| Candidate Name | Centre Number | Candidate Number |
|---|---|---|
| | | 0 |

WJEC CBAC

# GCSE

241/02

# ADDITIONAL SCIENCE

## HIGHER TIER

## PHYSICS 2

A.M. WEDNESDAY, 20 January 2010

45 minutes

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



W10 241 02

**ADDITIONAL MATERIALS**

In addition to this paper you may require a calculator.

**INSTRUCTIONS TO CANDIDATES**

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

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

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

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

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

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

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

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

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

$$\text{change in potential energy} = \text{mass} \times \text{gravitational field strength} \times \text{change in height}$$

$$= mgh$$

*Answer* **all** *questions*.

**1.** In the diagram, figure **A** represents a 'ring main' circuit used in the home. A power point (socket) is shown correctly wired to the ring main. The switch is shown separately for clarity.
Figure **B** represents another switched power point.

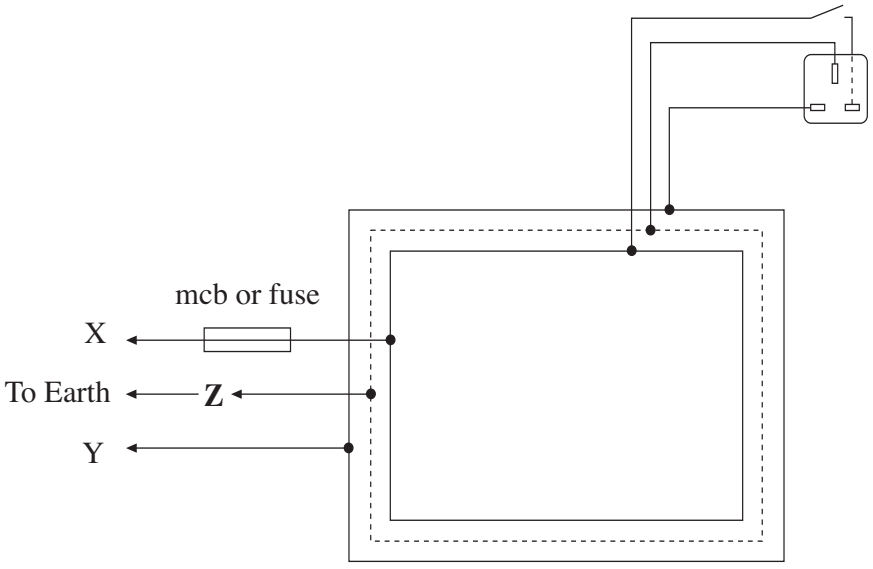


Figure **A**

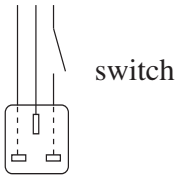


Figure **B**

*(a)* (i) **Complete the diagram** to show how the power point in Figure **B** should be correctly wired into the 'ring main'. [1]

(ii) Give a reason why **X** in Figure **A** must be the live lead. [1]

.....

(iii) An appliance is safely connected to one of these power points. Compare the currents in **X** and **Y**. [1]

.....

*(b)* The metal body of all electrical appliances should be connected to the Earth wire. Explain how this gives protection to the user of the appliance. [2]

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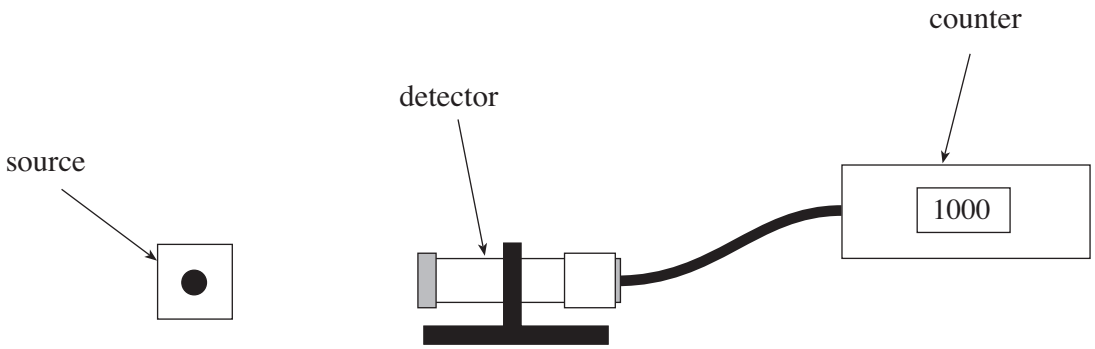
5



