Surname	Centre Number	Candidate Number
Other Names		0

GCSE

4473/02

S15-4473-02

ADDITIONAL SCIENCE/PHYSICS

PHYSICS 2
HIGHER TIER

P.M. WEDNESDAY, 20 May 2015

1 hour

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**11**	
2.	**7**	
3.	**6**	
4.	**14**	
5.	**13**	
6.	**9**	
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 answers to questions **3** 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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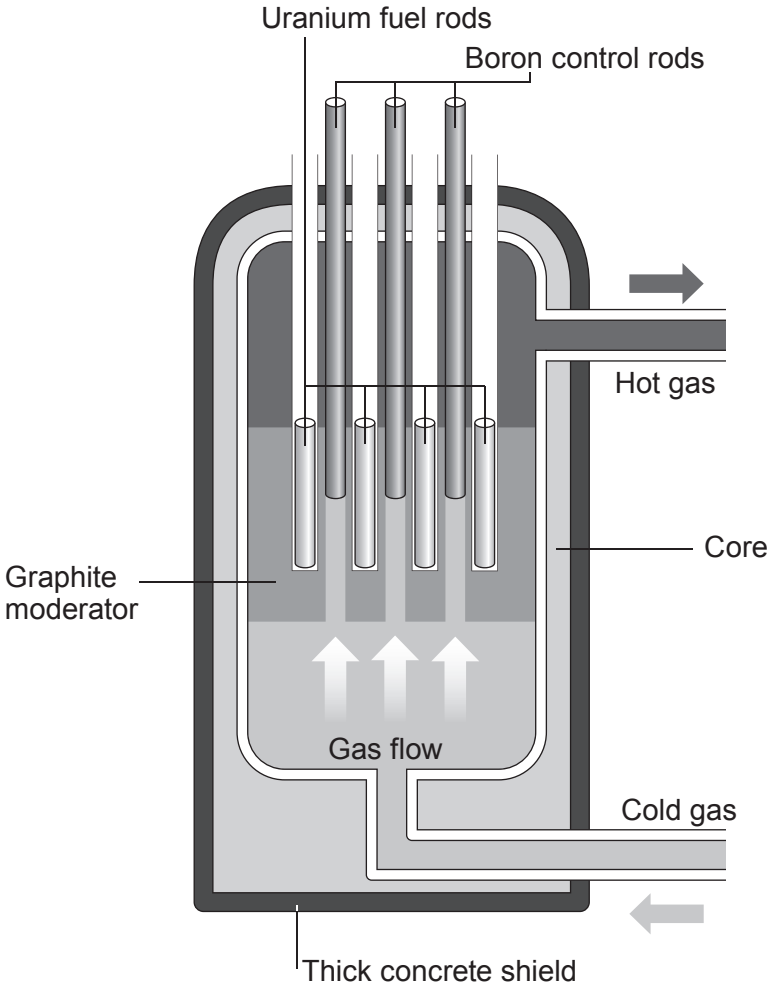
Answer **all** *questions.*

1. Read the information in the passage and study the diagram before answering the questions that follow.

In the reactor, energy is released by fission and is the result of a controlled chain reaction. Fuel rods are made of uranium. The graphite moderator surrounds the fuel rods. The boron control rods can be raised and lowered.

The diagram shows the important parts in the core of a gas-cooled nuclear reactor.



(a) (i) Describe the process of fission of a single uranium nucleus in a gas-cooled reactor. [2]

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(ii) Explain the purpose of the graphite moderator. [2]

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(iii) Explain why raising the boron control rods increases the energy released in the reactor. [2]

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(b) The table below shows different isotopes of uranium (U).

