Surname	Centre Number	Candidate Number
Other Names		0

GCSE

4473/01

S15-4473-01

ADDITIONAL SCIENCE/PHYSICS

PHYSICS 2
FOUNDATION TIER

P.M. WEDNESDAY, 20 May 2015

1 hour

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**10**	
2.	**6**	
3.	**11**	
4.	**9**	
5.	**11**	
6.	**7**	
7.	**6**	
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**.

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Equations

power = voltage × current	$P = VI$
current = $\frac{\text{voltage}}{\text{resistance}}$	$I = \frac{V}{R}$
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	
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	$W = Fd$

SI multipliers

Prefix	Multiplier	
m	10^{-3}	$\frac{1}{1000}$
k	10^{3}	1000
M	10^{6}	1000000

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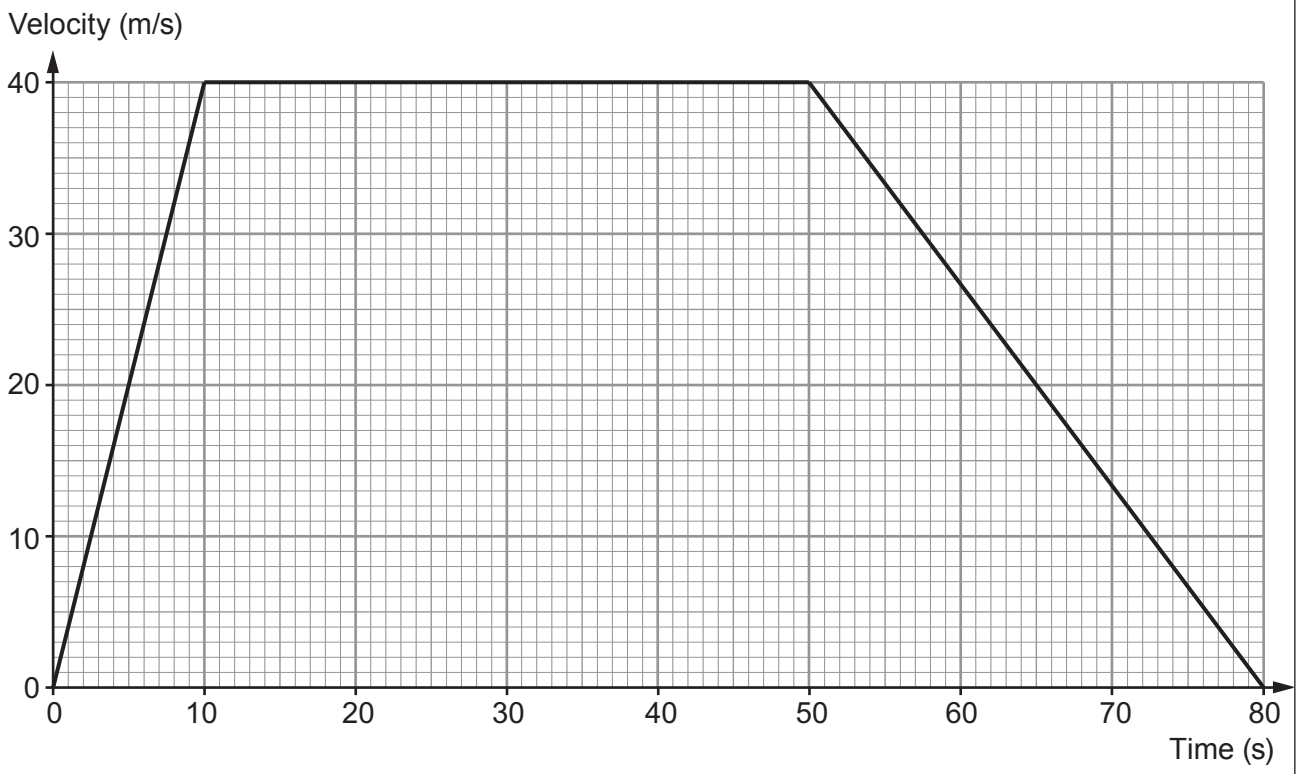
Answer **all** *questions.*

1. *(a)* Draw a line from each box on the left to the correct box on the right to link each quantity with its correct unit. [3]

deceleration	m/s
mean speed	m/s^2
time	m
distance	s

(b) Part of the journey of a car is shown by the graph below.



