National
Qualifications
SPECIMEN ONLY

S857/75/02

Physics
Section 1 — Questions

Date — Not applicable

Duration — 2 hours

Instructions for the completion of Section 1 are given on *page 02* of your question and answer booklet S857/75/01.

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 S857/75/11.

You must leave your answer booklet on your desk; if you do not, you could lose all the marks for this paper.

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Speed of light in materials

Material	Speed in m s^{-1}
Air	3.0×10^8
Carbon dioxide	3.0×10^8
Diamond	1.2×10^8
Glass	2.0×10^8
Glycerol	2.1×10^8
Water	2.3×10^8

Gravitational field strengths

	Gravitational field strength on the surface in N kg^{-1}
Earth	9.8
Jupiter	24.8
Mars	3.7
Mercury	3.7
Moon	1.6
Neptune	11.2
Saturn	10.4
Sun	274
Uranus	8.7
Venus	8.9

Specific latent heat of fusion of materials

Material	Specific latent heat of fusion in J kg^{-1}
Alcohol	0.99×10^5
Aluminium	3.96×10^5
Carbon dioxide	1.84×10^5
Copper	2.06×10^5
Iron	2.67×10^5
Lead	0.23×10^5
Water	3.34×10^5

Specific latent heat of vaporisation of materials

Material	Specific latent heat of vaporisation in J kg^{-1}
Alcohol	11.2×10^5
Carbon dioxide	3.53×10^5
Glycerol	8.30×10^5
Turpentine	2.90×10^5
Water	22.6×10^5

Speed of sound in materials

Material	Speed in m s^{-1}
Aluminium	6400
Air	340
Bone	4100
Carbon dioxide	260
Glycerol	1900
Muscle	1600
Steel	5900
Tissue	1500
Water	1500

Specific heat capacity of materials

Material	Specific heat capacity in J kg^{-1} °C^{-1}
Alcohol	2440
Aluminium	897
Copper	385
Glass	670
Ice	2090
Iron	449
Lead	129
Oil	2130
Water	4180

Melting and boiling points of materials

Material	Melting point in °C	Boiling point in °C
Alcohol	−98	65
Aluminium	660	2519
Copper	1084	2560
Lead	327	1749
Iron	1538	2861
Water	0	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 — 20 marks

Attempt ALL questions

1. Which of the following contains two scalar quantities?

A Force and mass

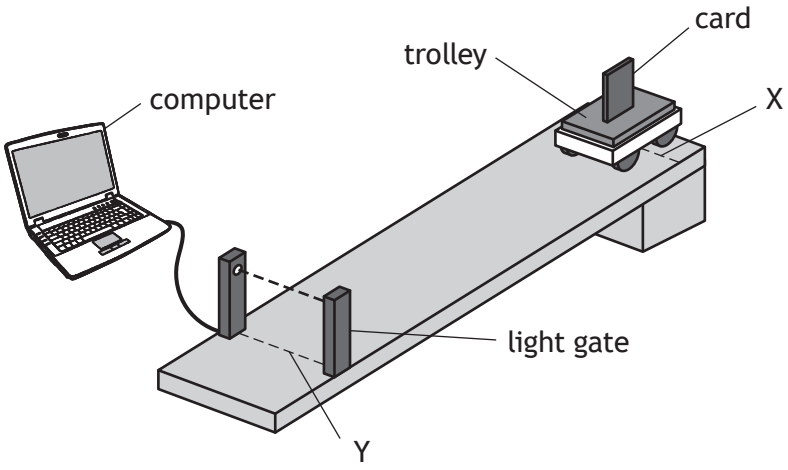
B Weight and mass

C Displacement and speed

D Distance and speed

E Displacement and velocity

2. A student sets up the apparatus shown.



The trolley is released from X and moves down the ramp.

The following measurements are recorded.

time for card to pass through light gate = 0.080 s

distance from X to Y = 0.50 m

length of card = 0.040 m

The instantaneous speed of the trolley at Y is

A $0.50\ m\,s^{-1}$

B $1.6\ m\,s^{-1}$

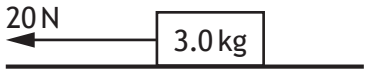
C $2.0\ m\,s^{-1}$

D $3.2\ m\,s^{-1}$

E $6.3\ m\,s^{-1}$.

[Turn over

3. A block of mass 3.0 kg is pulled across a horizontal bench by a force of 20 N as shown.



The block accelerates at 4.0 m s^{-2}.

The force of friction between the block and the bench is

A 0 N

B 8 N

C 12 N

D 20 N

E 32 N.

4. An aircraft engine exerts a force on the air.

Which of the following completes the 'Newton pair' of forces?

A The force of the air on the aircraft engine.

B The force of friction between the aircraft engine and the air.

C The force of the aircraft engine on the aircraft.

D The force of the Earth on the aircraft engine.

E The force of the aircraft engine on the Earth.

5. The Mars Curiosity Rover has a mass of 900 kg on Earth.

Which row of the table gives the mass and weight of the Rover on Mars?

	Mass (kg)	**Weight (N)**
A	243	243
B	243	900
C	900	900
D	900	3330
E	900	8820

6. A student makes the following statements about the Universe.

I The Big Bang Theory is a theory about the origin of the Universe.

II The Universe is approximately 14 million years old.

III The Universe is expanding.

Which of these statements is/are correct?

A I only

B II only

C I and II only

D I and III only

E I, II and III

[Turn over

7. A conductor carries a current of 4.0 μA for 250 s.

The total charge passing a point in the conductor is

A 1.6×10^{-8} C

B 1.0×10^{-3} C

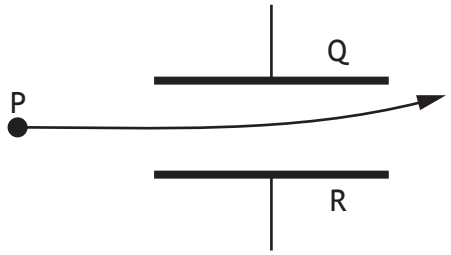
C 6.25×10^{1} C

D 1.0×10^{3} C

E 6.25×10^{7} C.

8. A uniform electric field exists between plates Q and R.

The diagram shows the path taken by a charged particle as it travels through the field.



Which row in the table identifies the charge on the particle, the charge on plate Q, and the charge on plate R?

	Charge on particle	**Charge on Q**	**Charge on R**
A	negative	positive	negative
B	negative	negative	positive
C	no charge	negative	positive
D	no charge	positive	negative
E	positive	positive	negative

9. 1 volt is equivalent to

A 1 ampere per watt

B 1 coulomb per second

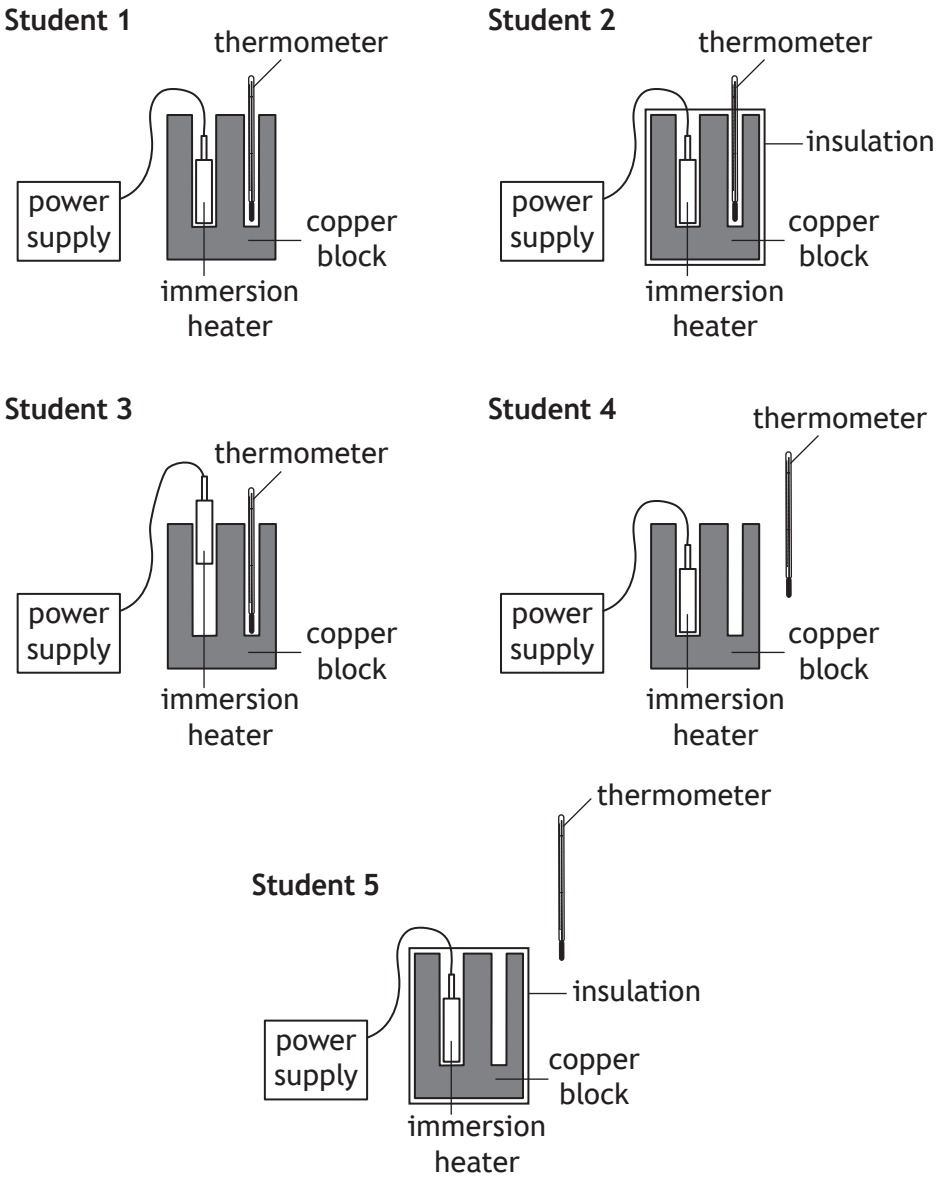
C 1 joule per coulomb

D 1 joule per second

E 1 watt per second.