Isotope	Nuclear symbol
U-230	$^{230}_{92}U$
U-234	$^{234}_{92}U$
U-235	$^{235}_{92}U$
U-238	$^{238}_{92}U$

(i) Tick (✓) the boxes next to **three** correct statements about the isotopes shown in the table. [3]

All the isotopes have nuclei which contain 92 neutrons ☐

A nucleus of U-230 contains the least number of neutrons ☐

A nucleus of U-235 contains 143 neutrons ☐

A nucleus of U-234 contains 92 protons ☐

A nucleus of U-238 contains 238 protons ☐

(ii) Complete the following nuclear equations which show the decay of two of the uranium isotopes listed in the table above. [2]

$$^{238}_{92}U \rightarrow {}^{4}_{2}He + {}^{.....}_{90}Th$$

$$..... \rightarrow {}^{4}_{2}He + {}^{230}_{90}Th$$

11

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2. The table below shows information about some radioisotopes.

Radioisotope	Half-life	Method of decay
Tellurium-133	12 minutes	beta
Astatine-211	7.2 hours	alpha
Cobalt-60	5 years	beta and gamma
Caesium-137	30 years	beta
Americium-241	432 years	alpha

(a) Using the information in the table, select the most suitable radioisotope for the tasks below, and give reasons for your choice. [4]

(i) Treating cancer by injecting the radioisotope directly into the tumour.

Name of radioisotope: .....

Reasons:

I. .....

.....

II. .....

.....

(ii) To sterilise packaged surgical instruments.

Name of radioisotope: .....

Reasons:

I. .....

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II. .....

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(b) A sample of tellurium-133 has an initial activity of 288 Bq.

(i) How many half-lives occur in 1 hour? ..... [1]

(ii) Calculate the activity of the sample after 1 hour. [2]

activity = ... Bq

7

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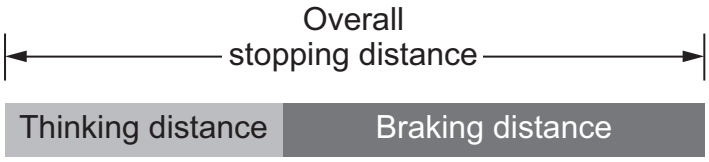
3. The Highway Code provides information about stopping distances.



The **overall stopping distance** is divided into two parts, **thinking distance** and **braking distance.**

Some of the factors which affect the **overall stopping distance** are shown in the table below.

Column A	Column B	Column C
speed of the vehicle	condition of the brakes **or** road surface conditions	alcohol **or** tiredness

Choose **one factor** from **each column** of the table and describe fully how **the chosen factors** affect the distances described above. [6 QWC]

In your answer, include the following:

- the **three** factors you have chosen;
- for **each** factor refer to the thinking distance, braking distance and overall stopping distance;
- describe clearly whether these distances are **increased, decreased** or **unaffected** by the factor.

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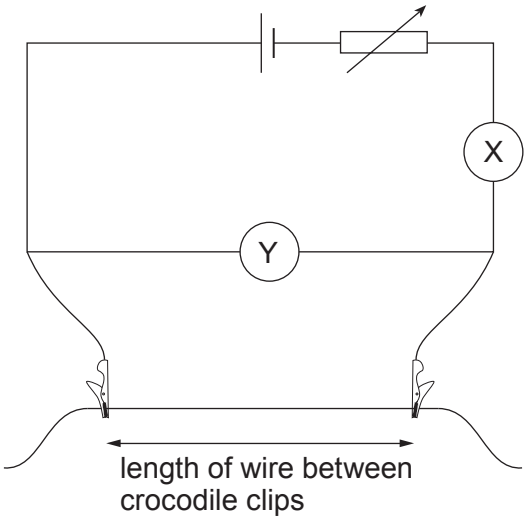
4. The circuit shown is used to investigate how the current changes for different lengths of a wire. Each wire has the same thickness and is made from the same material.



The results from the experiment are displayed.