(i) Write down the times at which the car's velocity was 20 m/s. [1]

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(ii) Use the graph and the equation:

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

to calculate the acceleration during the first 10 s. [2]

acceleration = ... m/s^2

(c) (i) The car and driver have a mass of 1 200 kg.

Use the equation:

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

to calculate the momentum of the car and driver at 50 s. [2]

momentum = ... kg m/s

(ii) The car stops at 80 s.

Use the equation:

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

to calculate the force acting on the car whilst it decelerates. [2]

force = ... N

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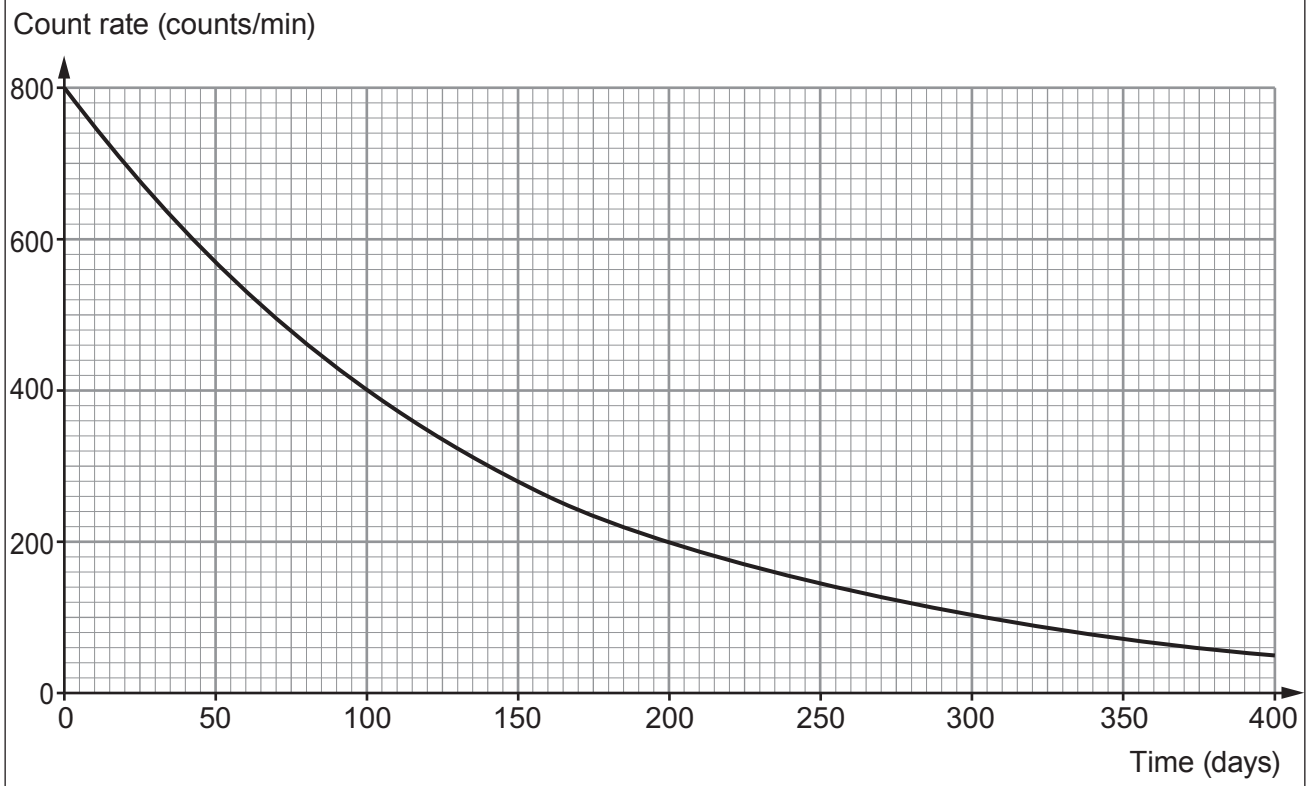
2. *(a)* Put ticks (✓) in the boxes that correctly give the meaning of the **half-life** of a radioactive substance. [2]

The time taken for the radioactivity to halve.	
The time taken for the atoms to split in half.	
The time taken for the number of undecayed particles to halve.	
The time taken for the count rate to halve.	
The time taken for half of the alpha particles to decay.	

