FOR OFFICIAL USE

N5

National Qualifications 2014

Mark

X757/75/01

Physics
Section 1—Answer Grid and Section 2

THURSDAY, 22 MAY
9:00 AM – 11:00 AM

* X 7 5 7 7 5 0 1 *

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
D D	M M	Y Y

Scottish candidate number

Total marks — 110

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

SECTION 2 — 90 marks
Attempt ALL questions in this section.

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.

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.

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 ©

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.
Do NOT use gel pens.

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.

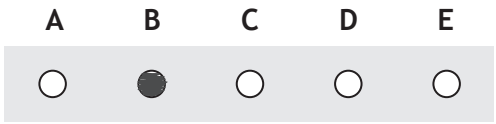
3. Any rough work must be written in the additional space for answers and rough work at the end of this booklet.

Sample Question

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

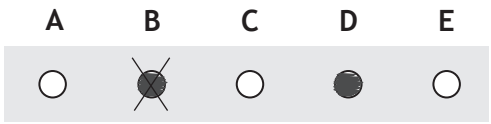
A ampere
B kilowatt-hour
C watt
D coulomb
E volt.

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

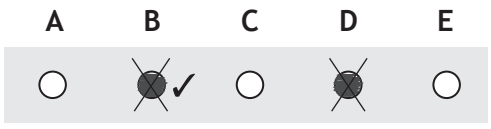


Changing an answer

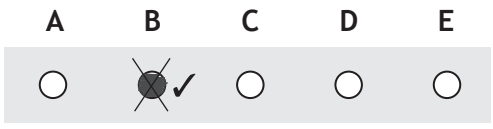
If you decide to change your answer, cancel your first answer by putting a cross through it (see below) and fill in the answer you want. The answer below has been changed to **D**.



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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[Turn over for Question 1 on *Page six*

DO NOT WRITE ON THIS PAGE

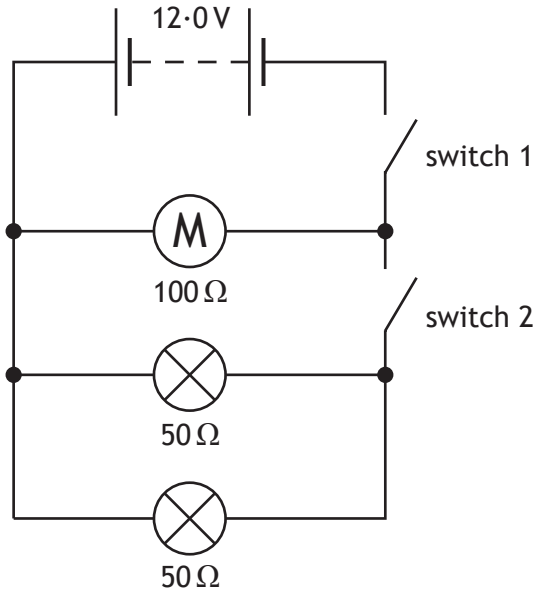
SECTION 2 — 90 marks

Attempt ALL questions

MARKS DO NOT WRITE IN THIS MARGIN

1. A toy car contains an electric circuit which consists of a 12·0 V battery, an electric motor and two lamps.

The circuit diagram is shown.



(a) Switch 1 is now closed.

Calculate the power dissipated in the motor when operating. **3**

Space for working and answer

1. (continued)

(b) Switch 2 is now also closed.

(i) Calculate the total resistance of the motor and the two lamps. **3**

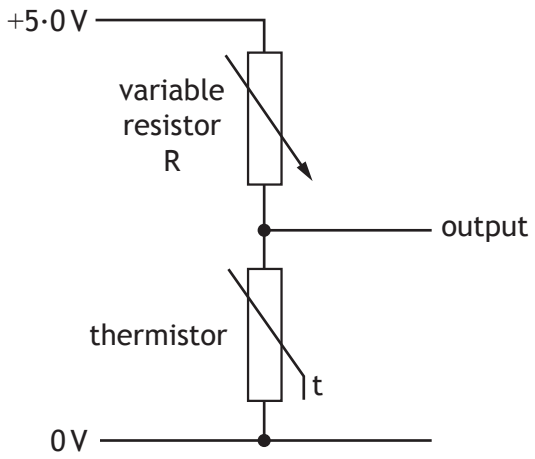
Space for working and answer

(ii) One of the lamps now develops a fault and stops working.
State the effect this has on the other lamp.
You **must** justify your answer. **2**

Total marks 8

[Turn over

2. A thermistor is used as a temperature sensor in a circuit to monitor and control the temperature of water in a tank. Part of the circuit is shown.



