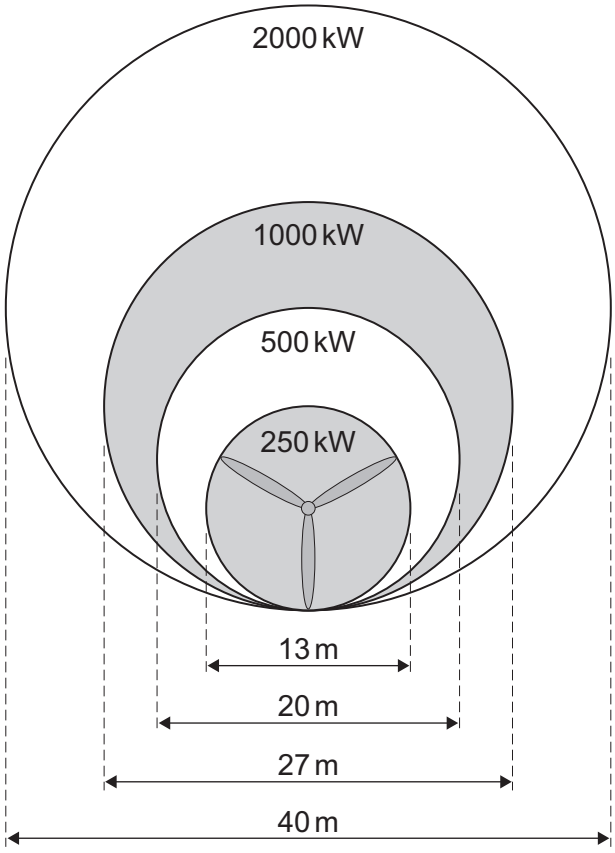
.....

Kinetic energy = ... J

(2 marks)

Do not write outside the box

4 (b) Part of the kinetic energy of the wind is transformed into electrical energy.
The diagram shows that, for the same wind speed, the power output of a turbine, in kilowatts, depends on the length of the turbine blades.



Give a reason why doubling the diameter of the blades more than doubles the power output of a turbine.

.....

.....

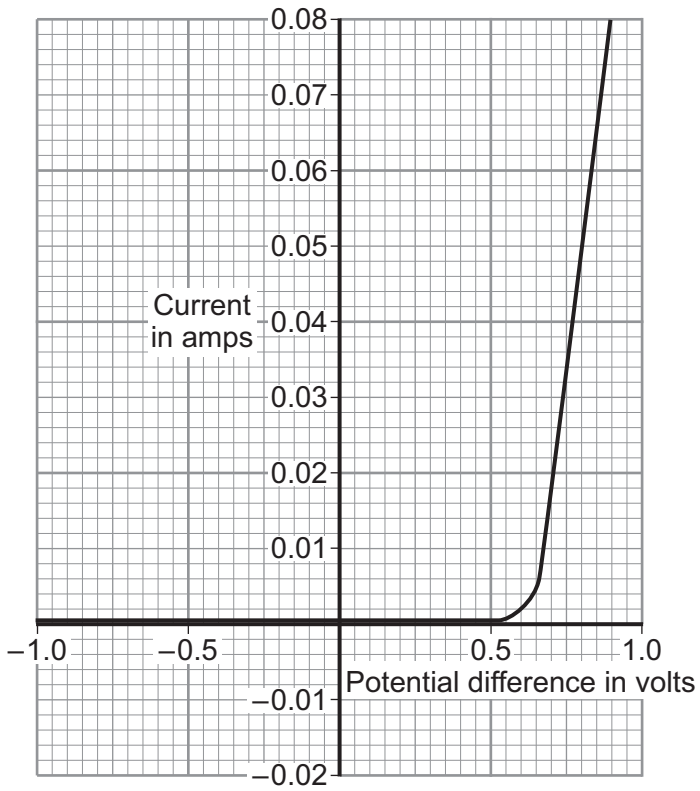
(1 mark)

3

Turn over for the next question

Do not write outside the box

5 The current – potential difference graph for one type of electrical component is drawn below.



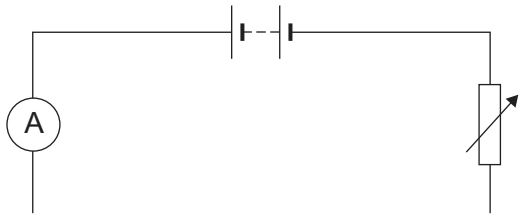
5 (a) What is the component?

.....

(1 mark)

Do not write outside the box

5 (b) Complete the diagram to show a circuit that can be used to obtain the data needed to plot the graph. Use the correct circuit symbol for each component that you add to the diagram.



(2 marks)

5 (c) (i) What is the current through the component when the potential difference across the component is 0.8 volts?

Current ..... amps
(1 mark)

5 (c) (ii) Use the equation in the box to calculate the resistance of the component when the potential difference across it is 0.8 volts.

potential difference = current × resistance

Show clearly how you work out your answer.

.....

.....

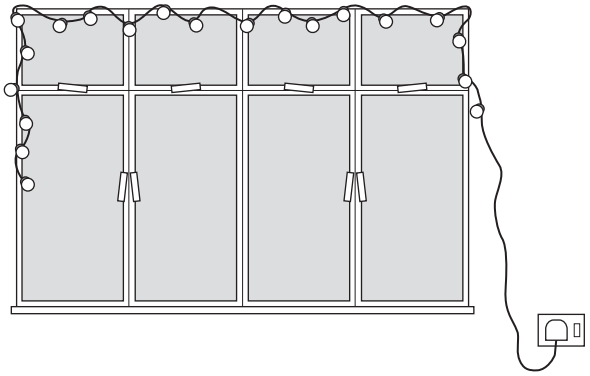
Resistance = ... Ω
(2 marks)

6

Turn over for the next question

Do not write outside the box

6 A set of lights consists of 20 lamps connected in series to the 230 V mains electricity supply.



6 (a) When the lights are switched on and working correctly, the current through each lamp is 0.25 A.

6 (a) (i) What is the total current drawn from the mains supply?

.....

(1 mark)

6 (a) (ii) Use the equation in the box to calculate the charge passing through **one** of the lamps in 5 minutes.

charge = current × time

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

.....

.....

.....

.....

Total charge = ...

(3 marks)

Do not write outside the box

6 (b) One of the lamps in the set is a fuse lamp. This contains a filament which melts if a fault occurs. A short time after the lights are switched on, a fault causes the filament inside the fuse lamp to melt and all the lamps go out.

The householder cannot find another fuse lamp so connects a piece of aluminium foil across the contacts inside the fuse lamp holder.
When switched on, the nineteen remaining lamps work.
What the householder has done is dangerous.

Explain why.

.....

.....

.....

.....

(2 marks)

6

Turn over for the next question

Do not write outside the box

7 (a) Complete the following sentence.

The momentum of a moving object has a magnitude, in kg m/s,

and a ..... . *(1 mark)*

7 (b) A car being driven at 9.0 m/s collides with the back of a stationary lorry. The car slows down and stops in 0.20 seconds. The total mass of the car and driver is 1200 kg.

Use the equations in the box to calculate the average force exerted by the lorry on the car during the collision.

$$\text{momentum} = \text{mass} \times \text{velocity}$$

$$\text{force} = \frac{\text{change in momentum}}{\text{time take for the change}}$$

Show clearly how you work out your answer.

.....

.....

Force = ... N

(2 marks)

7 (c) Within 0.04 s of the car hitting the back of the lorry, the car driver's airbag inflates. The airbag deflates when it is hit by the driver's head.



Use the idea of momentum to explain why the airbag reduces the risk of the driver sustaining a serious head injury.

.....

.....

.....

.....

.....

.....

(3 marks)

6

END OF QUESTIONS

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Version1.0: 24/02/2011

General Certificate of Secondary Education

Additional Science 4463 / Physics 4451

PHY2H Unit Physics 2

Mark Scheme

2011 Examination – January Series

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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 candidates' 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 candidates' 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 candidates' 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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Marking Guidance for Examiners

GCSE Science Papers

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 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.

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

Candidate	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)

Candidate	Response	Marks awarded
1	Pluto, Mars, Moon	1
2	Pluto, 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, 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.

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PHY2H

Question 1

question	answers	extra information	mark
1(a)(i)	120		1
1(a)(ii)	20	accept 140-their (a)(i) provided answer is not negative	1
1(a)(iii)	as speed increases drag force / water resistance / friction / **D** increases (until) **D** = 140 N or (until) **D** = **T**	 forces balance is insufficient	1 1 1
1(b)(i)	(average) speed (of swimmer)		1
1(b)(ii)	any **two** from: • more data • force may vary (a lot) / change • give more <u>reliable average</u>	 accept results for data do **not** accept more accurate data ignore references to anomalies ignore accurate / precise	2

Question 1 continues on the next page . . .

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PHY2H

Question 1 continued . . .

question	answers	extra information	mark
1(b)(iii)	examples of acceptable responses: • most / some females produce smaller forces • most / some males produce larger forces • some females swim as fast as males but use a smaller force • most of the faster swimmers are male • most of the slower swimmers are female • range of the (average) speed of males is smaller than the range of the (average) speed of females • range of the (average) force of the males is greater than the range of the (average) force of the females	do **not** accept <u>all</u> females produce smaller forces do **not** accept <u>all</u> males produce larger forces do **not** accept <u>all</u> males swim faster do **not** accept <u>all</u> females swim slower	1
1(b)(iv)	exert maximum (hand) force (throughout the swim / stroke)	accept (any method to) increase (hand) force practise more is insufficient	1
Total			**10**

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PHY2H

Question 2

question	answers	extra information	mark
2(a)	3rd box The negative charge in the water is repelled by the rod and the positive charge is attracted.		1
2(b)(i)	friction between bottles and conveyor belt / (plastic) guides charge transfers between bottles and conveyor belt / (plastic) guides	accept bottles rub against conveyor belt / (plastic) guides accept specific reference eg electrons move onto / off the bottles reference to positive electrons / protons negates this mark	1 1
2(b)(ii)	an atom that has lost / gained electron(s)	do **not** accept a charged particle	1
2(b)(iii)	charge will not (easily) flow off the conveyor belt	accept the conveyor belt / bottle is an insulator / not a conductor accept conveyor belt is rubber	1
Total			**5**

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PHY2H

Question 3

question	answers	extra information	mark
3(a)(i)	any **one** from: • food / drink • rocks / building materials • cosmic rays / rays from space	accept correctly named example	1
3(a)(ii)	any **one** from: • nuclear power / coal power (stations) • nuclear accidents • nuclear weapons testing	accept nuclear waste accept named accident eg Chernobyl accept named medical procedure which involves a radioactive source accept radiotherapy nuclear activity / radiation is insufficient do **not** accept CT scans	1
3(a)(iii)	different number of / fewer protons **or** different atomic number	accept does not have 86 protons accept only has 84 protons do **not** accept bottom number different reference to mass number negates this mark	1

Question 3 continues on the next page . . .

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PHY2H

Question 3 continued . . .

question	answers	extra information	mark
3(b)	168	accept 169 if clear, correct method is shown allow **1** mark for a correct dose ratio involving the spine eg 2:140 etc **or** ratio of days to dose is 1.2 **or** ratio of dose to days is 0.83	2
3(c)(i)	**Group A**: **J M O**; **Group B**: **K L N**	all correct any order within each group	1
3(c)(ii)	similar (number) / same (number) / large (number)	accept the same specific number in each group eg three reference to other factors such as age is neutral	1
3(c)(iii)	how many people in each group developed cancer	a clear comparison is required	1

Question 3 continues on the next page . . .

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PHY2H

Question 3 continued . . .

question	answers	extra information	mark
3(c)(iv)	**Yes** the benefit of having the scan is greater than the risk **or** the risk is (very) small (compared to the chance from natural causes) **No** no additional risk is acceptable	there are no marks for **Yes** or **No** the mark is for the reason accept the risk is much greater from natural causes	1
Total			**9**

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PHY2H

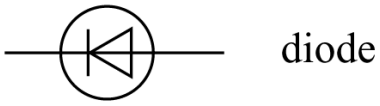
Question 4

question	answers	extra information	mark
4(a)	1 080 000	allow **1** mark for correct substitution ie ½ × 15 000 × 12 × 12	2
4(b)	any **one** from: • KE (of wind) more than doubles • mass of air (hitting blades) more than doubles • area swept out by blades more than doubles • area swept out by blades increases × 4	do **not** accept blades are larger / have a bigger area	1
Total			**3**

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PHY2H

Question 5

question	answers	extra information	mark
5(a)	diode	accept LED	1
5(b)	all symbols correct  voltmeter in parallel with component added in series	must include at least voltmeter and diode allow ecf from part (a) if the component is not identified as a diode allow symbol without the line through triangle ignore polarity of diode any additional components must not affect the ability to measure **V** and **I** for the diode / their (a)	1 1
5(c)(i)	0.05	accept 50 mA accept between 0.048 and 0.050 inclusive	1
5(c)(ii)	16	$\frac{0.8}{\text{their (c)(i)}}$ correctly calculated gains both marks allow **1** mark for correct transformation and substitution ie $\frac{0.8}{0.05}$ or $\frac{0.8}{\text{their (c)(i)}}$ allow 17 if using 0.048	2
Total			**6**

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PHY2H

Question 6

question	answers	extra information	mark
6(a)(i)	0.25 (A)		1
6(a)(ii)	75 coulombs or C	allow **1** mark for converting 5 minutes to 300 seconds **or** allow **1** mark for correct substitution ie 0.25 × 300 allow **1** mark for an answer 1.25 allow **1** mark only for their (a)(i) × 300 correctly calculated do **not** accept c	2 1
6(b)	any **two** from: • fault not repaired • larger current will (still) flow • aluminium foil will not melt (if a fault) • wiring will overheat / (may) cause a fire	 accept if a fault was to occur accept aluminium foil needs a higher current / charge to melt accept idea of fire hazard do **not** accept explode etc	2
Total			**6**

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PHY2H

Question 7

question	answers	extra information	mark
7(a)	direction		1
7(b)	54 000	allow **1** mark for calculating and identifying momentum as 10 800 **or** allow **1** mark for correct substitution into second equation ie $\frac{1200 \times 9}{0.2}$	2
7(c)	increases the time taken (for head) to stop	accept increases impact time do **not** accept reference to slowing down time unless qualified	1
	decreases rate of change in momentum	accept reduces acceleration / deceleration accept increases the time taken to reduce momentum to zero is worth **2** marks reduces momentum is insufficient	1
	reduces the <u>force</u> (on the head)		1
Total			**6**

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Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

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

General Certificate of Secondary Education
Higher Tier
June 2010

Additional Science
Unit Physics P2

PHY2H

H

Physics
Unit Physics P2

Friday 28 May 2010 9.00 am to 9.45 am

For this paper you must have:
- a ruler.

You may use a calculator.

Time allowed
- 45 minutes

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 45.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.