(b) The following graph shows the decay curve for a radioactive substance.



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(i) Use information from the graph on page 6 to write down the count rate after 100 days. [1]

count rate = ... counts/min

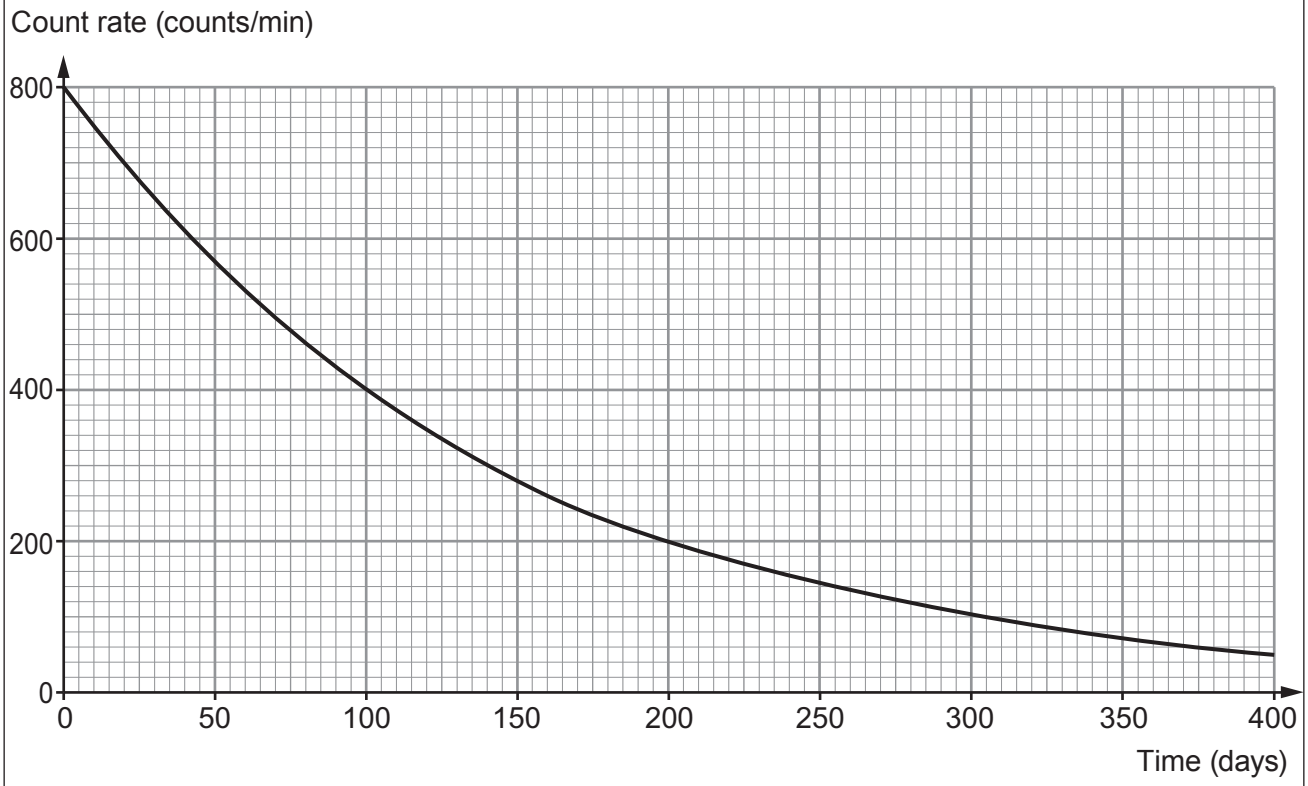
(ii) Write down the half-life of this radioactive substance. [1]

half-life = ... days

(iii) Write down the time it would take for the count rate to fall from 50 to 25 counts/min. [1]

time = ... days

(iv) Draw a decay curve on the grid **below** for a radioactive substance that has a starting count rate of 800 counts/min and a shorter half-life than the one shown. [1]



