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**	

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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.

EQUATIONS

Resistance	=	$\dfrac{\text{voltage}}{\text{current}}$
Power	=	current × voltage
Speed	=	$\dfrac{\text{distance}}{\text{time}}$
Resultant force	=	mass × 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 × gravitational field strength × change in height
	=	mgh

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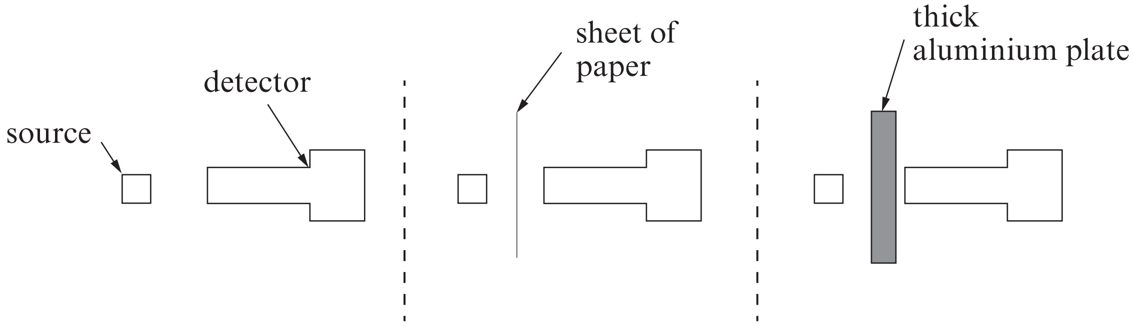
Answer **all** *questions.*

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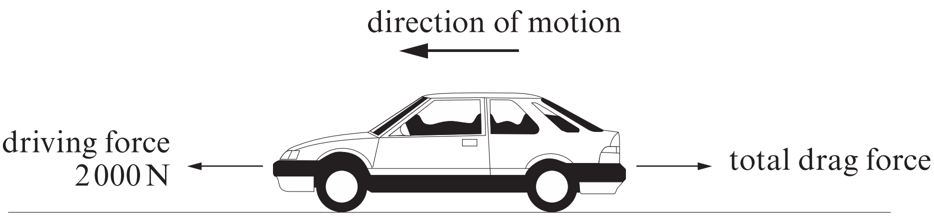
2. The diagram below shows some of the forces acting on a car of mass 800 kg.



(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 3 200 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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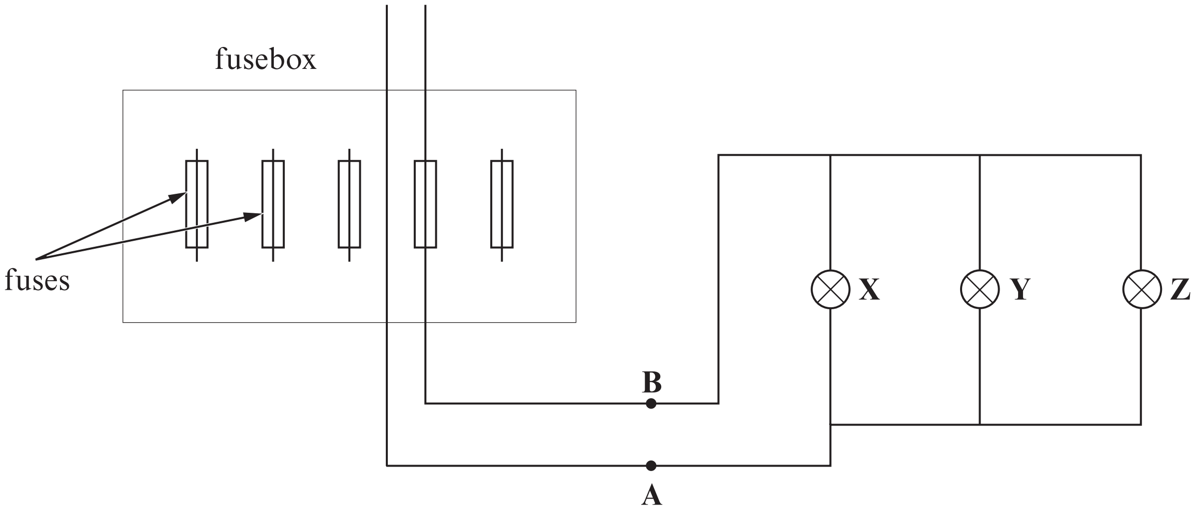
3. The diagram shows part of the household lighting circuit joined into the fusebox.