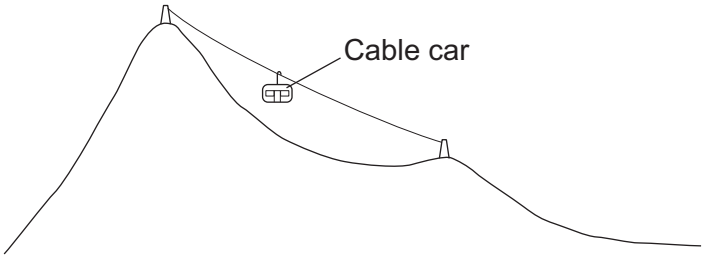
Advice
- In all calculations, show clearly how you work out your answer.

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Do not write outside the box

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

1 (a) The diagram shows a cable car used to take skiers to the top of a mountain.



1 (a) (i) The total mass of the cable car and skiers is 7500 kg.

Use the equation in the box to calculate the weight of the cable car and skiers.

weight = mass × gravitational field strength

gravitational field strength = 10 N/kg

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

.....

.....

Weight = ...

(3 marks)

Do not write outside the box

1 (a) (ii) The cable car moves at a constant speed. It lifts skiers through a vertical height of 800 metres in 7 minutes.

Use the following equation to calculate the work done to lift the cable car and skiers.

work done = force applied × distance moved in the direction of force

Show clearly how you work out your answer.

.....

.....

Work done = ... J

(2 marks)

1 (b) The diagram shows a skier who is accelerating down a steep ski slope.



1 (b) (i) Draw an arrow on the diagram to show the direction of the resultant force acting on the skier.

(1 mark)

1 (b) (ii) How and why does the kinetic energy of the skier change?

.....

.....

.....

.....

(2 marks)

Question 1 continues on the next page

Do not write outside the box

1 (c) Last year, 18 000 skiers suffered a head injury. It is thought that nearly 8000 of these injuries could have been avoided if the skier had been wearing a helmet.
However, at present, there are no laws to make skiers wear helmets.

Suggest why skiers should be made aware of the benefits of wearing a helmet.

.....

.....

(1 mark)

9

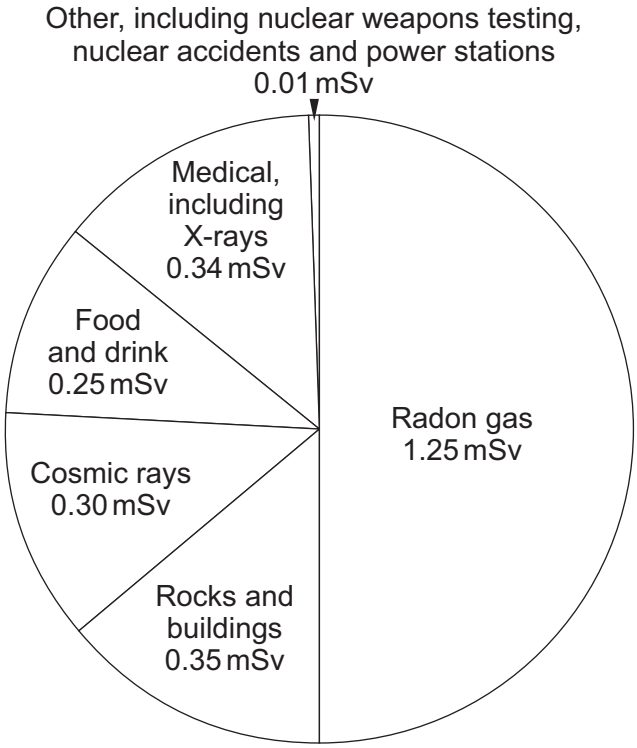
Do not write outside the box

Turn over for the next question

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

Do not write outside the box

2 The pie chart shows the sources of the background radiation and the radiation doses that the average person in the UK is exposed to in one year.
Radiation dose is measured in millisieverts (mSv).



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

.....

.....

Total radiation dose = ... mSv
(1 mark)

Do not write outside the box

2 (a) (ii) A student looked at the pie chart and then wrote down three statements.

Which **one** of the following statements is a correct conclusion from this data?

Put a tick (✓) in the box next to your answer.

In the future, more people will be exposed to a greater proportion of radon gas. ☐

People that have never had an X-ray get 50% of their radiation dose from radon gas. ☐

The radiation dose from natural sources is much greater than from artificial sources. ☐

(1 mark)

Question 2 continues on the next page

Do not write outside the box

2 (b) The concentration of radon gas inside a home can vary from day to day. In some homes, the level can build up to produce a significant health risk. It is estimated that each year 1000 to 2000 people die because of the effects of radiation from radon gas.

2 (b) (i) It is not possible to give an exact figure for the number of deaths caused by the effects of radiation from radon gas. Why?

.....

.....

(1 mark)

The table gives data for the radiation levels measured in homes in 4 different parts of the UK. The radiation levels were measured using two detectors, one in the living room and one in the bedroom. The measurements were taken over 3 months.

Area of the UK	Number of homes in the area	Number of homes in the sample	Average radiation level in Bq/m^3	Maximum radiation level in Bq/m^3
A	590 000	160	15	81
B	484 000	130	18	92
C	221 000	68 000	162	10 000
D	318 000	35 300	95	6 900

2 (b) (ii) Give **one** reason why the measurements were taken over 3 months using detectors in different rooms.

.....

.....

(1 mark)

2 (b) (iii) Use information from the table to suggest why a much higher proportion of homes were sampled in areas **C** and **D** than in areas **A** and **B**.

.....

.....

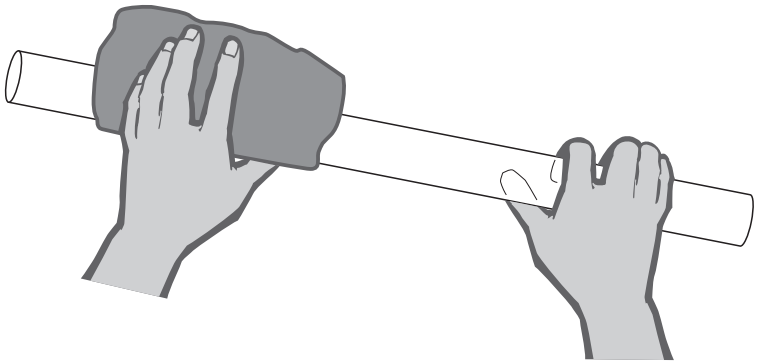
.....

(2 marks)

6

Do not write outside the box

3 (a) When a glass rod is rubbed with a woollen cloth, the rod becomes positively charged.



3 (a) (i) Explain why the glass becomes positively charged.

.....

.....

.....

.....

(2 marks)

3 (a) (ii) A glass TV screen, polished with a dry cloth on a dry day, soon becomes dusty again.

Explain why.

.....

.....

.....

.....

(2 marks)

Question 3 continues on the next page

Do not write outside the box

3 (b) Many devices use electrostatic charge to work.
The following sentences describe how a photocopier works using electrostatic charge.
The sentences are in the wrong order.

J A strong light is used to form an image of the page to be copied on the roller.

K The charged areas of the roller attract particles of black toner powder.

L The charge left on the roller has the same pattern as the dark parts of the original page.

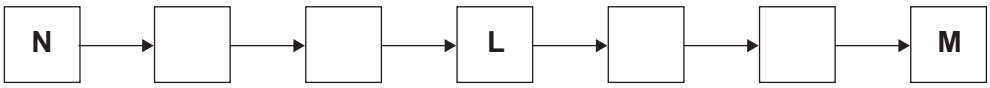
M The toner melts and sticks to the paper. This is now a photocopy of the original.

N A roller coated with a photoconducting material is given a charge.

O Where light hits the roller, the charge leaks away.

P A blank piece of paper is heated and pressed against the roller.

3 (b) (i) Arrange the sentences in the correct order.
Three of the sentences have been put into the correct places.



(3 marks)

3 (b) (ii) Why is it important that the blank piece of paper is heated?

.....

.....

(1 mark)

8

Do not write outside the box

4 (a) Uranium atoms do not always have the same number of neutrons.
What are atoms of the same element that have different numbers of neutrons called?

.....

(1 mark)

4 (b) By emitting an alpha particle, an atom of uranium-235 decays into an atom of thorium.

An alpha particle, which is the same as a helium nucleus, is represented by the symbol $^{4}_{2}He$.

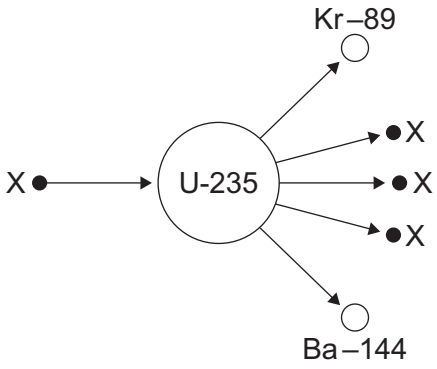
The decay can be represented by the equation below.

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

$$^{235}_{92}U \longrightarrow \square \quad Th \; + \; ^{4}_{2}He$$

(2 marks)

4 (c) The diagram shows an atom of uranium-235 being split into several pieces.



4 (c) (i) Name the process shown in the diagram.

.....

(1 mark)

4 (c) (ii) Name the particles labelled X.

.....

(1 mark)

4 (d) Uranium-235 is used as a fuel in some nuclear reactors.
Name another substance used as a fuel in some nuclear reactors.

.....

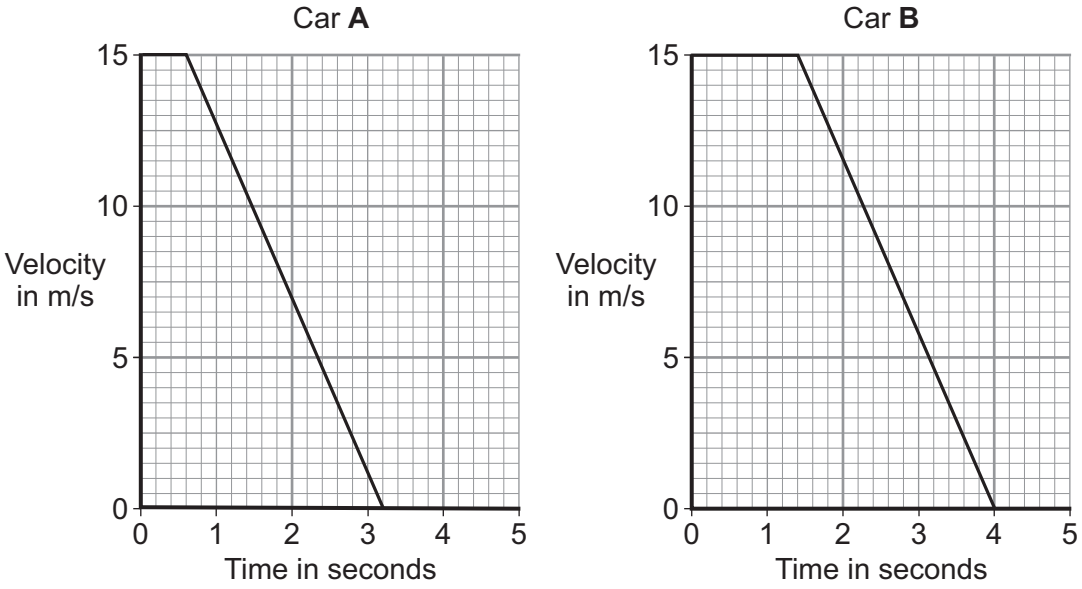
(1 mark)

6

Turn over ▶

Do not write outside the box

5 (a) The graphs show how the velocity of two cars, **A** and **B**, change from the moment the car drivers see an obstacle blocking the road.



One of the car drivers has been drinking alcohol. The other driver is wide awake and alert.

5 (a) (i) How does a comparison of the two graphs suggest that the driver of car **B** is the one who has been drinking alcohol?

.....

.....

(1 mark)

5 (a) (ii) How do the graphs show that the two cars have the same deceleration?

.....

.....

(1 mark)

5 (a) (iii) Use the graphs to calculate how much further car **B** travels before stopping compared to car **A**.

Show clearly how you work out your answer.

.....

.....

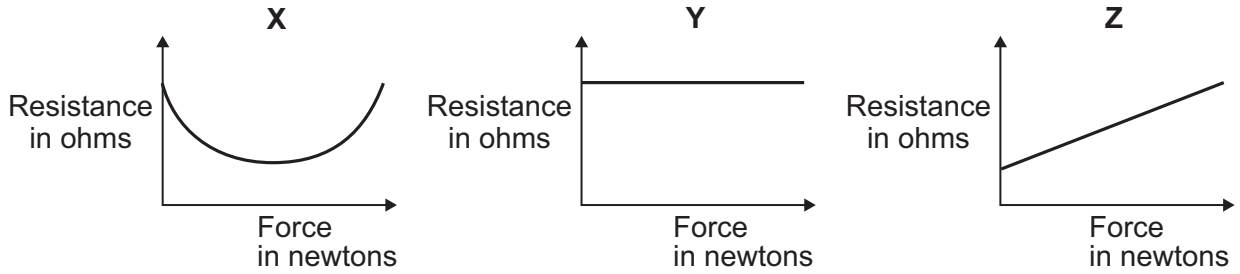
.....

Additional stopping distance = ... m

(3 marks)

Do not write outside the box

5 (b) In a crash test laboratory, scientists use sensors to measure the forces exerted in collisions. The graphs show how the electrical resistance of 3 experimental types of sensor, **X**, **Y** and **Z**, change with the force applied to the sensor.



Which of the sensors, **X**, **Y** or **Z**, would be the best one to use as a force sensor?

.....

Give a reason for your answer.

.....

.....

.....

.....

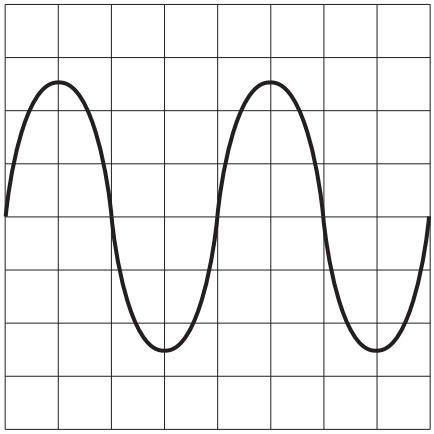
(2 marks)

7

Turn over for the next question

Do not write outside the box

6 An oscilloscope is connected to an alternating current (a.c.) supply.
The diagram shows the trace produced on the oscilloscope screen.



Each horizontal division on the oscilloscope screen represents 0.002 s.

6 (a) Calculate the frequency of the alternating current supply.

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

.....

.....

.....

Frequency = ...

(3 marks)

6 (b) What is the frequency of the a.c. mains electricity supply in the UK?

.....