[Turn over

10. Five students each carry out an experiment to determine the specific heat capacity of copper. The setup used by each student is shown.



The student with the setup that would allow the most accurate value for the specific heat capacity of copper to be determined is

A student 1

B student 2

C student 3

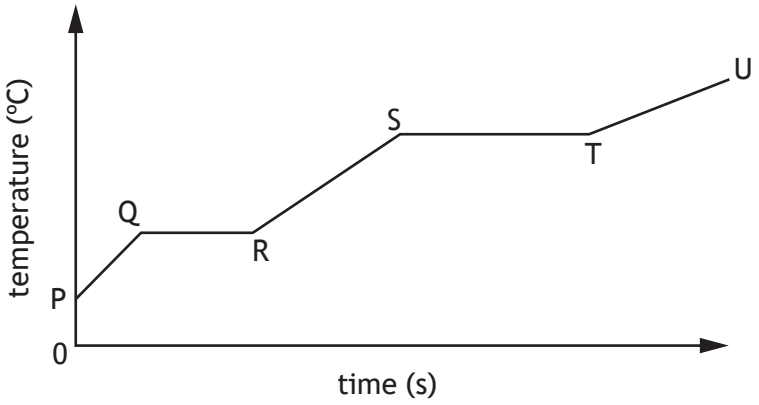
D student 4

E student 5.

11. A heater is immersed in a substance.

The heater is switched on.

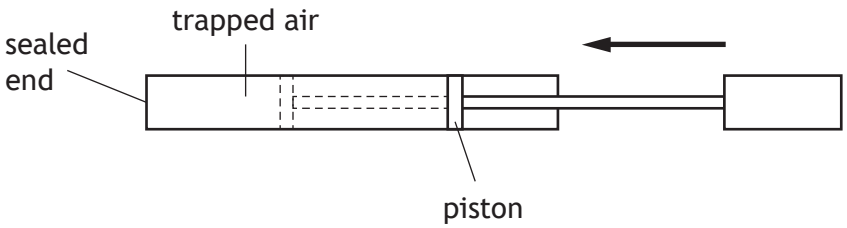
The graph shows the temperature of the substance over a period of time.



Which row in the table identifies the sections of the graph when the substance is changing state?

	Solid to liquid	**Liquid to gas**
A	QR	TU
B	QR	ST
C	PQ	RS
D	PQ	TU
E	ST	QR

12. A bicycle pump is sealed at one end and the piston pushed until the pressure of the trapped air is 4.00×10^5 Pa.



The area of the piston compressing the air is 5.00×10^{-4} m^2.

The force that the trapped air exerts on the piston is

A 1.25×10^{-9} N

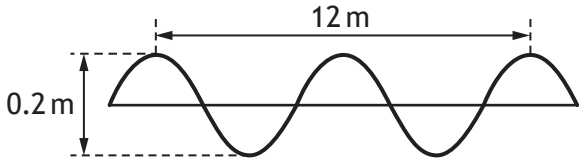
B 8.00×10^{-1} N

C 2.00×10^{2} N

D 8.00×10^{8} N

E 2.00×10^{10} N.

13. The following diagram shows a wave.



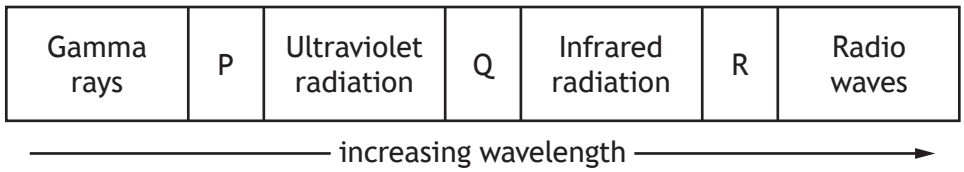
Which row in the table gives the wavelength and the amplitude of the wave?

	Wavelength (m)	**Amplitude (m)**
A	4	0.2
B	6	0.2
C	6	0.1
D	12	0.1
E	12	0.2

14. A wave machine in a swimming pool generates 15 waves per minute.
The wavelength of these waves is 2.0 m.
The frequency of the waves is

A 0.25 Hz
B 0.50 Hz
C 4.0 Hz
D 15 Hz
E 30 Hz.

15. The diagram shows members of the electromagnetic spectrum in order of increasing wavelength.

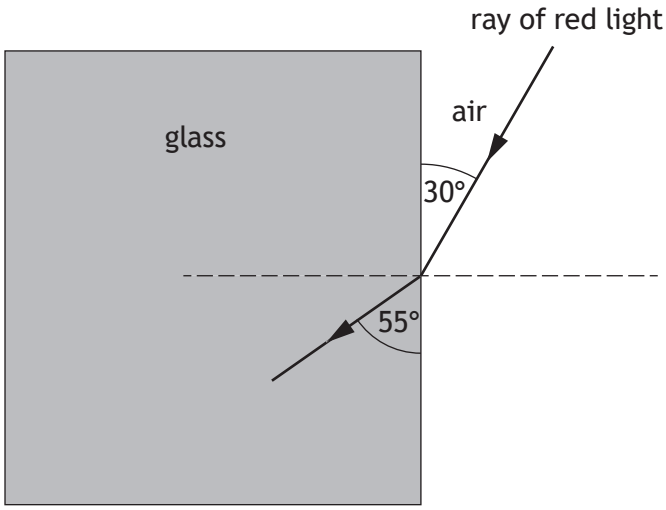


Which row in the table identifies the radiations represented by the letters P, Q, and R?

	P	**Q**	**R**
A	X-rays	visible light	microwaves
B	X-rays	microwaves	visible light
C	microwaves	visible light	X-rays
D	visible light	microwaves	X-rays
E	visible light	X-rays	microwaves

[Turn over

16. A ray of red light is incident on a glass block as shown.



Which row in the table shows the values of the angle of incidence and the angle of refraction?

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

17. Which of the following describes the term ionisation?

A A nucleus emitting a gamma ray.

B A nucleus emitting a neutron.

C A nucleus emitting an alpha particle.

D An atom losing a proton.

E An atom losing an orbiting electron.

18. A student writes the following statements about the activity of a radioactive source.

I The activity decreases with time.

II The activity is measured in becquerels.

III The activity is the number of decays per second.

Which of these statements is/are correct?

A I only

B II only

C I and II only

D II and III only

E I, II and III

19. A worker in a nuclear power station is exposed to 3.00 mGy of gamma radiation and 0.500 mGy of fast neutrons.

The total equivalent dose received by the worker is

A 3.50 mSv

B 8.00 mSv

C 30.5 mSv

D 35.0 mSv

E 38.5 mSv.

[Turn over

20. The size of the buoyancy force F_b acting on an object in a fluid is given by the relationship

$$F_b = \rho g V$$

where: ρ is the density of the fluid in kg m^{-3}

g is the gravitational field strength in N kg^{-1}

V is the volume of the object in m^3.

The volume of an object that experiences a buoyancy force of 360 N when immersed in a fluid of density 1020 kg m^{-3} is

A 0.036 m^3

B 0.33 m^3

C 3.5 m^3

D 28 m^3

E 37 000 m^3.

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

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Mark

S857/75/01

Physics
Section 1 — Answer grid and Section 2

Date — Not applicable

Duration — 2 hours

S8577501

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

SECTION 2 — 90 marks
Attempt ALL questions.

Reference may be made to the data sheet on *page 02* of the question paper S857/75/02 and to the relationships sheet S857/75/11.

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.

Do not remove any exam materials. You must leave this booklet on your desk; if you do not, you could lose all the marks for this paper.

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SECTION 1 — 20 marks

The questions for Section 1 are contained in the question paper S857/75/02.

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

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

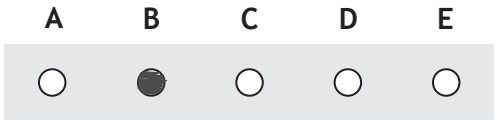
B kilowatt-hour

C watt

D coulomb

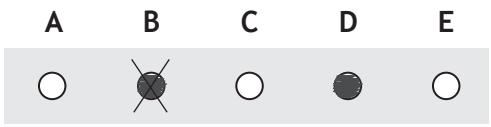
E volt.