Length of wire (cm)	Voltage (V)	Current (A)
10	1.80	0.90
20	1.80	0.45
30	1.80	0.30
50	1.80	0.18
60	1.80	0.15
75	1.80	0.12

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(i) The student carrying out the experiment **cannot** say if these results are repeatable. Explain what she should do to enable her to judge the repeatability of her data. [2]

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(ii) The student **correctly** suggests that the **resistance** of the wire is directly proportional to its **length**. Explain how the results in the table agree with this statement. [3]

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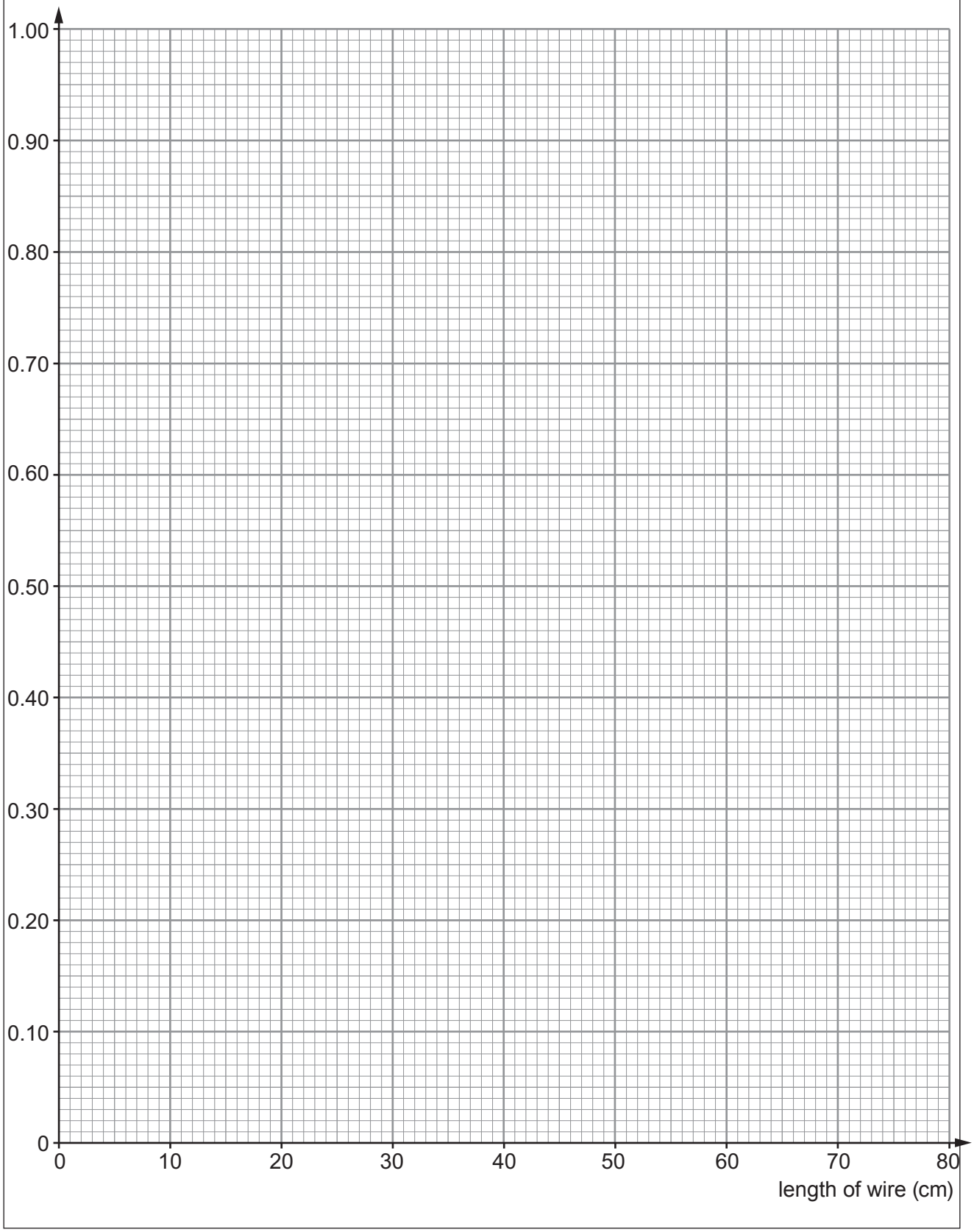
(iii) Plot the data on the grid below and draw a suitable line. [3]



