WJEC GCSE PHYSICS

PHYSICS



EXAM QUESTION PACK

UNIT P2 HIGHER TIER 0241 PAPERS

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Surname	Centre Number	Candidate Number
Other Names		0

GCSE

0241/02

ADDITIONAL SCIENCE
HIGHER TIER
PHYSICS 2

A.M. WEDNESDAY, 30 January 2013

45 minutes

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**4**	
2.	**7**	
3.	**6**	
4.	**12**	
5.	**4**	
6.	**9**	
7.	**8**	
Total	**50**	

0241
020001

ADDITIONAL MATERIALS

In addition to this paper you may require a calculator.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen.
Write your name, centre number and candidate number in the spaces at the top of this page.
Answer **all** questions.
Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.
You are reminded of the necessity for good English and orderly presentation in your answers.

A list of equations is printed on page 2 of the examination paper. In calculations you should show all your working.

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EQUATIONS

Resistance	=	$\frac{\text{voltage}}{\text{current}}$
Power	=	current × voltage
Speed	=	$\frac{\text{distance}}{\text{time}}$
Resultant force	=	mass × acceleration
Acceleration	=	$\frac{\text{change in speed}}{\text{time}}$
Force	=	$\frac{\text{work done}}{\text{distance}}$
Kinetic Energy	=	$\frac{\text{mass} \times \text{speed}^2}{2}$
	=	$\frac{1}{2} mv^2$
Change in potential energy	=	mass × gravitational field strength × change in height
	=	mgh

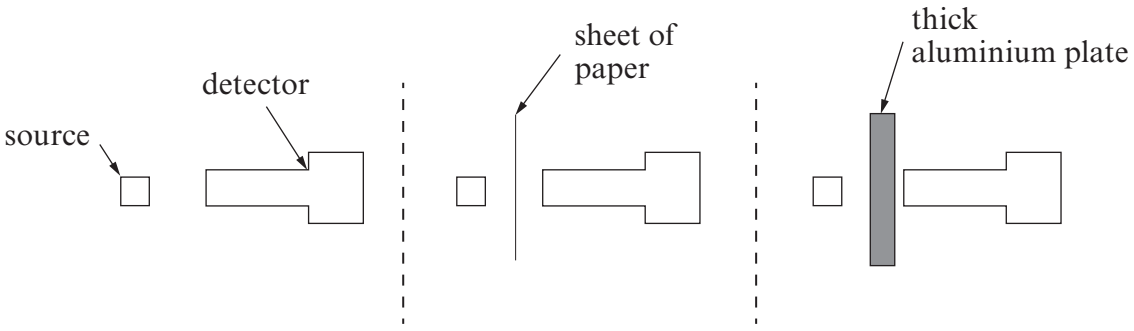
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Answer **all** *questions.*

1. A radioactive source emitting alpha, beta and gamma radiations was placed in front of a detector. The three diagrams show how the count rate in counts per minute (cpm) changed when different absorbers were placed between the source and the detector.



count rate = 300 counts per minute

count rate = 250 counts per minute

count rate = 120 counts per minute

(a) (i) How much of the original count rate was due to gamma radiation?

..... cpm

(ii) Calculate the count rate due to alpha radiation.

..... cpm
[2]

(b) By referring to the diagram explain why the count rate due to beta radiation was 130 cpm. [2]

.....

.....

.....

4

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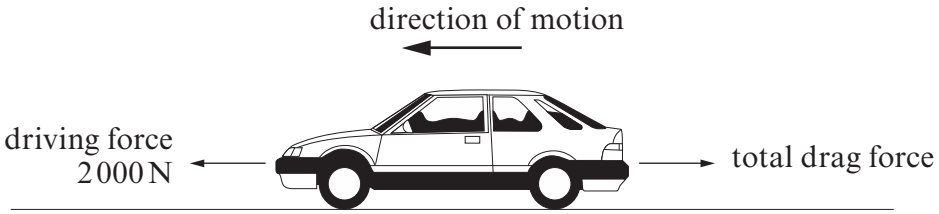
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2. The diagram below shows some of the forces acting on a car of mass 800 kg.



(a) The car is travelling at **constant speed**. State the size of the total drag force. [1]

..... N

(b) The driving force is now **increased** to 3200 N.

(i) Find the resultant force on the car at this instant. [1]

.....

.....

(ii) Select and write down an equation from page 2 and use it to calculate the initial acceleration of the car.

Equation .....

.....

[1]

Acceleration = ... m/s^2

[2]

(c) Explain why the car will eventually reach a **new higher constant speed**. [2]

.....

.....

.....

.....

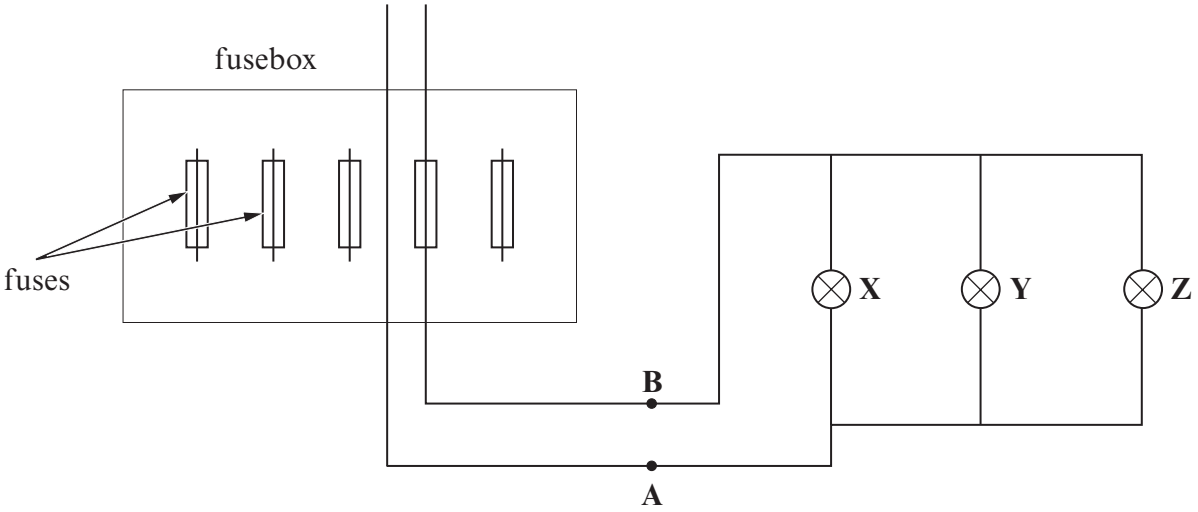
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3. The diagram shows part of the household lighting circuit joined into the fusebox.



(a) How can you tell from the diagram that **B** is the live wire? [1]

.....

.....

(b) **Add to the circuit** in a safe position:

(i) a switch S_1 which controls lamp **X** only,

(ii) a switch S_2 which controls both lamps **Y** and **Z**. [3]

(c) The fuse wire rating for a normal household lighting circuit is 5 A. By describing the purpose of a fuse, explain what a 5 A fuse rating means. [2]

.....

.....

.....

6

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4. *(a)* Radioactive carbon-14 is a beta emitter and has a half-life of 5 700 years.
Explain carefully what the following statements mean:

(i) carbon-14 is a beta emitter. [2]

.....

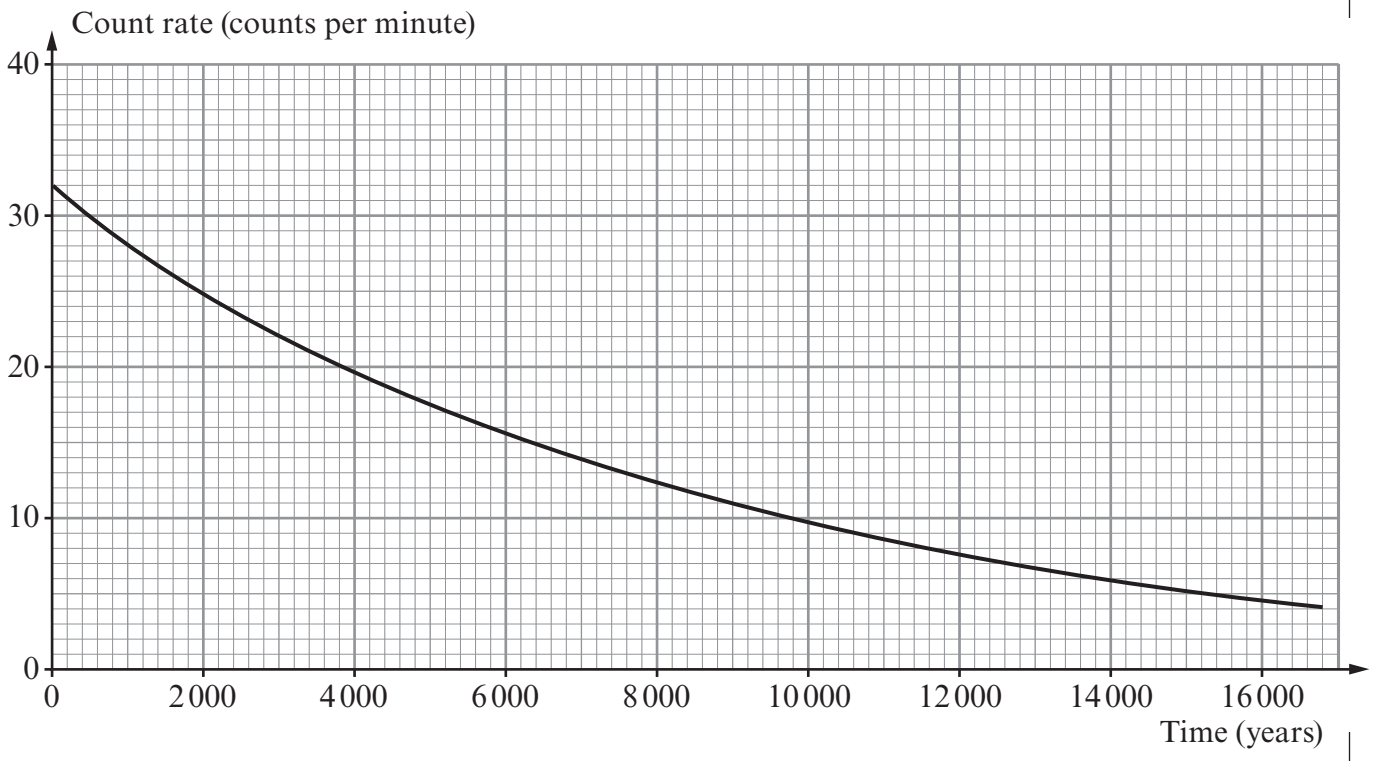
.....

(ii) carbon-14 has a half-life of 5 700 years. [2]

.....

.....

(b) Living trees absorb carbon in the form of carbon dioxide and the amount of radioactive carbon-14 remains at a constant level within the tree. When a tree dies, the amount of carbon-14 decreases with time.
The decay curve for carbon-14 shows how the count rate would change over the next 16 000 years.



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The carbon-14 from a sample of living wood near an ancient village gave a count rate of 32 counts per minute. Carbon-14 from a sample of wood taken from one of the huts in the village gave a count rate of 14 counts per minute.

(i) Suggest a reason why the wood from the hut gave a lower count rate than that from the trees nearby. [2]

.....

.....

(ii) **Use the graph** to estimate the age of the village. [1]

..... years

(c) The industrial use of radioactive materials leads to the production of increasing amounts of radioactive waste **in liquid form**.
The waste contains a mixture of radioactive materials, which emit alpha, beta and gamma radiation and which generally have long half-lives.
Explain why the safe disposal of radioactive waste is essential but costly. [3]

.....

.....

.....

.....

.....

.....

(d) A radioactive mixture has a count rate of 320 counts per second (cps). The mixture consists of element X which has a count rate of 160 cps and a half-life of 2 hours and element Y which also has a count rate of 160 cps and a half-life of 1 hour. Calculate the count rate after 2 hours. [2]

Count rate = ... cps

12

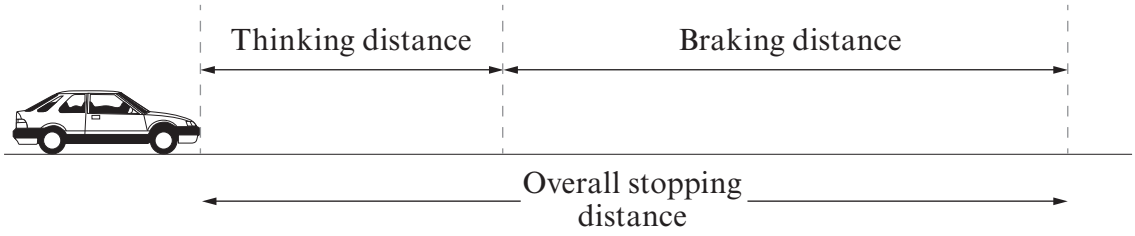
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5. The overall stopping distance of a car is made up of two parts: the distance that the car travels when the driver is reacting (thinking distance); and the distance that the car travels after the brakes have been applied (braking distance).



The table below shows the stopping distances for a car driven at various speeds along the same dry road.

