FOR OFFICIAL USE

N5

National Qualifications 2015

Mark

X757/75/01

Physics
Section 1—Answer Grid and Section 2

TUESDAY, 5 MAY
9:00 AM – 11:00 AM

X7577501

Fill in these boxes and read what is printed below.

Full name of centre

Town

Forename(s)

Surname

Number of seat

Date of birth
Day Month Year

Scottish candidate number

Total marks — 110

SECTION 1 — 20 marks
Attempt ALL questions.
Instructions for the completion of Section 1 are given on *Page two*.

SECTION 2 — 90 marks
Attempt ALL questions.

Reference may be made to the Data Sheet on *Page two* of the question paper X757/75/02 and to the Relationship Sheet X757/75/11.
Care should be taken to give an appropriate number of significant figures in the final answers to calculations.
Write your answers clearly in the spaces provided in this booklet. Additional space for answers and rough work is provided at the end of this booklet. If you use this space you must clearly identify the question number you are attempting. Any rough work must be written in this booklet. You should score through your rough work when you have written your final copy.
Use **blue** or **black** ink.
Before leaving the examination room you must give this booklet to the Invigilator; if you do not, you may lose all the marks for this paper.

SQA ©

X7577501 01

SECTION 1 — 20 marks

The questions for Section 1 are contained in the question paper X757/75/02.
Read these and record your answers on the answer grid on *Page three* opposite.
Use **blue** or **black** ink. Do NOT use gel pens or pencil.

1. The answer to each question is **either** A, B, C, D or E. Decide what your answer is, then fill in the appropriate bubble (see sample question below).

2. There is **only one correct** answer to each question.

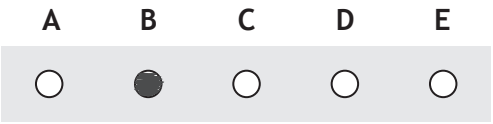
3. Any rough work must be written in the additional space for answers and rough work at the end of this booklet.

Sample Question

The energy unit measured by the electricity meter in your home is the:

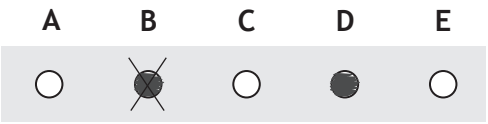
A ampere
B kilowatt-hour
C watt
D coulomb
E volt.

The correct answer is **B**—kilowatt-hour. The answer **B** bubble has been clearly filled in (see below).

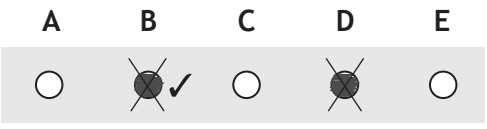


Changing an answer

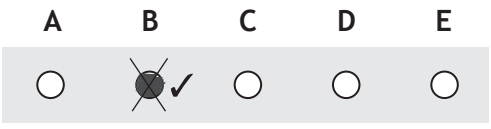
If you decide to change your answer, cancel your first answer by putting a cross through it (see below) and fill in the answer you want. The answer below has been changed to **D**.



If you then decide to change back to an answer you have already scored out, put a tick (✓) to the **right** of the answer you want, as shown below:



or



SECTION 1 — Answer Grid

0BJ20AE1

	A	B	C	D	E
1	○	○	○	○	○
2	○	○	○	○	○
3	○	○	○	○	○
4	○	○	○	○	○
5	○	○	○	○	○
6	○	○	○	○	○
7	○	○	○	○	○
8	○	○	○	○	○
9	○	○	○	○	○
10	○	○	○	○	○
11	○	○	○	○	○
12	○	○	○	○	○
13	○	○	○	○	○
14	○	○	○	○	○
15	○	○	○	○	○
16	○	○	○	○	○
17	○	○	○	○	○
18	○	○	○	○	○
19	○	○	○	○	○
20	○	○	○	○	○

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MARKS | DO NOT WRITE IN THIS MARGIN

[Turn over for Question 1 on *Page six*

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SECTION 2 — 90 marks

Attempt ALL questions

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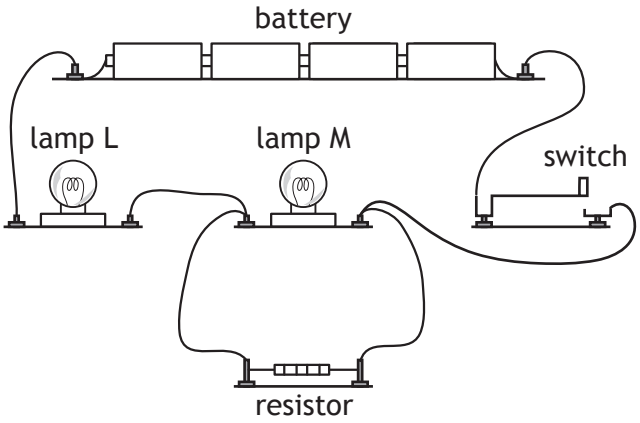
1. A student sets up the following circuit using a battery, two lamps, a switch and a resistor.



