Surname	Centre Number	Candidate Number
Other Names		0

GCSE

4473/01

S16-4473-01

ADDITIONAL SCIENCE/PHYSICS

PHYSICS 2
FOUNDATION TIER

P.M. WEDNESDAY, 25 May 2016

1 hour

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**5**	
2.	**8**	
3.	**7**	
4.	**7**	
5.	**9**	
6.	**11**	
7.	**13**	
Total	**60**	

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ADDITIONAL MATERIALS

In addition to this paper you may require a calculator and a ruler.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen. Do not use gel pen or correction fluid.

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.

If you run out of space, use the continuation page at the back of the booklet, taking care to number the question(s) correctly.

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.

You are reminded that assessment will take into account the quality of written communication (QWC) used in your answer to question **7**(*a*).

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Equations

power = voltage × current	$P = VI$
current = $\dfrac{\text{voltage}}{\text{resistance}}$	$I = \dfrac{V}{R}$
speed = $\dfrac{\text{distance}}{\text{time}}$	
acceleration [or deceleration] = $\dfrac{\text{change in velocity}}{\text{time}}$	$a = \dfrac{\Delta v}{t}$
acceleration = gradient of a velocity-time graph	
momentum = mass × velocity	$p = mv$
resultant force = mass × acceleration	$F = ma$
force = $\dfrac{\text{change in momentum}}{\text{time}}$	$F = \dfrac{\Delta p}{t}$
work = force × distance	$W = Fd$

SI multipliers

Prefix	Multiplier	
m	10^{-3}	$\dfrac{1}{1\,000}$
k	10^{3}	1 000
M	10^{6}	1 000 000

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Answer **all** *questions.*

1. *(a)* The list on the left gives statements about the forces acting on a skydiver falling through the air. The list on the right gives 5 possible effects of these forces on the motion of the skydiver. **Draw one line** from each box on the left to the correct box on the right. [3]

	The skydiver slows down.
Air resistance is greater than the weight.	The skydiver moves upwards.
The air resistance is equal to the weight.	The skydiver speeds up.
The weight is greater than the air resistance.	The skydiver falls at constant speed.
	The skydiver stops.

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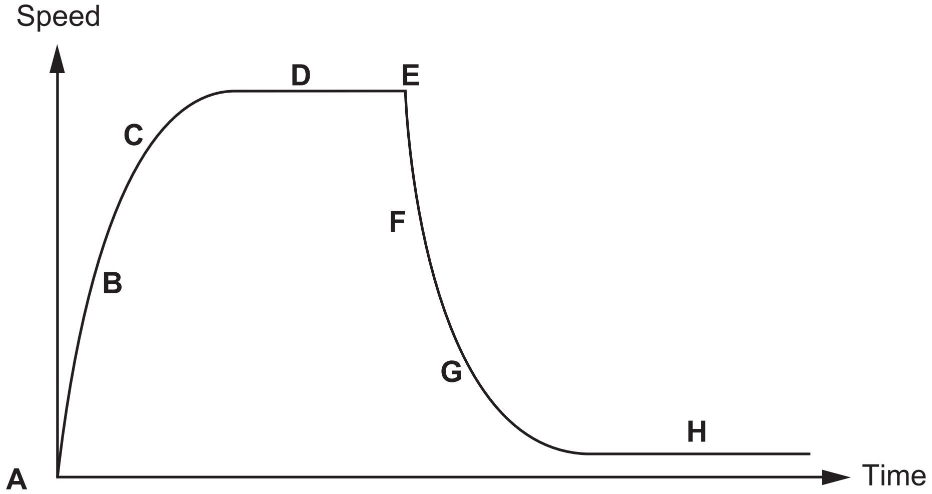
(b) The graph below shows how the speed changes with time for the skydiver.



Choose letters from the graph which complete the following questions.