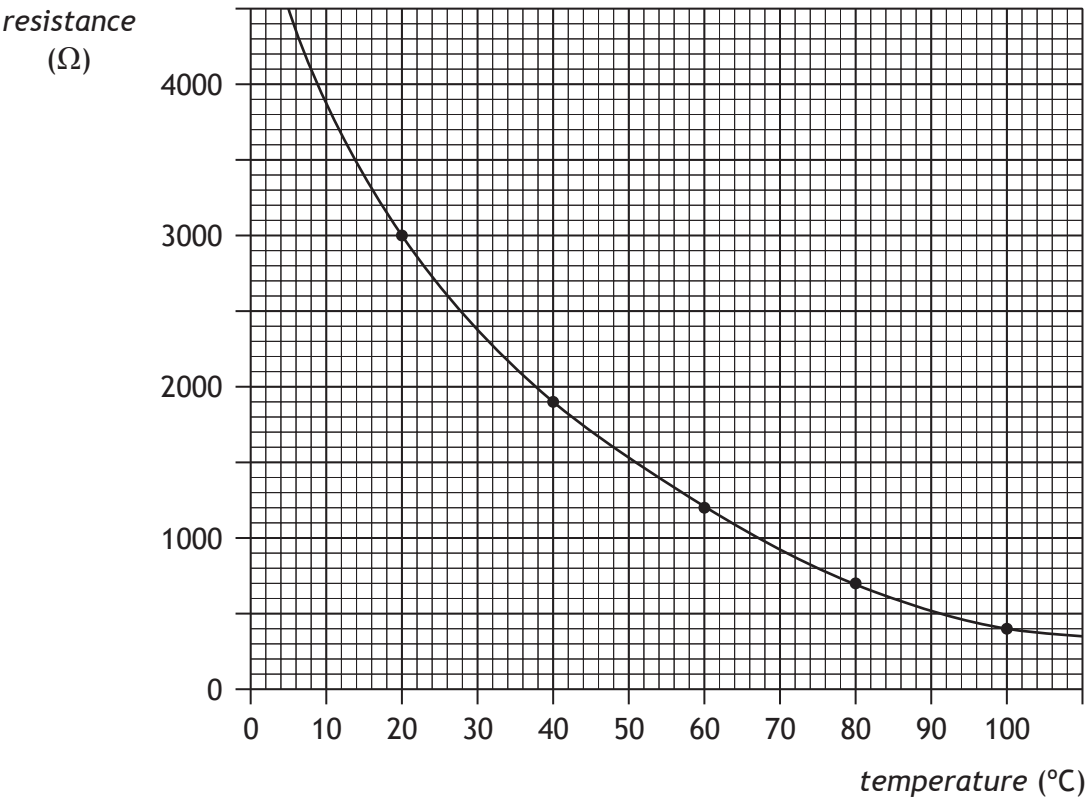
(a) (i) The variable resistor R is set at a resistance of 1050 Ω.

Calculate the resistance of the thermistor when the voltage across the thermistor is 2·0 V. **4**

Space for working and answer

2. (a) (continued)

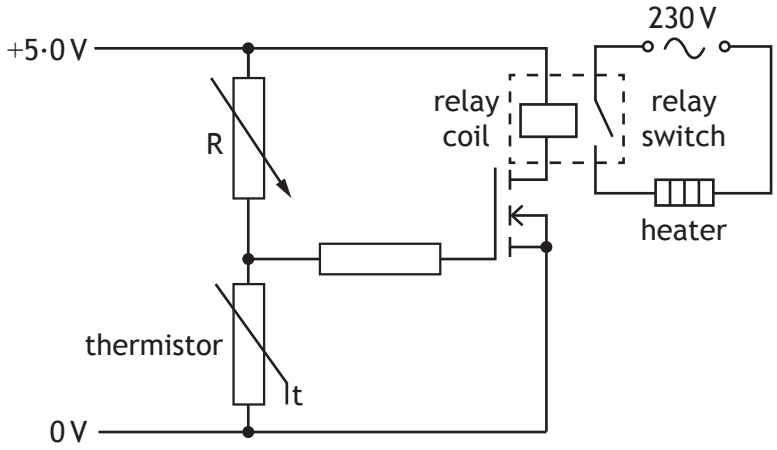
(ii) The graph shows how the resistance of the thermistor varies with temperature.



Use the graph to determine the temperature of the water when the voltage across the thermistor is 2·0 V. **1**

2. (continued)

(b) The circuit is now connected to a switching circuit to operate a heater.



(i) Explain how the circuit operates to switch on the heater when the temperature falls below a certain value. **3**

(ii) The resistance of the variable resistor R is now increased.

What effect does this have on the temperature at which the heater is switched on?