**Turn over.**

Examiner only

**2.** Some radioactive elements emit more than one type of radiation. The apparatus below was used to investigate the radiation emitted from a particular source which was placed close to the detector.




The table shows the average number of counts per minute when different absorbers were placed between the source and detector. All figures have been corrected for background radiation.

| Original count / min with no absorber | Count / min with a paper absorber | Count / min with 3 mm Aluminium absorber | Count / min with 1 cm Lead absorber | Count / min with 2 cm Lead absorber |
|---|---|---|---|---|
| 1000 | 900 | 900 | 100 | 0 |

*(a)* (i) By how much does the 1 cm of lead change the **original** count rate? [1]

.....

(ii) What type of radiation passes through 1 cm of lead? ..... [1]

*(b)* How much of the original count rate was produced by:

(i) alpha radiation? ..... count / min

(ii) beta radiation? ..... count / min

(iii) gamma radiation? ..... count / min [3]

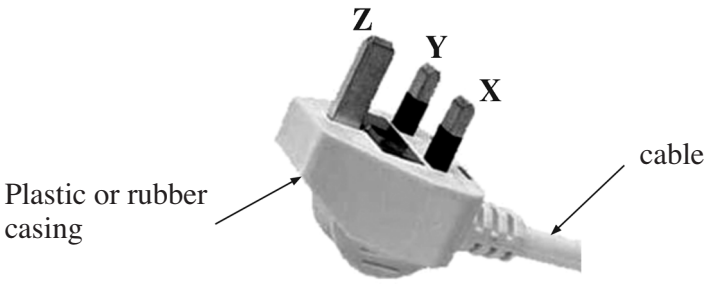
*(c)* What does the phrase, "corrected for background radiation," mean? [1]

.....

.....

6

**3.**




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

*(a)* To which pin should the blue-covered wire be connected? ..... [1]

*(b)* Give a reason why the casing of a 3-pin plug is made of plastic or rubber. [1]

.....

.....

*(c)* State the type of fault that would cause the fuse in the plug to break the circuit. [1]

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.....



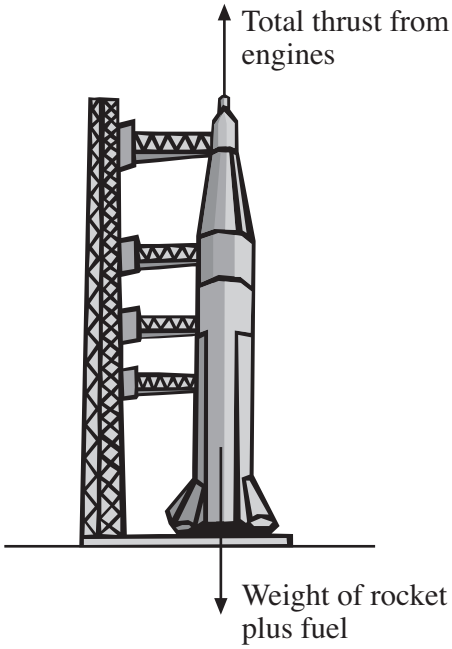
3



**Turn over.**

Examiner only

**4.** The diagram shows a test rocket on its launch pad.




The rocket is powered by 3 engines **each** of which produces a thrust of 2 000 N. The mass of the rocket and its fuel is 500 kg, so that its weight is 5 000 N.