(1 mark)

4

Do not write outside the box

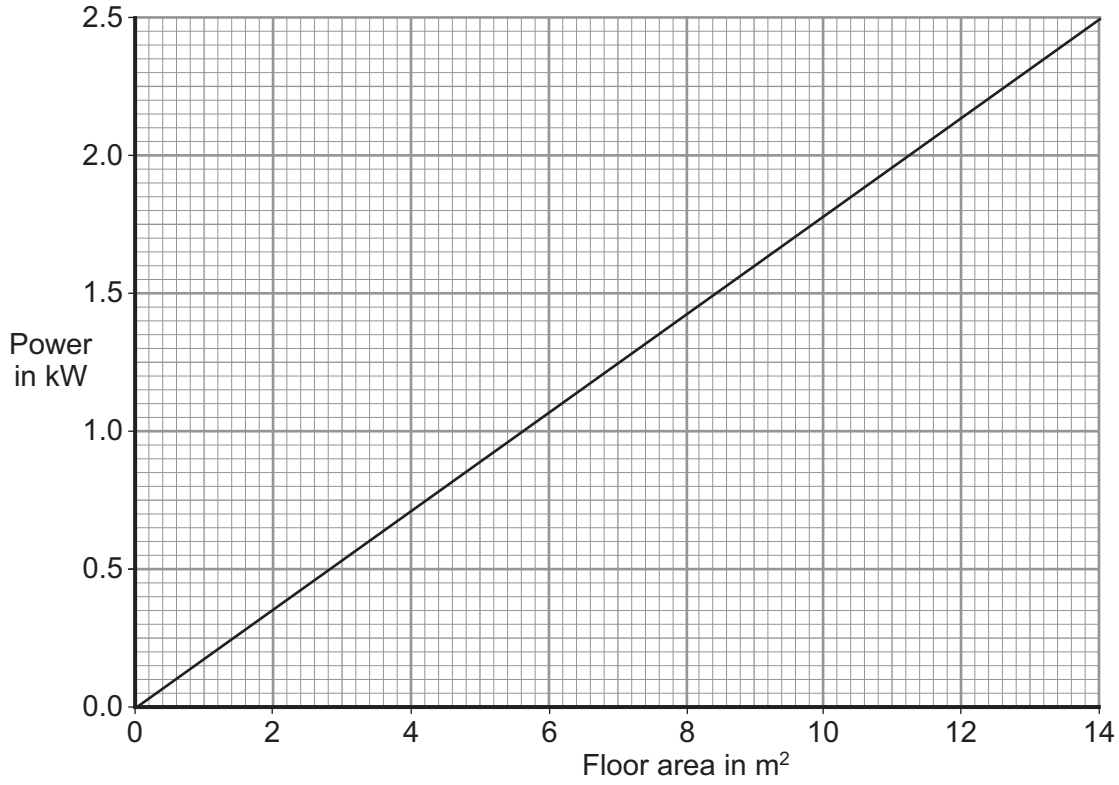
7 A homeowner has installed electric underfloor heating in the kitchen. When the heating is switched on, an electric current flows through wires running under the tiled floor surface.

7 (a) What is an electric current?

.....

(1 mark)

7 (b) The graph shows how the power output of an underfloor heating system depends on the area of the floor that is heated.



The area of the homeowner's kitchen floor is 9.0 m^2.

Use the graph and the equation in the box to calculate the current drawn from the 230 V mains supply by the heating system.

power = current × potential difference

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

.....

.....

.....

.....

Current = ...

(4 marks)

5

END OF QUESTIONS

There are no questions printed on this page

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Version : 29/07/2010

General Certificate of Secondary Education

Additional Science 4463 / Physics 4451

PHY2H Unit Physics 2

Final Mark Scheme

2010 Examination – June Series

STEMUP.CO.UK

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 candidates' 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 candidates' 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 candidates' 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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Marking Guidance for Examiners

GCSE Science Papers

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 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	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)

Candidate	Response	Marks awarded
1	Pluto, Mars, Moon	1
2	Pluto, 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, 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.

3.8 Unexpected Correct Answers not in the Mark Scheme

The Examiner should use the **?** area in the CMI+ software to forward such answers to a Senior Examiner.

PHY2H

Question 1

question	answers	extra information	mark
1(a)(i)	75 000 newtons / N	accept correct substitution for **1** mark ie 7500 × 10 do **not** accept n full credit for using g = 9.8 **or** 9.81	2 1
1(a)(ii)	60 000 000	accept for both marks their (a)(i) × 800 correctly calculated accept correct substitution for **1** mark ie their (a)(i) × 800	2
1(b)(i)	arrow drawn parallel (to) **and** down (the) slope	accept arrow drawn anywhere on the diagram	1
1(b)(ii)	increases GPE transformed to KE **or** speed increasing	 accept is accelerating however 'speed increasing' only scores if correctly linked to increasing kinetic energy	1 1
1(c)	so more likely to wear one **or** they know wearing a helmet is likely to / will reduce (risk) head injury **or** so can make an (informed) choice (about wearing one)		1
Total			**9**

PHY2H

Question 2

question	answers	extra information	mark
2(a)(i)	2.5		1
2(a)(ii)	The radiation dose from natural sources is much greater than from artificial sources.		1
2(b)(i)	other factors may be involved	accept a specific suggestion eg they may be exposed to other types of radiation accept cannot be sure (in many cases) that the cause of death is radon (poisoning)	1
2(b)(ii)	any **one** from: • different concentrations in different rooms • to average out daily fluctuations	accept to find an average accept to make the result (more) reliable / valid do **not** accept to make more accurate on its own	1
2(b)(iii)	average level (much) higher (in **C** and **D**) some homes have very high level (in **C** and **D**) **or** maximum level in some homes (in **C** and **D**) is very high	accept converse accept maximum level in **A** and **B** is low accept higher radiation levels (in **C** and **D**) for **1** mark	1 1
Total			**6**

PHY2H

Question 3

question	answers	extra information	mark
3(a)(i)	electrons transfer / removed to the cloth / from the rod	do **not** accept negatively charged atoms this only scores if first mark given accept negative charge transfer to the cloth / removed from rod for **1** mark transfer of positive charge / positive electrons scores zero transfer of electrons to the rod scores zero	1 1
3(a)(ii)	TV screen becomes (positively / negatively) charged attracts (negatively / positively charged) dust	if the sign of the charge is given then must be opposites to score both marks do **not** accept TV screen becomes static correct answer in terms of induced charge gains full credit	1 1
3(b)(i)	**J** **O** **K** **P**	**3** marks for 4 correct **2** marks for 2 correct **1** mark for 1 correct	3
3(b)(ii)	to melt the toner	accept to make the toner stick unless a reason is given that infers this is due to attraction of charged particles	1
Total			**8**

PHY2H

Question 4

question	answers	extra information	mark
4(a)	isotopes		1
4(b)	$^{231}_{90}Th$	correct order only	1 1
4(c)(i)	(nuclear) fission	accept fision do **not** accept any spelling that may be confused with fusion	1
4(c)(ii)	neutron / neutrons		1
4(d)	plutonium (239)	accept MOX (mixed oxide) accept Pu do **not** accept uranium 238 / hydrogen	1
Total			**6**

PHY2H

Question 5

question	answers	extra information	mark
5(a)(i)	longer reaction time **or** greater thinking distance **or** greater stopping distance	accept slower reactions do **not** accept slower reaction time unless qualified accept greater thinking time accept greater stopping time greater braking distance negates answer	1
5(a)(ii)	lines / slopes have the same gradient **or** velocity decreases to zero in same time / in 2.6 seconds	accept slopes are the same accept any time between 2.3 and 2.8 accept braking distances are the same	1
5(a)(iii)	12	accept extracting both reaction times correctly for **1** mark (0.6 and 1.4) **or** time = 0.8(s) for **1** mark accept 0.8 × 15 for **2** marks accept calculating the distance travelled by car **A** as 28.5 m **or** the distance travelled by car **B** as 40.5 m for **2** marks	3

Question 5 continues on next page…

PHY2H

Question 5 continued…

question	answers	extra information	mark
5(b)	**Z**		1
	different force values give a unique / different resistance	only scores if **Z** chosen do **not** accept force and resistance are (directly) proportional accept answers in terms of why either **X or Y** would not be the best eg **X** – same resistance value is obtained for 2 different force values **Y** – all force values give the same resistance	1
Total			**7**

PHY2H

Question 6

question	answers	extra information	mark
6(a)	125	allow **1** mark for obtaining time period = 0.008 (s) **or** frequency = 1 / time period (or their calculated time period)	2
	hertz **or** Hz	do **not** accept hz	1
6(b)	50 (hertz)		1
Total			**4**

PHY2H

Question 7

question	answers	extra information	mark
7(a)	(rate of) <u>flow</u> of charge / electrons / ions	accept movement for flow do **not** accept flow of electricity	1
7(b)	7(.0)	accept 6.96 / 6.95 or an answer that would approximate to 6.96 if rounded allow **1** mark for obtaining correct power and changing to watts ie 1600 **or** allow **2** marks for correct substitution and transformation ie 1600 ÷ 230 an answer 0.00696 / 0.007 gains **2** marks allow **1** mark for 1.6 / 230 or 1.7 / 230 an answer 7.39 or 7.4 gains **2** marks	3
	amp (ere)	accept A	1
Total			**5**

Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

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

General Certificate of Secondary Education
Higher Tier
January 2010

Additional Science
Unit Physics P2

PHY2H

H

Physics
Unit Physics P2

Wednesday 20 January 2010 9.00 am to 9.45 am

For this paper you must have:
- a ruler.

You may use a calculator.

Time allowed
- 45 minutes

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. Answers written in margins or on blank pages will not be marked.
- 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 45.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.

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

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Areas outside the box will not be scanned for marking

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

1 A cyclist travelling along a straight level road accelerates at 1.2 m/s^2 for 5 seconds. The mass of the cyclist and the bicycle is 80 kg.

1 (a) Use the equation in the box to calculate the resultant force needed to produce this acceleration.

resultant force = mass × acceleration

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

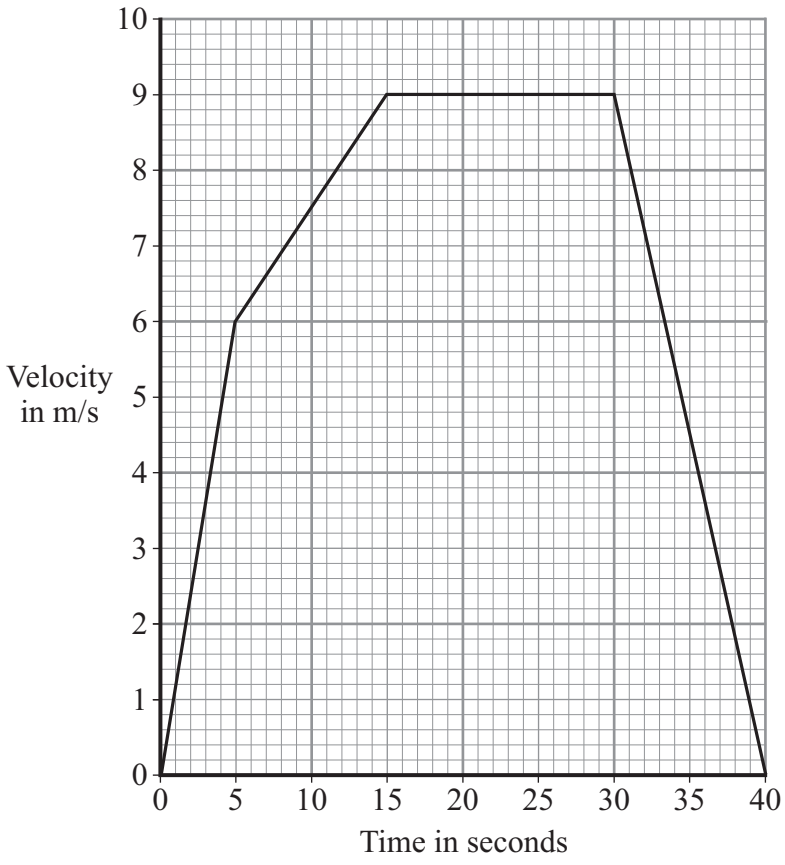
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Resultant force = ...

(3 marks)

1 (b) The graph shows how the velocity of the cyclist changes with time.



Areas outside the box will not be scanned for marking

1 (b) (i) Complete the following sentence.

The velocity includes both the speed and the ..... of the cyclist.

(1 mark)

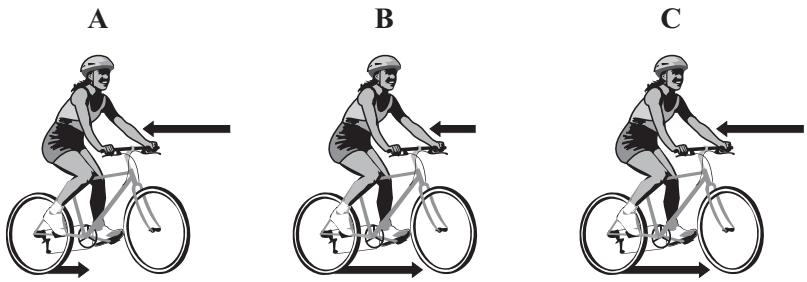
1 (b) (ii) Why has the data for the cyclist been shown as a line graph instead of a bar chart?

.....

.....

(1 mark)

1 (b) (iii) The diagrams show the horizontal forces acting on the cyclist at three different speeds. The length of an arrow represents the size of the force.



Which **one** of the diagrams, **A**, **B** or **C**, represents the forces acting when the cyclist is travelling at a constant 9 m/s?

.....

Explain the reason for your choice.

.....

.....

.....

.....

.....

.....

(3 marks)

8

Areas outside the box will not be scanned for marking

2 (a) The process of nuclear fusion results in the release of energy.

2 (a) (i) Describe the process of nuclear fusion.

.....

.....

.....

.....

(2 marks)

2 (a) (ii) Where does nuclear fusion happen naturally?

.....

(1 mark)

2 (b) For many years, scientists have tried to produce a controlled nuclear fusion reaction that lasts long enough to be useful. However, the experimental fusion reactors use more energy than they produce.

2 (b) (i) From the information given, suggest **one** reason why nuclear fusion reactors are not used to produce energy in a nuclear power station.

.....

.....

(1 mark)

2 (b) (ii) Suggest **one** reason why scientists continue to try to develop a practical nuclear fusion reactor.

.....

.....

(1 mark)

Areas outside the box will not be scanned for marking

2 (c) In 1989, two scientists claimed in a daily newspaper that they had produced nuclear fusion reactions in normal laboratory conditions. The process became known as 'cold fusion'. Other scientists thought that the evidence produced to support 'cold fusion' was unreliable.

2 (c) (i) Suggest **one** reason why other scientists thought that the evidence to support 'cold fusion' was unreliable.

.....

.....

(1 mark)

2 (c) (ii) In 2007, the results of a new 'cold fusion' research project were published in a respected scientific journal. This journal includes scientists such as Albert Einstein amongst its past authors.

Suggest why people may be more likely to believe an article published in a respected scientific journal than one published in a daily newspaper.

.....

.....

.....