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

Total marks 11

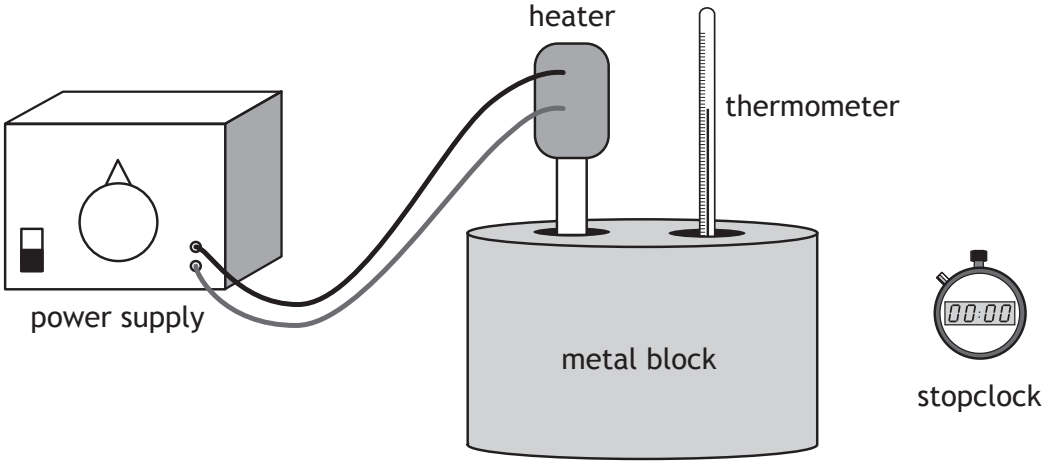
[Turn over for Question 3 on *Page twelve*

DO NOT WRITE ON THIS PAGE

3. A student is investigating the specific heat capacity of three metal blocks X, Y and Z.

Each block has a mass of 1·0 kg.

A heater and thermometer are inserted into a block as shown.



The heater has a power rating of 15 W.

The initial temperature of the block is measured.

The heater is switched on for 10 minutes and the final temperature of the block is recorded.

This procedure is repeated for the other two blocks.

The student's results are shown in the table.

Block	*Initial temperature* (°C)	*Final temperature* (°C)
X	15	25
Y	15	85
Z	15	34

(a) Show that the energy provided by the heater to each block is 9000 J. **2**

Space for working and answer

3. (continued)

(b) (i) By referring to the results in the table, identify the block that has the greatest specific heat capacity. **1**

(ii) Calculate the specific heat capacity of the block identified in (b)(i). **3**

Space for working and answer

(c) Due to energy losses, the specific heat capacities calculated in this investigation are different from the accepted values.

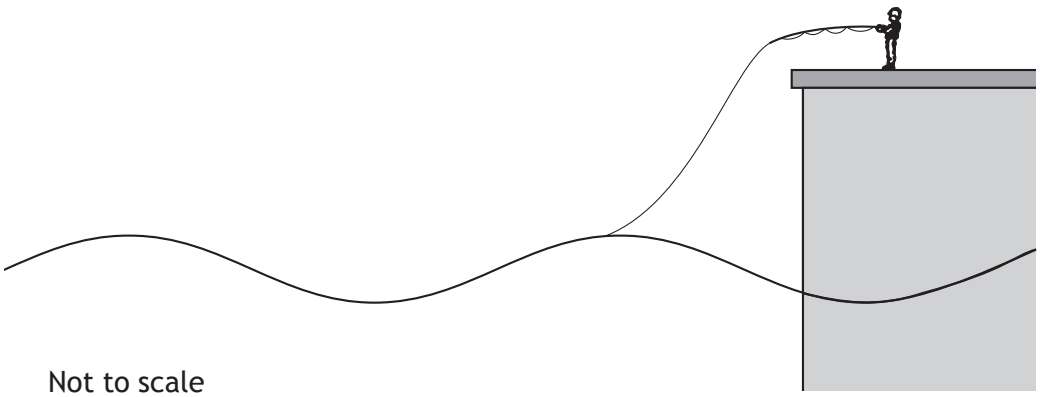
The student decides to improve the set up in order to obtain a value closer to the accepted value for each block.

(i) Suggest a possible improvement that would reduce energy losses. **1**

(ii) State the effect that this improvement would have on the final temperature. **1**

Total marks 8

4. A student, fishing from a pier, counts four waves passing the end of the pier in 20 seconds. The student estimates that the wavelength of the waves is 12 m.



