EDEXCEL GCSE PHYSICS

PHYSICS



EXAM QUESTION PACK

UNIT P2 HIGHER TIER 5PH2H PAPERS

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Write your name here

Surname	Other names

Pearson Edexcel GCSE

Centre Number | | | | | |

Candidate Number | | | | |

Physics/Additional Science

Unit P2: Physics for Your Future

Higher Tier

Friday 26 January 2018 – Morning
Time: 1 hour

Paper Reference
5PH2H/01

You must have:
Calculator, ruler

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided
  – *there may be more space than you need.*

Information

- The total mark for this paper is 60.
- The marks for **each** question are shown in brackets
  – *use this as a guide as to how much time to spend on each question.*
- Questions labelled with an **asterisk** (*) are ones where the quality of your written communication will be assessed
  – *you should take particular care with your spelling, punctuation and grammar, as well as the clarity of expression, on these questions.*

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

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FORMULAE

You may find the following formulae useful.

charge = current × time $Q = I \times t$

potential difference = current × resistance $V = I \times R$

electrical power = current × potential difference $P = I \times V$

energy transferred = current × potential difference × time $E = I \times V \times t$

$$\text{speed} = \frac{\text{distance}}{\text{time}}$$

$$\text{acceleration} = \frac{\text{change in velocity}}{\text{time taken}} \qquad a = \frac{(v-u)}{t}$$

force = mass × acceleration $F = m \times a$

weight = mass × gravitational field strength $W = m \times g$

momentum = mass × velocity $P = m \times v$

$$\text{force} = \frac{\text{change in momentum}}{\text{time}} \qquad F = \frac{(mv-mu)}{t}$$

work done = force × distance moved in the direction of the force $E = F \times d$

$$\text{power} = \frac{\text{work done}}{\text{time taken}} \qquad P = \frac{E}{t}$$

gravitational potential energy = mass × gravitational field strength × vertical height

$\text{GPE} = m \times g \times h$

kinetic energy = ½ × mass × velocity^2 $\text{KE} = \frac{1}{2} \times m \times v^2$

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Questions begin on next page.

Answer ALL questions.

Some questions must be answered with a cross in a box ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

Static electricity

1 (a) A student rubs a plastic rod with a dry cloth.
The cloth becomes positively charged.

(i) Complete the sentence by putting a cross (☒) in the box next to your answer.

(1)

The cloth becomes positively charged because

☒ **A** negative charge has moved from the cloth to the rod

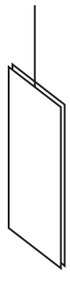
☒ **B** negative charge has moved from the rod to the cloth

☒ **C** positive charge has moved from the cloth to the rod

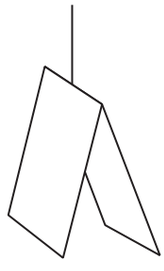
☒ **D** positive charge has moved from the rod to the cloth

(ii) Two plastic strips are joined at the top and hang by a thread.
The student rubs both strips with another dry cloth.
The diagram shows the two plastic strips before and after the student rubs them.

the two strips before rubbing



the two strips after rubbing



Explain why the strips behave in this way after the student rubs them with the cloth.

(2)

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(b) The student reads an article about the build-up of static electricity that could occur during the refuelling of an aircraft.

(i) Explain why this build-up could be dangerous.

(2)

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(ii) The article states that the aircraft is connected by a metal cable to the ground. The aircraft is also connected by a metal cable to the refuelling tanker.

Explain how these cables reduce the dangers during the refuelling of the aircraft.

(3)

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(Total for Question 1 = 8 marks)

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Using radioactive materials

2 (a) A scientist investigates a radioactive sample.

She measures a count rate of 130 counts per minute.

The average background radiation count rate in her laboratory is 10 counts per minute.

(i) What is the count rate due to this sample?

Put a cross (☒) in the box next to your answer.

(1)

☒ **A** 13 counts per minute

☒ **B** 120 counts per minute

☒ **C** 140 counts per minute

☒ **D** 1300 counts per minute

(ii) State **one** source of background radiation.

(1)

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(iii) Explain why some people are exposed to more background radiation than others.

(2)

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(iv) Complete the sentence by putting a cross (☒) in the box next to your answer.

The recommended safe limit for exposure to radiation has been reduced over the last 80 years.

This is because

(1)

☒ **A** scientists now have better instruments to make measurements more quickly

☒ **B** global warming has increased the rate of decay of radioactive materials

☒ **C** humans have released more radioactive materials into the environment

☒ **D** scientists now have a better understanding of the dangers of radiation

(b) After an accident at a nuclear power plant in Japan, some drinking water was contaminated with radioactive iodine-131.

When iodine-131 decays, it emits beta radiation.
State **one** possible danger to health from exposure to beta radiation.

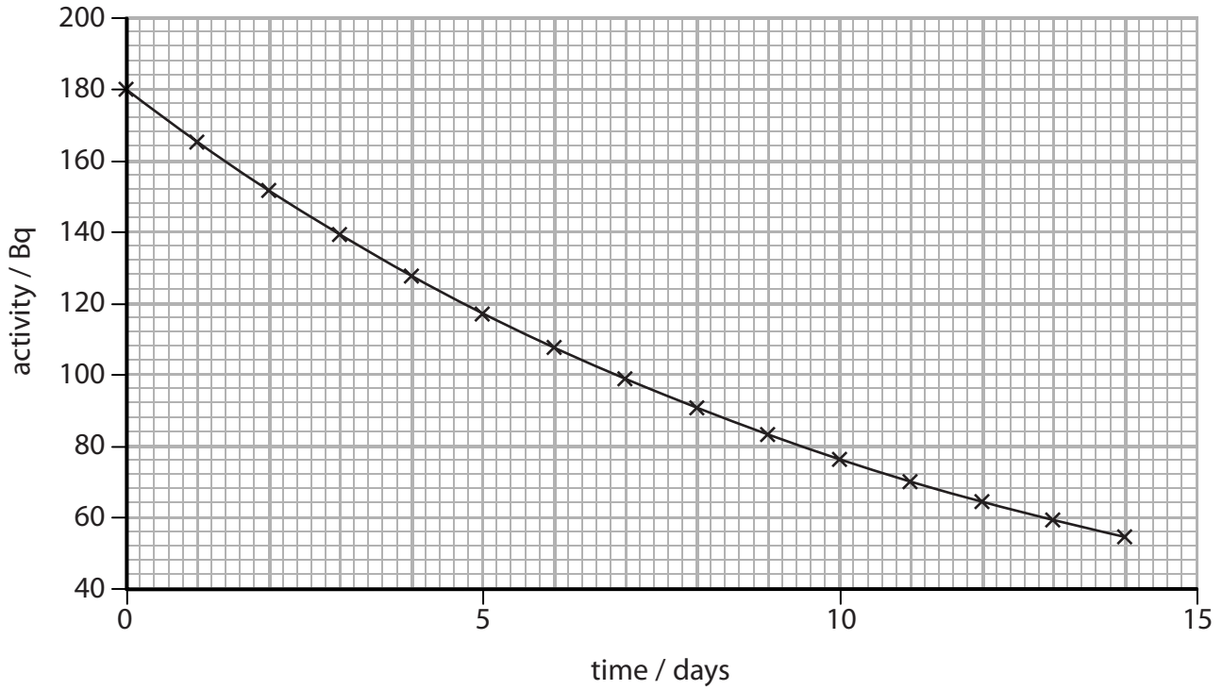
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(c) The graph shows how the activity of a sample of iodine-131 changes over a period of 14 days.



(i) Use the graph to estimate the half-life of iodine-131.

Show your working.

(2)

half-life = ... days

(ii) Estimate the time it would take for the activity to fall from 180 Bq to 40 Bq.

(1)

time taken = ... days

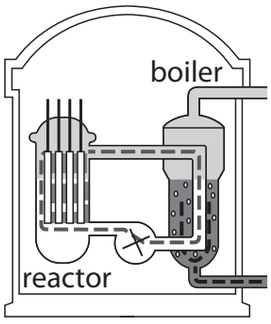
(Total for Question 2 = 9 marks)

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Nuclear fission

3 Electricity is generated in a nuclear power station.
The diagram shows the first stages in this process.



(a) The thermal energy released in the reactor is used to produce steam.
Describe how the steam is used to generate electricity.

(2)

(b) Controlled nuclear chain reactions take place in the reactor.

Describe how the fission of a uranium-235 nucleus can start off a chain reaction.
You may draw a diagram to help with your answer.

(3)

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(c) There are both fuel rods and control rods inside the reactor.

Explain how pushing control rods between the fuel rods changes the rate of nuclear fission in the reactor.

(2)

(d) One of the products of the fission of uranium-235 is krypton-91.

Which of these could be a product of the same reaction?

(1)

Put a cross (☒) in the box next to your answer.

☒ **A** barium-143

☒ **B** barium-145

☒ **C** barium-147

☒ **D** barium-235

(e) Nuclear fusion is another type of nuclear reaction.
It needs large amounts of energy to make it happen.

Explain why large amounts of energy are needed to make a fusion reaction happen.

(2)

(Total for Question 3 = 10 marks)

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Forces and movement

4 (a) Which one of these is a vector quantity?

Put a cross (☒) in the box next to your answer.

(1)

☒ **A** energy

☒ **B** momentum

☒ **C** power

☒ **D** work

(b) A father pushes his child in a cart.



The child and cart have a total mass of 60 kg.
The total momentum of the child and the cart is 90 kg m / s.

(i) Calculate the velocity of the child and the cart.

(3)

velocity = ... m / s

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(ii) The father stops pushing when the momentum of the child and cart is 420 kg m/s. The cart takes a further 18 s to come to rest.

Calculate the force that brings the cart to rest.

(2)

force = ... N

(c) The image shows a mother and her daughter standing still on an ice rink.



The mother and daughter push each other away.
They move in opposite directions with different speeds.

Explain why they have different speeds.

(3)

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(Total for Question 4 = 9 marks)

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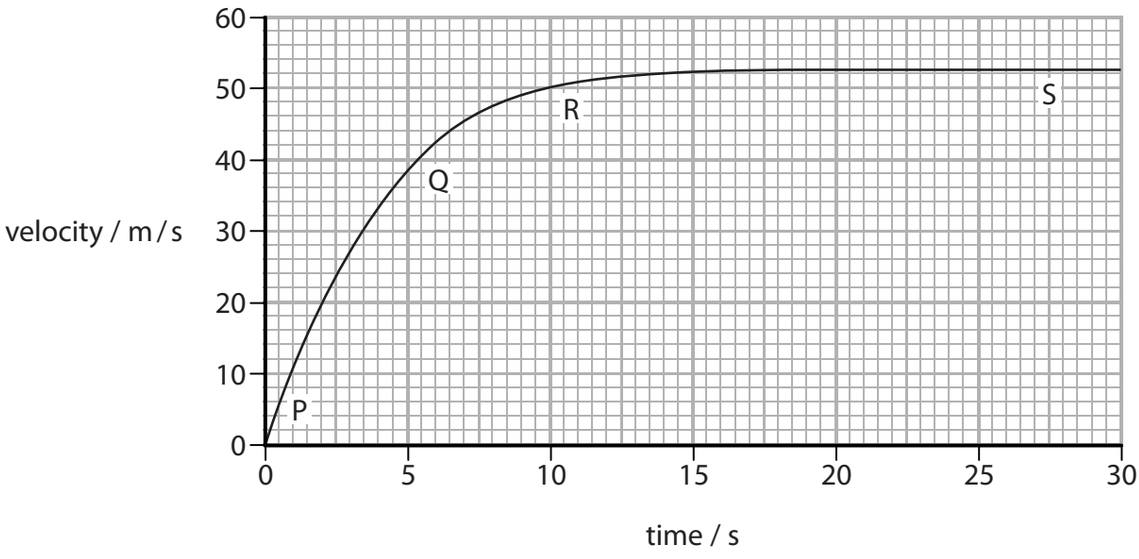
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5 A free-fall parachutist is falling straight down.

This is a velocity/time graph of the first part of the jump, before the parachute is opened.



(a) Which of these points on the graph shows the largest acceleration?

Put a cross (☒) in the box next to your answer.

(1)

☒ **A** P

☒ **B** Q

☒ **C** R

☒ **D** S

(b) Estimate the distance that the parachutist falls in the first 2.5 s.

(3)

distance = ... m

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(c) Explain the difference between velocity and speed.

(2)

*(d) Explain, in terms of forces, why the parachutist's velocity changes as shown in the graph.

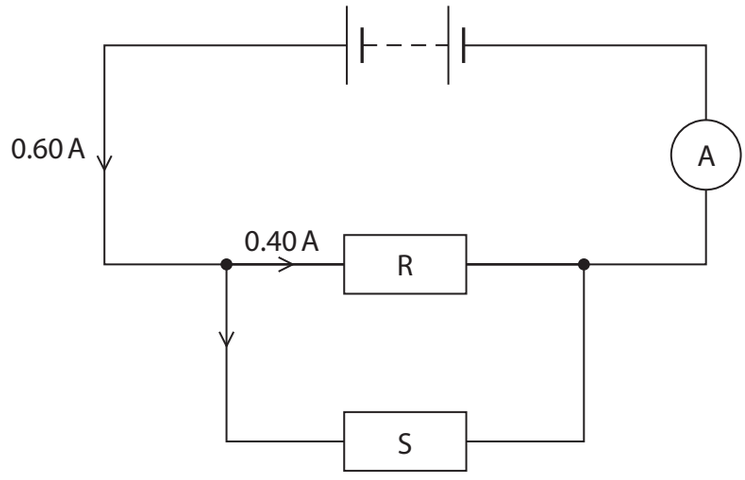
(6)

(Total for Question 5 = 12 marks)

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Circuits

6 (a) The diagram shows a circuit with two resistors, R and S.



R has a resistance of 15 Ω

(i) Calculate the potential difference across R.

(2)

potential difference = ... V

(ii) The unit of potential difference is the volt.

Complete the sentence by putting a cross (☒) in the box next to your answer.

1 volt is equivalent to

(1)

☒ **A** 1 joule per second

☒ **B** 1 joule per amp

☒ **C** 1 joule per coulomb

☒ **D** 1 joule per ohm

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(iii) Use information from the diagram to calculate the current in S.

(1)

current = ... A

(b) Explain why the temperature of a resistor rises when the current in it increases.

(2)

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*(c) The photograph shows some temporary traffic lights.



The lights are powered by a battery.
These lights need to be very bright during the day so that they can be seen clearly.
They do not need to be as bright at night.
Explain how using a light-dependent resistor in series with the lights can make the energy stored in the battery last longer.

(6)

(Total for Question 6 = 12 marks)

TOTAL FOR PAPER = 60 MARKS

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Mark Scheme (Results)

January 2018

Pearson Edexcel GCSE
In Physics (5PH2H)
Paper 01

edexcel

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General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

Question Number	Answer	Acceptable answers	Mark
1(a)(i)	**A -** negative charge has moved from the cloth to the rod		**(1)**

Question Number	Answer	Acceptable answers	Mark
1(a)(ii)	An explanation linking they repel (1) (strips have) like charge (1)	 push away same (type of) charge ignore equal charge	**(2)**

Question Number	Answer	Acceptable answers	Mark
1(b)(i)	An explanation linking any **two** from charges are separated (1) possibility of a spark (1) ignite the fuel (1)	ignore ref to electric shock pd (between plane and ground) cause fire / explosion	**(2)**

Question Number	Answer	Acceptable answers	Mark
1(b)(ii)	An explanation linking **three** From Metals /cables are (good) conductors (1) Electrons/(negative) charge can flow through wire (1) charge goes from/to the ground / earth (1) charge does not build up/dissipates/no spark possible (1)	 Reject flow of positive charge for this mark plane is earthed/grounded/no (build-up of) pd discharge the tank/aircraft/pipes	**(3)**

Question Number	Answer	Acceptable answers	Mark
2(a) (i)	B 120 counts per minute		**(1)**

Question Number	Answer	Acceptable answers	Mark
2(a) (ii)	Any one of the following Rocks Food Radon gas Cosmic rays Own bodies Fall-out Sun/stars (1)	Plausible named food such as coffee, brazil nut, bananas Space Specified medical/industrial use of x-rays Ignore smoke alarms, power stations (in normal use)	**(1)**

Question Number	Answer	Acceptable answers	Mark
2(a) (iii)	An explanation linking • personal circumstances such as geographical location nature of their work lifestyle (1) • the consequences such as radiation from radon gas/particular rocks/fall-out (eg Chernobyl) greater exposure to X-rays greater exposure to cosmic rays (1)	Ignore simply more radiation	**(2)**

Question Number	Answer	Acceptable answers	Mark
2(a) (iv)	D scientists have a better understanding of the dangers of radiation		**(1)**

Question Number	Answer	Acceptable answers	Mark
2(b)	Any one of the following: • Mutation of DNA • Ionisation of cells • (Increases risk of) cancer (1)	damage / mutate cells allow radiation sickness / poisoning	**(1)**

Question Number	Answer	Acceptable answers	Mark
2(c) (i)	From the graph Time taken to fall (from 180 to) 90 (1) = 8 (days) (1)	Any other suitable pair of readings from graph 8.1, 8.2 Full marks for correct answer even if no working is evident	**(2)**

Question Number	Answer	Acceptable answers	Mark
2(c) (ii)	17.4 (days) (1)	17 to 18 (days)	**(1)**

Question Number	Answer	Acceptable answers	Mark
3 (a)	A description including the following points • steam {drives/turns} turbine (1) • (which){drives/turns/powers/is connected to} generator (1)	 transfers thermal energy to ke transfers ke to electrical energy or rotates a magnet in coils or coils in magnet accept dynamo for generator	**(2)**

Question Number	Answer	Acceptable answers	Mark
3(b)	A description including the following points • neutron {hits / splits / is absorbed by} uranium (nucleus) (1) • producing more neutrons (1) • at least one neutron can {hit / split / be absorbed by} other uranium (nuclei) (1)	full marks may be scored on a labelled diagram fired at other U (nuclei) or "process repeats" must see word nucleus at least once for full marks	**(3)**

Question Number	Answer	Acceptable answers	Mark
3 (c)	An explanation linking • control rods absorb (more) neutrons(1) • decreases rate of fission (1)	 stop neutrons slow down the reaction Ignore "keep steady" (this is not changing the rate)	**(2)**

Question Number	Answer	Acceptable answers	Mark
3 (d)	A barium-143		**(1)**

Question Number	Answer	Acceptable answers	Mark
3 (e)	An explanation linking the following points • nuclei are positively charged (1) • (need enough energy) to overcome repulsion (1)	ignore references to high temp and pressure accept same charge accept protons for nuclei accept atoms (must mention nuclei or protons or atoms) and will repel each other	**(2)**

Question Number	Answer	Acceptable answers	Mark
4 a	B momentum		**(1)**

Question Number	Answer	Acceptable answers	Mark
4b(i)	substitution (1) 90 = 60 x velocity transposition velocity = 90 / 60 (1) evaluation 1.5 (m/s) (1)	award full marks for correct answer with no working	**(3)**

Question Number	Answer	Acceptable answers	Mark
4 b(ii)	use of force = change in momentum ÷ time (1) evaluation (1) (force =) 23 (N)	accept F = ma together with a = (v – u)/t allow answer that round to 23 e.g. 23.3 (N) award full marks for correct answer with no working	**(2)**

Question Number	Answer	Acceptable answers	Mark
4(c)	An explanation which uses conservation of momentum to link three from Mother and daughter have different mass (1) Momentum is conserved / is zero to start with (1) Both have same size/magnitude of momentum (after the push) (1) so speed of the daughter is greater than that of the mother (1)	An explanation based on Newton's laws and linking three from Each have a different mass (1) Each experience the same size force / action and reaction are equal (1) Each experiences a different acceleration (1) so speed of the daughter is greater than that of the mother (1)	**(3)**

Question Number	Answer	Acceptable answers	Mark
5(a)	☒ **A** **P**		**(1)**

Question Number	Answer	Acceptable answers	Mark
5(b)	distance travelled = area under graph (1) substitution (1) ½ x 24 x 2.5 evaluation (1) 30 (m)	distance = average speed x time = 12 × 2.5 allow (distance) = speed × time OR 24 x 2.5 OR 60 for 1 mark give full marks for correct answer, no working	**(3)**

Question Number	Answer	Acceptable answers	Mark
5(c)	An explanation linking the following points • velocity is a vector (1) • (whereas) speed is not (1)	 velocity has magnitude and direction velocity has direction speed is a scalar speed has {no direction}/{magnitude only} allow for 2 marks velocity is speed in a straight line velocity = displacement / time NOTE answers in terms of momentum must still refer to vectors or direction to gain credit	**(2)**

Question Number		Indicative Content	Mark
QWC	***5(d)**	An explanation linking some of the following **Forces acting** • weight down • air resistance up (opposing motion) **Forces during fall** • weight constant • air resistance increases • with speed • resultant force = W – R **Effect on shape of graph** • at start, resultant force is large so acceleration large / gradient steep • mid resultant force decreasing so acceleration decreasing / gradient decreasing • terminal velocity, resultant force is zero so acceleration zero / gradient zero	**(6)**
Level	**Mark**	**Descriptor**	
	0	No rewardable content	
1	**1 - 2**	• a limited explanation linking a few facts from the indicative content. E.g. at terminal velocity, forces are equal so constant speed. • • the answer communicates ideas using simple language and uses limited scientific terminology • • spelling, punctuation and grammar are used with limited accuracy	
2	**3 - 4**	• a simple explanation linking some of the indicative content to the shape of the graph e.g. At the start weight > air resistance so acceleration and at the end weight = air resistance so no acceleration • the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately • spelling, punctuation and grammar are used with some accuracy	
3	**5 - 6**	• a detailed explanation linking most of the indicative content to the complete shape of the graph e.g. At the start weight > air resistance so acceleration. Then air resistance increases (with speed) so acceleration decreases. At the end weight = air resistance so no acceleration. • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors	

Question Number	Answer	Acceptable answers	Mark
6 (a) (i)	substitution (1) potential difference = 0.4 x 15 (Ω) evaluation 6.0 (V) (1)	give full marks for correct answer, no working	**(2)**

Question Number	Answer	Acceptable answers	Mark
6 (a) (ii)	☒ **C** 1 joule per coulomb		**(1)**

Question Number	Answer	Acceptable answers	Mark
6 (a) (iii)	0.20 (A) (1)	0.2, 0.2A, 0.20, 0.20A, 0.2 amps, 0.20 amps	**(1)**

Question Number	Answer	Acceptable answers	Mark
6 (b)	An explanation linking (more) collision of electrons (1) with other electrons /ions / lattice (1)	 (more) kinetic/electrical energy is transferred to thermal /heat energy	**(2)**

Question Number		Indicative Content	Mark
QWC	***6(c)**	An explanation linking some of the following. • Resistance (of LDR or circuit) would increase with less ambient light • less current is used at night-time • Higher resistance will allow less current (in the circuit) (ORA) • Less current in circuit means less energy transferred from the battery (per second) • Less power required in the dark ORA for light conditions • Dimmer lights (at night-time) means less energy transferred from battery (per second) • Total energy transferred is less during night time (than it would otherwise have been) due to the higher resistance of the LDR	**(6)**
Level	**0**	No rewardable content	
1	**1 - 2**	• A limited explanation EITHER linking the light level to EITHER resistance OR current. OR linking reduced current with less energy/ power from the battery. e.g. It increases the resistance in the dark. • the answer communicates ideas using simple language and uses limited scientific terminology • spelling, punctuation and grammar are used with limited accuracy	
2	**3 - 4**	• A simple explanation linking the light level to TWO of resistance, current, energy. e.g. At night-time its resistance would increase. This would reduce the current from the battery • the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately • spelling, punctuation and grammar are used with some accuracy	
3	**5 - 6**	• A detailed explanation linking the light level to resistance AND current, AND energy. e.g. At night-time the resistance would be more. This would reduce the current and mean that the battery will not have to supply as much energy. • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors	

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Physics/Additional Science

Unit P2: Physics for Your Future

Higher Tier

Friday 16 June 2017 – Morning
Time: 1 hour

Paper Reference
5PH2H/01

You must have:
Calculator, ruler

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided
  – *there may be more space than you need.*

Information

- The total mark for this paper is 60.
- The marks for **each** question are shown in brackets
  – *use this as a guide as to how much time to spend on each question.*
- Questions labelled with an **asterisk** (*) are ones where the quality of your written communication will be assessed
  – *you should take particular care with your spelling, punctuation and grammar, as well as the clarity of expression, on these questions.*

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

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FORMULAE

You may find the following formulae useful.

charge = current × time $Q = I \times t$

potential difference = current × resistance $V = I \times R$

electrical power = current × potential difference $P = I \times V$

energy transferred = current × potential difference × time $E = I \times V \times t$

$$\text{speed} = \frac{\text{distance}}{\text{time}}$$

$$\text{acceleration} = \frac{\text{change in velocity}}{\text{time taken}} \qquad a = \frac{(v - u)}{t}$$

force = mass × acceleration $F = m \times a$

weight = mass × gravitational field strength $W = m \times g$

momentum = mass × velocity $P = m \times v$

$$\text{force} = \frac{\text{change in momentum}}{\text{time}} \qquad F = \frac{(mv - mu)}{t}$$

work done = force × distance moved in the direction of the force $E = F \times d$

$$\text{power} = \frac{\text{work done}}{\text{time taken}} \qquad P = \frac{E}{t}$$

gravitational potential energy = mass × gravitational field strength × vertical height

$\text{GPE} = m \times g \times h$

kinetic energy = ½ × mass × velocity^2 $\text{KE} = ½ \times m \times v^2$

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Questions begin on next page.

Answer ALL questions.

Some questions must be answered with a cross in a box ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

Nuclear energy

1 (a) (i) Complete the sentence by putting a cross (☒) in the box next to your answer.

(1)

In a nuclear power station, thermal energy is transferred into electrical energy using

☒ **A** a turbine and a generator

☒ **B** a moderator and a turbine

☒ **C** a moderator and a generator

☒ **D** a turbine and a transformer

(ii) In many nuclear power stations, nuclei of uranium-235 undergo fission.

State **three** different products released in the fission of a uranium-235 nucleus.

(3)

1 .....

2 .....

3 .....

(iii) Describe how the fission of a nucleus of uranium-235 can lead to a chain reaction.

(2)

.....

.....

.....

.....

(b) Scientists are designing a different type of nuclear power station.

This power station will use the fusion of isotopes of hydrogen to make helium.

Explain why large amounts of energy are needed to make this nuclear fusion reaction take place.

(2)

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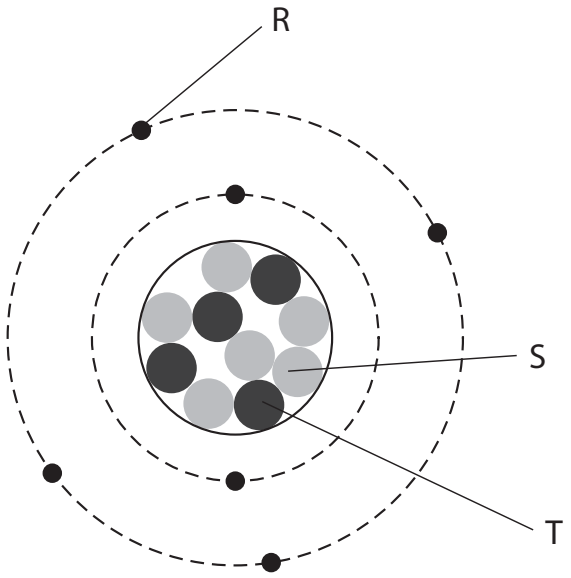
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(Total for Question 1 = 8 marks)

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Electric charge

2 (a) The diagram represents the particles in an atom. The atom is neutral.



Draw one line from each particle box to the correct label box.

(2)

particle	label
electron	R
neutron	S
proton	T

(b) When a battery is connected to a lamp, charge flows through the connecting wires in the circuit.

Complete the sentence by putting a cross (☒) in the box next to your answer.

(1)

In the connecting wires

☒ **A** positive charge flows towards the positive terminal of the battery

☒ **B** positive charge flows towards the negative terminal of the battery

☒ **C** negative charge flows towards the positive terminal of the battery

☒ **D** negative charge flows towards the negative terminal of the battery

(c) Polyethylene terephthalate (PET) and polyvinyl chloride (PVC) are two common types of plastic that can be recycled from household waste. They need to be separated in the recycling plant.

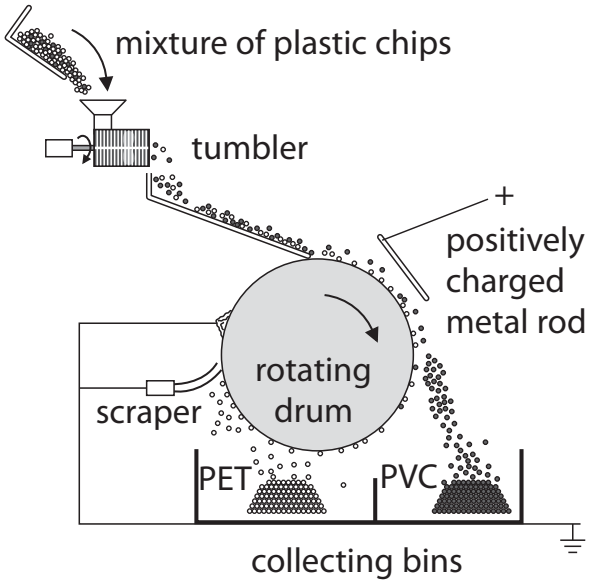
The waste plastics are crushed into small chips and tumbled together.
The PET chips become positively charged.
The PVC chips become negatively charged.

(i) Explain how the PET chips become positively charged and the PVC chips become negatively charged.

(2)

(ii) The mixture is dropped onto a rotating drum.

The mixture sticks to the outside of the drum.



The mixture goes past a metal rod that has a positive charge.
PVC chips leave the drum and fall into the collecting bin on the right.

Explain why the PVC chips leave the drum.

(2)

(iii) The PET chips are carried round until they reach the scraper.
They fall into the collecting bin on the left.
Both of the bins and the scraper are connected to earth.

Suggest why the bins and scraper are connected to earth.

(1)

.....

.....

(Total for Question 2 = 8 marks)

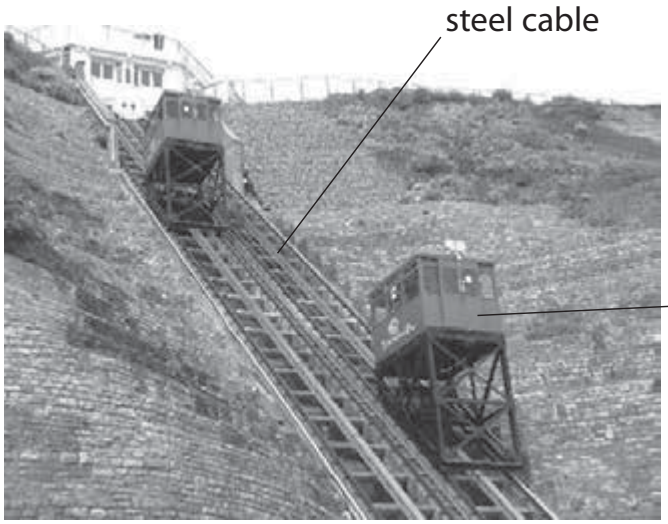
3 (a) A motorcyclist is climbing a hill at a constant speed of 13 m/s.

Calculate the time it takes for the motorcyclist to travel 29 m.

(2)

time = ... s

(b) The picture shows a railway that carries passengers up and down a cliff at the seaside.



© geograph.org.uk

The top ends of the two passenger cabins are joined by a steel cable around a pulley at the top of the cliff.

When one cabin goes down, the other cabin goes up.

Explain how this design makes good use of energy transfers in the system.

(2)

.....

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.....

(c) A car is travelling along a level road when the driver applies the brakes to stop it. The work done to stop the car is 510 000 J.

The car has a mass of 1400 kg.

(i) State the value of the kinetic energy of the car when the brakes were first applied.

(1)

kinetic energy = ... J

(ii) Calculate the velocity of the car when the brakes were first applied.

(3)

velocity = ... m/s

(iii) The brakes applied an average force of 15 000 N.

Calculate the distance it takes for the brakes to stop the car.

(2)

distance = ... m

(Total for Question 3 = 10 marks)

4 (a) A technician is testing a filament lamp from a car.

He connects the lamp to a test circuit with a 1.5 V d.c. power supply.

(i) Complete the sentence by putting a cross (☒) in the box next to your answer.

(1)

The power supply transfers

☒ **A** 1.5 joules per coulomb

☒ **B** 1.5 joules per ohm

☒ **C** 1.5 amps per coulomb

☒ **D** 1.5 volts per joule

(ii) The circuit shows the lamp and the power supply.



The technician adds a meter to measure the current in the circuit.

Add an appropriate meter symbol to the circuit to show how the meter should be connected.

(1)

(iii) The current is 0.18 A.

Calculate the resistance of the filament in the lamp.

(3)

resistance = ... Ω

(b) The lamp is designed to be used in a car with a 12 V battery.

(i) When it is connected to the 12 V battery, there is a current of 800 mA in the lamp.

Calculate the power of the lamp.