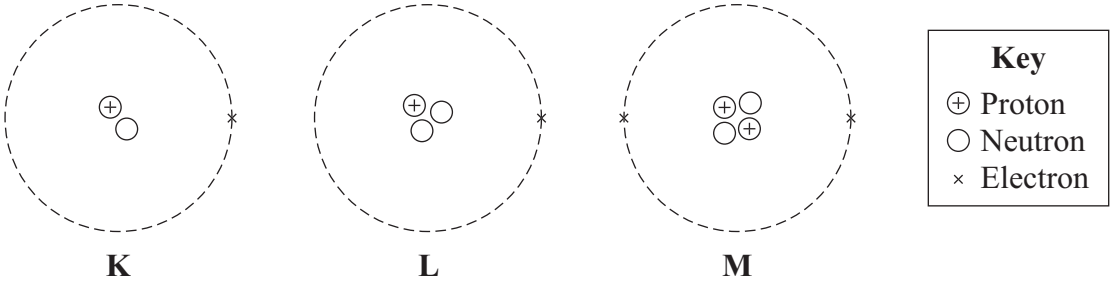
(1 mark)

7

Turn over for the next question

Areas outside the box will not be scanned for marking

3 (a) The diagram represents 3 atoms, **K**, **L** and **M**.



K **L** **M**

3 (a) (i) Which **two** of the atoms are isotopes of the same element?

..... and .....

(1 mark)

3 (a) (ii) Give a reason why the **two** atoms that you chose in part (a)(i) are:

(1) atoms of the same element .....

.....

(2) different isotopes of the same element. .....

.....

.....

(2 marks)

3 (b) The table gives some information about the radioactive isotope thorium-230.

mass number	230
atomic number	90

3 (b) (i) How many electrons are there in an atom of thorium-230?

.....

(1 mark)

3 (b) (ii) How many neutrons are there in an atom of thorium-230?

.....

(1 mark)

Areas outside the box will not be scanned for marking

3 (c) When a thorium-230 nucleus decays, it emits radiation and changes into radium-226.

$$^{230}_{90}\text{Th} \longrightarrow {}^{226}_{88}\text{Ra} + \boxed{\text{Radiation}}$$

What type of radiation, alpha, beta or gamma, is emitted by thorium-230?

.....

Explain the reason for your answer.

.....

.....

.....

.....

.....

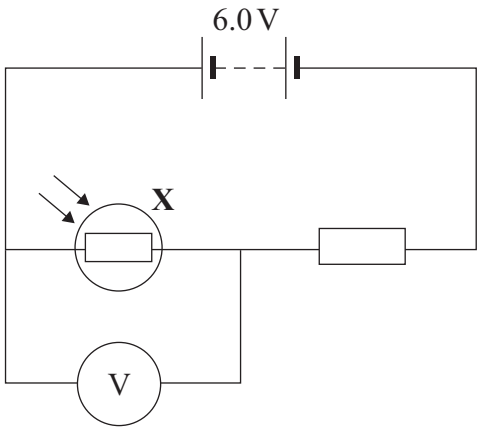
(3 marks)

8

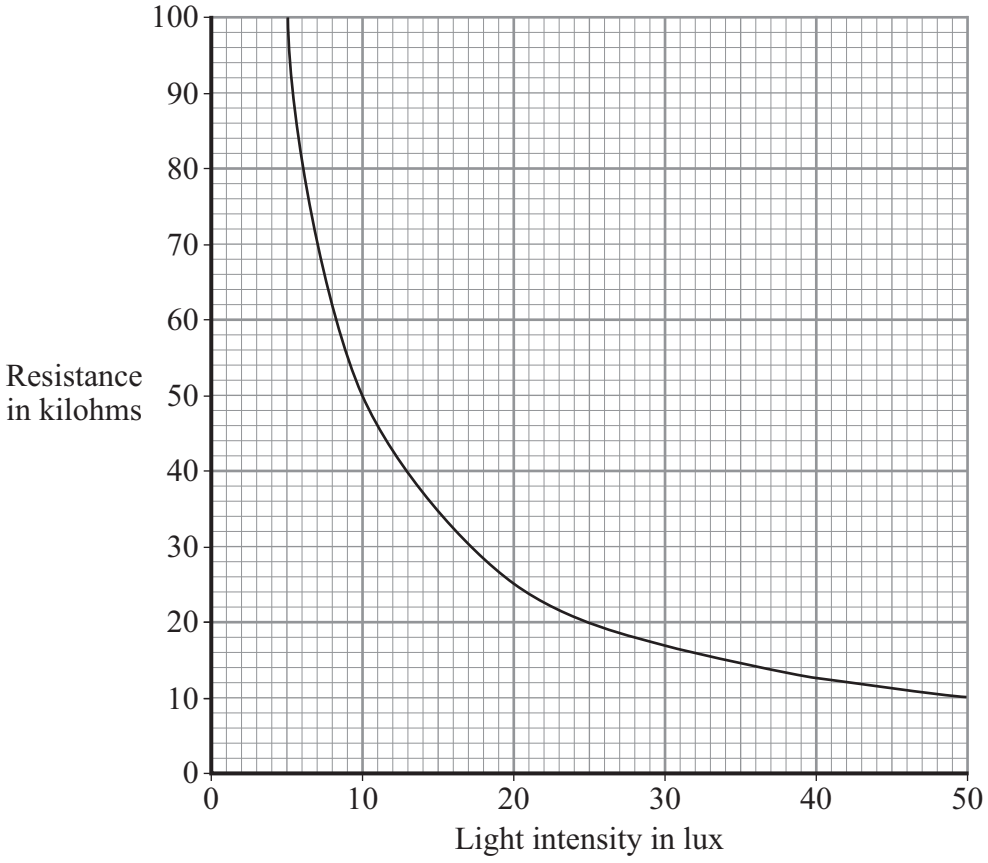
Turn over for the next question

Areas outside the box will not be scanned for marking

4 The diagram shows a simple light-sensing circuit.



4 (a) The graph, supplied by the manufacturer, shows how the resistance of the component labelled **X** varies with light intensity.



Areas outside the box will not be scanned for marking

4 (a) (i) What is component **X**?

.....

(1 mark)

4 (a) (ii) Use the graph to find the resistance of component **X** when the light intensity is 20 lux.

.....

(1 mark)

4 (a) (iii) When the light intensity is 20 lux, the current through the circuit is 0.0002 A.

Use the equation in the box to calculate the reading on the voltmeter when the light intensity is 20 lux.

potential difference = current × resistance

Show clearly how you work out your answer.

.....

.....

Voltmeter reading = ... volts

(2 marks)

Question 4 continues on the next page

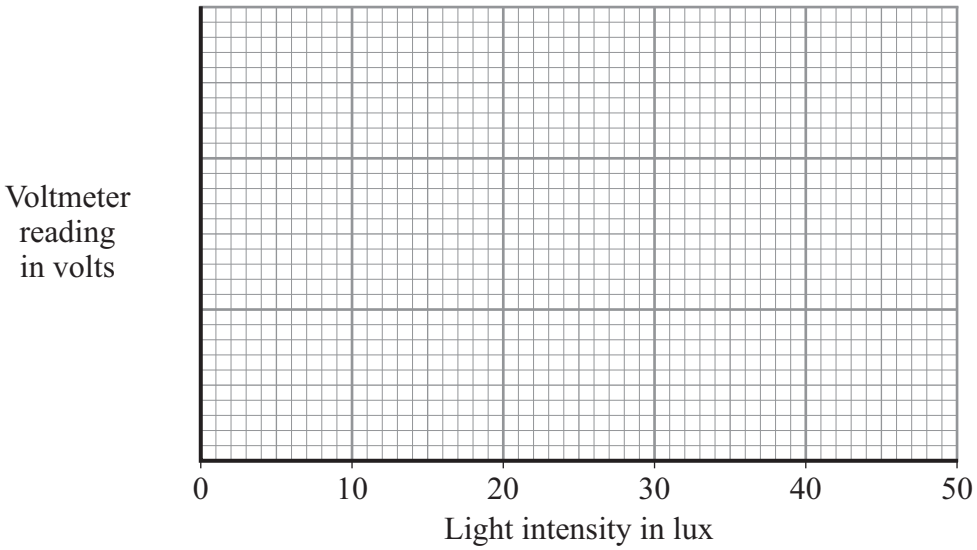
Areas outside the box will not be scanned for marking

4 (b) Use the grid below to show how the voltmeter reading in the light-sensing circuit varies with light intensity.

4 (b) (i) Add a suitable scale to the *y*-axis (vertical axis).

(1 mark)

4 (b) (ii) Complete the sketch graph by drawing a line on the grid to show how the voltmeter reading will vary with light intensity.



(2 marks)

4 (c) The following passage is taken from the technical data supplied for component **X** by the manufacturer.

> For any given light intensity, the resistance of this component can vary by plus or minus 50% of the value shown on the **graph of light intensity and resistance**.

4 (c) (i) Calculate the maximum resistance that component **X** could have at 20 lux light intensity.

.....

Maximum resistance = ... kilohms

(1 mark)

4 (c) (ii) Explain why this light-sensing circuit would **not** be used to measure values of light intensity.

.....

.....

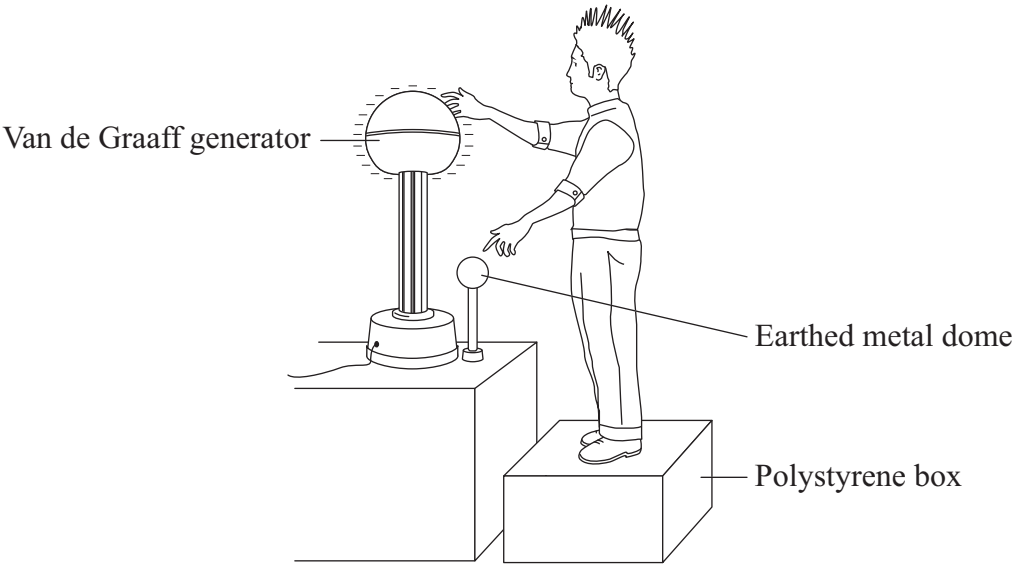
.....

(2 marks)

10

Areas outside the box will not be scanned for marking

5 (a) The diagram shows a student touching the metal dome of a Van de Graaff generator. When the generator is switched on, the metal dome becomes negatively charged.



Explain why the student's hair stands on end when the generator is switched on.

.....

.....

.....

(2 marks)

5 (b) When the potential difference between the student and a nearby earthed metal dome reached 15 kV, a spark jumped between the student and the earthed dome. The spark transformed 30 mJ of energy into heat, light and sound. (1 mJ = 0.001 J)

Use the equation in the box to calculate the charge carried by the spark.

energy transformed = potential difference × charge

.....

.....

Charge transferred = ... coulombs

(2 marks)

5 (c) What name is given to the rate of flow of charge?

.....

(1 mark)

5

Turn over ▶

Areas outside the box will not be scanned for marking

6 (a) In any collision, the total momentum of the colliding objects is usually conserved.

6 (a) (i) What is meant by the term 'momentum is conserved'?

.....

.....

(1 mark)

6 (a) (ii) In a collision, momentum is **not** always conserved.

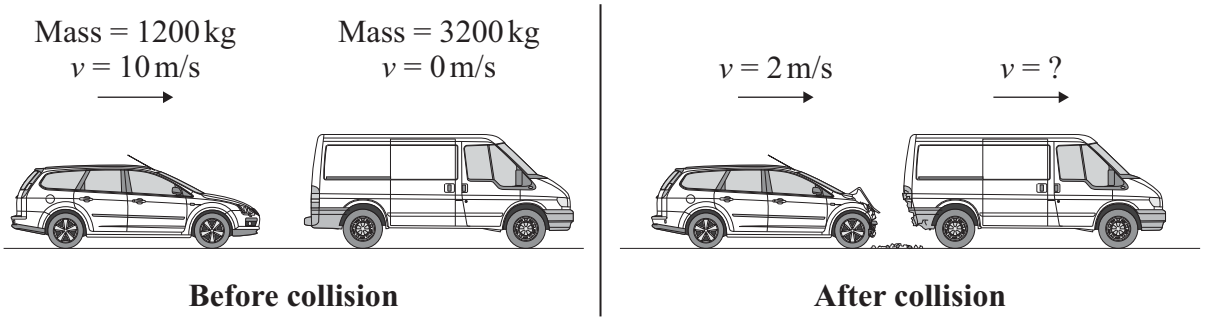
Why?

.....

.....

(1 mark)

6 (b) The diagram shows a car and a van, just before and just after the car collided with the van.



Before collision **After collision**

Areas outside the box will not be scanned for marking

6 (b) (i) Use the information in the diagram and the equation in the box to calculate the **change** in the momentum of the car.

momentum = mass × velocity

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

.....

.....

.....

.....

Change in momentum = ...

(3 marks)

6 (b) (ii) Use the idea of conservation of momentum to calculate the velocity of the van when it is pushed forward by the collision.

Show clearly how you work out your answer.

.....

.....

.....

Velocity = ... m/s forward

(2 marks)

7

END OF QUESTIONS

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Version : 24/02/2010

General Certificate of Secondary Education

Additional Science 4463/ Physics 4451

PHY2H Unit Physics 2

Mark Scheme

2010 examination - January series

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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 candidates' 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 candidates' 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 candidates' 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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Dr Michael Cresswell Director General

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 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.

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

Candidate	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)

Candidate	Response	Marks awarded
1	Pluto, Mars, Moon	1
2	Pluto, 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, 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.

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PHY2H

Question 1

question	answers	extra information	mark
1(a)	96	allow **1** mark for correct substitution ie 80 × 1.2	2
	newton or N	allow Newton do **not** allow n	1
1(b)(i)	direction		1
1(b)(ii)	velocity <u>and</u> time are continuous (variables)	answers must refer to both variables accept the variables are continuous / not categoric accept the data / 'it' is continuous accept the data / 'it' is not categoric	1
1(b)(iii)	**C**		1
	velocity is not changing	the **2** marks for reason may be scored even if **A** or **B** are chosen accept speed for velocity accept speed is constant (9 m/s) accept **not** decelerating accept **not** accelerating accept reached terminal velocity	1
	forces must be balanced **or** resultant force is zero	accept forces are equal accept arrows are the same length / size do **not** accept the arrows are equal	1
Total			**8**

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PHY2H

Question 2

question	answers	extra information	mark
2(a)(i)	(two) nuclei (of light elements) join forming a larger / heavier nucleus / one	accept hydrogen atoms for nuclei accept comparative term equivalent to larger accept forms a helium (nucleus / atom) this mark only scores if fusion is in terms of hydrogen atoms	1 1
2(a)(ii)	stars	accept a named star e.g. the Sun accept nebula mention of planets negates answer	1
2(b)(i)	any **one** from: • (currently) only experimental • reaction does not last long enough • use more energy than they produce	 allow difficult to control do **not** allow inefficient on its own	1
2(b)(ii)	any **one** from: • will give another source of energy • unlimited fuel supplies / energy • would not produce any radioactive waste • want to show that it can be done	do **not** accept answers only in terms of fossil fuels or carbon dioxide accept unlimited hydrogen accept less radioactive waste accept nuclear for radioactive do **not** accept toxic waste accept any sensible suggestion	1

Question 2 continues on the next page . . .