(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]

....

....

....

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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]

....

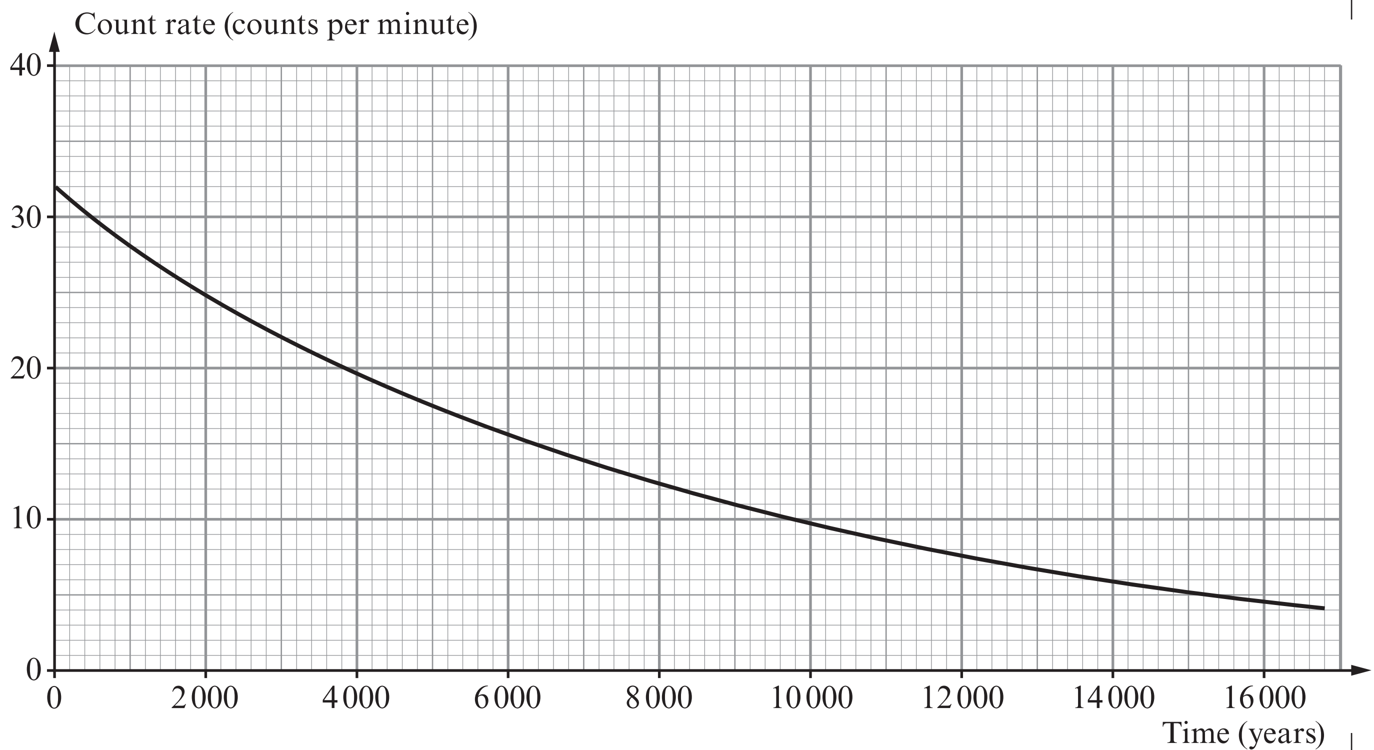
....