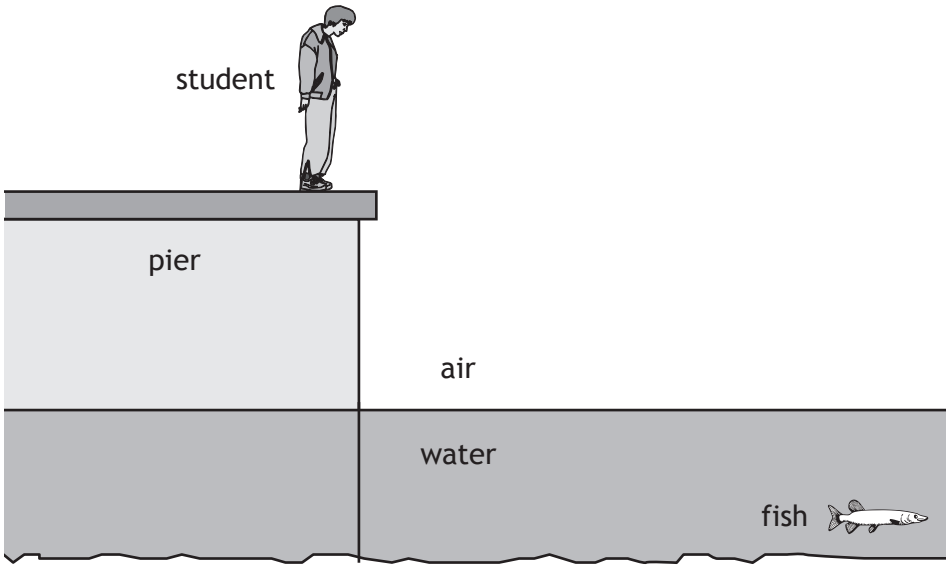
Not to scale

(a) Calculate the speed of the water waves. **4**

Space for working and answer

4. (continued)

(b) When looking down into the calm water behind the pier the student sees a fish.



Complete the diagram to show the path of a ray of light from the fish to the student.

You should include the normal in your diagram. **3**

(An additional diagram, if required, can be found on *Page thirty-one*.)

Total marks 7

[Turn over

5. The UV Index is an international standard measurement of the intensity of ultraviolet radiation from the Sun. Its purpose is to help people to effectively protect themselves from UV rays.

The UV index table is shown.

UV Index	*Description*
0 — 2	Low risk from the Sun's UV rays for the average person
3 — 5	Moderate risk of harm from unprotected Sun exposure
6 — 7	High risk of harm from unprotected Sun exposure
8 — 10	Very high risk of harm from unprotected Sun exposure
11+	Extreme risk of harm from unprotected Sun exposure

The UV index can be calculated using

$$UV\ index = \left[\begin{array}{c} total\ effect\ of \\ UV\ radiation \end{array} \times \begin{array}{c} elevation\ above \\ sea\ level\ adjustment \end{array} \times \begin{array}{c} cloud \\ adjustment \end{array} \right] \div 25$$

The UV index is then rounded to the nearest whole number.

The tables below give information for elevation above sea level and cloud cover.

Elevation above sea level (km)	*Elevation above sea level adjustment*
1	1·06
2	1·12
3	1·18

Cloud cover	*Cloud adjustment*
Clear skies	1·00
Scattered clouds	0·89
Broken clouds	0·73
Overcast skies	0·31

5. (continued)

MARKS | DO NOT WRITE IN THIS MARGIN

(a) At a particular location the total effect of UV radiation is 280.

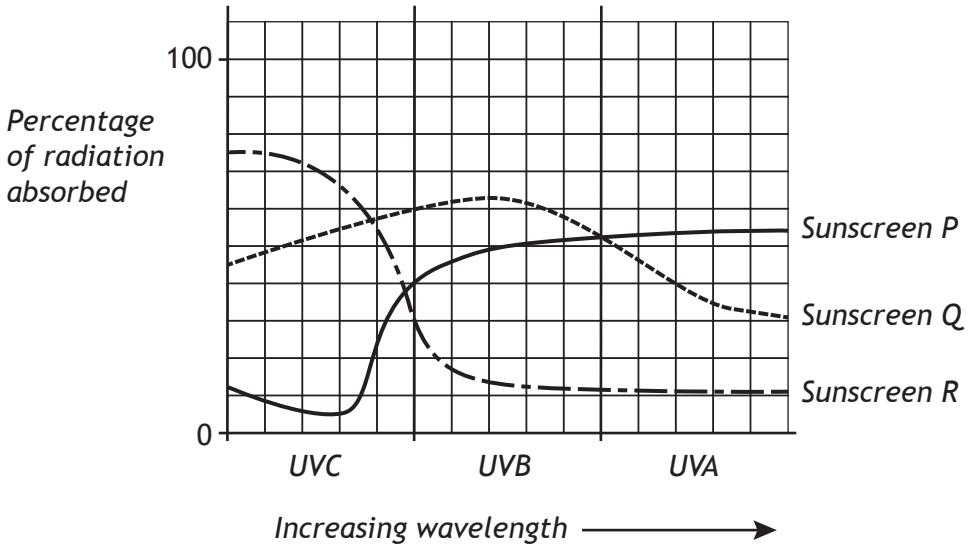
The elevation is 2 km above sea level with overcast skies.

Calculate the UV index value for this location. **2**

Space for working and answer

(b) Applying sunscreen to the skin is one method of protecting people from the Sun's harmful UV rays. UV radiation can be divided into three wavelength ranges, called UVA, UVB and UVC.

A manufacturer carries out some tests on experimental sunscreens P, Q and R to determine how effective they are at absorbing UV radiation. The test results are displayed in the graph.