(i) The point at which the skydiver opens the parachute is .... [1]

(ii) The skydiver is at terminal speed with the parachute open at .... [1]

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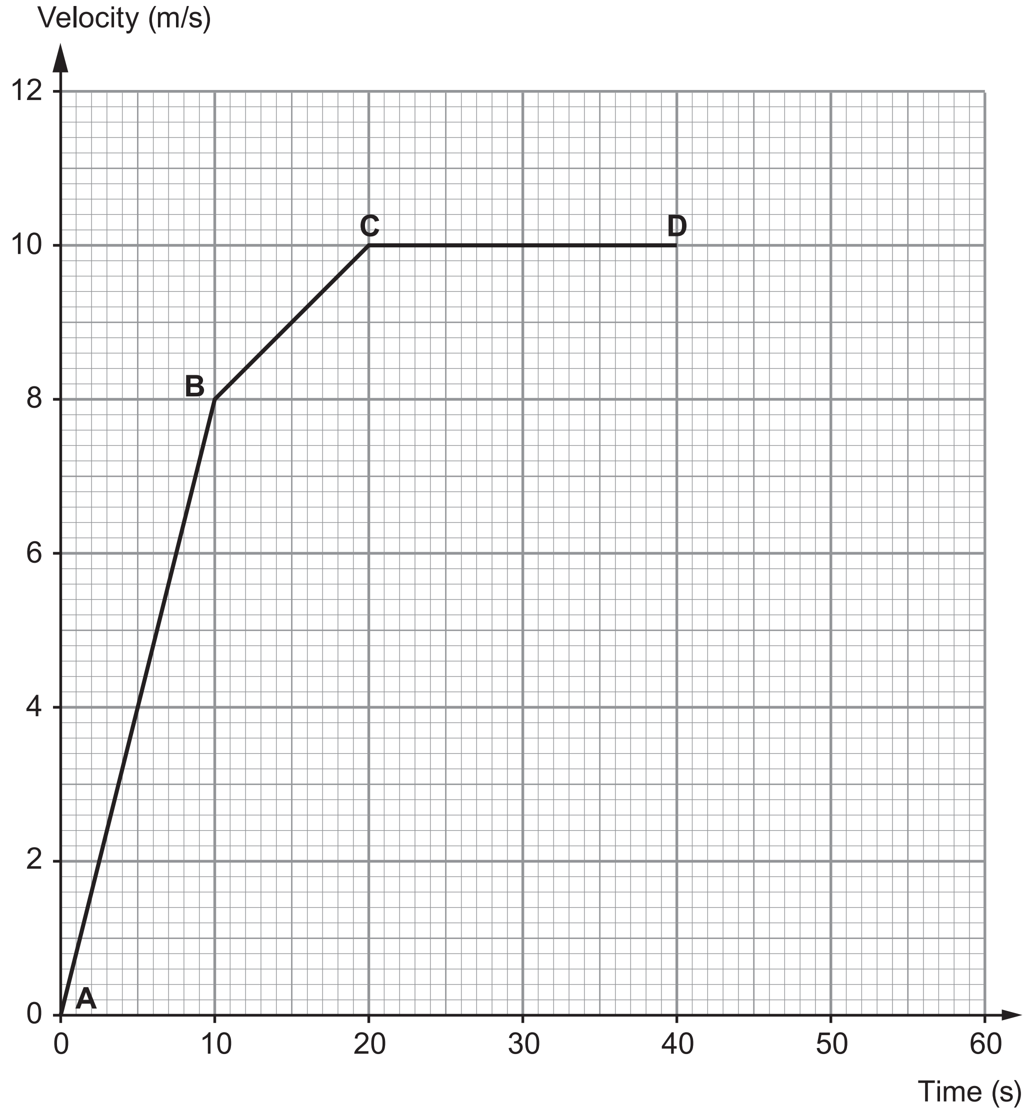
2. Part of the journey of a cyclist is shown on the velocity-time graph below.



(a) (i) Use the equation:

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

to calculate the acceleration of the cyclist between **A** and **B**. [2]

acceleration = ... m/s^2

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(ii) Explain how the acceleration between **B** and **C** is different from **A** to **B**. [2]

....

....

....

(iii) Use the equation:

distance = speed × time

to calculate the distance the cyclist travels between **C** and **D**. [2]

distance = ... m

(b) After 40 s the cyclist decelerates steadily to rest in 15 s. Use this information **to complete the graph**. [2]

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3. The following equation shows a nuclear reaction.

REACTANTS	PRODUCTS

$$ {}^{2}_{1}\mathrm{H} + {}^{3}_{1}\mathrm{H} \rightarrow {}^{4}_{2}\mathrm{He} + {}^{1}_{0}\mathrm{n} $$

(a) The reactants have to move very quickly for this reaction to take place and controlling this reaction on Earth is difficult. **Complete** the following sentences. [2]

(i) The reactants are made to collide with high energies by making the gas

....

(ii) The problem this causes is ....

....

