N5 National Qualifications 2019

X857/75/02

Physics
Section 1 — Questions

WEDNESDAY, 15 MAY

1:00 PM – 3:30 PM

Instructions for the completion of Section 1 are given on *page 02* of your question and answer booklet X857/75/01.

Record your answers on the answer grid on *page 03* of your question and answer booklet.

Reference may be made to the Data sheet on *page 02* of this booklet and to the Relationships sheet X857/75/11.

Before leaving the examination room you must give your question and answer booklet to the Invigilator; if you do not, you may lose all the marks for this paper.

DATA SHEET

Speed of light in materials

Material	*Speed* in m s^{-1}
Air	$3{\cdot}0 \times 10^8$
Carbon dioxide	$3{\cdot}0 \times 10^8$
Diamond	$1{\cdot}2 \times 10^8$
Glass	$2{\cdot}0 \times 10^8$
Glycerol	$2{\cdot}1 \times 10^8$
Water	$2{\cdot}3 \times 10^8$

Gravitational field strengths

	Gravitational field strength on the surface in N kg^{-1}
Earth	9·8
Jupiter	23
Mars	3·7
Mercury	3·7
Moon	1·6
Neptune	11
Saturn	9·0
Sun	270
Uranus	8·7
Venus	8·9

Specific latent heat of fusion of materials

Material	*Specific latent heat of fusion* in J kg^{-1}
Alcohol	$0{\cdot}99 \times 10^5$
Aluminium	$3{\cdot}95 \times 10^5$
Carbon Dioxide	$1{\cdot}80 \times 10^5$
Copper	$2{\cdot}05 \times 10^5$
Iron	$2{\cdot}67 \times 10^5$
Lead	$0{\cdot}25 \times 10^5$
Water	$3{\cdot}34 \times 10^5$

Specific latent heat of vaporisation of materials

Material	*Specific latent heat of vaporisation* in J kg^{-1}
Alcohol	$11{\cdot}2 \times 10^5$
Carbon Dioxide	$3{\cdot}77 \times 10^5$
Glycerol	$8{\cdot}30 \times 10^5$
Turpentine	$2{\cdot}90 \times 10^5$
Water	$22{\cdot}6 \times 10^5$

Speed of sound in materials

Material	*Speed* in m s^{-1}
Aluminium	5200
Air	340
Bone	4100
Carbon dioxide	270
Glycerol	1900
Muscle	1600
Steel	5200
Tissue	1500
Water	1500

Specific heat capacity of materials

Material	*Specific heat capacity* in J kg^{-1} °C^{-1}
Alcohol	2350
Aluminium	902
Copper	386
Glass	500
Ice	2100
Iron	480
Lead	128
Oil	2130
Water	4180

Melting and boiling points of materials

Material	*Melting point* in °C	*Boiling point* in °C
Alcohol	–98	65
Aluminium	660	2470
Copper	1077	2567
Lead	328	1737
Iron	1537	2737
Water	–	100

Radiation weighting factors

Type of radiation	*Radiation weighting factor*
alpha	20
beta	1
fast neutrons	10
gamma	1
slow neutrons	3
X-rays	1

SECTION 1

Attempt ALL questions

1. Which of the following are **both** vectors?

A weight and acceleration

B kinetic energy and acceleration

C mass and acceleration

D force and speed

E speed and acceleration

2. A car is travelling at $6 \cdot 0\,\text{m}\,\text{s}^{-1}$ along a straight level road.

The car then accelerates uniformly at $2 \cdot 0\,\text{m}\,\text{s}^{-2}$ for $4 \cdot 0\,\text{s}$.

The final speed of the car is

A $8 \cdot 0\,\text{m}\,\text{s}^{-1}$

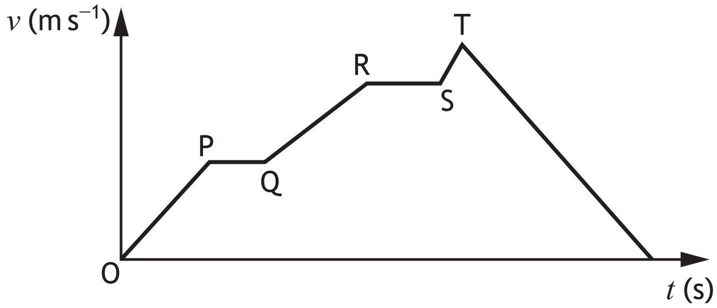
B $14\,\text{m}\,\text{s}^{-1}$

C $22\,\text{m}\,\text{s}^{-1}$

D $26\,\text{m}\,\text{s}^{-1}$

E $48\,\text{m}\,\text{s}^{-1}$.

3. The graph shows how the speed v of a car varies with time t.



During which part of the journey does the car have the greatest acceleration?

A OP

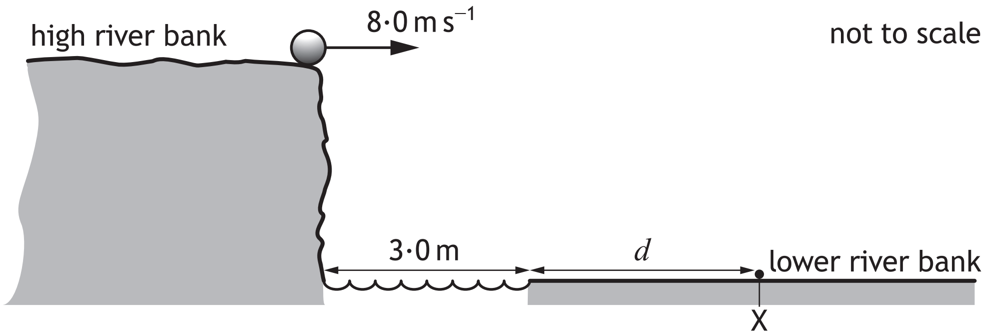
B PQ

C QR

D RS

E ST

4. A ball is kicked horizontally off a high river bank as shown.



The ball lands on the lower river bank at X, 2·0 s after the ball is kicked.

The river is 3·0 m wide.

The effect of air resistance on the ball is negligible.

The distance d between the edge of the lower river bank and X is

A 1·0 m

B 4·0 m

C 13 m

D 16 m

E 19 m.

5. The table gives the distance from Earth, the approximate surface temperature and the age of five stars.

Star	Distance from Earth (light-years)	Approximate surface temperature (K)	Age (years)
Sirius A	8·6	9900	$2{\cdot}4 \times 10^8$
Polaris	430	6000	$7{\cdot}0 \times 10^7$
Betelgeuse	640	3600	$7{\cdot}9 \times 10^6$
Rigel	860	11 000	$8{\cdot}0 \times 10^6$
VY Canis Majoris	3900	3500	$1{\cdot}0 \times 10^7$

A student makes the following statements based on this information.

I As the distance from Earth increases, the age of a star decreases.

II As the age of a star increases, the approximate surface temperature of the star increases.

III There is no apparent relationship between the distance from Earth and the approximate surface temperature of a star.

Which of these statements is/are correct?

A I only

B II only

C III only

D I and III only

E I, II and III

[Turn over

6. A geostationary satellite orbits the Earth.

Which row in the table shows the altitude above the surface of the Earth and orbital period of the geostationary satellite?

	Altitude above the surface of the Earth (km)	**Orbital period (hours)**
A	36 000	12
B	36 000	24
C	36 000	48
D	18 000	12
E	18 000	24

7. The weight of a robot on Earth is 240 N.

The weight of the robot on Mars is

A 3·7 N

B 65 N

C 91 N

D 240 N

E 890 N.

8. A hairdryer is connected to a 230 V supply.

The current in the hairdryer is 2·0 A.

The electrical charge that passes through the hairdryer in 5 minutes is

A 10 C

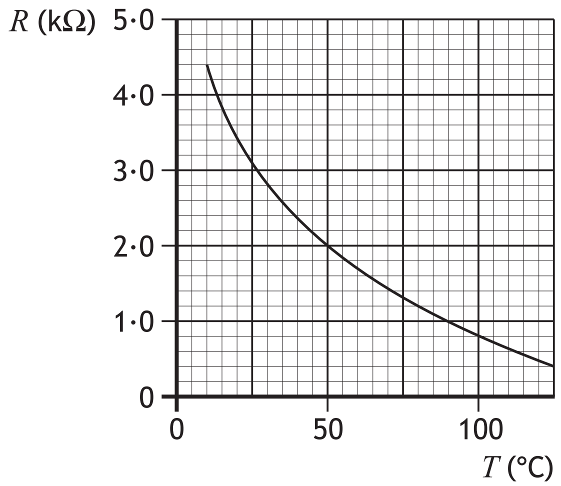
B 460 C

C 600 C

D 1150 C

E 69 000 C.