Using information from the graph, complete the following table. **2**

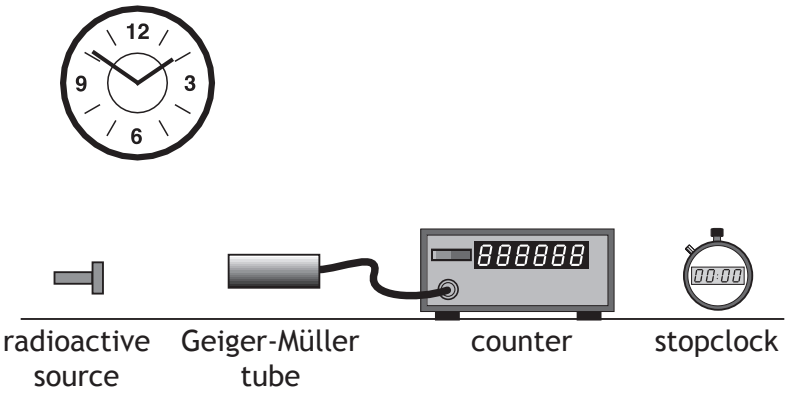
	UVA	*UVB*	*UVC*
Type of sunscreen that absorbs most of this radiation		Sunscreen Q	
Type of sunscreen that absorbs least of this radiation	Sunscreen R		

(c) State one useful application of UV radiation. **1**

Total marks 5

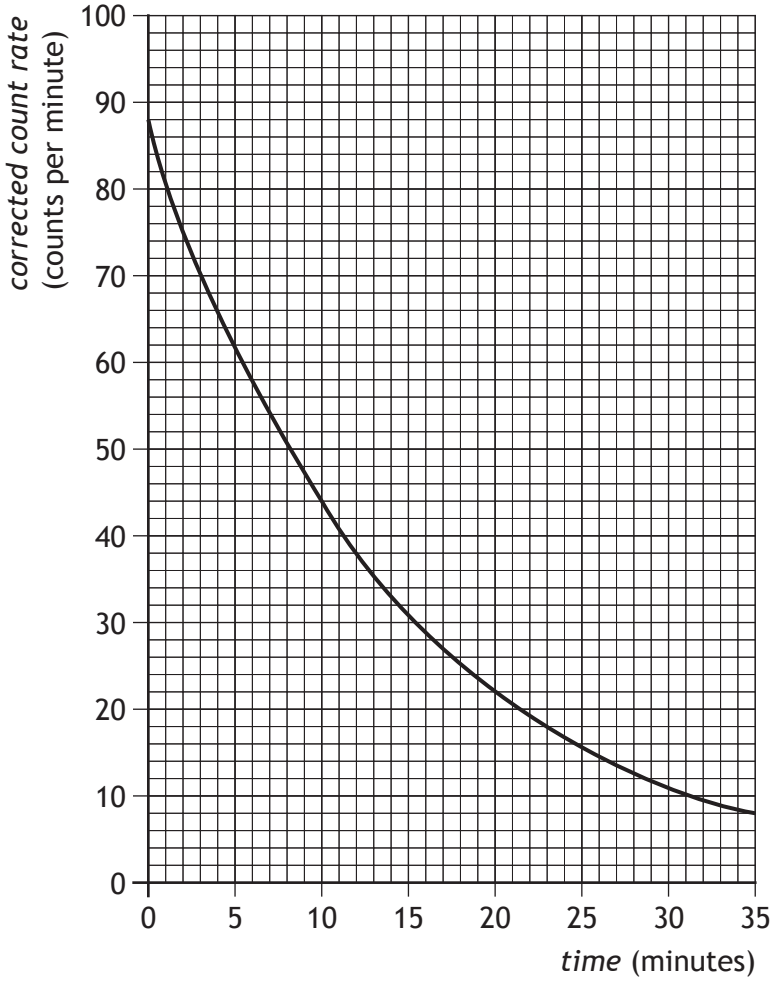
MARKS | DO NOT WRITE IN THIS MARGIN

6. A technician carries out an experiment, using the apparatus shown, to determine the half-life of a radioactive source.



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

(b) The technician displays the data obtained from the experiment in the graph below.



6. (b) (continued)

(i) Describe how the apparatus could be used to obtain the experimental data required to produce this graph. **3**

(ii) Use information from the graph to determine the half-life of the radioactive source. **1**