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

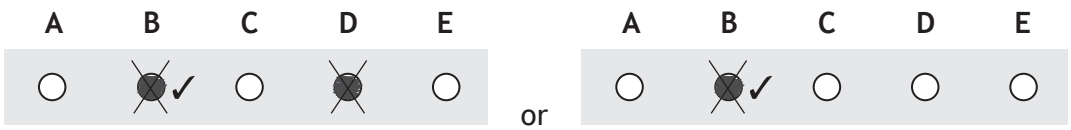


Changing an answer

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:



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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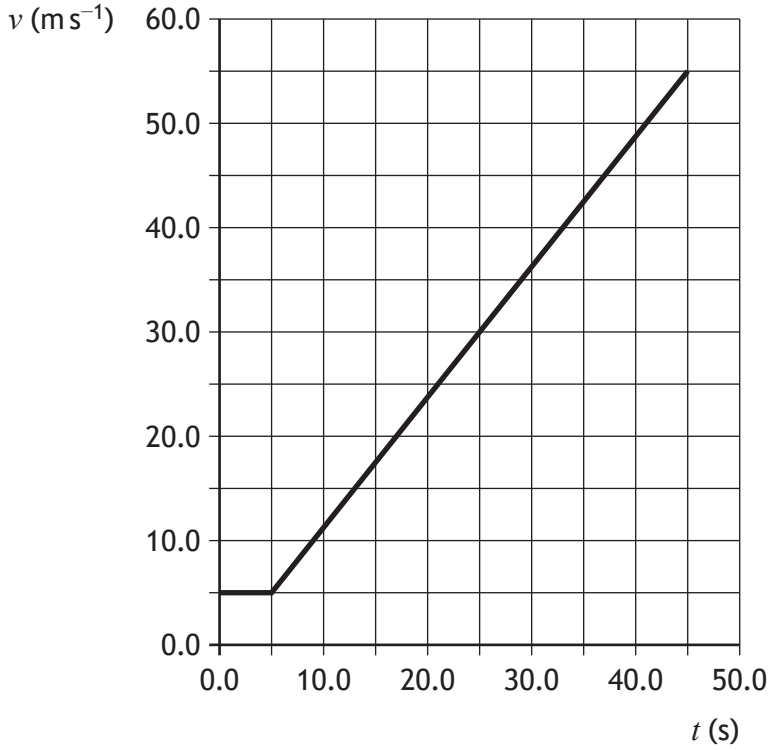
SECTION 2 — 90 marks

Attempt ALL questions

1. An aircraft is making a journey between two airports. A graph of the aircraft's velocity during take-off is shown.

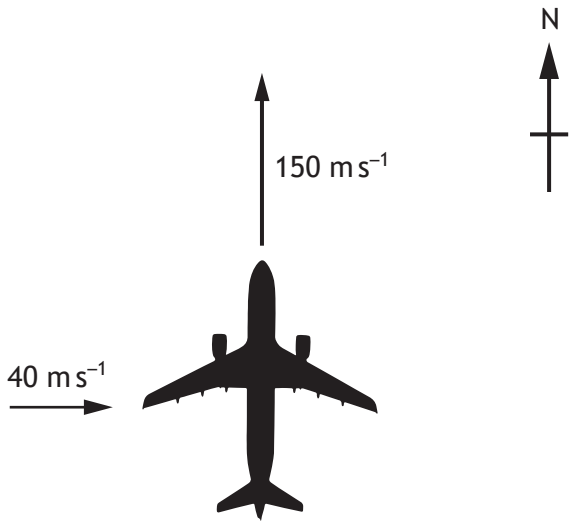


(a) Calculate the acceleration of the aircraft between $t = 5.0$ s and $t = 45.0$ s. **3**

Space for working and answer

1. (continued)

(b) During the flight, the aircraft is travelling at a velocity of 150 m s^{-1} due North and encounters a crosswind of 40 m s^{-1} due East.



By scale diagram or otherwise, determine:

(i) the magnitude of the resultant velocity of the aircraft; **2**

Space for working and answer

(ii) the direction of the resultant velocity of the aircraft. **2**

Space for working and answer

MARKS

DO NOT WRITE IN THIS MARGIN

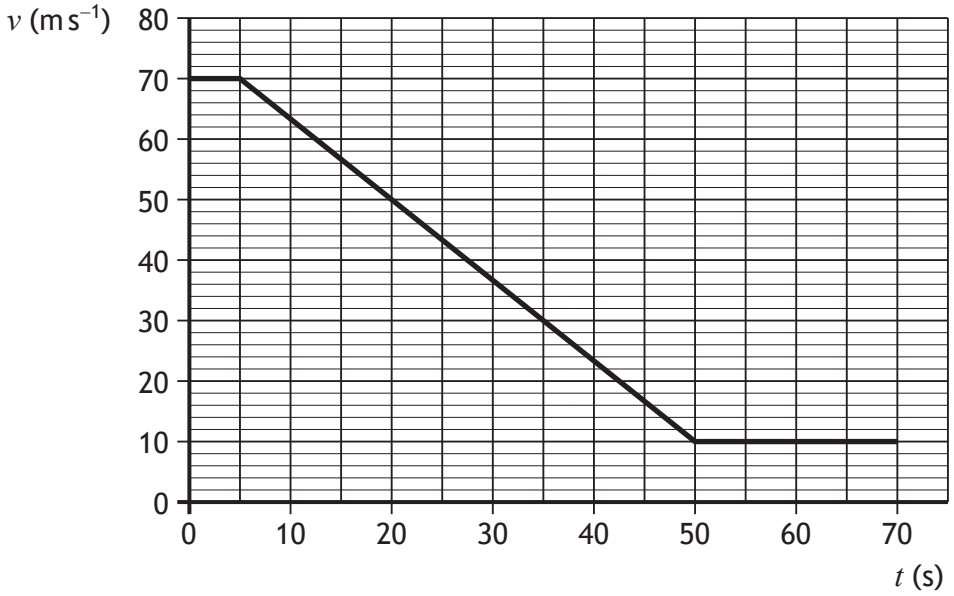
(c) The aircraft arrives at the destination airport.

There are three runways, X, Y, and Z, available for the aircraft to land on.

The length of each runway is given in the table.

Runway	Length (m)
X	3776
Y	3048
Z	2742

The speed-time (v–t) graph below shows the speed of the aircraft during landing on the runway, from the moment the wheels touch down until it leaves the runway.



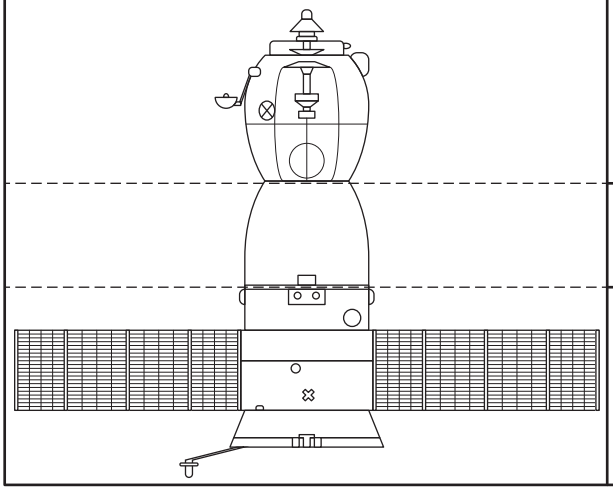
Determine which runways the aircraft could have used to land safely.

Justify your answer by calculation. **4**

Space for working and answer

2. The Soyuz Spacecraft is used to transport astronauts from the International Space Station (ISS) to Earth.

The spacecraft consists of three parts.



Part	Mass (kg)
Orbital Module	1300
Descent Module (including astronauts)	2950
Instrumentation/ Propulsion Module	2900

(a) When the spacecraft leaves the ISS, the three parts are launched together.

The propulsion module produces a force of 1430 N.

Determine the acceleration of the spacecraft as it leaves the ISS. **4**

Space for working and answer

2. (continued)

(b) During the flight, the Orbital Module and the Instrumentation/Propulsion Module are jettisoned. Instead of returning to Earth, they burn up in the atmosphere at a very high temperature.

Explain why these Modules burn up on re-entry into the atmosphere. **2**

(c) After the Descent Module has re-entered the atmosphere, its speed is reduced dramatically. Four parachutes are used to slow the Module's rate of descent.

Explain, in terms of forces, how the parachutes reduce the speed of the Module. **2**

[Turn over

2. (continued)

(d) The ISS orbits with an altitude of between 3.30×10^5 m and 4.35×10^5 m above the surface of the Earth.

(i) The orbital period T, in seconds, of the ISS can be calculated using the relationship

$$T = \frac{2\pi R}{v}$$

where v is the orbital speed in m s^{-1}

R is the orbital radius in m.

The orbital radius is the sum of the radius of the Earth and the altitude above the surface of the Earth.

The radius of Earth is 6.4×10^6 m.

The orbital speed of the ISS can be taken to be 7.7×10^3 m s^{-1}.

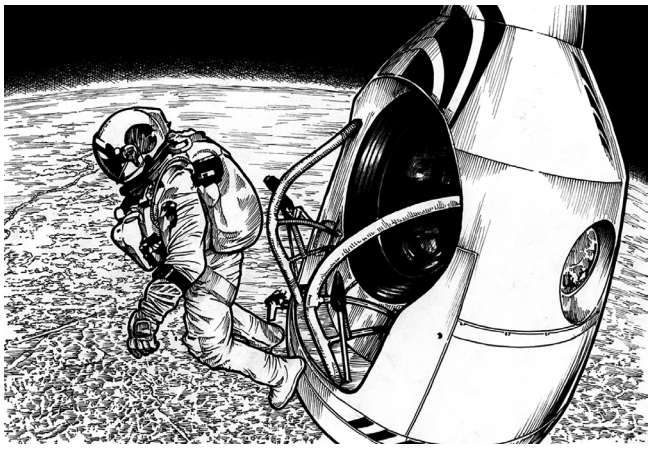
Calculate the orbital period of the ISS when it is orbiting at an altitude of 3.30×10^5 m. **3**

Space for working and answer

(ii) Explain, in terms of horizontal velocity and weight, how the ISS remains in orbit around the Earth. **2**

3. In October 2012, a skydiver jumped from a balloon at a height of 39 km above the surface of the Earth.

The skydiver became the first person to jump from this height. The skydiver also became the first human to fall at speeds greater than the speed of sound in air.



Using your knowledge of physics, comment on the challenges faced by the skydiver when making this jump. **3**

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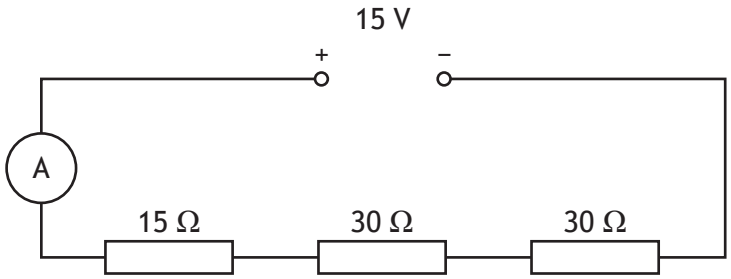
3. (continued)

4. (a) A student sets up the following circuit.