(a) Draw a circuit diagram for this circuit using the correct symbols for the components. **3**

(b) Each lamp is rated 2·5 V, 0·50 A.

Calculate the resistance of one of the lamps when it is operating at the correct voltage. **3**

Space for working and answer

1. (continued)

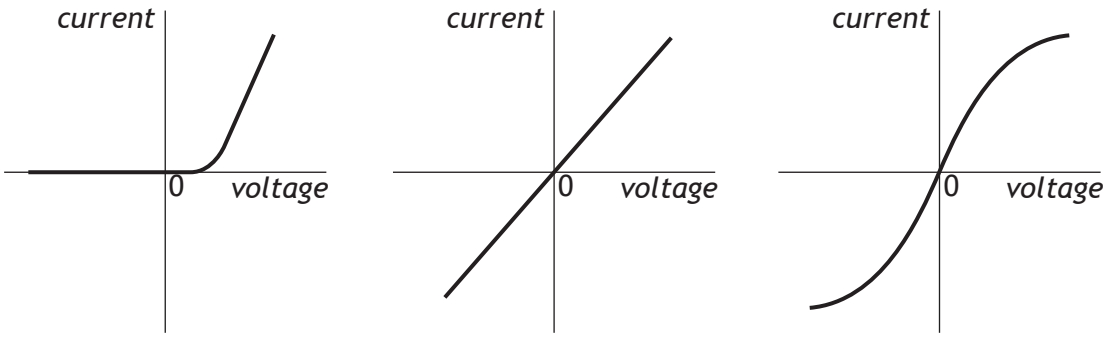
(c) When the switch is closed, will lamp L be brighter, dimmer or the same brightness as lamp M?

You **must** justify your answer. **3**

[Turn over

2. (a) A student investigates the electrical properties of three different components; a lamp, an LED and a fixed resistor.

Current-voltage graphs produced from the student's results are shown.



Graph X Graph Y Graph Z

Explain which graph X, Y or Z is obtained from the student's results for the LED. **2**

(b) One of the components is operated at 4·0 V with a current of 0·50 A for 60 seconds.

(i) Calculate the energy transferred to the component during this time. **4**

Space for working and answer

2. (b) (continued)

(ii) Calculate the charge which passes through this component during this time. **3**

Space for working and answer

[Turn over

3. A technician uses pulses of ultrasound (high frequency sound) to detect imperfections in a sample of steel.

The pulses of ultrasound are transmitted into the steel.

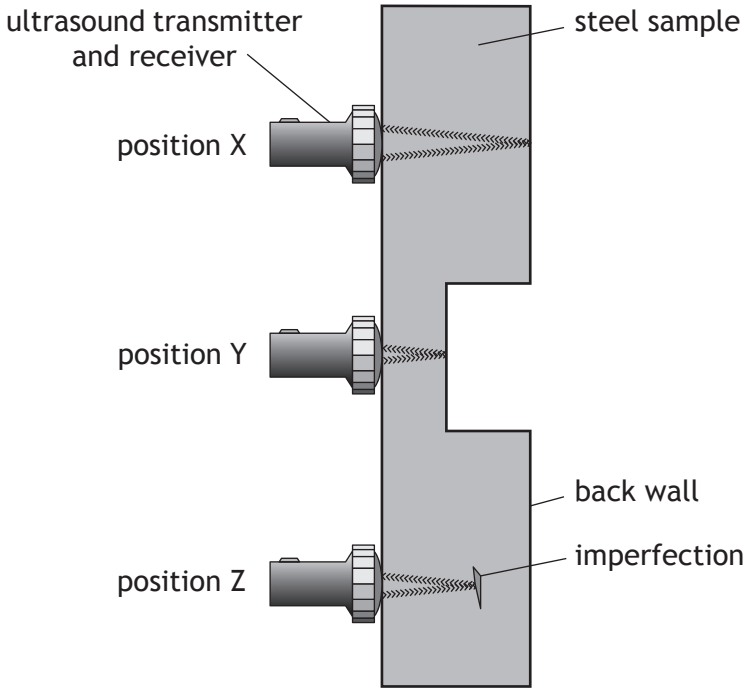
The speed of ultrasound in steel is 5200 m s^{-1}.

Where there are no imperfections, the pulses of ultrasound travel through the steel and are reflected by the back wall of the steel.