9. The graph shows how the resistance R of a thermistor varies with temperature T.



The thermistor is connected in a circuit.

At a temperature of 50 °C the current in the thermistor is 0·004 A.

At this temperature the voltage across the thermistor is

A 0·000 02 V

B 0·002 V

C 0·008 V

D 8 V

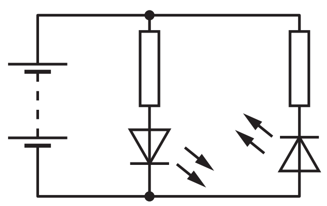
E 500 V.

[Turn over

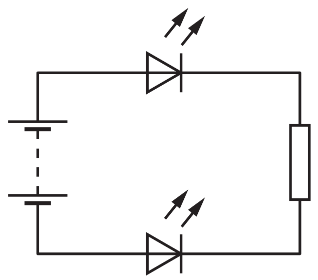
10. A student sets up the circuits shown.

In which circuit will both LEDs be lit?

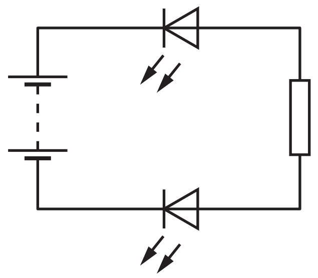
A



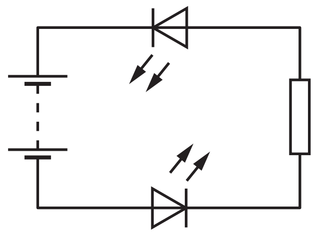
B



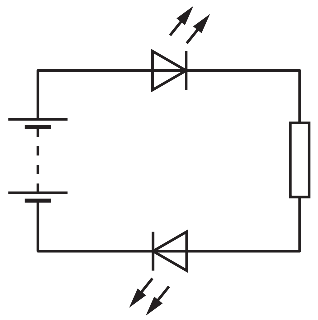
C



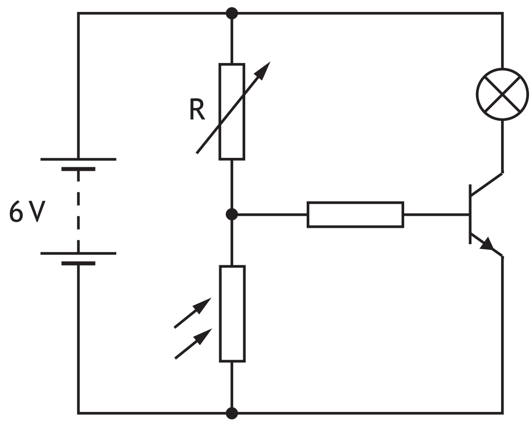
D



E



11. A circuit is set up as shown.



The room temperature is 20 °C.

The lamp is off.

The lamp will light when

A the light level is decreased below a certain value

B the light level is increased above a certain value

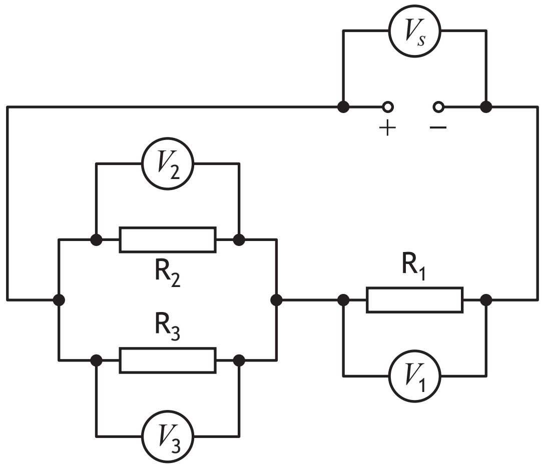
C the resistance of R is increased above a certain value

D the battery voltage is reduced to 5 V

E the temperature is increased above a certain value.

[Turn over

12. A circuit is set up as shown.



A student makes the following statements about the readings on the voltmeters.

I $V_1 = V_2$

II $V_2 = V_3$

III $V_S = V_1 + V_2$

Which of these statements must **always** be true?

A II only

B I and II only

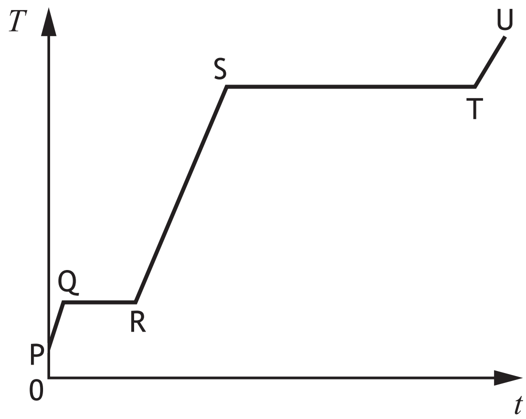
C I and III only

D II and III only

E I, II and III

13. A solid substance is placed in an insulated container and heated.

The graph shows how the temperature T of the substance varies with time t.



To calculate the specific latent heat of fusion of the substance a student would use the time from section

A PQ

B QR

C RS

D ST

E TU.

14. The pressure p due to a liquid at a depth h is given by the relationship

$$p = \rho g h$$

where ρ is the density of the liquid and g is the gravitational field strength.

A liquid has a density of 990 kg m^{-3}.

When the pressure due to the liquid is 1470 Pa, the depth in the liquid is

A 0·069 m

B 0·15 m

C 0·67 m

D 1·5 m

E 6·6 m.

[Turn over

15. A car is parked in the sun for some time. During this time the air pressure inside the tyres increases.

The reason for this increase in pressure is

A the volume occupied by the air particles in the tyres has increased

B the force produced by the air particles in the tyres acts over a smaller area

C the average spacing between the air particles in the tyres has increased

D the increased temperature has made the air particles in the tyres expand

E the air particles in the tyres are moving with greater kinetic energy.

16. The temperature of a sample of gas in a container is 20 °C.

The volume of the gas is $0{\cdot}30\,m^3$.

The container is free to expand in order to maintain a constant pressure.

The temperature of the gas is increased to 50 °C.

The volume now occupied by the gas is

A $0{\cdot}12\,m^3$

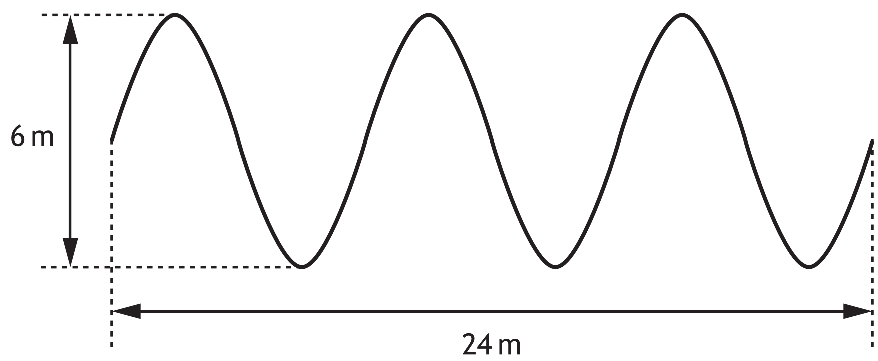
B $0{\cdot}27\,m^3$

C $0{\cdot}30\,m^3$

D $0{\cdot}33\,m^3$

E $0{\cdot}75\,m^3$.

17. The following diagram gives information about a wave.



Which row in the table shows the amplitude and wavelength of the wave?

	Amplitude (m)	Wavelength (m)
A	3	4
B	3	8
C	6	4
D	6	8
E	8	3

18. A student is studying waves with a period of 80·0 ms and a wavelength of 4·00 m.

The frequency of these waves is

A 0·0125 Hz

B 0·320 Hz

C 12·5 Hz

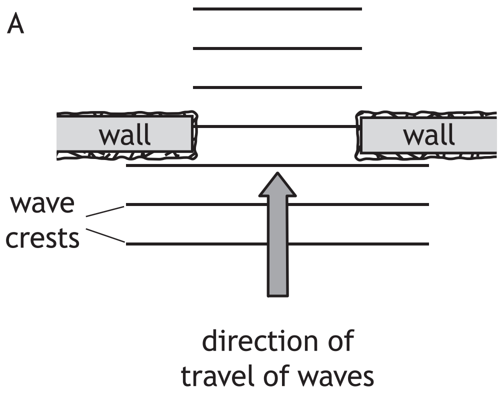
D 80·0 Hz

E 320 Hz.