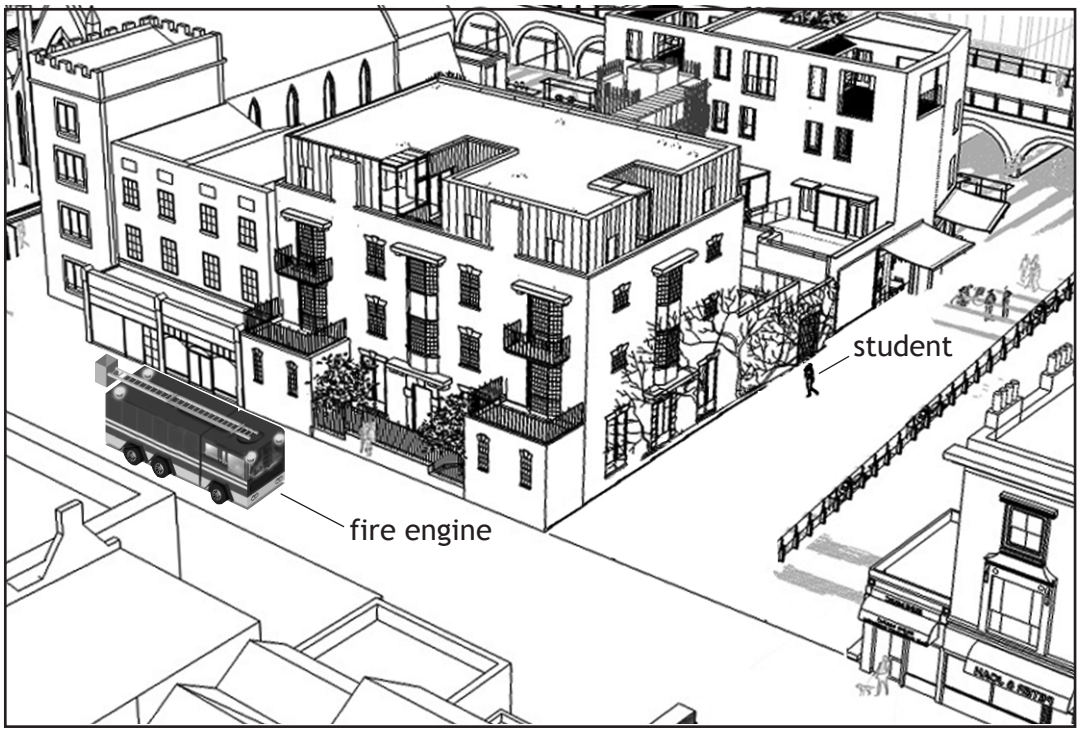
(iii) Determine the corrected count rate after 40 minutes. **2**

Space for working and answer

Total marks 7

7. A fire engine on its way to an emergency is travelling along a main street. The siren on the fire engine is sounding.

A student standing in a nearby street cannot see the fire engine but can hear the siren.



Use your knowledge of physics to comment on why the student can hear the siren even though the fire engine is not in view. **3**

8. An airport worker passes suitcases through an X-ray machine.

(a) The worker has a mass of 80·0 kg and on a particular day absorbs 7·2 mJ of energy from the X-ray machine.

(i) Calculate the absorbed dose received by the worker. **3**

Space for working and answer

(ii) Calculate the equivalent dose received by the worker. **3**

Space for working and answer

8. (continued)

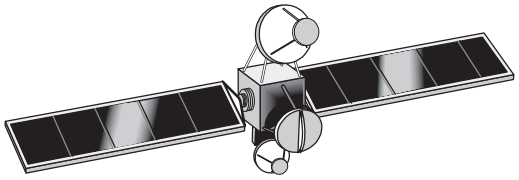
(b) X-rays can cause ionisation.

Explain what is meant by *ionisation*. **1**

Total marks 7

MARKS | DO NOT WRITE IN THIS MARGIN

9. A communications satellite is used to transmit live television broadcasts from the UK to Canada.

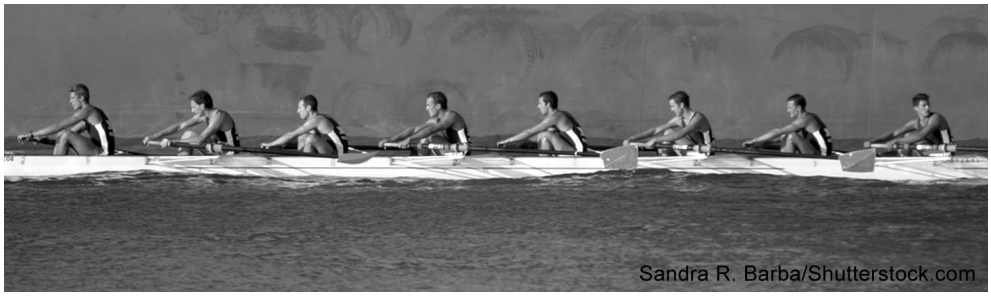


A student states that, to allow the live television broadcasts to be received in Canada, it is important that the satellite does not move.

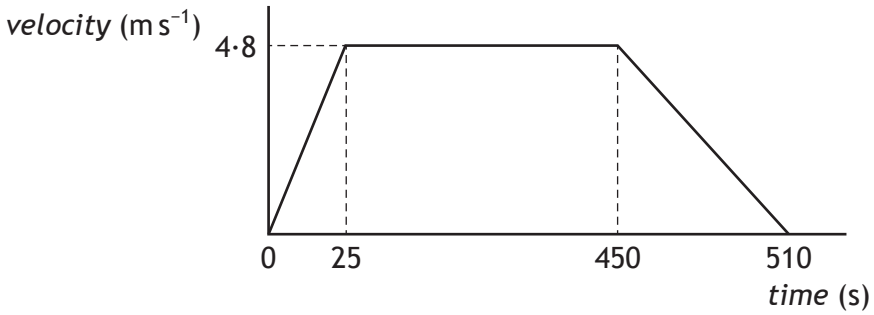
Use your knowledge of physics to comment on this statement. **3**

[Turn over

10. In a rowing event a boat moves off in a straight line.



A graph of the boat's motion is shown.



