Surname	Centre Number	Candidate Number
Other Names		0

GCSE

4473/02

S16-4473-02

ADDITIONAL SCIENCE/PHYSICS

PHYSICS 2
HIGHER TIER

P.M. WEDNESDAY, 25 May 2016

1 hour

4473 020001

For Examiner's use only		
Question	Maximum Mark	Mark Awarded
1.	11	
2.	13	
3.	9	
4.	6	
5.	7	
6.	14	
Total	60	

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 answers to questions **2**(*a*) and **6**(*b*).

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Equations

power = voltage × current	$P = VI$
current = $\frac{\text{voltage}}{\text{resistance}}$	$I = \frac{V}{R}$
power = current^2 × resistance	$P = I^2R$
speed = $\frac{\text{distance}}{\text{time}}$	
acceleration [or deceleration] = $\frac{\text{change in velocity}}{\text{time}}$	$a = \frac{\Delta v}{t}$
acceleration = gradient of a velocity-time graph	
distance travelled = area under a velocity-time graph	
momentum = mass × velocity	$p = mv$
resultant force = mass × acceleration	$F = ma$
force = $\frac{\text{change in momentum}}{\text{time}}$	$F = \frac{\Delta p}{t}$
work = force × distance	$W = Fd$
kinetic energy = $\frac{\text{mass} \times \text{speed}^2}{2}$	$KE = \frac{1}{2}mv^2$
change in potential energy = mass × gravitational field strength × change in height	$PE = mgh$

SI multipliers

Prefix	Multiplier
p	10^{-12}
n	10^{-9}
µ	10^{-6}
m	10^{-3}

Prefix	Multiplier
k	10^{3}
M	10^{6}
G	10^{9}
T	10^{12}

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Answer **all** *questions.*

1. 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]

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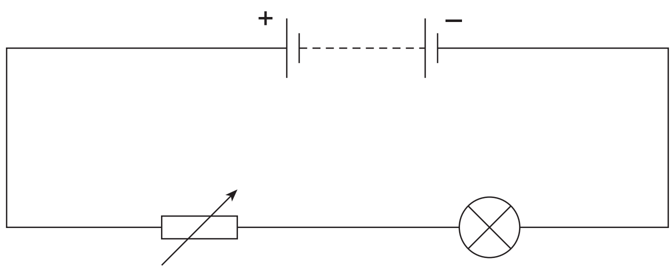
2. The diagram shows a lamp connected to a battery and a variable resistor.



(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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TURN OVER FOR THE REST OF THE QUESTION

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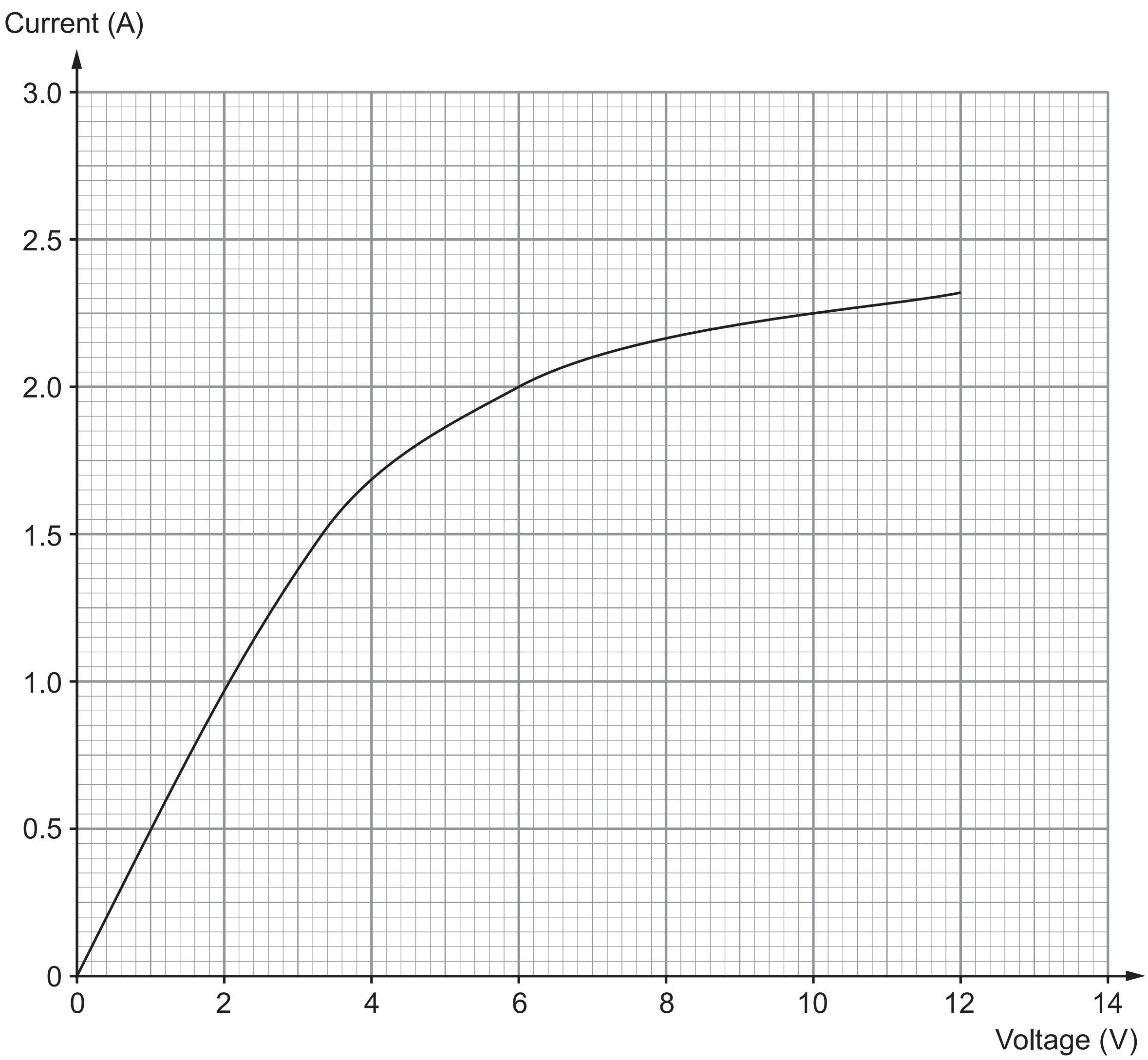
(b) The current through the lamp was measured for voltages up to 12 V.
A graph of the results is shown on the grid below.