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(iv) Describe the relationship between the **length** of the wire and the **current**. [2]

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(v) The wire used in the experiment had been labelled by the science technician as $0.2\,\Omega$/cm.
Using your graph and the equation $V = IR$, explain if your results for a 45 cm length of wire agree with the information on the label. [4]

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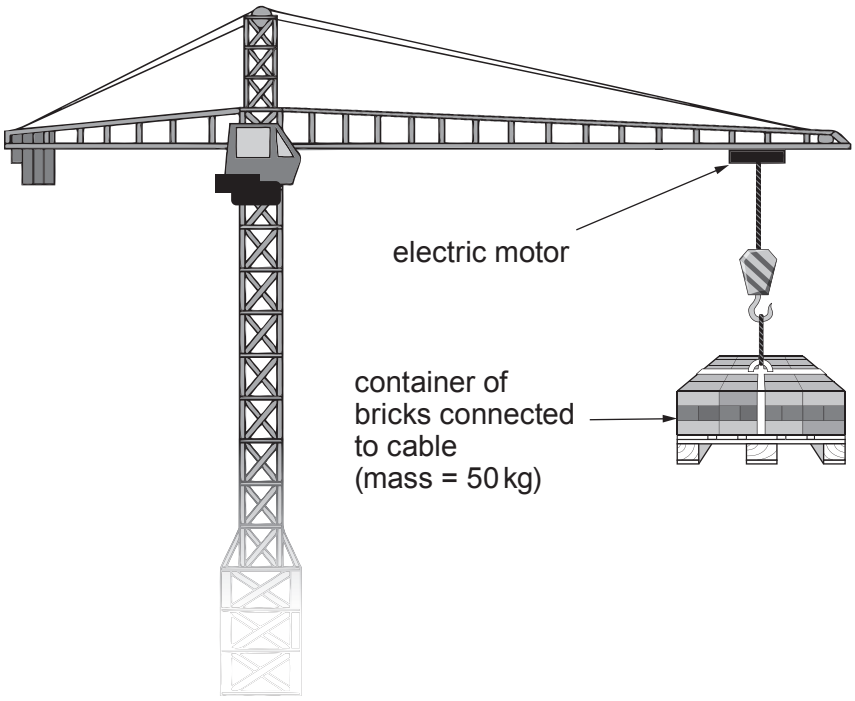
5. A crane is used on a building site to vertically lift building materials. It uses an electric motor to winch a cable that is connected to a container full of bricks of mass 50 kg.