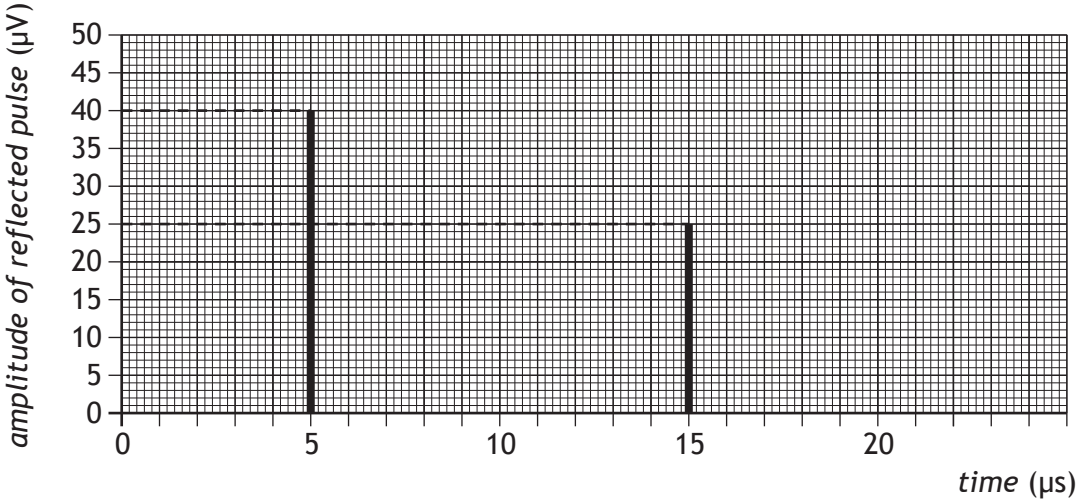
Where there are imperfections in the steel, the pulses of ultrasound are reflected by these imperfections.

The reflected pulses return through the sample and are detected by the ultrasound receiver.

The technician transmits pulses of ultrasound into the steel at positions X, Y and Z as shown.



The times between the pulses being transmitted and received for positions X and Y are shown in the graph.



3. (continued)

MARKS DO NOT WRITE IN THIS MARGIN

(a) (i) State the time taken between the pulse being transmitted and received at position X. **1**

(ii) Calculate the thickness of the steel sample at position X. **4**

Space for working and answer

(b) On the graph on the previous page, draw a line to show the reflected pulse from position Z. **2**

(c) The ultrasound pulses used have a period of 4·0 μs.

(i) Show that the frequency of the ultrasound pulses is $2{\cdot}5 \times 10^5$ Hz. **2**

Space for working and answer

(ii) Calculate the wavelength of the ultrasound pulses in the steel sample. **3**

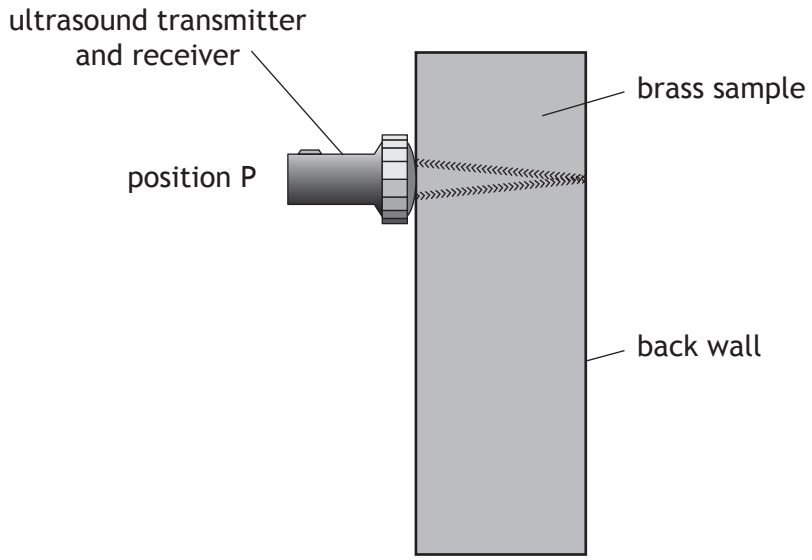
Space for working and answer

3. (continued)

(d) The technician replaces the steel sample with a brass sample.

The brass sample has the same thickness as the steel sample at position X.

The technician transmits pulses of ultrasound into the brass at position P as shown.



The time between the ultrasound pulse being transmitted and received at position P is greater than the time recorded at position X in the steel sample.

State whether the speed of ultrasound in brass is less than, equal to or greater than the speed of ultrasound in steel.

You **must** justify your answer. **2**

MARKS | DO NOT WRITE IN THIS MARGIN

4. A science technician removes two metal blocks from an oven. Immediately after the blocks are removed from the oven the technician measures the temperature of each block, using an infrared thermometer. The temperature of each block is 230 °C.

After several minutes the temperature of each block is measured again. One block is now at a temperature of 123 °C and the other block is at a temperature of 187 °C.