(i) Determine the total resistance in the circuit. **1**

Space for working and answer

(ii) Calculate the current in the circuit. **3**

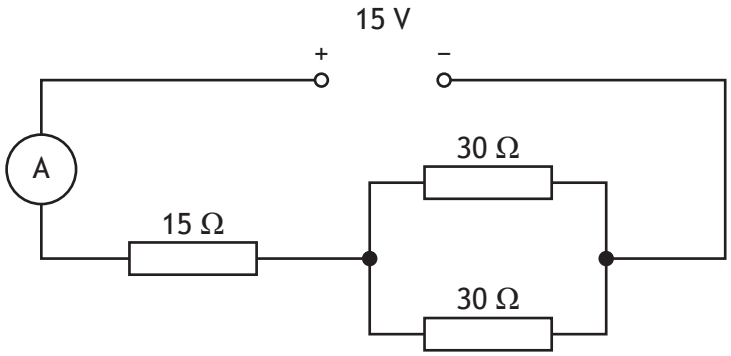
Space for working and answer

(iii) Calculate the power dissipated in the 15 Ω resistor. **3**

Space for working and answer

4. (continued)

(b) The circuit is now rearranged as shown.

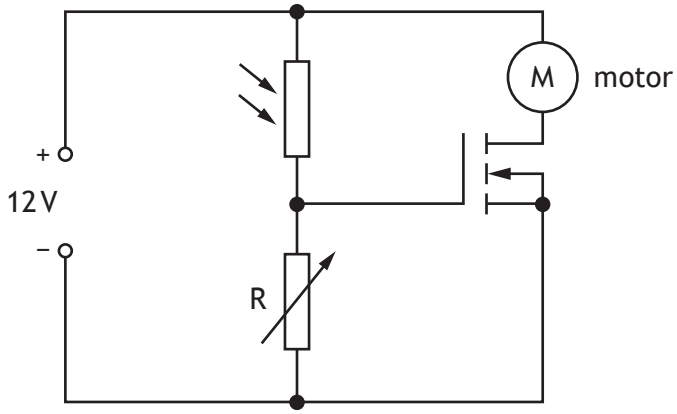


State how the power dissipated in the 15 Ω resistor compares to your answer in (a) (iii).

You must justify your answer. **3**

5. An office has an automatic window blind that closes when the light level outside gets too high.

The electronic circuit that operates the motor to close the blind is shown.



(a) The MOSFET switches on when the voltage across R reaches 2.4 V.

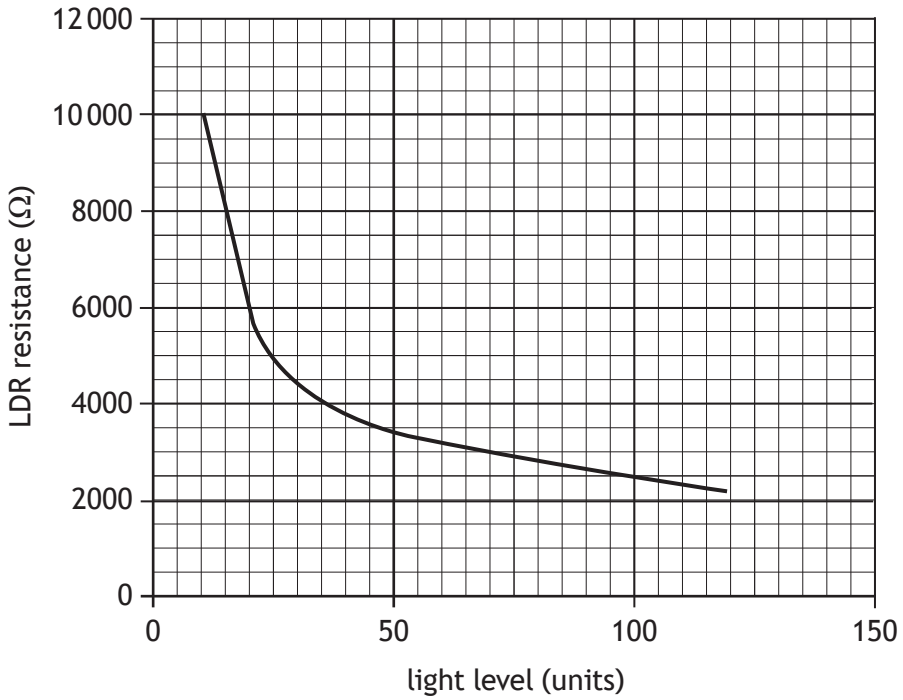
(i) Explain how this circuit works to close the blind. **3**

(ii) State the purpose of the variable resistor R. **1**

[Turn over

5. (continued)

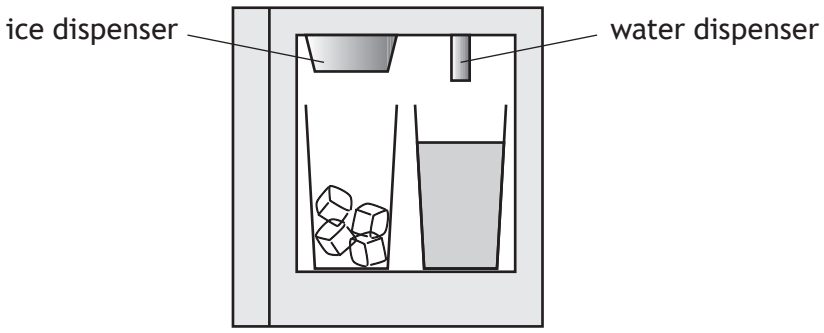
(b) The graph shows how the resistance of the LDR varies with light level.



(i) Determine the resistance of the LDR when the light level is 70 units. **1**

(ii) The variable resistor R is set at a resistance of 640 Ω.
Calculate the voltage across R when the light level is 70 units. **3**
Space for working and answer

6. A fridge/freezer has water and ice dispensers as shown.



(a) Water of mass 0.100 kg flows into the freezer at 15.0 °C and is cooled to 0 °C.

Show that 6.27×10^3 J of energy is removed when the water cools. **2**

Space for working and answer

(b) Calculate the energy released when 0.100 kg of water at 0 °C changes to 0.100 kg of ice at 0 °C. **3**

Space for working and answer

6. (continued)

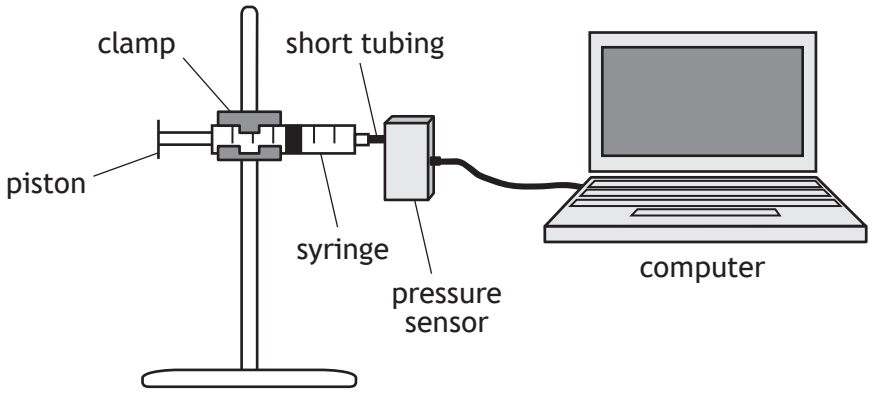
(c) The fridge/freezer system removes heat energy at a rate of 115 $J s^{-1}$.

(i) Determine the minimum time taken to produce 0.100 kg of ice at 0 °C from 0.100 kg of water at 15.0 °C. **4**

Space for working and answer

(ii) Explain why the actual time taken to make the ice will be longer than the time calculated in (c) (i). **2**

7. A student carries out an experiment to investigate the relationship between the pressure and volume of a fixed mass of gas using the apparatus shown.



The pressure p of the gas is recorded using a pressure sensor connected to a computer. The volume V of the gas in the syringe is also recorded. The student pushes the piston to alter the volume and a series of readings is taken.

The temperature of the gas is constant during the experiment.

The results are shown.

p (kPa)	100	125	152	185	200
V (cm^3)	50.0	40.0	33.0	27.0	25.0
$\frac{1}{V}$ (cm^{-3})	0.0200	0.0250	0.0303	0.0370	0.0400

(a) (i) Using the square-ruled paper on *page 20*, draw a graph of p against $\frac{1}{V}$. **3**