Speed (m/s)	Thinking distance (m)	Braking distance (m)	Overall stopping distance (m)
5	3	2·5	5.5
10	6	10·0	16.0
15	9	22·5	31.5
20	12	40·0	52.0

(a) When the speed doubles, i.e. from 5 m/s to 10 m/s or from 10 m/s to 20 m/s,

(i) state how the thinking distance changes, [1]

.....

(ii) state how the braking distance changes. [1]

.....

(b) Now calculate the overall stopping distance for a car travelling at 40 m/s. [2]

.....

.....

.....

Overall stopping distance ..... m

4

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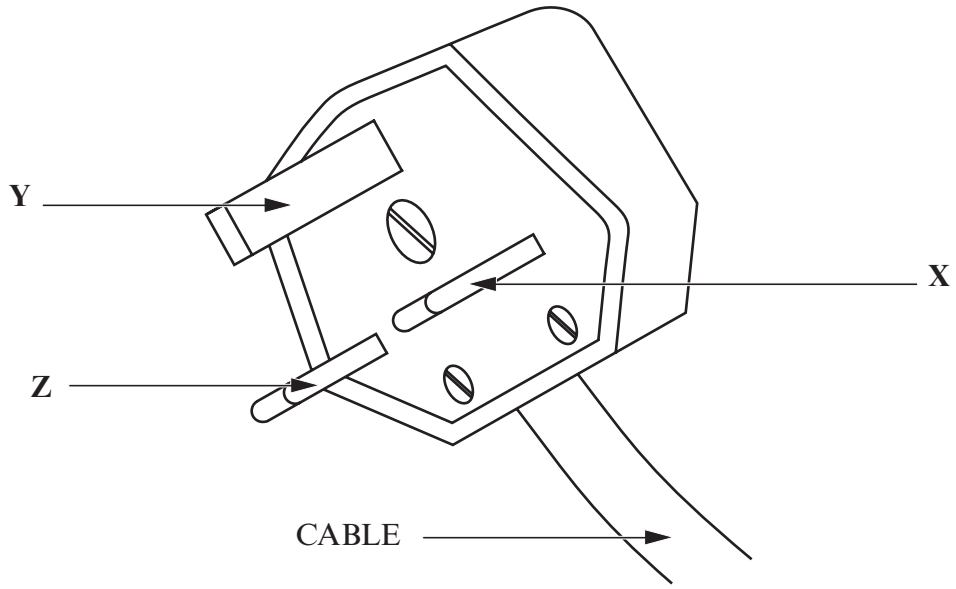
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6. Inside the cable of a British 3-pin plug are three wires covered in coloured plastic. They are connected inside the plug to the metal pins **X**, **Y** and **Z**.



(a) State which pin **X**, **Y** or **Z**:

(i) is the live pin; .....

(ii) has the green and yellow covered wire connected to it. ..... [2]

(b) The other end of the cable is connected to a 2.3 kW chainsaw which is operated on the 230 V mains supply. Use the equations:

$$\text{power} = \text{current} \times \text{voltage}$$

$$\text{resistance} = \frac{\text{voltage}}{\text{current}}$$

to calculate:

(i) the current through the chainsaw; [3]

current = ... A

(ii) the resistance of the chainsaw circuit. [2]

resistance = ... Ω

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(c) The earth wire and fuse in the plug together provide some protection for users of the chainsaw. Manufacturers however, recommend that a residual current device (r.c.d.) be used in the chainsaw circuit to provide additional protection for the user.

Give **two** reasons why the r.c.d. gives **greater protection** than the earth wire and fuse.

.....

.....

.....

.....

[2]

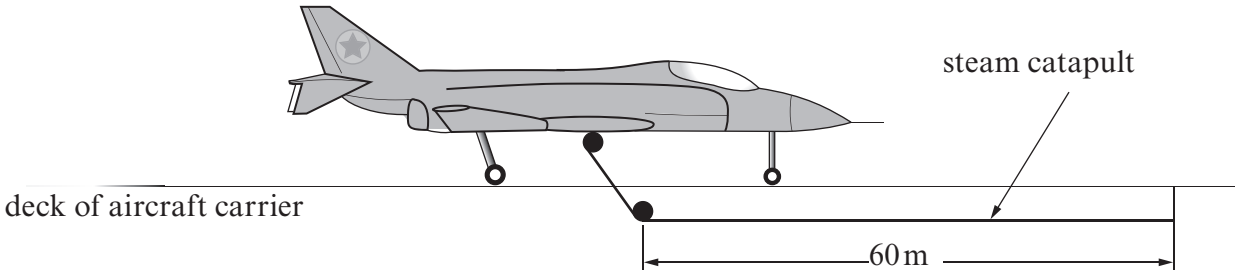
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7. To take-off from the deck of an aircraft carrier a fighter jet must have a minimum take-off speed.



Two forces act on the fighter jet of mass 24 000 kg to produce the minimum take-off speed. These are 2×10^5 N from the engines of the fighter jet and 10.8×10^5 N from a steam catapult. Both forces act over the 60 m take-off distance. Use the equations:

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

$$\text{KE} = \tfrac{1}{2} mv^2$$

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

to calculate:

(i) the total work done by the engines and catapult during take-off; [3]

total work done = ... J

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(ii) the minimum take-off speed for the fighter jet; [3]

minimum take-off speed = ... m/s

(iii) the take-off time for the fighter jet. [2]

take-off time = ... s

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END OF PAPER

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GCSE MARKING SCHEME

SCIENCE - PHYSICS (LEGACY)

JANUARY 2013

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INTRODUCTION

The marking schemes which follow were those used by WJEC for the January 2013 examination in GCSE SCIENCE - PHYSICS (LEGACY). They were finalised after detailed discussion at examiners' conferences by all the examiners involved in the assessment. The conferences were held shortly after the papers were taken so that reference could be made to the full range of candidates' responses, with photocopied scripts forming the basis of discussion. The aim of the conferences was to ensure that the marking schemes were interpreted and applied in the same way by all examiners.

It is hoped that this information will be of assistance to centres but it is recognised at the same time that, without the benefit of participation in the examiners' conferences, teachers may have different views on certain matters of detail or interpretation.

WJEC regrets that it cannot enter into any discussion or correspondence about these marking schemes.

Unit	Page
P1 - FOUNDATION TIER	1
P1 - HIGHER TIER	4
P2 - FOUNDATION TIER	7
P2 - HIGHER TIER	10
P3 - FOUNDATION TIER	13
P3 - HIGHER TIER	16

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GCSE Science - Physics (Legacy) - P2

Mark Scheme

FOUNDATION TIER

Question			Marking details	Marks Available
1.	*(a)*	(i)	H and A	1
		(ii)	G and B	1
	(b)		Good insulator / poor conductor or implied	2
			Question total	**[4]**
2.	*(a)*		150 x 2 = 300 [J] substitution (1) answer (1)	2
	(b)		Energy required to operate lifting gear	1
			Question total	**[3]**
3.	*(a)*		Statement (ii) (1) Low level radiation from surroundings (1)	2
	(b)	(i)	$\frac{108}{5}$ (1) = 21 / 22 [cpm] (1)	2
		(ii)	Statement 2	1
			Question total	**[5]**
4.	*(a)*		6 400 [W]	1
	(b)		$\frac{6400}{230}$ = 27.8 [A] Substitution (1) answer (1)	2
	(c)		m.c.b. needs a value above 28 A / too much current for the m.c.b.	1
			Question total	**[4]**
5.			Any 2 x (1) from: Containment / safe transport / long activity / highly radioactive	2
			Question total	**[2]**

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Question			Marking details	Marks Available
6.	*(a)*	(i)	8 [m]	1
		(ii)	2 [s]	1
	(b)		$\frac{8}{2}$ (1) **ecf** = 4 [m/s] (1)	2
			Question total	**[4]**
7.	*(a)*	(i)	Measure voltage (1)	
		(ii)	Measure current (1)	
		(iii)	Change resistance / change meter readings / change current / change voltage across the coil (1)	3
	(b)		$\frac{6}{1.5}$ = 4 [Ω] Substitution (1) answer (1)	2
			Question total	**[5]**
8.	*(a)*		Computer generated from readings picked up by gamma camera	1
	(b)		Low energy gamma [emitter] / easily escapes the body	1
	(c)	(i)	640	1
		(ii)	24 [hours]	1
			Question total	**[4]**
9.	*(a)*		Straight line to (50,25) (1) Straight line from (50,25) to (60,0) (1) **ecf**	2
	(b)		Accelerates / uniform increase in speed / increase speed to 25 m/s	1
	(c)		$\frac{25-0}{10}$ **ecf** from graph = 2.5 [m/s^2] Substitution (1) answer (1)	2
			Question total	**[5]**

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Question			Marking details	Marks Available
10.	*(a)*	(i)	120 [cpm] (1)	
		(ii)	300-250 = 50 [cpm] (1)	2
	(b)		This was amount absorbed by the aluminium plate (1) and beta are absorbed by aluminium (1)	2
			Question total	**[4]**
11.	*(a)*		2 000 [N]	1
	(b)	(i)	3 200 – 2 000 = 1 200 [N]	1
		(ii)	Acceleration = $\frac{\text{Resultant force}}{\text{Mass}}$	1
			$\frac{1200}{800}$ **ecf** = 1.5 [m/s^2]	2
			Question total	**[5]**
12.	*(a)*		B is connected to the fuse (not goes through the fuse box)	1
	(b)	(i)	S_1 and S_2 in position to control lamp X and lamps Y and Z (2 x (1))	3
		(ii)	Both S_1 and S_2 on live side (B) (1)	
	(c)		Currents in excess of 5 A (1) melts / breaks the fuse (1)	2
			Question total	**[6]**
			Total Foundation paper	**50**

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HIGHER TIER

Question			Marking details	Marks Available
1.	*(a)*	(i)	120 [cpm] (1)	
		(ii)	300-250 = 50 [cpm] (1)	2
	(b)		This was amount absorbed by the aluminium plate (1) and beta are absorbed by aluminium (1)	2
			Question total	**[4]**
2.	*(a)*		2 000 [N]	1
	(b)	(i)	3 200 – 2 000 = 1 200 [N]	1
		(ii)	acceleration = $\frac{\text{resultant force}}{\text{mass}}$	1
			$\frac{1200}{800}$ **ecf** = 1.5 [m/s^2]	2
	(c)		Drag increases as speed increases (1) until it equals the new driving force (1) Or drag becomes equal to the new driving force (2)	2
			Question total	**[7]**
3.	*(a)*		B is connected to the fuse	1
	(b)	(i)	S_1 and S_2 in position to control lamp X and lamps Y and Z (2 x (1))	3
		(ii)	Both S_1 and S_2 on live side (B) (1)	
	(c)		Currents in excess of 5 A (1) melts / breaks the fuse (1)	2
			Question total	**[6]**

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Question			Marking details	Marks Available
4.	*(a)*	(i)	C-14 atoms / their nuclei (1) decay emitting an electron (1)	2
		(ii)	In 5 700 years (1) the activity / number of C-14 atoms halves (1)	2
	(b)	(i)	Dead wood decays, therefore decreasing the activity (1) not taking in C-14 (1) or living wood maintains its activity level (2)	2
		(ii)	7 000 [years] Accept: 6 800 – 7 200	1
	c)		Any 3 x (1) from: • Dangerous to humans • Costly because of containment • Site / transport • Length of time it is active	3
	(d)		X activity = 80 (1) and Y activity = 40 (1) [120 cps]	2
			Question total	**[12]**
5.	*(a)*	(i)	Doubles	1
		(ii)	Quadruples [increase / increase earns 1 mark only]	1
	(b)		24(1) + 160(1) = [184 m]	2
			Question total	**[4]**

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Question			Marking details	Marks Available
6.	*(a)*	(i)	Z (1)	2
		(ii)	Y (1)	
	(b)	(i)	2.3 x 1000 = *I* x 230 Substitution (1) manipulation (1) *I* = 10 [A] (1)	3
		(ii)	R = $\frac{230}{10}$ (1) **ecf** = 23 [Ω](1)	2
	(c)		Faster acting (1) More sensitive / detects small changes in current (1)	2
			Question total	**[9]**
7.		(i)	Work done by engines: 2 x 10^5 x 60 = 1.2 x 10^7 [J](1) Work done by catapult: 10.8 x 10^5 x 60 = 6.48 x 10^7 [J](1) Total work done = 7.68 x 10^7 [J](1) **ecf**	3
		(ii)	½ x 24 000 x v^2 = 7.68 x 10^7 (1) **ecf** $v^2 = \frac{2x7.68x10^7}{24000}$ (1) v^2 = 6 400 *v* = 80 [m/s] (1)	3
		(iii)	$\frac{60}{80}$ (1) **ecf** = 0.75 [s](1)	2
			Question total	**[8]**
			Total Higher Tier	**50**

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Surname	Centre Number	Candidate Number
Other Names		0

GCSE

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ADDITIONAL SCIENCE
HIGHER TIER
PHYSICS 2

A.M. THURSDAY, 24 May 2012

45 minutes

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**6**	
2.	**5**	
3.	**6**	
4.	**9**	
5.	**5**	
6.	**10**	
7.	**9**	
Total	**50**	