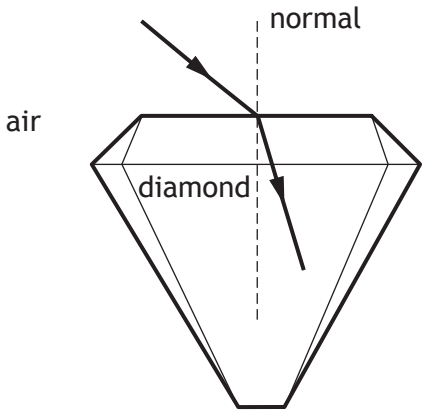
Using your knowledge of physics, comment on possible explanations for this difference in temperature. **3**

[Turn over

5. Diamonds are popular and sought after gemstones.

Light is refracted as it enters and leaves a diamond.

The diagram shows a ray of light entering a diamond.



(a) On the diagram, label the angle of incidence *i* and the angle of refraction *r*. **1**

(b) State what happens to the speed of the light as it enters the diamond. **1**

(c) The optical density of a gemstone is a measure of its ability to refract light.

Gemstones of higher optical density cause more refraction.

A ray of light is directed into a gemstone at an angle of incidence of 45°.

The angle of refraction is then measured.

This is repeated for different gemstones.

Gemstone	*Angle of refraction*
A	24·3°
B	17·0°
C	27·3°
D	19·0°
E	25·5°

Diamond is known to have the highest optical density.

Identify which gemstone is most likely to be diamond. **1**

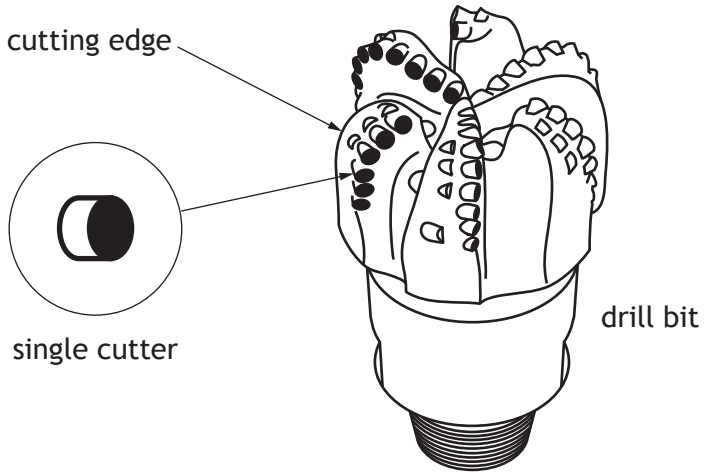
MARKS DO NOT WRITE IN THIS MARGIN

5. (continued)

(d) Diamond is one of the hardest known substances.

Synthetic diamonds are attached to the cutting edges of drill bits for use in the oil industry.

These drill bits are able to cut into rock.



The area of a single cutter in contact with the rock is $1{\cdot}1 \times 10^{-5}\,m^2$.

When drilling, this cutter is designed to exert a maximum force of 61 kN on the rock.

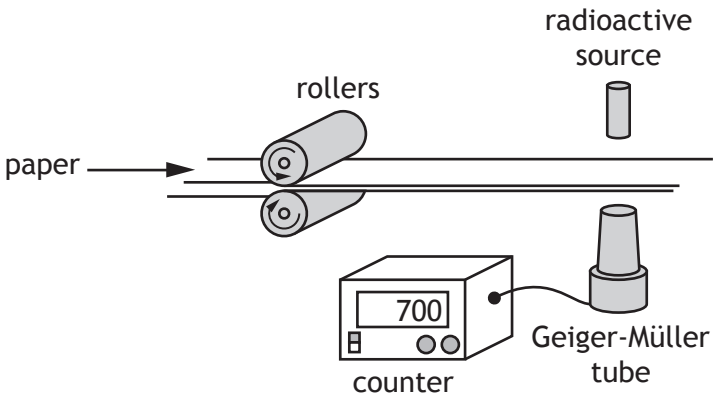
Calculate the maximum pressure that the cutter can exert on the rock. **3**

Space for working and answer

[Turn over

6. A paper mill uses a radioactive source in a system to monitor the thickness of paper.

MARKS | DO NOT WRITE IN THIS MARGIN



Radiation passing through the paper is detected by the Geiger-Müller tube. The count rate is displayed on the counter as shown. The radioactive source has a half-life that allows the system to run continuously.

(a) State what happens to the count rate if the thickness of the paper decreases. **1**

(b) The following radioactive sources are available.

Radioactive Source	*Half-life*	*Radiation emitted*
W	600 years	alpha
X	50 years	beta
Y	4 hours	beta
Z	350 years	gamma

(i) State which radioactive source should be used.