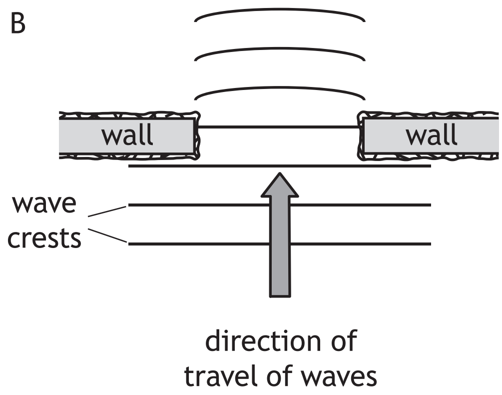
[Turn over

19. Which of the following diagrams shows the diffraction of water waves as they pass between two walls?

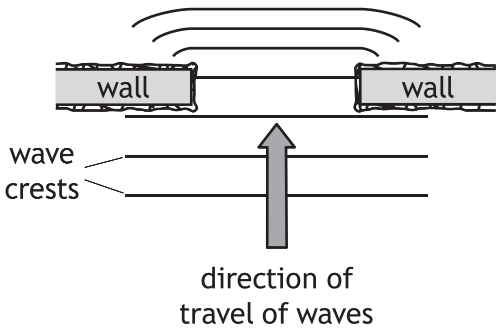
A



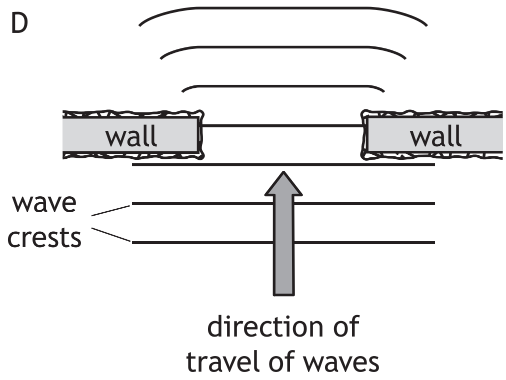
B



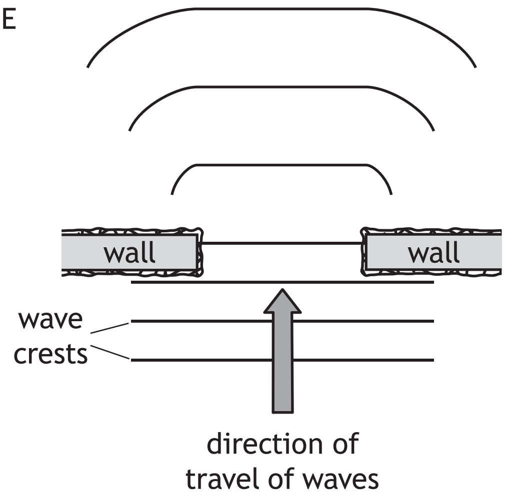
C



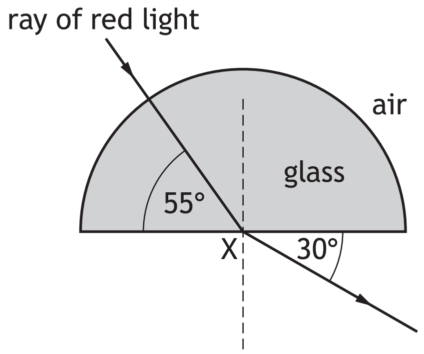
D



E



20. A ray of red light passes through a glass block as shown.

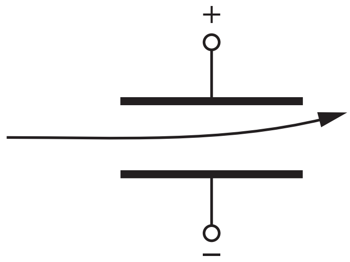
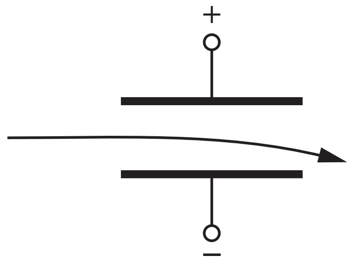
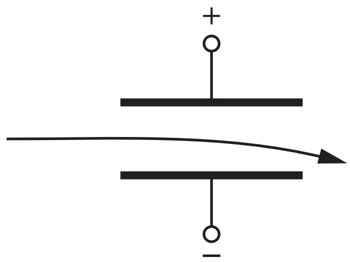
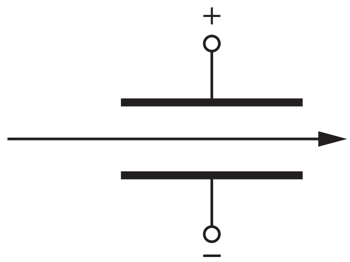
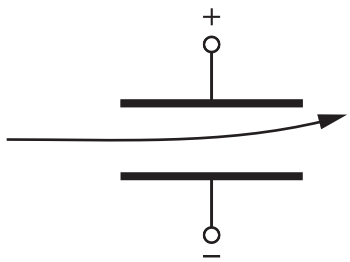
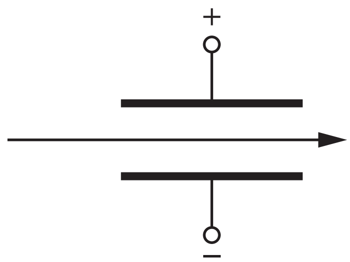
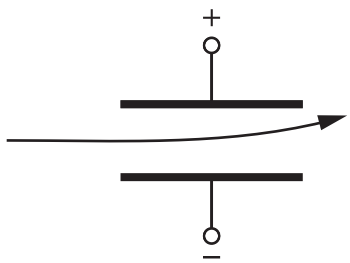
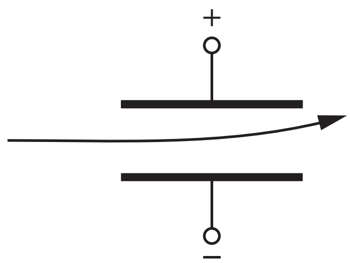
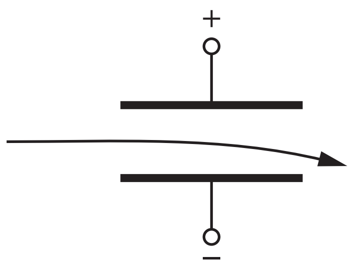
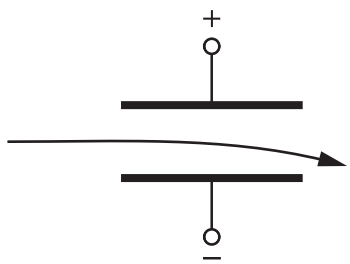


Which row in the table shows the angle of incidence and the corresponding angle of refraction at point X?

	Angle of incidence	Angle of refraction
A	35°	60°
B	30°	55°
C	35°	30°
D	55°	30°
E	60°	35°

[Turn over

21. Which row in the table shows the paths taken by alpha particles and gamma radiation as they pass through a uniform electric field between two metal plates?

	Path taken by alpha particles	Path taken by gamma radiation
A		
B		
C		
D		
E		

22. For a particular radioactive source, 1800 atoms decay in a time of 3 minutes.

The activity of the source is

A 10 Bq

B 600 Bq

C 1800 Bq

D 5400 Bq

E 324 000 Bq.

23. The crew on an aircraft during a transatlantic flight are exposed to cosmic radiation at an equivalent dose rate of $5 \cdot 0\,\mu Sv\,h^{-1}$.

The crew complete 6 transatlantic flights each month. The average duration of a flight is 8 hours.

The equivalent dose received by the crew due to cosmic radiation during transatlantic flights in **one year** is

A 30 μSv

B 40 μSv

C 60 μSv

D 240 μSv

E 2880 μSv.

24. A radioactive tracer is injected into a patient to enable doctors to check the function of a patient's kidneys.

Radiation from the tracer is monitored outside the patient's body by a detector.

Which row in the table shows the most suitable type of radiation emitted and the half-life for the tracer?

	Type of radiation emitted	**Half-life of tracer**
A	alpha	6 hours
B	beta	6 hours
C	beta	6 years
D	gamma	6 hours
E	gamma	6 years

[Turn over for next question

25. The activity of a radioactive source is 56 MBq.

The activity of the source 40 hours later is 3·5 MBq.