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

current = ... A

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(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

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(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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3. Nuclear medicine uses radioisotopes which emit radiation from within the body. One tracer uses iodine, which is injected into the body to treat the thyroid gland. The table shows four isotopes of iodine.

Form of iodine	Radiation emitted	Half-life
iodine-125	gamma	59.4 days
iodine-128	beta	25 minutes
iodine-129	beta and gamma	15 000 000 years
iodine-131	beta and gamma	8.4 days

(a) Iodine-129 emits both beta and gamma radiation. Describe the nature of these types of radiation. [2]

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(b) The table shows that the half-life of iodine-125 is 59.4 days. State what this means. [2]

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(c) (i) Use the data to explain why iodine-131 is the most suitable form of iodine for treating thyroid cancer. [2]

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(ii) Patients are advised that after treatment with iodine-131, the radiation they are exposed to will not drop to the background value until 12 weeks after treatment. Calculate the fraction of radioactivity due to iodine-131 remaining after 12 weeks. [3]

fraction remaining = ...

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4. Energy can be released in nuclear fission and nuclear fusion reactions.

(i) Explain how a sustainable, controlled chain reaction is achieved in a nuclear fission reactor containing uranium fuel rods, a moderator and control rods. [4]

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(ii) Explain why controlled nuclear fusion reactions are difficult to achieve on Earth. [2]

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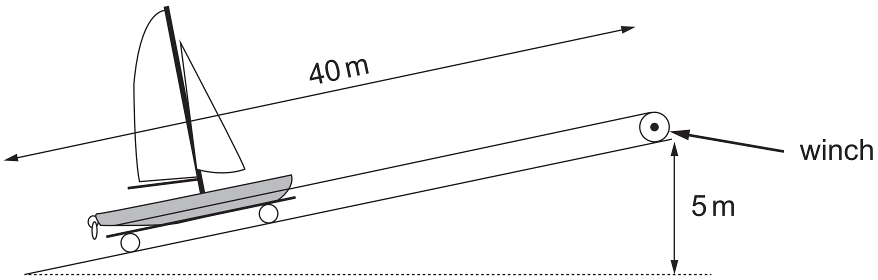
5. The diagram shows a winch which is used to pull a boat 40 m up the slipway through a height of 5 m.



Use equations from page 2 to answer the following questions.

(i) Calculate the gain in potential energy of the boat when it is pulled up to the top of the slipway. (Mass of boat = 1 200 kg; gravitational field strength = 10 N/kg) [2]

gain in potential energy = ... J

(ii) A frictional force of 1 000 N acts against the boat as it is pulled up the slipway. Calculate the work done against this frictional force. [2]

work done = ... J

(iii) Calculate the force that must be applied by the winch in pulling the boat up the slipway. [3]