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PHY2H

Question 2 continued . . .

question	answers	extra information	mark
2(c)(i)	any **one** from: • repeating did not produce the same results / data • experiments were not / may not be reproducible • data / experiments were not valid	accept could not be repeated accept has not been repeated do **not** accept answers in terms of scientists being biased	1
2(c)(ii)	any **one** from: • cannot trust journalists • newspaper journalist may not have a science background • newspaper may publish what people want to read • newspaper may simplify ideas • people believe / trust the scientists writing the journal • people have heard of the scientists writing in the journal • scientists writing in the journal are famous • journal only publishes the work of respected / famous scientists • data is checked by other scientists before published in the journal	bias is insufficient on its own accept any sensible suggestion, these are examples they do not constitute a full list	1
Total			**7**

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PHY2H

Question 3

question	answers	extra information	mark
3(a)(i)	**K** and **L**	both answers required either order	1
3(a)(ii)	(1) same number of protons (2) different numbers of neutrons	accept same number of electrons accept same atomic number	1 1
3(b)(i)	90		1
3(b)(ii)	140		1
3(c)	alpha (particle) mass number goes down by 4 **or** number of protons and neutrons goes down by 4 **or** number of neutrons goes down by 2 atomic / proton number goes down by 2 **or** number of protons goes down by 2	reason may score even if beta or gamma is chosen candidates that answer correctly in terms of why gamma **and** beta decay are not possible gain full credit accept an alpha particle consists of 2 neutrons and 2 protons for **1** mark accept alpha equals $^{4}_{2}$He or $^{4}_{2}\alpha$ for **1** mark an alpha particle is a helium nucleus is insufficient for this mark	1 1 1
Total			**8**

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PHY2H

Question 4

question	answers	extra information	mark
4(a)(i)	light dependent resistor / LDR	accept ldr	1
4(a)(ii)	25 (kilohms)	accept 24 - 26 inclusive accept 25 000 Ω	1
4(a)(iii)	5 (V) or their (a)(ii) correctly converted to ohms × 0.0002 correctly calculated	allow **1** mark for converting 25 kΩ / their (a)(ii) to ohms **or** allow **1** mark for correct substitution ie 0.0002 × 25(000) **or** 0.0002 × their (a)(ii) allow an incorrect conversion from kilohms providing this is clearly shown	2
4(b)(i)	linear scale	using all of the available axis must cover the range 4 - 6 v **or** their (a)(iii) − 6 v and lie within the range 0 – 15 inc.	1
4(b)(ii)	negative gradient line passing through 20 lux and their (a)(iii)	do **not** allow lines with both positive and negative gradients only scores if the first mark is awarded only scores if line does not go above 6 volts	1 1
4(c)(i)	37.5 (kΩ) or their (a)(ii) + 50 % (a)(ii) correctly calculated		1

Question 4 continues on the next page . . .

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PHY2H

Question 4 continued . . .

question	answers	extra information	mark
4(c)(ii)	light intensity value would be unreliable / not accurate		1
	due to variation in <u>resistance</u> value	accept because resistance varies by ± 50 % accept tolerance of resistor is too great do **not** accept results are not accurate	1
Total			**10**

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PHY2H

Question 5

question	answers	extra information	mark
5(a)	each hair gains the <u>same</u> (type of) charge **or** (each) hair is negatively charged **or** (each) hair gains electrons	do **not** accept hair becomes positively charged	1
	similar charges repel **or** negative charges repel **or** electrons repel	accept positive charges repel providing first marking point is in terms of positive charge	1
5(b)	0.000002 **or** 2×10^{-6} **or** 2 μC	accept correct substitution and transformation for **1** mark ie 30 / 15 or .03 / 15000 or 30 / 15000 or .03 / 15 answers 2 and 0.002 gain **1** mark	2
5(c)	current	do **not** accept amp / amperes	1
Total			**5**

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PHY2H

Question 6

question	answers	extra information	mark
6(a)(i)	momentum before = momentum after **or** (total) momentum stays the same	accept no momentum is lost accept no momentum is gained	1
6(a)(ii)	an external force acts (on the colliding objects)	accept colliding objects are not isolated	1
6(b)(i)	9600 kg m/s **or** Ns	allow **1** mark for correct calculation of momentum before or after ie 12000 or 2400 **or** correct substitution using change in velocity = 8 m/s ie 1200 × 8 this may be given in words rather than symbols	2 1
6(b)(ii)	3 or their (b)(i) ÷ 3200 correctly calculated	allow **1** mark for stating momentum before = momentum after **or** clear attempt to use conservation of momentum	2
Total			**7**

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Surname		Other Names	
Centre Number			Candidate Number				
Candidate Signature									

For Examiner's Use

General Certificate of Secondary Education
June 2009

ADDITIONAL SCIENCE
Unit Physics P2

PHY2H

H

PHYSICS
Unit Physics P2

Higher Tier

Wednesday 10 June 2009 1.30 pm to 2.15 pm

For this paper you must have:
- a ruler.

You may use a calculator.

Time allowed: 45 minutes

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. Answers written in margins or on blank pages will not be marked.
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information
- The maximum mark for this paper is 45.
- The marks for questions are shown in brackets.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.

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

For Examiner's Use			
Question	Mark	Question	Mark
1		3	
2		4	
		5	
		6	
Total (Column 1) →			
Total (Column 2) →			
TOTAL			
Examiner's Initials			

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Areas outside the box will not be scanned for marking

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

1 The table gives information about the three types of particle that make up an atom.

Particle	Relative mass	Relative charge
Proton		+1
Neutron	1	
Electron	very small	–1

1 (a) Complete the table by adding the **two** missing values. *(2 marks)*

1 (b) Use the information in the table to explain why an atom has no overall electrical charge.

.....

.....

.....

.....

(2 marks)

1 (c) Uranium has two natural isotopes, uranium-235 and uranium-238.
Uranium-235 is used as a fuel inside a nuclear reactor.
Inside the reactor, atoms of uranium-235 are split and energy is released.

1 (c) (i) How is the structure of an atom of uranium-235 different from the structure of an atom of uranium-238?

.....

.....

(1 mark)

1 (c) (ii) The nucleus of a uranium-235 atom must absorb a particle before the atom is able to split.

What type of particle is absorbed?

.....

(1 mark)

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Areas outside the box will not be scanned for marking

1 (c) (iii) The nucleus of an atom splits into smaller parts in a reactor.

What name is given to this process?

.....

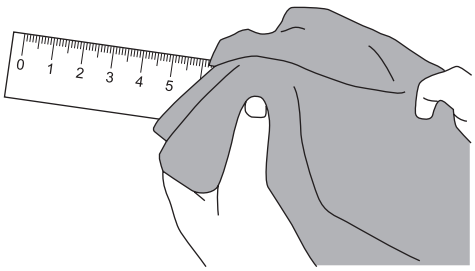
(1 mark)

7

Turn over for the next question

Areas outside the box will not be scanned for marking

2 (a) A plastic ruler is rubbed with a cloth.



The ruler becomes negatively charged.

2 (a) (i) Complete the following sentence by drawing a ring around the correct line in the box.

The ruler becomes negatively charged because it has

gained electrons
lost neutrons
lost protons

.

(1 mark)

2 (a) (ii) How could you show that the ruler is charged?

.....

.....

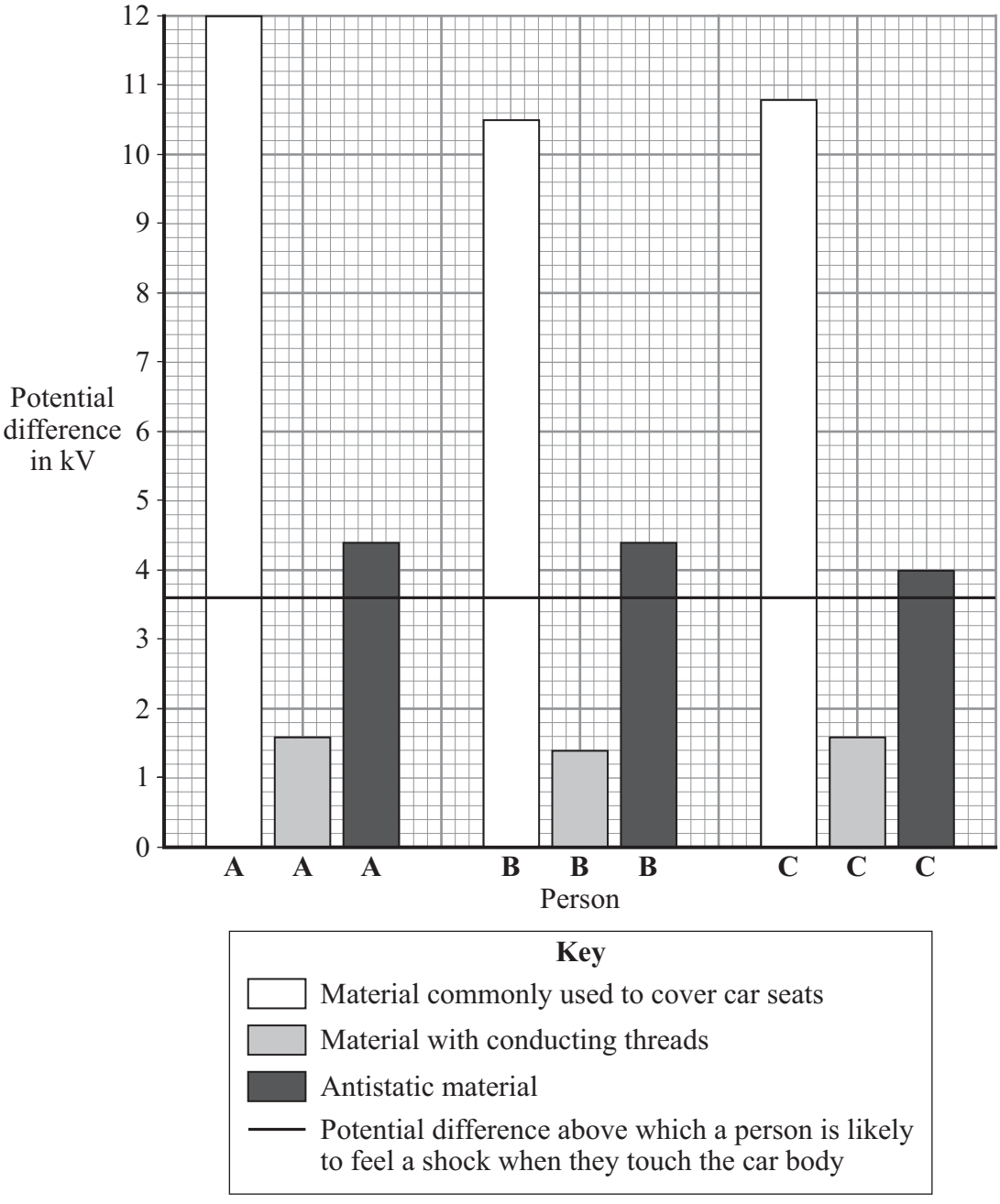
(1 mark)

Areas outside the box will not be scanned for marking

2 (b) People often become electrostatically charged as they get out of a car.
This happens because their clothing rubs against the car seat.

A scientist was asked to find out whether the amount of charge on a person depended on the type of material which covered the car seat.
Three people, **A**, **B** and **C**, were used to test three different types of seat covering.

In each test, the person got out of the car and stood on a thick sheet of plastic.
The scientist then measured the potential difference between the person and the car body.
The results of the investigation are displayed in the bar chart.



Question 2 continues on the next page

Turn over ▶

Areas outside the box will not be scanned for marking

2 (b) (i) Explain why the measurement was made with the person standing on a thick sheet of plastic.

.....

.....

.....

.....

(2 marks)

2 (b) (ii) To make this a fair test, the three people, **A**, **B** and **C**, each wore the same type of clothing.

Suggest a reason why this was important.

.....

.....

(1 mark)

2 (b) (iii) The smallest scale division on the voltmeter was 0.1 kV.

Suggest why, from the data, it was **not** necessary to increase the precision of the potential difference measurements.

.....

.....

(1 mark)

2 (b) (iv) Explain why this investigation may cause a manufacturer to change the material used to cover car seats.

.....

.....

.....

.....

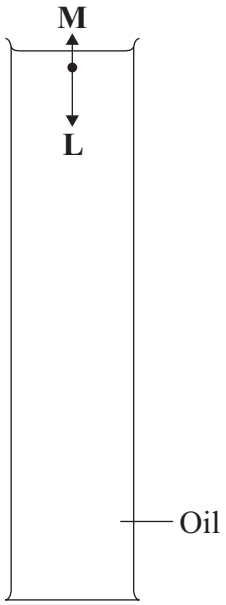
(2 marks)

8

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Areas outside the box will not be scanned for marking

3 (a) The diagram shows a steel ball-bearing falling through a tube of oil.
The forces, **L** and **M**, act on the ball-bearing.



What causes force **L**?

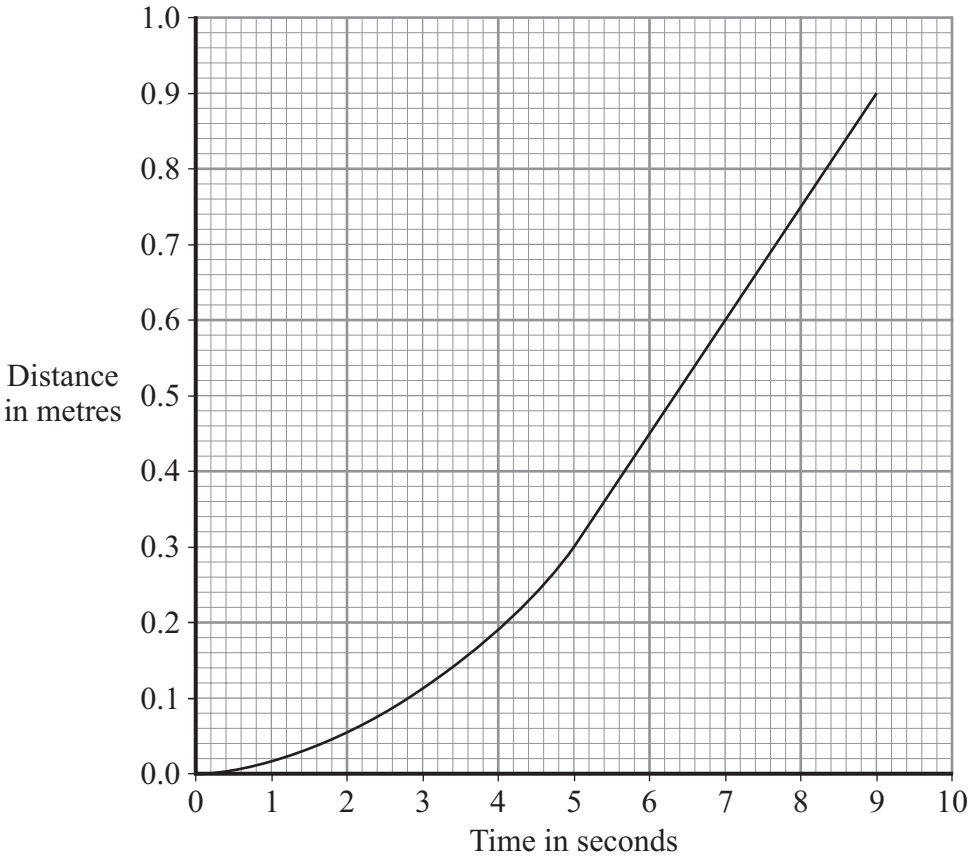
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(1 mark)

Question 3 continues on the next page

Areas outside the box will not be scanned for marking

3 (b) The distance–time graph represents the motion of the ball-bearing as it falls through the oil.