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020001

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EQUATIONS

Voltage = current × resistance

Power = current × voltage

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

Resultant force = mass × acceleration

Acceleration = $\frac{\text{change in speed}}{\text{time}}$

Force = $\frac{\text{work done}}{\text{distance}}$

Kinetic Energy = $\frac{\text{mass} \times \text{speed}^2}{2}$

= $\frac{1}{2} mv^2$

Change in potential energy = mass × gravitational field strength × change in height

= mgh

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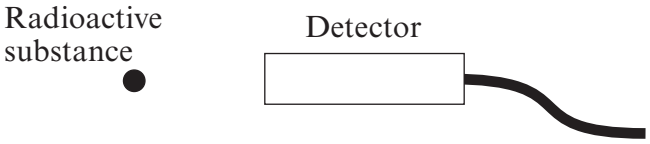
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Answer **all** *questions.*

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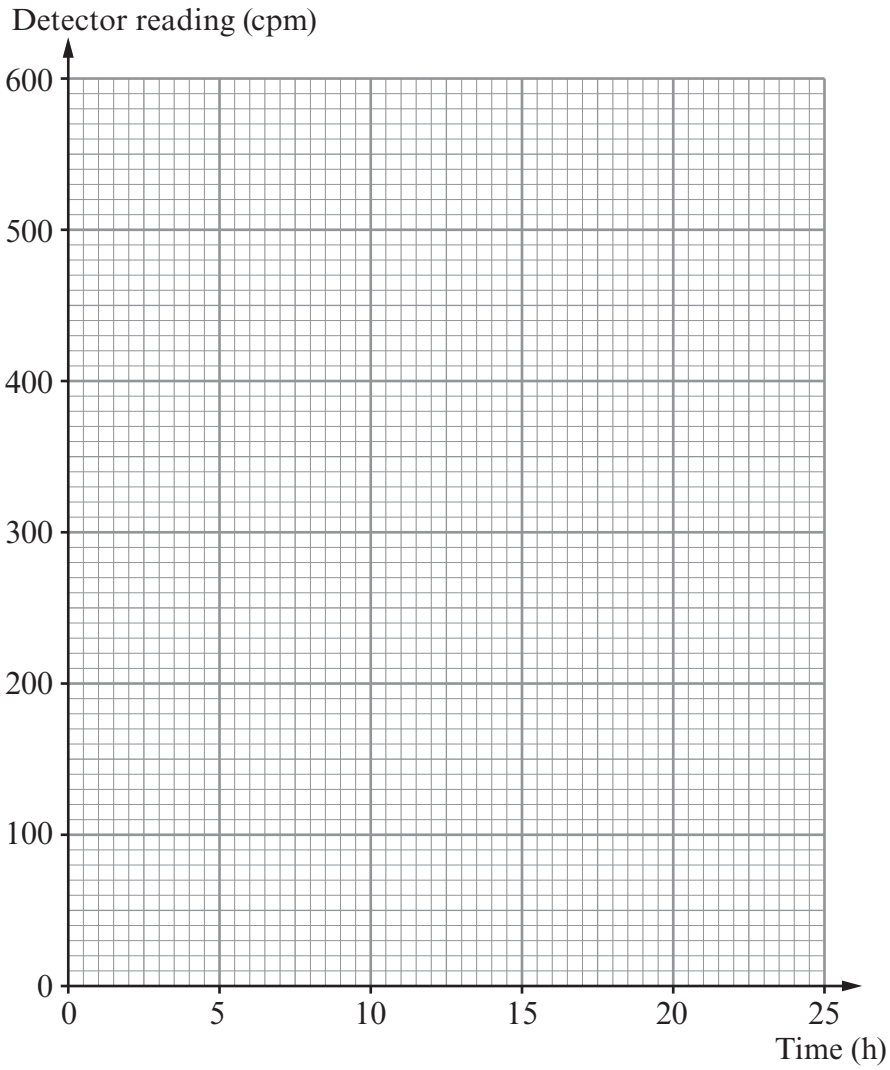
1. A radioactive substance which decays by gamma emission was placed in front of a detector.



The reading on the detector, corrected for background radiation, changed in the way shown in the table.

Time (h)	0	5	10	15	20
Reading on the detector (counts per minute)	480	290	180	110	70

(a) On the grid below, plot the points and draw a decay curve for this substance. [3]



(b) Use your graph to find the half life of this substance. [1]

Half life = ... hours

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(c) Explain whether or not this substance may be suitable for use as a tracer in medicine. [2]

.....

.....

.....

6

2. Electrical appliances and their users are protected in the home by fuses in plugs, earth wires, residual current devices (r.c.d.) and miniature circuit breakers (m.c.b.).

(a) State how the earth wire protects the user. [1]

.....

.....

(b) Explain how an r.c.d. protects household circuits when a fault causes a current to flow to earth. [2]

.....

.....

.....

(c) One advantage of miniature circuit breakers over fuses in circuits is they can be reset after breaking a circuit.
State **two** *other* advantages. [2]

1. .....

.....

2. .....

.....

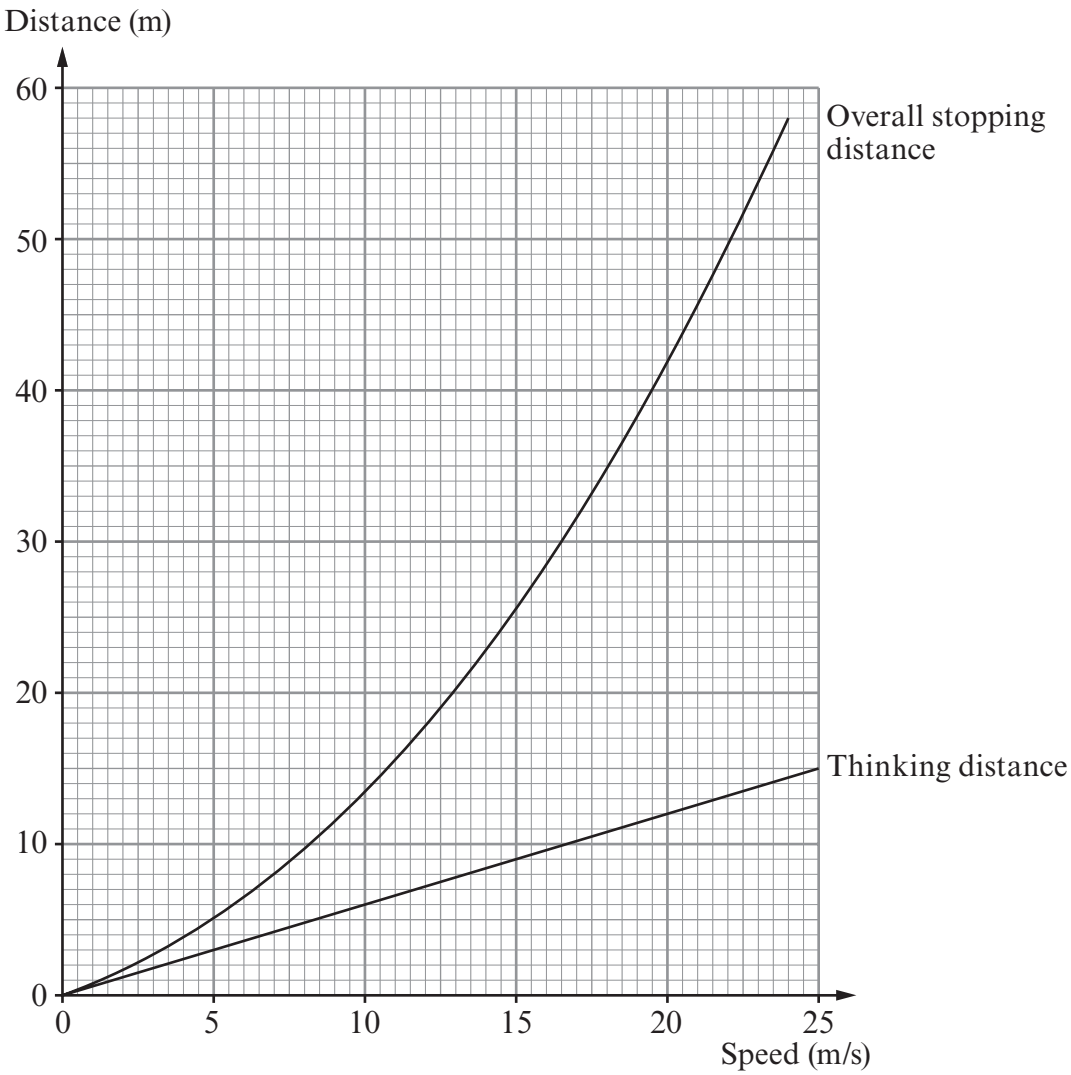
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3. The graph below shows how the **overall stopping distance** for a car and the **driver's thinking distance** change with the speed of the car.



(a) Use information from the graph and the equation

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

to calculate the **thinking time** for the driver of a car travelling at 15 m/s. [2]

Time = ... s

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(b) (i) Use information from the graph to find the braking distance when the car travels at 20 m/s. [2]

Braking distance = ... m

(ii) Use the graph to give a reason why the braking distance at 10 m/s is not half of your answer to *(b)*(i). [1]

.....

.....

(c) Name **one** factor that could make the thinking distance graph steeper. [1]

.....

6

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4. *(a)* Henri Bequerel discovered radioactivity. He left a uranium compound in a steel box in his drawer, which also contained a photographic film. When he developed the film he found that it had been exposed to something, even though it hadn't been opened to any light. He realised that the uranium had given off invisible rays that could darken film.

(i) Name the radiation that the film was exposed to. [1]

.....

(ii) State how Bequerel could have made sure that his findings were **reliable**. [1]

.....

(iii) State what he could have done in order to get his findings accepted by other scientists. [1]

.....

(b) Marie Curie continued research into radioactive materials, discovering radioactive elements that included radium which decays to produce radon gas. Radon gas undergoes alpha particle decay. Marie Curie died from a disease linked to radiation exposure.

(i) Explain why exposure to radon gas is so dangerous to human beings. [3]

.....

.....

.....

.....

.....

(ii) State **one** way that exposure to radon gas in the home could be minimised. [1]

.....

.....

(iii) Name **two** precautions that are taken by people who now work with radioactive materials. [2]

.....

.....

.....

9

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5. Before opening the parachute, a free fall parachutist reaches terminal speed.

(a) Explain in terms of the forces acting, why the parachutist reaches terminal speed. [3]

.....

.....

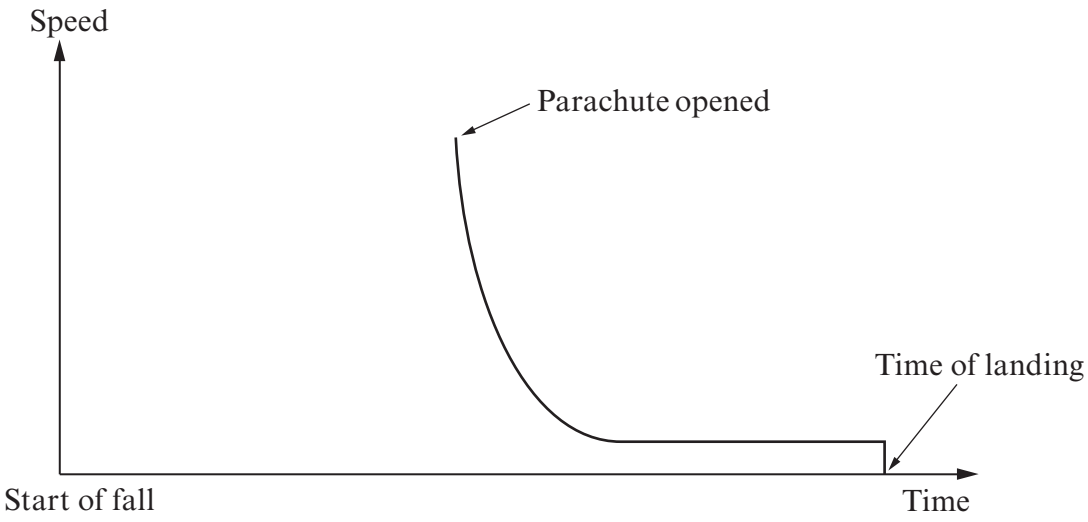
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(b) After opening the parachute, she decelerates to a low speed from which she can land safely. Complete the shape of the speed – time graph below from the start of her fall to the point at which the parachute is opened. [2]



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6. *(a)* A 2 kW electric kettle is connected to the 230 V mains electricity supply in the U.K. Its resistance is constant at 26.45 Ω.

(i) Use the equation

$$\text{current} = \frac{\text{power}}{\text{voltage}}$$

to find the current that passes through its wires. [2]

Current = ... A

(ii) The same electric kettle was taken to the U.S.A. where the voltage is 110 V. Use the equation

$$\text{voltage} = \text{current} \times \text{resistance}$$

to calculate the current that would flow through the kettle in the U.S.A. [3]

Current = ... A

(iii) This kettle's power in the U.S.A. is about a quarter of its U.K. power. State the difference that would be noticed when a kettle full of water is boiled in the U.S.A. compared with its use in the U.K. [1]

.....