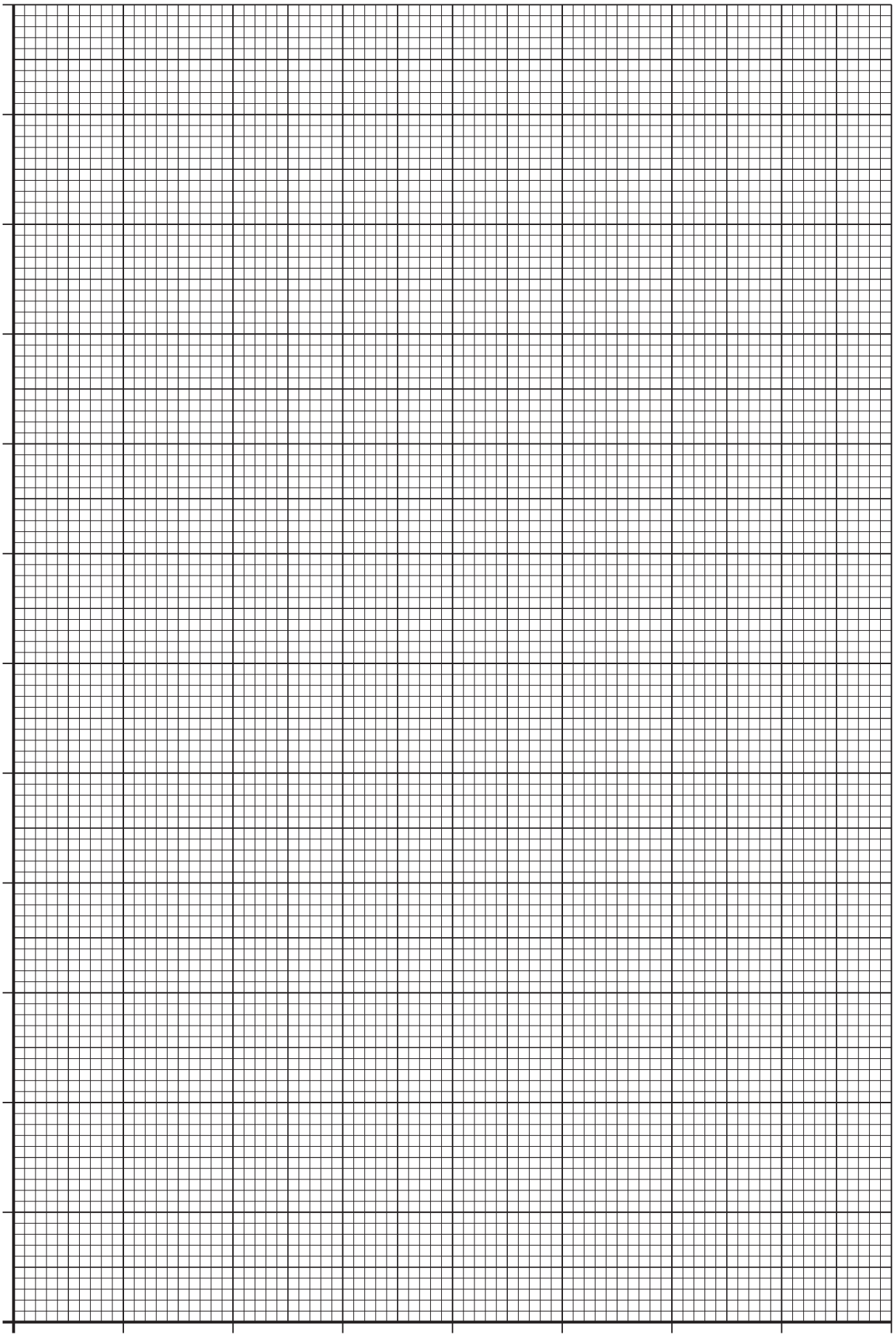
You must start the scale on each axis from 0.

(Additional square-ruled paper, if required, can be found on *page 29*.)

(ii) Explain how the graph confirms that pressure is directly proportional to $\frac{1}{\text{volume}}$. **1**

[Turn over

7. (a) (continued)



DO NOT WRITE IN THIS MARGIN

7. (continued)

(b) Calculate the pressure of the gas in the syringe when the volume of the gas is 8.0 cm^3. **3**

Space for working and answer

(c) (i) When carrying out the experiment, the student clamped the syringe rather than holding it in their hand.

Explain why this is better experimental practice. **2**

(ii) A second student suggests that replacing the short tubing between the syringe and the pressure sensor with a longer tube would improve the experiment.

Explain why this student's suggestion is incorrect. **2**

8. A mountain climber carries a small, portable device that receives microwave signals from satellites to determine the climber's position.

The device can also be used to send the climber's position to the emergency services in the event of an accident.

(a) One satellite sends a microwave signal that is received by the device 0.0047 s after transmission.

Calculate the distance between this satellite and the climber. **3**

Space for working and answer

(b) The device sends a microwave signal via the satellite to the emergency services.

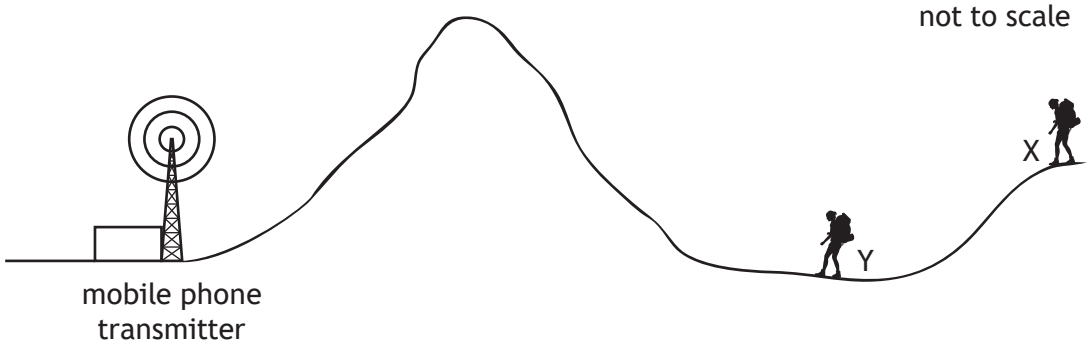
The frequency of the signal is 1620 MHz.

Show that the wavelength of this signal is 0.19 m. **2**

Space for working and answer

8. (continued)

(c) The climber also carries a mobile phone. The climber notices that the phone receives a signal at X but not at Y.



Explain why the phone receives a signal at X but not at Y. **2**

[Turn over

9. A physics textbook contains the following statement.

'Electromagnetic waves can be sent out like ripples on a pond.'

Using your knowledge of physics, comment on the similarities and/or differences between electromagnetic waves and the ripples on a pond. **3**

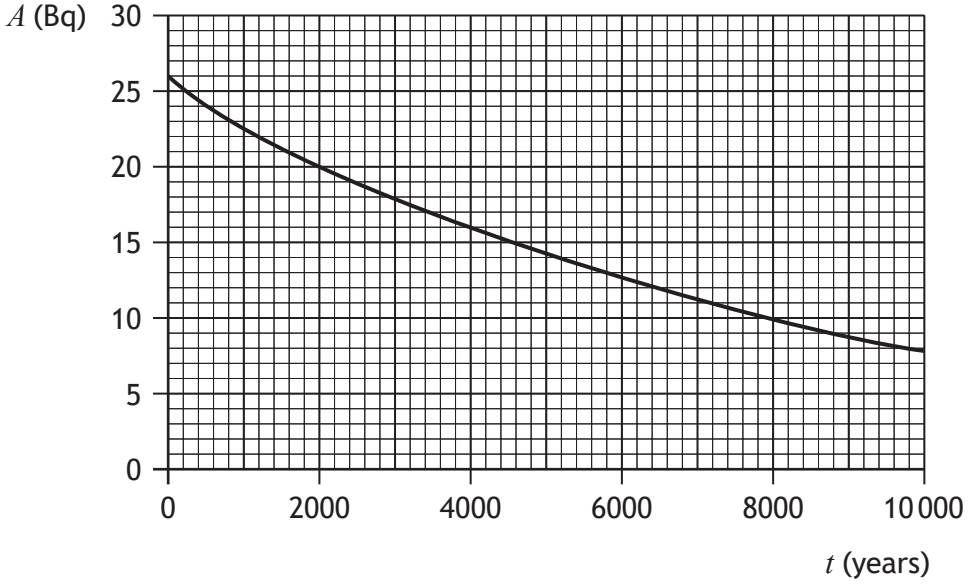
DO NOT WRITE IN THIS MARGIN

9. (continued)

[Turn over

10. Trees continually absorb carbon-14 when they are alive. When a tree dies, the carbon-14 contained in its wood is not replaced. Carbon-14 is radioactive and decays by beta emission.

(a) Following the tree's death, the activity A of the carbon-14 within a 25 mg sample of its wood changes as shown in the graph.



(i) Use the graph to determine the half-life of carbon-14. **1**

(ii) Calculate the time taken for the activity of this sample of carbon-14 to fall to 6.5 Bq. **3**

Space for working and answer

10. (a) (continued)

(iii) During an archaeological dig, a 125 mg sample of the same type of wood was obtained. The activity of this sample was 40 Bq.

Estimate the age of this sample. **3**

Space for working and answer

(b) Explain why this method could not be used to estimate the age of a tree that died 100 years ago. **1**

[Turn over

11. A worker in the radiation industry uses a radioactive sample to investigate the effect of gamma rays on biological tissue.

(a) State what is meant by the term *gamma rays*. **1**

(b) In one experiment, a biological tissue sample of mass 0.10 kg receives an absorbed dose of 50 μGy.