(2)

power = ... W

(ii) The technician connects the lamp to a 6 V motorcycle battery instead of the 12 V car battery.

He expects the current to be 400 mA (exactly ½ of the current in the 12 V circuit).

He measures the current and finds that it is not 400 mA.

Explain why the current is not 400 mA.

(3)

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(Total for Question 4 = 10 marks)

Using parachutes

5 A relief organisation drops food parcels by parachute from a helicopter.

(a) Each food parcel has a weight of 80 N.

The gravitational field strength is 10 N/kg.

Complete the sentence by putting a cross (☒) in the box next to your answer.

(1)

The mass of one food parcel is

☒ **A** 0.8 kg

☒ **B** 8.0 kg

☒ **C** 80 kg

☒ **D** 800 kg

(b) The helicopter is hovering at a constant height above the ground.

It drops a food parcel.

The parcel falls for a few seconds before the parachute starts to open.

Calculate the velocity of the food parcel after falling for 1.2 s.

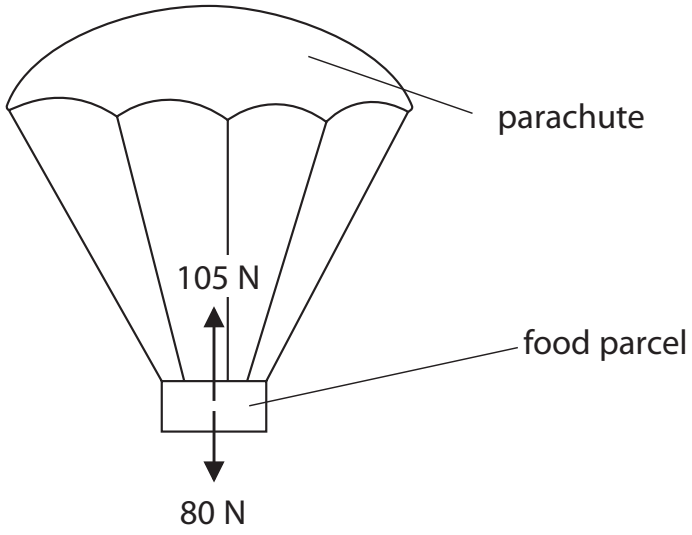
Ignore any air resistance acting on the food parcel.

Acceleration due to gravity, $g = 10$ m/s^2.

(3)

velocity = ... m/s

(c) The diagram shows the forces acting on the food parcel soon after the parachute has opened.



Complete the sentence by putting a cross (☒) in the box next to your answer.

(1)

The resultant force on the food parcel is

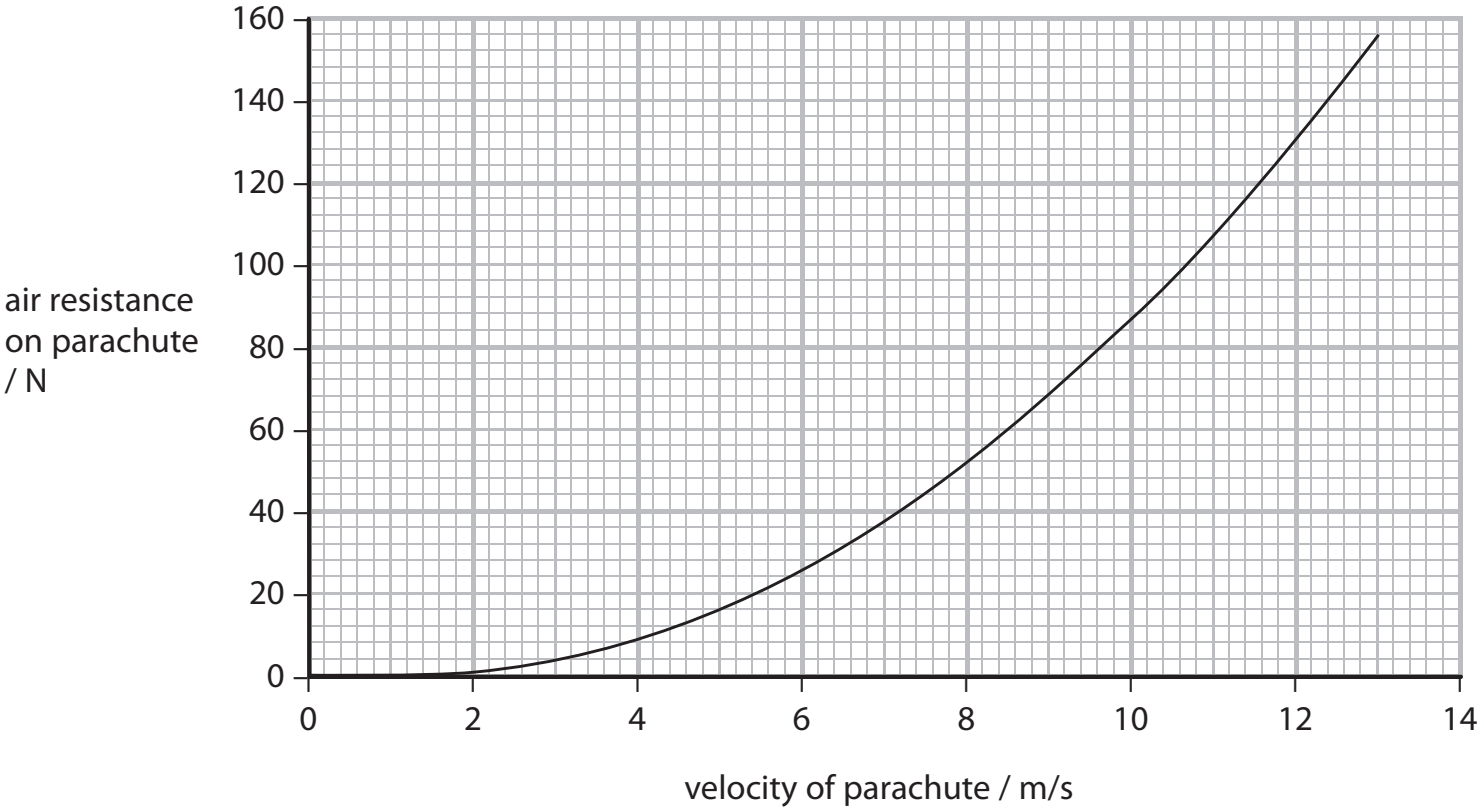
☒ **A** 25 N downwards

☒ **B** 25 N upwards

☒ **C** 185 N downwards

☒ **D** 185 N upwards

(d) The graph shows the results of tests on the parachute. It shows how the air resistance acting on the parachute varies with the velocity of the parachute.



(i) Describe the relationship shown by the graph.

(2)

.....

.....

.....

.....

*(ii) The food parcel, weighing 80 N, falls the last 20 m to the ground at a constant velocity of 9.6 m/s.

Explain how the forces acting on the food parcel change the velocity of the parcel as it falls from the helicopter to the ground.

You may draw a diagram or graph to help with your explanation.

(6)

(Total for Question 5 = 13 marks)

Radioactive materials

6 (a) (i) Thorium is a radioactive element. It has several isotopes.

State what is meant by the term **isotopes**.

(1)

.....

.....

(ii) One isotope of thorium has a half-life of 1.9 years.
Radium is another radioactive element.
One isotope of radium has a half-life of 3.5 days.

A sample of thorium and a sample of radium start with the same number of atoms.

Compare the initial activities of the samples.

(2)

.....

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.....

(iii) Thorium and radium emit alpha radiation when they decay.

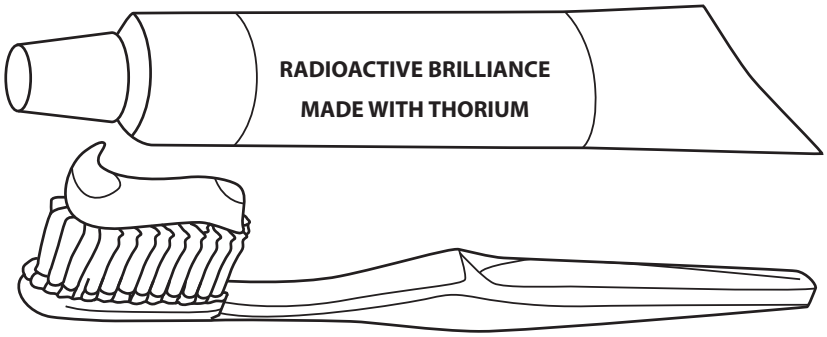
Complete the sentence by putting a cross (☒) in the box next to your answer.

(1)

Alpha radiation

- ☒ **A** can penetrate a few mm of aluminium
- ☒ **B** is highly ionising
- ☒ **C** is a type of electromagnetic radiation
- ☒ **D** has a negative charge

(b) This is a brand of toothpaste that was sold about 75 years ago.



"Use toothpaste with thorium! Have sparkling, brilliant teeth—radioactive brilliance!"

It contained a small amount of radioactive thorium. Some people believed that it would make their teeth much brighter.

(i) This toothpaste cannot be sold today.

Complete the sentence by putting a cross (☒) in the box next to your answer.

(1)

Today, there are laws about how radioactive materials can be used because

☒ **A** we can make better measurements of their half-life

☒ **B** the radioactivity of these materials has increased over the last 75 years

☒ **C** we understand more about the effects of radiation

☒ **D** doctors have become better trained

*(ii) An isotope of thorium decays into radium.
Radium is also unstable and decays into radon gas.

This table gives information about these decays.

isotope	half-life	radiation emitted	decays into
thorium	1.9 years	alpha	radium
radium	3.6 days	alpha	radon
radon (gas)	55 seconds	alpha	polonium

Discuss how dangerous it would be to use this isotope of thorium in the toothpaste.

(6)

(Total for Question 6 = 11 marks)

TOTAL FOR PAPER = 60 MARKS

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Mark Scheme (Standardisation)

Summer 2017

Pearson Edexcel GCSE

In Physics (5PH2H) Paper 2H

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General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

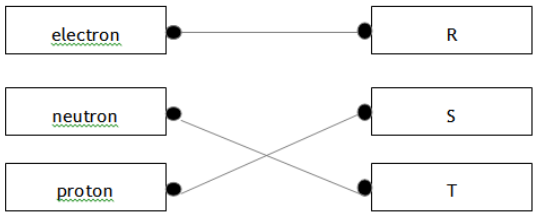
Question number	Answer	Acceptable answers	Marks
1 (a) (i)	**A** a turbine and a generator **The only correct answer is A** **B** is not correct because a moderator does not produce thermal energy and a turbine produces kinetic energy **C** is not correct because a moderator does not produce thermal energy **D** is not correct because a transformer does not produce electrical energy from kinetic energy		**(2)**

Question number	Answer	Acceptable answers	Marks
1 (a) (ii)	One mark for each correct line Neutron(s) (1) Daughter nucleus/nuclei (1) (Thermal)Energy (1)	 barium / krypton / two <u>smaller</u> nuclei/isotopes Award 2 marks for Barium AND Krypton on separate lines Em/ γ radiation Mark each line independently. Correct answers may appear in any order.	**(3)**

Question number	Answer	Acceptable answers	Marks
1 (a) (iii)	A description including Neutron (released from fission) (1) Collides with a (further) U-235/nucleus (1)		**(2)**

Question number	Answer	Acceptable answers	Marks
1 (b)	An explanation linking Large <u>kinetic</u> energy required (1) To overcome (electrostatic) repulsion (1)	High (collision) speed required <u>very</u> high temperature	**(2)**

(Total for Question 1 = 8 marks)

Question number	Answer	Acceptable answers	Marks
2 (a) (i)	 Allow 1 mark for one correct line only		**(2)**

Question number	Answer	Acceptable answers	Marks
2 (b)	**C** negative charge flows towards the positive terminal of the battery **The only correct answer is C** **A** is not correct because positive charge does not flow **B** is not correct because positive charge does not flow **D** is not correct because negative charge would be repelled by the negative terminal of the battery		**(1)**

Question number	Answer	Acceptable answers	Marks
2 (c) (i)	An explanation linking Electrons/**negative charges** move ***/*** transferred (1) From PET to PVC (1)	PET loses electrons PVC gains electrons	**(2)**

Question number	Answer	Acceptable answers	Marks
2 (c) (ii)	An explanation linking (Force of) attraction (1) Between opposite charges (1)	PVC is attracted to positive charge for 2 marks	**(2)**

Question number	Answer	Acceptable answers	Marks
2 (c) (iii)	A suggestion to include discharge {chips/drum/bins} (1)	To prevent a build up of charge/sparking/shock	**(1)**

(Total for Question 2 = 8 marks)

Question number	Answer	Acceptable answers	Marks
3 (a)	Substitution (1) 13 = 29 ÷ t Rearrangement and Evaluation (1) 2.2 (s)	t = 29 ÷ 13 Values which round to 2.2 e.g. 2.23076 Allow correct value with no working shown for 2 marks	**(2)**

Question number	Answer	Acceptable answers	Marks
3 (b)	A suggestion to include any two of gravitational potential energy (GPE) energy is transferred {to Kinetic energy (KE)} / {between cabins} (1) The gravitational potential energy (GPE) of descending/top cabin decreases (1) (transferred into/ increases) KE/GPE of bottom cabin (1)		**(2)**

Question number	Answer	Acceptable answers	Marks
3 (c) (i)	510 000 (J)	510 kJ	**(1)**

Question number	Answer	Acceptable answers	Marks
3 (c) (ii)	Substitution 510 000 = ½ x 1400 x v^2 (1) Transposition v^2 = 2 x 510 000 / 1400 (1) Evaluation (v =) 27 (m/s) (1)	Allow ECF from ci v = √730 for 2 marks Values which round to 27 e.g. 26.992 Allow correct value with no working shown for 3 marks	**(3)**

Question number	Answer	Acceptable answers	Marks
3 (c) (iii)	Substitution 510 000 = 15 000 x d (1) Transposition and evaluation (d =) 34 (m) (1)	Allow correct value with no working shown for 2 marks	**(2)**

(Total for Question 3 = 9 marks)

Question number	Answer	Acceptable answers	Marks
4 (a) (i)	**A** 1.5 joules per coulomb **The only correct answer is A** **B** is not correct because one volt is not equivalent to one joule per ohm **C** is not correct because one volt is not equivalent to one amp per coulomb **D** is not correct because one volt is not equivalent to one volt per joule		**(1)**

Question number	Answer	Acceptable answers	Marks
4 (a) (ii)	An ammeter connected in series with lamp and power supply (1)	Ignore line through symbol	**(1)**

Question number	Answer	Acceptable answers	Marks
4 (a) (iii)	Substitution 1.5 = 0.18 x R (1) Transposition R = 1.5/0.18 (1) Evaluation 8.3 (ohms) (1)	Substitution and transposition can be in either order Give full marks for correct answer with no working shown	**(3)**

Question number	Answer	Acceptable answers	Marks
4 (b) (i)	Substitution (P =) 12 (v) x 800 (mA) (1) Unit conversion and evaluation 9.6 (W) (1)	Ignore unit conversion until evaluation stage 9600 mW Give full marks for correct answer with no working shown Allow 1 mark for POT error even with no working shown	**(2)**

Question number	Answer	Acceptable answers	Marks
4 (b) (ii)	An explanation to include In the 6V circuit…. Resistance (in the circuit) has changed (1) Temperature of filament is lower / Fewer collisions (in the lattice) (1) Current is more than 400 mA (conditional on first MP) OR Current is not proportional to voltage (1)	Reverse argument for 12V circuit Bulb/lamp is less bright Current is more than 0.4 A/ expected	**(3)**

(Total for Question 4 = 11 marks)

Question number	Answer	Acceptable answers	Marks
5 (a)	**B** 8.0 kg **The only correct answer is B** **A** is not correct because 0.8 kg has a weight of 8 N **C** is not correct because 80 kg has a weight of 800N **D** is not correct because 800 kg has a weight of 8,000 N		**(1)**

Question number	Answer	Acceptable answers	Marks
5 (b)	Substitution 10 = v / 1.2 (1) Transposition V = 10 x 1.2 (1) Evaluation 12 (m/s) (1)	Transposition and substitution can be in either order Give full marks for correct answer with no working shown	**(3)**

Question number	Answer	Acceptable answers	Marks
5 (c)	**B** 25 N upwards **The only correct answer is B** **A** is not correct because although the value of 25N is correct, it is in the wrong direction **C** is not correct because the forces must be subtracted from each other **D** is not correct because the forces must be subtracted from each other		**(1)**

Question number	Answer	Acceptable answers	Marks
5 (d) (i)	a description to include air resistance / drag increases with (increase in) velocity (1) relationship is non-linear (1)	positive correlation increases more for higher velocities not (directly) proportional rate of change/ gradient changes	**(2)**

Question Number		Indicative Content	Mark
QWC	***5dii**	An explanation to include some of the following points at some different stages during the decent • Initially downward acceleration • initially only gravitational force acting • initial downwards resultant force • downward acceleration decreases because.. • air resistance increases with speed • reduces resultant force • possibly the gravitational and air resistance forces balance/ become equal • zero resultant force • reaches terminal velocity • when parachute opens air resistance provides upwards force • relevant numerical values from graph / diagram • to start with, air resistance is very large • so large upward resultant force • causes velocity of parcel to decrease • eventually air resistance = weight of food parcel • no resultant force • reached terminal velocity • hits ground with terminal velocity • this will be 9.6 m/s Credit can be gained from points made on labelled diagram or graph	**(6)**
Level	**0**	No rewardable content	
1	**1 - 2**	• A limited explanation which refers to the change in velocity in at least 2 stages OR which links the change in velocity in one stage with a resultant force which cause this change. e.g. before the parachute opens the parcel accelerates; after the parachute opens the parcel reaches terminal velocity • the answer communicates ideas using simple language and uses limited scientific terminology • spelling, punctuation and grammar are used with limited accuracy	
2	**3- 4**	• A simple explanation which refers to the change in velocity in at least 2 stages and links this with the forces causing the change in one of those stages e.g. before the parachute opens the parcel accelerates; after the	

		parachute opens the parcel reaches terminal velocity because air resistance is equal to weight • the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately • spelling, punctuation and grammar are used with some accuracy
3	**5- 6**	• A detailed explanation linking the change in velocity with the forces causing this for at least 2 stages e.g. after the parachute opens air resistance is greater than the weight so it slows down. Eventually it reaches terminal velocity when the air resistance and weight are equal and so resultant force is zero • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors

(Total for Question 5 = 13 marks)

Question number	Answer	Acceptable answers	Marks
6 (a) (i)	(nuclei) having the same number of protons but different number of neutrons	Same atomic number but different mass number Same element but different number of neutrons	**(1)**

Question number	Answer	Acceptable answers	Marks
6 (a) (ii)	A comparison linking • Activity of thorium is lower (1) Linked to **one** of • thorium decays more slowly (1) • half-life of thorium is longer (1) • takes longer for the same number of thorium atoms to decay (1) • the rate of decay for thorium is less than the rate of decay of radium (1)	Reverse argument for radium	**(2)**

Question number	Answer	Acceptable answers	Marks
6 (a) (iii)	B is highly ionising **The only correct answer is B** **A** is not correct because alpha radiation cannot penetrate aluminium **C** is not correct because alpha radiation consists of particle, not electromagnetic radiation **D** is not correct because alpha radiation has a positive charge		**(1)**

Question number	Answer	Acceptable answers	Marks
6 (b) (i)	**C** we understand more about the effects of radiation **The only correct answer is C** **A** is not correct because better measurement of half-life does not give information about the hazards of radiation **B** is not correct because radioactivity decreases with time. **D** is not correct because training of doctors does not have any bearing on laws dealing with the hazards of radioactive materials.		**(1)**

Question Number		Indicative Content	Mark
QWC	***6bii**	A discussion to include some of the following points Possible hazards • thorium is radioactive/ emits alpha radiation • alpha radiation is highly ionising • radiation can damage DNA / cause cancer Factors reducing risk • alpha stopped by tube • so radiation from toothpaste in tube unlikely to affect people • thorium has low activity • only small amount of thorium Factors increasing risk • radium has high activity • if ingested then alpha almost certain to reach cells • radon released (when tube is opened / left open) • radon has a very high activity / very short half-life/ high chance of decay while in the body • valid environmental considerations e.g. waste toothpaste	**(6)**
Level	**0**	No rewardable content	
1	**1 - 2**	• A limited discussion of the dangers which might include some of the hazards e.g. The alpha radiation from the toothpaste is ionising and can cause cancer. • the answer communicates ideas using simple language and uses limited scientific terminology • spelling, punctuation and grammar are used with limited accuracy	
2	**3- 4**	• A simple discussion of the dangers including some of the hazards and factors increasing OR reducing risk e.g. The ionising radiation from the toothpaste could cause cancer in people using because when it is inside your body, the alpha radiation can cause mutations of cells • the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately • spelling, punctuation and grammar are used with some accuracy	
3	**5 - 6**	• A detailed discussion of the dangers including most of the hazards and the factors affecting the balance of risk e.g. The ionising radiation from the toothpaste could cause cancer in people using because when it is inside your body, the alpha radiation can cause mutations of cells. However, while it is in the tube, the alpha radiation could not escape and so the toothpaste is not very dangerous. • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors	

(Total for Question 6 = 11 marks)

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Write your name here

Surname	Other names

Pearson Edexcel GCSE

Centre Number | | | | | |

Candidate Number | | | | |

Physics/Additional Science

Unit P2: Physics for Your Future

Higher Tier

Friday 17 June 2016 – Morning
Time: 1 hour

Paper Reference
5PH2H/01

You must have:
Calculator, ruler

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided
  – *there may be more space than you need.*

Information

- The total mark for this paper is 60.
- The marks for **each** question are shown in brackets
  – *use this as a guide as to how much time to spend on each question.*
- Questions labelled with an **asterisk** (*) are ones where the quality of your written communication will be assessed
  – *you should take particular care with your spelling, punctuation and grammar, as well as the clarity of expression, on these questions.*

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

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FORMULAE

You may find the following formulae useful.

charge = current × time $Q = I \times t$

potential difference = current × resistance $V = I \times R$

electrical power = current × potential difference $P = I \times V$

energy transferred = current × potential difference × time $E = I \times V \times t$

$$\text{speed} = \frac{\text{distance}}{\text{time}}$$

$$\text{acceleration} = \frac{\text{change in velocity}}{\text{time taken}} \qquad a = \frac{(v-u)}{t}$$

force = mass × acceleration $F = m \times a$

weight = mass × gravitational field strength $W = m \times g$

momentum = mass × velocity $P = m \times v$

$$\text{force} = \frac{\text{change in momentum}}{\text{time}} \qquad F = \frac{(mv-mu)}{t}$$

work done = force × distance moved in the direction of the force $E = F \times d$

$$\text{power} = \frac{\text{work done}}{\text{time taken}} \qquad P = \frac{E}{t}$$

gravitational potential energy = mass × gravitational field strength × vertical height

$\text{GPE} = m \times g \times h$

kinetic energy = ½ × mass × velocity^2 $\text{KE} = ½ \times m \times v^2$

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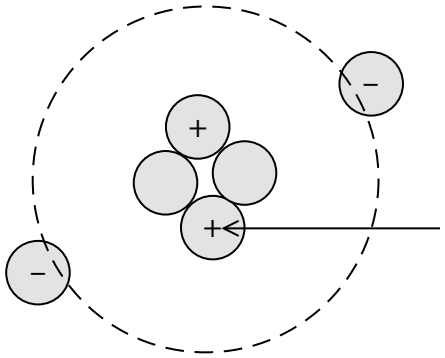
Questions begin on next page.

Answer ALL questions.

Some questions must be answered with a cross in a box ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

Static electricity and charge

1 (a) The diagram represents an atom.



Not to scale

The arrow is pointing to a single particle.

Complete the sentence by putting a cross (☒) in the box next to your answer.

The arrow is pointing to

(1)

☒ **A** an electron

☒ **B** a neutron

☒ **C** a nucleus

☒ **D** a proton

(b) A student has a nylon carpet in her bedroom.

She becomes positively charged as she walks across the carpet.

(i) Explain how the student becomes positively charged.

(3)

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(ii) When the student touches a metal door handle she feels an electric shock. Explain why she feels an electric shock.

(2)

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(c) An electric torch is switched on for 90 s.

The current in the torch is 70 mA.

Calculate the amount of charge flowing from the torch battery during this time.

(2)

charge = ... C

(Total for Question 1 = 8 marks)

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Nuclear fission and nuclear fusion

2 (a) Complete the sentence by putting a cross (☒) in the box next to your answer.

The difference between fission and fusion is that only fission

(1)

☒ **A** creates new nuclei

☒ **B** is triggered by neutrons

☒ **C** releases electrons

☒ **D** releases energy

(b) A nucleus of uranium-235, used in a fission reactor, can be represented as

$$^{235}_{92}U$$

Insert the correct numbers into this sentence:

(2)

A nucleus of uranium-235 contains ..... protons and ..... neutrons.

(c) Describe the purpose of the moderator in a nuclear fission reactor.

(2)

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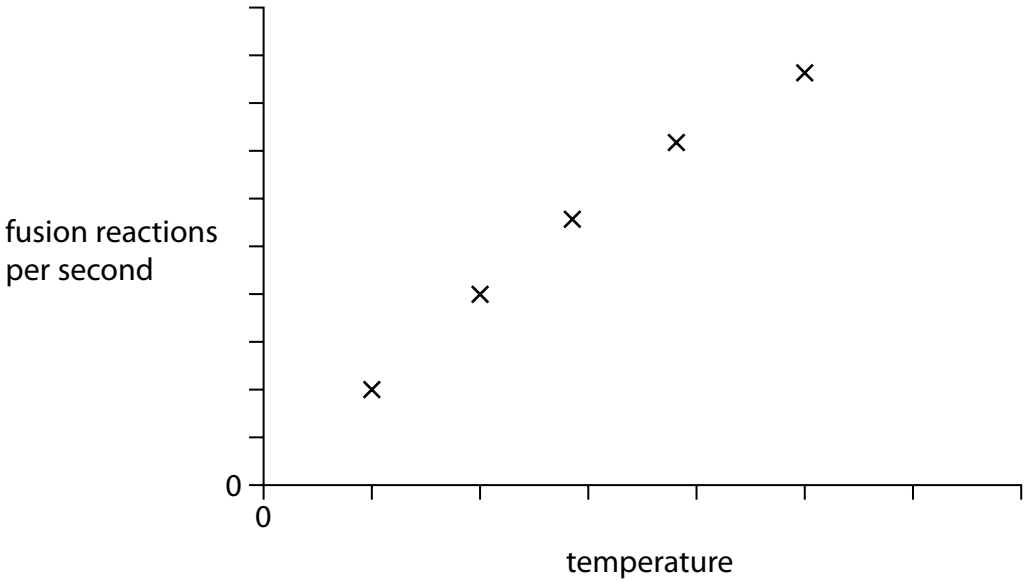
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(d) Scientists have studied fusion reactors.

They have found that the number of fusion reactions per second varies with temperature.

This variation is shown on a graph.



Explain why the number of fusion reactions per second varies with temperature in this way.

(2)

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(e) In 1989, some scientists claimed to have achieved fusion at room temperature.

Suggest why their claim is no longer believed.

(1)

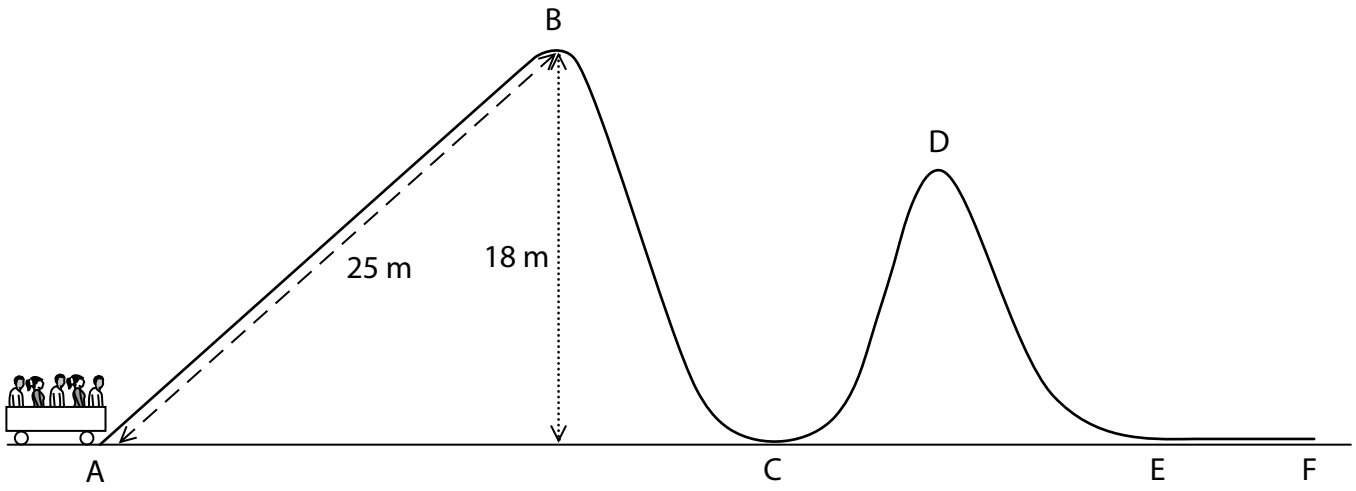
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(Total for Question 2 = 8 marks)

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3 The diagram shows a car and passengers at the start of a roller coaster ride at an amusement park.



(a) An electric motor pulls the car from A to B at a steady speed.

The total mass of the car and passengers is 9500 kg.

Calculate the amount of work done on the car and passengers.
[Gravitational field strength, g = 10 N/kg]

(2)

work done = ... J

(b) The car is released at B and continues down the track.

State the maximum possible kinetic energy of the car and passengers at C.

(1)

maximum KE = ... J

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(c) Describe the main energy transfer that takes place between C and D.

(2)

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(d) When the car and passengers reach E, they have a total momentum of 150 000 kg m/s.

The total mass of the car and passengers is 9500 kg.

Calculate the velocity of the car and passengers at E.

(3)

velocity = ... m/s

(e) Brakes are applied as the car passes E.

This brings the car to a stop at F.

Explain why it is more comfortable for the passengers if there is a large distance between E and F.

(2)

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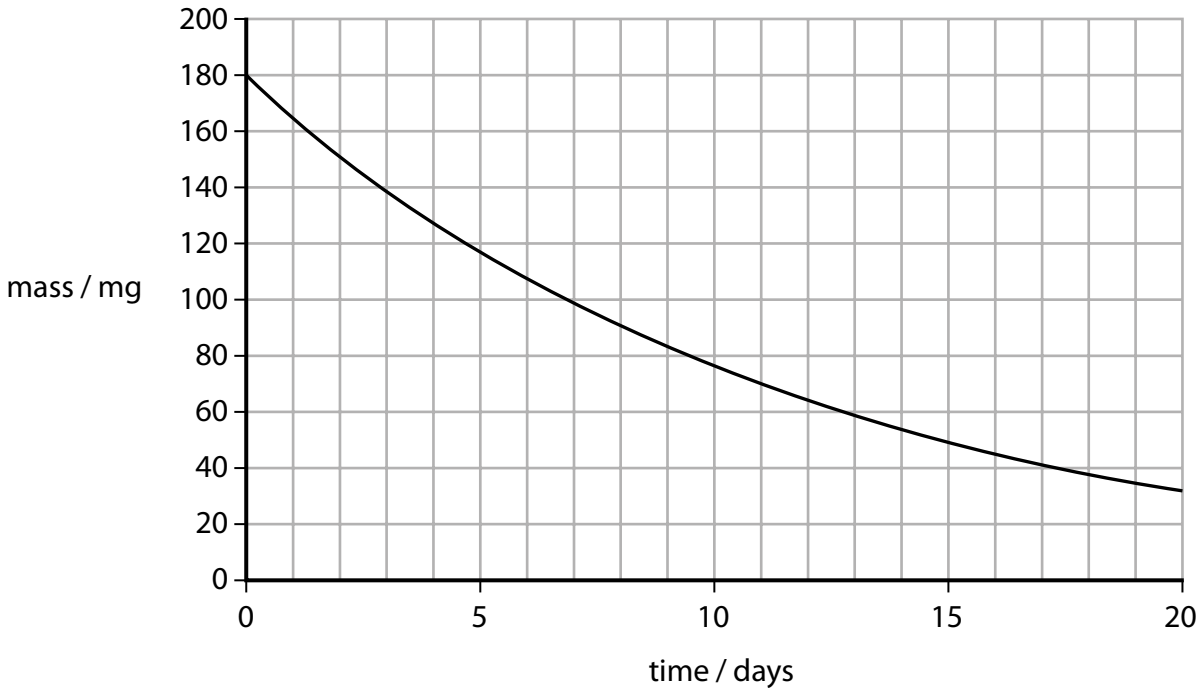
(Total for Question 3 = 10 marks)

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4 (a) Iodine-131 is used in hospitals.
The graph shows the decay of a sample of iodine-131.



(i) Use the graph to find the half-life of iodine-131.

(2)

half-life = ... days

(ii) Estimate the mass of iodine-131 in the sample 7 days before the start of the graph.

(1)

mass = ... mg

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(iii) Iodine-131 emits beta particles and gamma rays.

A patient is only given a small dose of iodine-131 during treatment.

