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.

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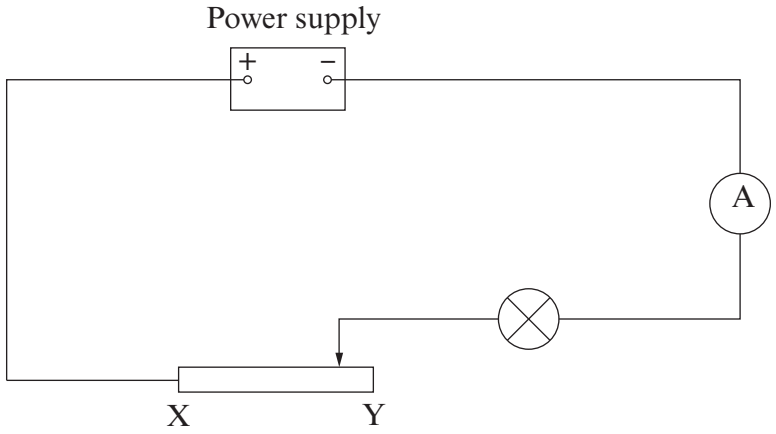
Answer **all** *questions in the spaces provided.*

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]

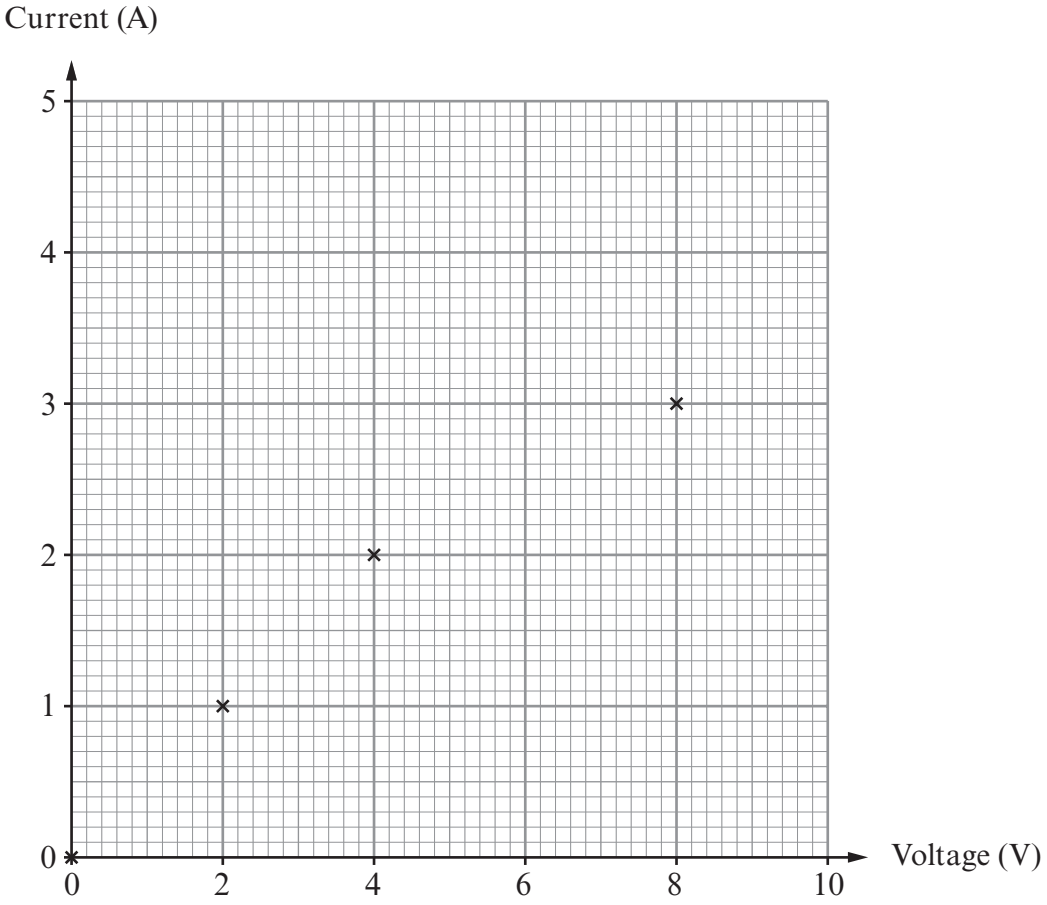
.....

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

.....

(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



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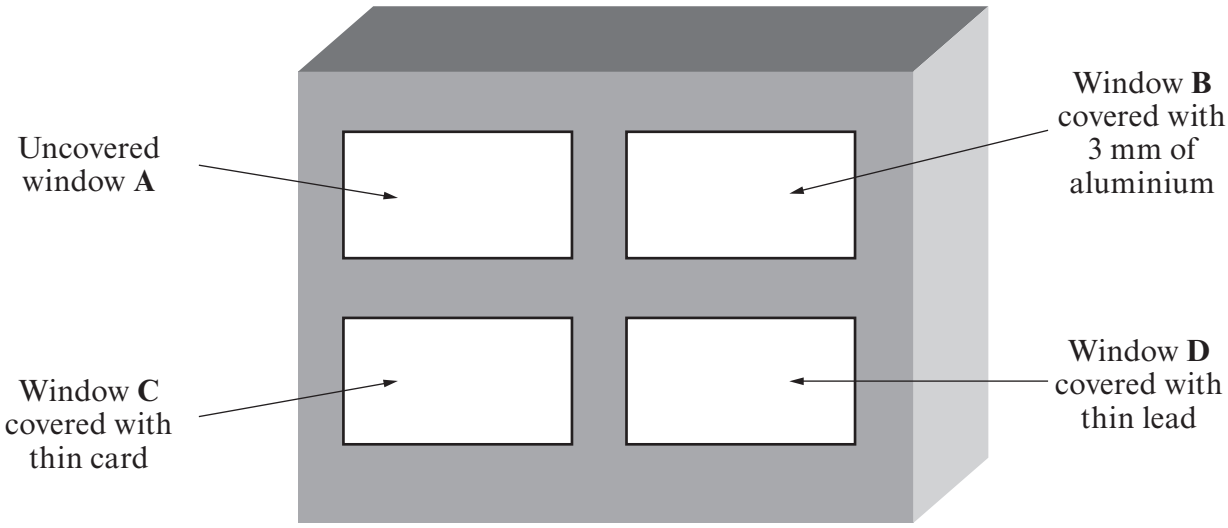
2. A radiation film badge is used by scientists who work near radioactive materials. The badges consist of four windows, behind which is a radiation sensitive film. Each badge is inspected at the end of the month and a new one is issued.