The half-life of this source is

A 8 hours

B 10 hours

C 16 hours

D 20 hours

E 28 hours.

[END OF SECTION 1. NOW ATTEMPT THE QUESTIONS IN SECTION 2 OF YOUR QUESTION AND ANSWER BOOKLET]

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N5 National Qualifications 2019

Mark

X857/75/01

Physics
Section 1 — Answer grid and Section 2

WEDNESDAY, 15 MAY

1:00 PM – 3:30 PM

* X 8 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

Scottish candidate number

Total marks — 135

SECTION 1 — 25 marks

Attempt ALL questions.

Instructions for completion of Section 1 are given on *page 02*.

SECTION 2 — 110 marks

Attempt ALL questions.

Reference may be made to the Data sheet on *page 02* of the question paper X857/75/02 and to the Relationships sheet X857/75/11.

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. 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.

* X 8 5 7 7 5 0 1 0 1 *

A/SA

SECTION 1 — 25 marks

The questions for Section 1 are contained in the question paper X857/75/02.

Read these and record your answers on the answer grid on *page 03* 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.

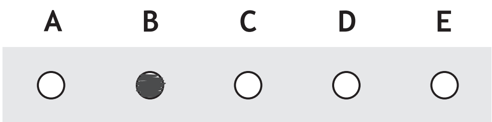
3. Any rough work must be written in the additional space for answers and rough work at the end of this booklet.

Sample question

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

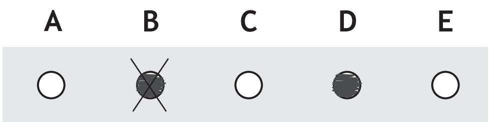
A ampere
B kilowatt-hour
C watt
D coulomb
E volt.

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

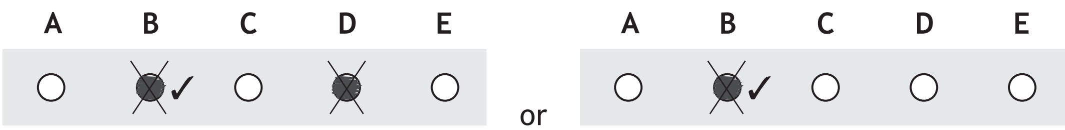


Changing an answer

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:



OBJ25AE1

You must record your answers to Section 1 questions on the answer grid on **Page 03** of your **answer booklet.**

X857750103

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[Turn over for SECTION 2

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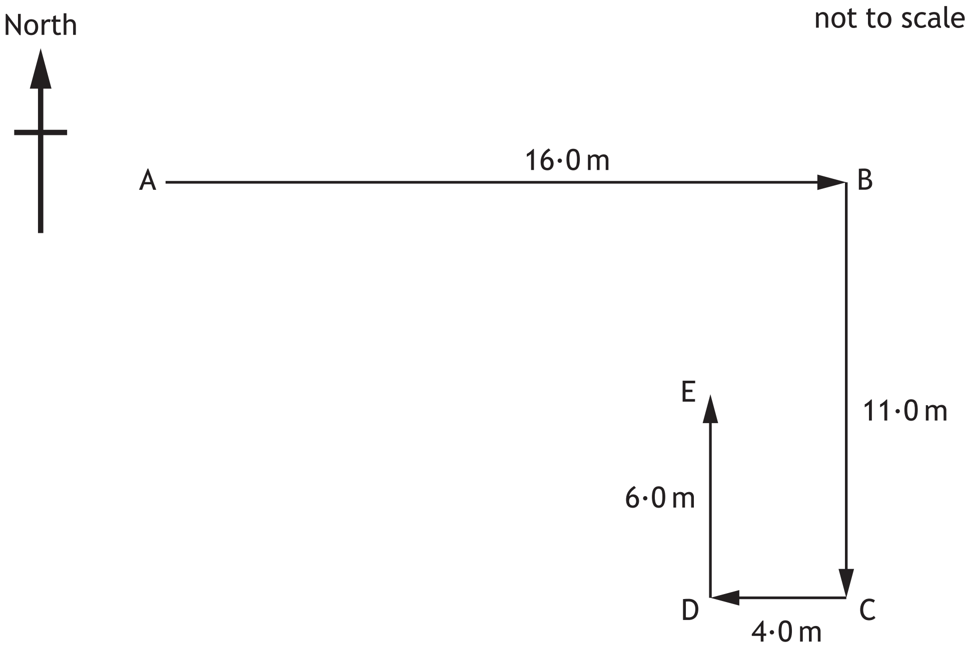
SECTION 2 — 110 marks

Attempt ALL questions

1. A quadcopter is a drone with four rotating blades.

(a) In a race, the quadcopter is flown along a route from point A to point E.



1. (a) (continued)

(i) By scale drawing or otherwise, determine the magnitude of the resultant displacement of the quadcopter from point A to point E. **2**

Space for working and answer

(ii) By scale drawing or otherwise, determine the direction of the resultant displacement of the quadcopter from point A to point E. **2**

Space for working and answer

[Turn over

1. (continued)

(b) The quadcopter takes 32·5 s to complete the race.

Determine the average velocity of the quadcopter over the whole race. **3**

Space for working and answer

(c) A second quadcopter completes the race at an average speed of $1{\cdot}25\ \mathrm{m\,s^{-1}}$.

The distance travelled by this quadcopter during the race is 37·0 m.

Determine the **difference** in the times taken by the quadcopters to complete the race. **3**

Space for working and answer

1. (continued)

(d) After passing point E, the quadcopter hovers at a constant height.

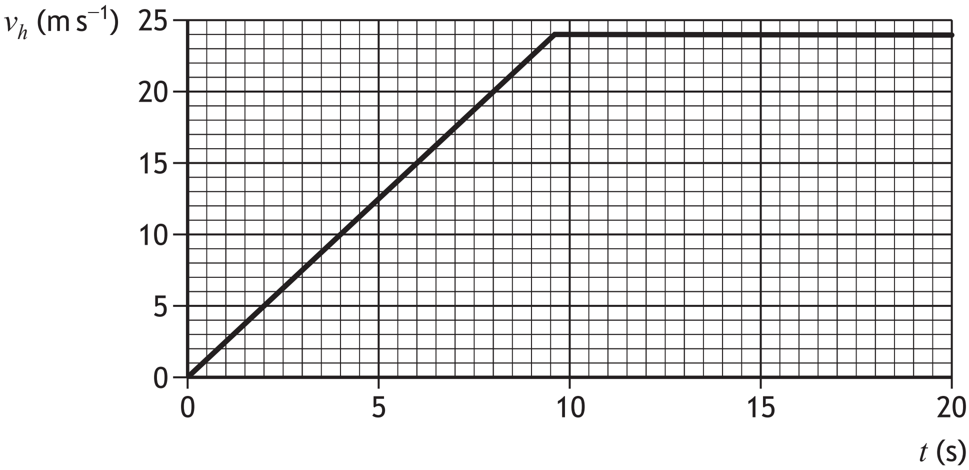
Describe how the overall lift force provided by the four rotating blades compares to the weight of the quadcopter. **1**

[Turn over

MARKS | DO NOT WRITE IN THIS MARGIN

2. A glider is accelerated from rest by a cable attached to a winch.

The graph shows the horizontal velocity v_h of the glider for the first 20 s of its motion.



(a) The glider is accelerated by a constant unbalanced force of 925 N.

(i) Show that the initial acceleration of the glider is $2{\cdot}5\ \text{m s}^{-2}$. **2**

Space for working and answer

(ii) Calculate the mass of the glider. **3**

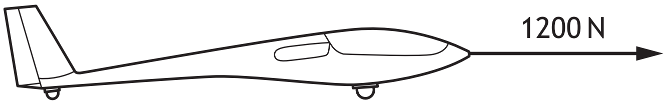
Space for working and answer

* X 8 5 7 7 5 0 1 1 0 *

MARKS DO NOT WRITE IN THIS MARGIN

2. (a) (continued)

(iii) At 2·0 s the cable pulls the glider with a force of 1200 N.