Hospital staff who administer this treatment to a lot of patients are potentially exposed to greater risk.

Explain the dangers to hospital staff.

(2)

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(iv) State one safety precaution related to the use of radioactive material.

(1)

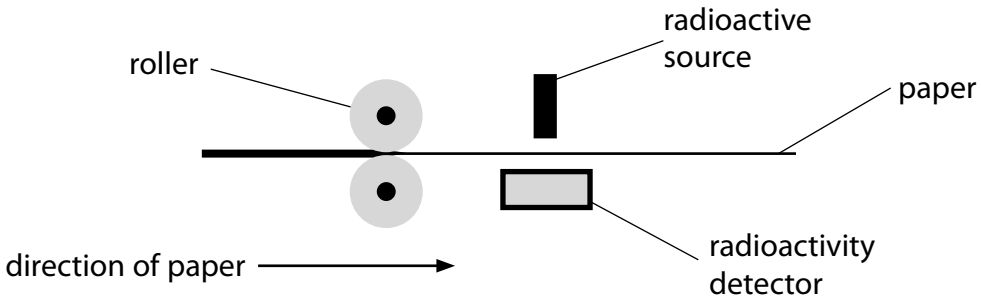
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(b) Radioactive sources are also used in factories that make paper.

The distance between two rollers controls the thickness of the paper.
The factories use a system to control this distance.

The system contains a radioactive source and a radioactivity detector.



(i) Which of these sources should be used?

Put a cross (☒) in the box next to your answer.

(1)

☒ **A** an alpha emitter

☒ **B** a beta emitter

☒ **C** a gamma emitter

☒ **D** an alpha and gamma emitter

(ii) Explain how this system controls the thickness of the paper.

(3)

(Total for Question 4 = 10 marks)

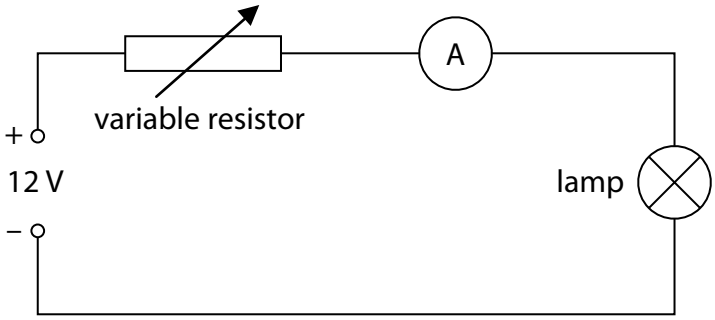
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Electrical resistance

5 A student uses this circuit to investigate how the current in a filament lamp varies with the potential difference (voltage) across the lamp.



(a) Add a voltmeter to the circuit that can be used to measure the potential difference (voltage) across the lamp.

(1)

(b) Complete the sentence by putting a cross (☒) in the box next to your answer.

The 12 V electrical supply transfers

(1)

☒ **A** 12 joules per coulomb

☒ **B** 12 coulombs per joule

☒ **C** 12 joules per ohm

☒ **D** 12 volts per amp

(c) When the variable resistor is at the half-way position, the ammeter reads 0.37 A and the voltmeter reads 4.0 V.

Show that the resistance of the filament in the lamp is about 11 Ω.

(2)

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(d) The student increases the resistance of the variable resistor.

Which of the following describes how the meter readings change?

Put a cross (☒) in the box next to your answer.

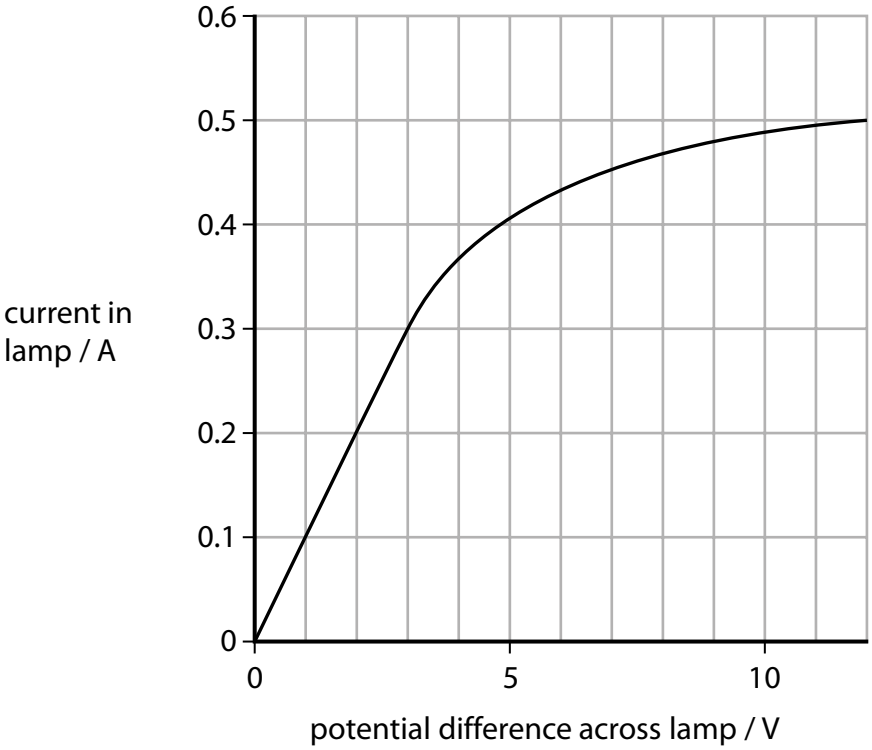
(1)

	the ammeter reading	the voltmeter reading
☒ **A**	increases	increases
☒ **B**	increases	decreases
☒ **C**	decreases	decreases
☒ **D**	decreases	increases

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*(e) The student takes a range of measurements for the filament lamp.

He plots this graph from his measurements.



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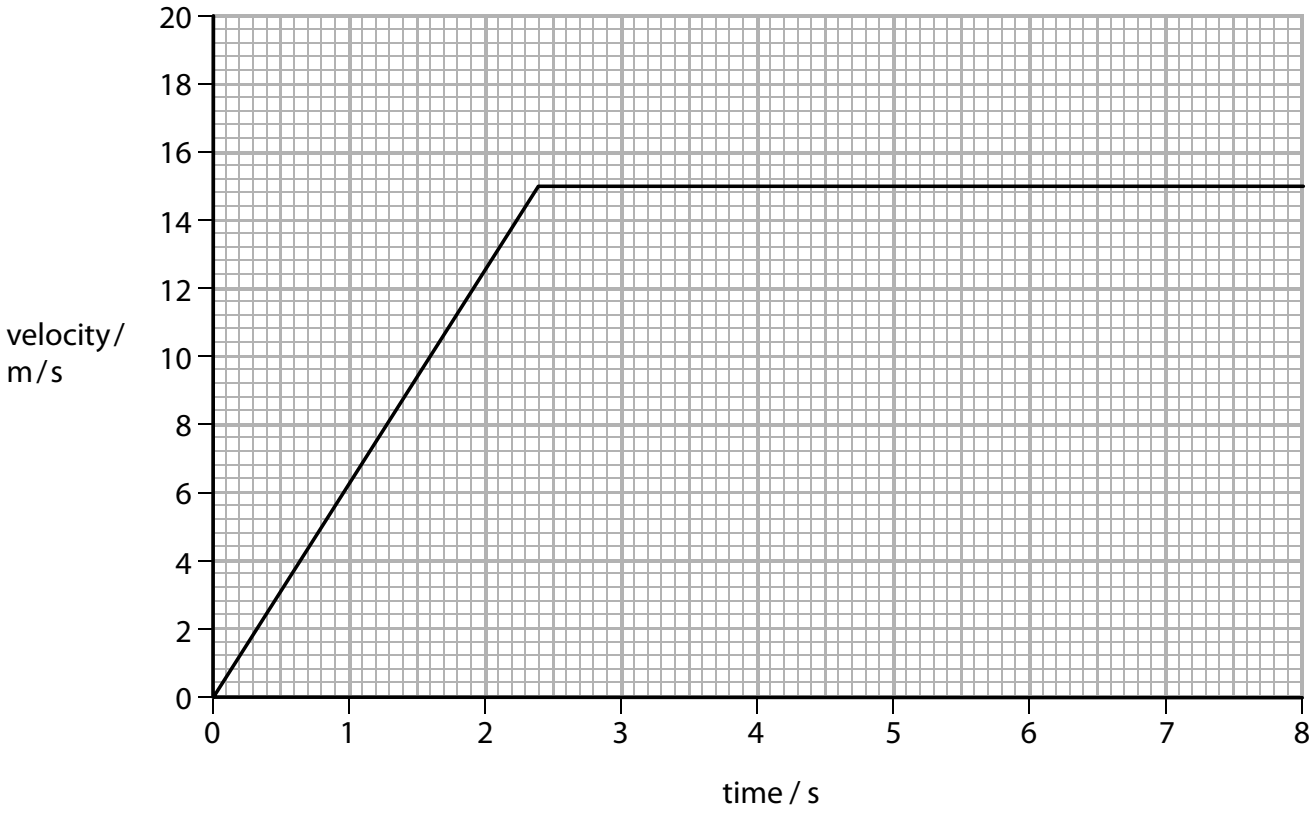
Explain how changes in the filament of the lamp account for this graph.

(6)

(Total for Question 5 = 11 marks)

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6 (a) The graph represents the motion of a cyclist at the start of an Olympic race.



(i) Calculate the initial acceleration.

(2)

acceleration = ... m/s^2

(ii) Another cyclist has a smaller initial acceleration but then reaches a constant velocity of 17 m/s.
Draw her motion on the graph above.

(1)

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(iii) The cyclists have to keep pedalling to maintain their constant velocity.

Give one reason why they have to keep pedalling to maintain their constant velocity.

(1)

.....

.....

(iv) One cyclist produces an average power output of 600 W during the race. She completes the race in exactly 4 minutes.

Calculate the work done by the cyclist during the race.

(3)

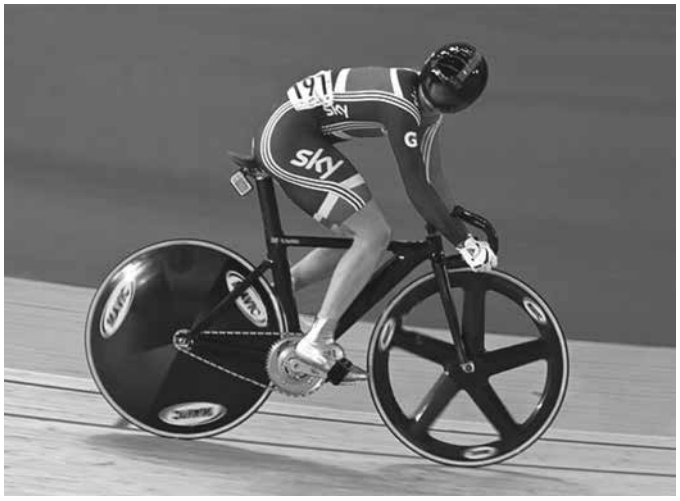
work done = ...J

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*(b) The photographs show cyclists and the winning times for the same event in two different Olympic Games.



1920: 5 min 14 s



2012: 3 min 51 s

The designs of the cyclists' clothing and their bicycles have changed.

These changes have helped the modern cyclist to improve the winning time from 5 min 14 s to 3 min 51 s.

Describe **one** of these changes and use scientific principles to explain how this change has helped cyclists improve the winning time.

(6)

(Total for Question 6 = 13 marks)

TOTAL FOR PAPER = 60 MARKS

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Mark Scheme (Results)

Summer 2016

Pearson Edexcel GCSE in Physics (5PH2H) Paper 01
Unit P2: Physics for your future

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General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- For questions worth more than one mark, the answer column shows how partial credit can be allocated. This has been done by the inclusion of part marks eg (1).
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

Quality of Written Communication

Questions which involve the writing of continuous prose will expect candidates to:

- Write legibly, with accurate spelling, grammar and punctuation in order to make the meaning clear
- Select and use a form and style of writing appropriate to purpose and to complex subject matter
- Organise information clearly and coherently, using specialist vocabulary when appropriate.

Full marks will be awarded if the candidate has demonstrated the above abilities.

Questions where QWC is likely to be particularly important are indicated (QWC) in the mark scheme, but this does not preclude others.

Question Number	Answer	Acceptable answers	Mark
1(a)	D (Proton)		**(1)**

Question Number	Answer	Acceptable answers	Mark
1 (b)(i)	An explanation linking • friction (between shoes and carpet) (1) • movement of electrons (1) • {electrons/-ve charges} move from the student (to carpet) (1) stating that positive charges move can only score a maximum of one from the last two marking points	• rubbing (of shoes on carpet) • movement / transfer of charge friction causes the student to lose electrons to the carpet gains all 3 marks	**(3)**

Question Number	Answer	Acceptable answers	Mark
1 (b)(ii)	An explanation linking any two from • electrons flow (1) • to the student (1) • through the metal handle (1)	Current Condone charge for electrons Student is discharged/ charge is earthed /student is earthed from the {handle / ground / earth} metal / handle is a conductor	**(2)**

Question Number	Answer	Acceptable answers	Mark
1 (c)	Substitution 70 (x 10^{-3}) x 90 (1) Evaluation: 6.3 (C) (1)	allow 1 mark maximum for power of ten error in final answer (C) Allow 2 marks for correct answer with no working shown.	**(2)**

Question Number	Answer	Acceptable answers	Mark
2 (a)	B (is triggered by neutrons)		**(1)**

Question Number	Answer	Acceptable answers	Mark
2 (b)	92 (protons) (1) 143 (neutrons) (1)	Must be in this order	**(2)**

Question Number	Answer	Acceptable answers	Mark
2 (c)	A description to include any two from • Slow down neutrons (1) • Allow capture by nucleus (1) • To increase the rate of / maintain the reaction / eq (1)	Allow uranium for nucleus **increase** chance of collision / fission	**(2)**

Question Number	Answer	Acceptable answers	Mark
2 (d)	An explanation linking any two from at high(er) temperature.... • the nuclei have a high (kinetic) energy (1) • more able to overcome (mutual) repulsion (1) • likelihood of fusion reaction is higher (1) ORA	condone atoms for nuclei nuclei are moving (more) quickly	**(2)**

Question Number	Answer	Acceptable answers	Mark
2 (e)	A suggestion to include Results not verified / validated (by scientific community) (1)	Could not reproduce results / insufficient evidence	**(1)**

Question Number	Answer	Acceptable answers	Mark
3(a)	Substitution into PE = m x g x h: 18 x 9500 x 10 (1) Evaluation: 1 710 000 (J) (1)	 Allow 1 mark for evaluation of 2 375 000 (arising from using 25m for distance) 1 710 kJ Allow full marks for correct answer with no working shown	**(2)**

Question Number	Answer	Acceptable answers	Mark
3 (b)	1 710 000 J (1)	Allow ecf from 3 a	**(1)**

Question Number	Answer	Acceptable answers	Mark
3(c)	A description to include An energy transfer involving (gravitational) **potential energy** and **kinetic energy** (1) Correct direction of that transfer, i.e. potential energy increases / kinetic energy decreases (from C to D) (1) second mark point is dependent on first	 Ignore heat / sound energy Accept kinetic energy is transferred into potential energy for both marks	**(2)**

Question Number	Answer	Acceptable answers	Mark
3(d)	Substitution into p = m x v (1) 150 000 = 9 500 x v Transposition: (1) v = 150 000 / 9 500 evaluation: (1) 16 (m/s)	 Substitution and transposition can be in either order Answers which round to 16 such as 15.8, 15.79 etc Allow full marks for correct answer with no working shown	**(3)**

Question Number	Answer	Acceptable answers	Mark
3(e)	An explanation linking any **two** from **EITHER** (larger distance) allows more time to stop (1) smaller rate of change of momentum / velocity (1) smaller force (on passengers) (1) **OR** Use of work done = force x distance (1) smaller force (on passengers) (1) to do work (required to bring car to a stop) (1)	slow down gradually owtte Note: takes "longer" without reference to time gets no credit for first MP(repeat of stem)	**(2)**

Question Number	Answer	Acceptable answers	Mark
4(ai)	Relevant working on graph (1) 8 (days) (1)	for example ; line from 90 mg to curve OR from curve to 8 days 7.5 to 8.5 days Allow both marks for correct answer with no working shown.	**(2)**

Question Number	Answer	Acceptable answers	Mark
4(aii)	330 (mg)	Any answer in the range 300 – 360 inclusive	**(1)**

Question Number	Answer	Acceptable answers	Mark
4(a iii)	An explanation linking any two of • **gamma** rays are highly penetrating (1) • cause DNA/cells to mutate **(1)** • if subjected to repeated exposure (1)	Beta /gamma is ionising Gamma/Beta rays penetrate tissue/skin OR Gamma have long range damage/kill cells/ tissues cause cancer ignore ultimate effects such as organ failure/ death etc	**(2)**

Question Number	Answer	Acceptable answers	Mark
4(a iv)	any **one** from: • store in a lead (-lined) box **(1)** • warning signs **(1)** • restricted access owtte **(1)** • shielding **(1)** • do not touch **(1)** • relevant protective clothing **(1)** • monitor dose **(1)**	any reasonable precaution	**(1)**

Question Number	Answer	Acceptable answers	Mark
4(b)(i)	**B** a beta emitter		**(1)**

Question Number	Answer	Acceptable answers	Mark
4(b)(ii)	An explanation linking the following points: • paper absorbs radiation (1) • detector send signals (to system controlling) rollers (1) • when paper too thick, rollers pushed closer together.(1)	ignore type of radiation used radiation penetrates the paper detector reacts to change in amount of radiation received reverse argument	**(3)**

Question Number	Answer	Acceptable answers	Mark
5(a)	voltmeter in parallel with lamp (1)	Any recognisable symbol or drawing	**(1)**

Question Number	Answer	Acceptable answers	Mark
5(b)	A (12 joules per coulomb)		**(1)**

Question Number	Answer	Acceptable answers	Mark
5(c)	Substitution: (using R=V/I) 4.0 / 0.37 (1) Evaluation: 10.8 (Ω) (1) (Approx 11) Accept answer of 10.8 with no working for both marks	Substitution: (using V = IR) 0.37 x 11 (1) Evaluation: 4.07 (V) (1) (approx 4) Accept answer of 4.07 with no working for both marks **Or** Substitution: (using I = V/R) 4/11 (1) Evaluation: 0.364 (A) (1) (approx. 0.37) Accept answer of 0.364 with no working for both marks	**(2)**

Question Number	Answer	Acceptable answers	Mark
5(d)	C (decreases decreases)		**(1)**

Question Number		Indicative Content	Mark
QWC	***5(e)**	An explanation linking some of the following points <u>Change in resistance</u> • calculation of two (different) resistances • resistance of lamp constant up to (about)3 V • resistance of lamp increases with increasing voltage/current • qualitative comparison of lamp resistance values at different voltages/currents • relationship between voltage and current linear at low values but becomes non-linear <u>Change in temperature</u> • higher currents / voltages produce higher temperatures/heating in lamp/ increase in brightness <u>Change in energy transfer</u> • Higher currents / voltages result in greater energy transfer (per second) <u>Events in lattice</u> • energy transfer as a result of collisions in filament • collisions between electrons (and ions in lattice) • lattice vibrations linked to temperature	**(6)**
Level	**0**	No rewardable content	
1	**1 - 2**	• A limited explanation identifying a change in the filament (lamp). e.g. a comparison of at least two correct values of resistance OR resistance of lamp increases at higher voltages / currents compared with low voltages / currents • the answer communicates ideas using simple language and uses limited scientific terminology • spelling, punctuation and grammar are used with limited accuracy	
2	**3 - 4**	• A simple explanation that links at least two of the above points e.g. The resistance increases at high voltages due to collisions in the filament OR higher currents produce higher temperatures/heating in lamp. This means the resistance increases • the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately • spelling, punctuation and grammar are used with some accuracy	

3	**5 - 6**	• a detailed explanation that links at least two points and uses a correct theory of events in the lattice e.g. the collision theory to explain that link. e.g. The resistance of lamp increases at higher voltage as higher currents produce higher temperatures/heating in the lamp. This is due to collisions between electrons and ions OR Higher currents produce higher temperatures/heating in lamp. The heat energy comes from increased energy transfer as a result of collisions in filament. • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors

Question Number	Answer	Acceptable answers	Mark
6ai	evidence of calculation of gradient of graph during acceleration: (1) Evaluation: (1) 6.3 (m/s^2)	Allow full marks for correct answer with no working shown accept values from 6.0 to 6.5 inclusive	**(2)**

Question Number	Answer	Acceptable answers	Mark
6aii	Line with smaller initial gradient and then horizontal at 17 m/s (1)	Ignore time at which acceleration stops. Judge horizontal value by eye but do not accept any part of line which goes outside range of 16 to 18	**(1)**

Question Number	Answer	Acceptable answers	Mark
6 a iii	A reason which includes reference to air resistance / drag / friction (1)	 Wind resistance overcome resistance	(1)

Question Number	Answer	Acceptable answers	Mark
6 a iv	Substitution : (1) 600 = w / 240 Transposition (1) w = 600 x 240 evaluation: (1) 144 000 J	conversion between mins and secs can be delayed until evaluation 600 = w / 4 W = 600 x 4 Substitution and transposition can be in either order 144 kJ Allow full marks for correct answer with no working shown 2400 obtained by failure to convert mins to secs can score a maximum of 2 marks	**(3)**

Question Number		Indicative Content	Mark
QWC	***6(b)**	An explanation linking some of the following points **What** has changed / improved; eg: • Bicycle has less mass • Tyres are thinner/ lighter • Frame / wheels / body position more aerodynamic / stiffer • Clothing or headgear is lighter / smoother / streamlined **Why** this is an advantage: eg: • Greater acceleration (for the same force) • Less frictional force (eg air resistance/ rolling resistance) to overcome • Total work done over the race is less **How** this has decreased record times eg: • Less total energy used to overcome friction • Frictional forces balance driving forces at a higher velocity • Greater velocity reached during acceleration at the start • Allowing cyclist to maintain higher (average) velocity • For same cyclist power, less time required to do less work	**(6)**
Level	**0**	No rewardable content	
1	**1 - 2**	• a limited explanation which describes what has changed. eg: the cyclists' clothes make them more streamlined • the answer communicates ideas using simple language and uses limited scientific terminology • spelling, punctuation and grammar are used with limited accuracy	
2	**3 - 4**	• a simple explanation which includes why the change described is an advantage eg: the cyclists are more streamlined and so the air resistance is less • the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately • spelling, punctuation and grammar are used with some accuracy	
3	**5 - 6**	• a detailed explanation which includes how the change described has decreased time eg: the cyclists are more streamlined so the air resistance is less. They can travel at a higher velocity before they meet the same frictional forces. • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors	

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Centre Number | | | | | |

Candidate Number | | | | |

Physics/Additional Science

Unit P2: Physics for Your Future

Higher Tier

Friday 12 June 2015 – Afternoon
Time: 1 hour

Paper Reference
5PH2H/01

You must have:
Calculator, ruler

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided
  – *there may be more space than you need.*

Information

- The total mark for this paper is 60.
- The marks for **each** question are shown in brackets
  – *use this as a guide as to how much time to spend on each question.*
- Questions labelled with an **asterisk** (*) are ones where the quality of your written communication will be assessed
  – *you should take particular care with your spelling, punctuation and grammar, as well as the clarity of expression, on these questions.*

Advice

- Read each question carefully before you start to answer it.
- Keep an eye on the time.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

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FORMULAE

You may find the following formulae useful.

charge = current × time $Q = I \times t$

potential difference = current × resistance $V = I \times R$

electrical power = current × potential difference $P = I \times V$

energy transferred = current × potential difference × time $E = I \times V \times t$

$$\text{speed} = \frac{\text{distance}}{\text{time}}$$

$$\text{acceleration} = \frac{\text{change in velocity}}{\text{time taken}} \qquad a = \frac{(v-u)}{t}$$

force = mass × acceleration $F = m \times a$

weight = mass × gravitational field strength $W = m \times g$

momentum = mass × velocity $P = m \times v$

$$\text{force} = \frac{\text{change in momentum}}{\text{time}} \qquad F = \frac{(mv-mu)}{t}$$

work done = force × distance moved in the direction of the force $E = F \times d$

$$\text{power} = \frac{\text{work done}}{\text{time taken}} \qquad P = \frac{E}{t}$$

gravitational potential energy = mass × gravitational field strength × vertical height

$\text{GPE} = m \times g \times h$

kinetic energy = ½ × mass × velocity^2 $\text{KE} = ½ \times m \times v^2$

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Answer ALL questions.

Some questions must be answered with a cross in a box ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

Nuclear power

1 Many countries generate electricity using nuclear fission.

(a) The decay products from nuclear fission emit different types of ionising radiation.

Draw **one** line from each type of radiation to its correct description.

(2)

type of radiation	description
alpha	electromagnetic wave
beta	electron
gamma	helium nucleus

(b) There are both fuel rods and control rods inside each fission reactor.

Explain how pushing control rods between the fuel rods changes the rate of nuclear fission in the reactor.

(2)

.....

.....

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(c) Engineers are trying to generate electricity using the energy from nuclear fusion reactions.

(i) Complete the sentence by putting a cross (☒) in the box next to your answer.

High temperatures and pressures are needed in a nuclear fusion reactor.
This is to overcome

(1)

☒ **A** the kinetic energy of nuclei

☒ **B** the electrostatic repulsion of protons

☒ **C** the magnetic repulsion of neutrons

☒ **D** nuclear fission

(ii) Describe what happens to nuclei in a nuclear fusion reaction.

(2)

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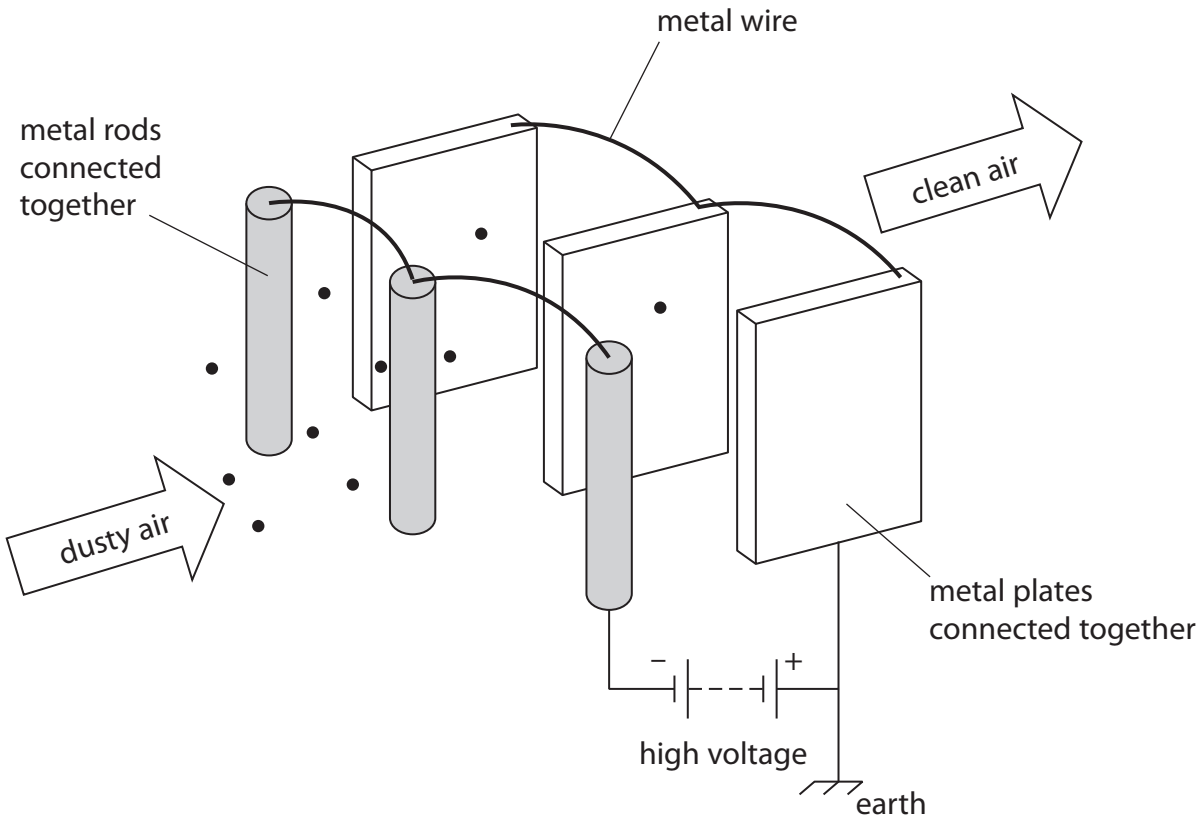
(Total for Question 1 = 7 marks)

Electrostatic air filters

2 An electrostatic air filter is designed to remove dust particles from the air in a room.

A fan blows dusty air past several metal rods and metal plates.

There is a large potential difference (voltage) between the metal rods and the metal plates.



(a) Complete the sentence by putting a cross (☒) in the box next to your answer.

When dusty air goes past the metal rods, the dust particles become negatively charged.

This is because the dust particles

(1)

☒ **A** lose electrons

☒ **B** lose protons

☒ **C** gain electrons

☒ **D** gain protons

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(b) When the dusty air flows past the metal plates, the dust particles settle on the metal plates.

Explain why the dust particles settle on the metal plates.

(2)

.....

.....

.....

.....

(c) (i) State what happens to the charge on the dust particles when they settle on the metal plates.

(1)

.....

.....

(ii) Explain why the charge does not build up on the metal plates.

(2)

.....

.....

.....

.....

(d) There is a current of 1.2 mA in the circuit.

Calculate the charge transferred by this current in 40 s.

State the unit.

(3)

charge transferred = ... unit: .....

(Total for Question 2 = 9 marks)

Modelling meteorite impacts

3 Some students investigate a model of the craters produced by meteorite impacts.

They drop balls into a tray filled with sand.

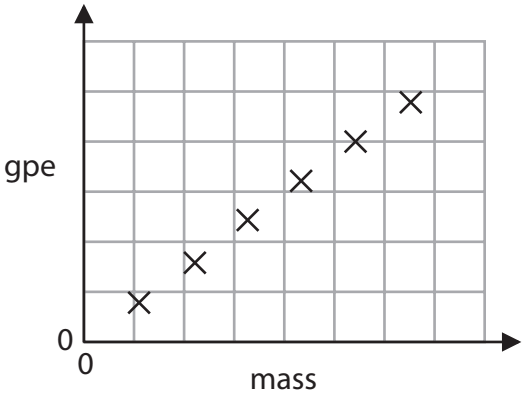
They use six balls with different masses.

They drop each ball from the same height.

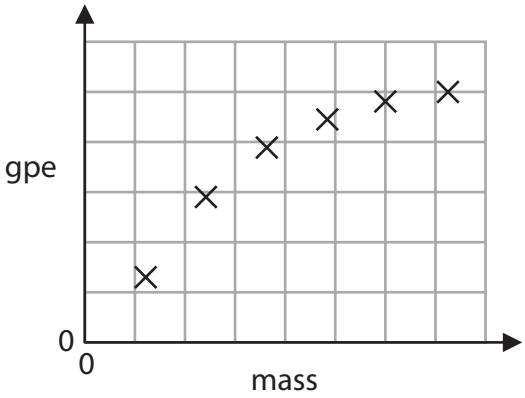
(a) (i) Which one of these graphs shows the relationship between the gravitational potential energy (gpe) of the balls and their mass when they are all at the same height?

Put a cross (☒) in the box next to your answer.

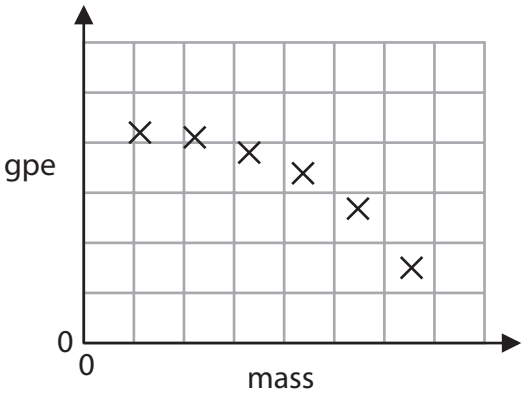
(1)



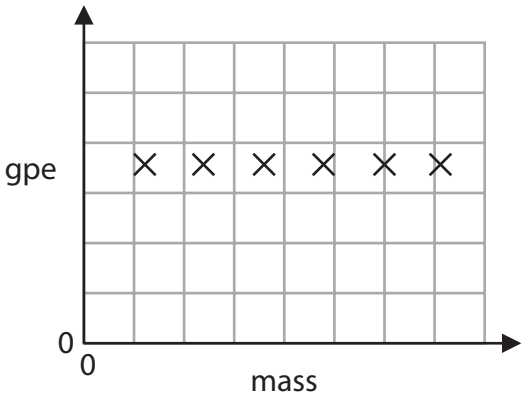
☒ **A**



☒ **B**



☒ **C**



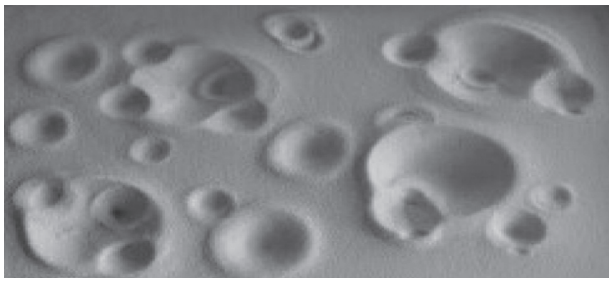
☒ **D**

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(ii) Describe how the energy of a ball changes as it drops towards the sand.