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

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.....

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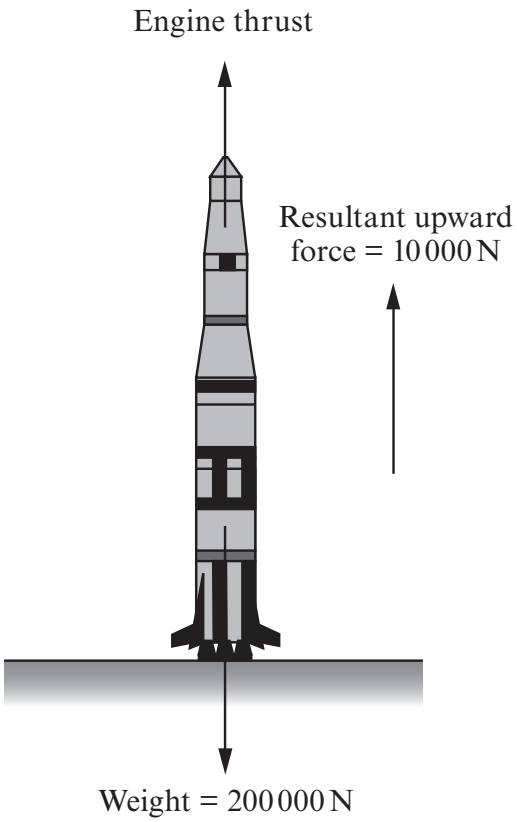
3. The diagram shows a space rocket on its launch pad.



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

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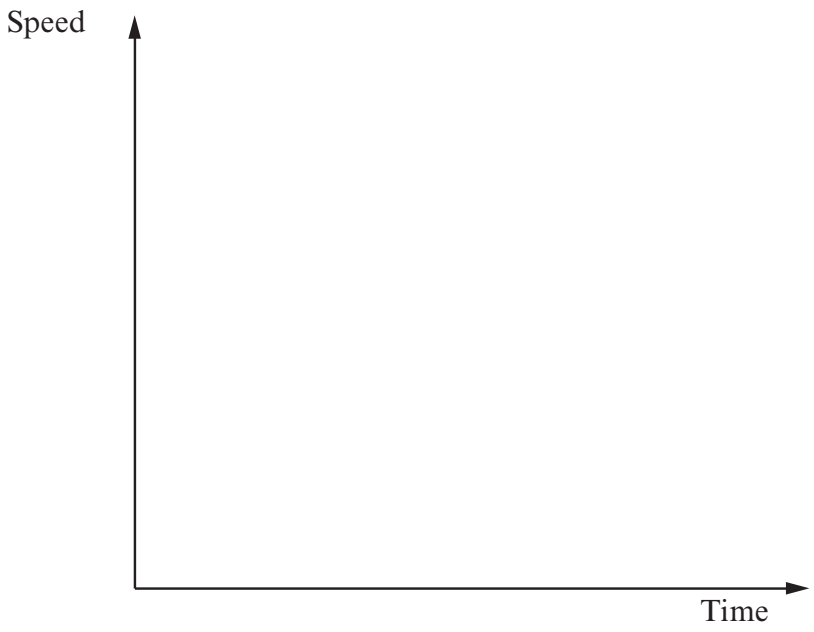
(c) Sketch the speed-time graph for the rocket on the axes below. [2]



9

Examiner only

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]

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(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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Examiner only

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]

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(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: .....

.....

.....

(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]

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.....

(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 = ...

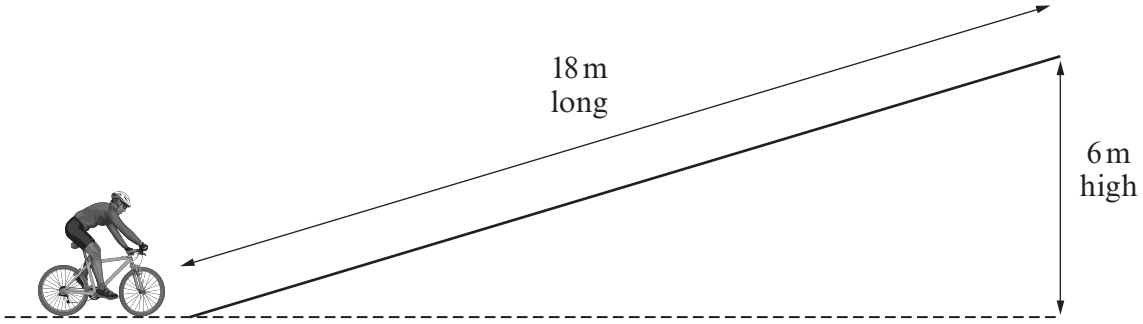
(iii) After remedial action had been taken, the danger factor fell to 0.6. Calculate the total counts per minute reading in the house from this figure. [3]

Reading = ... cpm

12

Examiner only

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