*(a)* When the engines are fired:

(i) Calculate the total thrust on the rocket.

Thrust = ..... N

(ii) Explain why the rocket moves upwards.

.....

.....

(iii) Calculate the resultant force on the rocket.

Resultant force = ..... N

(iv) Use the equation

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

to calculate the take-off acceleration of the rocket.

Acceleration = ..... $m/s^2$

[5]

*(b)* After 2 s, the rocket engines have used up 20 kg of fuel. Assuming that the thrust of the engines is constant, calculate

(i) the mass of the rocket and fuel after 2 s,

Mass = ..... kg

(ii) the **resultant force** in newtons on the rocket after 2 s,

Resultant force = ..... N

(iii) the acceleration of the rocket after 2 s.

Acceleration = ..... $m/s^2$

[3]

*(c)* Assuming that the thrust of the engines is constant, explain why the acceleration of the rocket will continue to increase for as long as the engines are fired. [2]

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10

Examiner only

**5.** *(a)* A small portable electrical generator has a maximum output of 1.5 kW, 230 V a.c.

Select and write down an equation from page 2 and use it to find the maximum current the generator is designed to supply.

Equation: .....

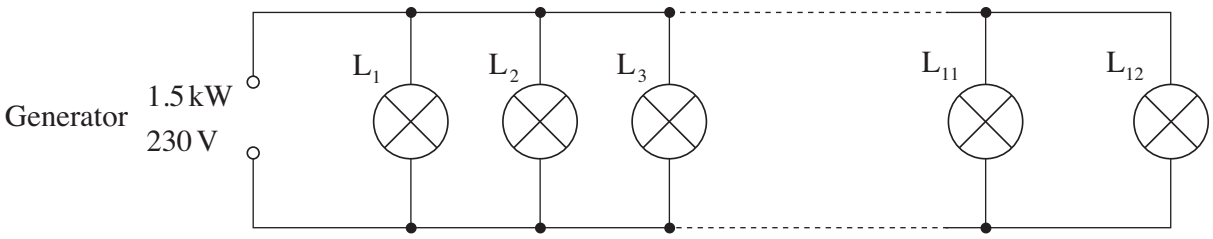
.....

[1]

Calculation [3]

Maximum current = ..... A

*(b)* The generator is used to provide emergency lighting for a building. There are 12 light fittings connected to the generator.




The table shows the type of lamp, the number of each type used in the circuit and the current taken by each type of lamp when lit to full brightness.

| Lamp type | Number of lamps used | Current through each lamp (A) | Current through lamps used (A) |
|---|---|---|---|
| A | 8 | 0.43 | ..... |
| B | 4 | 0.65 | ..... |

Examiner only

(i) **Complete the table** to show the total current taken by both A and B lamps used in the circuit. [2]

(ii) Use the equation selected in *(a)* to calculate the power used to light all 12 lamps in the circuit at full brightness. [3]

Power used = ..... W

9

Examiner only

**6.** Read the information in the box before answering the questions that follow.

> Carbon-14 (C-14) is a beta (β) emitter. It is formed in small quantities in the upper atmosphere by the interaction of cosmic radiation with nitrogen. C-14 mixes with non-radioactive carbon-12 (C-12) in the lower atmosphere, where both C-14 and C-12 are absorbed by the leaves of trees during photosynthesis.
> The wood in living trees shows slight traces of radioactivity because of the presence of C-14. When a tree dies or is cut down, the radioactivity decreases over time because the C-14 in the wood decays and is not replaced by photosynthesis.

*(a)* (i) Give a reason why C-14 is radioactive.

.....

(ii) Explain what happens to a C-14 atom when it decays.

.....

.....

(iii) Give a reason why the radioactivity of living trees remains fairly constant over time.

.....

.....

.....