(2)

(b) This photograph shows the sand after several balls have hit it.



The students read this information in a textbook:

'When work is done, energy is transferred.'

Explain how work is done when the balls impact on the sand.

(2)

(c) When one ball hits the sand, it has a velocity of 6.2 m/s.

It has a momentum of 0.46 kg m/s.

(i) Calculate the mass of the ball.

(3)

mass of ball = ... kg

(ii) The ball takes 0.17 s to come to rest after it hits the sand.

Calculate the average impact force.

(2)

average impact force = ... N

(Total for Question 3 = 10 marks)

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Radiation from rocks

4 (a) One isotope of the element potassium is potassium-40.

A nucleus of potassium-40 is represented by:

$$^{40}_{19}K$$

(i) Complete the sentence by putting a cross (☒) in the box next to your answer.

The number of neutrons in a nucleus of potassium-40 is

(1)

☒ **A** 19

☒ **B** 21

☒ **C** 40

☒ **D** 59

(ii) Which of these symbols is correct for the nucleus of a different isotope of potassium?

Put a cross (☒) in the box next to your answer.

(1)

$^{39}_{19}K$ ☒ **A**

$^{40}_{20}K$ ☒ **B**

$^{19}_{40}K$ ☒ **C**

$^{39}_{20}K$ ☒ **D**

(iii) A sample of potassium-40 is left for a long time.

Some of the potassium-40 nuclei will emit gamma radiation as they turn into argon-40 nuclei.

Argon-40 nuclei never change.

Describe what information this gives about the isotope potassium-40.

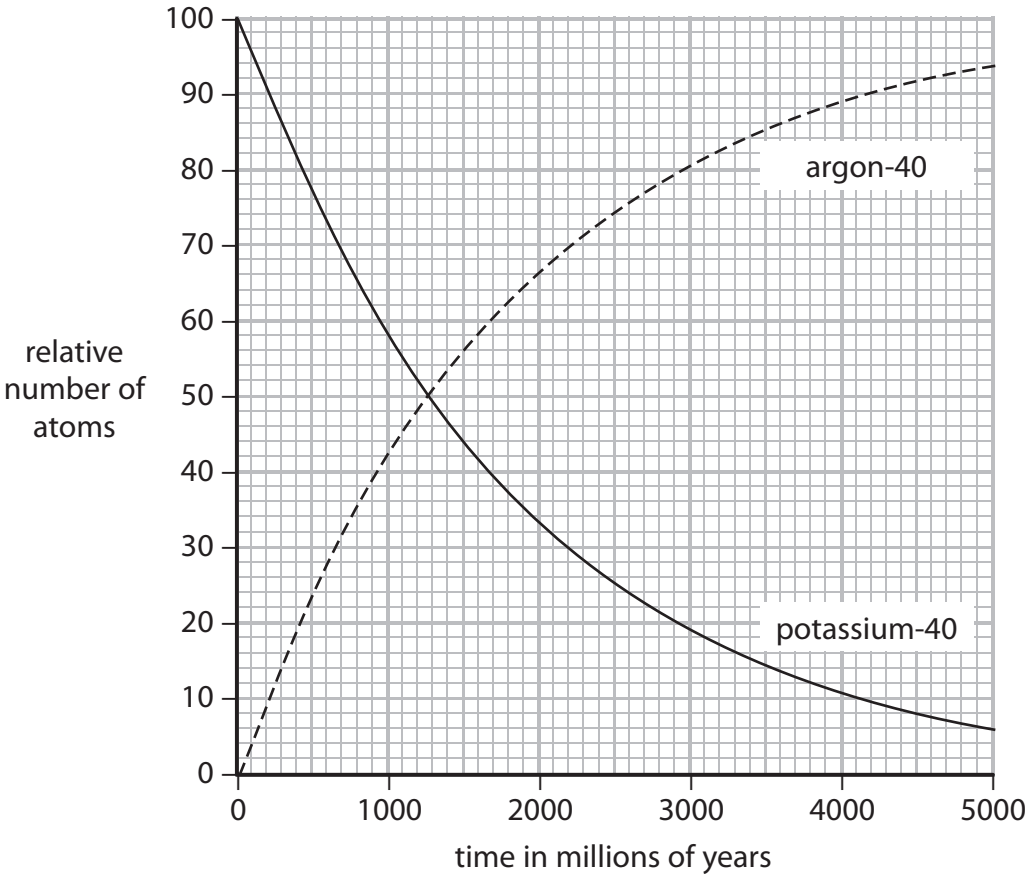
(2)

(b) Some rocks containing potassium were formed many millions of years ago.

There was no argon-40 in the rocks when they were formed.

When scientists analyse samples of these rocks, they find small amounts of argon-40 trapped inside.

The graph shows how the relative amounts of potassium-40 and argon-40 change over time.



(i) Use the graph to find the half-life of potassium-40.

(1)

half-life = ... million years

(ii) Scientists analyse a sample taken from inside a rock.

They find that there is exactly 3 times as much argon-40 as there is potassium-40.

Use the graph to find the age of the rock.

(2)

age of rock = ... million years

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(c) Some other rocks contained uranium when they were formed.

Radioactive decay in these rocks produces radon gas.

Explain why people living near these rocks have an increased health risk from background radiation.

(3)

.....

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.....

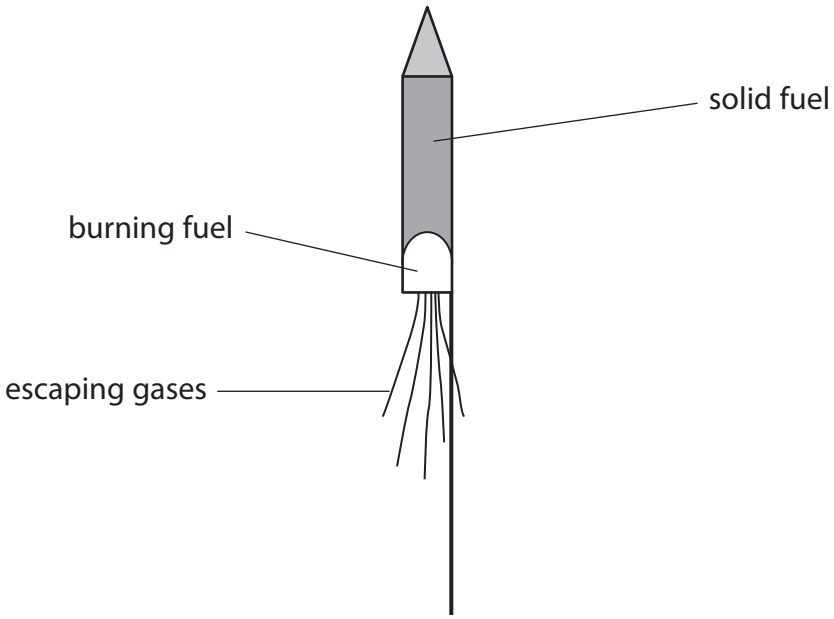
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(Total for Question 4 = 10 marks)

Forces and rockets

5 (a) A firework rocket contains a solid fuel inside a cardboard tube.

The burning of the fuel creates a thrust to propel the rocket upwards.



(i) Scientists can refer to several different quantities when describing the motion of the rocket.

mass	energy	speed	force

Only one of these quantities is a vector.

Complete this sentence using **one** of the words from the box.

(1)

The vector quantity is .....

(ii) Before the fuse is lit, the total weight of a rocket including fuel is 0.7 N.

The gravitational field strength is 10 N/kg.

Complete the sentence by putting a cross (☒) in the box next to your answer.

The total mass of the rocket including fuel is

(1)

☒ **A** 0.007 kg

☒ **B** 0.07 kg

☒ **C** 0.7 kg

☒ **D** 7 kg

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(iii) There is a resultant force on the rocket of 0.5 N upwards when it takes off.

The arrow on the diagram shows the size and direction of the force of gravity acting on the rocket when it takes off.



Add another arrow to the diagram to show the thrust produced by the burning fuel at the time the rocket takes off.

You should label the arrow with the size of the thrust.

(2)

(b) Another rocket has a total mass of 90 g when it takes off.
The acceleration of the rocket when it takes off is 3.3 m/s^2.

(i) Calculate the resultant force on the rocket when it takes off.

(2)

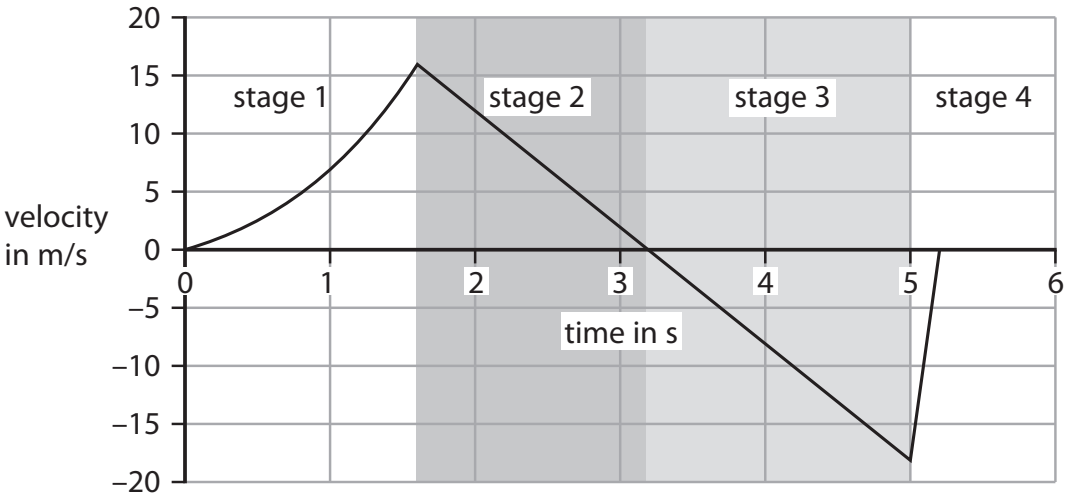
resultant force = ... N

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*(ii) The rocket contains 50 g of fuel when it takes off.
The fuel burns and the rocket rises vertically.
After a while, there is no fuel left.
Eventually the empty rocket falls back to the ground.

The graph is a velocity–time graph for the rocket.

Four stages are labelled on the graph.



Explain why the velocity of the rocket changes as shown in the graph.

(6)

(Total for Question 5 = 12 marks)

Light-dependent resistors

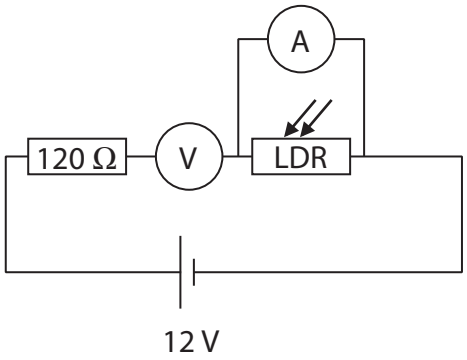
6 (a) A technician investigates a light-dependent resistor (LDR) connected in series with a 120 Ω resistor and a voltage source.

The technician measures the voltage across the LDR and also the current in the LDR.

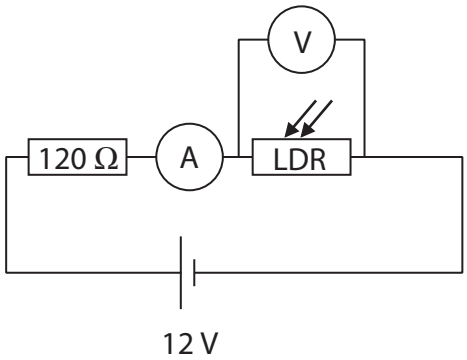
(i) Which **one** of these circuits should the technician use?

Put a cross (☒) in the box next to your answer.

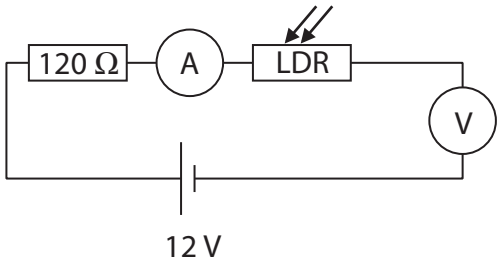
(1)



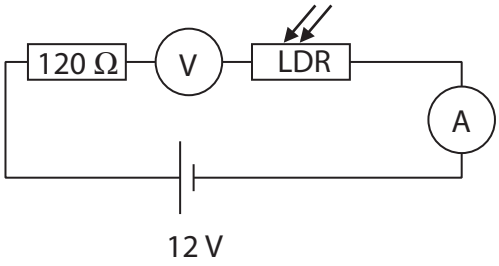
☒ **A**



☒ **B**



☒ **C**



☒ **D**

(ii) When the LDR is in bright sunlight, its resistance is 185 Ω.
The voltage across the LDR is then 7.2 V.

Show that the current in the LDR is about 0.039 A.

(2)

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(iii) Complete the sentence by putting a cross (☒) in the box next to your answer.

The current in the 120 Ω resistor is

(1)

☒ **A** much more than the current in the LDR

☒ **B** much less than the current in the LDR

☒ **C** the same as the current in the LDR

☒ **D** the opposite of the current in the LDR

(iv) The technician repeats the readings with the LDR in different light conditions.

The table gives two of the readings.

light condition	current in LDR
bright sunlight	0.039 A
cloudy skies	0.028 A

Explain why the two current readings are different.

(2)

.....

.....

.....

.....

*(b) The photograph shows a temporary traffic sign.



The traffic sign uses many small lights all powered by a rechargeable battery.
These lights need to be very bright during the day so that they can be seen clearly.
They do not need to be as bright at night.

Explain how using a light-dependent resistor can make the energy stored in the battery last longer.

(6)

(Total for Question 6 = 12 marks)

TOTAL FOR PAPER = 60 MARKS

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Mark Scheme (Results)

Summer 2015

Pearson Edexcel GCSE in Physics (5PH2H) Paper 01 Unit P2: Physics for your future

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General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

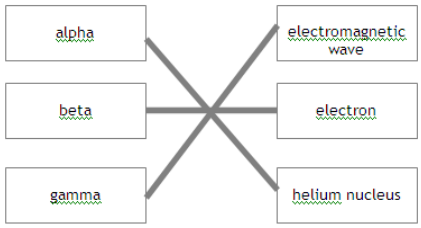
Quality of Written Communication

Questions which involve the writing of continuous prose will expect candidates to:

- Write legibly, with accurate spelling, grammar and punctuation in order to make the meaning clear
- Select and use a form and style of writing appropriate to purpose and to complex subject matter
- Organise information clearly and coherently, using specialist vocabulary when appropriate.

Full marks will be awarded if the candidate has demonstrated the above abilities.

Questions where QWC is likely to be particularly important are indicated (QWC) in the mark scheme, but this does not preclude others.

Question Number	Answer	Acceptable answers	Mark
1(a)	Three lines as shown:  (2)	Any one line correct only scores 1 mark	**(2)**

Question Number	Answer	Acceptable answers	Mark
1(b)	An explanation linking Absorb (more) neutrons (1) (to) reduce the number of fission reactions (1)	ignore slow down neutrons slow down (the rate of) the reaction/fission	**(2)**

Question Number	Answer	Acceptable answers	Mark
1(c)(i)	**B** electrostatic repulsion of protons		**(1)**

Question Number	Answer	Acceptable answers	Mark
1(c)(ii)	A description to include • (two/or more/smaller) nuclei combine/fuse/join (1) • (to produce) a larger nucleus (1)	{(two or more) hydrogen nuclei/protons OR deuterium and tritium} combine/fuse (forming) helium nucleus ONLY penalise use of atoms instead of nuclei ONCE ignore references to release of energy as this is given earlier in the question.	**(2)**

Total for Question 1 = 7 marks

Question Number	Answer	Acceptable answers	Mark
2(a)	C (gain electrons)		**(1)**

Question Number	Answer	Acceptable answers	Mark
2(b)	An explanation linking • (Force of) attraction (1) • (plates have) opposite charge (to dust) (1)	Plates have a positive charge Ignore different charge	**(2)**

Question Number	Answer	Acceptable answers	Mark
2(c)(i)	transferred to plate / lost (1)	neutral / become discharged	**(1)**

Question Number	Answer	Acceptable answers	Mark
2(c)(ii)	An explanation linking any two of • Metal is a conductor (1) • Electrons / (negative) charge moves (through the plates/ wire) (1) • Towards the voltage supply / earth /ground (1)	Metal not an insulator Plates / charges are earthed	**(2)**

Question Number	Answer	Acceptable answers	Mark
2(d)	Substitution: $Q = 1.2 \times 10^{-3} \times 40$ (1) Evaluation: 0.048 or 4.8×10^{-2} (1) C / coulombs (1)	Give 2 marks for correct answer with no working shown Unit mark is independent Allow for 1 mark 48 (with incorrect or no units) Allow for 2 marks 48 C Allow for all 3 marks 48 mC	**(3)**

Total for Question 2 = 9 marks

Question Number	Answer	Acceptable answers	Mark
3(a)(i)	**A**		**(1)**

Question Number	Answer	Acceptable answers	Mark
3(a)(ii)	A description to include any two of • Gravitational / potential energy reduces (1) • kinetic energy increases (1) • total energy remains constant (1)	Ignore energy changes resulting from impact with sand GPE reduces KE increases Allow GPE is transferred to KE for 2 mark	**(2)**

Question Number	Answer	Acceptable answers	Mark
3(b)	A explanation linking • (work is done) displacing the sand (1) with EITHER • (as) <u>kinetic</u> energy of the ball(s) has been transferred (1) OR • by the force between the ball and the sand (1)	sand moving/ pushing/ blowing upwards OWTTE or ball sinking into sand	**(2)**

Question Number	Answer	Acceptable answers	Mark
3(c)(i)	transposition mass = momentum / velocity (1) substitution mass = 0.46 / 6.2 (1) evaluation 0.074 (kg) / 74g (1)	Subst. and transform. either order 1 mark only can be scored for correct substitution after incorrect transposition. Give full marks for correct answer with no working. Answers that round to 0.074 (kg) 0.07 (kg)	**(3)**

Question Number	Answer	Acceptable answers	Mark
3(c)(ii)	substitution (impact) force = 0.46 / 0.17 (1) evaluation 2.7 (N) (1)	Give full marks for correct answer with no working. Ignore power of ten error until evaluation Answers which round to 2.7 Allow ECF if candidate has used mass from part (i) in F=m(v-u) / T F= $\frac{6.2 - 0}{0.17}$ X 0.074 (1) = 2.7 (N) (1)	**(2)**

Total for Question 3 = 10 marks

Question Number	Answer	Acceptable answers	Mark
4 (a)(i)	**B 21**		**(1)**

Question Number	Answer	Acceptable answers	Mark
4 (a)(ii)	**A** $^{39}_{19}K$		**(1)**

Question Number	Answer	Acceptable answers	Mark
4(a)(iii)	A description to include any two of • (nucleus/isotope is) unstable (1) • (nucleus/isotope is) radioactive (1) • decay is random (1) • long half life (1)		**(2)**

Question Number	Answer	Acceptable answers	Mark
4(b)(i)	1250 (million years) (1)	Between 1200 and 1300 (my) inclusive	**(1)**

Question Number	Answer	Acceptable answers	**Mark**
4(b)(ii)	2 half lives (1) 2500 (million years) (1)	 Allow ecf from (bi) Give full marks for answer between 2400 and 2600 with no working.	**(2)**

Question Number	Answer	Acceptable answers	Mark
4(c)	An explanation linking any three from • Radon is radioactive (1) • Radon can escape from rocks and buildings (1) • Radon can be inhaled (1) • Radiation (from radon) can cause cancer (1) • Radon emits alpha (1)	Ignore radiation from rocks themselves Radon enters/gets trapped in buildings/homes / increases background radiation (breathed into) lungs (DNA) mutation / cell damage (Highly) ionising radiation	**(3)**

Total for Question 4 = 10 marks

Question Number	Answer	Acceptable answers	Mark
5(a)(i)	force (1)	If than one word given then 0 marks.	**(1)**

Question Number	Answer	Acceptable answers	Mark
5 (a)(ii)	B 0.07kg		**(1)**

Question Number	Answer	Acceptable answers	Mark
5 (a)(iii)	Arrow pointing (vertically) upwards (1) Value of 1.2 (N) (written near to arrow) (1)	 Marks are independent of each other	**(2)**

Question Number	Answer	Acceptable answers	Mark
5(b)(i)	Substitution $\frac{90}{1000}$ x 3.3 (1) evaluation 0.30 (N) (1)	 A value which rounds to 0.30 eg 0.297 Give full marks for correct answer with no working Ignore power of ten error until evaluation Allow 1 mark for 297 even with no working shown	**(2)**

Question Number		Indicative Content	Mark
QWC	***5(b)(ii)**	An explanation demonstrating some of the following: Descriptions of the graph • Accelerates upwards during stage1 • Maximum velocity is reached at the end of stage 1 • Accelerates downwards / decelerates during stage 2 • Accelerates during stage 3 • Comes to rest during stage 4. Interpretations of the shape of the graph • Fuel is burnt creating thrust in stage • Thrust is upwards in stage 1/ • Gravity/weight (is always) a downward force • Fuel runs out at end of stage 1/ has ran out by stage 2 • Still going up during/ max height at end of stage 2 • Starts to fall at start of stage 3 • Negative velocity during stage 3 because it is falling. • Rapid deceleration / collision with the ground during stage 4/end of stage 3 Explanations for changes in velocity • Resultant force upwards/ thrust greater than gravity force during stage 1 • Acceleration non-linear because mass is decreasing / resultant force is increasing • Linear deceleration in stage 2/3 because force of gravity is constant • Resultant downward force/only gravity/ weight is acting during stage 2 and 3 • Large resultant force of impact during stage 4	**(6)**

Level	0	No rewardable content
1	**1 - 2**	• A limited explanation involving descriptions of the graph. • E.g. The rocket gets faster as it goes up during stage 1. The rocket slows down during stage 2 • the answer communicates ideas using simple language and uses limited scientific terminology • spelling, punctuation and grammar are used with limited accuracy
2	**3 - 4**	• A simple explanation involving interpretations of the shape of the graph e.g. The rocket's velocity increases during stage 1 because the burning fuel provides a force. The rocket accelerates downwards during stage 3 • the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately • spelling, punctuation and grammar are used with some accuracy
3	**5 - 6**	• A detailed explanation which includes descriptions and interpretations for the shape of the graph including an explanation. E.g. The rocket's acceleration during stage 1 is increasing because it is losing mass as the fuel is burnt. It then slows down until it reaches maximum height at the end of stage 2 • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors

Total for Question 5 = 12 marks

Question Number	Answer	Acceptable answers	Mark
6 (a)(i)	**B**		**(1)**

Question Number	Answer	Acceptable answers	Mark
6 (a)(ii)	substitution V = 0.039 x 185 (1) evaluation 7.215 (which is about 7.2) (V) (1)	Substitution 7.2 = I x 185 (1) transposition I = 7.2 ÷ 185 (1)	**(2)**

Question Number	Answer	Acceptable answers	Mark
6 (a)(iii)	**C** (same as)		**(1)**

Question Number	Answer	Acceptable answers	Mark
6(a)(iv)	An explanation to include The resistance (of the LDR) changes Greater resistance when in the dark	 LDR has less resistance in the light	**(2)**

Question Number		Indicative Content	Mark
QWC	***6(b)**	An explanation linking some of the following. • less current is used at night-time • Resistance (of LDR or circuit) would increase with less ambient light • Higher resistance will allow less current (in the circuit) (ORA) • Less current in circuit means less energy from the battery • Less power required in the dark ORA for light conditions • Less current means less energy transferred (per second) • Total energy transferred is less during night time (than it would otherwise have been) due to the higher resistance of the LDR	**(6)**
Level	**0**	No rewardable content	
1	**1 - 2**	• A limited explanation linking the light level to EITHER resistance OR current. eg. It increases the resistance in the dark. • the answer communicates ideas using simple language and uses limited scientific terminology • spelling, punctuation and grammar are used with limited accuracy	
2	**3 - 4**	• A simple explanation linking the light level to TWO of resistance, current, energy. eg. At night-time its resistance would increase. This would reduce the current from the battery • the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately • spelling, punctuation and grammar are used with some accuracy	
3	**5 - 6**	• A detailed explanation linking the light level to resistance AND current, AND energy. e.g. At night-time the resistance would be more. This would reduce the current and mean that the battery will not have to supply as much energy. • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors	

Total for Question 6 = 12 marks

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Surname	Other names

Pearson Edexcel GCSE

Centre Number	Candidate Number

Physics/Additional Science

Unit P2: Physics for Your Future

Higher Tier

Thursday 12 June 2014 – Morning
Time: 1 hour

Paper Reference
5PH2H/01

You must have:
Calculator, ruler

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided
  – *there may be more space than you need.*

Information

- The total mark for this paper is 60.
- The marks for **each** question are shown in brackets
  – *use this as a guide as to how much time to spend on each question.*
- Questions labelled with an **asterisk** (*) are ones where the quality of your written communication will be assessed
  – *you should take particular care with your spelling, punctuation and grammar, as well as the clarity of expression, on these questions.*

Advice

- Read each question carefully before you start to answer it.
- Keep an eye on the time.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

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FORMULAE

You may find the following formulae useful.

charge = current × time $Q = I \times t$

potential difference = current × resistance $V = I \times R$

electrical power = current × potential difference $P = I \times V$

energy transferred = current × potential difference × time $E = I \times V \times t$

$$\text{speed} = \frac{\text{distance}}{\text{time}}$$

$$\text{acceleration} = \frac{\text{change in velocity}}{\text{time taken}} \qquad a = \frac{(v-u)}{t}$$

force = mass × acceleration $F = m \times a$

weight = mass × gravitational field strength $W = m \times g$

momentum = mass × velocity $P = m \times v$

$$\text{force} = \frac{\text{change in momentum}}{\text{time}} \qquad F = \frac{(mv-mu)}{t}$$

work done = force × distance moved in the direction of the force $E = F \times d$

$$\text{power} = \frac{\text{work done}}{\text{time taken}} \qquad P = \frac{E}{t}$$

gravitational potential energy = mass × gravitational field strength × vertical height

$\text{GPE} = m \times g \times h$

kinetic energy = ½ × mass × velocity^2 $\text{KE} = ½ \times m \times v^2$

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Questions begin on next page.

Answer ALL questions.

Some questions must be answered with a cross in a box ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

Static electricity

1 (a) A student rubs a plastic rod with a dry cloth. The cloth becomes positively charged.

(i) Complete the sentence by putting a cross (☒) in the box next to your answer.

The cloth becomes positively charged because

(1)

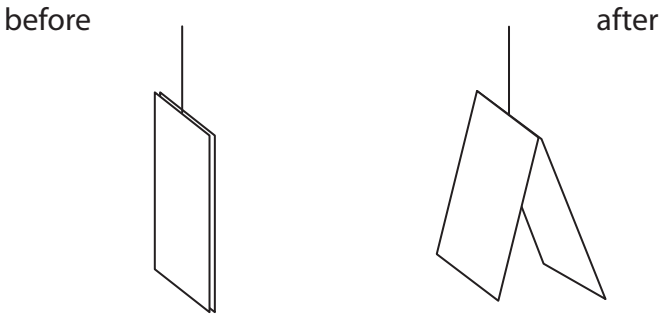
☒ **A** negative charge has moved from the cloth to the rod

☒ **B** negative charge has moved from the rod to the cloth

☒ **C** positive charge has moved from the cloth to the rod

☒ **D** positive charge has moved from the rod to the cloth.

(ii) Two plastic strips are joined at the top and are hanging by a thread.
The student rubs both strips with another dry cloth.
The diagram shows the two plastic strips before and after the student rubs them.



Explain why the strips behave in this way after they are rubbed with the cloth.

(2)

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(b) The student reads an article about the possible build-up of static electricity during the refuelling of an aircraft.

(i) Explain why this build-up could be dangerous.

(2)

(ii) The article also states that the aircraft is connected by a metal cable to the ground. The aircraft is also connected by a metal cable to the refuelling tanker.

Explain how these cables reduce the dangers when refuelling the aircraft.

(3)

(Total for Question 1 = 8 marks)

Using electric current

2 A student uses an electric kettle.



It works from the 230 V mains supply.

(a) Complete the sentence by putting a cross (☒) in the box next to your answer.

A potential difference of 1 volt is the same as

(1)

☒ **A** 1 joule per coulomb

☒ **B** 1 joule per ohm

☒ **C** 1 watt per ohm

☒ **D** 1 watt per coulomb

(b) The power of the kettle when it is heating water is 1.8 kW.
The mains voltage is 230 V.

(i) Calculate the current in the kettle.

(3)

current = ... A

(ii) The kettle is switched on for 2 minutes.

Calculate the total amount of energy transferred by the kettle in this time.

(2)

energy transferred = ... J

(iii) The heating element of the kettle contains a resistor made from a long length of wire. Explain why an electric current in a resistor makes the resistor heat up.

(2)

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(Total for Question 2 = 8 marks)

Momentum, energy, work and power

3 (a) A father pushes his child in a cart. The cart starts to move.



Scientists can use many physical quantities to describe what is happening.

Four of these are shown in the box.

energy	momentum	power	work

(i) Which one of these can be measured in joules per second?

Put a cross (☒) in the box next to your answer.

(1)

- ☒ **A** energy
- ☒ **B** momentum
- ☒ **C** power
- ☒ **D** work

(ii) Complete the sentence using words from the box.

(1)

The ..... transferred to the cart is equal to the ..... done on the cart.

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(iii) The child and cart have a total mass of 50 kg. They travel at a velocity of 4 m/s.

Calculate the momentum of the child and cart.

(2)

momentum = ... kg m/s

(iv) The father applies a steady force for a time of 1.5 s. The momentum of the child and cart increases by 450 kg m/s.

Calculate the force which the father applies.

(2)

force = ... N

(v) Momentum is a vector quantity.

State what is meant by a vector quantity.

(1)

.....

.....

(b) The photograph shows a mother and her daughter stationary on an ice rink.



The mother and daughter push each other away.
They move in opposite directions with different speeds.

Explain why they have different speeds.

(3)

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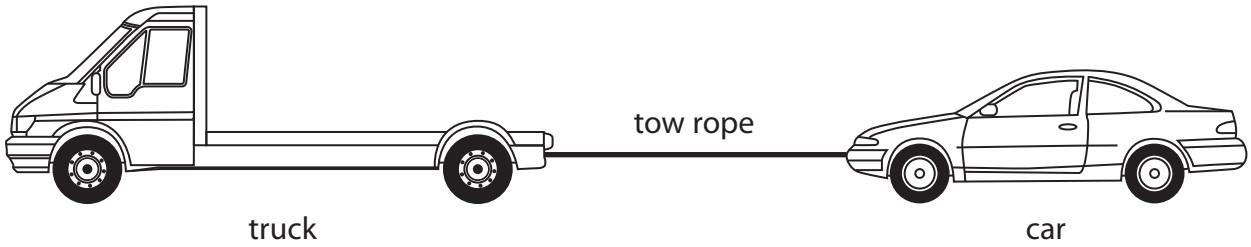
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(Total for Question 3 = 10 marks)

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4 A truck is towing a car along a level road at a constant velocity.

A tow rope is attached to the truck and the car.



(a) Which of these shows the directions of the forces between the car and the tow rope?

Put a cross (☒) in the box next to your answer.

(1)

	force exerted by car on tow rope	force exerted by tow rope on car
☒ **A**	←	→
☒ **B**	→	←
☒ **C**	→	→
☒ **D**	←	←

(b) The truck has to provide a force of 4000 N to the left on the car to keep the car at a constant velocity.

Complete the sentence by putting a cross (☒) in the box next to your answer.

The resultant force on the car is

(1)

☒ **A** 0 N

☒ **B** 4000 N to the left

☒ **C** 4000 N to the right

☒ **D** 8000 N to the left

(c) Both vehicles are travelling at 13 m/s.

The driver of the truck then accelerates at 1.2 m/s^2 until both vehicles are travelling at 20 m/s.

(i) Calculate the time taken for this acceleration.

(3)

time = ... s

(ii) The mass of the car is 1400 kg.

Calculate the resultant force on the car needed to produce an acceleration of 1.2 m/s^2.

(2)

force = ... N

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(iii) A rope can withstand a tension of 12 000 N before it breaks.
The weight of the car is 14 000 N.

Discuss whether this rope could be strong enough to tow the car with the truck.

(3)

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.....

(Total for Question 4 = 10 marks)

Nuclear reactors

5 (a) Fast neutrons are released during nuclear fission.

(i) Three different components of a nuclear fission reactor are shown.
Three different materials used in a nuclear fission reactor are also shown.

Draw one line from each component to the material it contains.

(2)

Component	Material
fuel	boron (absorbs neutrons)
control rod	uranium (releases neutrons)
moderator	graphite (slows neutrons)

(ii) Another type of nuclear reactor is a fusion reactor.
Nuclear fusion also releases fast neutrons.