(a) (i) Calculate the acceleration of the boat during the first 25 s. **3**

Space for working and answer

(ii) Describe the motion of the boat between 25 s and 450 s. **1**

10. (a) (continued)

(iii) Draw a diagram showing the horizontal forces acting on the boat between 25 s and 450 s.

You **must** name these forces and show their directions. **2**

(b) The boat comes to rest after 510 s.

(i) Calculate the total distance travelled by the boat. **3**

Space for working and answer

(ii) Calculate the average velocity of the boat.

A direction is not required. **3**

Space for working and answer

Total marks 12

11. A helicopter is used to take tourists on sightseeing flights.

Information about the helicopter is shown in the table.

weight of empty helicopter	13 500 N
maximum take-off weight	24 000 N
cruising speed	67 m s^{-1}
maximum speed	80 m s^{-1}
maximum range	610 km

(a) The pilot and passengers are weighed before they board the helicopter.

Explain the reason for this. **1**

(b) Six passengers and the pilot with a combined weight of 6125 N board the helicopter.

Determine the minimum upward force required by the helicopter at take-off. **1**

Space for working and answer

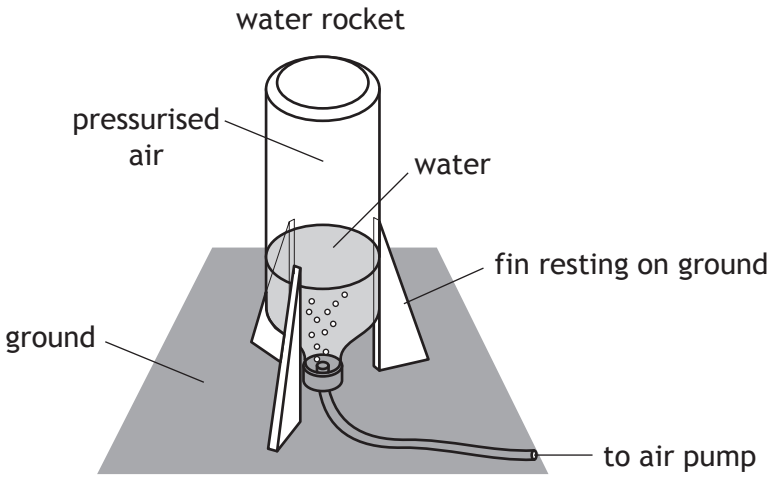
11. (continued)

(c) The helicopter travels 201 km at its cruising speed.
Calculate the time taken to travel this distance. **3**
Space for working and answer

Total marks 5

[Turn over

12. A student is investigating the motion of water rockets. The water rocket is made from an upturned plastic bottle containing some water. Air is pumped into the bottle. When the pressure of the air is great enough the plastic bottle is launched upwards.



The mass of the rocket before launch is 0·94 kg.

(a) Calculate the weight of the water rocket. **3**

Space for working and answer

(b) Before launch, the water rocket rests on three fins on the ground.
The area of each fin in contact with the ground is $2{\cdot}0 \times 10^{-4}\,m^2$.
Calculate the total pressure exerted on the ground by the fins. **4**

Space for working and answer

12. (continued)

(c) Use Newton's Third Law to explain how the rocket launches. **1**

(d) At launch, the initial upward thrust on the rocket is 370 N.

Calculate the initial acceleration of the rocket. **4**

Space for working and answer

(e) The student launches the rocket a second time.