.....

(iv) A kettle designed to work on 110 V in the U.S.A. is brought to the U.K. What will happen if it is connected to the U.K. supply? [1]

.....

.....

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(b) State and explain **one** advantage and **one** disadvantage that the mains electricity supply in the U.S.A. at 110 V has over the U.K.'s 230 V. [3]

Advantage: .....

.....

.....

Disadvantage: .....

.....

.....

10

TURN OVER FOR QUESTION 7.

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7. A cruise ship's engines produce a constant thrust of 1.6×10^6 N. It has a mass of 1.2×10^8 kg.

(a) Use the equation

$$\text{acceleration} = \frac{\text{resultant force}}{\text{mass}}$$

to calculate the ship's initial acceleration. [2]

Acceleration = ... m/s^2

(b) Once at sea, the ship's speed increases from 5 m/s to 9 m/s over a distance of 2400 m. By using the equations

$$\text{work} = \text{force} \times \text{distance}$$

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

(i) calculate the work done by the ship's engines over the 2400 m travelled at sea, [2]

Work done = ... J

(ii) calculate the increase in the ship's kinetic energy. [2]

K.E. increase = ... J

(iii) Use your answers to parts (i) and (ii) to calculate the mean work done against the ship as its speed increases. Hence find the value of the mean drag force acting against the ship. [3]

Mean work done = ... J

Mean drag force = ... N

9

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GCSE MARKING SCHEME

SCIENCE - PHYSICS (LEGACY)

SUMMER 2012

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INTRODUCTION

The marking schemes which follow were those used by WJEC for the Summer 2012 examination in GCSE SCIENCE - PHYSICS (LEGACY). They were finalised after detailed discussion at examiners' conferences by all the examiners involved in the assessment. The conferences were held shortly after the papers were taken so that reference could be made to the full range of candidates' responses, with photocopied scripts forming the basis of discussion. The aim of the conferences was to ensure that the marking schemes were interpreted and applied in the same way by all examiners.

It is hoped that this information will be of assistance to centres but it is recognised at the same time that, without the benefit of participation in the examiners' conferences, teachers may have different views on certain matters of detail or interpretation.

WJEC regrets that it cannot enter into any discussion or correspondence about these marking schemes.

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PHYSICS 2 - FOUNDATION TIER

Question			Marking details	Marks Available
1.	*(a)*	(i)	gamma (1) [accept: γ, gama]	
		(ii)	gamma (1) [accept: γ, gama]	
		(iii)	alpha (1) [accept: α, alfa, alffa]	3
	(b)		Any 2 × (1) from: reduce exposure time (✓), protective clothing (✓), barrier (✓), breathing apparatus (✓), handling equipment (1), monitoring equipment (✓) [One mark available for each line – if one line is blank, 2 marks are available for the other line]	2
			Question total	**[5]**
2.	*(a)*	(i)	10%	1
		(ii)	cosmic [accept: rays from the sun]	1
		(iii)	nuclear power stations only contribute a very small part, or equiv [must recognise the low level contribution] – accept the converse argument.	1
		(iv)	30 [cpm]	1
	(b)		radon gas levels vary / difference in rock type / altitude [Not just: proximity to radiation source] **Notes**: Context must be correct if given, e.g. Limestone is more radioactive × Granite / igneous rocks more radioactive ✓ It depends if there are radioactive substances in the area –× not specific enough.	1
			Question total	**[5]**
3.	*(a)*		**Lamp**	1
	(b)		$\frac{920}{230}$ (1) = 4 [A] (1) [correct answer → 2 marks]	2
	(c)		13, 3, 13 in last three cells	1
			Question total	**[4]**

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Question			Marking details	Marks Available
4.	*(a)*		A and V in correct places [accept a and v]	1
	(b)		$R = \frac{2}{4}$ (1 subst) = 0.5 [Ω] (1 ans)	2
	(c)	(i)	variable resistor [accept: rheostat / reostat]	1
		(ii)	variable resistor (ecf on name) altered in steps [Accept: change the resistance / the resistance changes the current]	1
	(d)	(i)	2 [V] [accept 2 – 2.1]	1
		(ii)	line curves beyond that point / it is straight only up to 2 V [accept a resistance calculation up to 2 V and at a higher voltage] **Notes**: The description of the change must be clear, e.g. **not**: the current starts to slow down ✗ **not** increase in current slows down ✗ **but** the current increases at a slower rate - ✓b.o.d.	1
			Question total	**[7]**
5.	*(a)*		$a = \frac{12}{4}$ (1 subs) = 3 (1 ans) Unit: m/s^2 (1)	3
	(b)		F = 90 x 3 **ecf** (1 subs) = 270[N] (1)	2
			Question total	**[5]**

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Question			Marking details	Marks Available
6.	*(a)*		*W*= 500 000 x 0.9 (1) = 450 000 [J] (1)	2
	(b)		Any 2 × (1) from • crumple zone ✓ [**not** crumble zone!] • air bag ✓ • rigid [accept strong] passenger cell ✓	2
			Question total	**[4]**
7.	*(a)*	(i)	stays the same [accept: <u>is</u> constant](1) increases [accept: <u>gets</u> bigger] (1)	3
		(ii)	equal to (1)	
	(b)		decelerates (1) to a [new] constant speed (1)	2
			Question total	**[5]**
8.	*(a)*		all points plotted <u>±</u> half square (2x1) deduct 1 mark for each wrong plot [min 0], smooth curve [ignore t>20 hrs] (1)	3
	(b)		7 ± 0.5 [h] [for incorrect graphs, take the graph reading ± 0.5 h]	1
			Question total	**[4]**
9.	*(a)*		takes current [accept: electricity] to ground / earth [Accept: prevents metal casings becoming live / stops the current going through the user / stops them getting electrocuted / an electric shock] **Notes**: The explanation must not have an incorrect context, e.g. **not** if there is too much current × **not** prevents fire ×	1
	(b)		Context mark: difference in live and neutral currents (1) Effect mark: makes it turn off [all] household circuits [accept: appliance] / operates a <u>magnetic</u> switch (1) 'Stops the current' – accept for the 2nd mark. **Notes:** Effect mark can only be given if the context mark is given.	2
	(c)		Quick[er] acting [however expressed](1) [accept 'straight away'] more sensitive [however expressed] (1)	2
			Question total	**[5]**

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Question			Marking details	Marks Available
10.	*(a)*		$t = = \frac{9(1)}{15}$ [1 for 9 taken from graph] = 0.6 [s](1)	2
	(b)	(i)	42(1) – 12(1) = [30 m] [correct answer, only, implies correct working] **Notes**: Credit 42 (✓) and 12 (✓) and 30 (✓✓) in the working space, but if 30 is further manipulated to give a final incorrect answer, 1 mark is given. Do not credit 42 or 12 in the answer line – × If correct distances are <u>added</u> – 1 mark only.	2
		(ii)	because the total stopping distance increases as a curve / because the graphs are not straight. **Notes**: If numerical answer for 10 m/s given [braking distance 7.5 m] credit only if a suitable comment is given, e.g. 'this is not / less than half the 20 m/s value'	1
	(c)		[The driver is] tired / drunk / drugged / distracted (e.g. phone / inattentive) / old aged [accept just: alcohol]	1
			Question total	**[6]**
			Total For Foundation Tier paper	**50**

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PHYSICS 2 (LEGACY)

HIGHER TIER

Question			Marking details	Marks Available
1.	*(a)*		all points plotted ± half square (2x1) deduct 1 mark for each wrong plot [min 0], smooth curve [ignore t>20 hrs] (1)	3
	(b)		7 ± 0.5 [h] [for incorrect graphs, take the graph reading ± 0.5 h]	1
	(c)		yes because:[it is a gamma emitter] – so it escapes the body / can be detected outside [accept: low ionizing / highly penetrating] (1), suitably short half life (1)	2
			Question total	**[6]**
2.	*(a)*		takes current [accept: electricity] to ground / earth [Accept: prevents metal casings becoming live / stops the current going through the user / stops them getting electrocuted / an electric shock] **Notes**: The explanation must not have an incorrect context, e.g. **not** If there is too much current × **not** prevents fire ×	1
	(b)		Context mark: difference in live and neutral currents (1) Effect mark: makes it turn off [all] household circuits [accept: appliance] / operates a magnetic switch (1) 'Stops the current' – accept for the 2nd mark. **Notes:** Effect mark can only be given if the context mark is given.	2
	(c)		Quicker acting [however expressed](1) [accept 'straight away'] more sensitive [however expressed] (1)	2
			Question total	**[5]**

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Question			Marking details	Marks Available
3.	*(a)*		$t = = \frac{9(1)}{15}$ [1 mark for '9' taken from graph] = 0.6 [s](1) **Notes:** '9' in the answer space does not score	2
	(b)	(i)	42(1) – 12(1) = 30 [m] [correct answer, only, implies correct working] **Notes**: Credit 42 (✓) and 12 (✓) and 30 (✓✓) in the working space, but if 30 is further manipulated to give a final incorrect answer, 1 mark is given. Do not credit 42 or 12 in the answer line – × If correct distances are <u>added</u> – 1 mark only.	2
		(ii)	because the total stopping distance increases as a curve / because the graphs are not straight. **Notes**: If numerical answer for 10 m/s given [braking distance 7.5 m] credit only if a suitable comment is given, e.g. 'this is not / less than half the 20 m/s value'	1
	(c)		[The driver is] tired / drunk / drugged / distracted (e.g. phone / inattentive) / old aged [accept just: alcohol]	1
			Question total	**[6]**
4.	*(a)*	(i)	gamma [nuclear radiation – not enough]	1
		(ii)	Repeat the experiment / carry out similar experiments	1
		(iii)	Publish his results / allow others to verify / share outcomes [however expressed, e.g. patent the experiment] **Note:** 'Recording' – not enough	1
	(b)	(i)	When inhaled (1) radon emits alpha particles [inside the body] (1) which cannot escape [the body] [**not just** 'cannot get through the skin']/ are [highly] ionising / damage DNA / damage cells [**not** <u>destroy</u> cells] (1) [**not** just: 'causes cancer]. **Notes:** It must be clear that <u>radon</u> enters the body and <u>alpha</u> [particles] cause the ionisation	3
		(ii)	Seal floors / increase ventilation. Not 'insulation' - ×	1
		(iii)	Any 2 × (1) from: reduce exposure time (✓), <u>protective</u> clothing (✓), barrier (✓), breathing apparatus (✓), handling equipment (1), monitoring equipment (✓)	2
			Question total	**[9]**

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Question			Marking details	Marks Available
5.	*(a)*		• initially the weight is greater than the air resistance / the resultant force is downwards (1) [accept: the force of gravity / weight produces a downward acceleration] • air resistance [or upward force] increases / resultant force decreases (1) • [eventually] air resistance [or upward force] equals weight [or downward force] / zero resultant force (1) **Notes:** Unless the terms air resistance [or drag or equiv] **and** weight [or gravitational force – accept gravity] are correctly used at least once, a maximum of 2 marks can be awarded.	3
	(b)		correct initial curvature (1) levelling off [NB must not be higher than the parachute opening point – but allow some tolerance] (1)	2
			Question total	**[5]**
6.	*(a)*	(i)	Current = $\frac{2000(1)}{230}$ = 8.70 [A](1) **Notes:** $\frac{2}{230} \rightarrow 0.0087 \rightarrow$ 1 mark $\frac{2}{230} \rightarrow 8.7 \rightarrow$ 1 mark $\frac{2\text{ kW}}{230\text{ V}} \rightarrow 8.7 \rightarrow$ 2 marks $\frac{2}{230} \rightarrow 115 \rightarrow$ 0 marks	2
		(ii)	110= $I \times 26.45$ (1 sub) Current = $\frac{110}{26.45}$ (1 manip) = 4.16 [A] (1) (Accept 4.2 but not 4.1 or 4)	3
		(iii)	Longer time to boil / converse	1
		(iv)	Would burn out [accept: break] / blow a fuse/overheat **Not** – kettle / fuse will blow <u>up</u>	1
	(b)		Any 3 × (1) from: Advantage: safer (✓), because less likely to <u>be killed</u> by 110 than 230 V / smaller [current] shock (✓) Disadvantage: thicker wires have to be used for the same power appliances (✓) because the current taken is bigger (✓)	3
			Question total	**[10]**

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Question			Marking details	Marks Available
7.	*(a)*		accel = $\frac{1.6\times10^{6}}{1.2\times10^{8}}$ = (1 subst or manip)=0.01[3333] [m/s^2] (1 ans)	2
	(b)	(i)	Work = 2400× 1.6 × 10^6 (1) **= 3.84 × 10^9 [J]** (1)	2
		(ii)	Initial K.E. = 0.5 × (1.2 × 10^8) × 5^2 **= 1.5 × 10^9 J (1)** Final K.E. = 0.5 × (1.2 × 10^8) × 9^2 **= 4.86 × 10^9 J** (1) K.E. increase **= 3.36 × 10^9 [J]** [correct answer → 2 marks] **Notes: If** $\frac{1}{2}mv^2$ used correctly twice but with a numerical slip, 1 method mark is available for subtracting correctly.	2
		(iii)	W.D against drag = 3.84 × 10^9 – 3.36 × 10^9 **= 4.8 × 10^8[J]** (1) e.c.f. from *(b)*(i) and (ii) Force = $\frac{WD}{d} = \frac{4.8\times10^{8}(ecf)}{2400}$ (1 – subs) + (1 – manip) **= 2 × 10^5[N]**	3
			Question total	**[9]**
			Total Higher Tier	**50**

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Surname	Centre Number	Candidate Number
Other Names		0

GCSE

0241/02

ADDITIONAL SCIENCE
HIGHER TIER
PHYSICS 2

P.M. MONDAY, 30 January 2012

45 minutes

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**9**	
2.	**4**	
3.	**9**	
4.	**7**	
5.	**12**	
6.	**9**	
Total	**50**	

0241
020001

ADDITIONAL MATERIALS

In addition to this paper you may require a calculator.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.