Suggest why a nuclear fusion reactor does not need anything to slow these neutrons down.

(1)

.....

.....

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(b) Both nuclear fission and nuclear fusion release thermal energy.

Describe how the thermal energy released could be converted into electrical energy in a power station.

(3)

*(c) Scientists and engineers are still trying to build a practical and economic nuclear fusion reactor.

They have not been able to sustain the extreme conditions needed for controlled nuclear fusion.

Explain what these conditions are and why they are needed.

(6)

(Total for Question 5 = 12 marks)

Using radioactive materials

6 (a) In some countries food is sold with this label.



This food has been deliberately exposed to gamma radiation.

Complete the sentence by putting a cross (☒) in the box next to your answer.

The gamma radiation is used to

(1)

☒ **A** produce cancer cells in the food

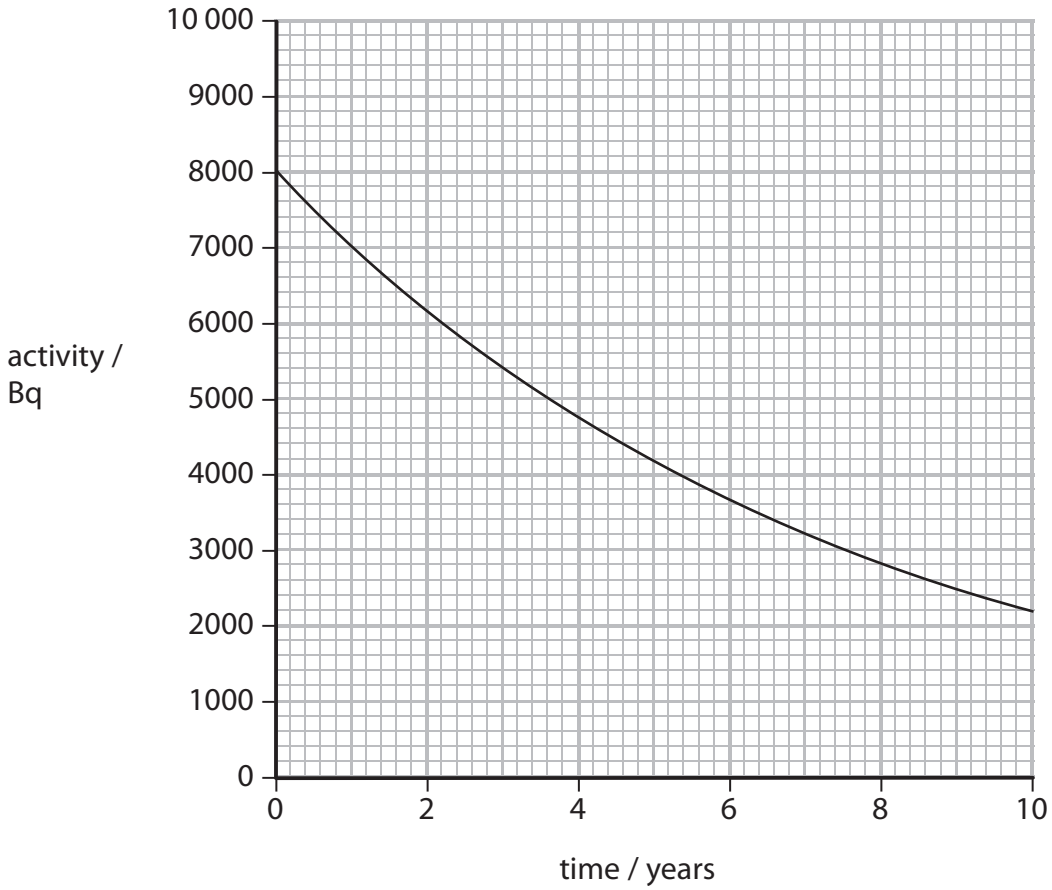
☒ **B** kill cancer cells in the food

☒ **C** kill microbes in the food

☒ **D** make the food radioactive.

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(b) Cobalt-60 is one source of gamma radiation used for food irradiation.
This graph shows how the activity of a sample of cobalt-60 changes over 10 years.



(i) Use the graph to find the half-life of cobalt-60.

(2)

half-life = ... years

(ii) The cobalt-60 has to be replaced when its activity has fallen below 1000 Bq.

Estimate how long it takes for the activity to fall from 8000 Bq to 1000 Bq.

(1)

time taken = ... years

(c) The cobalt-60 sources used to irradiate the food are small metal rods about the size of a pencil. They are made from stable cobalt-59 which is put inside a nuclear reactor. Some of the cobalt-59 is turned into cobalt-60 by the radiation in the reactor.

(i) The nuclei of the two isotopes can be represented as

$$^{60}_{27}\text{Co} \qquad\qquad ^{59}_{27}\text{Co}$$

Compare these two isotopes of cobalt.

(2)

*(ii) When it is time to replace the cobalt-60 rods there are two options.

- The rods can be disposed of.
- The rods can be transported to a nuclear reactor to turn more of the cobalt-59 into cobalt-60 so that they can be used again.

Discuss the hazards in these two options.

(6)

(Total for Question 6 = 12 marks)

TOTAL FOR PAPER = 60 MARKS

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Mark Scheme (Results)

Summer 2014

Pearson Edexcel GCSE in Physics (5PH2H) Paper 01

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Question Number	Answer	Acceptable answers	Mark
1(a)(i)	**A -** negative charge has moved from the cloth to the rod		**(1)**

Question Number	Answer	Acceptable answers	Mark
1(a)(ii)	An explanation linking they repelled (1) (strips had) like charge (1)	 push away same (type of) charge	**(2)**

Question Number	Answer	Acceptable answers	Mark
1(b)(i)	An explanation linking any **two** from charges are separated (1) possibility of a spark (1) ignite the fuel (1)	ignore ref to electric shock pd between plane and ground cause fire / explosion	**(2)**

Question Number	Answer	Acceptable answers	Mark
1(b)(ii)	An explanation linking **three** from Metals are (good) conductors (1) Electrons/(negative) charge can flow through wire (1) charge goes from/to the ground / earth (1) discharge the tank/aircraft/pipes (1)	Reject flow of positive charge for this mark plane is earthed/grounded charge does not build up/dissipates Allow no pd between plane and ground so no spark possible for 2 marks	**(3)**

(Total for Question 1 = 8 marks)

Question Number	Answer	Acceptable answers	Mark
2(a)	**A -** 1 joule per coulomb		**(1)**

Question Number	Answer	Acceptable answers	Mark
2(b)(i)	Substitution (1) 1800 = 230 x I Transformation (1) I = 1800 / 230 Evaluation (1) 7.8 (A) substitution and transposition can be in either order	 current = power / pd Any value which rounds to 7.8 such as 7.8261 Allow full marks for correct answer with no working shown	**(3)**

Question Number	Answer	Acceptable answers	Mark
2(b)(ii)	Using E = I x V x T: Substitution (1) 7.8 x 230 x 2 (x 60) Evaluation(1) 220 000 (J) (note: incorrect conversion of time loses the evaluation mark)	Allow ecf from 2(b)(i) Using energy = power x time 1800 x 2 (x 60) (1) Values which round to 220 000 such as 216 000 (J) 215 280 (J) Allow correct conversion to MJ or kJ Allow full marks for correct answer with no working shown	**(2)**

Question Number	Answer	Acceptable answers	Mark
2(b)(iii)	An explanation linking two from Energy is transferred (1) (as a result of) collisions of electrons (1) with ions/atoms / lattice (1)	electrons collide with each other for 2 marks	**(2)**

(Total for Question 2 = 8 marks)

Question Number	Answer	Acceptable answers	Mark
3 (a)(i)	C - power		**(1)**

Question Number	Answer	Acceptable answers	Mark
3 (a)(ii)	energy work	Must be in correct order	**(1)**

Question Number	Answer	Acceptable answers	Mark
3 a(iii)	Substitution 50 x 4 (1) Evaluation 200 (kg m/s) (1)	 Allow full marks for correct answer with no working shown	**(2)**

Question Number	Answer	Acceptable answers	Mark
3 a(iv)	Substitution 450 / 1.5 (1) Evaluation 300 (N) (1)	 Allow full marks for correct answer with no working shown Allow (1) for 167 (N) obtained by 450-200 / 1.5	**(2)**

Question Number	Answer	Acceptable answers	Mark
3 (a)(v)	An explanation to include (quantity has) a size and a direction	ignore any named examples	**(1)**

Question Number	Answer	Acceptable answers	Mark
3 (b)	An explanation which uses conservation of momentum to link three from Mother and daughter have different mass (1) Momentum is conserved / is zero to start with (1) Both have same size momentum (after the push) (1) so speed of the daughter is greater than that of the mother (1)	An explanation based on Newton's laws and linking three from Each have a different mass (1) Each experience the same size force / action and reaction are equal (1) Each experiences a different acceleration (1) so speed of the daughter is greater than that of the mother (1)	**(3)**

(Total for Question 3 = 10 marks)

Question Number	Answer	Acceptable answers	Mark
4 (a)	B 		**(1)**

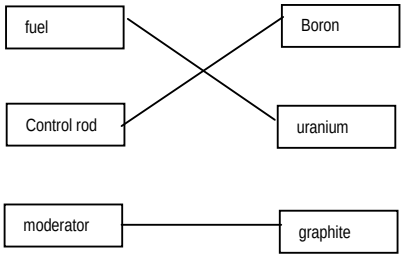
Question Number	Answer	Acceptable answers	Mark
4 (b)	**A –** 0 N		**(1)**

Question Number	Answer	Acceptable answers	Mark
4(c)(i)	Substitution (1) 1.2 = (20 – 13) / t Transposition (1) t = (20-13)/1.2 Evaluation 5.8 (s) (1) substitution and transposition can be in either order	1.2 = 7 / t t = 7/1.2 5.833 (etc) Give full marks for correct answer, no working	**(3)**

Question Number	Answer	Acceptable answers	Mark
4(c) (ii)	Substitution 1400 x 1.2 (1) Evaluation 1700 (N) (1)	1680 Allow full marks for correct answer with no working shown	**(2)**

Question Number	Answer	Acceptable answers	Mark
4 (c) (iii)	An discussion to include three of the following points The tow rope does not have to support the weight of the car (1) Tension is caused by accelerating force (plus frictional forces) (1) Tension is 5700 N (in this situation)(1) Forces could be kept below 12,000N (1) If acceleration is kept small (1) Numerical justification using f = m x a (1)	forces are horizontal not vertical / only needs to overcome friction Force is needed to accelerate / resultant force is 0 at constant velocity Force to accelerate is 1700N Forces could be kept small If truck is driven gently/slowly	**(3)**

(Total for Question 4 = 10 marks)

Question Number	Answer	Acceptable answers	Mark
5 (a) (i)		All three correct for 2 marks One or two only correct for 1 mark Reject any box with more than one line	**(2)**

Question Number	Answer	Acceptable answers	Mark
5(a) (ii)	A suggestion to include Neutrons do not need to be captured (by another nucleus) / do not play a part in the fusion process	 Fusion does not use neutrons No chain reaction	**(1)**

Question Number	Answer	Acceptable answers	Mark
5 (b)	A description to include Thermal energy used to create steam / boil water(1) (Steam used to drive) turbine (1) (Turbine used to turn) generator (1)	Ignore detail of fission process.	**(3)**

Question Number		Indicative Content	Mark
QWC	***5(c)**	An explanation including some of the following points • Description of the problem - Nuclei have positive charge - Repel each other - Reduces possibility of suitable collisions - Rate of fusion too small to be useful • Description of how this can be overcome o Very high temperature (of fuel) o Very high KE / speed of nuclei o High KE can overcome repulsion o Very high density / pressure o Increases possibility of suitable collisions	**(6)**
Level	**0**	No rewardable content	
1	**1 - 2**	A limited explanation e.g. The fuel has to be at a high temperature to start the reaction/to make particles collide. Or The fuel has to be at a very high temperature and pressure. • the answer communicates ideas using simple language and uses limited scientific terminology • spelling, punctuation and grammar are used with limited accuracy	
2	**3 - 4**	• A simple explanation. e.g. We need to overcome repulsion of nuclei to make them collide. This is achieved by having a high temperature and pressure. • the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately • spelling, punctuation and grammar are used with some accuracy	
3	**5 - 6**	• A detailed explanation • e.g. The nuclei repel each other. To overcome this they need very high kinetic energy which is achieved by generating high temperature and pressure. • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors	

(Total for Question 5 = 12 marks)

Question Number	Answer	Acceptable answers	Mark
6 (a)	C - kill microbes in the food		**(1)**

Question Number	Answer	Acceptable answers	Mark
6 (b)(i)	From the graph Time taken to fall (from 8000) to 4000 (1) = 5.3 (years) (1)	Any other suitable pair of readings from the graph. Between 5.1 and 5.5 Full marks for correct answer even if no working is evident	**(2)**

Question Number	Answer	Acceptable answers	Mark
6 (b)(ii)	3 x 5.3 (= 15.9 years)	Allow attempt at extrapolation only if the answer is between 15.5 and 16.5 Allow ecf of 3 half lives from bi.	**(1)**

Question Number	Answer	Acceptable answers	Mark
6 (c)(i)	Comparison including any two from Same number of protons (1) Different number of neutrons (1) Cobalt-60 is unstable (1)	 Same atomic/proton number/charge Different nucleon number/mass number/atomic mass Cobalt 60 is radioactive Ignore reference to electrons	**(2)**

Question Number		Indicative Content	Mark
QWC	***6(c) (ii)**	A discussion which includes description of the hazards (H) and / or possible precautions (P) to reduce risks arising from them such as • In either option. o Rods are radioactive (H) o Gamma radiation is highly penetrating / ionising (H) o Radiation from them can cause cancer / damage to organisms / people / environment (H) o Need for shielding (P) o Security to prevent public access (P) • Transportation / reprocessing o Danger of accident during transport (H) o Need to be suitably protected against damage. (P) o Danger of interception/high-jacking/terrorists (H) o Need security (P) o Workers could be exposed to radiation (H) o Special facilities required (P) • Disposal o Can damage environment if not properly contained (H) o Special disposal facilities, not landfill (P) o Remain radioactive for some time (H) o Need to be kept secure while decaying to safe levels. (P) o Relatively short half-life means that very long term storage is not necessary. (P)	**(6)**

Level	0	No rewardable content
1	1 - 2	• a limited description of hazards or precautions in one option e.g. The rods are radioactive. Radiation can cause cancer. When the rods are disposed of then they will remain radioactive for some time. • the answer communicates ideas using simple language and uses limited scientific terminology • spelling, punctuation and grammar are used with limited accuracy
2	3 - 4	• a simple discussion of hazards for both options or a detailed discussion of one option. • A detail discussion may **either** expand on several descriptive points about the hazard **or** may include suitable precautions. e.g. The gamma radiation from the rods is highly penetrating. If they were simply put into landfill then they could damage the environment and so they would need special storage facilities until they had decayed to a safe level. • the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately • spelling, punctuation and grammar are used with some accuracy
3	5 - 6	• a detailed discussion of hazards for both options. e.g. Response as above PLUS if they were transported back to the reactor then they must be in very strong containers so that, if there was an accident, they would not be damaged and allow radioactive material to escape. • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors

(Total for Question 6 = 12 marks)

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Surname	Other names

Edexcel GCSE

Centre Number	Candidate Number

Physics/Additional Science

Unit P2: Physics for Your Future

Higher Tier

Tuesday 18 June 2013 – Morning **Time: 1 hour**	Paper Reference **5PH2H/01**

You must have: Calculator, ruler	Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided
  – *there may be more space than you need.*

Information

- The total mark for this paper is 60.
- The marks for **each** question are shown in brackets
  – *use this as a guide as to how much time to spend on each question.*
- Questions labelled with an **asterisk** (*) are ones where the quality of your written communication will be assessed
  – *you should take particular care with your spelling, punctuation and grammar, as well as the clarity of expression, on these questions.*

Advice

- Read each question carefully before you start to answer it.
- Keep an eye on the time.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

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1/1/1/1/1/

P 4 1 9 4 5 A 0 1 1 6

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FORMULAE

You may find the following formulae useful.

charge = current × time $Q = I \times t$

potential difference = current × resistance $V = I \times R$

electrical power = current × potential difference $P = I \times V$

energy transferred = current × potential difference × time $E = I \times V \times t$

$$\text{speed} = \frac{\text{distance}}{\text{time}}$$

$$\text{acceleration} = \frac{\text{change in velocity}}{\text{time taken}} \qquad a = \frac{(v - u)}{t}$$

force = mass × acceleration $F = m \times a$

weight = mass × gravitational field strength $W = m \times g$

momentum = mass × velocity $P = m \times v$

$$\text{force} = \frac{\text{change in momentum}}{\text{time}} \qquad F = \frac{(mv - mu)}{t}$$

work done = force × distance moved in the direction of the force $E = F \times d$

$$\text{power} = \frac{\text{work done}}{\text{time taken}} \qquad P = \frac{E}{t}$$

gravitational potential energy = mass × gravitational field strength × vertical height
$\text{GPE} = m \times g \times h$

kinetic energy = ½ × mass × velocity^2 $\text{KE} = ½ \times m \times v^2$

P 4 1 9 4 5 A 0 2 1 6

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Questions begin on next page

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Answer ALL questions.

Some questions must be answered with a cross in a box ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

Static electricity

1 (a) A student wins a trophy. It is a metal cup on a black plastic base.



The student cleans the trophy.
She holds one of the metal handles and rubs the rest of the trophy with a dry cloth.

(i) Complete the sentence by putting a cross (☒) in the box next to your answer.

The plastic base becomes negatively charged because it gains

(1)

☒ **A** atoms

☒ **B** electrons

☒ **C** neutrons

☒ **D** protons

(ii) Explain why the base gains a negative charge when she rubs the trophy with the cloth.

(2)

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(iii) The metal cup does not become charged when she rubs the trophy.
Suggest why the cup does not become charged.

(2)

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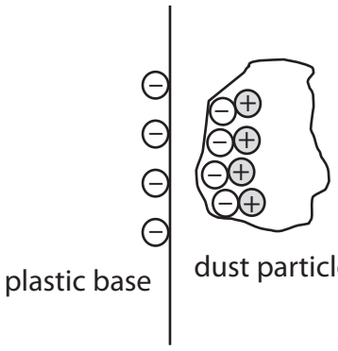
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(iv) Some dust particles in the air drift near to the plastic base just after she cleans the trophy.

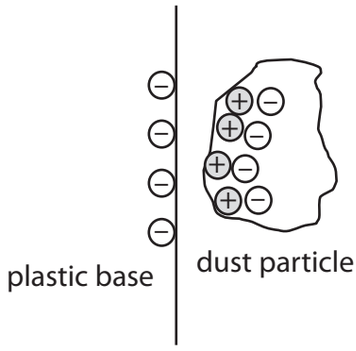
Which diagram shows the correct distribution of charges on a dust particle near to the charged plastic base?

Put a cross (☒) in the box next to your answer.

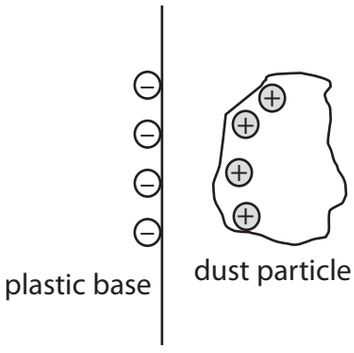
(1)



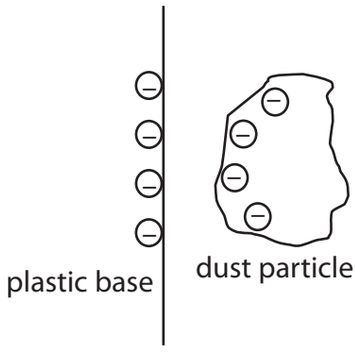
☒ **A**



☒ **B**



☒ **C**



☒ **D**

(b) Describe **one** situation where separation of electric charge can create a spark.

(2)

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(Total for Question 1 = 8 marks)

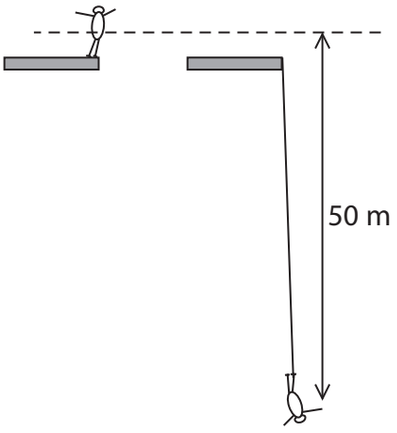
P 4 1 9 4 5 A 0 5 1 6

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Bungee jumping

2 A 60 kg student weighs 600 N.
He does a bungee jump.





The bungee cord becomes straight and starts to stretch when he has fallen 50 m.

(a) Complete the sentence by putting a cross (☒) in the box next to your answer.

He first stops moving

(1)

- ☒ **A** before all the energy has disappeared
- ☒ **B** before the bungee cord starts to stretch
- ☒ **C** when the bungee cord is stretched the most
- ☒ **D** when the elastic potential energy is zero

(b) Complete the sentence by putting a cross (☒) in the box next to your answer.

When his speed is 10 m/s his momentum is

(1)

- ☒ **A** 600 kg m/s
- ☒ **B** 3 000 kg m/s
- ☒ **C** 6 000 N m/s
- ☒ **D** 30 000 N m/s

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(c) (i) Calculate the change in gravitational potential energy as the student falls 50 m.

Give the unit.

(3)

change in gravitational potential energy = ... unit .....

(ii) State at what point in the bungee jump the student has maximum kinetic energy.

(1)

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(iii) Explain why his maximum kinetic energy is likely to be less than your answer to (c)(i).

(2)

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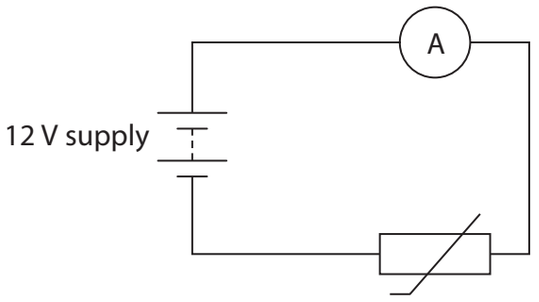
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(Total for Question 2 = 8 marks)

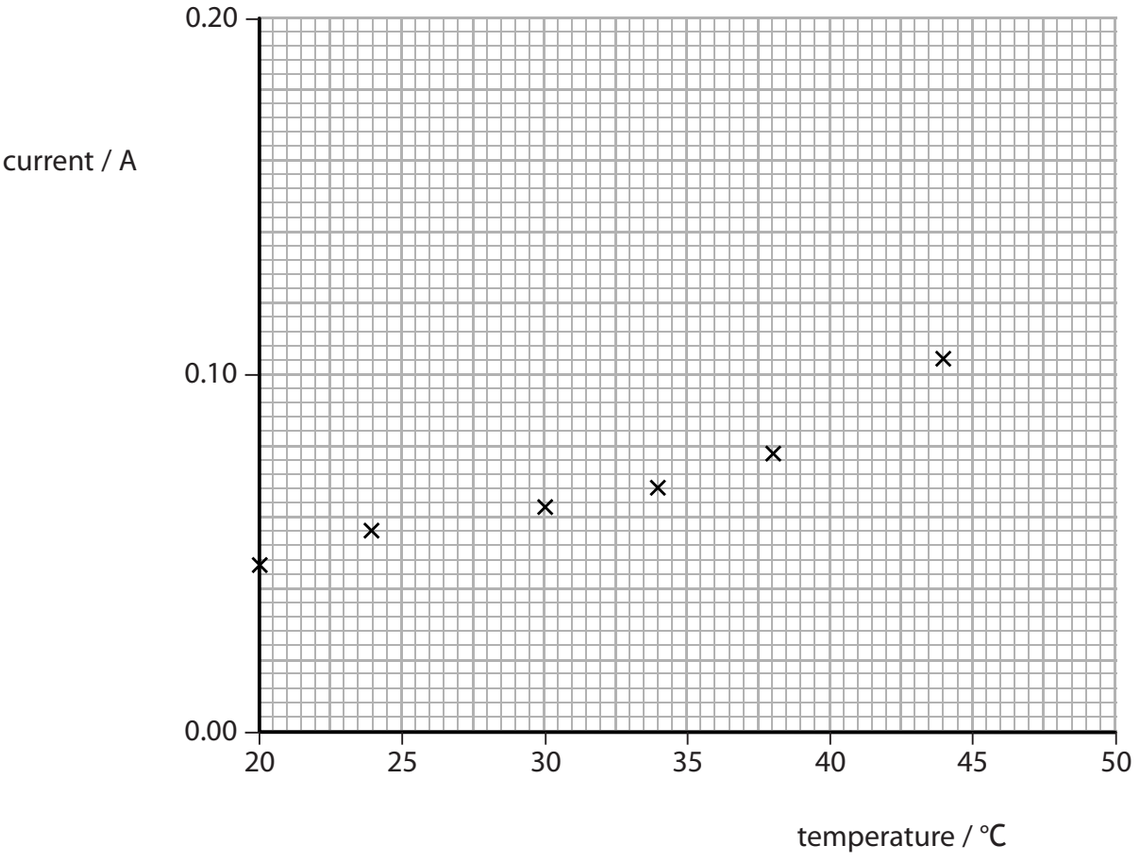
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Electric current and temperature

3 (a) A designer is going to use a thermistor in a temperature gauge. He connects the thermistor into this circuit.



He heats the thermistor and measures the current at different temperatures. Here are some of the results plotted on a graph.



At 47 °C the current was 0.138 A.

(i) Plot this value on the graph.

(1)

(ii) Draw the curve of best fit through the points.

(1)

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(iii) The supply voltage is 12 V.
At 20 °C the current is 0.047 A.

Calculate the resistance of the thermistor at this temperature.

(3)

resistance = ... Ω

(iv) Use this graph of current against temperature to explain the relationship between resistance and temperature for this thermistor.

(2)

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(b) (i) When there is an electric current in a resistor, the resistor gets hot.

Explain why the resistor gets hot.

(2)

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(ii) Suggest why the thermistor in a temperature gauge might indicate a temperature slightly higher than the actual temperature of its surroundings.

(1)

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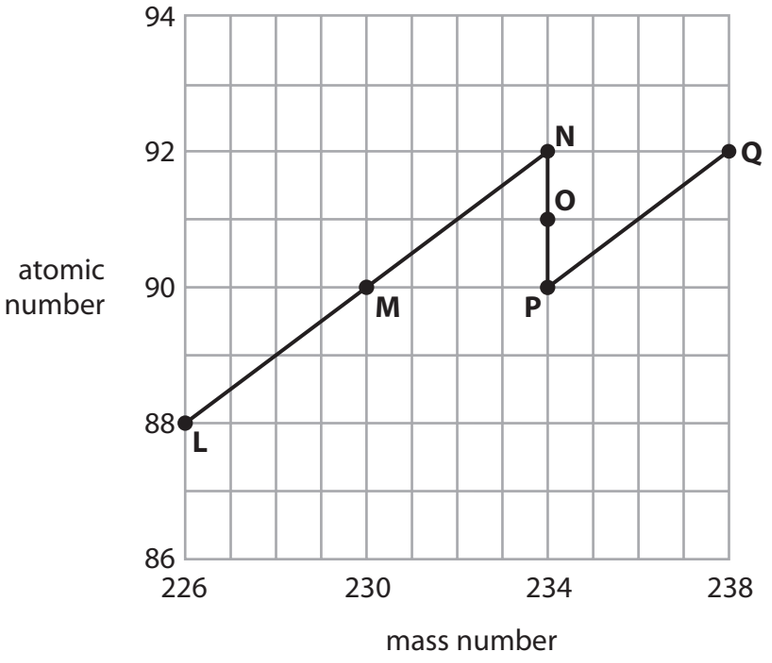
(Total for Question 3 = 10 marks)

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Uranium-238

4 Uranium-238 is an isotope of uranium. It may undergo either radioactive decay or nuclear fission.

A nucleus of uranium-238 is shown as **Q** in the chart.



(a) State **two** letters from the chart which show isotopes of the same element.

(1)

..... and .....

(b) Explain what happens when **Q** decays to **P**.

(2)

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(c) Explain what happens when **P** decays to **O**.

(2)

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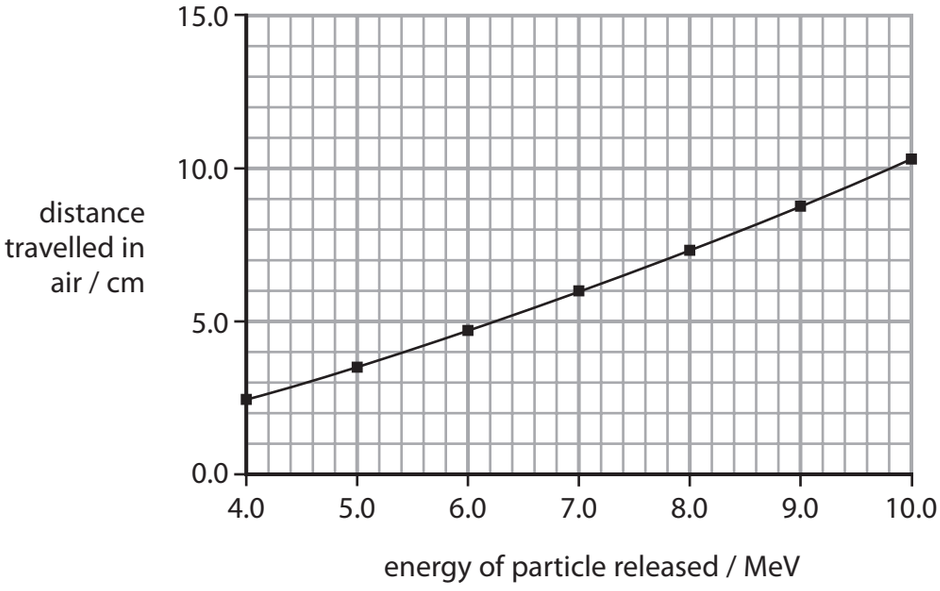
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P 4 1 9 4 5 A 0 1 0 1 6

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(d) Particles released during radioactive decay can have different energies.
A suitable unit for these energies is MeV.
For one type of decay, the particles released have energies between 4.0 MeV and 10.0 MeV.
The graph shows how far the particles with these energies travel in air.



(i) State the name of this type of particle.

(1)

.....

(ii) Use information from the graph to describe how the distance travelled in air depends on the energy of the particle.

(2)

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(e) Uranium-238 can only undergo nuclear fission by absorbing fast neutrons.
The fission emits neutrons which very quickly lose their energy.

Suggest why the fission of uranium-238 does not produce a chain reaction.

(2)

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(Total for Question 4 = 10 marks)

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Force and acceleration

5 (a) A car is travelling along a level road.



(i) Complete the sentence by putting a cross (☒) in the box next to your answer.

When the velocity of the car is constant, the force of friction on it is

(1)

☒ **A** zero

☒ **B** greater than the driving force

☒ **C** smaller than the driving force

☒ **D** the same size as the driving force

(ii) The car now accelerates in a straight line.
Its average acceleration is 12 m/s^2.

Calculate the increase in velocity of the car in 4.0 s.

(3)

speed = ... m/s

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(b) This table shows data about two other cars.

car	mass	time taken to reach 30 m/s from rest
family car	1400 kg	10 s
sports car	600 kg	5 s

The owner of the family car claims that although the sports car has greater acceleration, it produces a smaller accelerating force than his family car.

Explain how these figures support his claim.

(2)

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*(c) After going to the shops, a car driver places a bag of shopping on the passenger seat. During the journey home, the driver has to use the brakes to stop very suddenly. The driver is wearing a seat belt.

Explain what happens next to the car, the driver and the shopping bag.

(6)

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(Total for Question 5 = 12 marks)



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Radioactivity

6 (a) An underground oil pipe starts to leak oil.
To find the leak, a technician adds a gamma source to the oil flowing in the pipe.

Describe how the technician can find the position of the leak.

(2)

.....

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(b) Which of these is correct for half-life?

Put a cross (☒) in the box next to your answer.