(A) Determine the size of the frictional forces acting on the glider at this time. **1**

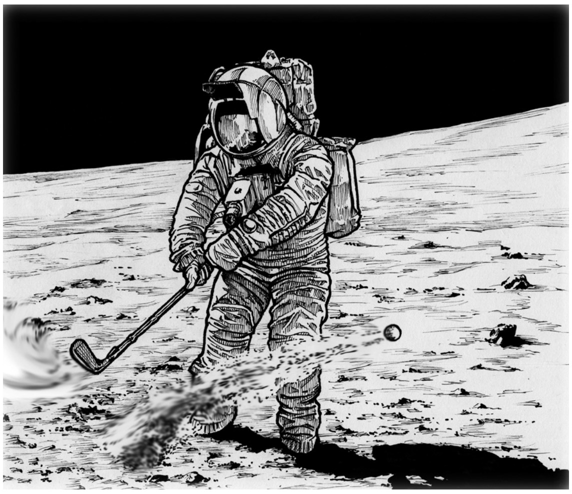
(B) Suggest one design feature of the glider that reduces the frictional forces acting on it. **1**

(b) At 8·0 s the glider reaches its take-off speed and leaves the ground.

Determine the distance the glider travels along the ground before take-off. **3**

Space for working and answer

3. In 1971, the astronaut Alan Shepard hit a golf ball on the surface of the Moon.



Using your knowledge of physics, comment on the similarities and/or differences between this event and hitting an identical ball on the surface of the Earth. **3**

DO NOT WRITE IN THIS MARGIN

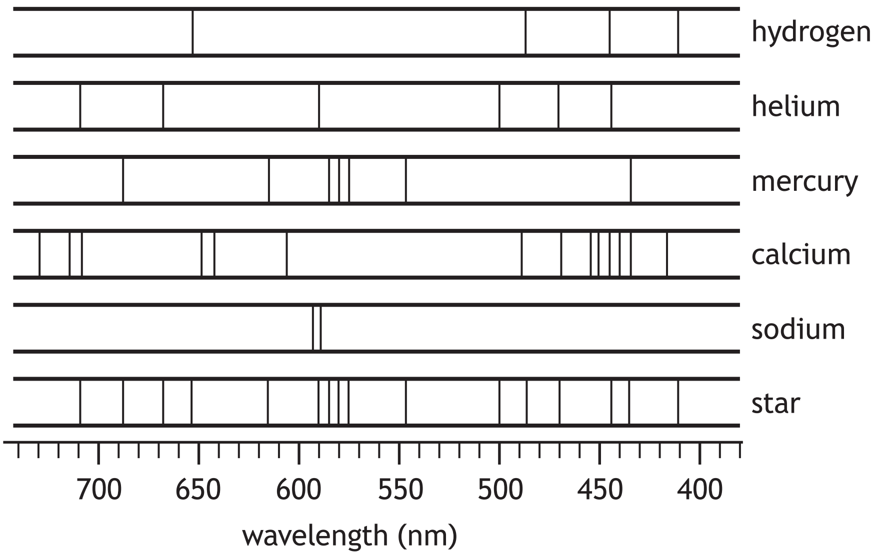
3. (continued)

* X 8 5 7 7 5 0 1 1 3 *

[Turn over

4. Astronomers studying a distant star analyse the light from the star that reaches Earth.

The line spectrum from the star is shown, along with the line spectra of the elements hydrogen, helium, mercury, calcium, and sodium.



(a) Determine which of these elements are present in the star. **1**

MARKS | DO NOT WRITE IN THIS MARGIN

4. **(continued)**

(b) The star is 97 light-years from Earth.

(i) State what is meant by the term *light-year*. **1**

(ii) Calculate the distance, in metres, from the star to Earth. **3**

Space for working and answer

(c) Astronomers use satellite-based telescopes to collect information about objects in space.

(i) Suggest an advantage of using satellite-based telescopes such as the Hubble Space Telescope. **1**

(ii) State one **other** use of satellites. **1**

5. A student is investigating how the length of a wire affects its resistance.

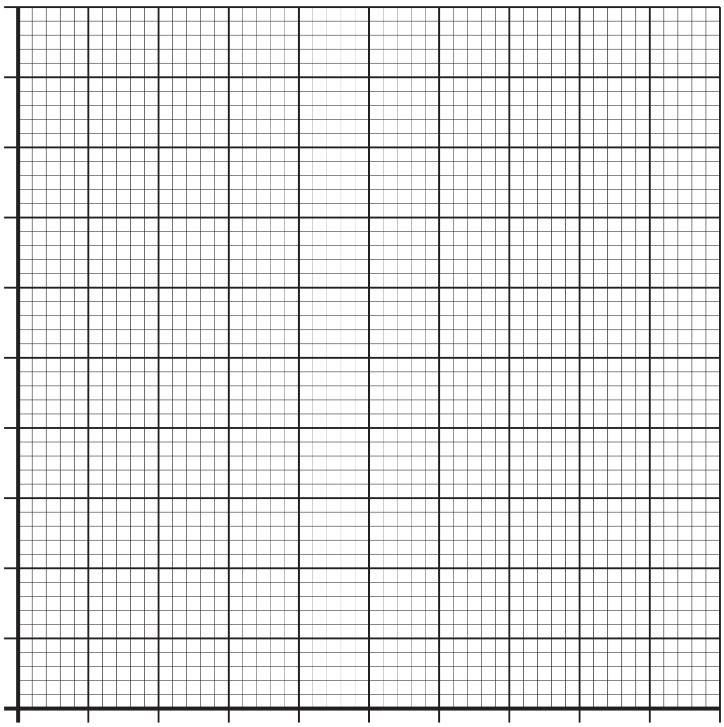
The student connects different lengths of wire to a power supply of fixed voltage and measures the current in each length of wire.

(a) The measurements taken by the student are shown in the table.

Length of wire (m)	**Current (A)**
0·20	0·94
0·40	0·66
0·60	0·47
0·80	0·37
1·00	0·32

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

(Additional graph paper, if required, can be found on *page 38*)



5. (a) (continued)

(ii) State whether the resistance of the wire increases, decreases or stays the same, as the length of wire increases.

Justify your answer. **2**

(iii) Use your graph to predict the current in a 0·50 m length of wire, when connected to the power supply. **1**

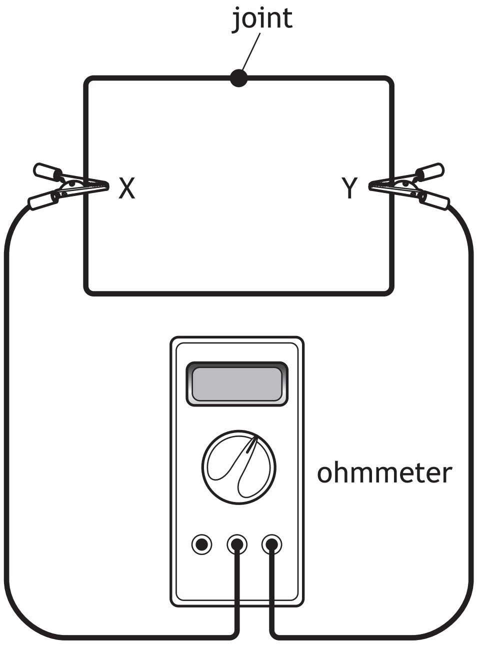
(iv) Suggest one way in which the experimental procedure could be improved to give more reliable results. **1**

[Turn over

5. (continued)

(b) A length of the wire with a resistance of 5·2 Ω is then folded into a rectangular shape and the ends are joined together.

An ohmmeter is connected across the wire between point X and point Y as shown.



State whether the reading on the ohmmeter would be less than, equal to or greater than 5·2 Ω.

You must justify your answer. **2**

[Turn over for next question

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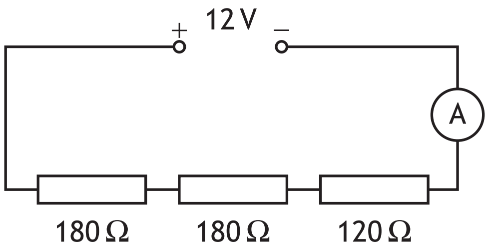
6. A student is investigating connecting different combinations of resistors in circuits.

(a) The student sets up a circuit as shown.



(i) Calculate the current in the circuit. **4**

Space for working and answer

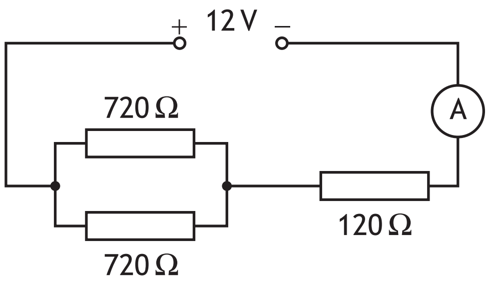
(ii) Calculate the power dissipated in the 120 Ω resistor. **3**

Space for working and answer

MARKS | DO NOT WRITE IN THIS MARGIN

6. (continued)

(b) The student then sets up a different circuit as shown.