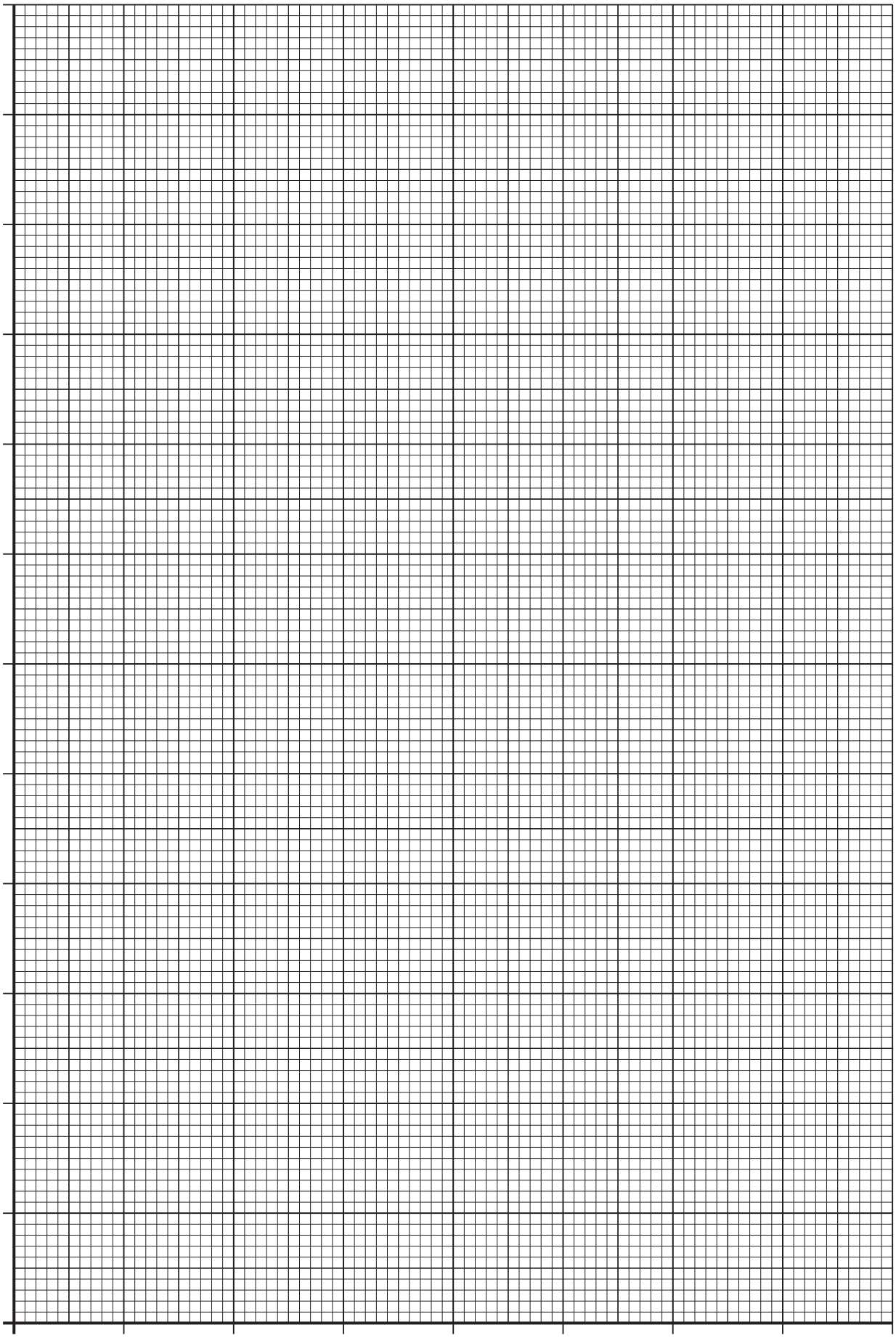
Calculate the energy absorbed by the tissue. **3**

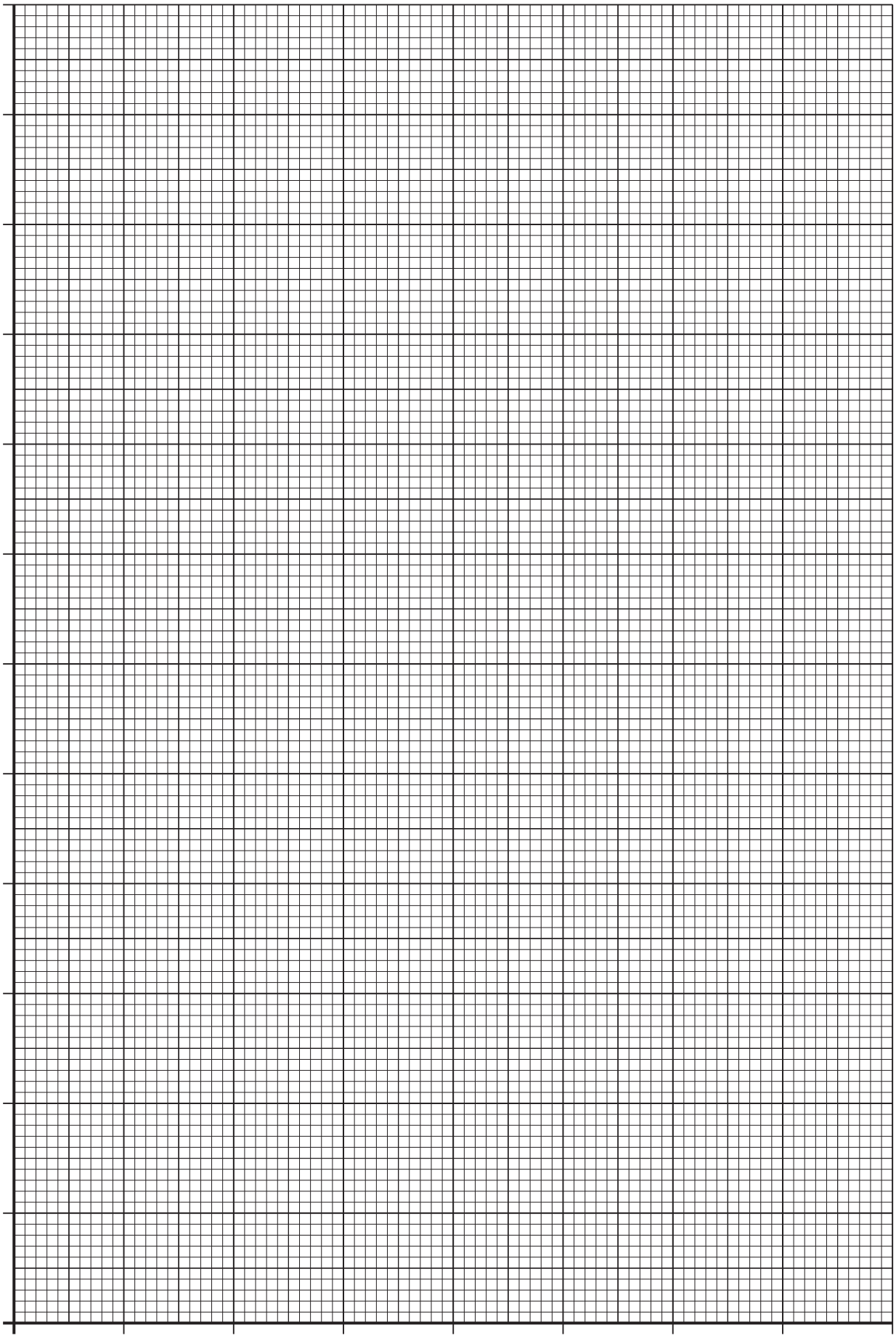
Space for working and answer

(c) The radioactive source must be stored in a lead-lined container.

Explain why a lead-lined container must be used. **1**

[END OF SPECIMEN QUESTION PAPER]





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ADDITIONAL SPACE FOR ANSWERS FOR AND ROUGH WORK

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ADDITIONAL SPACE FOR ANSWERS FOR AND ROUGH WORK

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S857/75/11

Physics
Relationships sheet

Date — Not applicable

Duration — 2 hours

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$$d = vt$$

$$d = \bar{v}t$$

$$s = vt$$

$$s = \bar{v}t$$

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

$$F = ma$$

$$W = mg$$

$$E_w = Fd$$

$$E_p = mgh$$

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

$$Q = It$$

$$V = IR$$

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

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

$$R_T = R_1 + R_2 + \ldots$$

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

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

$$P = IV$$

$$P = I^2R$$

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

$$E_h = cm\Delta T$$

$$E_h = ml$$

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

$$p_1V_1 = p_2V_2$$

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

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

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

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

$$v = f\lambda$$

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

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

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

$$H = Dw_r$$

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

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

Group 1 (1)	Group 2 (2)	Transition elements (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

National
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S857/75/01 **Physics**

Marking Instructions

These marking instructions have been provided to show how Qualifications Scotland would mark this specimen question paper.

Qualifications Scotland
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General marking principles for National 5 Physics

This information is provided to help you understand the general principles you must apply when marking candidate responses to questions in this paper. These principles must be read in conjunction with the detailed marking instructions, which identify the key features required in candidate responses.

(a) Marks for each candidate response must **always** be assigned in line with these marking principles, the Physics: general marking principles (GMPs) (Physics: general marking principles - National 3 to Advanced Higher (qualifications.gov.scot)) and the detailed marking instructions for this assessment.

(b) Marking should always be positive. This means that, for each candidate response, marks are accumulated for the demonstration of relevant skills, knowledge and understanding: they are not deducted from a maximum on the basis of errors or omissions.

(c) If a specific candidate response does not seem to be covered by either the principles or detailed marking instructions, and you are uncertain how to assess it, you must seek guidance from your team leader.

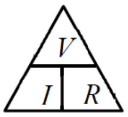
(d) Where a candidate answers part of a question incorrectly and carries the incorrect answer forward in the following part, award marks if the incorrect answer has then been used correctly in the subsequent part or 'follow-on'. (GMP 16)

(e) Award marks for non-standard symbols where the symbols are defined and the relationship is correct, or where the substitution shows that the relationship used is correct. This must be clear and unambiguous. (GMP 20)

(f) Award full marks for a correct final answer (including units if required) on its own, unless a numerical question specifically requires evidence of working to be shown, eg in a 'show' question. (GMP 1)

(g) Award marks where a diagram or sketch conveys correctly the response required by the question. It will usually require clear and correct labels (or the use of standard symbols). (GMP 19)

(h) Marks are allocated for knowledge of relevant relationships alone. Do not award a mark when a candidate writes down several relationships and does not select the correct one to continue with, for example by substituting values. (GMP 1c)

(i) Do not award marks if a 'magic triangle', eg , 

is the only statement in a candidate's response.

To gain the mark, the correct relationship must be stated eg $V = IR$ or $R = \frac{V}{I}$, etc. (GMP 2)

(j) In rounding to an expected number of significant figures, award the mark for correct answers which have up to two figures more or one figure less than the number in the data with the fewest significant figures. (GMP 6)

(Note: the use of a recurrence dot, eg $0.\dot{6}$, would imply an infinite number of significant figures and would therefore not be acceptable.)