3 (b) (i) Explain, in terms of the forces, **L** and **M**, why the ball-bearing accelerates at first but then falls at constant speed.

.....

.....

.....

.....

.....

.....

(3 marks)

3 (b) (ii) What name is given to the constant speed reached by the falling ball-bearing?

.....

(1 mark)

Areas outside the box will not be scanned for marking

3 (b) (iii) Calculate the constant speed reached by the ball-bearing.

Show clearly how you use the graph to work out your answer.

.....

.....

.....

Speed = ... m/s

(2 marks)

7

Turn over for the next question

Areas outside the box will not be scanned for marking

4 The diagram shows a child on a playground swing.
The playground has a rubber safety surface.



4 (a) The child, with a mass of 35 kg, falls off the swing and hits the ground at a speed of 6 m/s.

4 (a) (i) Use the equation in the box to calculate the momentum of the child as it hits the ground.

momentum = mass × velocity

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

.....

.....

.....

Momentum = ...

(3 marks)

Areas outside the box will not be scanned for marking

4 (a) (ii) After hitting the ground, the child slows down and stops in 0.25 s.
Use the equation in the box to calculate the force exerted by the ground on the child.

$$\text{force} = \frac{\text{change in momentum}}{\text{time taken for the change}}$$

Show clearly how you work out your answer.

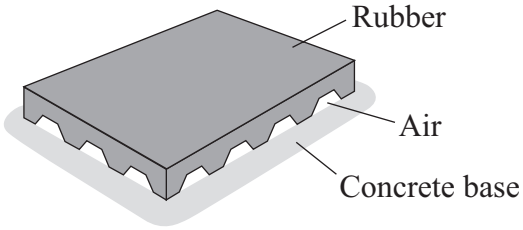
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.....

Force = ... N

(2 marks)

4 (b) The diagram shows the type of rubber tile used to cover the playground surface.



Explain how the rubber tiles reduce the risk of children being seriously injured when they fall off the playground equipment.

.....

.....

.....

.....

.....

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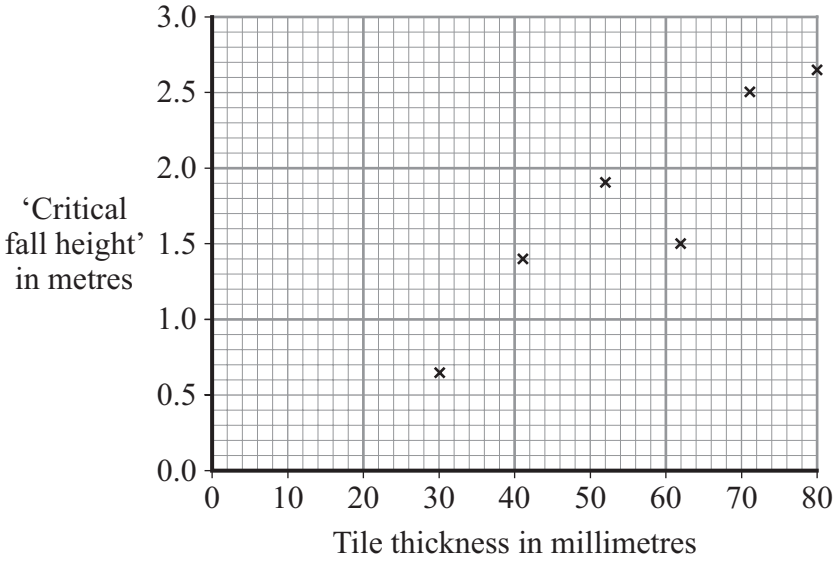
(3 marks)

Question 4 continues on the next page

Areas outside the box will not be scanned for marking

4 (c) The 'critical fall height' is the height that a child can fall and **not** be expected to sustain a life-threatening head injury.
A new type of tile, made in a range of different thicknesses, was tested in a laboratory using test dummies and the 'critical fall height' measured. Only one test was completed on each tile.

The results are shown in the graph.



The 'critical fall height' for playground equipment varies from 0.5 m to 3.0 m.

Suggest **two** reasons why more tests are needed before this new type of tile can be used in a playground.

1.....

.....

2.....

.....

(2 marks)

4 (d) Developments in technology allow manufacturers to make rubber tiles from scrap car tyres.

Suggest why this process may benefit the environment.

.....

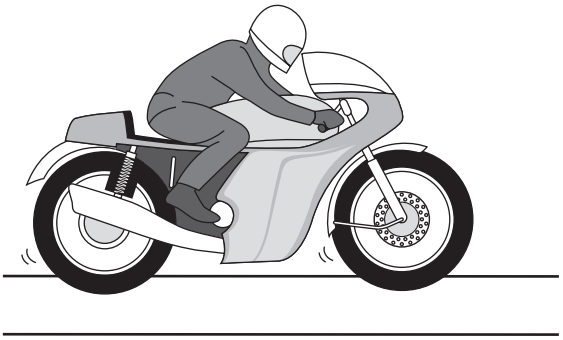
.....

(1 mark)

11

Areas outside the box will not be scanned for marking

5 The diagram shows a motorbike of mass 300 kg being ridden along a straight road.



The rider sees a traffic queue ahead. He applies the brakes and reduces the speed of the motorbike from 18 m/s to 3 m/s.

5 (a) Use the equation in the box to calculate the kinetic energy lost by the motorbike.

$$\text{kinetic energy} = \frac{1}{2} \times \text{mass} \times \text{speed}^2$$

Show clearly how you work out your answer.

.....

.....

.....

.....

Kinetic energy lost = ... J

(2 marks)

5 (b) (i) How much work is done on the motorbike by the braking force?

.....

(1 mark)

5 (b) (ii) What happens to the kinetic energy lost by the motorbike?

.....

(1 mark)

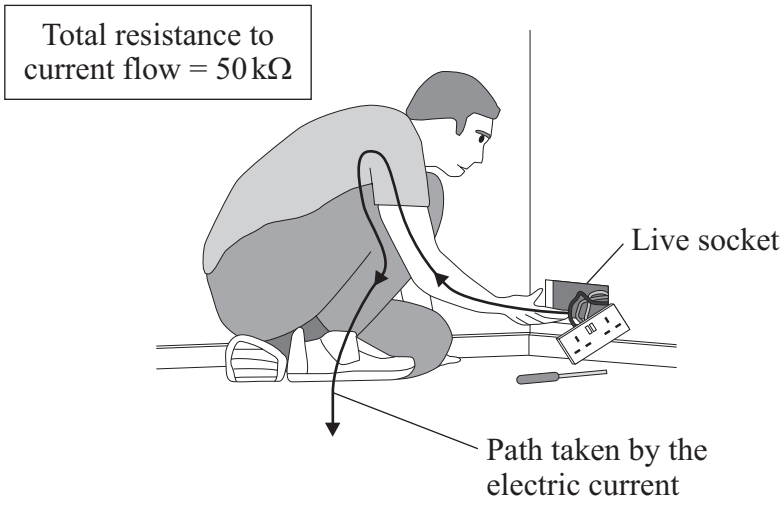
4

Turn over ▶

Areas outside the box will not be scanned for marking

6 The diagram shows someone accidentally touching the live wire inside a dismantled 230 volt mains electricity socket.

A current flows through the person giving him an electric shock.



6 (a) (i) Use the equation in the box to calculate the current that will flow through the person.

potential difference	=	current	×	resistance

Show clearly how you work out your answer.

.....

.....

Current = ... A

(2 marks)

6 (a) (ii) Rubber is a good insulator.

Explain why it is a good idea for electricians to wear rubber soled boots when working.

.....

.....

.....

.....

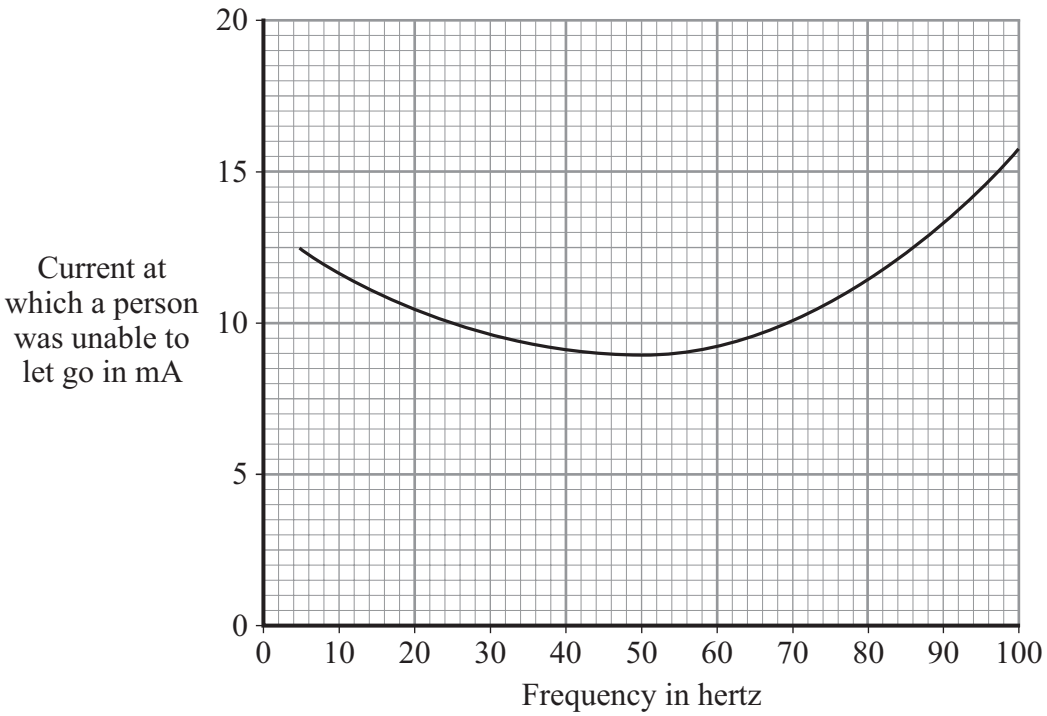
(2 marks)

Areas outside the box will not be scanned for marking

6 (b) If the current flowing through a person is too high, the person cannot let go of the electrical source.

Different people were tested to see whether the ability to let go of an electrical source depended on the frequency of the current.

The results of the test are shown in the graph.



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

.....

(1 mark)

6 (b) (ii) From a safety point of view, is the frequency of the UK mains electricity supply suitable?

Give a reason for your answer.

.....

.....

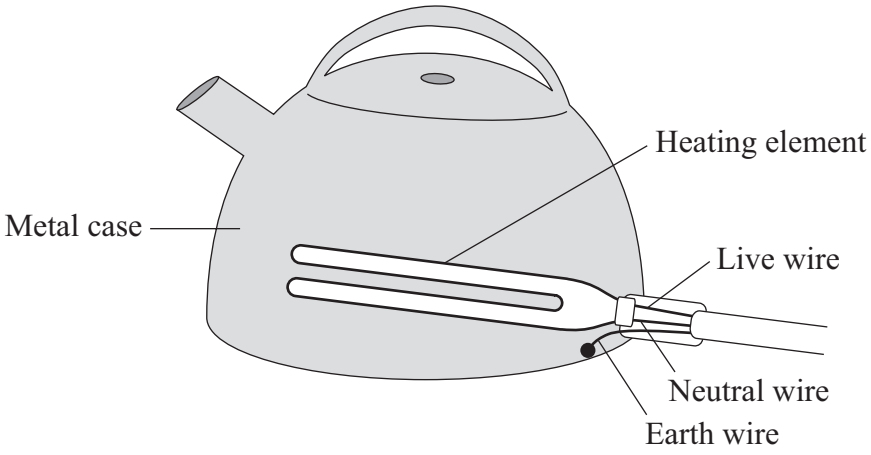
(1 mark)

Question 6 continues on the next page

Turn over ▶

Areas outside the box will not be scanned for marking

6 (c) The diagram shows how the electric supply cable is connected to an electric kettle. The earth wire is connected to the metal case of the kettle.



If a fault makes the metal case live, the earth wire and the fuse inside the plug protect anyone using the kettle from an electric shock.

Explain how.

.....

.....

.....

.....

(2 marks)

8

END OF QUESTIONS

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Version 1.0: 21/07/2009

ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Secondary Education

Additional Science 4463/ Physics 4451

PHY2H Unit Physics 2

Mark Scheme

2009 examination – June series

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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 candidates' 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 candidates' 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 candidates' 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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Dr Michael Cresswell Director General

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 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.

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

Candidate	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)

Candidate	Response	Marks awarded
1	Pluto, Mars, Moon	1
2	Pluto, 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, 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.

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PHY2H

Question 1

<table>
<tr><th>question</th><th>answers</th><th>extra information</th><th>mark</th></tr>
<tr><td>1(a)</td><td>
<table>
<tr><td>Particle</td><td>Relative Mass</td><td>Relative charge</td></tr>
<tr><td>Proton</td><td>1</td><td></td></tr>
<tr><td>Neutron</td><td></td><td>0</td></tr>
</table>
</td><td>accept one, accept +1
do not accept -1
accept zero
do not accept no charge/ nothing/ neutral unless given with 0</td><td>1

1</td></tr>
<tr><td>1(b)</td><td>equal numbers/amounts of protons and electrons

protons and electrons have equal but opposite charge</td><td>

accept protons charge +1 and electron charge -1
accept (charge on) proton cancels/balances (charge on) electron
accept positive (charges) cancel out the negative(charges)
neutrons have no charge is neutral
do not accept total charge of protons, electrons (and neutrons) is 0 unless qualified</td><td>1

1</td></tr>
</table>

Question 1 continues on the next page . . .