[5]

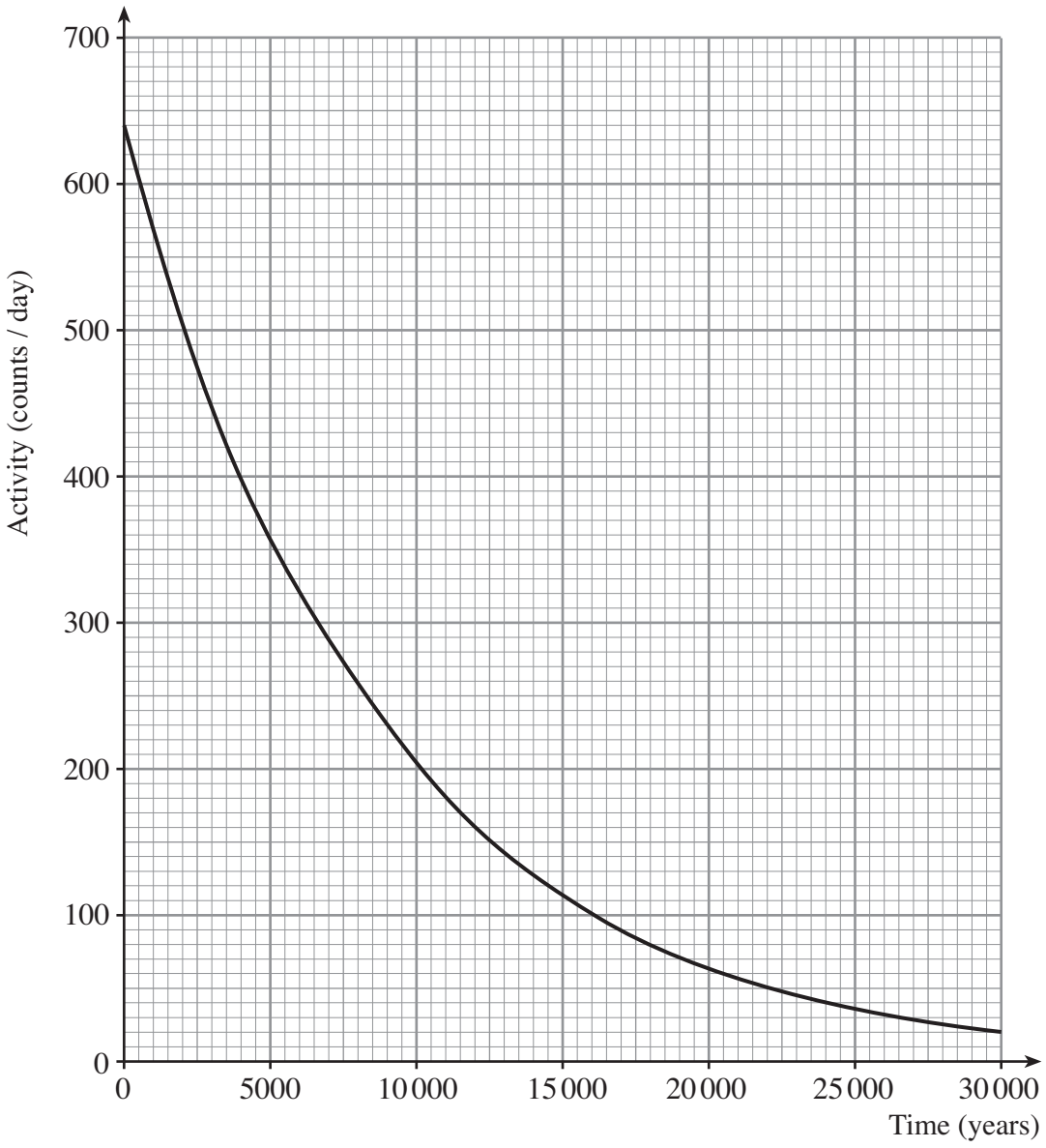
*(b)* A tree is cut down and the graph on the next page shows how the C-14 in **100 gram** of its wood decays over the next 30 000 years.