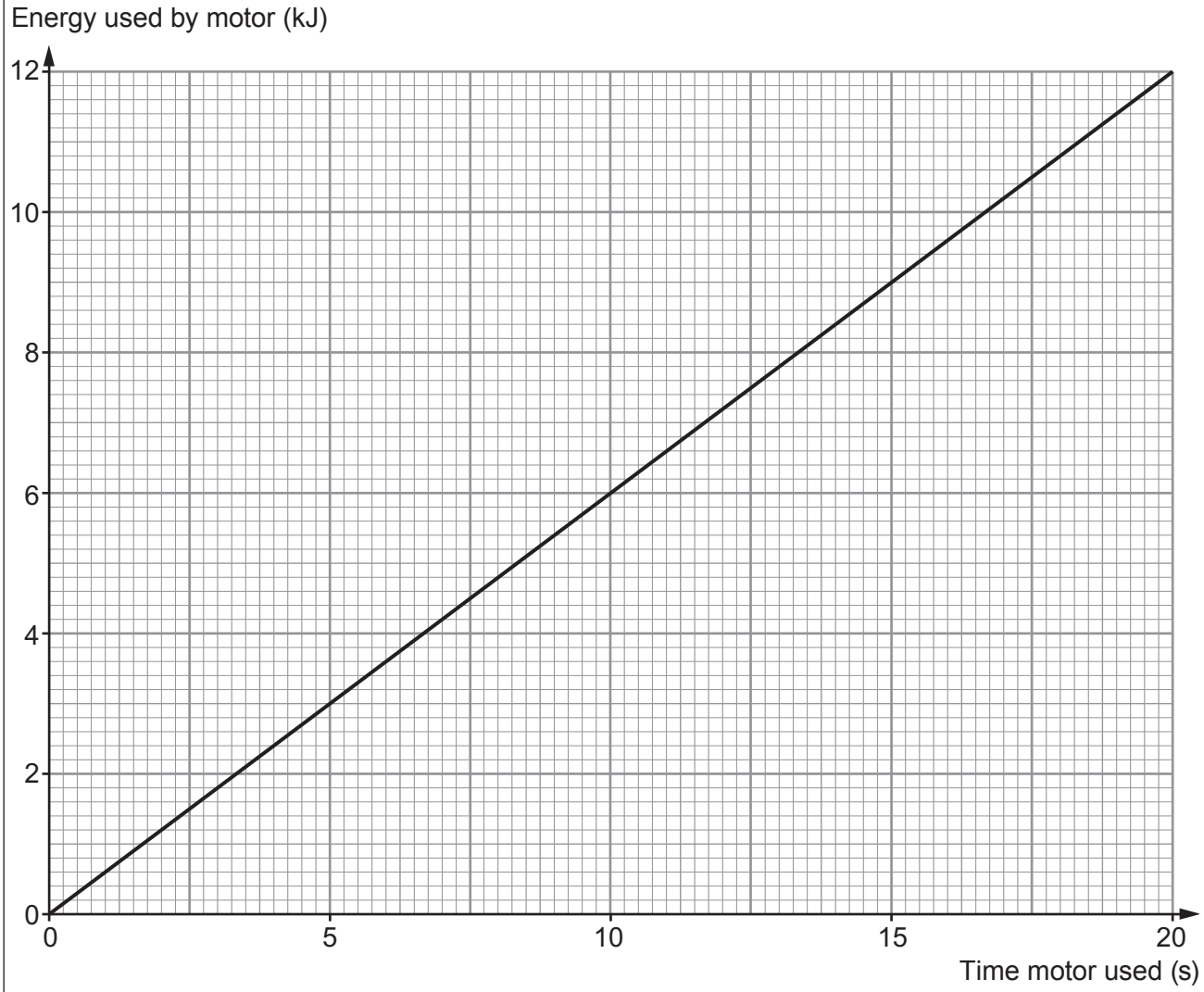


(a) (i) To lift the container of bricks the electric motor is supplied with a voltage of 120 V and a current of 5 A. Using an equation from page 2, calculate the power developed by the motor. [2]

power = ... W

Examiner only

(ii) The energy used by the motor increases with time as shown in the graph below.



The motor is used for 15 seconds to lift the container of bricks. State the amount of energy **(in J)** used by the motor to lift the container of bricks. [1]

energy = ... J

Examiner only

(iii) The container of bricks is lifted through a height of 14 m. Using an equation from page 2, calculate the gain in gravitational potential energy whilst using the electric motor to lift the container of bricks. (g = 10 N/kg) [2]

potential energy gain = ... J

(iv) State why the answers to parts (ii) and (iii) are different. [1]

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(b) The motor is stopped when the container of bricks reaches a height of 14 m. It is held stationary above the ground.