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PHY2H

Question 1 continued . . .

question	answers	extra information	mark
1(c)(i)	(3) fewer neutrons . . .	accept lower/ smaller mass number do **not** accept different numbers of neutrons any mention of fewer/more protons or electrons negates mark accept answers in terms of U-238 providing U-238 is specifically stated i.e. U-238 has (3) more neutrons	1
1(c)(ii)	neutron		1
1(c)(iii)	(nuclear) fission	accept fision do **not** accept any spelling that may be taken as fusion	1
Total			**7**

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PHY2H

Question 2

question	answers	extra information	mark
2(a)(i)	gained electrons		1
2(a)(ii)	see if it exerts a force on another (charged) object **or** see if it will pick up (small) pieces of paper	accept repels another negative(ly charged)object accept attracts a positive(ly charged) object accept attracts or repels a charged object accept any correct way of showing an electrostatic effect i.e. bend a (slow moving) stream of water (from a tap) do **not** accept see if you get an electric shock on its own	1
2(b)(i)	plastic is an insulator stop them discharging **or** stop them being earthed	accept plastic is a poor conductor any mention of heat negates this mark accept keeps the charge on the person accept stop them being grounded do **not** accept so don't get an electric shock accept electricity cannot go to earth	1 1
2(b)(ii)	type of clothing could affect (build up of) charge/data	accept it is a variable/ factor (that needs to be controlled) do **not** accept fair test on its own	1
2(b)(iii)	there is a clear pattern **or** enough precision to tell difference (between the materials) **or** accept none of the results are within 0.1kV of the shock line or each other	accept there is a wide range of results	1

Question 2 continues on the next page . . .

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PHY2H

Question 2 continued . . .

question	answers	extra information	mark
2(b)(iv)	any **two** from: • the material normally used has a value above the p.d likely to cause a shock • use a material that reduces pd (below 3.6 kV) • so people are less likely to be shocked • can put 'non-shock' seating in adverts • may sell more seats/ cars	accept use a material that reduces charge (on the person) accept so people will not feel a shock owtte	2
Total			**8**

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PHY2H

Question 3

question	answers	extra information	mark
3(a)	gravity	accept weight do **not** accept mass accept gravitational pull	1
3(b)(i)	Initially force L greater than force M	accept there is a resultant force downwards	1
	(as speed increases) force M increases	accept the resultant force decreases	1
	when M = L, (speed is constant)	accept resultant force is 0 accept gravity/weighty for L accept drag/ upthrust/ resistance/friction for M do **not** accept air resistance for M but penalise only once	1
3(b)(ii)	terminal <u>velocity</u>		1
3(b)(iii)	0.15	accept an answer between 0.14 – 0.16 an answer of 0.1 gains no credit allow **1** mark for showing correct use of the graph	2
Total			**7**

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PHY2H

Question 4

question	answers	extra information	mark
4(a)(i)	210	allow **1** mark for correct substitution i.e. 35 × 6	2
	kg m/s **or** Ns	do **not** accept n for N accept 210 000g m/s for **3** marks	1
4(a)(ii)	840	if answer given is not 840 accept their (a)(i) in kg m/s ÷ 0.25 correctly calculated for both marks allow **1** mark for correct substitution i.e. 210 ÷ 0.25 or their (a)(i) ÷ 0.25	2
4(b)	increases the time to stop	accept increases impact time do **not** accept any references to slowing down time	1
	decreases rate of change in momentum	accept reduces acceleration/ deceleration reduces momentum is insufficient	1
	reduces the force (on the child)		1
4(c)	any **two** from: • insufficient range of tests/ thicknesses for required cfh	accept need data for thicknesses above 80 mm/ cfh 2.7m not enough tests is insufficient	2
	• (seems to be) some anomalous data		
	• *(*repeats) needed to improve reliability (of data)	accept data/ results are unreliable do **not** accept maybe systematic/ random error do **not** accept reference to precision	
	• need to test greater range/variety of dummies	accept children for dummies accept specific factor such as weight/height/size	

Question 4 continues on the next page . . .

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PHY2H

Question 4 continued . . .

question	answers	extra information	mark
4(d)	Tyres do not need to be dumped/ burned/ less land-fill/ saves on raw materials	accept less waste do **not** accept recycling on its own	1
Total			**11**

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PHY2H

Question 5

question	answers	extra information	mark
5(a)	47250	answers of 1350/ 33750/ 48600 gain **1** mark allow **1** mark for correct substitution using both 18 and 3	2
5(b)(i)	47250 or their (a)	accept statement 'same as the KE (lost)' ignore any units	1
5(b)(ii)	transformed into heat/ thermal energy	sound on its own is insufficient accept transferred/ lost/ for transformed do **not** accept any other form of energy included as a list	1
Total			**4**

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PHY2H

Question 6

question	answers	extra information	mark
6(a)(i)	0.0046	accept 4.6 mA allow **1** mark for correct substitution and transformation i.e. current = $\frac{230}{50\,000}$ an answer of 4.6 gains **1** mark	2
6(a)(ii)	• increases overall resistance • (in event of a shock) gives a smaller current	 accept gives smaller shock do **not** accept no shock/current	1 1
6(b)(i)	50 (hertz)	ignore units	1
6(b)(ii)	NO has the lowest current at which people cannot let go **or** YES changing the frequency changes the current by only a small amount	answer and reason needed accept a sensible reason in terms of their answer to (b) (i)	1

Question 6 continues on the next page . . .

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PHY2H

Question 6 continued . . .

question	answers	extra information	mark
6(c)	a current flows through from the live wire/metal case to the earth wire	accept a current flows from live to earth do **not** accept on its own if the current is too high	1
	this current causes the fuse to melt	accept blow for melt	1
Total			**8**

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Surname		Other Names	
Centre Number			Candidate Number				
Candidate Signature								

For Examiner's Use

General Certificate of Secondary Education
January 2009

ADDITIONAL SCIENCE
Unit Physics P2

PHY2H

H

PHYSICS
Unit Physics P2

Higher Tier

Monday 19 January 2009 9.00 am to 9.45 am

For this paper you must have:
- a ruler.

You may use a calculator.

Time allowed: 45 minutes

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. Answers written in margins or on blank pages will not be marked.
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information
- The maximum mark for this paper is 45.
- The marks for questions are shown in brackets.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.

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

For Examiner's Use			
Question	Mark	Question	Mark
1		3	
2		4	
		5	
		6	
		7	
Total (Column 1) →			
Total (Column 2) →			
TOTAL			
Examiner's Initials			

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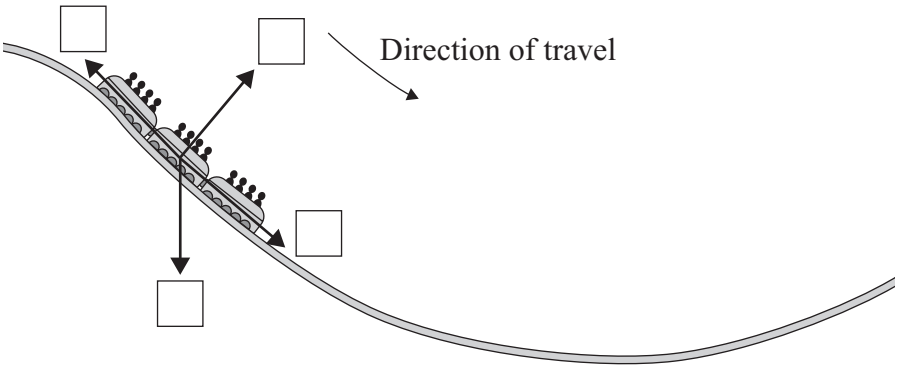
Areas outside the box will not be scanned for marking

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

1 The diagram shows the passenger train on part of a rollercoaster ride.

1 (a) Which arrow shows the direction of the resultant force acting on the passenger train?

Put a tick (✓) in the box next to your choice.



(1 mark)

1 (b) At the bottom of the slope, the passengers in the train all have the same speed but they each have a different kinetic energy.

Why is the kinetic energy of each passenger different?

.....

.....

(1 mark)

1 (c) For part of the ride, the maximum gravitational field strength acting on the passengers seems 3 times bigger than normal.

Normal gravitational field strength = 10 N/kg

1 (c) (i) Calculate the maximum gravitational field strength that seems to act on the passengers during the ride.

.....

.....

Maximum gravitational field strength = ... N/kg

(1 mark)

Areas outside the box will not be scanned for marking

1 (c) (ii) One of the passengers has a mass of 80 kg.

Use the equation in the box to calculate the maximum weight this passenger seems to have during the ride.

weight = mass × gravitational field strength

Show clearly how you work out your answer.

.....

.....

Maximum weight = ... N

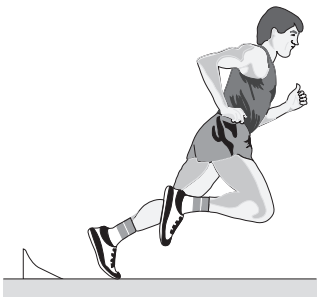
(2 marks)

5

Turn over for the next question

Areas outside the box will not be scanned for marking

2 (a) The diagram shows an athlete at the start of a race. The race is along a straight track.



In the first 2 seconds, the athlete accelerates constantly and reaches a speed of 9 m/s.

2 (a) (i) Use the equation in the box to calculate the acceleration of the athlete.

$$\text{acceleration} = \frac{\text{change in velocity}}{\text{time taken for change}}$$

Show clearly how you work out your answer.

.....

.....

.....

Acceleration = ...

(2 marks)

2 (a) (ii) Which **one** of the following is the unit for acceleration?

Draw a ring around your answer.

J/s **m/s** **m/s^2** **Nm**

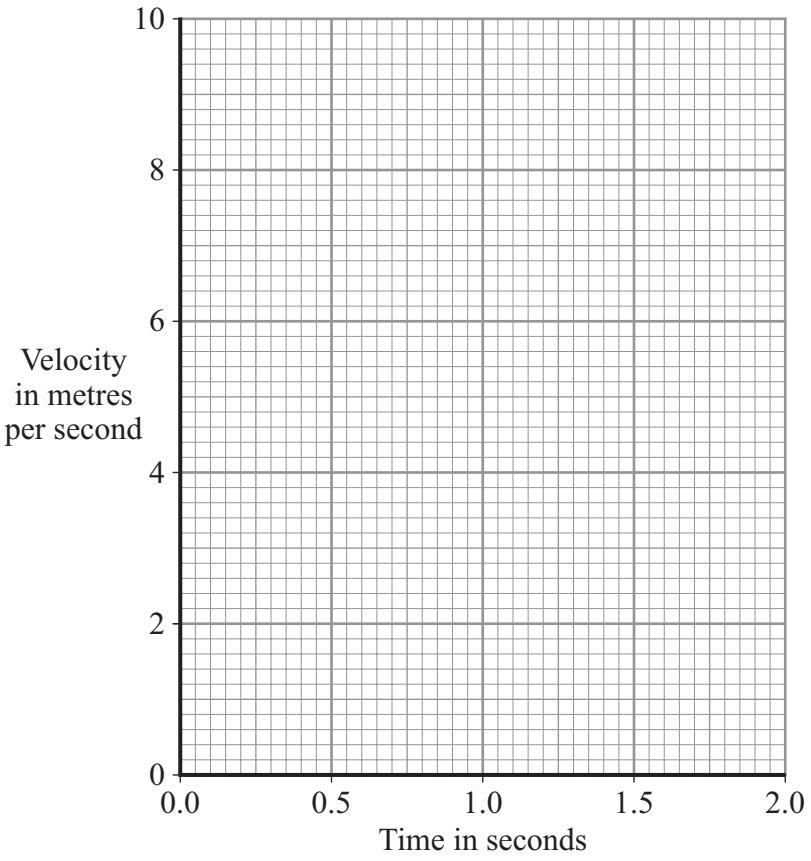
(1 mark)

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2 (a) (iii) Complete the following sentence.

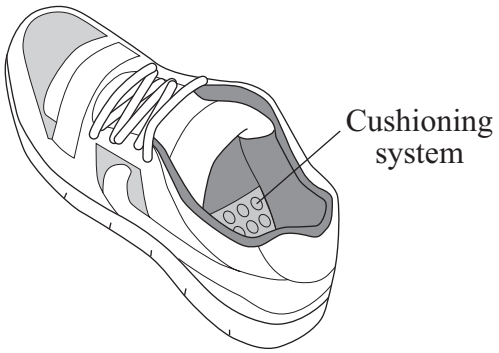
The velocity of the athlete is the ..... of the athlete in a given direction. *(1 mark)*

2 (a) (iv) Complete the graph to show how the velocity of the athlete changes during the first 2 seconds of the race.



(2 marks)

2 (b) Many running shoes have a cushioning system. This reduces the impact force on the athlete as the heel of the running shoe hits the ground.

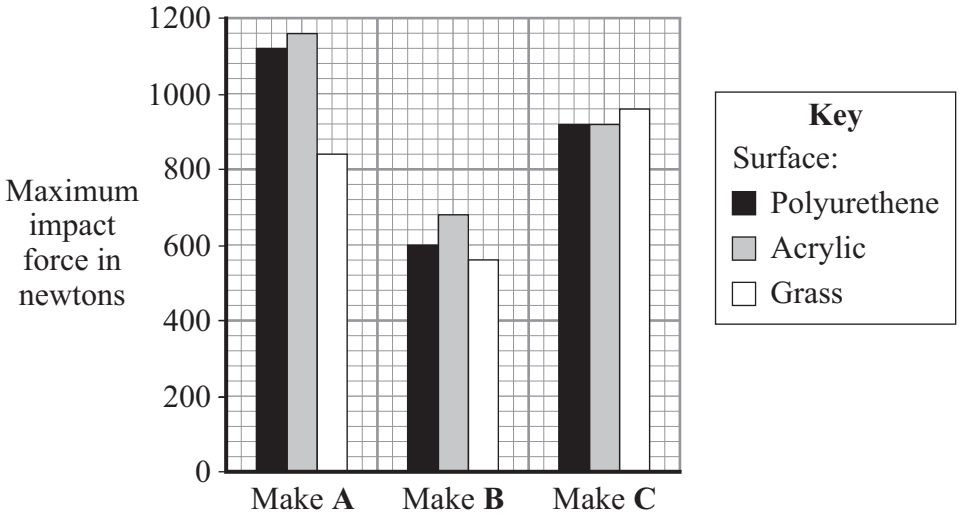


Question 2 continues on the next page

Turn over ▶

Areas outside the box will not be scanned for marking

The bar chart shows the maximum impact force for three different makes of running shoe used on three different types of surface.



2 (b) (i) Which **one** of the three makes of running shoe, **A**, **B** or **C**, has the best cushioning system?

.....

Explain the reason for your answer.

.....

.....

.....

.....

(3 marks)

2 (b) (ii) The data needed to draw the bar chart was obtained using a robotic athlete fitted with electronic sensors.

Why is this data likely to be more reliable than data obtained using human athletes?

.....

.....

(1 mark)

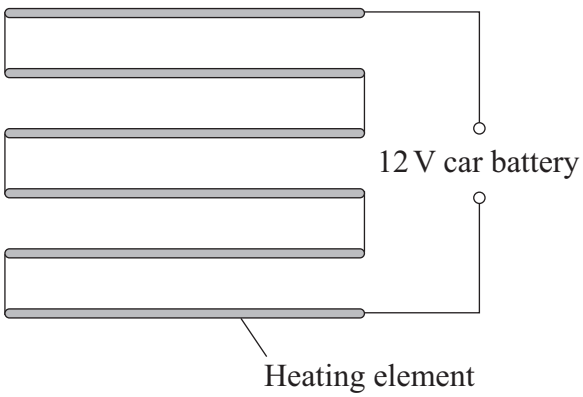
10

Turn over for the next question

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

Areas outside the box will not be scanned for marking

3 The diagram shows a simple type of car rear window heater. The six heating elements are exactly the same.



3 (a) Each heating element has a resistance of 5 Ω. The current passing through each element is 0.4 A.