You are reminded of the necessity for good English and orderly presentation in your answers.

A list of equations is printed on page 2 of the examination paper. In calculations you should show all your working.

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EQUATIONS

Resistance $= \dfrac{\text{voltage}}{\text{current}}$

Current $= \dfrac{\text{power}}{\text{voltage}}$

Distance $=$ speed $\times$ time

Acceleration (or deceleration) $= \dfrac{\text{change in speed}}{\text{time}}$

Resultant force $=$ mass $\times$ acceleration

Work $=$ force $\times$ distance

Kinetic Energy $= \dfrac{\text{mass} \times \text{velocity}^2}{2}$

$= \frac{1}{2} mv^2$

Change in potential energy $=$ mass $\times$ gravitational field strength $\times$ height

$= mg\Delta h$

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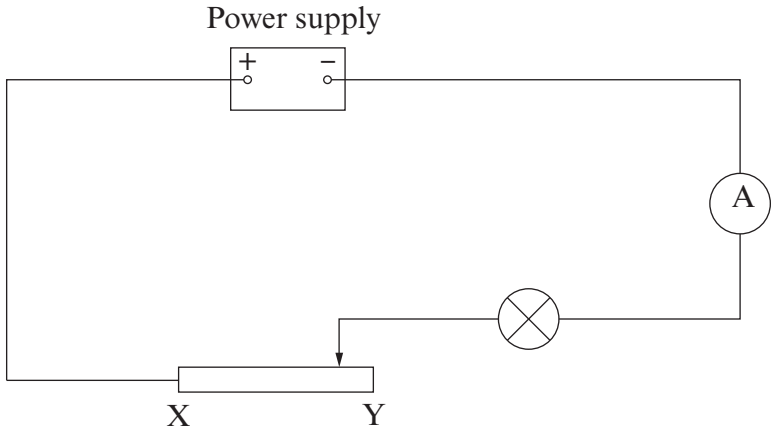
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Examiner only

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

1. A group of pupils set up the following circuit to investigate how the current through a lamp depends on the voltage applied to it.



(a) The ammeter measures the current through the lamp.
Draw a voltmeter on the circuit above that measures the voltage across the lamp. [1]

(b) The slider on the variable resistor is moved to the end Y.

(i) State what effect this has on the current through the lamp. [1]

.....

(ii) State what effect this has on the voltage across the lamp. [1]

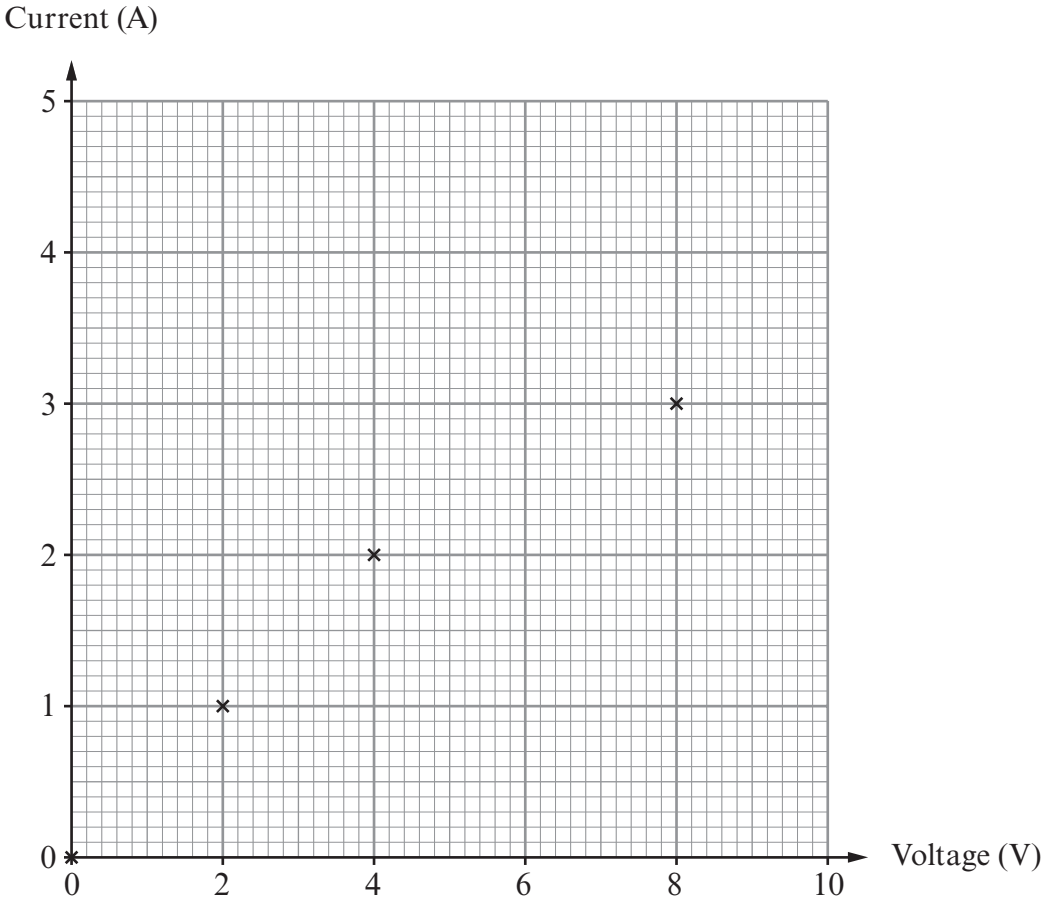
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(c) They obtained the following results and plotted them on the grid on the next page.

Current (A)	Voltage (V)
0.0	0
1.0	2
2.0	4
2.7	6
3.0	8

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(i) One point is missing from the grid.
Plot the missing point on the grid and draw the graph line. [2]

(ii) Use the equation

$$\text{resistance} = \frac{\text{voltage}}{\text{current}}$$

to calculate the resistance of the lamp when the voltage is 8 V. [2]

Resistance = ... Ω

(iii) State how the resistance of the lamp changes as the voltage increases.
Use the graph to explain your answer. [2]

.....

.....

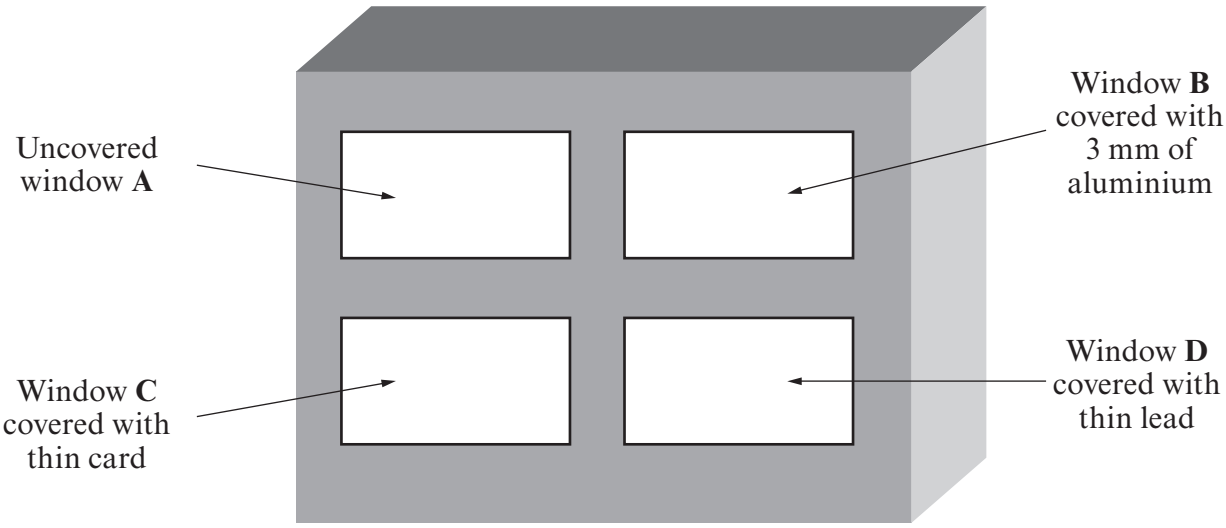
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2. A radiation film badge is used by scientists who work near radioactive materials. The badges consist of four windows, behind which is a radiation sensitive film. Each badge is inspected at the end of the month and a new one is issued.



(a) What is the purpose of having an uncovered window, **A**? [1]

.....

.....

(b) At the end of a particular month, the number of counts detected at the windows was as follows:

Counts made in the month	Window at which these counts were detected	Types of radiations detected
9 500	A	Alpha, beta, gamma
5 500	B	.....
6 250	C	.....
4 800	D	Gamma

Complete the third column in the table. [2]

(c) How many of the counts were produced from just beta radiation? ..... [1]

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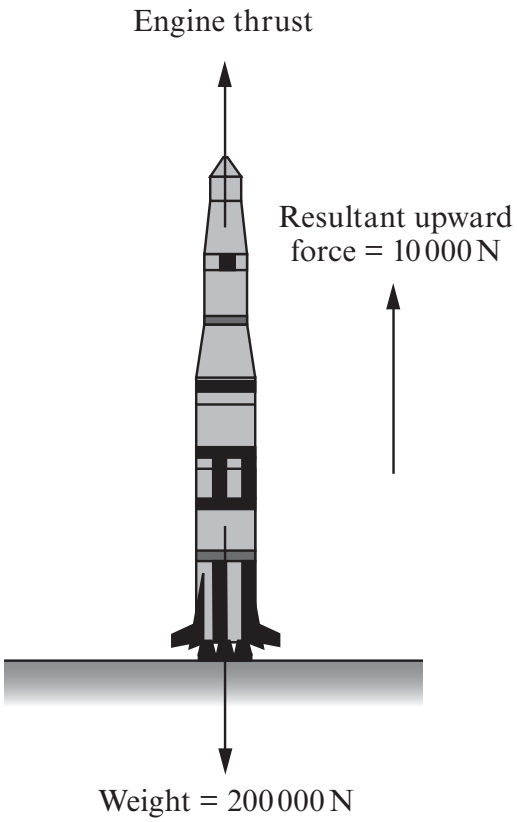
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0241
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3. The diagram shows a space rocket on its launch pad.



The rocket and fuel have a mass of 20 000 kg and weigh 200 000 N.
It is powered by 3 rocket engines.
At lift-off, the resultant upwards force is 10 000 N.

(a) (i) Calculate the upward thrust produced by **each** of the 3 rocket engines. [2]

Thrust = ... N

(ii) Use the equation:

$$\text{acceleration} = \frac{\text{resultant force}}{\text{mass}}$$

to calculate the acceleration at lift-off. [2]

Acceleration = ... m/s^2

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(b) The thrust of the engines remains constant for as long as they are being fired. However, the acceleration of the rocket continues to increase after lift-off. By referring to the equation in *(a)*(ii), explain why the acceleration continues to increase. [3]

.....

.....

.....

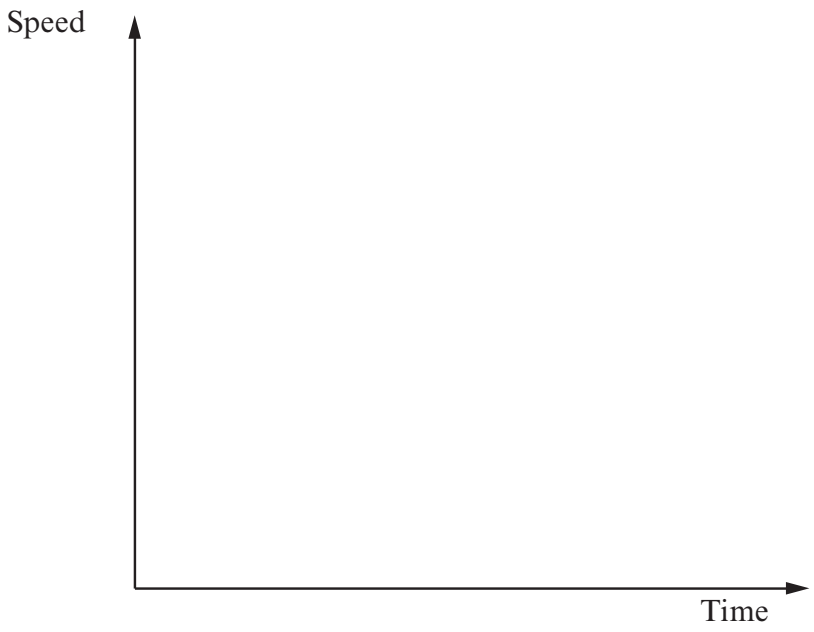
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(c) Sketch the speed-time graph for the rocket on the axes below. [2]



9

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4. *(a)* A number of devices are included in household electrical circuits that give protection to consumers, to appliances and to circuits. Apart from a fuse, name two of these devices. [2]

1. .....