(i) Determine the total resistance of this circuit. **4**

Space for working and answer

(ii) State how the power dissipated in the 120 Ω resistor in this circuit compares to the power dissipated in the 120 Ω resistor in the circuit in part (a) (ii).

Justify your answer. **2**

7. A hot water dispenser is used to heat enough water for one cup at a time.

The rating plate for the hot water dispenser is shown.

Model: 1-KUPPA
3·5 kW
230 V
50 Hz

The hot water dispenser takes 26 s to heat enough water for one cup.

(a) Show that the energy supplied to the hot water dispenser during this time is 91 000 J. **2**

Space for working and answer

7. (continued)

(b) The hot water dispenser heats 0·250 kg of water for each cup.

(i) Calculate the minimum energy required to heat 0·250 kg of water from an initial temperature of 20·0 °C to its boiling point. 3

Space for working and answer

(ii) As the water is dispensed into the cup, steam is released.

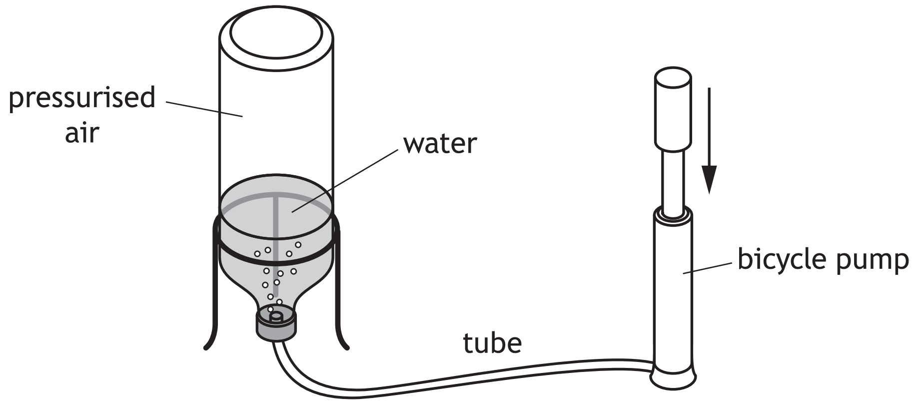
Determine the maximum mass of steam that can be produced while the water for one cup is being heated. 4

Space for working and answer

(iii) Explain why, in practice, the mass of steam produced is less than calculated in (b)(ii). 1

MARKS | DO NOT WRITE IN THIS MARGIN

8. A water rocket consists of a plastic bottle partly filled with water. Air is pumped in through the water. When the pressure is great enough, the tube detaches from the bottle. Water is forced out of the bottle, which causes the bottle to be launched upwards.

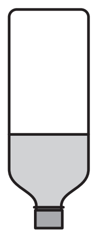


At launch, the air in the bottle is at a pressure of $1{\cdot}74 \times 10^{5}$ Pa.

(a) On the diagram below, show all the forces acting vertically on the bottle as it is launched.

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

(An additional diagram, if required, can be found on *page 39*)



8. (continued)

(b) The area of water in contact with the pressurised air in the bottle is $4{\cdot}50 \times 10^{-3}\,m^2$.

Calculate the force exerted on the water by the pressurised air at launch. **3**

Space for working and answer

(c) At launch, the air in the bottle has a volume of $7{\cdot}5 \times 10^{-4}\,m^3$.

At one point in the flight, the volume of air in the bottle has **increased by** $1{\cdot}2 \times 10^{-4}\,m^3$.

During the flight the temperature of the air in the bottle remains constant.

(i) Calculate the pressure of the air inside the bottle at this point in the flight. **4**

Space for working and answer

MARKS | DO NOT WRITE IN THIS MARGIN

8. (c) (continued)

(ii) Using the kinetic model, explain what happens to the pressure of the air inside the bottle as the volume of the air increases. **3**

[Turn over for next question

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MARKS | DO NOT WRITE IN THIS MARGIN

9. A lifeboat crew is made up of local volunteers. When there is an emergency they have to get to the lifeboat quickly.

The lifeboat crew members are alerted to an emergency using a pager.

Text messages are sent to the pager using radio waves.

(a) The radio waves have a frequency of 153 MHz.

Calculate the wavelength of the radio waves. **3**

Space for working and answer

(b) When the pager receives a message it beeps loudly and a light on the pager flashes.

A crew member holding the pager observes the beeps and the flashes happening at the same time.

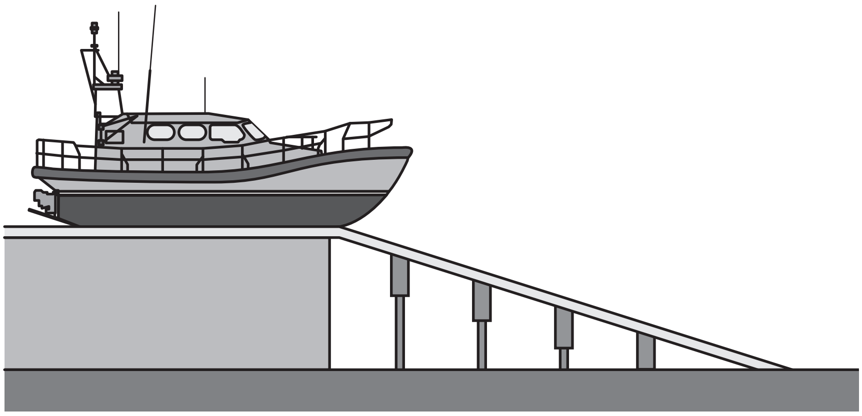
A second crew member, who is 100 m away from the pager, also observes the beeps and the flashes.

Explain why the second crew member does not observe the beeps and the flashes happening at the same time. **2**

MARKS | DO NOT WRITE IN THIS MARGIN

9. (continued)

(c) The lifeboat has a mass of 25 000 kg. When it is launched, it loses $4{\cdot}5 \times 10^5$ J of gravitational potential energy before it enters the water.



(i) Calculate the maximum speed of the lifeboat as it enters the water. **3**

Space for working and answer

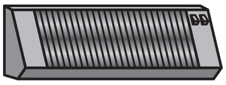
(ii) Explain why, in practice, the speed of the lifeboat as it enters the water is less than calculated in (c) (i). **1**

10. Infrared and gamma rays are both members of a family of waves.

(a) State the name given to this family of waves. **1**

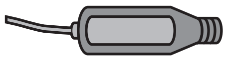
(b) State how the frequency of infrared compares to the frequency of gamma rays. **1**

(c) Some examples of sources and detectors of waves in this family are shown.

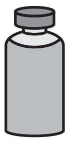


heater

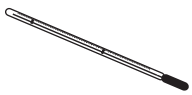
radioactive waste



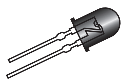
Geiger-Müller tube



fluorescent ink



black-bulb thermometer



LED

(i) From the examples shown, identify

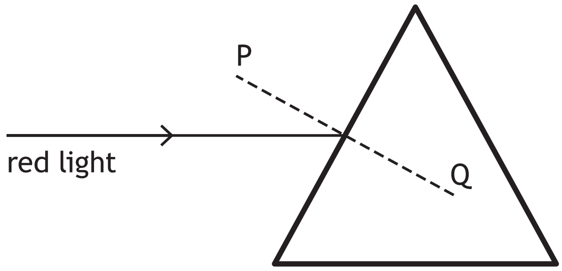
(A) the detector of infrared **1**

(B) the source of gamma rays. **1**

(ii) Suggest one application for the waves that are detected using fluorescent ink. **1**

11. A student carries out an experiment to investigate the effect of different shaped glass blocks on the path of a ray of light.

(a) The student directs a ray of red light at a triangular glass block as shown.



(i) Complete the diagram above to show the path of the ray of red light through and out of the glass block. **2**

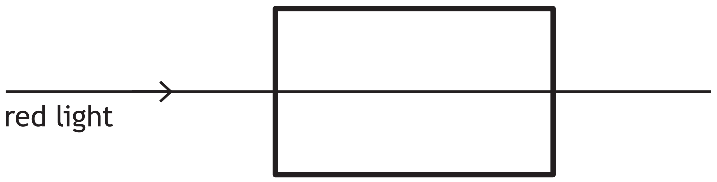
(An additional diagram, if required, can be found on *page 39*)

(ii) The diagram shows a dashed line PQ.