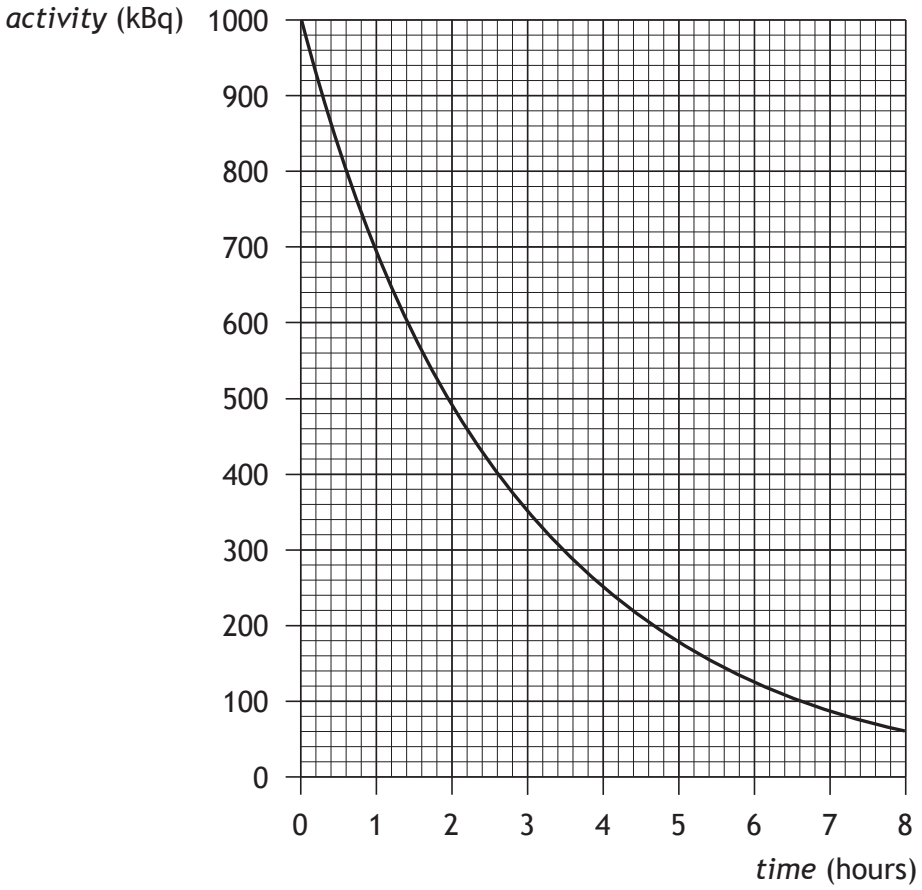
You **must** explain your answer. **3**

6. (b) (continued)

(ii) State what is meant by the term *half-life*. **1**

(iii) State what is meant by a gamma ray. **1**

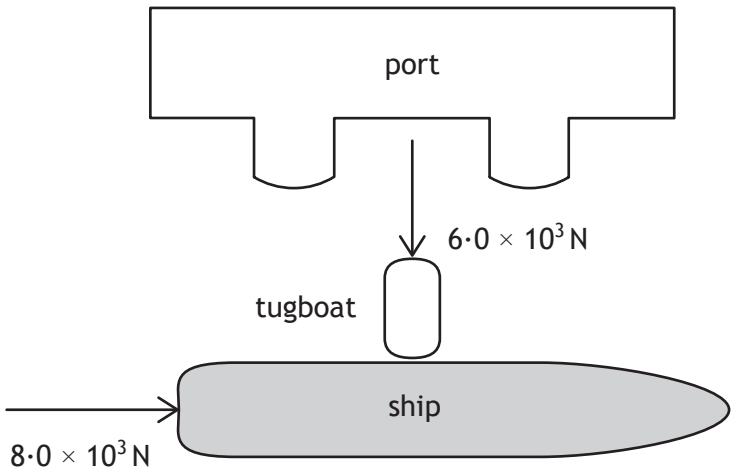
(c) The graph below shows how the activity of another radioactive source varies with time.



Determine the half-life of this radioactive source. **1**

[Turn over

7. A ship of mass $5{\cdot}0 \times 10^6$ kg leaves a port. Its engine produces a forward force of $8{\cdot}0 \times 10^3$ N. A tugboat pushes against one side of the ship as shown. The tugboat applies a pushing force of $6{\cdot}0 \times 10^3$ N.



(a) (i) By scale drawing, or otherwise, determine the size of the resultant force acting on the ship. **2**

Space for working and answer

(ii) Determine the direction of the resultant force relative to the $8{\cdot}0 \times 10^3$ N force. **2**

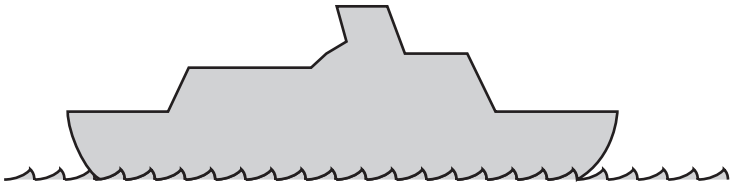
Space for working and answer

7. (a) (continued)

(iii) Calculate the size of the acceleration of the ship. **3**

Space for working and answer

(b) Out in the open sea the ship comes to rest.