(i) **Use the graph** to find out how long it would take for the count rate for **100 g** of wood to fall from 300 to 150 counts / day. [1]

Time = ..... years

Examiner only

**Decay graph for C-14 in 100 g of wood**




(ii) A wooden bowl of mass **300 g**, found on an archaeological site, gives a count rate of 600 counts / day.

**Explain** and **show** how the graph for **100 g** of wood could be used to provide an estimate of the age of the bowl. [3]

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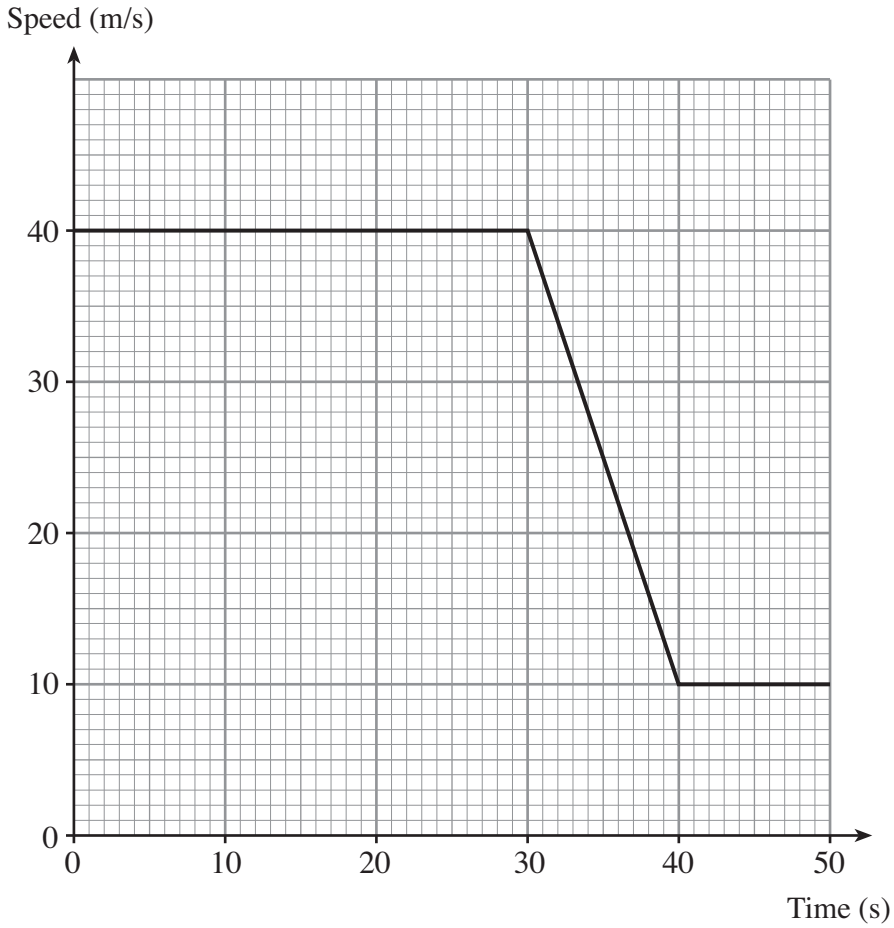
**Turn over.**

Examiner only

**7.** The graph shows a car, of mass 1200 kg, braking hard to reduce speed before entering a speed restriction area.




*(a)* **Use the graph** to find the average speed of the car between 30 s and 40 s (during braking). [1]

Average speed = ..... m/s

*(b)* Use the equation

Distance travelled = average speed × time

to show that the distance travelled during braking is 250 m. [1]

.....

.....

.....

Examiner only

*(c)* Use the equations

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

and Work done = force × distance

to calculate

(i) the change in kinetic energy of the car during braking, [3]

Change in kinetic energy = ..... J

(ii) the average force exerted by the brakes during the 250 m of braking. [2]

Force = ..... N

*(d)* State what has happened to the kinetic energy lost by the car during braking. [1]

.....

.....

8