State the name given to this line. **1**

(iii) **On the diagram above**, label an angle of incidence i. **1**

(b) The student replaces the triangular glass block with a rectangular block made of the same material. The path of the ray of red light is as shown.



State whether the wavelength of the red light in this block is less than, the same as, or greater than the wavelength of the red light in the triangular glass block in (a).

Justify your answer. **2**

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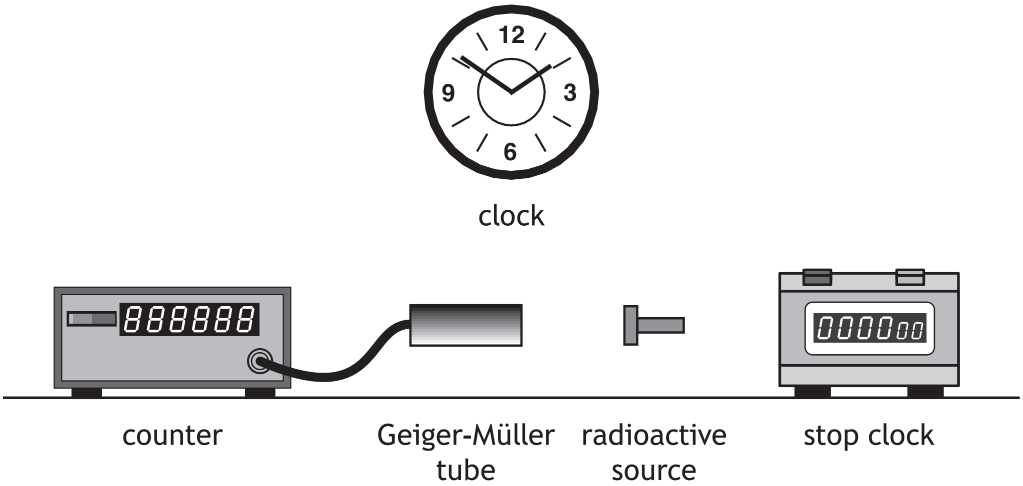
12. A technician carries out an experiment, using the apparatus shown, to determine the half-life of a radioactive source.

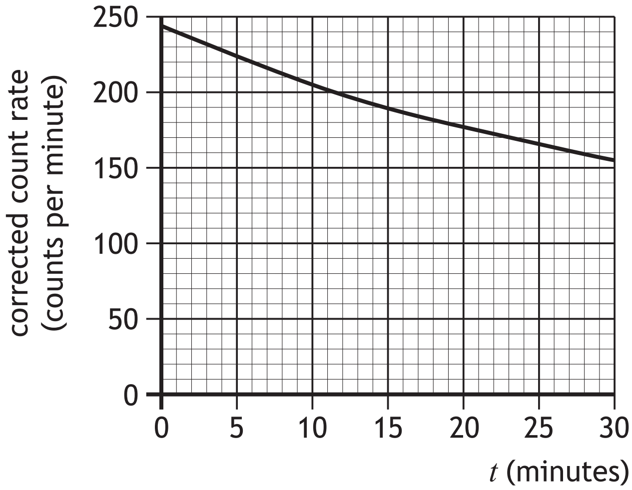


(a) Describe how the apparatus can be used to determine the half-life of the radioactive source. **3**

[Turn over

12. (continued)

(b) The technician carries out the experiment over a period of 30 minutes, and displays the data obtained in a graph as shown.



Suggest an improvement that the technician could make to the procedure to more easily determine a value for the half-life of this source. **1**

(c) In a second experiment, the technician absorbs $1{\cdot}2\,\mu J$ of energy throughout their body from a radioactive source.

The mass of the technician is $80{\cdot}0\,kg$.

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

Space for working and answer

12. (c) (continued)

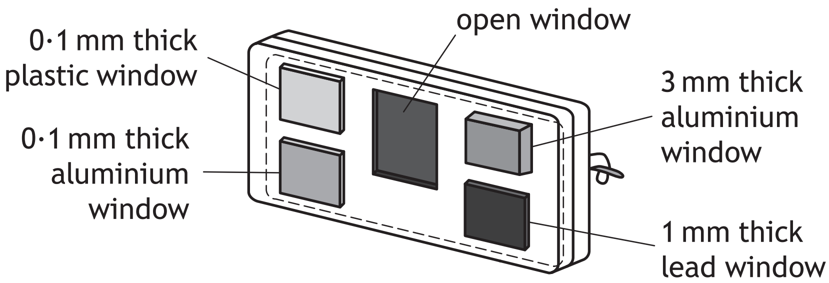
(ii) During the experiment, the technician receives an equivalent dose of $4{\cdot}5 \times 10^{-8}$ Sv.

Calculate the radiation weighting factor of this source. **3**

Space for working and answer

(d) The technician wears a film badge to monitor exposure to radiation.

The film badge contains a piece of photographic film behind windows of different materials.



Explain how this badge is used to determine the type of radiation the technician has been exposed to. **2**

[Turn over for next question

MARKS | DO NOT WRITE IN THIS MARGIN

13. A physics teacher makes the following statement.

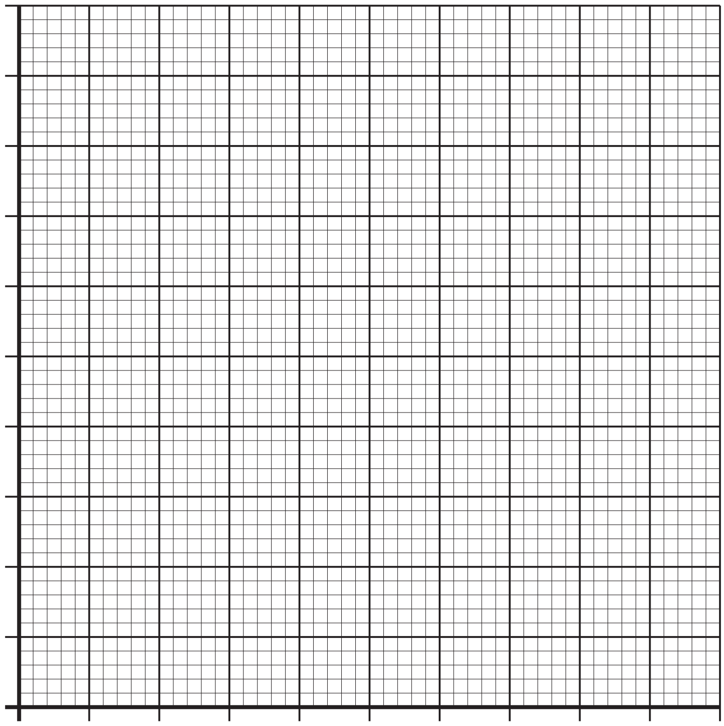
'Instead of nuclear fission, perhaps one day nuclear fusion will become a practical source of generating energy.'

Using your knowledge of physics, comment on the similarities and/or differences between using nuclear fission and nuclear fusion to generate energy. **3**

[END OF QUESTION PAPER]

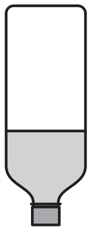
ADDITIONAL SPACE FOR ANSWERS AND ROUGH WORK

Additional graph paper for Q5 (a) (i)

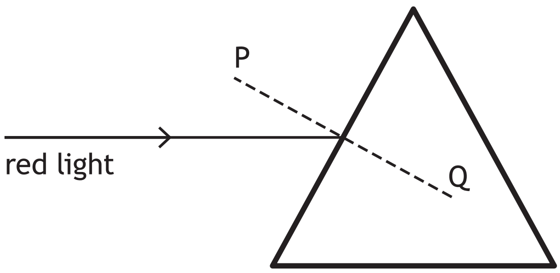


ADDITIONAL SPACE FOR ANSWERS AND ROUGH WORK

Additional diagram for Q8 (a)



Additional diagram for Q11 (a) (i)