(1)

☒ **A** It is half the time for all the atoms to decay

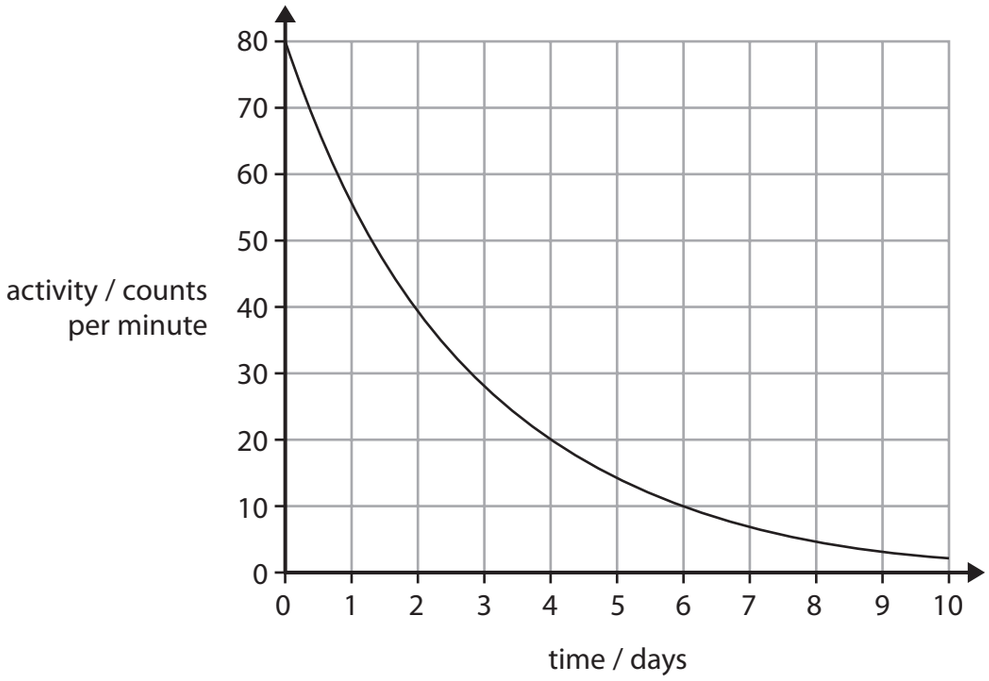
☒ **B** It is the time it takes for an atom to half decay

☒ **C** It is the time it takes for half an atom to decay

☒ **D** It is the time it takes for half the atoms to decay

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(c) The graph shows how the activity of a sample of a radioactive material changes with time.
The sample has an initial activity of 80 counts per minute.



(i) Use the graph to find the half-life of the material.

(1)

half life = ... days

(ii) Another sample of the material has an initial count rate of 40 counts per minute.

Sketch, on the same axes, the activity of this sample for the first 4 days.

(2)

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*(d) Some scientists carry out an experiment to measure the radioactivity from a source to be used in a factory.
They measure the background radiation before and after their experiment.
They take the background count at the same place as they do their experiment.

Explain how this procedure helps to make sure that the results of the experiment are valid.

(6)

(Total for Question 6 = 12 marks)

TOTAL FOR PAPER = 60 MARKS

P 4 1 9 4 5 A 0 1 6 1 6

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Mark Scheme (Results)

Summer 2013

GCSE Physics (5PH2H)
Paper 01

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General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- For questions worth more than one mark, the answer column shows how partial credit can be allocated. This has been done by the inclusion of part marks eg (1).
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

Quality of Written Communication

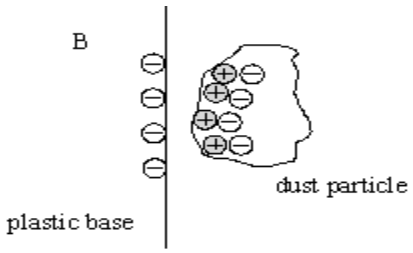
Questions which involve the writing of continuous prose will expect candidates to:

- Write legibly, with accurate spelling, grammar and punctuation in order to make the meaning clear
- Select and use a form and style of writing appropriate to purpose and to complex subject matter
- Organise information clearly and coherently, using specialist vocabulary when appropriate.

Question Number	Answer	Acceptable answers	Mark
1(a)(i)	B electrons		**(1)**

Question Number	Answer	Acceptable answers	Mark
1(a)(ii)	An explanation linking (negative) electrons transfer (1) because of friction/from cloth (to base) (1)	 negative charge (reject protons and positive charge for this mp) moves cloth loses {electrons/negative charge} (to base) = 2	**(2)**

Question Number	Answer	Acceptable answers	Mark
1(a)(iii)	A suggestion to include charge (any) could move through cup /metal (1) (cup is) earthed (1)	 cup/metal is a conductor ignore metal is not an insulator to {earth/ ground} / {to/ through} student's hand	**(2)**

Question Number	Answer	Acceptable answers	Mark
1(a)(iv)	B  		**(1)**

Question Number	Answer	Acceptable answers	Mark
1(b)	A description to include the situation which caused the charge separation (1) where the spark travelled {from or to}(1)	examples when refuelling, spark between end of {fuel/pipe} and vehicle =2 spark {between/from /to} person comb/clothes/metal handle and, when combing hair/removing clothing/opening door = 2 lightning flash, between cloud and cloud/plane/ground, =2 ignore between plug and socket/jump leads	**(2)**

Question Number	Answer	Acceptable answers	Mark
2(a)	**C** when the bungee cord is stretched the most		**(1)**

Question Number	Answer	Acceptable answers	Mark
2(b)	**A** 600 kg m/s		**(1)**

Question Number	Answer	Acceptable answers	Mark
2(c)(i)	Substitution: (1) 60 x 10 x 50 or 600 x 50 Evaluation: (1) 30 000 Unit: (1) J / Nm	 give two marks for correct answer no working j / joule 30 kJ for full marks	**(3)**

Question Number	Answer	Acceptable answers	Mark
2(c)(ii)	After falling 50 m / when the cord becomes straight/when cord starts to stretch	tension starting to increase at terminal velocity ignore maximum velocity/speed	**(1)**

Question Number	Answer	Acceptable answers	Mark
2(c)(iii)	An explanation linking any two of not all GPE is transferred to KE (1) some {of the GPE transfers to thermal energy /work is done} (1) due to drag (1)	 not all GPE goes to KE maximum energy is same (value) as GPE before falling /speed does not reach the speed at which he should fall some lost as heat/sound (of rope or movement through air) (air) resistance / friction ignore wind	**(2)**

Question Number	Answer	Acceptable answers	Mark
3 (a) (i)	Correctly plotted point (1)	+/- ½ a small square	**(1)**

Question Number	Answer	Acceptable answers	Mark
3 (a)(ii)	Smooth line through most (at least 5) crosses / points (1)	Do not accept clearly dot-to-dot or excessive tramlining Ignore any part of line after 45	**(1)**

Question Number	Answer	Acceptable answers	Mark
3 (a) (iii)	Substitution: (1) 12 = 0.047 x R Transposition: (1) R = 12/0.047 Evaluation: (1) R = 260	 transposition and substitution in either order substitution mark can be scored when incorrectly transposed word/symbol equation is given 255.3, 255 give full marks for correct answer no working power of 10 errors with no working score max 1 mark	**(3)**

Question Number	Answer	Acceptable answers	Mark
3 (a) (iv)	An explanation linking • current increases with temperature (1) with • (so) resistance decreases(1) or • the voltage is constant (1) with • (so) resistance decreases (with temperature increase)(1)	 (for this first MP) ignore faster/slower (charge/current) ignore references to heat, current flows more can score both marks by quoting two suitable pairs of values from graph For full marks, there must be a reference to change of either I or R with temperature	**(2)**

Question Number	Answer	Acceptable answers	Mark
3 (b)(i)	An explanation linking • {electrons / negative charges} (1) • collide with {ions/lattice/electrons} (1)	atoms / nuclei allow for 1 mark,electrical energy transferred to {thermal/heat} energy if no other scored	**(2)**

Question Number	Answer	Acceptable answers	Mark
3 (b) (ii)	A suggestion including energy transfer in {the thermistor/ any component part of the electrical circuit} causes a rise in temperature of thermistor (above surroundings)(1)	thermistor/resistor {gets hot/is heated}	**(1)**

Question Number	Answer	Acceptable answers	Mark
4(a)	P and M OR M and P OR N and Q OR Q and N	one mark for a pair	**(1)**

Question Number	Answer	Acceptable answers	Mark
4(b)	{atomic /proton} number drops by 2 **and** {mass/nucleon} number by 4 (1) (which is) alpha decay (1)	2 protons **and** 2 neutrons are lost 92 → 90 **and** 238 → 234 helium nucleus given off (which is) alpha particle	**(2)**

Question Number	Answer	Acceptable answers	Mark
4(c)	same {mass/nucleon} number but {atomic/proton} number increases by 1 (1) (negative) beta decay (1)	a neutron changes to a proton ignore GAINS a proton beta particle /electron given off	**(2)**

Question Number	Answer	Acceptable answers	Mark
4(d)(i)	alpha	Alpha ray, alpha particle, α Ignore capital letters	**(1)**

Question Number	Answer	Acceptable answers	Mark
4(d)(ii)	A description including two of one increases as other increases (1) rate of increase is in the range from 1.17 to 1.33 (cm/MeV) (1) range gradually increases more with energy (1)	 the particles with higher energy travel further accept values quoted from graph not (quite) linear/not proportional /curves upwards accept values quoted from graph	**(2)**

Question Number	Answer	Acceptable answers	Mark
4(e)	chain reaction needs a neutron from one fission to reach another uranium nucleus/atom (at the right speed) (1) (fission of 238) needs {fast/high(er) energy} neutrons (1)	idea of continuous nature of chain reaction the neutrons would be going too slowly /do not have enough energy / lose energy too fast	**(2)**

Question Number	Answer	Acceptable answers	Mark
5 (a) (i)	D the same size as the driving force		**(1)**

Question Number	Answer	Acceptable answers	Mark
5 (a) (ii)	transposition: (1) {change in) speed= accelerationxtime substitution: (1) speed = 12 x 4 evaluation: (1) 48 (m/s) (1)	transposition and substitution can be in either order substitution mark can be scored when incorrectly transposed word/symbol equation is given Give full marks for correct answer no working	**(3)**

Question Number	Answer	Acceptable answers	Mark
5 (b)	An explanation linking • {acceleration of sports is 2x / time to reach 30 m/s is ½} that of family car / RA (1) • mass of sports car LESS than ½ that of family car or RA (1) (so resultant force required is less)	Attempt to use f = m x a scores one mark e.g. 4200 OR 3600 scores 1 Correct numerical comparison scores both marks e.g. 4200:3600 numerically or in words scores 2 marks	**(2)**

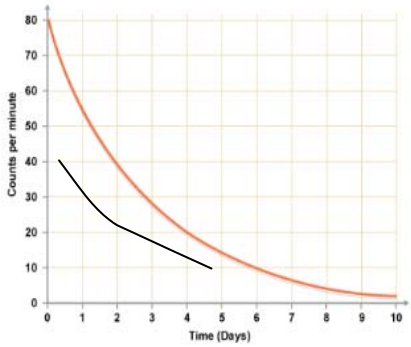
Question Number		Indicative Content	Mark
QWC	***5(c)**	An explanation including some of the following ideas • brakes apply a force to the car • this force from brakes makes the car decelerate/ lose velocity • a force also acts on the driver • driver decelerates at same rate as the car • does not move with respect to car/ stays in the driving seat • moves slightly because belt stretches • small/ no horizontal force acts on the shopping bag • shopping bag continues at similar/ same velocity • until shopping bag falls off seat / hits dashboard • ideas can be expressed in terms of energy, momentum and/or by reference to Newton's laws	**(6)**
Level	**0**	No rewardable content	
1	**1 - 2**	• A limited explanation of the difference in decelerations of at least two of the objects Car **(C)**, Shopping **(S)** and Passenger **(P)** mainly describing the effects. E.g. (at start) **C** stops (very quickly) while {**P / S**} carries on moving (for a longer time) OR **S** {carries on at same speed / hits the dashboard} while **P** is {held back / slowed down} (by the seatbelt) • the answer communicates ideas using simple language and uses limited scientific terminology • spelling, punctuation and grammar are used with limited accuracy	
2	**3 - 4**	• A simple explanation of the difference in decelerations of at least **two** of the objects Car, Shopping and Passenger, including a reason for at least one of the decelerations. E.g.(at start) **C** stops (very quickly) **because of** friction at the brakes and at the road while {**P / S**} carries on moving (for a longer time) OR **S** {carries on moving (at same speed) / hits the dashboard} while **P** is {held back / slowed down} **because of** stretching force from the seatbelt) • the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately • spelling, punctuation and grammar are used with some accuracy	

3	**5 - 6**	• A detailed explanation of the relative decelerations of **C**, **S and P** including mention of the physical principles involved in any two such as that named forces are needed to change given motions. E.g. (The force of) friction is large for **C** to {slow down / stop} quickly but is low for **P** and **S**. {**So / thus / therefore etc**} **P** or **S** carry on at the same speed (initially). **P** decelerates more slowly than **C** {**because / as a result etc**} of the stretching (force) of the seatbelt. OR *The idea of* {Newton's first law / inertia / need for a force to change motion} and the role of friction and {elastic / tension / stretching} force in producing the **three** named decelerations. OR Named force needed for a described change in {momentum/kinetic energy} to {stop / slow down} each of the **three** objects. • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors

Question Number	Answer	Acceptable answers	Mark
6(a)	A description to include • name of detector / move detector over the ground (1) • where leak is, there will be an increased rate (1)	(move) until a {leak/high reading} is found	**(2)**

Question Number	Answer	Acceptable answers	Mark
6(b)	D It is the time it takes for half the atoms to decay		**(1)**

Question Number	Answer	Acceptable answers	Mark
6(c)i	1.9-2 (days)		**(1)**

Question Number	Answer	Acceptable answers	Mark
6(c)ii	 plotting (0,40), (2,20) and (4,10) **OR ANY** line which passes through those coordinates (1) smooth curve through those points (1)	Ignore any part of line after 4 days	**(2)**

Question Number		Indicative Content	Mark
QWC	***6(d)**	An explanation including some of the following ideas **Need for measurement (N)** Background radiation • is {always present/all around us} • has (natural) source(s) exemplified by space, living things, rocks, food, nuclear/medical sources etc. • would give false reading in experiment **How and why to measure(H)** Background radiation measurement • is taken at site of experiment **because** it is different in different places • is taken with all apparatus **except** source in place • is taken before and after **because** {it can change with time / they need an average} • {must be worked out for same time as (or longer than) experiment / rate found} **so** analysis is simpler • It is {taken several times/ averaged} **because** it is random **Analysis (A)** Background radiation measurement • must be subtracted from {measurements with source /main count rate}	**(6)**
Level	**0**	No rewardable content	
1	**1 - 2**	• A limited explanation mentioning any **two** from N or **one** from H or A e.g. Background comes from space and rocks.(N) It is there all the time. (N) OR Readings for background must be repeated because they are random. (H) OR Background must be taken away from all other readings (A) • the answer communicates ideas using simple language and uses limited scientific terminology • spelling, punctuation and grammar are used with limited accuracy	
2	**3 - 4**	• A simple explanation ***linking*** aspects of two ideas i.e. **N** + **H** OR **N** + **A** OR **H** + **A** e.g Take readings without source (H) and subtract them from the main readings with source present.(A) OR It should be taken several times because it is random (H)so that the average can be subtracted from the main readings (A) • the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately • spelling, punctuation and grammar are used with some accuracy	

3	**5 - 6**	• A detailed explanation ***linking*** **A** with EITHER N + an idea from **H** OR two or more ideas from **H** e.g. Background radiation is there all the time. (N) You need to take readings at the place where you will do the experiment and with all the apparatus set up except the source because BR changes from place to place.(H) Then you should subtract background readings from the main experimental readings.(A) OR Take several readings of count rate for averaging since the effect is random (H) and make sure that they are taken in the same place.(H) Then subtract from readings in main experiment.(A) • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors

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Edexcel GCSE

Centre Number	Candidate Number

Physics/Additional Science

Unit 2: Physics for Your Future

Higher Tier

Thursday 7 March 2013 – Morning **Time: 1 hour**	Paper Reference **5PH2H/01**

You must have:
Calculator, ruler

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided
  – *there may be more space than you need.*

Information

- The total mark for this paper is 60.
- The marks for **each** question are shown in brackets
  – *use this as a guide as to how much time to spend on each question.*
- Questions labelled with an **asterisk** (*) are ones where the quality of your written communication will be assessed
  – *you should take particular care with your spelling, punctuation and grammar, as well as the clarity of expression, on these questions.*

Advice

- Read each question carefully before you start to answer it.
- Keep an eye on the time.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

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P 4 1 9 6 1 A 0 1 2 0

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FORMULAE

You may find the following formulae useful.

charge = current × time $Q = I \times t$

potential difference = current × resistance $V = I \times R$

electrical power = current × potential difference $P = I \times V$

energy transferred = current × potential difference × time $E = I \times V \times t$

$$\text{speed} = \frac{\text{distance}}{\text{time}}$$

$$\text{acceleration} = \frac{\text{change in velocity}}{\text{time taken}} \qquad a = \frac{(v-u)}{t}$$

force = mass × acceleration $F = m \times a$

weight = mass × gravitational field strength $W = m \times g$

momentum = mass × velocity $P = m \times v$

$$\text{force} = \frac{\text{change in momentum}}{\text{time}} \qquad F = \frac{(mv-mu)}{t}$$

work done = force × distance moved in the direction of the force $E = F \times d$

$$\text{power} = \frac{\text{work done}}{\text{time taken}} \qquad P = \frac{E}{t}$$

gravitational potential energy = mass × gravitational field strength × vertical height
$\text{GPE} = m \times g \times h$

kinetic energy = ½ × mass × velocity^2 $\text{KE} = ½ \times m \times v^2$

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Questions begin on next page

Answer ALL questions.

Some questions must be answered with a cross in a box ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

Charge and Current

1 A battery sends a current through a metal wire.

(a) (i) Complete the sentence by putting a cross (☒) in the box next to your answer.

Direct current is movement of charge

(1)

☐ **A** backwards and forwards

☐ **B** in many directions

☐ **C** in one direction

☐ **D** up and down

(ii) Complete the sentence by putting a cross (☒) in the box next to your answer.

The particles that flow in the metal wire are

(1)

☐ **A** atoms

☐ **B** electrons

☐ **C** protons

☐ **D** neutrons

(b) The current in a wire is 3.7 A.

Calculate the charge that flows into the wire in 13 s.

(2)

charge = ... C

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(c) Plastic is an insulator.

A student rubs a piece of plastic with a cloth.

This gives the plastic a negative charge.

(i) Explain how the plastic is charged by the rubbing.

(2)

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(ii) The cloth is also charged when it rubs against the plastic.

Describe the charge on the cloth.

(2)

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(Total for Question 1 = 8 marks)

Going downhill

2 Andrew skis down a hill.



(a) Andrew starts from the top of the hill and his speed increases as he goes downhill.

He controls his speed and direction by using his skis.

He brings himself to a stop at the bottom of the hill.

Describe the energy changes that happen between starting and stopping.

(3)

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(b) Andrew returns to the top of the hill and starts again.

(i) His mass is 67 kg.

Show that his momentum is about 2000 kg m/s when his velocity is 31 m/s.

(2)

(ii) He falls over when his momentum is 2000 kg m/s.

After he falls over, he slows down by sliding across the snow.

It takes 2.3 s for his momentum to reduce to zero.

Calculate the average force on Andrew as he slows down.

(2)

force = ... N

(iii) Andrew is not injured by the fall even though he was moving quickly.

Use ideas about force and momentum to explain why he is not injured.

(2)

.....

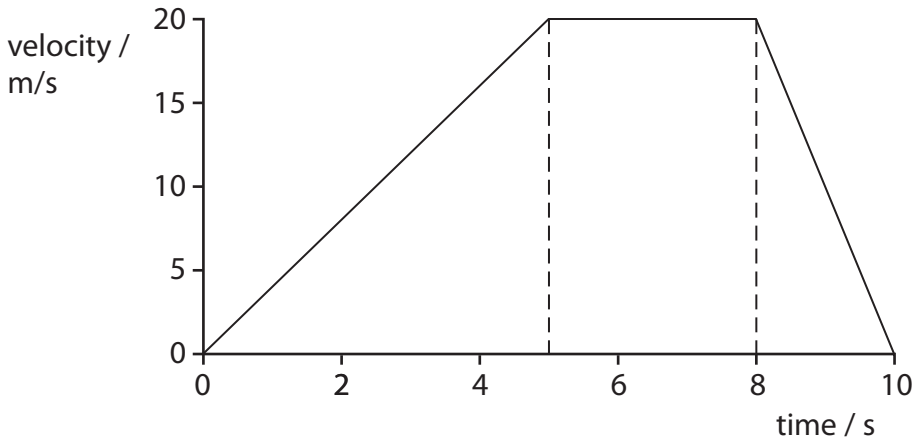
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(Total for Question 2 = 9 marks)

3 The graph shows how the velocity of a small car changes with time.



(a) Complete the sentence by putting a cross (☒) in the box next to your answer.

The resultant force on the car will be zero when the car is

(1)

☒ **A** accelerating

☒ **B** decelerating

☒ **C** changing velocity

☒ **D** moving at a constant velocity

(b) (i) Use the graph to estimate the velocity of the car at three seconds.

(1)

velocity ..... m/s

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(ii) Calculate the acceleration of the car when it is speeding up.

(2)

acceleration = ... m/s^2

(iii) Explain why the units of acceleration are m/s^2.

(2)

.....

.....

.....

.....

(iv) Show that the car travels further at a constant velocity than it does when it is slowing down.

(3)

(Total for Question 3 = 9 marks)

Carbon dating

4 Carbon-14 is a radioactive isotope that occurs naturally.

Scientists use carbon-14 to help find the age of old pieces of wood.

This technique is called carbon dating.

It uses the idea of half-life.

(a) Which of these describes half-life?

Put a cross (☒) in the box next to your answer.

(1)

☐ **A** the time it takes for half of the undecayed nuclei to decay

☐ **B** the time it takes for all of the undecayed nuclei to decay

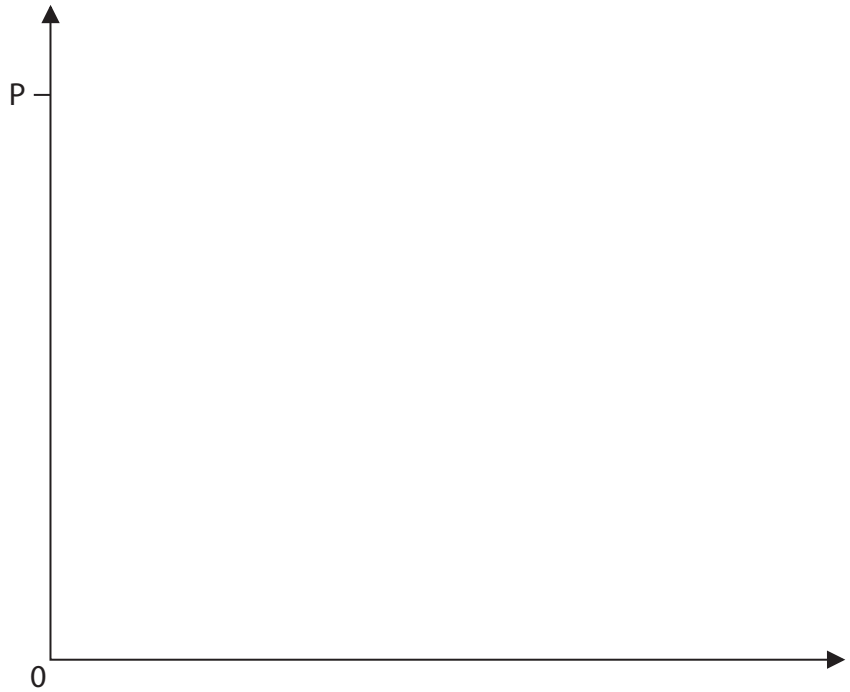
☐ **C** half the time it takes for all of the undecayed nuclei to decay

☐ **D** half the time it takes for half of the undecayed nuclei to decay

(b) Sketch a graph to show how the activity of a radioactive isotope changes with time.

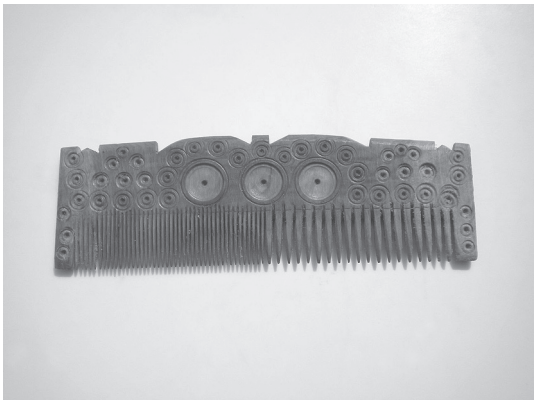
Use the axes below. Start your line from point P.

(3)



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(c) A scientist investigates an old wooden comb.



The activity of the carbon-14 in it is 0.55 Bq.

The estimated age of the comb is 11 400 years.

The half-life of carbon-14 is 5700 years.

(i) Calculate the activity of the carbon-14 in the comb when it was new.

(3)

activity = ... Bq

(ii) The scientist takes several readings of background radiation.

Explain why this is necessary to improve the accuracy of the investigation.

(2)

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.....

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(iii) Old objects like the comb emit a very small amount of radiation.

The activity from the comb is about the same as comes from background radiation.

Scientists have stopped measuring the activity of carbon-14 for carbon dating.

Instead, they can measure the mass of undecayed carbon-14 left in the sample.

Suggest a reason for this change.

(1)

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.....

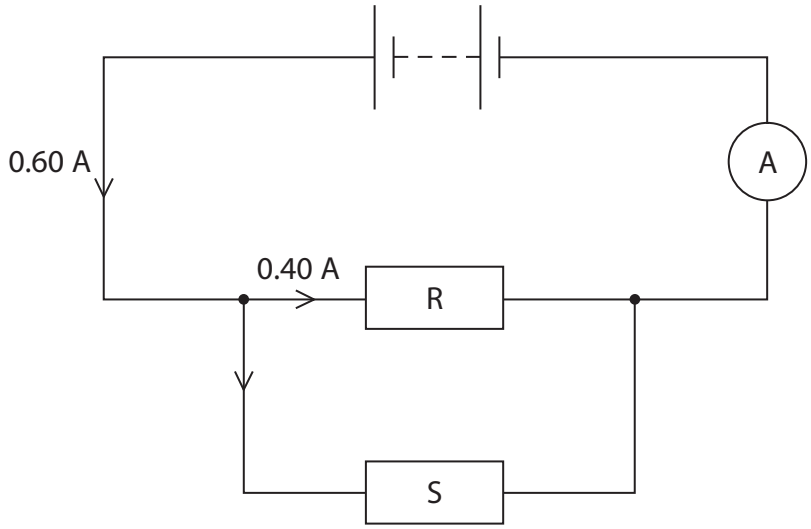
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(Total for Question 4 = 10 marks)

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Electric circuits

5 (a) The diagram shows an electric circuit with two resistors, R and S.



(i) R has a resistance of 11 ohms.

Calculate the potential difference across R.

(2)

potential difference = ... V

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(ii) Use information from the diagram to calculate the current in S.

(1)

current = ... A

(iii) Complete the sentence by putting a cross (☒) in the box next to your answer.

A student wants to measure the battery voltage with a voltmeter.

The voltmeter should be placed

(1)

☒ **A** in series with the battery

☒ **B** in parallel with the battery

☒ **C** in parallel with the ammeter

☒ **D** in series with either resistor R or S

(b) Explain why the temperature of a resistor increases when a current passes through it.

(2)

.....

.....

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.....

*(c) A resistor is a circuit component.

Two other circuit components are a light dependent resistor (LDR) and a thermistor.

Explain how LDRs and thermistors can be used to control the current in a circuit.

(6)

(Total for Question 5 = 12 marks)

Ionising radiation

6 Alpha, beta and gamma are types of ionising radiation.

(a) State **two** ways in which gamma radiation is different from alpha radiation.

(2)

.....

.....

.....

.....

(b) (i) Complete the sentence by putting a cross (☒) in the box next to your answer.

A beta particle is emitted by

(1)

- ☒ **A** an alpha particle
- ☒ **B** a fusion particle
- ☒ **C** a gamma ray
- ☒ **D** an unstable nucleus

(ii) Complete the sentence by putting a cross (☒) in the box next to your answer.

A beta particle has an identical charge to

(1)

- ☒ **A** an alpha particle
- ☒ **B** an electron
- ☒ **C** a neutron
- ☒ **D** a nucleus

(c) Explain how an atom becomes ionised by radiation.

(2)

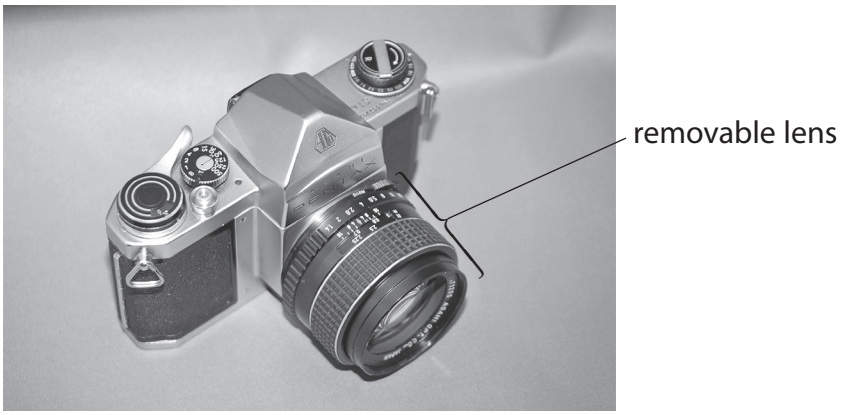
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*(d) The removable lens of this old camera has four pieces of glass in it.



One of the pieces of glass is radioactive. Its surface is covered with a thin layer of magnesium fluoride.

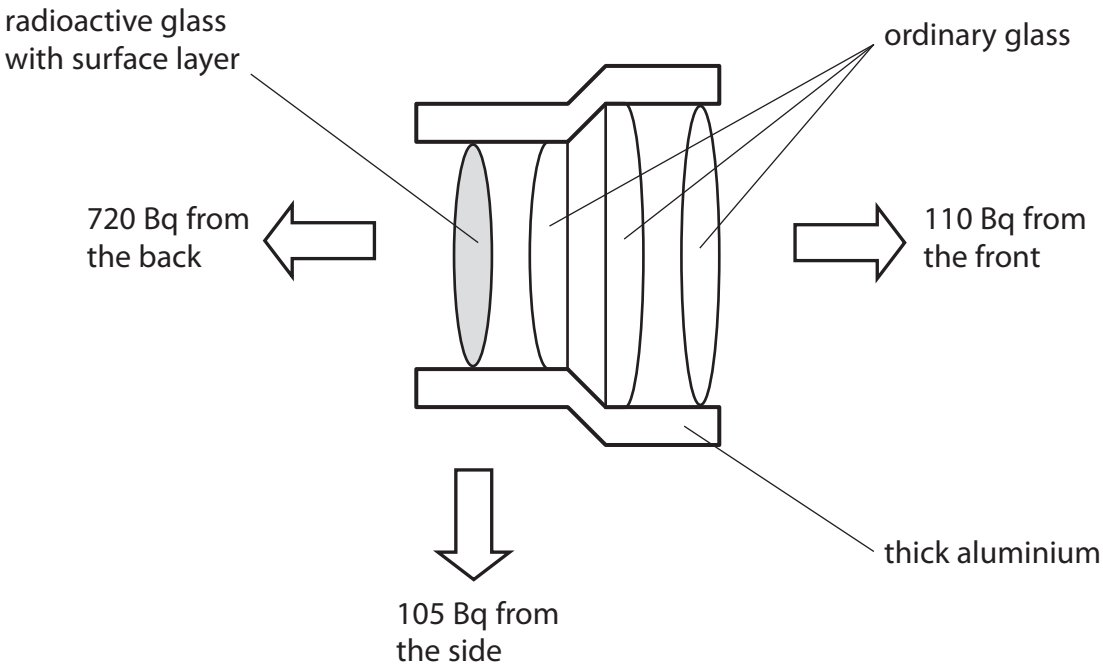
Radioactive isotopes in the glass emit alpha, beta and gamma radiation in all directions.

A scientist removes the lens from the camera. She measures the radiation coming from the back, front and side of the lens.

The amount of radiation is different in each direction.

No alpha radiation is detected.

The readings are shown on the diagram.



Explain why the readings in the three directions are different.