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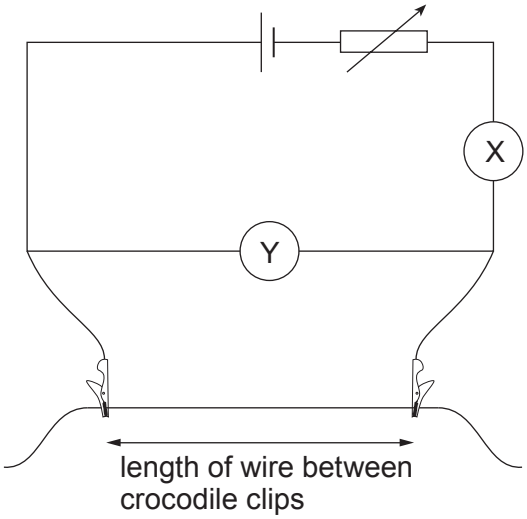
3. The circuit shown is used to investigate how the resistance depends upon the length of a wire.



The results from the experiment are shown in a table.

Length of wire (cm)	Voltage (V)	Current (A)	Resistance of wire (Ω)
10	1.80	0.90	2.00
20	1.80	0.45	4.00
30	1.80	.....	6.00
50	1.80	0.18	10.00
60	1.80	0.15	12.00
75	1.80	0.12	15.00

(a) Use the equation:

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

to fill in the missing value in the table. [2]

(b) Write down the name of the quantity that is measured by **X** in the diagram above. [1]

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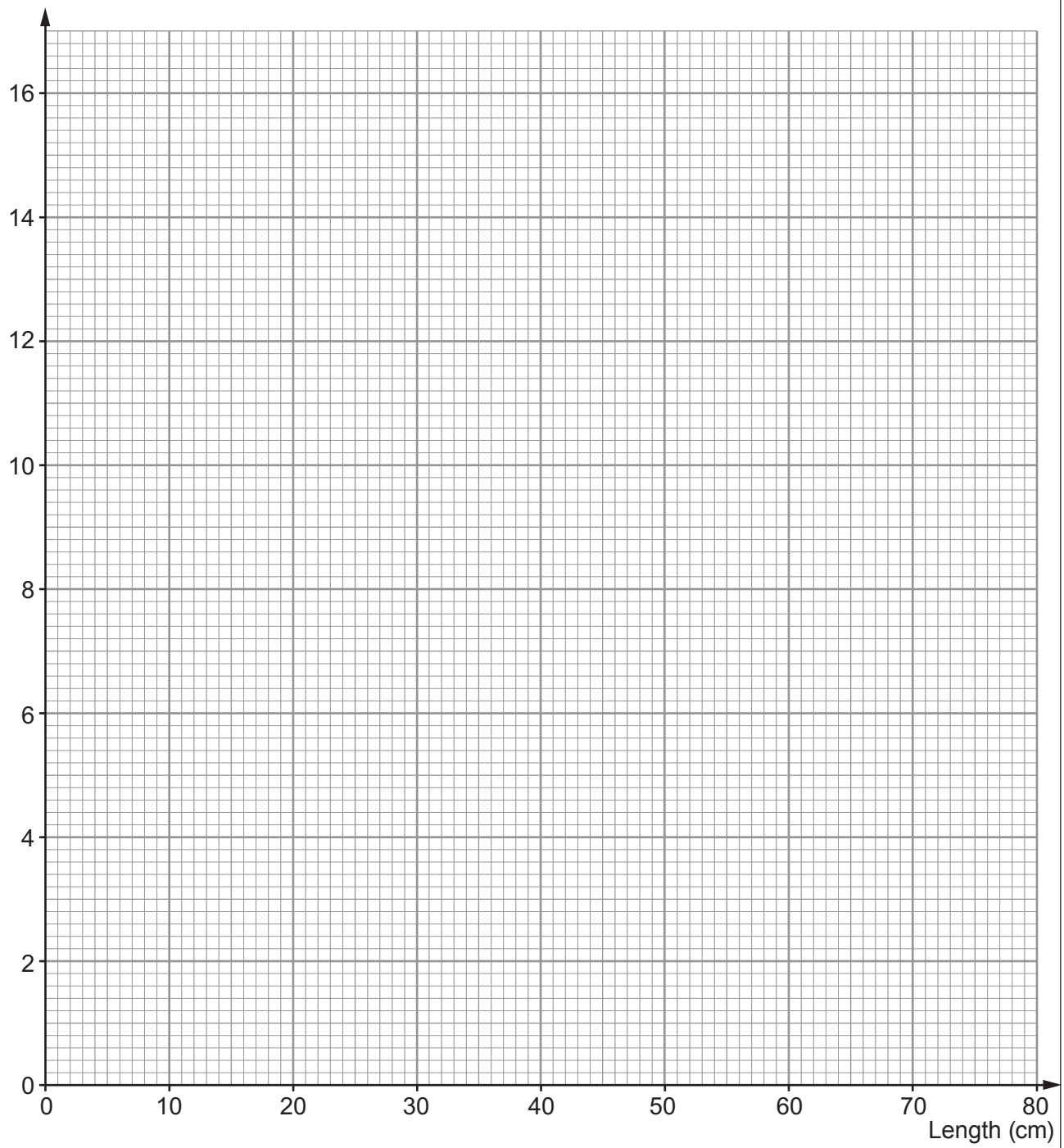
(c) (i) Plot the values of **resistance** against **length** for the wire on the following grid and draw a suitable line. [3]