2. .....

(b) A surge in electricity causes too much current to flow through an electric kettle. The fuse in the plug does not break but the kettle circuit switches off.
Explain which safety feature in a household circuit causes this to happen. [2]

.....

.....

.....

.....

(c) The live lead touches the metal casing of a fridge.
Explain carefully how a safety feature in a household electrical circuit makes the fridge safe for the user to touch. [3]

.....

.....

.....

.....

.....

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7

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5. The table gives information about some radioactive isotopes.

Radioactive element	Half life	Radiation emitted
Technetium - 99	8 hours	Gamma
Phosphorus - 32	14 days	Beta
Radon - 230	54.5 seconds	Alpha
Americium - 241	432 years	Alpha
Strontium - 90	29 years	Beta
Cobalt - 60	5 years	Gamma

(a) Explain the meaning of the term "half-life". [2]

.....

.....

.....

.....

(b) Select the most suitable radioactive material for use in each of the following applications. Give a clear reason for your selection. [4]

(i) Monitoring the thickness of aluminium sheet in a factory.

Choice: .....

Reason: .....

.....

.....

(ii) Monitoring internal organs in the body.

Choice: .....

Reason: .....

.....

.....

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(c) A homeowner paid to have measurements taken because she was concerned about the level of radiation from radon gas in her home.
The reading in the house was 550 counts per minute [cpm] in an area where the background count was 30 cpm. The safe level of radiation, called the action level, is 200 cpm above the background level.

(i) Explain why the activity measured in the house remains constant even though the radon has a half-life of only 54.5 seconds. [1]

.....

.....

(ii) How many **times** higher was the radiation from the radon alone greater than the action level? This is called the danger factor. [2]

Danger factor = ...

(iii) After remedial action had been taken, the danger factor fell to 0.6. Calculate the total counts per minute reading in the house from this figure. [3]

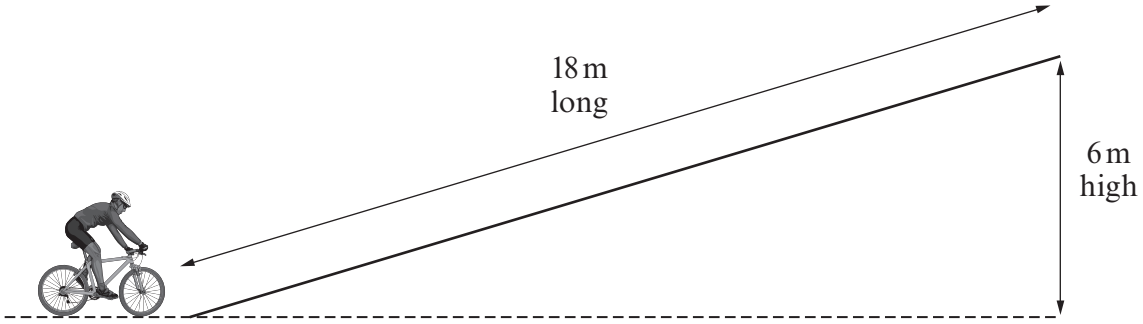
Reading = ... cpm

12

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6. A cyclist and cycle have a total mass of 90 kg.
The cyclist reaches the bottom of a ramp at a speed of 13 m/s and stops pedalling. On reaching the top of the ramp the speed is reduced to 5 m/s.
The ramp is 18 m long and 6 m high.



(a) By using the equations

$$\text{kinetic energy} = \frac{mv^2}{2} \quad \text{and potential energy} = mgh$$

where $g = 10$ N/kg, calculate:

(i) the kinetic energy of the cyclist (and cycle) at the bottom of the ramp. [2]

Kinetic energy = ... J

(ii) the **total energy** at the top of the ramp. [4]

Total energy = ... J

(b) Use your answers to part *(a)* and an equation from page 2 to calculate the frictional force acting against the cyclist up the ramp. [3]

Frictional force = ... N

THERE ARE NO MORE QUESTIONS IN THE EXAMINATION

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WJEC
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GCSE MARKING SCHEME

SCIENCE – PHYSICS (LEGACY)

JANUARY 2012

INTRODUCTION

The marking schemes which follow were those used by WJEC for the January 2012 examination in GCSE SCIENCE – PHYSICS (LEGACY). They were finalised after detailed discussion at examiners' conferences by all the examiners involved in the assessment. The conferences were held shortly after the papers were taken so that reference could be made to the full range of candidates' responses, with photocopied scripts forming the basis of discussion. The aim of the conferences was to ensure that the marking schemes were interpreted and applied in the same way by all examiners.

It is hoped that this information will be of assistance to centres but it is recognised at the same time that, without the benefit of participation in the examiners' conferences, teachers may have different views on certain matters of detail or interpretation.

WJEC regrets that it cannot enter into any discussion or correspondence about these marking schemes.

Unit	Page
Physics 1 (Legacy) Foundation Tier	1
Physics 1 (Legacy) Higher Tier	4
Physics 2 (Legacy) Foundation Tier	7
Physics 2 (Legacy) Higher Tier	10

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PHYSICS 2 (LEGACY)

FOUNDATION TIER

Question			Answer / Explanatory Notes	Marks Available
1.	(a)		head rest [1] (Accept crumple [zone])	1
	(b)		crumple [zone] [1]	1
				2
2.	(a)		10 (m/s) [1] – no tolerance	1
	(b)		3.5 (s) [1] – no tolerance	1
	(c)	(i)	$\frac{10-4}{2}$ [1] = 3 (m/s^2) [1] (no penalty on negative sign)	2
		(ii)	line is less steep [1] (or equivalent, e.g. in 2 s the speed only decreases by about 3 m/s instead of 6 m/s – reference to speed change **and** time needed in this approach)	1
				5
3.	(a)		nucleus [1] Accept neutron / accept plurals.	1
	(b)	(i)	100 [1]	1
		(ii)	5700 + 5700 **or** 11 400 (years) [1] (Credit 5700 + 5700 or 2 x 5700 where the answer has been miscalculated) Not "2 half lives"	1
				3
4.	(a)		The fuse / switch is always in the live wire **or** it is connected / attached to / contains the fuse/switch [1] NOT "is closer to the fuse" "Wire A runs through the fuse" - ok	1
	(b)		OFF [1], ON [1]	2
	(c)		current = $\frac{115}{230}$ [1 - subs]= 0.5 (A) [1 Ans] (N.B 230/115 = 0.5 gets no credit)	2
	(d)		current is <<13 Amp / fuse [value] much bigger than current [1] (Do not accept 'is less than', accept 'Fuse wouldn't melt before danger of a fire'] A suggested lower value of fuse e.g. 3A or 5A ✓ Not the current will never get that high ×	1
	(e)		Earth [1] [Accept: ground]	1
				7

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Question			Answer / Explanatory Notes	Marks Available
5.	(a)	(i) (ii) (iii)	stays the same / the same / same [1] bigger / gets bigger [1] stays the same / the same / same [1]	3
	(b)		**EITHER:** letter W plus arrow downwards [1] A plus arrow downwards [1] [**OR:** Both arrows downwards [1] both downward arrows labelled [1] – 2nd mark requires 1st] NB No requirement for arrows to make contact with ball but need to be within the horizontal extent of the ball.	2 **5**
6.			r.c.d. / residual current device [1] Accept r.c.b. m.c.b./ miniature circuit breaker [1] Accept m.c.d r.c.d. / residual current device [1] Accept r.c.b. NB – more than 1 answer - s.i.f.	3 **3**
7.	(a)		emits radiation [or a named form of nuclear radiation] [1], which damages [or harms] / ionises cells **or** causes mutations / cancer [1] No credit for reference to exposure. "radioactive waves" × "releases" radiation ✓	2
	(b)		cost [/ costly / expensive [1], danger of accident on take-off] (do not accept waste falling to earth on its own) [1] Accept: "can explode [in space and come back to Earth]" / "collide with space debris"	2
	(c)	(i)	long half life / long time to decay [1] Answer must relate to the time – not corrosion. "May be still active" ok	1
		(ii)	It can [or will] leak – reference to leakage [accept contamination of water, soil, food chain] [1]	1 **6**
8.	(a)		12 (m) [1]	1
	(b)	(i)	70 (m) [1] e.c.f. [ie 82 m – answer to (a)]	1
		(ii)	$t = \frac{70(\text{e.c.f.})}{10}$ = [1] 7 (s) [i.e ans to (b)(i)÷10]	2 **4**

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Question			Answer / Explanatory Notes	Marks Available
9.	(a)		correct symbol for voltmeter [accept line through] in parallel with lamp [1] (Above or below it) Accept the voltmeter shown across the lamp / ammeter pair.	1
	(b)	(i)	decreases [1] [not "slows the current"]["changes" – not enough] Not "dimmer"; accept: "the bulb has a lower current through it."	1
		(ii)	decreases [1]	1
	(c)	(i)	cross on coordinate (6, 2.7) ± ½ division[1] reasonably straight line becoming curved after coordinate (4,2) [1] NB – line must include origin but don't penalise for lies beyond 8 V. Badly plotted point – line mark still possible ecf. No double lines.	2
		(ii)	$\frac{8}{3[1]}$ [1 for 3.0 in denominator]= 2.7 (Ω) [Ans 1] (Accept 2.67 or 2.667 but not 2.6, 2.66 or 2.666) NB 2.6, 2.66... → 1 mark] NB 2.6 dot in the calculation gets the second mark even if the answer line shows 2.6 only.	2 **7**
10.	(a)		total radiation [or strength of rad^{n}] received [1] (Accept 'as a control') "To see if any rad^{n} present" ✓ "To see if any rad^{n} let in without protection "✓ "Monitor amount of each type of rad^{n}" – not enough Ref to background radiation × Accept: "to measure radiation going in" [or equiv.] ✓ Accept "total dose" ✓ Accept "to see how much α / alpha" ✓	1
	(b)		THIRD COLUMN ANSWERS: gamma (only) [1], beta & gamma (only)[1]	2
	(c)		750 [accept 1450]	1 **4**
11.		(i)	$\frac{210\,000(\text{N})[1]}{3}$ = 70 000 (N) [1] (No credit for $\frac{200\,000}{3}$) [$\frac{190\,000}{3}$ = 63000 N → 1 mark (ans)] NB Accept 210 000 [N] whenever it appears for the first mark	2
		(ii)	$\frac{10\,000}{20\,000}$ [1] = 0.5 (m/s^2) [1] (N.B $\frac{20\,000}{10\,000}$ = 0.5 gets no credit)	2 **4**
			Totals for foundation paper	**50**

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HIGHER TIER

Question			Answer / Explanatory Notes	Marks Available
1	(a)		correct symbol for voltmeter [accept line through] in parallel with lamp [1] (Above or below it) Accept the voltmeter shown across the lamp / ammeter pair.	1
	(b)	(i)	decreases [1] [not "slows the current"]["changes" – not enough] Not "dimmer"; accept: the bulb has a lower current through it.	1
		(ii)	decreases [1]	1
	(c)	(i)	cross on coordinate (6, 2.7) ± ½ division[1] reasonably straight line becoming curved after coordinate (4,2) [1] NB – line must include origin but don't penalise for lies beyond 8 V. Badly plotted point – line mark still possible ecf.	2
		(ii)	8/3.0 [1 for 3.0 in denominator]= 2.7 (Ohms) [Ans 1] (Accept 2.67 or 2.667 but not 2.6, 2.66 or 2.666) NB 2.6, 2.66... → 1 mark] NB 2.6 dot in the calculation gets the second mark even if the answer line shows 2.6 only.	2
		(iii)	EITHER: using calculations at early and late points[e.g. from (c)(ii)] [1], states that R has increased [1] OR Any 2 × (1) from • R constant up to 4 V ✓ • statement that gradient has decreased [after 4 V]✓ • states R has increased ✓ "The resistance of the lamp increases up to 4 V and then increases more slowly" → 0 marks "Rate at which the current increases gets less"✓	2 **9**
2.	(a)		total radiation [or strength of rad^{n}] received [1] (Accept 'as a control') "To see if any rad^{n} present" ✓ "To see if any rad^{n} let in without protection "✓ "Monitor amount of each type of rad^{n}" – not enough Ref to background radiation ×	1
	(b)		THIRD COLUMN ANSWERS: gamma (only) [1], beta & gamma (only)[1]	2
	(c)		750 [accept 1450]	1 **4**