Explain, with the aid of a labelled diagram, why the ship floats. **3**

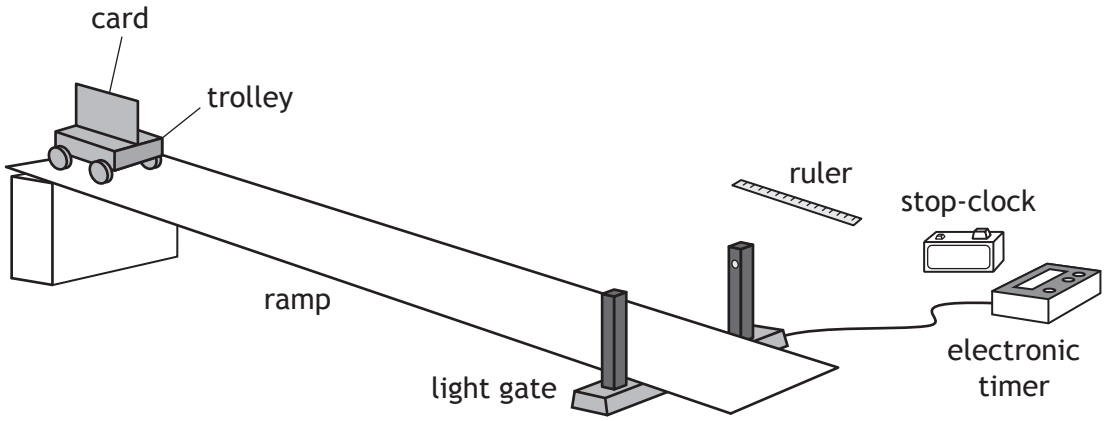
[Turn over

8. A student is investigating the motion of a trolley down a ramp.

MARKS DO NOT WRITE IN THIS MARGIN

(a) The student uses the apparatus shown to carry out an experiment to determine the acceleration of a trolley as it rolls down a ramp.

The trolley is released from rest at the top of the ramp.

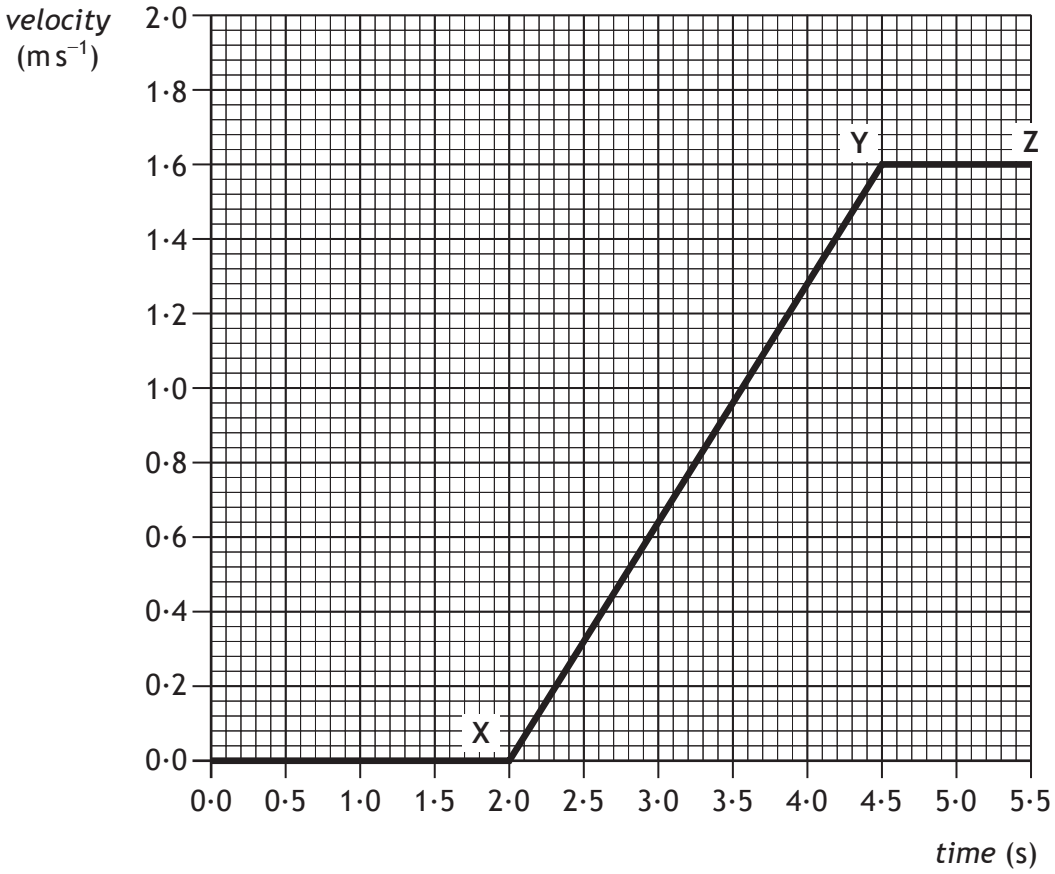


(i) State the measurements the student must make to calculate the acceleration of the trolley. **3**