3 (a) (i) Calculate the total resistance of the six heating elements.

Show clearly how you work out your answer.

.....

.....

Total resistance = ... ohms

(2 marks)

3 (a) (ii) Why is the current passing through each element the same?

.....

.....

(1 mark)

3 (a) (iii) What is the total current passing through the whole circuit?

.....

(1 mark)

3 (a) (iv) How is the 12 volt potential difference of the car battery shared between the six heating elements?

.....

.....

(1 mark)

Areas outside the box will not be scanned for marking

3 (b) It takes the heater two minutes to demist the car window.

Use the equation in the box to calculate how much charge flows through the heater in this time.

charge = current × time

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

.....

.....

Charge = ...

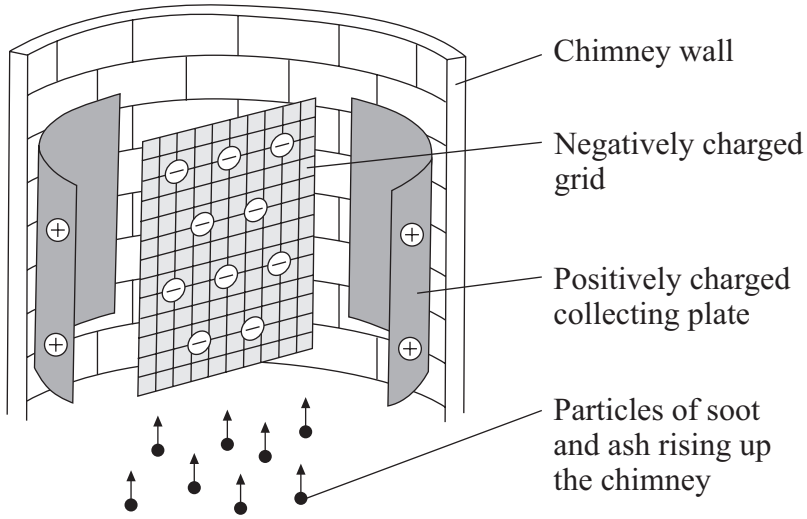
(3 marks)

8

Turn over for the next question

Areas outside the box will not be scanned for marking

4 (a) Burning coal produces soot, ash and waste gases.
The diagram shows an electrostatic precipitator used to separate the particles of soot and ash from the waste gases.



Explain how the electrostatic precipitator separates the particles of soot and ash from the waste gases.

.....

.....

.....

.....

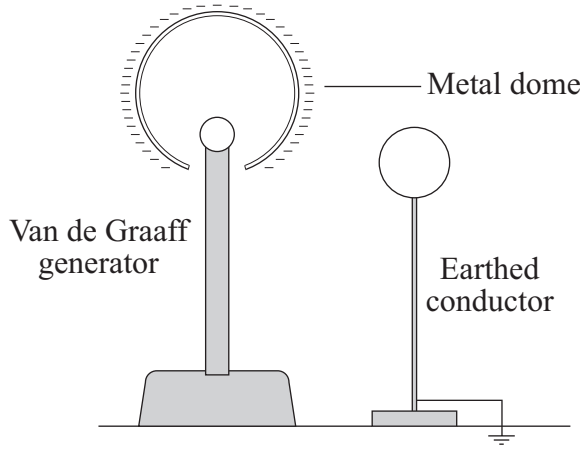
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.....

(3 marks)

Areas outside the box will not be scanned for marking

4 (b) The diagram shows a Van de Graaff generator. When the generator is switched on, the metal dome becomes negatively charged.



Explain what must happen to cause a spark to jump from the dome of the generator to an earthed conductor nearby.

.....

.....

.....

.....

(2 marks)

5

Turn over for the next question

Areas outside the box will not be scanned for marking

5 (a) Describe the difference between an alternating current (a.c.) and a direct current (d.c.).

.....

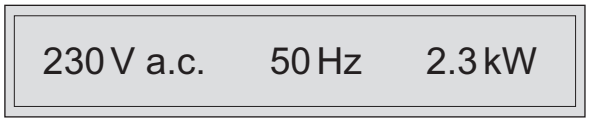
.....

.....

.....

(2 marks)

5 (b) The diagram shows the information plate on the bottom of an electric wallpaper steamer.



5 (b) (i) Use the equation in the box to calculate the current used by the steamer.

power = current × potential difference

Show clearly how you work out your answer.

.....

.....

Current ..... A

(2 marks)

5 (b) (ii) Which **one** of the following fuses should be used inside the plug of the steamer?

Draw a ring around your answer.

1 A **3 A** **5 A** **10 A** **13 A**

(1 mark)

5

Areas outside the box will not be scanned for marking

6 (a) Complete the following table for an atom of uranium-238 ($^{238}_{92}U$).

mass number	238
number of protons	92
number of neutrons	

(1 mark)

6 (b) Complete the following sentence.

The name given to the number of protons in an atom is the proton number or the

..... .

(1 mark)

6 (c) An atom of uranium-238 ($^{238}_{92}U$) decays to form an atom of thorium-234 ($^{234}_{90}Th$).

6 (c) (i) What type of radiation, alpha, beta or gamma, is emitted by uranium-238?

.....

(1 mark)

6 (c) (ii) Why does an atom that decays by emitting alpha or beta radiation become an atom of a different element?

.....

.....

(1 mark)

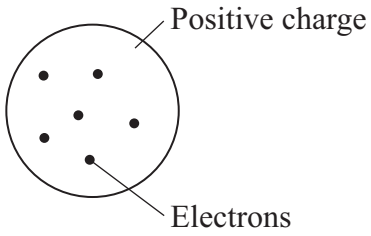
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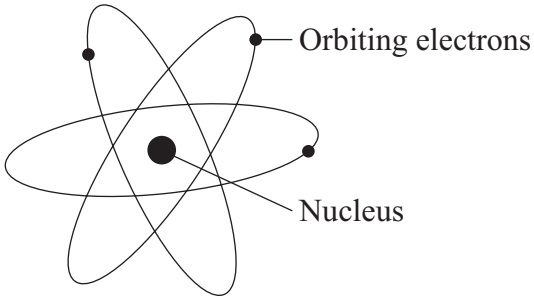
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Areas outside the box will not be scanned for marking

7 In the early part of the 20th century, scientists used the 'plum pudding' model to explain the structure of the atom.



Following work by Rutherford and Marsden, a new model of the atom, called the 'nuclear' model, was suggested.



7 (a) Describe the differences between the two models of the atom.

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(4 marks)

Areas outside the box will not be scanned for marking

7 (b) In their investigation, Rutherford and Marsden fired positively charged alpha particles at a very thin sheet of gold. Over a period of several months, the scientists made over 100 000 measurements. These measurements showed that:

- a very small number of alpha particles were deflected backwards from the gold foil.

Use the nuclear model to explain this experimental result.

.....

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.....

(2 marks)

7 (c) Why did the work of Rutherford and Marsden convince many scientists that the 'plum pudding' model of the atom was incorrect?

.....

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.....

.....

(2 marks)

8

END OF QUESTIONS

There are no questions printed on this page

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ASSESSMENT and QUALIFICATIONS ALLIANCE

General Certificate of Secondary Education

Additional Science 4463 / Physics 4451

PHY2H Unit Physics 2

Standardisation

Mark Scheme

2009 examination – January series

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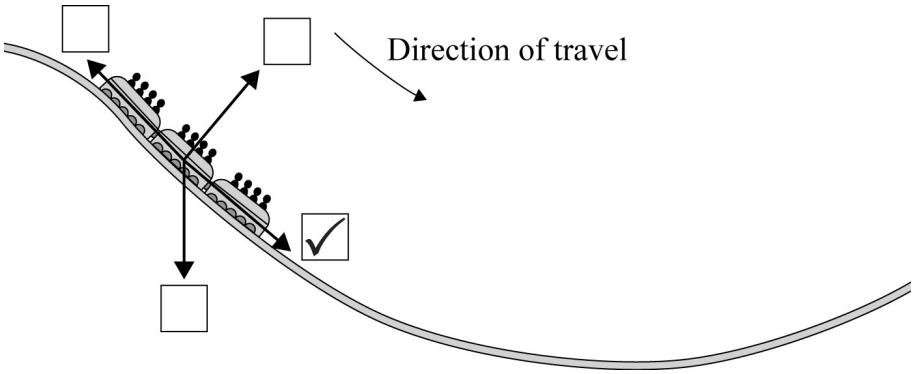
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PHY2H

Question 1

question	answers	extra information	mark
1(a)	correct box ticked 		1
1(b)	each passenger has a different mass	accept weight for mass ignore other irrelevant factors about the person e.g. mass and height do **not** accept a list with incorrect factors e.g. mass and position accept passengers started with different (gravitational) potential energy	1
1(c)(i)	30	ignore added units	1
1(c)(ii)	2400	accept their (c)(i) × 80 correctly calculated for both marks allow **1** mark for correct substitution of their (c)(i) and 80 an answer of 800 gains **1** mark only if answer to (c)(i) is not 10	2
Total			**5**

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PHY2H

Question 2

question	answers	extra information	mark
2(a)(i)	4.5	allow **1** mark for correct substitution i.e. 9 ÷ 2	2
2(a)(ii)	m/s^2	accept answer given in (a)(i) if not contradicted here	1
2(a)(iii)	speed		1
2(a)(iv)	straight line from the origin passing through (2s, 9 m/s)	allow **1** mark for straight line from the origin passing through to t = 2 seconds allow **1** mark for an attempt to draw a straight line from the origin passing through (2,9) allow **1** mark for a minimum of 3 points plotted with no line provided if joined up would give correct answer. Points must include(0,0) and (2,9)	2
2(b)(i)	**B** smallest (impact) force on all/ every/ any surfaces	if **A** or **C** given scores **0** marks in total these marks are awarded for comparative answers	1 1 1

Question 2 continues on the next page

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PHY2H

Question 2 continued

2(b)(ii)	(conditions) can be repeated **or** difficult to measure forces with human athletes	 accept answers in terms of variations in human athletes e.g. athletes may have different weights area / size of feet may be different difficult to measure forces athletes run at different speeds accept any answer that states or implies that with humans the conditions needed to repeat tests may not be constant e.g. athletes unable to maintain constant speed during tests (or during repeat tests) do **not** accept the robots are more accurate human error is insufficient fair test is insufficient	1

Total			**10**

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Question 3

question	answers	extra information	mark
3(a)(i)	30	allow **1** mark for showing correct method i.e. 5 × 6 **or** 12 ÷ 0.4	2
3(a)(ii)	connected in <u>series</u>	insufficient they are not connected in parallel	1
3(a)(iii)	0.4		1
3(a)(iv)	equally/ evenly	the same is insufficient allow credit for candidates that correctly mention pd across the connecting wires accept (nearly) 2 V (each)	1
3(b)	48 coulombs	do **not** accept e.c.f. if (a) (iii) = 12 or 5 accept their (a) (iii) × 120 correctly calculated for both marks allow **1** mark for correct substitution and conversion of time to seconds i.e. charge = 0.4 × 120 an answer 0.8 scores **1** mark allow **1** mark for their (a) (iii) x 2 correctly calculated accept C do **not** accept c do **not** accept amp seconds	2 1
Total			**8**

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PHY2H

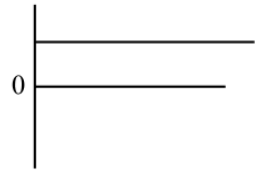
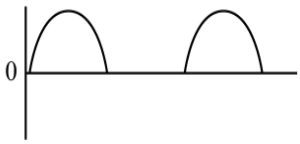
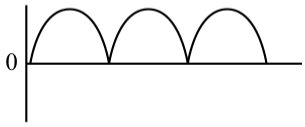
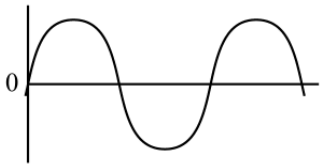
Question 4

question	answers	extra information	mark
4(a)	soot /ash/ waste gases pass (negatively) charged grid		1
	soot/ash given a negative charge	accept picks up electrons	1
	soot/ash repelled from (negative) grid **or** soot/ash attracted to (positively charged) metal plates		1
4(b)	charge must increase / build up	accept electrons for charge any reference to positive electrons negates this mark	1
	(producing) a large enough potential difference between dome and (earthed) conductor	accept voltage for pd any reference to positive earth negates this mark	1
Total			**5**

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Question 5

question	answers	extra information	mark
5(a)	d.c. flows in (only) one direction		1
	a.c. changes direction (twice every cycle)	accept a.c. constantly changing direction ignore references to frequency accept answers presented as a clear diagram e.g. dc:    ac:  	1

Question 5 continues on the next page

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Question 5 continued

5(b)(i)	10	allow **1** mark for correct transformation and substitution i.e. $\frac{2.3}{230}$ or $\frac{2300}{230}$ an answer 0.01 gains **1** mark	2
5(b)(ii)	13 A	e.c.f. accept the fuse size that is the next listed value greater than answer (b)(i)	1
Total			**5**

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Question 6

question	answers	extra information	mark
6(a)	146		1
6(b)	atomic number		1
6(c)(i)	alpha		1
6(c)(ii)	number of protons changes	accept atomic number changes accept <u>loses or gains</u> protons do **not** accept protons with any other particle e.g. number of protons and neutrons changes incorrect do **not** accept any reference to mass number	1
Total			**4**

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Question 7

question	answers	extra information	mark
7(a)	any **two** pairs from:	to gain credit it must be clear which model is being described do **not** accept simple descriptions on the diagram without comparison	4
	• nuclear model mass is concentrated at the centre / nucleus	accept the nuclear model has a nucleus/ the plum pudding model does not have a nucleus for 1 mark	(1)
	plum pudding model mass is evenly distributed		(1)
	• nuclear model positive charge occupies only a small part of the atom		(1)
	plum pudding model positive charge spread throughout the atom		(1)
	• nuclear model electrons orbit some distance from the centre / nucleus	accept electrons in shells/ orbits provided a valid comparison is made with the plum pudding model do **not** accept on its own	(1)
	plum pudding electrons embedded in the (mass) of positive (charge)	do **not** accept electrons at edge of plum pudding	(1)
	• nuclear model the atom mainly empty space		(1)
	plum pudding model is a 'solid' mass		(1)
7(b)	nucleus must be <u>positive</u> to deflect/ repel alpha particles	answers in terms of electrons/negative charge causing deflection negates mark answers in terms of reflection negates mark	1 1
	nucleus (very) small so few alpha particles deflected backwards	accept most of atom empty space so <u>most</u> pass through	

Question 7 continues on the next page

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PHY2H

Question 7 continued

question	answers	extra information	mark
7(c)	many/ 100 000 measurements taken	accept results for measurements accept data valid / reliable	1
	findings could not be explained by plum pudding model	accept a specific finding that could not be explained eg some alpha particles were deflected backwards	1
Total			**8**

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