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Question			Answer / Explanatory Notes	Marks Available
3.	(a)	(i)	$\frac{210\,000(N)[1]}{3}$ = 70 000 (N) [1] No credit for $\frac{200\,000}{3}$ [$\frac{190\,000}{3}$ = 63000 N → 1 mark (ans)]	2
		(ii)	$\frac{10\,000}{20\,000}$ [1] = 0.5 (m/s^2) [1] (N.B $\frac{20\,000}{10\,000}$ = 0.5 gets no credit)	2
	(b)		Any 3 × (1) from • mass decreases..✓ • because the fuel used up.✓ • <u>resultant</u> force increases ✓ • weight decreases ✓ NB weight decreases because gravity decreases – no additional credit.	3
	(c)		Graph starting at origin sloping upwards with correct curvature [increasing gradient] [1], never becoming vertical [1] NB Straight sloping line with upward curve [not vertical] at end → 1 mark NB Zero initial gradient loses first marking point.	2 **9**
4.	(a)		m.c.b. / miniature [accept: mini] circuit breaker, [1][mcd → bod] [1] r.c.d./ residual current device, [1] [rcb → bod] / e.l.c.b. / <u>earth-leakage</u> circuit breaker [1] accept earth lead / wire.✓ NB Not just "circuit breaker", Not insulated wires / plugs	2
	(b)		m.c.b breaks the circuit [1] because it is faster acting than a fuse[1] "Faster acting than fuses" ok even if referring to rcd. Accept "turn off the circuit" / more sensitive. Accept "fast acting" or "immediately" even if not compared to fuse.	2
	(c)		Current / electricity flows to earth [1] **Either** Then [accept senses / measures] there is a <u>difference</u> between the live and neutral <u>currents</u> [1] so r.c.d. breaks the circuit [1] **Or** Large <u>current</u> flows because it is a low resistance path [ ] so fuse [melts and] breaks the circuit [ ] Current through the Earth wire / lead – ok Large current flows causing fuse to melt → 1 mark	3 **7**

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Question			Answer / Explanatory Notes	Marks Available
5.	(a)		time taken [1] for activity / substance / material / mass / nuclei / atoms to reduce by half [1] [Not radioactivity or radiation] accept "half the substance the substance / material to decay" Not ...."for the count to decrease by ½ " but accept "or the count rate to decrease by ½ "	2
	(b)	(i)	Strontium : needs to be beta because fewer beta particles pass through thicker aluminium (not just IT IS A BETA EMITTER)[1]; it has a [reasonably] long half-life [stand alone] [their choice must have at least 5 years ½ life] [1] absorbed if the aluminium is too thick – ok / can penetrate a certain thickness of aluminium - ok	4 max
		(ii)	technetium : must be a gamma emitter because it passes out of the body easily / equivalent [1]AND it has a short [enough] half life [to decay from the body in a short term] [[stand alone but their choice must be technetium or phosphorus] [1] Not just –ionising. + both sources correct [1]	
	(c)	(i)	decayed radon is continually being replaced [1] [however stated, e.g. "there is a constant flow of radon [through cracks]"]	1
		(ii)	subtraction of 30 from 550 = 520 [1] Danger factor $= \frac{520(\text{ecf})}{200} = 2.6$ **or** $\frac{520(\text{ecf})}{230}$ [Ans 1] 2.6 →(2), 2.75 →(1); 2.3 → (2); 2.4 → (1)	2
		(iii)	activity of radon = 0.6 x 200 [1] = 120 [Ans 1] Total activity = 120 + 30 = 150 [Ans 1] ecf on 230 from (ii) for first 2 marks: 0.6(✓) x 230(✓) = 138(✓) → 3 marks. +30 -1 penalty	3
				12

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Question			Answer / Explanatory Notes	Marks Available
6	*(a)*	(i)	0.5 x 90 x 13 x 13 [1] = 7605 (J)[1]	2
		(ii)	PE = 90 x 10 x 6 [1] = 5400 (J) [1] KE = 0.5 x 90 x 5^2 = 1125 (J)[Ans 1] Total energy = 6525 (J)[1] Allow e.c.f. from error in PE or KE NB use of KE from (i) → only first two marks	4
	(b)		Energy conv to work = 7605-6525 = 1080 (J) [Ans 1] e.c.f.from (a)	3
			Force = $\frac{1080}{18}$ [1] [accept answer to (a)(i) &(ii) e.g. 7605 or 6525] = 60(N)[1] ecf from 2nd mark	
				9
			Total for higher tier paper	**50**

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Candidate Name	Centre Number	Candidate Number
		0

WJEC CBAC

GCSE

241/02

ADDITIONAL SCIENCE
HIGHER TIER
PHYSICS 2

A.M. FRIDAY, 27 May 2011

45 minutes

For Examiner's use only		
Question	**Maximum Mark**	**Mark awarded**
1.	**9**	
2.	**8**	
3.	**4**	
4.	**6**	
5.	**5**	
6.	**9**	
7.	**9**	
Total	**50**	

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ADDITIONAL MATERIALS

In addition to this paper you may require a calculator.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.

You are reminded of the necessity for good English and orderly presentation in your answers.

A list of equations is printed on page 2 of the examination paper. In calculations you should show all your working.

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EQUATIONS

Resistance = $\frac{\text{voltage}}{\text{current}}$

Power = current × voltage

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

Resultant force = mass × acceleration

Acceleration = $\frac{\text{change in speed}}{\text{time}}$

Force = $\frac{\text{work done}}{\text{distance}}$

Kinetic Energy = $\frac{\text{mass} \times \text{speed}^2}{2}$

= $\frac{1}{2} mv^2$

Change in potential energy = mass × gravitational field strength × change in height

= mgh

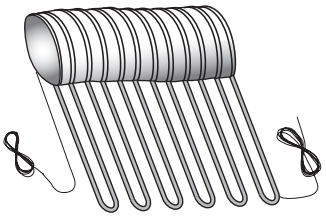
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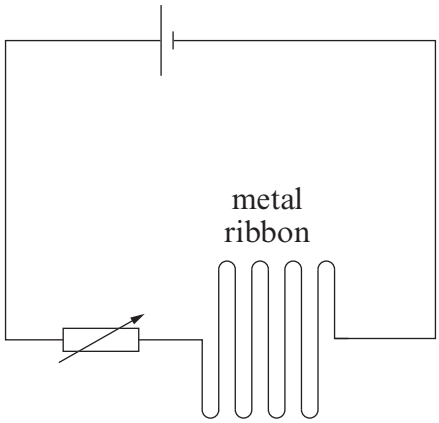
Examiner only

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

1. Homes can now be heated using metal ribbons laid under carpets.



The circuit below is used to find the resistance of the metal ribbons and the power developed in them.



(a) (i) **Add meters to the circuit** that allow you to calculate the resistance of the metal ribbon. [2]

(ii) What is the purpose of the variable resistor? [1]

.....

.....

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(b) When in use the voltage across the ribbons is 230 V and a current of 0.5 A flows through them.

(i) Write down in words an equation from page 2, and use it to calculate the resistance of the ribbons. [3]

Equation: .....

.....

Calculation:

Resistance = ... Ω

(ii) Write down in words an equation from page 2, and use it to calculate the power developed in the ribbons. [3]

Equation: .....

.....

Calculation:

Power = ... W

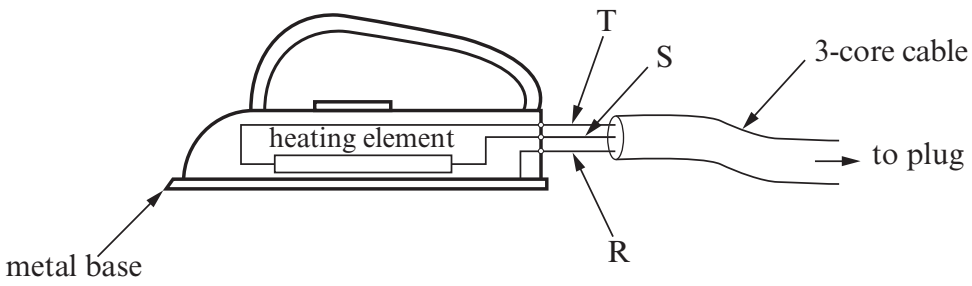
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2. The diagram shows the wiring to an electric iron.



(a) (i) Which wire, R, S or T, is the earth wire? ..... [1]

(ii) Give a reason for your answer. [1]

.....

.....

(iii) Explain how the earth wire protects the user from an electric shock. [2]

.....

.....

.....

.....

(b) (i) State the colour of the insulation covering the live wire. ..... [1]

(ii) Explain why the live wire is connected to the fuse in the plug. [2]

.....

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.....

(c) What is the purpose of the neutral wire? [1]

.....

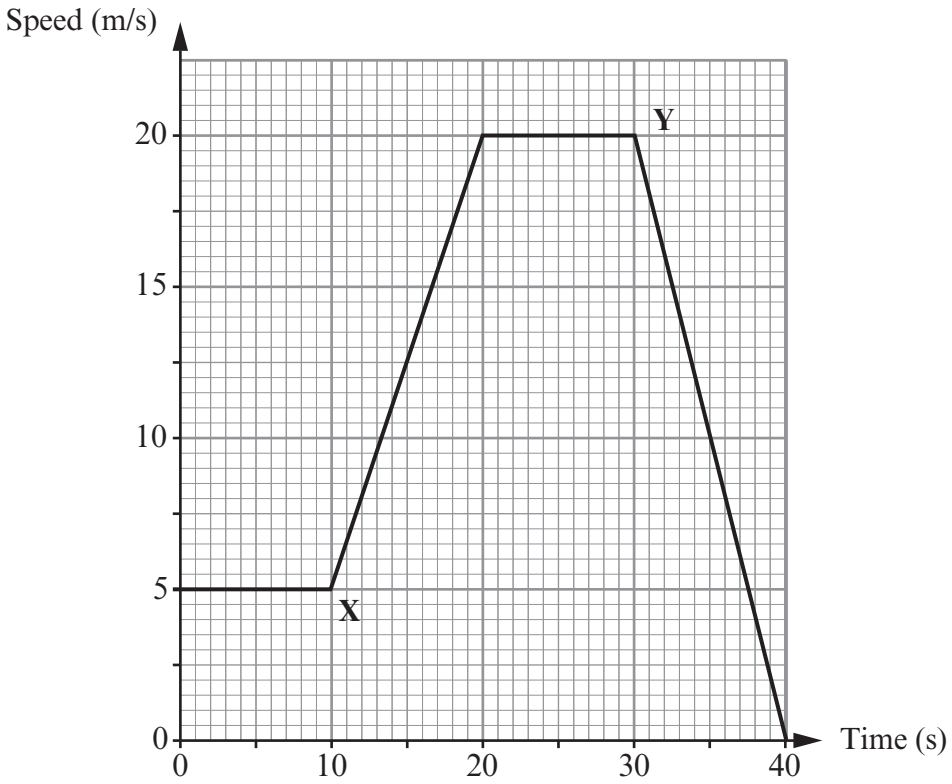
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8

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3. The graph shows the motion of a van for 40 s.



Describe carefully, giving numerical values, the motion of the van between X and Y. [4]

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4

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4. A car travels at 30 m/s. During an accident, the force on a passenger will depend on how long the car takes to stop as shown in the table below.

Time to stop (s)	Force (N)
0.2	12 000
0.4	6 000
0.6	4 000
0.8	3 000

(a) Use the information above and the equations

$$\text{deceleration} = \frac{\text{change in speed}}{\text{time}}$$

$$\text{Force} = \text{mass} \times \text{deceleration}$$

to find the mass of the passenger. [4]

Mass = ... kg

(b) Explain how crumple zones in cars protect passengers. [2]

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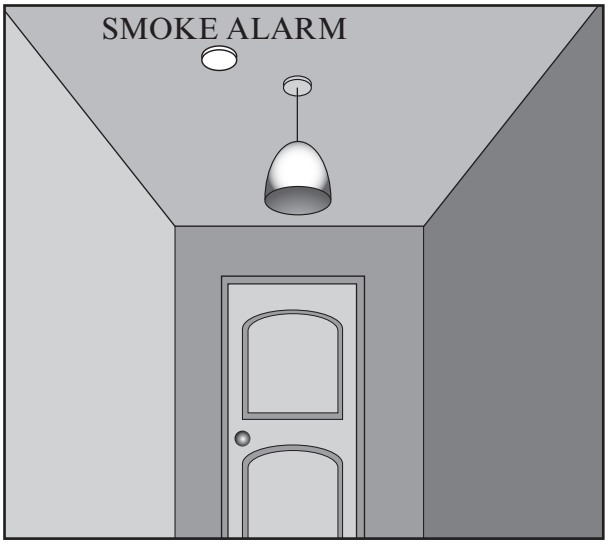
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5. Smoke alarms contain a radioactive source, americium, that emits alpha particles. The alpha radiation produces ions in the air which cross a gap to be picked up by a detector. Smoke stops the alpha radiation from ionising the air. Smoke alarms are usually placed on ceilings.



(a) (i) Explain why americium nuclei are unstable. [1]

.....

.....

(ii) Explain why a radioactive source that emits beta particles would be unsuitable for use in the smoke alarm. [1]

.....

.....

.....