(b) Underline the correct word in the brackets in each sentence below. [3]

(i) The reactants are isotopes of (**hydrogen / helium / neutrons**).

(ii) The reactants have the same numbers of (**neutrons / protons / nucleons**).

(iii) This reaction is an example of a (**fusion / fission / chain**) reaction.

(c) Give **two** reasons why this reaction is likely to be important in the future. [2]

I. ....

....

II. ....

....

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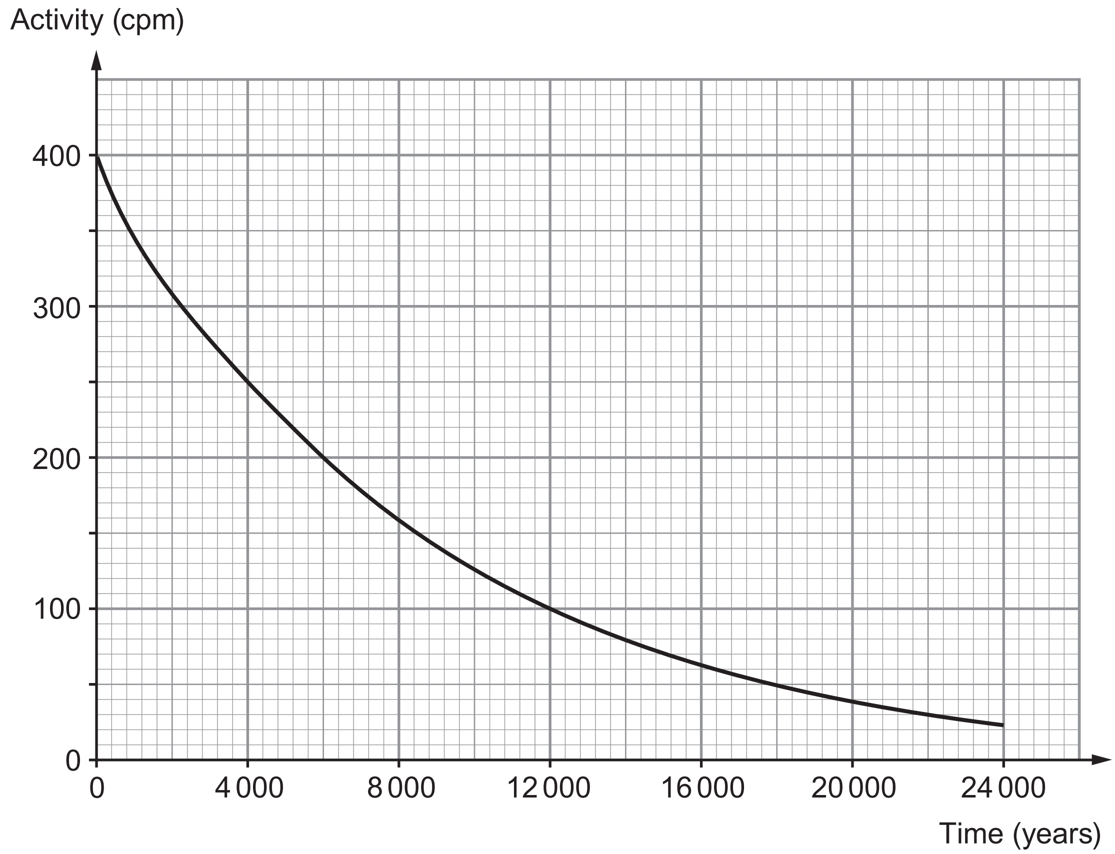
4. The graph below shows the radioactive decay in counts per minute (cpm) of a sample of carbon-14.



(a) (i) Use information from the graph to answer the following questions.

(I) State the activity after 4 000 years. [1]

activity = ... cpm

(II) State the time taken for the activity to fall from 400 cpm to 100 cpm. [1]

time = ... years

(III) State the half-life of carbon-14. [1]

half-life = ... years

(ii) State the time it would have taken for the activity to have fallen from 800 cpm to 400 cpm. [1]

time = ... years

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(b) The nuclear symbol for carbon-14 is ${}^{14}_{6}\mathrm{C}$. **Complete** the following table for the nucleus of carbon-14. [3]

Nucleon number	
Number of protons in its nucleus	
Number of neutrons in its nucleus	