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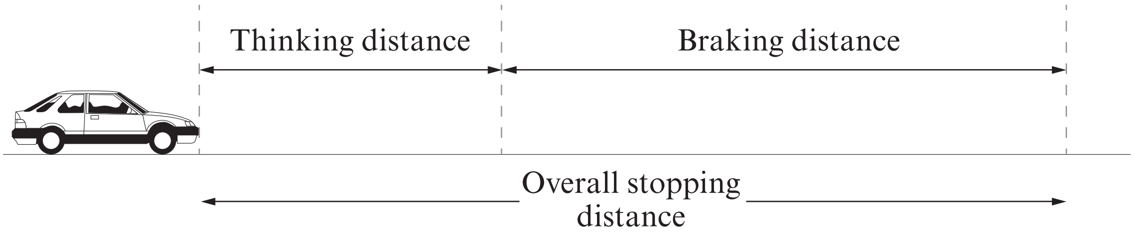
5. The overall stopping distance of a car is made up of two parts: the distance that the car travels when the driver is reacting (thinking distance); and the distance that the car travels after the brakes have been applied (braking distance).



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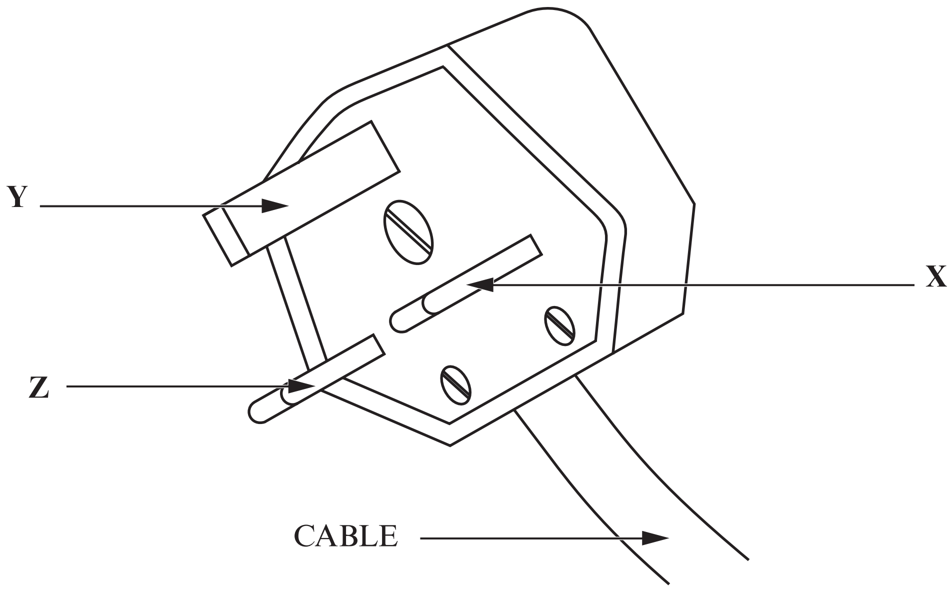
6. Inside the cable of a British 3-pin plug are three wires covered in coloured plastic. They are connected inside the plug to the metal pins **X**, **Y** and **Z**.



(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]

9

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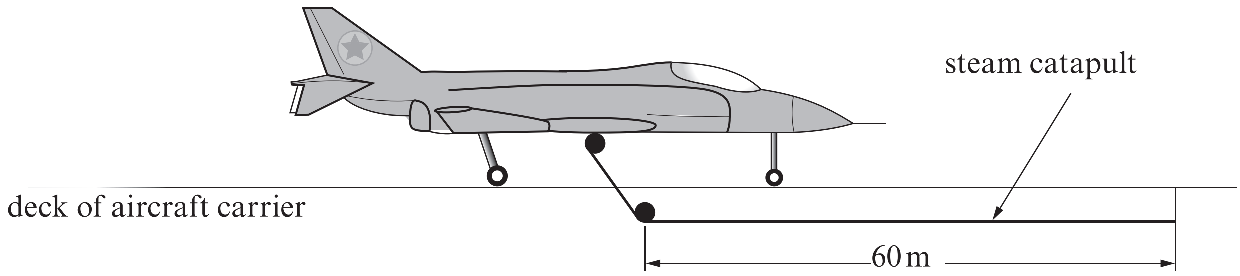
7. To take-off from the deck of an aircraft carrier a fighter jet must have a minimum take-off speed.



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:

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

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

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

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

8

END OF PAPER