(6)

(Total for Question 6 = 12 marks)

TOTAL FOR PAPER = 60 MARKS

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Mark Scheme (Results)

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GCSE Physics
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Question Number	Answer	Acceptable answers	Mark
1(a)(i)	C		**(1)**

Question Number	Answer	Acceptable answers	Mark
1(a)(ii)	B		**(1)**

Question Number	Answer	Acceptable answers	Mark
1(b)	substitution (1) 3.7 x 13 evaluation (1) 48 (C)	 48.1 Correct answer with no calculation scores 2 marks	**(2)**

Question Number	Answer	Acceptable answers	Mark
1(c)(i)	Correct responses can be seen in (i) or (ii) An explanation linking • <u>electrons</u> (1) and <u>one</u> of • removed by friction (1) • (transferred) <u>to</u> plastic (1)	 ["positive electrons/ protons moving", seen anywhere in part (i) or (ii) loses this mark] ignore reference to charge before rubbing transferred from cloth	**(2)**

Question Number	Answer	Acceptable answers	Mark
1(c)(ii)	opposite to charge on plastic (1) <u>equal</u> to charge on the plastic (1)	charge on cloth is positive <u>same size</u> as charge on plastic electrons transferred from the cloth equal to electrons lost by cloth	**(2)**

Total question 1 = 8 marks

Question Number	Answer	Acceptable answers	Mark
2(a)	Description including 3 of the following: • (Gravitational) potential energy (transferred) to KE(1) • Idea of energy transfer to heat/sound whilst descending (1) • Chemical energy is transferred to heat energy in Andrew (1) • Idea of energy dissipated on stopping (1)	(G)PE (transferred) to KE Allow gravitational energy for GPE Energy transferred to heat because of air resistance/ friction The energy goes to heat as he stops. Energy is transferred to the surroundings	**(3)**

Question Number	Answer	Acceptable answers	Mark
2(b)(i)	substitution (1) 67 × 31 evaluation (1) 2077 (kg m/s)	2080, 2100 working backwards using 2000 (v=) 29.85, 30 (m=) 64.52, 65 67 X 31=2000 scores only one mark	**(2)**

Question Number	Answer	Acceptable answers	Mark
2(b)(ii)	substitution (1) 2000 ÷ 2.3 evaluation (1) 870 (N)	answer to (b)(i)) ÷ 2.3 900, 869.6, 869.5 903	**(2)**

Question Number	Answer	Acceptable answers	Mark
2(b)(iii)	an explanation linking two of the following • Force on Andrew is quite small (1) • Because impact time is long (1) • The acceleration/deceleration is quite small (1) • Because impact distance is far (1)	 force is reduced/ less /not as strong slows down/changes momentum gradually acceleration = 1.35 'g' or 13.5 m/s^2 slows down (rate of) change of momentum scores 2 marks	**(2)**

Total question 2 = 8 marks

Question Number	Answer	Acceptable answers	Mark
3(a)	D		**(1)**

Question Number	Answer	Acceptable answers	Mark
3(b)(i)	12 (m/s) (1)	Range from 11(m/s) to 14 (m/s)	**(1)**

Question Number	Answer	Acceptable answers	Mark
3(b)(ii)	Substitution (1) $\frac{20-0}{5}$ evaluation (1) 4 (m/s^2)	$\frac{20}{5}$ Full marks for correct answer with no working Allow answers between 3.6 and 4.7 for 2 marks to reflect readings taken from the graph	**(2)**

Question Number	Answer	Acceptable answers	Mark
3b(iii)	• velocity/ speed (measured in) m/s (1) • <u>divided</u> by time in s (1)	velocity/ speed (measured in) ms^{-1} acceleration is rate of change of velocity m/s/s m per s per s [accept per for divide] do not accept m/s <u>times</u> time	**(2)**

Question Number	Answer	Acceptable answers	Mark
3b(iv)	at constant vel • distance = 60 (m) (1) slowing down • distance = ½×2×20 (1) • = 20 (m) (1)	correct answer scores 2 marks	**(3)**

Total for question 3=10 marks

Question Number	Answer	Acceptable answers	Mark
4(a)	A		**(1)**

Question Number	Answer	Acceptable answers	Mark
4(b)	axes labelled correctly With label or unit (1) correct shaped smooth curve (1) line does not reach zero activity (1)	activity / Bq / count rate ignore radioactivity time/ seconds/ any time unit	**(3)**

Question Number	Answer	Acceptable answers	Mark
4(c)(i)	Idea of 2 half-lives (1) 11 400 = 2 × 5700 Idea of halving activity twice (1) 0.55 × 2 × 2 Calculation (1) 2.2 (Bq)	11 400 / 5700 = 2 2.2 (Bq) for three marks	**(3)**

Question Number	Answer	Acceptable answers	Mark
4(c)(ii)	Explanation linking two of: • Background radiation affects the measurement (1) • Needs to be subtracted from readings (1) • Background radiation is variable (1) • Background radiation needs to be averaged (1)	accept interfering / including varies with place/time/random nature repeating test improves reliability	**(2)** **t**

Question Number	Answer	Acceptable answers	Mark
4(c)(iii)	One relevant idea: (New method) more accurate (1) Hard to measure a small activity (1) Background radiation affects readings (1) Need to find difference of two small quantities (1) Can test smaller samples (1)	ignore better method/results / more reliable difficult to distinguish between the reading and background	**(1) grad**

Total for question 4=10 marks

Question Number	Answer	Acceptable answers	Mark
5(a)(i)	11x 0.4 (substitution) (1) 4.4 (V) (1)	Full marks for correct answer with no calculation	**(2)**

Question Number	Answer	Acceptable answers	Mark
5(a)(ii)	0.6 - 0.4 (A) (1)	0.2 or 1/5 (A)	**(1)**

Question Number	Answer	Acceptable answers	Mark
5(a)(iii)	B		**(1)**

Question Number	Answer	Acceptable answers	Mark
5(b)	An explanation linking: electrons (1) {colliding with / bumping into} ions in the lattice /atoms in the metal (1)	colliding with other electrons If no other marks scored, allow for 1 mark for "electrical energy {transferred/changed} into thermal/heat energy" <u>do not allow</u> energy being created or produced	**(2)**

Question Number		Indicative Content	Mark
QWC	***5(c)**	A explanation including some of the following points Light dependent resistors (LDR) • Resistance changes with light intensity • Bright light , low resistance • No light (dark), high resistance • Low resistance gives high current.(RA) Thermistor • Resistance changes with temperature • Negative temperature coefficient • High temperature, low resistance • Low temperature, high resistance • Low resistance gives high current (RA)	**(6)**
Level	**0**	No rewardable content	
1	**1 - 2**	• a limited explanation linking light affecting LDR AND heat affecting thermistor OR a correct relationship for one device, e.g. thermistors change resistance when the temperature changes and LDRs change resistance when it gets dark OR the {resistance decreases/ current increases} of a LDR when the light gets brighter • the answer communicates ideas using simple language and uses limited scientific terminology • spelling, punctuation and grammar are used with limited accuracy	
2	**3 - 4**	• a simple explanation correctly linking the temperature and light with resistance or current for both devices OR a correct relationship for one device with a link to the way this affects the current and resistance. e.g. the resistance of a LDR increases when the light gets dimmer and when the temperature lowers the resistance of a thermistor increases OR the resistance of a LDR decreases when the light gets brighter and this increases the current • the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately • spelling, punctuation and grammar are used with some accuracy	
3	**5 - 6**	• a detailed explanation including the qualitative relationships for both devices and a link to the way resistance change affects the current in BOTH of them, e.g. the resistance of a LDR is less when the light gets brighter which increases the current. When the temperature lowers the resistance of a thermistor increases. This means that the current will decrease as the thermistor cools down. • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors	

Total for question 5 = 12 marks

Question Number	Answer	Acceptable answers	Mark
6(a)(i)	Any **two** of: Gamma is a wave (1) Alpha is a helium nucleus (1) Alpha is charged (1) Alpha has a mass (1) Gamma penetrates further/ highly (1) Gamma weakly ionising (1) Gamma travels faster (1)	Reverse arguments em radiation Gamma has no charge Gamma has no mass examples of penetrating power alpha highly ionising ignore vague comments eg stronger Ignore uses and dangers	**(2)**

Question Number	Answer	Acceptable answers	Mark
6(b)(i)	D		**(1)**

Question Number	Answer	Acceptable answers	Mark
6(b)(ii)	B		**(1)**

Question Number	Answer	Acceptable answers	Mark
6(c)	An explanation linking: electron(s) (1) is/are lost/gained (1)	 do not allow positive electron knocked off / removed/ released	**(2)**

Question Number		Indicative Content	Mark
QWC	***6(d)**	An explanation including some of the following points: <u>Radiation from the front of the lens</u> Alpha particles absorbed by glass Beta particles do not penetrate glass Gamma rays pass through glass Background radiation varies There is a large difference in size between front and back counts Radiation detected is gamma rays only <u>Radiation from side of the lens</u> Alpha particles cannot penetrate aluminium Beta particles are absorbed by aluminium Gamma rays pass through aluminium There is a small/no difference in size between front and side counts Perhaps a few gamma rays absorbed by aluminium Background radiation varies Likely to contain gamma rays only May be different from front count due to random nature of emissions <u>Radiation from the back of the lens</u> Alpha particles absorbed by coating and/or glass Beta particles are emitted the from rear surface Gamma rays emitted from radioactive glass There is a large difference in size between front and back counts Background radiation varies Radiation is both beta particles and gamma rays Difference between front and back counts due to beta particles	**(6)**
Level	**0**	No rewardable content	
1	**1 - 2**	• a limited explanation mentioning two unrelated points, but without linking them properly, e.g. beta particles are stopped by thick aluminium, there is most radiation behind the lens • the answer communicates ideas using simple language and uses limited scientific terminology • spelling, punctuation and grammar are used with limited accuracy	
2	**3 - 4**	• a simple explanation mentioning some points with an appropriate linkage to **one** of the readings e.g. no beta particles escape forwards because the glass absorbs them OR only gamma rays escape to the side because the aluminium stops alpha and beta particles • the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately • spelling, punctuation and grammar are used with some accuracy	

3	**5 - 6**	• a detailed explanation mentioning some of the points with appropriate linkage to a comparison of at least **two** of the readings e.g. no beta particles escape forwards because the glass absorbs them, but beta particles can escape backwards so that count is higher OR only gamma rays can get through the glass and the thick aluminium, so the front and side counts are about the same • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors

Total for question 6 = 12 marks

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Edexcel GCSE

Physics/Additional Science

Unit P2: Physics for Your Future

Higher Tier

Thursday 8 November 2012 – Morning
Time: 1 hour

Paper Reference
5PH2H/01

You must have:
Calculator, ruler

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided
  – *there may be more space than you need.*

Information

- The total mark for this paper is 60.
- The marks for **each** question are shown in brackets
  – *use this as a guide as to how much time to spend on each question.*
- Questions labelled with an **asterisk** (*) are ones where the quality of your written communication will be assessed
  – *you should take particular care with your spelling, punctuation and grammar, as well as the clarity of expression, on these questions.*

Advice

- Read each question carefully before you start to answer it.
- Keep an eye on the time.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

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FORMULAE

You may find the following formulae useful.

charge = current × time $Q = I \times t$

potential difference = current × resistance $V = I \times R$

electrical power = current × potential difference $P = I \times V$

energy transferred = current × potential difference × time $E = I \times V \times t$

$$\text{speed} = \frac{\text{distance}}{\text{time}}$$

$$\text{acceleration} = \frac{\text{change in velocity}}{\text{time taken}} \qquad a = \frac{(v-u)}{t}$$

force = mass × acceleration $F = m \times a$

weight = mass × gravitational field strength $W = m \times g$

momentum = mass × velocity

$$\text{force} = \frac{\text{change in momentum}}{\text{time}} \qquad F = \frac{(mv-mu)}{t}$$

work done = force × distance moved in the direction of the force $E = F \times d$

$$\text{power} = \frac{\text{work done}}{\text{time taken}} \qquad P = \frac{E}{t}$$

gravitational potential energy = mass × gravitational field strength × vertical height

$\text{GPE} = m \times g \times h$

kinetic energy = ½ × mass × velocity^2 $\text{KE} = ½ \times m \times v^2$

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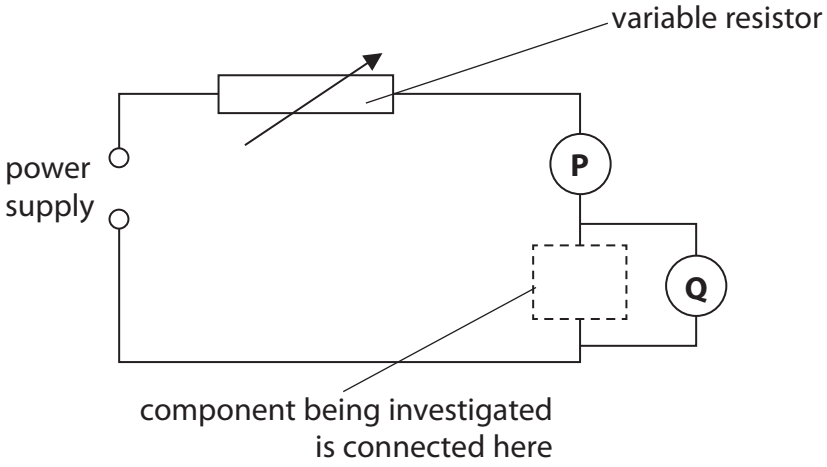
Questions begin on next page.

Answer ALL questions.

Some questions must be answered with a cross in a box ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

Electrical resistance

1 (a) Some students investigate the electrical resistance of different components using this circuit.



(i) Which row of the table is correct for both meters **P** and **Q**?

Put a cross (☒) in the box next to your answer.

(1)

	meter P is	meter Q is
☒ **A**	an ammeter	an ammeter
☒ **B**	an ammeter	a voltmeter
☒ **C**	a voltmeter	a voltmeter
☒ **D**	a voltmeter	an ammeter

(ii) One of the components being investigated is a 12 ohm resistor. When it is in the circuit, the ammeter reading is 0.50 A.

Calculate the voltmeter reading.

(2)

voltmeter reading = ... V

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(iii) The students reduce the resistance of the variable resistor.
State what happens to the readings on each of the meters **P** and **Q**.

(2)

.....

.....

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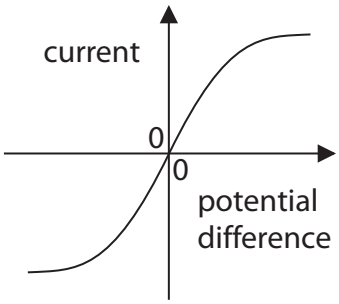
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(iv) The students then reduce the voltage of the power supply.
State what happens to the current in the circuit.

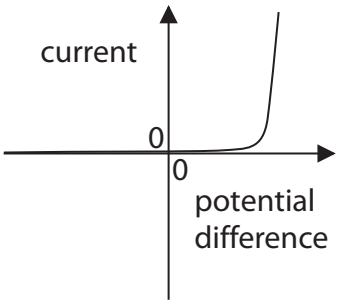
(1)

.....

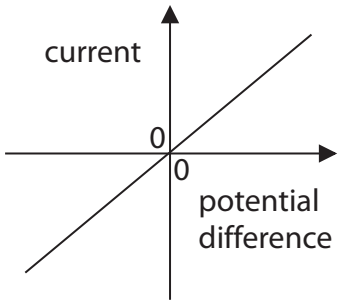
(b) The graphs **L**, **M** and **N** each show how the current in a component varies with the potential difference (voltage) across that component.



L



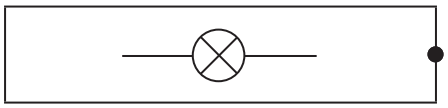
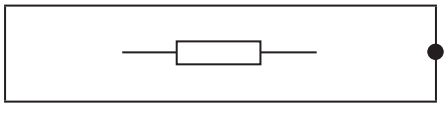
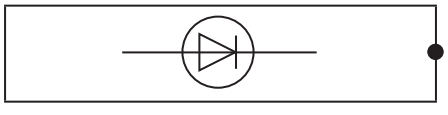
M



N

Match each graph with the symbol of the component to which it applies.
Draw lines to connect each symbol with its correct graph.

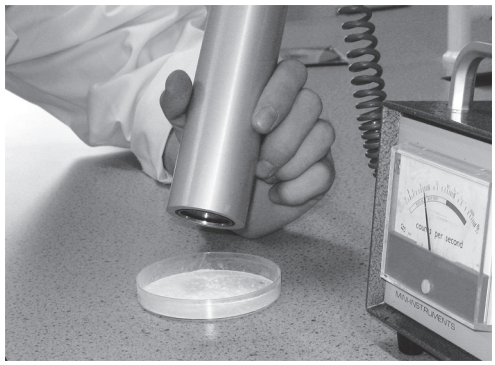
(2)

component symbol	**graph**
	graph **L**
	graph **M**
	graph **N**

(Total for Question 1 = 8 marks)

Measuring radioactivity

2 (a) A scientist uses a Geiger counter to measure the radioactivity of a sample.



She writes down the results in her notebook.
The Geiger counter gives a count rate of 120 counts per minute.
The average background radiation in her laboratory is 10 counts per minute.

(i) What should she write down for the count rate of this sample?

Put a cross (☒) in the box next to your answer.

(1)

☒ **A** 12 counts per minute

☒ **B** 110 counts per minute

☒ **C** 130 counts per minute

☒ **D** 1200 counts per minute

(ii) Name **one** source of background radiation.

(1)

.....

(iii) Explain why some people are exposed to more background radiation than others.

(2)

.....

.....

.....

.....

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(iv) Complete the sentence by putting a cross (☒) in the box next to your answer.

The recommended safe limit for exposure to radiation has been reduced over the last 80 years.
This is because now

(1)

☒ **A** better instruments allow scientists to make measurements more quickly

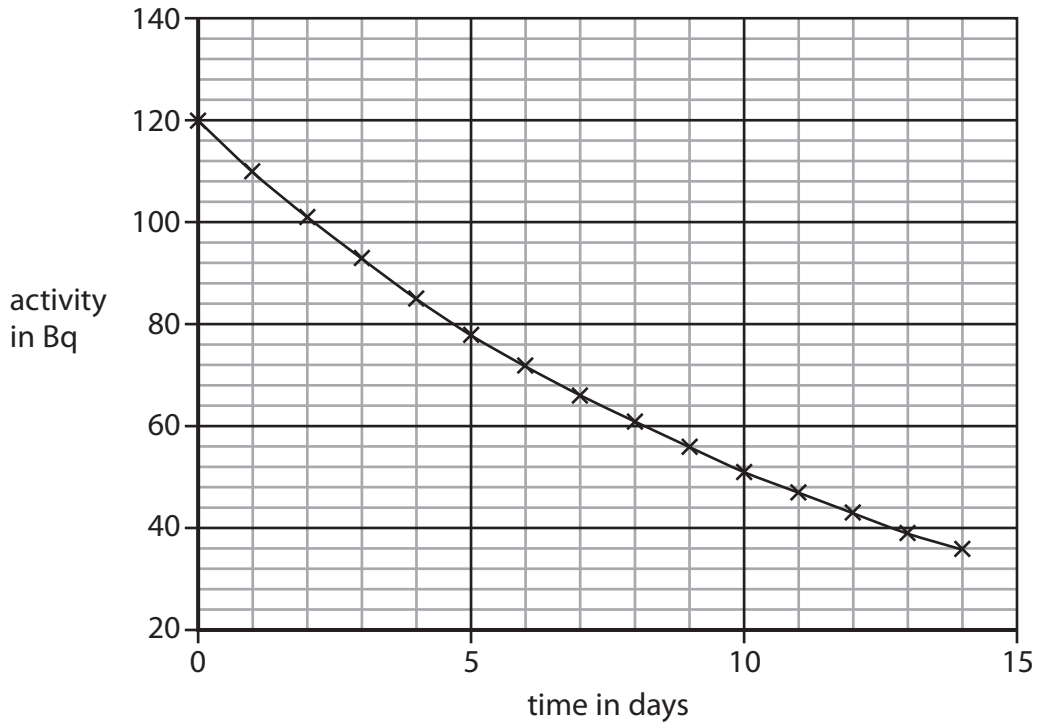
☒ **B** global warming has increased the rate of decay of radioactive materials

☒ **C** humans release more radioactive materials into the environment

☒ **D** scientists have a better understanding of the dangers of radiation

(b) After the accident at the Fukushima nuclear plant in Japan, some drinking water became contaminated with radioactive iodine-131.

The graph shows how the activity of a sample of iodine-131 changes over two weeks.



(i) Use the graph to estimate the half-life of the iodine-131.
Show your working clearly.

(2)

half-life = ... days

(ii) The recommended safe limit for a sample of this size is 100 Bq.

How long did it take for the activity of the sample to decay until it was below the safe limit?

(1)

time taken = ... days

(iii) When iodine-131 decays, it emits beta radiation.

State one possible danger to health from exposure to beta radiation.

(1)

.....

.....

(Total for Question 2 = 9 marks)

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Nuclear power

3 (a) Two isotopes of uranium are U-235 and U-238.

Here are the symbols of the nuclei of these isotopes.

$$^{235}_{92}U \quad \text{and} \quad ^{238}_{92}U$$

(i) Complete the sentence by putting a cross (☒) in the box next to your answer.
The U-235 isotope has

(1)

☒ **A** the same number of neutrons as U-238

☒ **B** the same number of protons as U-238

☒ **C** more neutrons than U-238

☒ **D** more protons than U-238

(ii) U-235 is radioactive.
When it decays, it releases an alpha particle.

Describe an alpha particle.

(2)

(b) U-235 can also be made to undergo fission.

Describe what happens during nuclear fission.

(4)

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(c) Fission is used in nuclear reactors.
Graphite is used as a moderator in nuclear reactors.

Explain why a moderator is needed in a nuclear reactor.

(2)

.....

.....

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(Total for Question 3 = 9 marks)

Static electricity

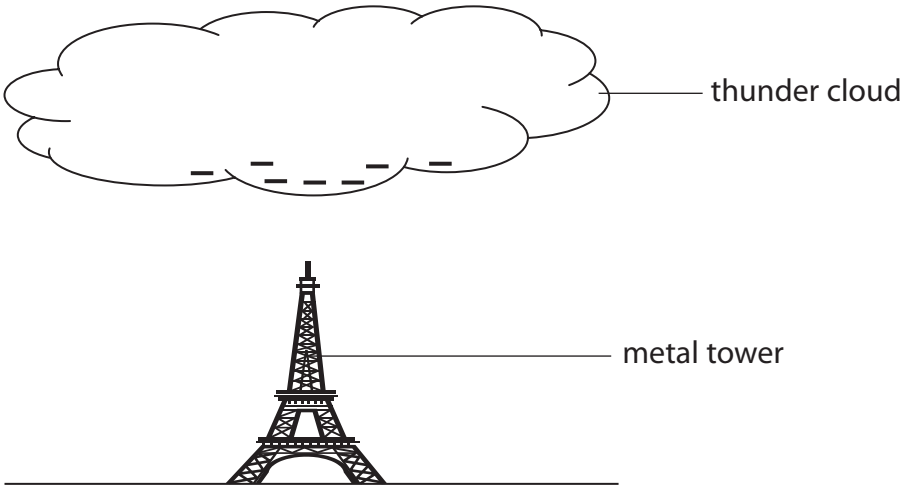
4 (a) A lightning strike on a metal tower can be described as follows.

In the cloud.

A thunder cloud contains moving ice particles.

Some of these ice particles are negatively charged and some are positively charged.

The negatively charged particles move to the bottom of the cloud.



Not to scale

When the charged cloud is over the metal tower.

A charge builds up on the top of the metal tower as the cloud passes over.

During the lightning flash.

Eventually a flash of lightning travels between the cloud and the tower.

(i) Which row of this table is correct when the cloud is over the top of the tower before the lightning flash?

Put a cross (☒) in the box next to your answer.

(1)

	charge on top of the cloud is	charge on top of the tower is
☒ **A**	negative	negative
☒ **B**	negative	positive
☒ **C**	positive	positive
☒ **D**	positive	negative

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(ii) Here are **four** statements.
Three of these are a reason for what happens at each stage.

1: opposite charges attract each other
2: like charges repel each other
3: ice particles gain electrons
4: ice particles lose protons

Choose the best reason for each of the stages listed below by writing its number in the box next to the description of what happens.
One has been done for you.
A reason can only be used **once**.

(2)

in the cloud	reason
the bottom of the cloud becomes negatively charged	

when the charged cloud is over the metal tower	reason
the top of the tower becomes charged	

during the lightning flash	reason
electrons move through the air	1

(iii) Explain what happens to the charge on the metal tower as a result of the lightning flash.

(2)

.....

.....

.....

.....

(b) During the lightning flash a total charge of 52 C flows.
The average current is 2600 A.

Calculate the duration of the flash in seconds.

(3)

duration of flash = ... s

(c) When fuel tanks on an aircraft are being filled, the aircraft, fuel pipes and tanker are connected by a metal wire to the ground.

Explain why this greatly reduces the chance of a spark.

(2)

.....

.....

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.....

.....

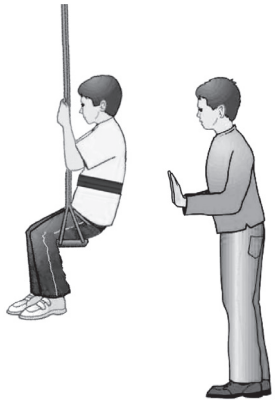
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(Total for Question 4 = 10 marks)

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The swing

5 A child is stationary on a swing.



(a) The child is given a push by his brother to start him swinging.
His brother applies a steady force of 84 N over a distance of 0.25 m.

(i) Calculate the work done by this force.

(2)

work done = ... J

(ii) State how much energy is transferred by this force.

(1)

energy transferred = ... J

(iii) After several more pushes, the child has a kinetic energy of 71 J.

The mass of the child is 27 kg.

Show that the velocity of the child at this point is about 2.3 m/s.

(2)

(iv) Which one of these quantities changes in both size and direction while he is swinging?

Put a cross (☒) in the box next to your answer.

(1)

☒ **A** his gravitational potential energy

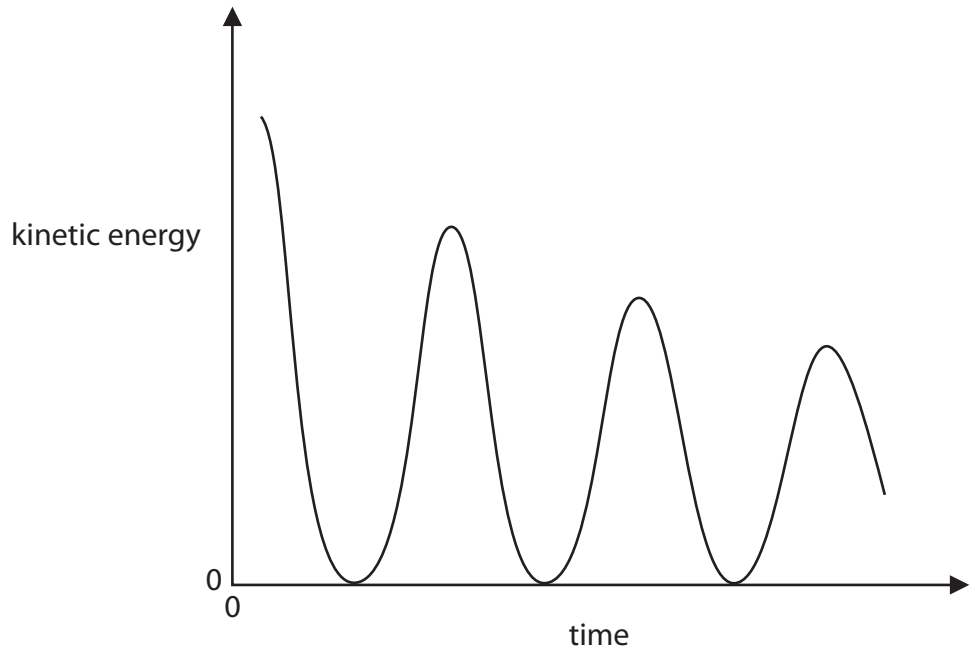
☒ **B** his momentum

☒ **C** the force of gravity acting on him

☒ **D** his kinetic energy

*(b) The brother then stops pushing the child.

The graph shows how the kinetic energy of the child varies over the next few swings.



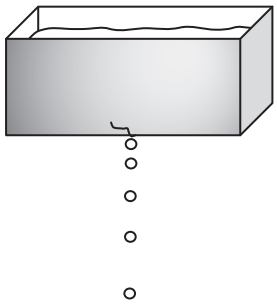
Explain the energy changes during this time.

(6)

(Total for Question 5 = 12 marks)

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6 A water tank drips water.



(a) Scientists could use four quantities to describe the movement of the water drops.
Three of these quantities are vectors.
The other quantity is a scalar.

acceleration	force	mass	velocity

(i) Complete the sentence by putting a cross (☒) in the box next to your answer.

The scalar quantity is

(1)

☒ **A** acceleration

☒ **B** force

☒ **C** mass

☒ **D** velocity

(ii) Complete the following sentence using one of the quantities from the word box above.

(1)

In a vacuum, all bodies falling towards the Earth's surface

have the same ..... .

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(b) The mass of one water drop is 0.000 08 kg.

Calculate its weight.

(gravitational field strength is 10 N/kg)

(2)

weight = ... N

(c) The water drop falls to the ground, 13 m below, in 1.7 s.

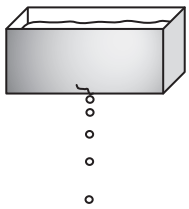
Calculate the average speed of the drop while it is falling.

(2)

average speed = ... m/s

*(d) The tank is a long way above the ground.
It drips at a steady rate.

The first drawing shows water drops which have just left the tank.
The second drawing shows water drops which are near to the ground.



drops leaving the tank



drops near to the ground

Explain why the drops which are near to the ground are an equal distance apart but the drops which have just started to fall are not.