ADDITIONAL SPACE FOR ANSWERS AND ROUGH WORK

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N5

National Qualifications 2019

X857/75/11

Physics
Relationships sheet

WEDNESDAY, 15 MAY

1:00 PM – 3:30 PM

X857751 1

$d = vt$

$d = \bar{v}t$

$s = vt$

$s = \bar{v}t$

$$a = \frac{v-u}{t}$$

$F = ma$

$W = mg$

$E_w = Fd$

$E_p = mgh$

$$E_k = \frac{1}{2}mv^2$$

$Q = It$

$V = IR$

$$V_2 = \left(\frac{R_2}{R_1 + R_2}\right)V_S$$

$$\frac{V_1}{V_2} = \frac{R_1}{R_2}$$

$R_T = R_1 + R_2 + \ldots$

$$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \ldots$$

$$P = \frac{E}{t}$$

$P = IV$

$P = I^2R$

$$P = \frac{V^2}{R}$$

$E_h = cm\Delta T$

$E_h = ml$

$$p = \frac{F}{A}$$

$p_1V_1 = p_2V_2$

$$\frac{p_1}{T_1} = \frac{p_2}{T_2}$$

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

$$\frac{pV}{T} = \text{constant}$$

$$f = \frac{N}{t}$$

$v = f\lambda$

$$T = \frac{1}{f}$$

$$A = \frac{N}{t}$$

$$D = \frac{E}{m}$$

$H = Dw_r$

$$\dot{H} = \frac{H}{t}$$

Additional relationships

Circle

circumference $= 2\pi r$

area $= \pi r^2$

Sphere

area $= 4\pi r^2$

volume $= \frac{4}{3}\pi r^3$

Trigonometry

$$\sin\theta = \frac{\text{opposite}}{\text{hypotenuse}}$$

$$\cos\theta = \frac{\text{adjacent}}{\text{hypotenuse}}$$

$$\tan\theta = \frac{\text{opposite}}{\text{adjacent}}$$

$$\sin^2\theta + \cos^2\theta = 1$$

Electron Arrangements of Elements

Key

Atomic number
Symbol
Electron arrangement
Name

Transition Elements

Group 1 (1)	Group 2 (2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	Group 3 (13)	Group 4 (14)	Group 5 (15)	Group 6 (16)	Group 7 (17)	Group 0 (18)
1 **H** 1 Hydrogen																	2 **He** 2 Helium
3 **Li** 2,1 Lithium	4 **Be** 2,2 Beryllium											5 **B** 2,3 Boron	6 **C** 2,4 Carbon	7 **N** 2,5 Nitrogen	8 **O** 2,6 Oxygen	9 **F** 2,7 Fluorine	10 **Ne** 2,8 Neon
11 **Na** 2,8,1 Sodium	12 **Mg** 2,8,2 Magnesium											13 **Al** 2,8,3 Aluminium	14 **Si** 2,8,4 Silicon	15 **P** 2,8,5 Phosphorus	16 **S** 2,8,6 Sulfur	17 **Cl** 2,8,7 Chlorine	18 **Ar** 2,8,8 Argon
19 **K** 2,8,8,1 Potassium	20 **Ca** 2,8,8,2 Calcium	21 **Sc** 2,8,9,2 Scandium	22 **Ti** 2,8,10,2 Titanium	23 **V** 2,8,11,2 Vanadium	24 **Cr** 2,8,13,1 Chromium	25 **Mn** 2,8,13,2 Manganese	26 **Fe** 2,8,14,2 Iron	27 **Co** 2,8,15,2 Cobalt	28 **Ni** 2,8,16,2 Nickel	29 **Cu** 2,8,18,1 Copper	30 **Zn** 2,8,18,2 Zinc	31 **Ga** 2,8,18,3 Gallium	32 **Ge** 2,8,18,4 Germanium	33 **As** 2,8,18,5 Arsenic	34 **Se** 2,8,18,6 Selenium	35 **Br** 2,8,18,7 Bromine	36 **Kr** 2,8,18,8 Krypton
37 **Rb** 2,8,18,8,1 Rubidium	38 **Sr** 2,8,18,8,2 Strontium	39 **Y** 2,8,18,9,2 Yttrium	40 **Zr** 2,8,18, 10,2 Zirconium	41 **Nb** 2,8,18, 12,1 Niobium	42 **Mo** 2,8,18,13, 1 Molybdenum	43 **Tc** 2,8,18,13, 2 Technetium	44 **Ru** 2,8,18,15, 1 Ruthenium	45 **Rh** 2,8,18,16, 1 Rhodium	46 **Pd** 2,8,18, 18,0 Palladium	47 **Ag** 2,8,18, 18,1 Silver	48 **Cd** 2,8,18, 18,2 Cadmium	49 **In** 2,8,18, 18,3 Indium	50 **Sn** 2,8,18, 18,4 Tin	51 **Sb** 2,8,18, 18,5 Antimony	52 **Te** 2,8,18, 18,6 Tellurium	53 **I** 2,8,18, 18,7 Iodine	54 **Xe** 2,8,18, 18,8 Xenon
55 **Cs** 2,8,18,18, 8,1 Caesium	56 **Ba** 2,8,18,18, 8,2 Barium	57 **La** 2,8,18,18, 9,2 Lanthanum	72 **Hf** 2,8,18,32, 10,2 Hafnium	73 **Ta** 2,8,18, 32,11,2 Tantalum	74 **W** 2,8,18,32, 12,2 Tungsten	75 **Re** 2,8,18,32, 13,2 Rhenium	76 **Os** 2,8,18,32, 14,2 Osmium	77 **Ir** 2,8,18,32, 15,2 Iridium	78 **Pt** 2,8,18,32, 17,1 Platinum	79 **Au** 2,8,18, 32,18,1 Gold	80 **Hg** 2,8,18, 32,18,2 Mercury	81 **Tl** 2,8,18, 32,18,3 Thallium	82 **Pb** 2,8,18, 32,18,4 Lead	83 **Bi** 2,8,18, 32,18,5 Bismuth	84 **Po** 2,8,18, 32,18,6 Polonium	85 **At** 2,8,18, 32,18,7 Astatine	86 **Rn** 2,8,18, 32,18,8 Radon
87 **Fr** 2,8,18,32, 18,8,1 Francium	88 **Ra** 2,8,18,32, 18,8,2 Radium	89 **Ac** 2,8,18,32, 18,9,2 Actinium	104 **Rf** 2,8,18,32, 32,10,2 Rutherfordium	105 **Db** 2,8,18,32, 32,11,2 Dubnium	106 **Sg** 2,8,18,32, 32,12,2 Seaborgium	107 **Bh** 2,8,18,32, 32,13,2 Bohrium	108 **Hs** 2,8,18,32, 32,14,2 Hassium	109 **Mt** 2,8,18,32, 32,15,2 Meitnerium	110 **Ds** 2,8,18,32, 32,17,1 Darmstadtium	111 **Rg** 2,8,18,32, 32,18,1 Roentgenium	112 **Cn** 2,8,18,32, 32,18,2 Copernicium						

Lanthanides	57 **La** 2,8,18, 18,9,2 Lanthanum	58 **Ce** 2,8,18, 20,8,2 Cerium	59 **Pr** 2,8,18,21, 8,2 Praseodymium	60 **Nd** 2,8,18,22, 8,2 Neodymium	61 **Pm** 2,8,18,23, 8,2 Promethium	62 **Sm** 2,8,18,24, 8,2 Samarium	63 **Eu** 2,8,18,25, 8,2 Europium	64 **Gd** 2,8,18,25, 9,2 Gadolinium	65 **Tb** 2,8,18,27, 8,2 Terbium	66 **Dy** 2,8,18,28, 8,2 Dysprosium	67 **Ho** 2,8,18,29, 8,2 Holmium	68 **Er** 2,8,18,30, 8,2 Erbium	69 **Tm** 2,8,18,31, 8,2 Thulium	70 **Yb** 2,8,18,32, 8,2 Ytterbium	71 **Lu** 2,8,18,32, 9,2 Lutetium
Actinides	89 **Ac** 2,8,18,32, 18,9,2 Actinium	90 **Th** 2,8,18,32, 18,10,2 Thorium	91 **Pa** 2,8,18,32, 20,9,2 Protactinium	92 **U** 2,8,18,32, 21,9,2 Uranium	93 **Np** 2,8,18,32, 22,9,2 Neptunium	94 **Pu** 2,8,18,32, 24,8,2 Plutonium	95 **Am** 2,8,18,32, 25,8,2 Americium	96 **Cm** 2,8,18,32, 25,9,2 Curium	97 **Bk** 2,8,18,32, 27,8,2 Berkelium	98 **Cf** 2,8,18,32, 28,8,2 Californium	99 **Es** 2,8,18,32, 29,8,2 Einsteinium	100 **Fm** 2,8,18,32, 30,8,2 Fermium	101 **Md** 2,8,18,32, 31,8,2 Mendelevium	102 **No** 2,8,18,32, 32,8,2 Nobelium	103 **Lr** 2,8,18,32, 32,9,2 Lawrencium