(ii) Suggest one reason why the acceleration calculated from these measurements might not be accurate. **1**

8. (continued)

(b) In a second experiment, the student uses a motion sensor and computer to produce the following velocity-time graph for the trolley



Calculate the acceleration of this trolley between X and Y. **3**

Space for working and answer

[Turn over

9. A child throws a stone horizontally from a bridge into a river.

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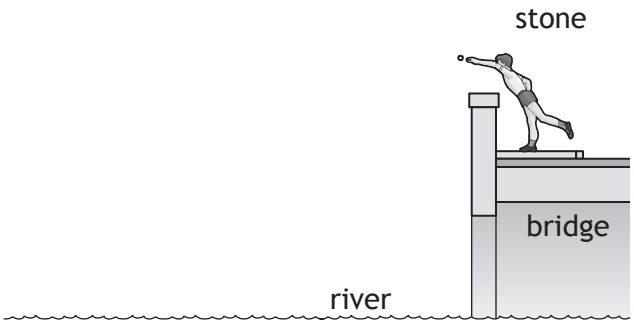


(a) On the above diagram sketch the path taken by the stone between leaving the child's hand and hitting the water. **1**

(b) The stone reaches the water 0·80 s after it was released.

(i) Calculate the vertical velocity of the stone as it reaches the water.

The effects of air resistance can be ignored. **3**

Space for working and answer

(ii) Determine the height above the water at which the stone was released. **4**

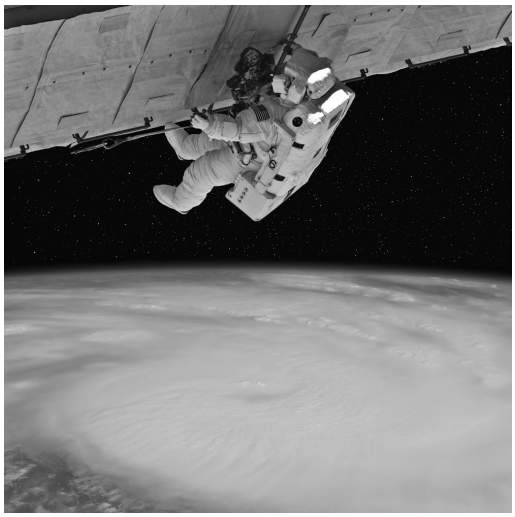
Space for working and answer

(c) The child now drops a similar stone vertically from the same height into the river.

State how the time taken for this stone to reach the water compares with the time taken for the stone in (b). **1**

MARKS | DO NOT WRITE IN THIS MARGIN

10. Space exploration involves placing astronauts in difficult environments. Despite this, many people believe the benefits of space exploration outweigh the risks.



Using your knowledge of physics, comment on the benefits and/or risks of space exploration. **3**

[Turn over

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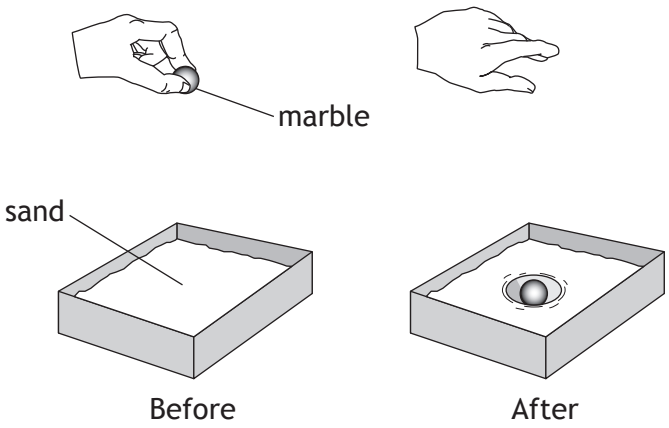
11. Craters on the Moon are caused by meteors striking its surface.

MARKS DO NOT WRITE IN THIS MARGIN

A student investigates how a crater is formed by dropping a marble into a tray of sand.



(a) The marble has a mass of 0·040 kg.