(i) Calculate the force in the cable. (g = 10 N/kg) [2]

force = ... N

(ii) The cable snaps. Using Newton's laws, explain the motion of the container of bricks. [2]

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(iii) Using your answer to *(a)*(iii) and an equation from page 2, calculate the **maximum** impact velocity of the container of bricks as they hit the ground. [3]

impact velocity = ... m/s

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TURN OVER FOR THE LAST QUESTION

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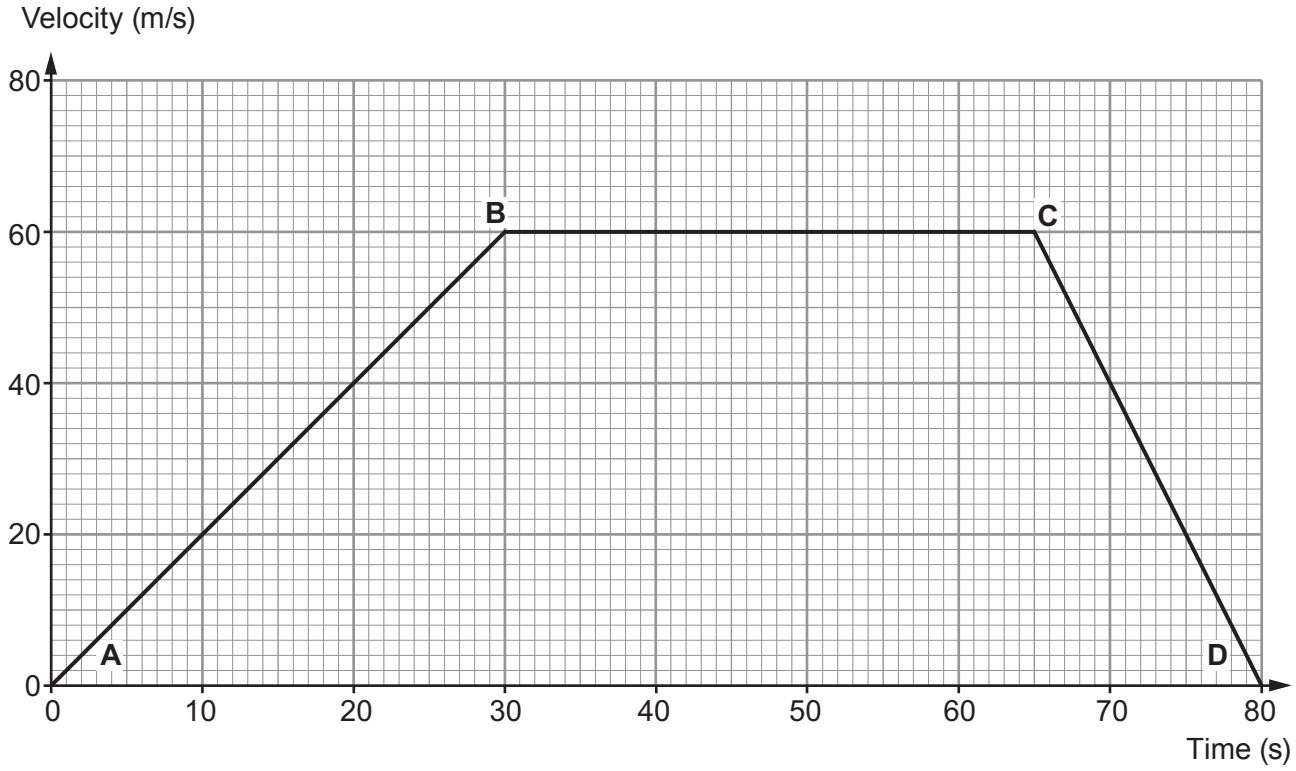
6. Part of the journey of a car is shown by the graph below.



(a) Use information from page 2 to calculate the total distance travelled by the car. [3]

distance = ... m

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(b) A passenger in the car has a mass of 70 kg. Discuss how the **resultant force** on the passenger changes throughout the 80 s of the journey. [6 QWC]

Include in your answer:

- calculations to show the resultant force on the passenger at different stages in the journey;
- an explanation of how the resultant force affects the motion of the passenger at all stages.

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END OF PAPER

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

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