(6)

(Total for Question 6 = 12 marks)

TOTAL FOR PAPER = 60 MARKS

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Mark Scheme (Results)

November 2012

GCSE Physics
5PH2H/01

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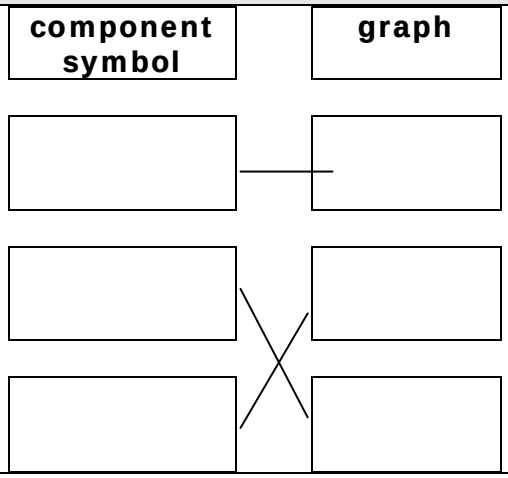
GCSE Physics 5PH2H/01 Mark Scheme – November 2012

Question Number	Answer	Acceptable answers	Mark
1(a)(i)	B		**(1)**

Question Number	Answer	Acceptable answers	Mark
1(a)(ii)	substitution (1) V = 0.5 x 12 evaluation (1) V = 6 (V)	Correct answer with no working shown gains two marks.	**(2)**

Question Number	Answer	Acceptable answers	Mark
1(a)(iii)	• P / ammeter reading would increase. (1) • Q / voltmeter reading would increase (1)	They(both) would increase for two marks	**(2)**

Question Number	Answer	Acceptable answers	Mark
1(a)(iv)	(current/it) would decrease (1)	smaller/lower/reduce/less Ignore slowing down	**(1)**

Question Number	Answer	Acceptable answers	Mark
1(b)		All three lines correct for 2 marks One or two lines correct for 1 mark More than one line against any box cannot score more than 1 mark in total.	**(2)**

Question Number	Answer	Acceptable answers	Mark
2(a) (i)	B		**(1)**

Question Number	Answer	Acceptable answers	Mark
2(a) (ii)	Any one of the following Rocks Food Radon gas Cosmic rays Own bodies Fall-out Sun/stars (1)	Plausible named food such as coffee, brazil nut, bananas Space Specified medical/industrial use of x-rays Ignore smoke alarms, power stations (in normal use)	**(1)**

Question Number	Answer	Acceptable answers	Mark
2(a) (iii)	An explanation linking • personal circumstances such as geographical location nature of their work lifestyle (1) • the consequences such as radiation from radon gas/particular rocks/fall-out (eg Chernobyl) greater exposure to x-rays greater exposure to cosmic rays (1)		**(2)**

Question Number	Answer	Acceptable answers	Mark
2(a) (iv)	D		**(1)**

Question Number	Answer	Acceptable answers	Mark
2(b) (i)	From the graph Time taken to fall (from 120 to) 60 (1) = 8 days (1)	Any other suitable pair of readings from graph 8.1, 8.2 Full marks for correct answer even if no working is evident	**(2)**

Question Number	Answer	Acceptable answers	Mark
2(b) (ii)	2.2 (days) (1)	between 2.0 and 2.5 2	**(1)**

Question Number	Answer	Acceptable answers	Mark
2(b) (iii)	Any one of the following: • Mutation of dna • Ionisation of cells • (Increases risk of) cancer (1)	damage / mutate cells	**(1)**

Question Number	Answer	Acceptable answers	Mark
3(a)(i)	B		**(1)**

Question Number	Answer	Acceptable answers	Mark
3(a) (ii)	(equivalent to a) helium nucleus	Two protons and two neutrons for 2 marks helium/mass of 4 for 1 mark charge of +2 for 1 mark correct statement of any property for 1 mark	**(2)**

Question Number	Answer	Acceptable answers	Mark
3 (b)	A description to include any four of the following • neutron • is captured by a U-235 nucleus • nucleus (is) unstable • nucleus splits • into 2 daughter nuclei (of similar size) • (2 or more) neutrons are released • energy is released	• collides with /absorbed by (U-235) nucleus • metastable • named isotopes	**(4)**

Question Number	Answer	Acceptable answers	Mark
3 (c)	An explanation linking • moderator slows down (absorbs energy from) neutrons • more likely to be captured /cause fission (if it collides with a U-235 nuclei)	Reverse argument	**(2)**

Question Number	Answer	Acceptable answers	Mark
4 (a)	C		**(1)**

Question Number	Answer	Acceptable answers	Mark
4 a(ii)	In the cloud : reason 3 (1) At the tower: reason 2 (1)		**(2)**

Question Number	Answer	Acceptable answers	Mark
4 a(iii)	An explanation linking • the charge was neutralised (1) • by a transfer/flow of electrons (1)	Discharged/ becomes zero gained electrons / negative charge	**(2)**

Question Number	Answer	Acceptable answers	Mark
4 (b)	substitution (1) 52 = 2600 x time transposition time = 52 / 2600 (1) evaluation 0.02 (s) (1)	T = Q / I Full marks for correct answer even if no working is evident	**(3)**

Question Number	Answer	Acceptable answers	Mark
4 (c)	An explanation linking two of the following • charges flow through the metal wire • to the ground / earth • preventing build-up of (excess) charge (2)	mention of earthing discharged / neutral all objects at the same potential	**(2)**

Question Number	Answer	Acceptable answers	Mark
5(a)(i)	substitution (1) work done = 84 x 0.25 evaluation (1) 21(J)	Full marks for correct answer even if no working is evident	**(2)**

Question Number	Answer	Acceptable answers	Mark
5(a)(ii)	21 J	Ecf from (a)(i)	**(1)**

Question Number	Answer	Acceptable answers	Mark
5(a)(iii)	substitution (1) KE = ½ x 27 x $(2.3)^2$ evaluation (1) = 71.4 (which is approx 71)	V=2.29 gains two marks Reverse argument which shows that V = √5.3 gains two marks	**(2)**

Question Number	Answer	Acceptable answers	Mark
5 (a)(iv)	B		**(1)**

Question Number		Indicative Content	Mark
QWC	***5(b)**	An explanation linking some of the following points • kinetic energy varies during swing • kinetic energy maximum at bottom of swing • kinetic energy minimum at top of swing • gravitational potential energy(gpe) varies during swing • gpe maximum at top of swing • gpe minimum at bottom of swing • (continuous) interchange of KE and gpe • total amount of energy is constant during one swing • over a number of swings max KE and max PE decreases • energy is dissipated/'lost' to surroundings • because of air resistance / friction • amplitude/size of swings decrease (as energy 'lost' to surroundings) ignore references to momentum	**(6)**
Level	**Mark**	**Descriptor**	
	0	No rewardable content	
1	**1 - 2**	• a limited explanation which states some facts e.g. (max) Kinetic energy decreases over time. KE will transfer to GPE. **or** KE increases and decreases over one swing. The height which the swing reaches gets less over time. • the answer communicates ideas using simple language and uses limited scientific terminology • spelling, punctuation and grammar are used with limited accuracy	
2	**3 - 4**	• a simple explanation with links between facts; either over one period of oscillation or over several periods of oscillations. Kinetic energy decreases as he gets higher and the GPE increases. There is a continuous interchange of KE and gpe as he swings. **or** KE is gradually transferred to heat so swing rises to a slightly lower height each time. • the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately • spelling, punctuation and grammar are used with some accuracy	
3	**5 - 6**	• a detailed explanation with links between facts over one period of oscillation **and** over several periods of oscillations e.g. kinetic energy is at a maximum at bottom of swing There is a continuous interchange of KE and gpe. KE (and gpe) reduce over a number of swings as energy is dissipated to the surroundings due to friction. • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors	

Question Number	Answer	Acceptable answers	Mark
6 (a) (i)	C		**(1)**

Question Number	Answer	Acceptable answers	Mark
6 (a) (ii)	acceleration	Recognisable mis-spellings More than one word written scores zero EXCEPT for the phrase Acceleration due to gravity which scores 1 mark	**(1)**

Question Number	Answer	Acceptable answers	Mark
6 (b)	Substitution weight = 0.00008 x 10 (1) evaluation 0.0008 (N) (1)	 8×10^{-4} 1/1250	**(2)**

Question Number	Answer	Acceptable answers	Mark
6 (c)	Substitution speed = 13 / 1.7 (1) evaluation 7.6 (m/s) (1)	An answer which rounds to 7.6 eg 7.647 7.65 7.7	**(2)**

Question Number		Indicative Content	Mark
QWC	***6(d)**	A explanation including some of the following points • drops near the top are accelerating • due to force of gravity • travel a greater distance in given time • there is air resistance on the drops as they fall • this increases with velocity • resultant force is downward • this reduces resultant force • eventually resultant force is zero • drops have reached terminal/ maximum velocity • drops near bottom are all travelling at terminal velocity • so travel same distance in given time	**(6)**
Level	**0**	No rewardable content	
1	**1 - 2**	• a limited explanation such as one which correctly addresses either why the drops at the bottom are evenly spaced or why the drops at the top are not e.g. drops at bottom are all going at the same speed OR drops at top are speeding up • the answer communicates ideas using simple language and uses limited scientific terminology • spelling, punctuation and grammar are used with limited accuracy	
2	**3 - 4**	• a simple explanation such as a correct comparison of the motion of the drops at top and bottom e.g. drops at bottom are travelling at terminal velocity whereas drops at top are still accelerating. **Or** a complete explanation of motion at either top or bottom e.g.at the bottom, air resistance and gravity forces are balanced so they travel at constant speed • the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately • spelling, punctuation and grammar are used with some accuracy	
3	**5 - 6**	• a detailed explanation such as one which explains why the motion of the drops at top and bottom are different e.g. The drops were initially accelerating due to a resultant force downwards. The acceleration decreased as they fell and eventually reached zero. With no acceleration their velocity was constant and so equal distance travelled in given time at the bottom. • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors	

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Physics/Additional Science

Unit 2: Physics for Your Future

Higher Tier

Thursday 24 May 2012 – Morning **Time: 1 hour**	Paper Reference **5PH2H/01**

You must have:
Calculator, ruler

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided
  – *there may be more space than you need.*

Information

- The total mark for this paper is 60.
- The marks for **each** question are shown in brackets
  – *use this as a guide as to how much time to spend on each question.*
- Questions labelled with an **asterisk** (*) are ones where the quality of your written communication will be assessed
  – *you should take particular care with your spelling, punctuation and grammar, as well as the clarity of expression, on these questions.*

Advice

- Read each question carefully before you start to answer it.
- Keep an eye on the time.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

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FORMULAE

You may find the following formulae useful

charge = current × time $Q = I \times t$

potential difference = current × resistance $V = I \times R$

electrical power = current × potential difference $P = I \times V$

energy transferred = current × potential difference × time $E = I \times V \times t$

$$\text{speed} = \frac{\text{distance}}{\text{time}}$$

$$\text{acceleration} = \frac{\text{change in velocity}}{\text{time taken}} \qquad a = \frac{(v-u)}{t}$$

force = mass × acceleration $F = m \times a$

weight = mass × gravitational field strength $W = m \times g$

momentum = mass × velocity $P = m \times v$

$$\text{force} = \frac{\text{change in momentum}}{\text{time}} \qquad F = \frac{(mv-mu)}{t}$$

work done = force × distance moved in the direction of the force $E = F \times d$

$$\text{power} = \frac{\text{work done}}{\text{time taken}} \qquad P = \frac{E}{t}$$

gravitational potential energy = mass × gravitational field strength × vertical height

$\text{GPE} = m \times g \times h$

kinetic energy = ½ × mass × velocity^2 $\text{KE} = ½ \times m \times v^2$

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Questions begin on next page.

Answer ALL questions

Some questions must be answered with a cross in a box ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

Weight lifting

1 The picture shows a weight lifter.



(a) In one lift, he does 5040 J of work against gravity.

(i) One lift takes 4 seconds.

Complete the sentence by putting a cross (☒) in a box next to your answer.

The power used to lift the weight is

(1)

☒ **A** 1260 W

☒ **B** 2016 W

☒ **C** 12600 W

☒ **D** 20160 W

(ii) The weight he lifts has a mass of 240 kg.
Gravitational Field Strength = 10 N/Kg
The energy gained by the mass is equal to the work done when lifting it.

Calculate the height he lifts this mass.

(3)

height = ... m

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(b) After lifting the mass, he must hold it steady for 3 seconds.
During this time, he does no work on the mass.

State why he does no work on the mass in this time.

(1)

.....

.....

(c) After the 3 seconds, the weight lifter drops the mass.
The velocity of the mass just before it hits the floor is 6.4 m/s.

Calculate the momentum of the mass just before it hits the floor.
State the unit.

(3)

momentum = ... unit = ...

(Total for Question 1 = 8 marks)

Electrostatics

2 A light, polystyrene ball is coated with a thin layer of metal.
Diagram 1 shows the ball on a metal plate.
In diagram 2, the plate has been charged and the ball is rising to hit the earthed lid.

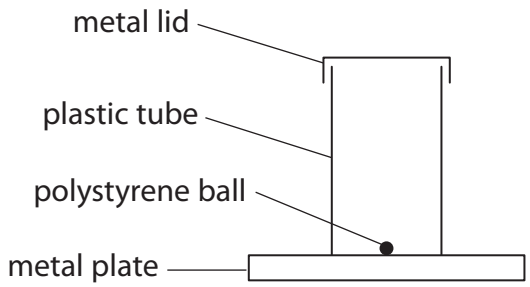


diagram 1

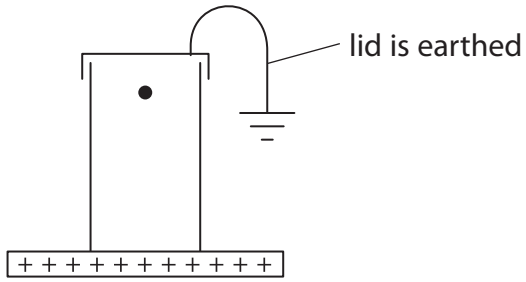


diagram 2

(a) (i) State the sign of the charge on the ball as it moves upwards.

(1)

.....

(ii) Explain why the ball moves upwards.

(2)

.....

.....

.....

.....

(b) The ball discharges when it hits the earthed lid.

Explain how the ball loses its charge.

(2)

.....

.....

.....

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(c) The ball continues to move up and down between the charged plate and the earthed lid.

Explain why the ball continues to move up and down.

(2)

.....

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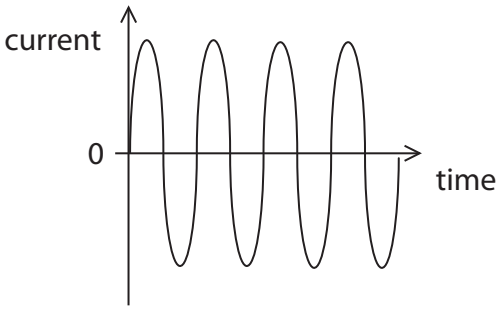
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(d) The current in the wire connected to earth may be described by a graph.

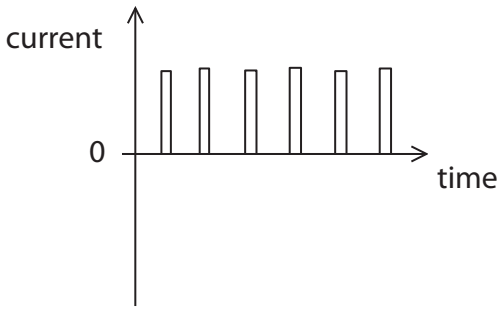
Which of these graphs best shows the current in the earth wire?

Put a cross (☒) in the box next to your answer.

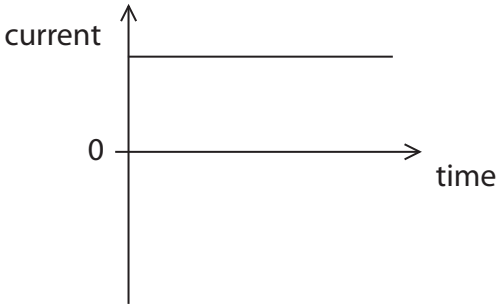
(1)



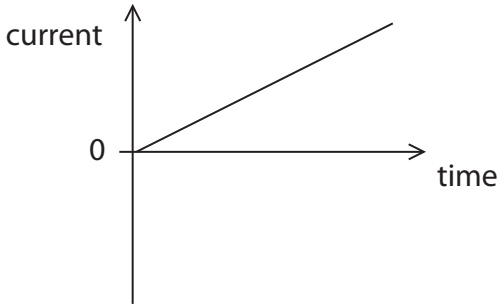
☒ **A**



☒ **B**



☒ **C**



☒ **D**

(Total for Question 2 = 8 marks)

Heating a greenhouse

3 A greenhouse contains an electric heater.



(a) The heater makes good use of the heating effect of an electric current.

Give an example of a device where the heating effect of an electric current is a **disadvantage**.

(1)

.....

.....

(b) This label is attached to the heater.

230 V	500 W
50 Hz	

Use this information to calculate the expected current in the heater.

(3)

current = ... A

(c) Complete the sentence by putting a cross (☒) in the box next to your answer.

The potential difference across the heater can be measured either in volts or in

(1)

- ☒ **A** amps per ohm
- ☒ **B** amps per joule
- ☒ **C** coulombs per ohm
- ☒ **D** joules per coulomb

(d) When a charge flows in a resistor, the resistor becomes hot.

Explain why the resistor becomes hot.

(2)

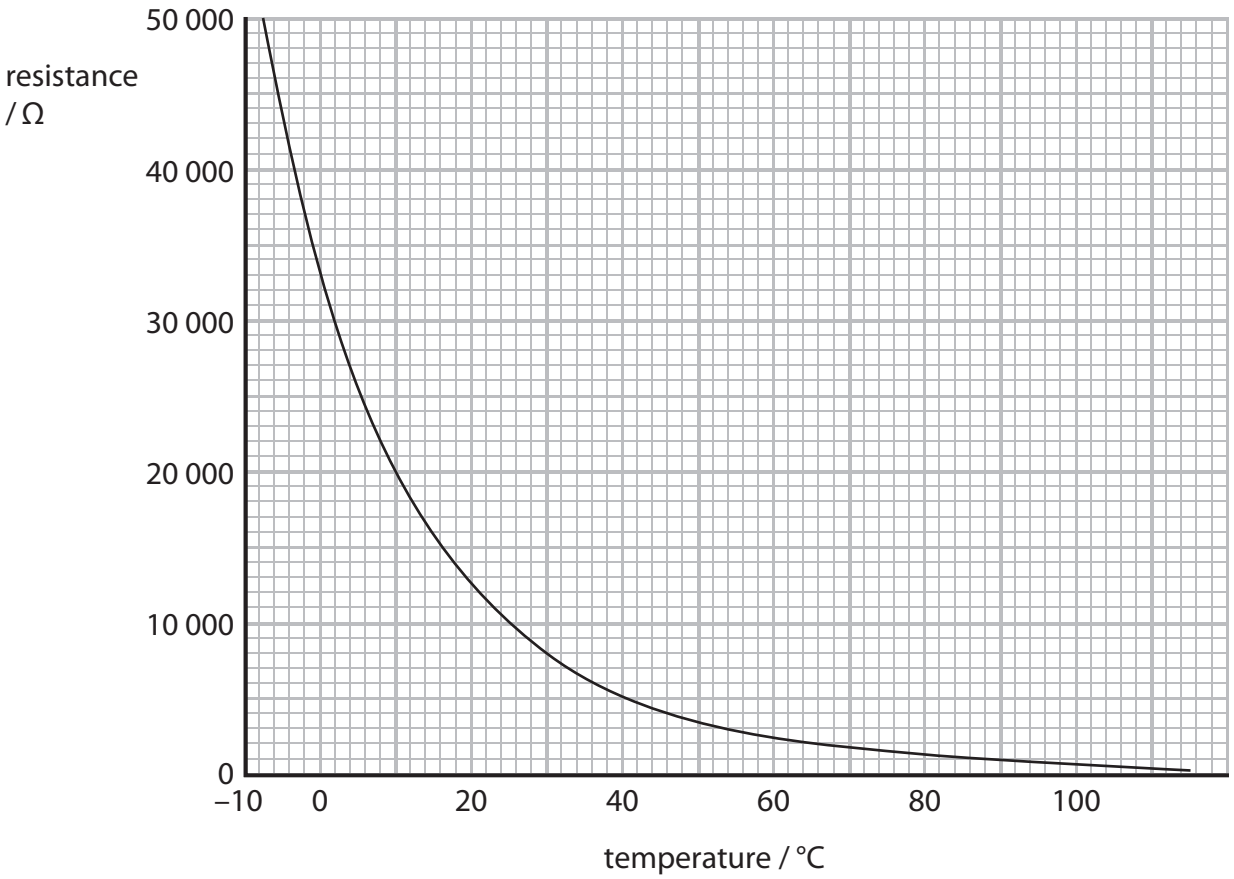
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(e) A thermistor is used to control the heater.
The graph shows how the resistance of the thermistor changes with temperature.



When the temperature is 10 °C, the current in the thermistor is 0.60 mA.

Calculate the potential difference across the thermistor at 10 °C.

(3)

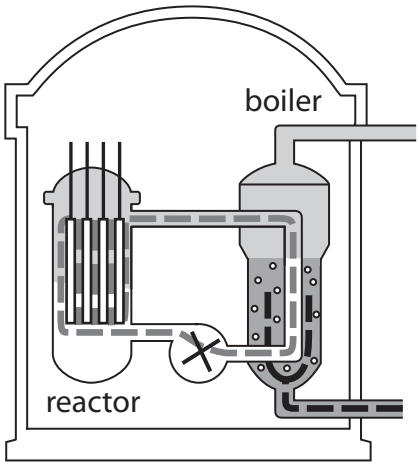
potential difference = ... V

(Total for Question 3 = 10 marks)

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Nuclear energy

4 Electricity is generated in a nuclear power station.
The diagram shows the first stages in this process.



(a) The thermal energy released in the reactor is used to generate steam.

Describe how the steam is used to generate electricity.

(2)

.....

.....

.....

.....

(b) Energy is released by a nuclear chain reaction.

Describe how the fission of a uranium-235 nucleus can start off a chain reaction.
You may draw a diagram to help with your answer.

(3)

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(c) One of the products of the fission of uranium-235 is barium-142.

Which of these could be a product of the same reaction?

Put a cross (☒) in the box next to your answer.

(1)

- ☒ **A** krypton-91
- ☒ **B** krypton-95
- ☒ **C** krypton-98
- ☒ **D** krypton-100

(d) Barium-142 emits beta radiation.
Beta radiation is ionising.

Explain what happens when beta radiation ionises.

(2)

(e) A fusion reaction does not have radioactive products.
However, it needs large amounts of energy to make it happen.

Explain why large amounts of energy are needed to make a fusion reaction happen.

(2)

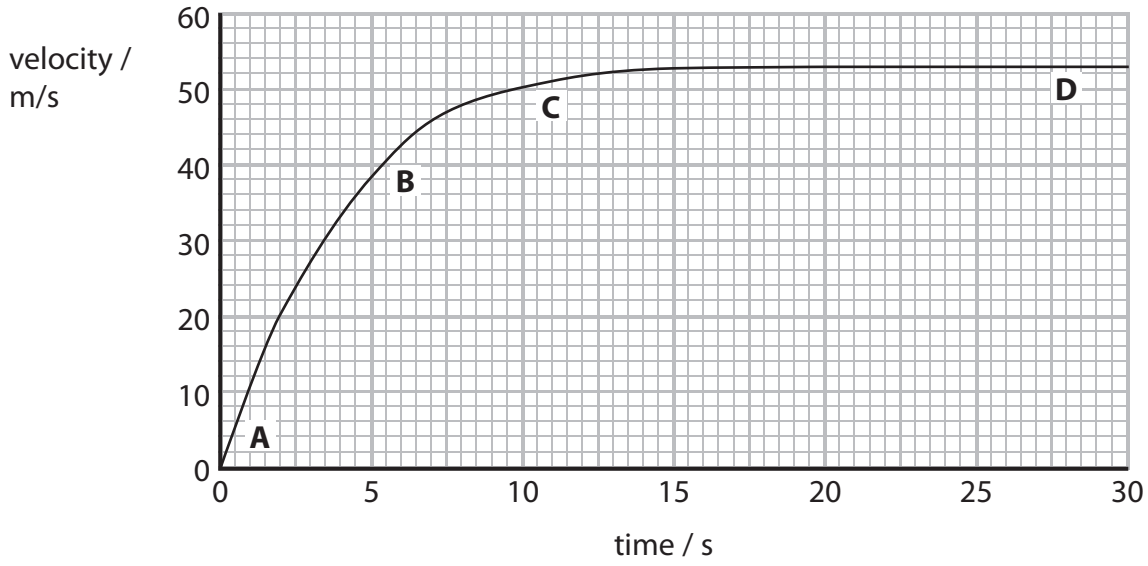
(Total for Question 4 = 10 marks)

Parachuting

5 Christine is a free-fall parachutist.



This is a velocity–time graph for her jump.



(a) Complete the sentence by putting a cross (☒) in a box next to your answer.

On the graph, the greatest acceleration is at

(1)

☒ **A**

☒ **B**

☒ **C**

☒ **D**

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(b) Estimate how far Christine falls in the first 2 s.

(3)

Christine falls = ... m

(c) Explain the difference between velocity and speed.

(2)

.....

.....

.....

.....

*(d) The graph shows how Christine's velocity changes from the time she leaves the plane until she reaches terminal velocity.

Explain, in terms of forces, why her velocity changes as shown in the graph.

(6)

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(Total for Question 5 = 12 marks)

Radioactivity and health

6 (a) Radioactive materials can be a risk to health.
Some food contains radioactive material.

Explain why people can eat this food without serious risk.

(2)

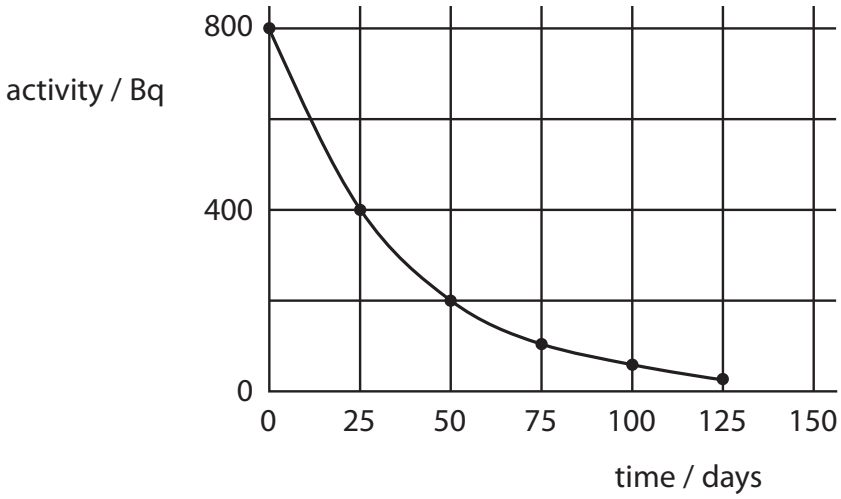
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(b) A radioactive material can be used to help diagnose heart disease.
The graph shows the decay curve for this material.



(i) A scientist measures the activity of a sample of this material as 400 Bq.
Some time later, he measures the activity as 100 Bq.

Put a cross (☒) in the box next to your answer.

The time between the two measurements is about

(1)

☒ **A** 25 days

☒ **B** 50 days

☒ **C** 75 days

☒ **D** 100 days

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(ii) Estimate the activity that should appear on the graph for a time of 150 days.

(1)

activity at 150 days = ... Bq

(c) Half-life is an important factor to consider when choosing isotopes for medical treatments.

Explain what **half-life** means.

(2)

.....

.....

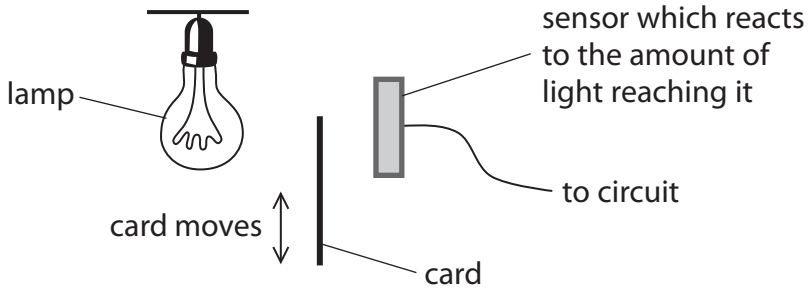
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*(d) A teacher decides to model how a machine checks the level of the liquid in medicine bottles.
The machine uses a radioactive source to sound an alarm when the level of liquid becomes too low.

He sets up the arrangement shown.



The piece of card can be moved up and down between the lamp and the detector.
Each part of the teacher's arrangement corresponds to a part of the machine.

By comparing the parts of the teacher's arrangement to the parts of the machine, discuss how effective this model is.

(6)

(Total for Question 6 = 12 marks)

TOTAL FOR PAPER = 60 MARKS

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Mark Scheme (Results)

Summer 2012

GCSE Physics
5PH2H/01

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GCSE Physics 5PH2H/01 Mark Scheme – Summer 2012

Question Number	Answer	Acceptable answers	Mark
1(a)(i)	**A** 1260 W		**(1)**

Question Number	Answer	Acceptable answers	Mark
1(a)(ii)	substitution (1) 5040 = 240 × 10 × height transposition (1) height = $\frac{5040}{240 \times 10}$ evaluation (1) 2.1 (m)	substitution and transposition in either order give full marks for correct answer, no working	**(3)**

Question Number	Answer	Acceptable answers	Mark
1(b)	no movement (in direction of force) / (work done=) weight x 0 = 0	stationary it is not changing height is in same position ignore ref to terminal velocity, force and acceleration	**(1)**

Question Number	Answer	Acceptable answers	Mark
1(c)	substitution (1) 240 × 6.4 evaluation (1) 1500 Unit (1) kg m/s independent mark	1536 give (2) marks for correct answer, no working Ns	**(3)**

Question Number	Answer	Acceptable answers	Mark
2(a)(i)	positive / + /plus /+ve /positively (charged)	accept poor spelling of positive	**(1)**

Question Number	Answer	Acceptable answers	Mark
2(a)(ii)	An explanation linking **two** from the following points • repulsion / repels (1) • (because) same charge (1) • (force) greater than gravity (1)	independent mark positive charges repel each other (2) both positive so repel(2) positive ball attracted to negative lid (2)	**(2)**

Question Number	Answer	Acceptable answers	Mark
2(b)	An explanation linking the following points • electrons move (1) • from ground to lid (1)	negative charge moves to neutralise positives	**(2)**

Question Number	Answer	Acceptable answers	Mark
2(c)	An explanation linking the following points • discharged /earthed so falls(1) • charged again/at plate so rises/repels (1)	pulled down by gravity reached the plate and process repeats ignore direction of charge flow – already assessed	**(2)**

Question Number	Answer	Acceptable answers	Mark
2(d)	**B**		**(1)**

Question Number	Answer	Acceptable answers	Mark
3(a)	Any **one** from the following points • (overheating) in a computer (1) • (waste heat) in a light bulb (1) • (sparks/heat) in an electric motor (1)	**Note:** any applicable example where dissipation of thermal energy is a clear disadvantage (charge flowing) in a resistor	**(1)**

Question Number	Answer	Acceptable answers	Mark
3(b)	substitution (1) 500 = I x 230 transposition (1) 500/230 evaluation (1) 2.2 (A)	substitution and transposition in either order 2.17 (A) / 2 (A) give full marks for correct answer, no working	**(3)**

Question Number	Answer	Acceptable answers	Mark
3(c)	**D** joules per coulomb		**(1)**

Question Number	Answer	Acceptable answers	Mark
3(d)	An explanation linking **two** of the following points • electron collision (1) • (in the/and the) lattice (1)	allow hit, bump into for collide atoms/electrons/molecules/ions not between atoms	**(2)**

Question Number	Answer	Acceptable answers	Mark
3(e)	(Resistance =) 20 000 Ω (from graph) (1) substitution (1) 0.0006 x 20 000 evaluation (1) 12 (V)	ecf if clear misread of R from graph ignore powers of ten until evaluation Give full marks for correct answer, no working	**(3)**

Question Number	Answer	Acceptable answers	Mark
4(a)	A description including the following points • steam {drives/turns} turbine (1) • (which){drives/turns/powers} generator (1)	transfers ke to electrical energy rotates a magnet in coils or coils in magnet accept dynamo for generator	**(2)**

Question Number	Answer	Acceptable answers	Mark
4(b)	A description including the following points • neutron {hits / splits / is absorbed by} uranium (nucleus) (1) • producing more neutrons (1) • at least one neutron can {hit / split / be absorbed by} other uranium (nuclei) (1)	full marks may be scored on a labelled diagram fired at other U (nuclei) or "process repeats"	**(3)**

Question Number	Answer	Acceptable answers	Mark
4(c)	**A** krypton-91		**(1)**

Question Number	Answer	Acceptable answers	Mark
4(d)	An explanation linking the following points • removes electrons (1) • from atoms (1)	collides with atoms ignore references to β decay process (nucleus losing an electron)	**(2)**

Question Number	Answer	Acceptable answers	Mark
4(e)	An explanation linking the following points • nuclei are positively charged (1) • need enough energy to overcome repulsion (1)	ignore references to high temp and pressure accept same charge accept protons for nuclei accept atoms and will repel each other	**(2)**

Question Number	Answer	Acceptable answers	Mark
5(a)	**A**		**(1)**

Question Number	Answer	Acceptable answers	Mark
5(b)	distance travelled = area under graph (1) substitution (1) ½ x 20 x 2 evaluation (1) 20 (m)	distance = average speed x time = 10 × 2 20 (m) allow (distance) = speed × time or 20 x 2 for 1 mark give full marks for correct answer, no working	**(3)**

Question Number	Answer	Acceptable answers	Mark
5(c)	An explanation linking the following points • velocity is a vector (1) • (whereas) speed is not (1)	velocity has magnitude and direction velocity has direction speed is a scalar speed has {no direction}/{magnitude only} allow for 2 marks velocity is speed in a straight line velocity = $\frac{\text{displacement}}{\text{time}}$ NOTE answers in terms of momentum must still refer to vectors or direction to gain credit	**(2)**

Question Number		Indicative Content	Mark
QWC	***5(d)**	An explanation linking some of the following **Forces acting** • weight down • air resistance up (opposing motion) **Forces during fall** • weight constant • air resistance increases • with speed • resultant force = W − R **Effect on shape of graph** • at start, resultant force is large so acceleration large / gradient steep • mid resultant force decreasing so acceleration decreasing / gradient decreasing • terminal velocity, resultant force is zero so acceleration zero / gradient zero	**(6)**
Level	**0**	No rewardable content	
1	**1 -2**	• a limited explanation linking a few facts from the indicative content. E.g. at terminal velocity, forces are equal so constant speed. • the answer communicates ideas using simple language and uses limited scientific terminology • spelling, punctuation and grammar are used with limited accuracy	
2	**3 -4**	• a simple explanation linking some of the indicative content to the shape of the graph e.g At the start weight > air resistance so acceleration and at the end weight = air resistance so no acceleration. • the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately • spelling, punctuation and grammar are used with some accuracy	
3	**5 -6**	• a detailed explanation linking most of the indicative content to the complete shape of the graph e.g. At the start weight > air resistance so acceleration. Then air resistance increases (with speed) so acceleration decreases. At the end weight = air resistance so no acceleration. • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors	

Question Number	Answer	Acceptable answers	Mark
6(a)	An explanation linking the following points • small percentage / amount of material (1) • activity level low / less than background (1)	radiation/radioactivity for activity within safe limits	**(2)**

Question Number	Answer	Acceptable answers	Mark
6(b)(i)	**B** 50 days		**(1)**

Question Number	Answer	Acceptable answers	Mark
6(b)(ii)	12.5	10 - 15	**(1)**

Question Number	Answer	Acceptable answers	Mark
6(c)	An explanation linking the following points • time for halving (1) • clear as to what is halving (1)	**Allow** for atoms: isotope / element / nuclei / (radioactive) substance /particles/(radioactive) material/radiation/count rate/Bq/activity/radioactivity time for half of the atoms to decay (2) time for the activity/count rate to drop to half (of original value) (2) time for ½ of it to decay (1)	**(2)**

Question Number		Indicative Content	Mark
QWC	***6(d)**	A discussion including some of the following points Model components related to actual machine • lamp – radioactive source (β- source) • sensor (LDR) – Geiger counter arrangement • card – liquid in bottle Interaction of components related to working of machine • rising of card - more liquid in bottle • rising of card – less light – higher resistance – smaller current / reading – circuit switches on if too much light • greater absorption gives less radiation to detect • machine discards bottle if too little liquid, model does not	**(6)**
Level	**0**	No rewardable content	
1	**1 - 2**	• a limited discussion comparing some of the indicative content. E.g. two of the lamp, sensor and card are related to the source (Geiger) counter and liquid respectively. • the answer communicates ideas using simple language and uses limited scientific terminology • spelling, punctuation and grammar are used with limited accuracy	
2	**3 - 4**	• a simple discussion comparing parts of the process. E.g. Two of the lamp, sensor and card are related to the source Geiger counter and liquid respectively. The rising of the card gives more liquid in the bottle. • the answer communicates ideas showing some evidence of clarity and organisation and uses scientific terminology appropriately • spelling, punctuation and grammar are used with some accuracy	
3	**5 - 6**	• a detailed discussion of the whole process. E.g. the lamp, sensor and card are related to the source Geiger counter and liquid respectively. The rising of the card gives more liquid in bottle. Too much light/ radiation getting through starts the alarm. • the answer communicates ideas clearly and coherently uses a range of scientific terminology accurately • spelling, punctuation and grammar are used with few errors	

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