force applied by winch = ... N

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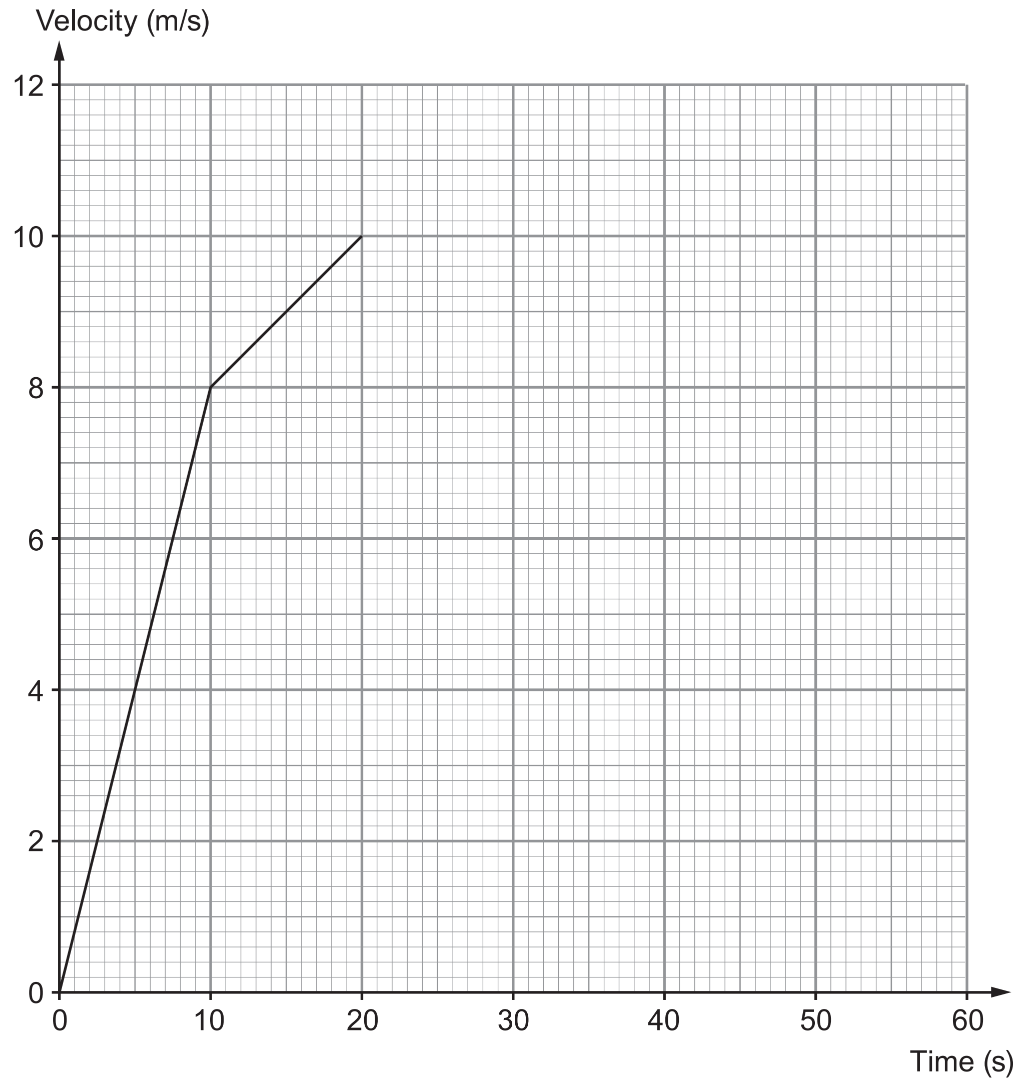
6. Part of the journey of a cyclist is represented on the velocity-time graph below.



(a) (i) Select an equation from page 2 and use it to calculate the acceleration of the cyclist between 10 s and 20 s. [2]

acceleration = ... m/s^2

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(ii) Select an equation from page 2 and use it to calculate the distance the cyclist travels between 10 s and 20 s. [2]

distance = ... m

(iii) After 20 s the cyclist continues at constant velocity for 15 s and then decelerates to rest with constant deceleration of 0.5 m/s^2. Use this information along with an equation from page 2 **to complete the graph**. [4]
Space for calculations if needed.

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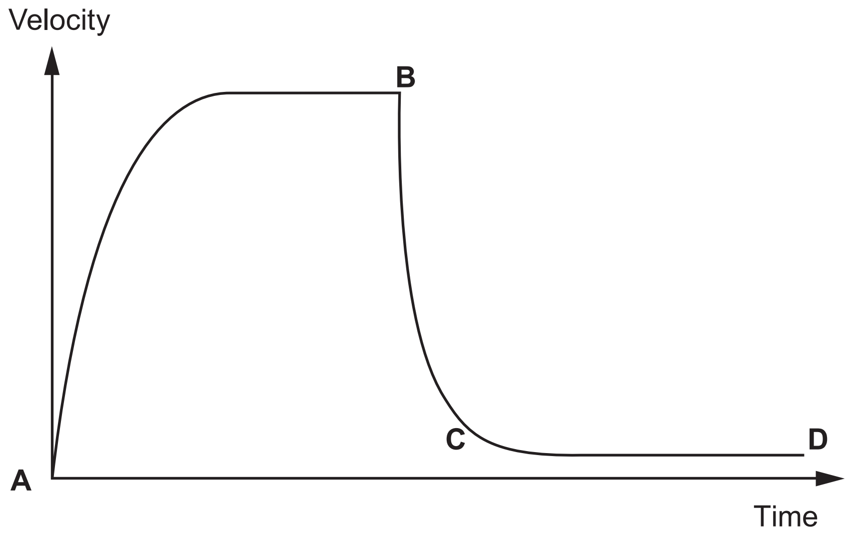
(b) Another velocity-time graph is shown below. It represents the motion of a skydiver.



Describe and explain the motion of the skydiver in **terms of forces**. [6 QWC]

Include in your answer:

- the type of motion in each region, **AB**, **BC**, and **CD**;
- the forces acting in each region and how they compare.

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END OF PAPER

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

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