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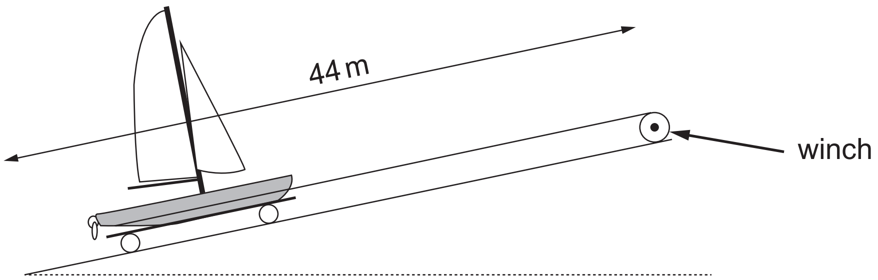
5. The diagram shows a winch that is used to pull a boat 44 m up a ramp.



(a) (i) There is a friction force of 50 N acting against the boat as it is being pulled up the ramp. Use the equation:

work = force × distance

to calculate the work done against friction. [2]

work done against friction = ... J

(ii) The boat has gained 3200 J of potential energy when it is at the top of the ramp. Calculate the total work done by the winch to move the boat up the ramp. [1]

total work done = ... J

(iii) Later, the boat is released from the top of the ramp and it rolls down to the sea. Some of its 3200 J of potential energy is used up as work against friction. Use your answer to *(a)*(i) to calculate the energy it has left when it reaches the sea. [1]

energy = ... J

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(b) The boat of mass 80 kg hits the sea at a speed of 5 m/s and slows down to 1 m/s.

(i) Use the equation:

$$\text{momentum} = \text{mass} \times \text{velocity}$$

to calculate the change in momentum of the boat. [2]

change in momentum = ... kg m/s

(ii) Use the equation:

$$\text{force} = \frac{\text{change in momentum}}{\text{time}}$$

to calculate the force applied by the sea to slow the boat in 2 s. [2]

force = ... N

(iii) State the value of the force applied by the boat on the sea as it slows down. [1]

force = ... N

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Examiner only

6. The table shows the typical thinking and braking distances for a car at different speeds.

Speed in miles per hour (mph)	Thinking distance (m)	Braking distance (m)
20	6	6
30	9	14
40	12	24
50	....	38
60	18	56
70	21	75

(a) (i) **Complete the table.** [1]

(ii) Calculate the overall stopping distance at 40 mph. [1]

stopping distance = ... m

(iii) Explain why the thinking distance changes as the speed increases. [2]

....

....

....

(b) The data in the table applies to an alert driver on a dry day. Describe how the data would compare if the driver is tired. [2]

....

....

....

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To improve motorway safety, some motorways have chevron markers. The gap between one chevron marker and the next is 40 m. Drivers are instructed to keep at least **two chevron gaps** away from the car in front.

(c) Calculate how long it will take to travel 2 chevron gaps at the motorway speed limit of 31 m/s (70 mph) using the equation: [3]

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

time = ... s

(d) Explain why the data in the table opposite shows the two chevron rule may not keep motorists safe even if they are travelling in a car at the motorway speed limit. [2]

....

....

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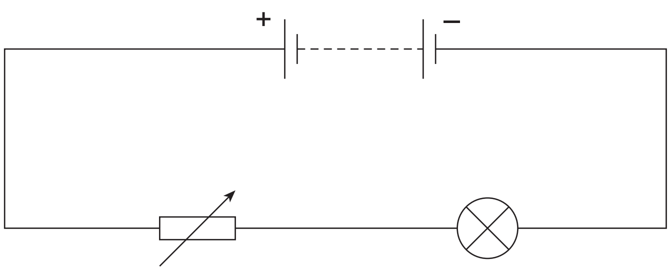
Examiner only

7. The diagram shows a lamp connected to a battery and a variable resistor.



(a) Describe how the circuit can be used to obtain a **series of measurements** to show how the current through the lamp varies with the voltage across it. [6 QWC]

In your answer you should:

- include the names of the measuring instruments needed;
- **add these instruments** to the circuit diagram above;
- describe how a series of measurements is obtained.