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(ii) Describe the relationship between the resistance and length of the wire. [2]

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(d) Use the table on page 8 to answer the following question. The science technician stated that a **one metre length** of the wire had a resistance of 30 Ω.
Explain whether this statement was true. [2]

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(e) State, giving a reason, whether a second set of readings should have been taken. [1]

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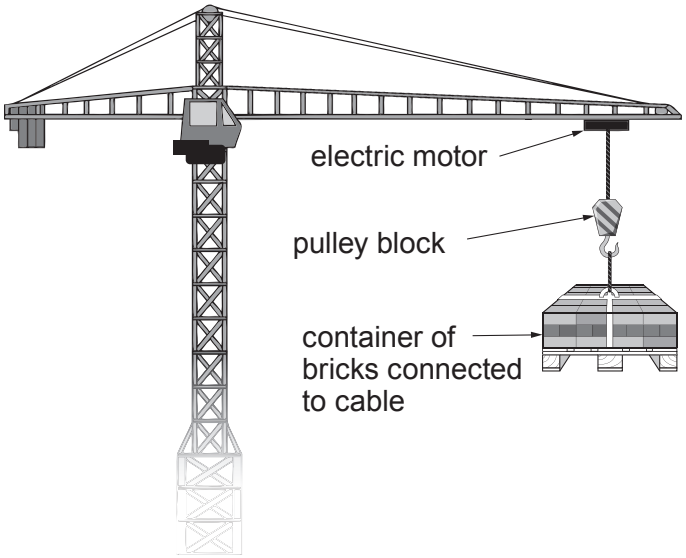
4. A crane is used on a building site to vertically lift building materials. It uses an electric motor to winch a cable that is connected to a container full of bricks.



(a) The electric motor is supplied with a voltage of 120 V and a current of 5.0 A to lift the bricks. Use the equation:

power = voltage × current

to calculate the power developed by the motor. [2]

power = ... W

(b) (i) State the difference between the mass and the weight of the bricks. [2]

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(ii) The weight of the bricks is 5 000 N. Calculate the mass of the bricks. [1]
(1 kg weighs 10 N)

mass = ... kg

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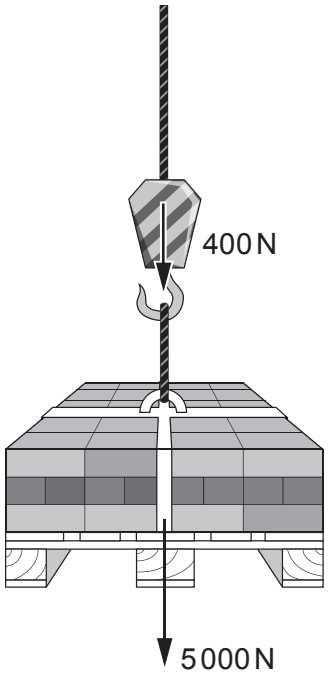
(c) The diagram shows the crane holding the bricks **at rest** above the ground. The attachment hook has a weight of 400 N.