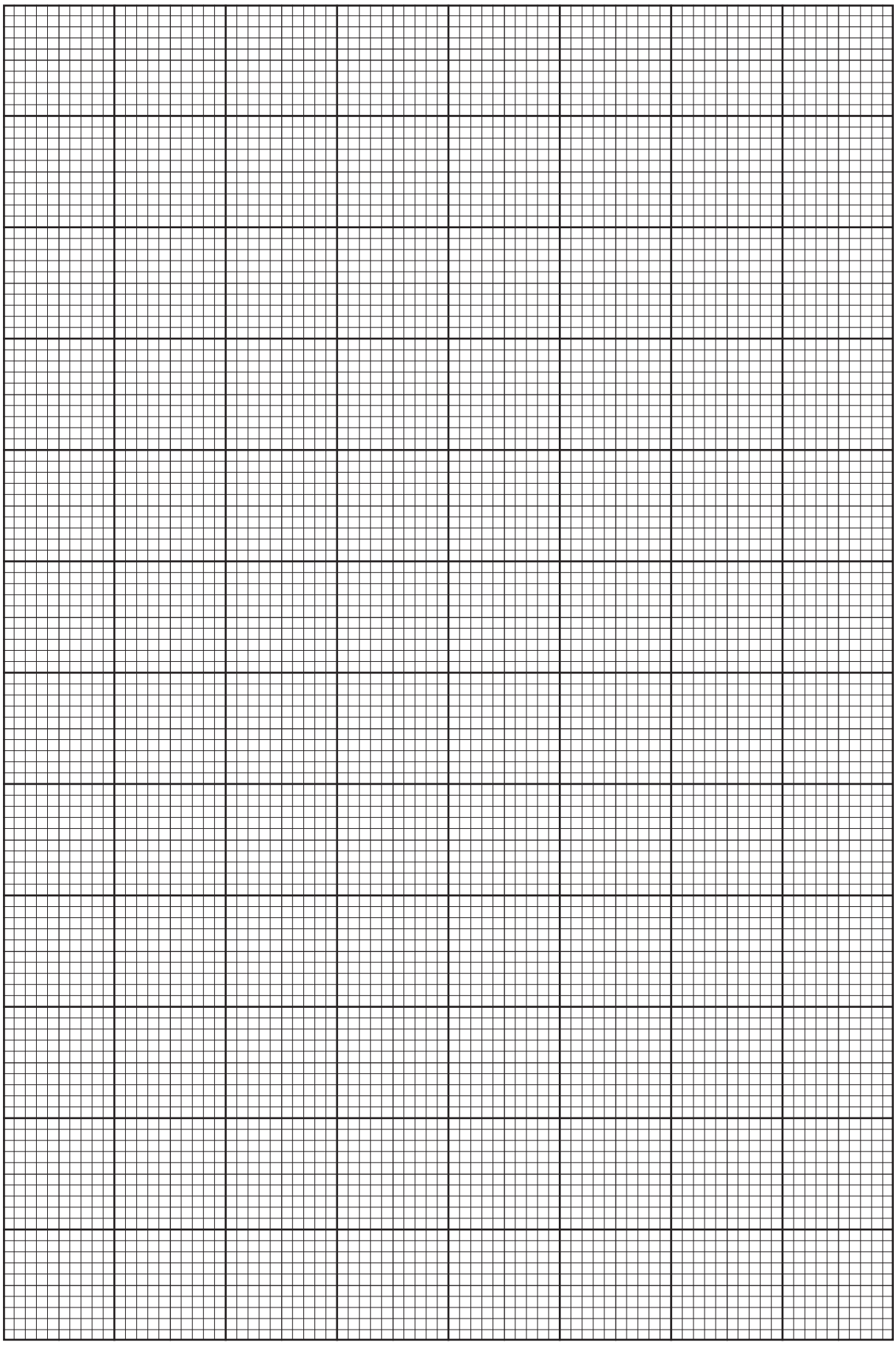
For this launch, the student adds a greater volume of water than before.

The same initial upward thrust acts on the rocket but it fails to reach the same height.

Explain why the rocket fails to reach the same height. **2**

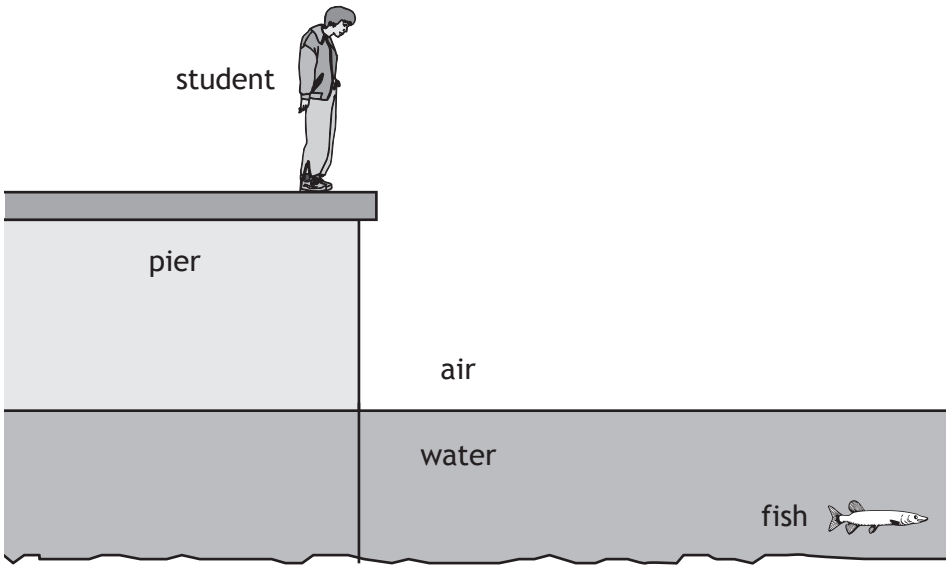
Total marks 14

[END OF QUESTION PAPER]



ADDITIONAL SPACE FOR ANSWERS AND ROUGH WORK

Additional diagram for Question 4 (b)



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ADDITIONAL SPACE FOR ANSWERS AND ROUGH WORK

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ADDITIONAL SPACE FOR ANSWERS AND ROUGH WORK

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ACKNOWLEDGEMENTS

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