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Examiner only

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TURN OVER FOR THE REST OF THE QUESTION

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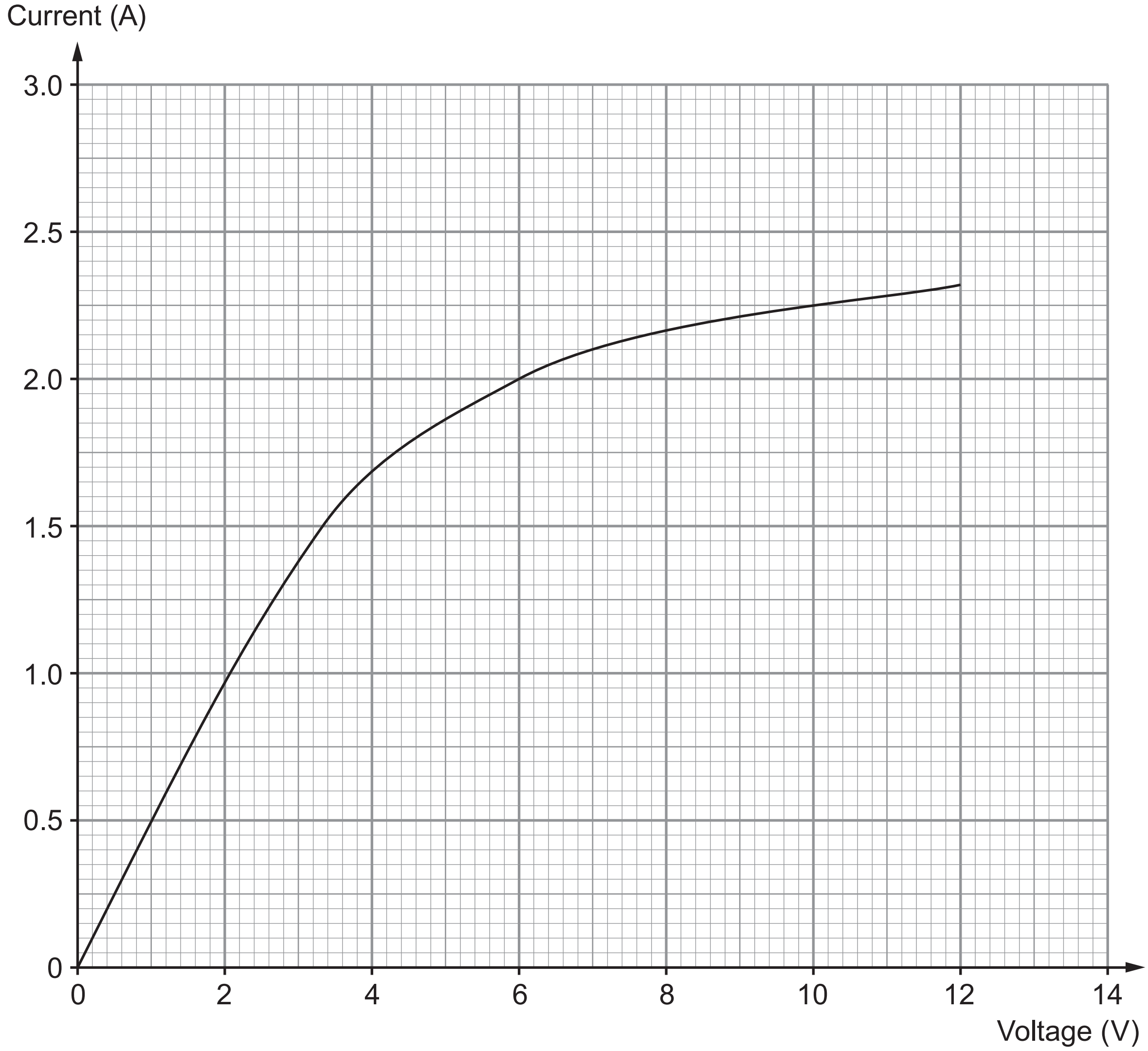
(b) The current through the lamp was measured for voltages up to 12 V. A graph of the results is shown on the grid below.



(i) Use the graph to find the current through the lamp when a voltage of 6 V is applied to it. [1]

current = ... A

Examiner only

(ii) Use the equation:

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

to calculate the resistance of the lamp at 6 V. [2]

resistance = ... Ω

(iii) Use an equation from page 2 to calculate the power produced by the lamp at 6 V. [2]

power = ... W

(iv) The lamp is replaced by a resistor which remains at constant temperature. At 10 V the resistor and lamp have the same resistance. **Add a line** to the graph to show how the current through the resistor varies with voltage. [2]

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Question number	Additional page, if required. Write the question number(s) in the left-hand margin.

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