(k) The incorrect spelling of technical terms should usually be ignored and candidates should be awarded the relevant mark, provided that answers can be interpreted and understood without any doubt as to the meaning.
Where there is ambiguity, do not award the mark. Two specific examples of this would be when the candidate uses a term:

- that might be interpreted as *reflection*, *refraction* or *diffraction*, eg 'defraction'
- that might be interpreted as either *fission* or *fusion*, eg 'fussion'

The spelling of these words is similar, but the words have totally different meanings. If the spelling (or handwriting) in an answer makes it difficult for you to interpret a candidate's intention, then do not award the mark. (GMP 22)

(l) Marks are awarded only for a valid response to the question asked. For example, in response to questions that ask candidates to:

- **identify**, **name**, **give**, or **state**, they need only name or present in brief form.
- **describe**, they must provide a statement or structure of characteristics and/or features.
- **explain**, they must relate cause and effect and/or make relationships between things clear.
- **determine** or **calculate**, they must determine a number from given facts, figures or information.
- **estimate**, they must determine an approximate value for something.
- **justify**, they must give reasons to support their suggestions or conclusions, eg this might be by identifying an appropriate relationship and the effect of changing variables.
- **show that**, they must use physics (and mathematics) to prove something, eg a given value. All steps, including the stated answer, must be shown
- **predict**, they must suggest what may happen based on available information.
- **suggest**, they must apply their knowledge and understanding of physics to a new situation. A number of responses are acceptable: award marks for any suggestions that are supported by knowledge and understanding of physics.
- **use your knowledge of physics or aspect of physics to comment on**, they must apply their skills, knowledge and understanding to respond appropriately to the problem/situation presented, for example by making a statement of principle(s) involved and/or a relationship or equation, and applying these to respond to the problem/situation. They will gain credit for the breadth and/or depth of their conceptual understanding.

Common issues with candidate responses

When marking National 5 Physics, there are some common issues that arise when considering candidates' answers.

There is often a range of acceptable responses which would sensibly answer a particular question. However, it is often difficult to anticipate all correct or partially correct responses to questions.

The detailed marking instructions contain ideal answers, and examples of other acceptable answers which offer guidance for interpreting candidates' responses. They may also contain advice on answers which are **not** acceptable, or only attract partial marks.

Units

Do not penalise use of upper/lower case when the abbreviated version is given, as long as it can be clearly identified, eg DB, sV, hZ, bq.

However, take care to ensure the unit has the correct prefix, eg for an answer t = 0.005 seconds, t = 5 ms is acceptable but t = 5 Ms is not.

Where a candidate makes multiple unit errors or conversion errors/omissions in any part of a question, penalise once only. For example, when calculating speed from distance and time, and the answer is required to be in m s^{-1}.

If d = 4 km and t = 2 minutes

$$v = \frac{d}{t} \quad \textbf{(1)}$$

$$v = \frac{400}{2} \quad \textbf{(1)}$$

$$v = 200 \quad \textbf{(0)}$$

Although the candidate has made three unit errors, (not correctly converted distance or time and has omitted the final unit), do not award the final mark only.

Some common units often attract incorrect abbreviations in answers to numerical questions.
When the abbreviation can be confused with a different unit then the final mark cannot be awarded, eg sec or secs as an abbreviation for seconds is **not** acceptable.

Common units and abbreviations	
Acceptable unit and abbreviation	*unacceptable version*
second, s	sec, secs
hours, h	hr, hrs
ampere, amp, amps, A, a	
metres per second, m/s, m s^{-1}	mps, m/s^{-1}
metres per second per second, m/s^2, m s^{-2}	m/s/s, mpsps, m/s^{-2}
joules per kilogram per degree celsius, J kg^{-1} $°C^{-1}$, J/kg °C	J/kg/°C

Standard form

Where a candidate fails to express an answer in standard form correctly, treat it as an arithmetic error and do not award the final mark. For example:

For an answer t = 400 000 s, then $t = 4 \times 10^5$ s would be correct but $t = 4^5$ s would be treated as an arithmetic error. (GMP 10)

Incorrect answer carried forward (GMP 16)

Do not apply a further penalty where a candidate carries forward an incorrect answer to part of a question, and uses that incorrect answer correctly:

- within that part of the question, eg from (a)(i) to (a)(ii)
- or to the next part of the question, eg from (a) to (b).

Similarly, if a candidate has selected the wrong value in a question which requires a data value, then award full marks in the subsequent answer for a correct response that uses **either** the candidate's wrong value **or** the correct data value. For example:

(a) State the speed of microwaves in air.
Candidate's answer: *240 m s^{-1}*. This answer would attract zero marks.

(b) Calculate the distance travelled by these microwaves in 0.34 seconds.
The candidate may use **either** the value given in part (a) **or** the correct value for the speed, and could gain full marks if correctly completed.

Where an incorrect answer may be carried forward, this is indicated in the additional guidance column of the detailed marking instructions by the comment 'or consistent with part...'.

Standard three marker

The examples below set out how to apportion marks to answers requiring calculations. These are the 'standard three marker' type of questions.

Award full marks for a correct answer to a numerical question, even if the steps are not shown explicitly, **unless** it specifically requires evidence of working to be shown.

For some questions requiring numerical calculations, there may be alternative methods (eg alternative relationships) that would lead to a correct answer.

Sometimes, a question requires a calculation which does not fit into the 'standard three marker' type of response. In these cases, the detailed marking instructions will contain guidance for marking the question.

When marking partially correct answers, apportion individual marks as shown over the page.

Example of a 'standard three marker' question

The current in a resistor is 1.5 amperes when the potential difference across it is 7.5 volts.

Calculate the resistance of the resistor. (3 marks)

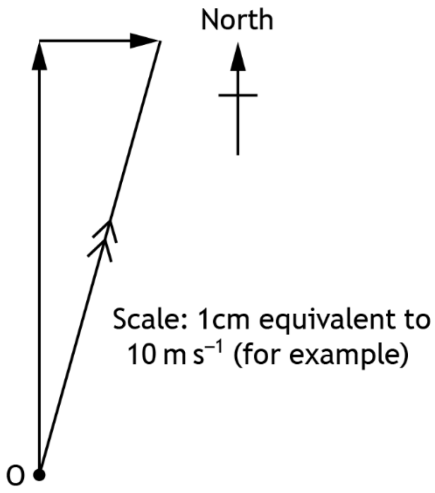
	Example response	Mark and comment
1.	$V = IR$ $7.5 = 1.5R$ $R = 5.0\ \Omega$	1 mark: relationship 1 mark: substitution 1 mark: correct answer
2.	$5.0\ \Omega$	3 marks: correct answer
3.	5.0	2 marks: unit missing
4.	$4.0\ \Omega$	0 marks: no evidence, wrong answer
5.	$\_\_\ \Omega$	0 marks: no working or final answer
6.	$R = \frac{V}{I} = \frac{7.5}{1.5} = 4.0\ \Omega$	2 marks: arithmetic error
7.	$R = \frac{V}{I} = 4.0\ \Omega$	1 mark: relationship only
8.	$R = \frac{V}{I} = \_\_\ \Omega$	1 mark: relationship only
9.	$R = \frac{V}{I} = \frac{7.5}{1.5} = \_\_\ \Omega$	2 marks: relationship and substitution, no final answer
10.	$R = \frac{V}{I} = \frac{7.5}{1.5} = 4.0$	2 marks: relationship and substitution, wrong answer
11.	$R = \frac{V}{I} = \frac{1.5}{7.5} = 5.0\ \Omega$	1 mark: relationship but wrong substitution
12.	$R = \frac{V}{I} = \frac{75}{1.5} = 5.0\ \Omega$	1 mark: relationship but wrong substitution
13.	$R = \frac{I}{V} = \frac{1.5}{7.5} = 5.0\ \Omega$	0 marks: wrong relationship
14.	$V = IR$ $7.5 = 1.5 \times R$ $R = 0.2\ \Omega$	2 marks: relationship and substitution, arithmetic error
15.	$V = IR$ $R = \frac{I}{V} = \frac{1.5}{7.5} = 0.2\ \Omega$	1 mark: relationship correct but wrong rearrangement of symbols

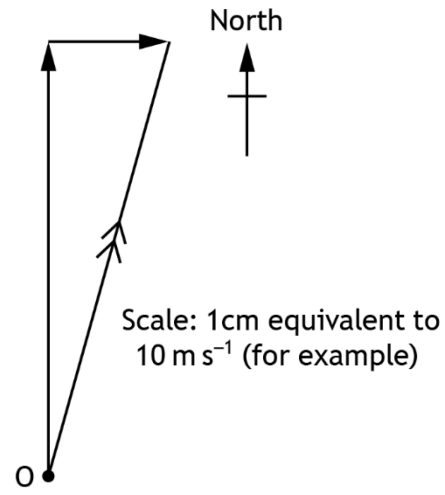
Marking instructions for each question

Section 1

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

Section 2

Question			Expected response	Max mark	Additional guidance
1.	(a)		$a = \dfrac{v-u}{t}$ **(1)** $a = \dfrac{55.0-5.0}{45.0-5.0}$ **(1)** $a = 1.25\ \text{m s}^{-2}$ **(1)**	**3**	Accept: 1.3, 1.250, 1.2500 Accept: a = gradient and substitution of appropriate data points from the line.
	(b)	(i)	**Using Pythagoras:** Resultant^2 = 150^2 + 40^2 **(1)** Resultant = 155 m s^{-1} **(1)** **Using scale diagram:**  Vectors to scale **(1)** Resultant = 155 m s^{-1} **(1)** (allow ± 3 m s^{-1} tolerance)	**2**	Ignore any direction stated in the final answer in this part. No requirement for arrows to be shown on diagram to calculate the magnitude of the resultant displacement. Regardless of method, if a candidate shows a vector diagram (or a representation of a vector diagram ie a triangle with no arrows) **and** the vectors have been added incorrectly eg head-to-head then **MAX (1)**. Accept: 160, 155.2, 155.24