(i) Calculate the loss in potential energy of the marble when it is dropped from a height of 0·50 m. **3**

Space for working and answer

(ii) Describe the energy change that takes place as the marble hits the sand. **1**

[Turn over

MARKS | DO NOT WRITE IN THIS MARGIN

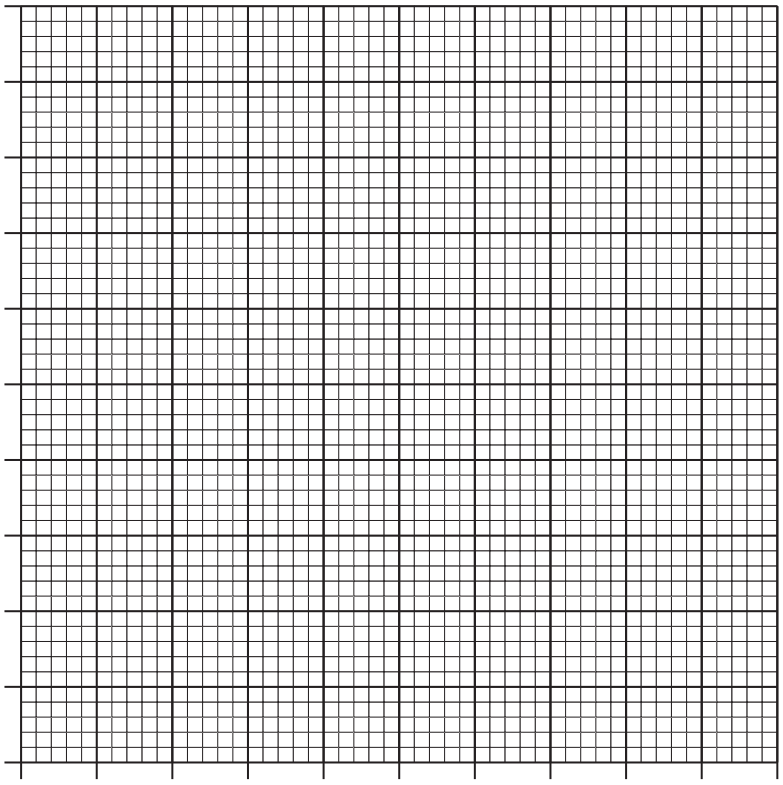
(b) The student drops the marble from different heights and measures the diameter of each crater that is formed.

The table shows the student's results.

height (m)	*diameter* (m)
0·05	0·030
0·10	0·044
0·15	0·053
0·35	0·074
0·40	0·076
0·45	0·076

(i) Using the graph paper below, draw a graph of these results. **3**

(Additional graph paper, if required, can be found on *Page twenty-eight*)



11. (b) (continued)

(ii) Use your graph to predict the diameter of the crater that is formed when the marble is dropped from a height of 0·25 m. **1**

(iii) Suggest two improvements that the student could make to this investigation. **2**

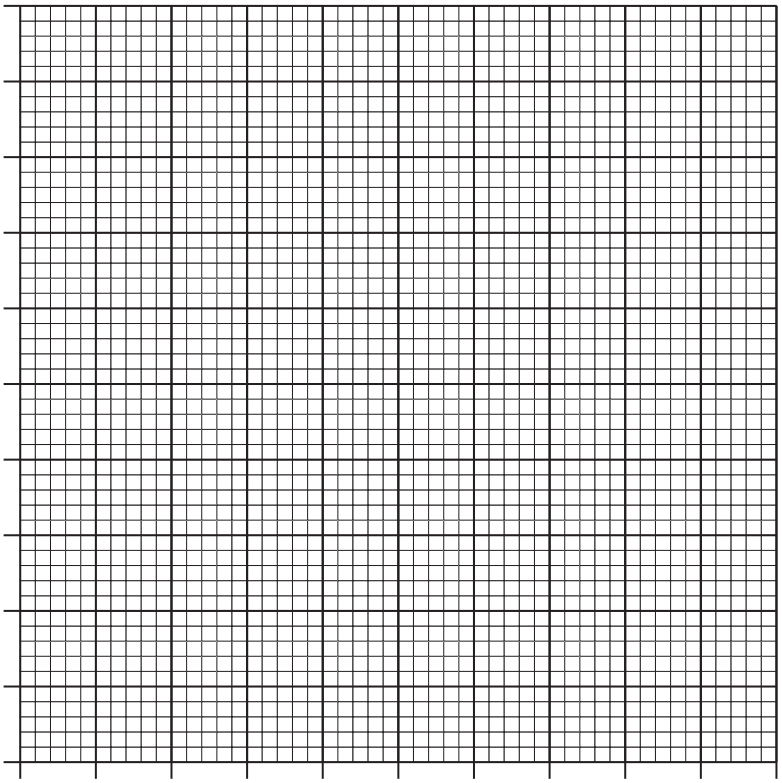
(c) (i) Suggest another variable, which could be investigated, that may affect the diameter of a crater. **1**

(ii) Describe experimental work that could be carried out to investigate how this variable affects the diameter of a crater. **2**

[END OF QUESTION PAPER]

ADDITIONAL SPACE FOR ANSWERS AND ROUGH WORKING

Additional graph paper for Q11 (b) (i)



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ADDITIONAL SPACE FOR ANSWERS AND ROUGH WORKING

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ADDITIONAL SPACE FOR ANSWERS AND ROUGH WORKING

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ACKNOWLEDGEMENTS

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Question 11 – Procy/shutterstock.com