(i) The cable supports the pulley block and bricks. Write down the value of the upward force applied in the cable. [2]

force = ... N

(ii) Underline the correct term in each bracket below. [2]

I. When the bricks are accelerated upwards, the force in the cable is (**smaller than** / **equal to** / **bigger than**) the total weight.

II. When the bricks move upwards at a constant speed, the force in the cable is (**smaller than** / **equal to** / **bigger than**) the total weight.

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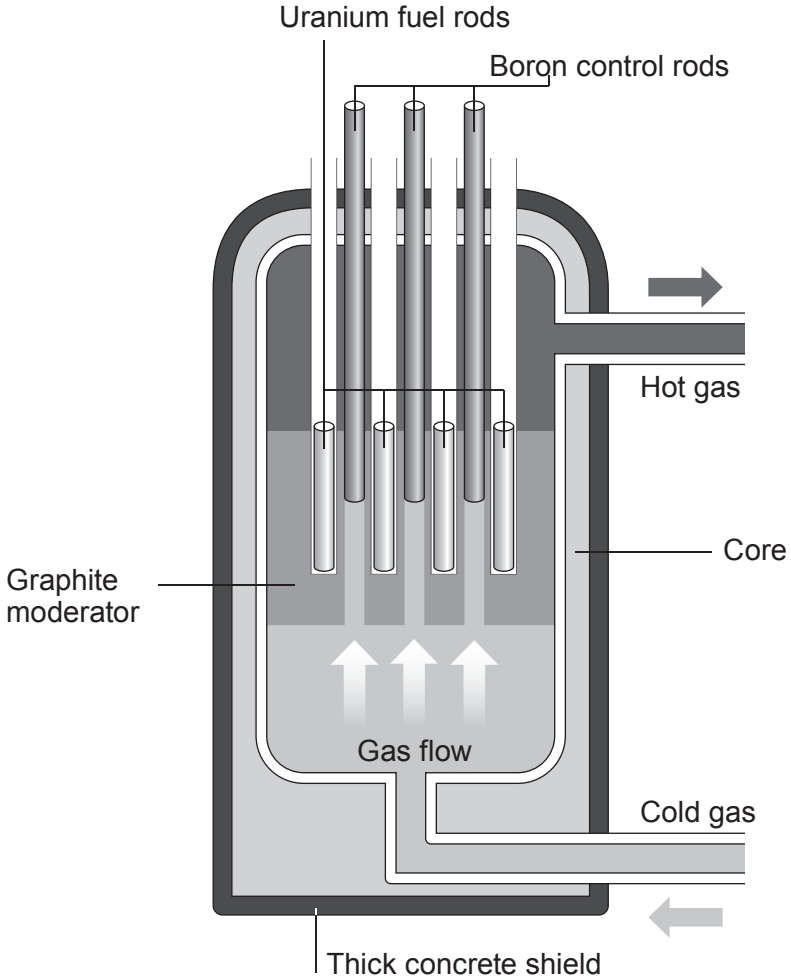
5. Read the information in the passage and study the diagram before answering the questions that follow.

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]

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

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

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6. 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. .....

.....

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

Turn over.

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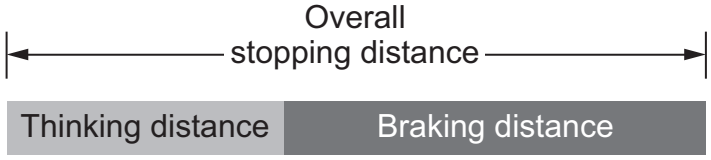
7. The Highway Code provides information about stopping distances.



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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END OF PAPER

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

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