(b) The safety leaflet in the smoke alarm pack informs users that they are at no risk from radiation when the smoke alarm is in normal use. However, there is a significant risk of harm if the smoke alarm is dismantled and the radioactive source swallowed. Explain why there is a difference in risk. [3]

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6. The photograph shows the vertical loop of a roller coaster 30 m high.



A car of mass 500 kg enters the bottom of the loop with a kinetic energy of 250 000 J.

(a) (i) Use the equation

$$\text{Potential energy} = \text{mass} \times g \times \text{height}$$

where g = 10 N/kg, to find the gain in potential energy of the car between the bottom and the top of the loop.. [2]

Gain in potential energy = ... J

(ii) What is the kinetic energy of the car at the top of the loop? [1]

Kinetic energy = ... J

(iii) Use the equation

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

to calculate the speed of the car at the top of the loop. [2]

Speed = ... m/s

(b) Explain why in practice, the speed of the car will be less than the value you have calculated above. [2]

.....

.....

.....

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(c) Towards the end of the ride the KE of the car is 20 000 J and it brakes to a stop in 8 m. Use the equation

Work done = force × distance

to calculate the braking force. [2]

Braking force = ... N

9

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7. Plutonium has several isotopes, all of which are radioactive.

(a) Plutonium-239 is a waste product of nuclear power generation. It has a half life of 24 000 years.
Explain why it is so costly to dispose of plutonium-239 safely. [3]

.....

.....

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.....

(b) Plutonium-238 is a radioactive isotope, with half-life of 88 years, used in radioisotope thermoelectric generators (RTG). RTG are nuclear electrical generators that obtain power from radioactive decay. They are used to provide power to unmanned spacecraft on long missions. The RTG in one type of spacecraft contains 4.8 kg of plutonium. **One gram** of plutonium-238 generates 0.5 W of power. This spacecraft will function normally until the RTG power output drops below 300 W.

(i) Calculate the initial power generated by 4.8 kg of plutonium-238. [2]

Initial power = ... W

(ii) Calculate how long the spacecraft will function normally. [3]

Time = ... years

(iii) Calculate how much plutonium-238 remains in the spacecraft when it stops functioning normally. [1]

Mass = ... kg

9

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Candidate Name	Centre Number	Candidate Number
		0

WJEC CBAC

GCSE

241/02

ADDITIONAL SCIENCE
HIGHER TIER
PHYSICS 2

A.M. WEDNESDAY, 19 January 2011

45 minutes

For Examiner's use only		
Question	**Maximum Mark**	**Mark awarded**
1.	**9**	
2.	**10**	
3.	**7**	
4.	**8**	
5.	**8**	
6.	**8**	
Total	**50**	

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ADDITIONAL MATERIALS

In addition to this paper you may require a calculator.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.

You are reminded of the necessity for good English and orderly presentation in your answers.

A list of equations is printed on page 2. In calculations you should show all your working.

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EQUATIONS

Resistance $= \dfrac{\text{voltage}}{\text{current}}$

Power $=$ current $\times$ voltage

Speed $= \dfrac{\text{distance}}{\text{time}}$

Resultant force $=$ mass $\times$ acceleration

Acceleration $= \dfrac{\text{change in speed}}{\text{time}}$

Force $= \dfrac{\text{Work done}}{\text{distance}}$

Kinetic Energy $= \dfrac{\text{mass} \times \text{speed}^2}{2}$

$= \frac{1}{2} mv^2$

Change in potential energy $=$ mass $\times$ gravitational field strength $\times$ change in height

$= mgh$

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Answer **all** *questions.*

1. The overall stopping distance for a car is given by the equation below:

Overall stopping distance = Thinking distance + Braking distance

The graph below is the speed-time graph for a car initially travelling at a constant speed. The time starts from the moment the driver sees an obstacle on the road.



(i) What is the reaction (thinking) time of the driver of this car? ..... [1]

(ii) Use the equation

distance = speed × time

to calculate the distance travelled by the car during the driver's thinking time. [2]

distance = ... m

(iii) Calculate the total stopping distance for the car if the braking distance is 52.5 m. [1]

Total stopping distance = ... m

(iv) How long does it take the car to come to a stop after the brakes have been applied? [1]

Time = ... s

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(v) Use the equation

$$\text{deceleration} = \frac{\text{change in speed}}{\text{time}}$$

to calculate the deceleration of the car during the time when the brakes are applied. [2]

Deceleration = ... m/s^2

(vi) The mass of the car is 1200 kg.
Use the equation

$$\text{deceleration} = \frac{\text{resultant force}}{\text{mass}}$$

to calculate the size of the resultant force that causes the car to decelerate. [2]

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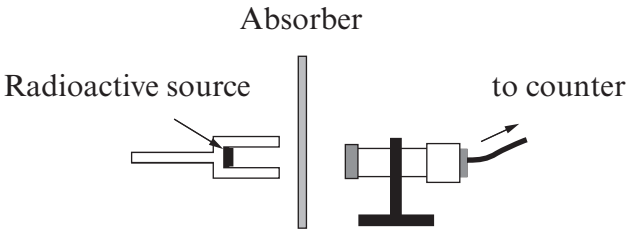
Resultant force = ... N

9

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2. *(a)* The diagram shows the apparatus used to investigate the radiation emitted from two sources, **Y** and **Z**.



The table below shows the **counts per minute** obtained when different materials were placed between the sources and the detector. All the readings do not include background radiation.

Radioactive Source	No absorber Present (counts/min)	Paper Absorber (counts/min)	Aluminium absorber 4 mm thick (counts/min)	Lead absorber 3 cm thick (counts/min)
Y	320	320	320	50
Z	315	180	180	0

Use the information in the table above to answer the following questions.

(i) How can you tell that source **Y** only emits one type of radiation? [1]

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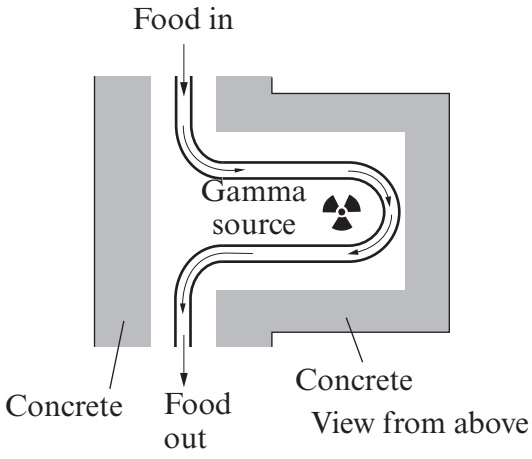
(ii) Explain how you can tell that source **Z** emits alpha and gamma radiation but not beta. [2]

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(b) Fresh fruit and vegetables can be treated with gamma radiation to kill the bacteria that make them rot.
The diagram shows how the food on a conveyor belt passes a gamma source.

(i) The food is packed in crates.
Give a reason why a gamma source must be used rather than alpha or beta. [1]



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(ii) Explain why the food treatment area must be enclosed with thick concrete. [2]

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(iii) Describe how the dose of gamma radiation received by the food can be varied. [1]

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(c) The use of radiation to treat food is controversial. Some people mistakenly believe that the food will become radioactive.

(i) What evidence could scientists provide to show that food treated with radiation is safe to eat? [2]

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(ii) In shops, radiation treated food is labelled with a sign.



Sign for irradiated food

Give a reason it is important to identify food in this way. [1]

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3. Domestic circuits have live, neutral and earth wires and either fuses or circuit breakers.

(a) (i) Describe the purpose of the neutral wire. [1]

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(ii) In modern homes, fuses have been replaced with miniature circuit brakers (mcb). What are the advantages of using mcb instead of fuses? [2]

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(iii) State the type of fault that would cause an mcb to break a circuit. [1]

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(b) Explain how the earth wire and fuse together protect consumers from fire and electric shocks. [3]

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4. Astatine 211 (At-211) is an alpha-emitting radioisotope with a half-life of 7.2 hours. It is used in the treatment of cancer.

(a) The nuclei of At-211 are unstable. Explain why. [2]

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(b) Explain why At-211 is only effective at treating cancer tumours when injected into them. [2]

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(c) (i) Explain what is meant by the statement, "The half-life of At-211 is 7.2 hours." [2]

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(ii) The radiation from At-211 is undetectable after 36 h. Calculate the fraction of the initial activity remaining after this time. [2]

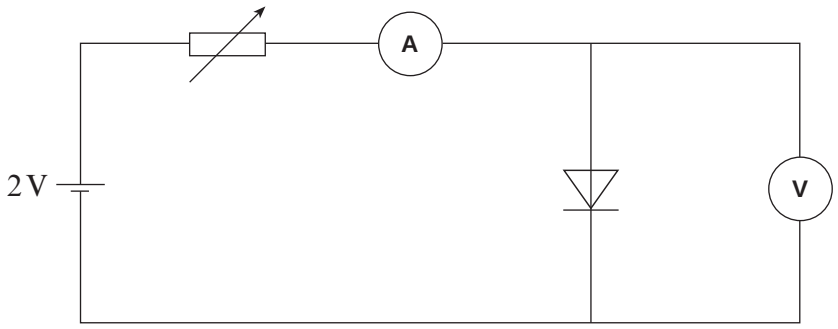
Fraction remaining = ...

8

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5. Students used the following circuit to investigate how the current through a diode changed as they altered the voltage.



(a) The students adjusted the variable resistor. Explain how this allowed a series of readings to be taken. [2]

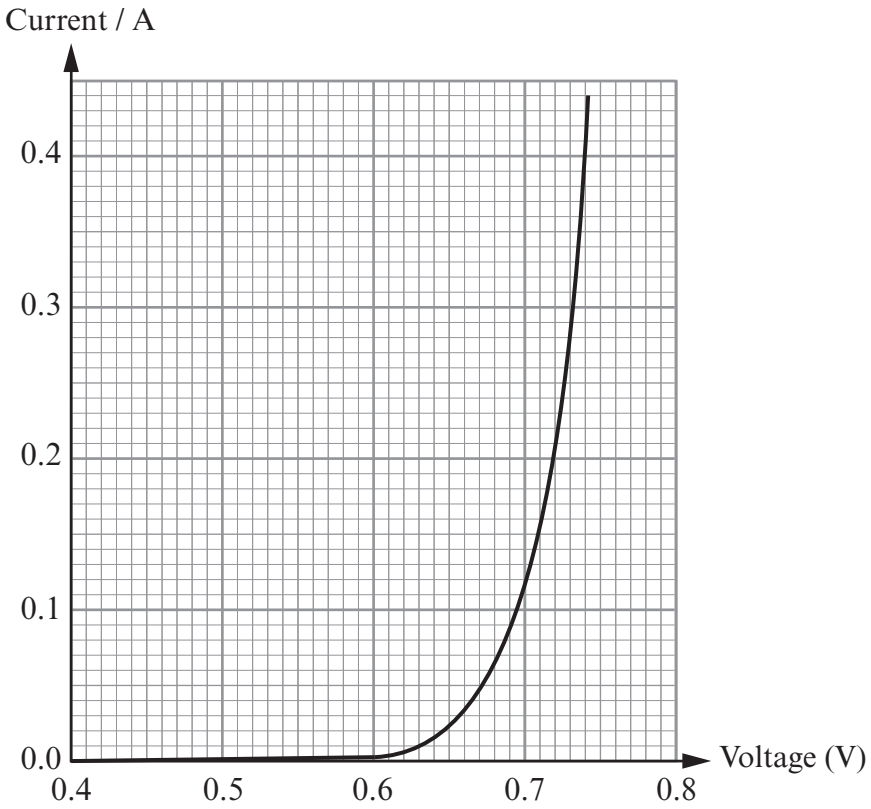
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(b) The students plotted the results as a graph.



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(i) Use the students' graph to find the lowest voltage for which the diode conducted a measurable current. [1]

Lowest voltage = ... V

(ii) Use the equation

$$\text{resistance} = \frac{\text{voltage}}{\text{current}}$$

to calculate the resistance of the diode at 0.7 V. [2]

Resistance = ... Ω

(c) The voltage on the diode was decreased from 0.7 V to 0.6 V.

(i) Use the graph in *(b)* to find the effect this change had on the current flowing through the diode.

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(ii) Use the equation in *(b)* to find the effect this change had on the resistance of the diode.

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[3]

8

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6. A ski lift carries a skier of mass 60 kg from the bottom to the top of a ski-slope. The skier gains 75 000 J of potential energy.

(a) The skier then slides down the slope starting from rest at the top.

(i) Write down an equation connecting kinetic energy, speed and mass as it appears on page 2 and use it to calculate the skier's maximum possible speed when she reaches the bottom of the slope.

Equation: .....

..... [1]

Calculation: [2]

Maximum possible speed = ... m/s

(ii) When her actual speed at the bottom of the hill is measured it is found to be 30 m/s. Explain in detail why her actual speed is less than the one you calculated in part (i). [2]

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(b) At the bottom of the hill the skier slows down from a speed of 30 m/s and stops in a distance of 20 m.
Calculate the average (braking) force needed to stop her in this distance. [3]
You will find the following equation useful in your calculation:

work done = force × distance

Force = ... N

8

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