Question			Expected response	Max mark	Additional guidance
1.	(b)	(ii)	**Using trigonometry:** $\tan\theta = \frac{40}{150}$ **(1)** $(\theta = 15^\circ)$ Direction = 015 **(1)** **Using scale diagram:**  Vectors to scale **(1)** Direction = 015 **(1)** (allow ±2° tolerance)	**2**	Or use of resultant value (and appropriate trigonometry) consistent with (b)(i). Regardless of method, if a candidate shows a vector diagram (or a representation of a vector diagram eg a triangle with no arrows) **and** the vectors have been represented incorrectly eg head-to head then **MAX (1)**. **Alternative methods:** $\tan\theta = \frac{150}{40}$ **(1)** $(\theta = 75.1^\circ)$ direction = 015 **(1)** **OR** Use of resultant value (and appropriate trigonometry) consistent with (b)(i) eg $\cos\theta = \frac{150}{155}$ or $\sin\theta = \frac{40}{155}$ Ignore the degree symbol if the direction is stated as a bearing. Accept: 15° East of North 75° North of East Can obtain first mark for scale diagram method from suitable diagram in part (b)(i) if not drawn in this part. However, the candidate must attempt an answer in this part. Ignore any magnitude stated in the final answer in this part. Do not accept incorrect statements of trig functions at substitution stage eg $\tan = \frac{40}{150}$ Accept: 14.9° East of North 014.9 14.93° East of North 014.93

Question			Expected response	Max mark	Additional guidance
1.	(c)		$s =$ area under $v-t$ graph **(1)** $s = (10\times 70)+(60\times 5)+\frac{1}{2}(60\times 45)$ **(1)** $s = 2350\ (\text{m})$ **(1)** Runways X, Y and Z could be used. **(1)**	**4**	

Question			Expected response	Max mark	Additional guidance
2.	(a)		$m = 1300 + 2950 + 2900$ **(1)** $F = ma$ **(1)** $1430 = (1300 + 2950 + 2900) \times a$ **(1)** $a = 0.200$ ms^{-2} **(1)**	**4**	Accept: 0.20, 0.2000.0.20000 Also accept: 0.2
	(b)		Force of friction between the atmosphere and the modules **(1)** causes heat to be produced. **(1)**	**2**	
	(c)		Upward force/air resistance is increased (by parachutes), **(1)** producing an unbalanced force upwards. **(1)**	**2**	
	(d)	(i)	$R = 6.4 \times 10^6 + 3.30 \times 10^5$ **(1)** $T = \frac{2\pi R}{v}$ $T = \frac{2 \times \pi \times (6.4 \times 10^6 + 3.30 \times 10^5)}{7.7 \times 10^3}$ **(1)** $T = 5500$ s **(1)**	**3**	Accept: 5000, 5490, 5492
		(ii)	The weight of the ISS causes it to accelerate towards the Earth. **(1)** It has sufficient horizontal velocity that as it falls towards the Earth, the surface of Earth 'curves away' from it. **(1)**	**2**	

Question			Expected response	Max mark	Additional guidance
3.			**Award 3 marks** where the candidate has demonstrated a good understanding of the physics involved. They show a good comprehension of the physics of the situation and provide a logically correct answer to the question posed. This type of response might include a statement of the principles involved, a relationship or an equation, and the application of these to respond to the problem. The answer does not need to be 'excellent' or 'complete' for the candidate to gain full marks. **Award 2 marks** where the candidate has demonstrated a reasonable understanding of the physics involved. They make some statement(s) that are relevant to the situation, showing that they have understood the problem. **Award 1 mark** where the candidate has demonstrated a limited understanding of the physics involved. They make some statement(s) that are relevant to the situation, showing that they have understood at least a little of the physics within the problem. **Award 0 marks** where the candidate has not demonstrated an understanding of the physics involved. There is no evidence that they have recognised the area of physics involved, or they have not given any statement of a relevant physics principle. Award this mark also if the candidate merely restates the physics given in the question.	**3**	Candidates may use a variety of physics arguments to answer this question. Award marks based on candidates demonstrating overall good, reasonable, limited, or no understanding.

Question			Expected response	Max mark	Additional guidance
4.	(a)	(i)	$(R_T = 15 + 30 + 30)$ $R_T = 75\ \Omega$	**1**	
		(ii)	$V = IR$ **(1)** $15 = I \times 75$ **(1)** $I = 0.20$ A **(1)**	**3**	Or consistent with (a)(i) Accept: 0.2, 0.200, 0.2000
		(iii)	$P = I^2R$ **(1)** $P = 0.20^2 \times 15$ **(1)** $P = 0.60$ W **(1)**	**3**	Or consistent with (a)(ii) Accept: 0.6, 0.600. 0.6000
	(b)		(The power dissipated is) greater (than that in (a)(iii)). **(1)** The total resistance of the circuit is now less. **(1)** The current in the circuit is now greater. **(1)**	**3**	'Must justify' question

Question			Expected response	Max mark	Additional guidance
5.	(a)	(i)	(As light level increases), the resistance of the LDR decreases. **(1)** (The voltage across the LDR decreases, so) voltage across R increases. **(1)** (When voltage across R reaches 2.4 V the MOSFET switches on) and the motor switches on/operates. **(1)**	**3**	Independent marks Accept: 'transistor' in place of MOSFET. Do not accept: npn transistor or pnp transistor in place of MOSFET.
		(ii)	The variable resistor controls the light level at which the motor operates the blind.	**1**	
	(b)	(i)	3000 Ω	**1**	
		(ii)	$V_2 = \left(\frac{R_2}{R_1 + R_2}\right) V_s$ **(1)** $V_2 = \left(\frac{640}{3000 + 640}\right) \times 12$ **(1)** $V_2 = 2.1\ \text{V}$ **(1)**	**3**	Or consistent with (b)(i) Accept: 2, 2.11, 2.110

Question			Expected response	Max mark	Additional guidance
6.	(a)		$E_h = cm\Delta T$ **(1)** $E_h = 4180 \times 0.100 \times (15.0 - 0)$ **(1)** $E_h = 6.27 \times 10^3$ J	**2**	'Show' question
	(b)		$E_h = ml$ **(1)** $E_h = 0.100 \times 3.34 \times 10^5$ **(1)** $E_h = 3.34 \times 10^4$ J **(1)**	**3**	Accept: 3.3, 3.340, 3.3400
	(c)	(i)	$E_h = 6.27 \times 10^3 + 3.34 \times 10^4$ **(1)** $P = \frac{E}{t}$ **(1)** $115 = \frac{\left(6.27 \times 10^3 + 3.34 \times 10^4\right)}{t}$ **(1)** $t = 345$ s **(1)**	**4**	Or consistent with (b) Accept: 340, 345.0, 344.96
		(ii)	Heat will be absorbed from the surroundings **(1)** so the system will have additional heat to remove. **(1)**	**2**	

Question			Expected response	Max mark	Additional guidance
7.	(a)	(i)	Suitable scales, labels, and units. **(1)** All points plotted accurately to ±half a division. **(1)** Best fit straight line. **(1)**	**3**	A non-linear scale or broken axis on either axis prevents access to any marks. **(0)** Axes can be transposed. A bar chart/histogram can obtain **MAX (1)** for scales, labels, and units.
		(ii)	The line of best fit is a straight line that passes through the origin.	**1**	
	(b)		$p_1V_1 = p_2V_2$ **(1)** $125 \times 40.0 = p_2 \times 8.0$ **(1)** $p_2 = 630$ kPa **(1)**	**3**	Accept: 600, 625, 625.0 Accept: any data point from the line of best fit for p_1 and V_1
	(c)	(i)	Using a clamp will prevent heat from the student's hand increasing the temperature of the gas in the syringe. **(1)** If the temperature of the gas in the syringe is not constant, the experiment would not be valid. **(1)**	**2**	Or equivalent statements
		(ii)	(The suggestion is incorrect) because the volume of air in the tubing is not included in the reading from the scale on the syringe. **(1)** A longer length of tubing would make the measurement of volume less accurate. **(1)**	**2**	Or equivalent statements

Question			Expected response	Max mark	Additional guidance
8.	(a)		$d = vt$ **(1)** $d = 3.0 \times 10^8 \times 0.0047$ **(1)** $d = 1.4 \times 10^6$ m **(1)**	**3**	Accept: 1, 1.41, 1.410
	(b)		$v = f\lambda$ **(1)** $3.0 \times 10^8 = 1620 \times 10^6 \times \lambda$ **(1)** $\lambda = 0.19$ m	**2**	'Show' question
	(c)		The waves from the transmitter will diffract over the hill to reach X **(1)** but will not diffract enough to reach Y. **(1)**	**2**	

Question			Expected response	Max mark	Additional guidance
9.			**Award 3 marks** where the candidate has demonstrated a good understanding of the physics involved. They show a good comprehension of the physics of the situation and provide a logically correct answer to the question posed. This type of response might include a statement of the principles involved, a relationship or an equation, and the application of these to respond to the problem. The answer does not need to be 'excellent' or 'complete' for the candidate to gain full marks. **Award 2 marks** where the candidate has demonstrated a reasonable understanding of the physics involved. They make some statement(s) that are relevant to the situation, showing that they have understood the problem. **Award 1 mark** where the candidate has demonstrated a limited understanding of the physics involved. They make some statement(s) that are relevant to the situation, showing that they have understood at least a little of the physics within the problem. **Award 0 marks** where the candidate has not demonstrated an understanding of the physics involved. There is no evidence that they have recognised the area of physics involved, or they have not given any statement of a relevant physics principle. Award this mark also if the candidate merely restates the physics given in the question.	**3**	Candidates may use a variety of physics arguments to answer this question. Award marks based on candidates demonstrating overall good, reasonable, limited, or no understanding.

Question			Expected response	Max mark	Additional guidance
10.	(a)	(i)	5800 ± 100 years	**1**	
		(ii)	$26 \rightarrow 13 \rightarrow 6.5$ Evidence of halving **(1)** Number of half-lives $= 2$ **(1)** $(t = 2 \times 5800)$ $t = 10\,600$ years **(1)**	**3**	Or consistent with a(i)
		(iii)	$\frac{125}{25} = 5$ **(1)** activity per 25 g $= \frac{40}{5} = 8$ (Bq) **(1)** From graph, age $= 9700 \pm 100$ years **(1)**	**3**	
	(b)		The activity (of a sample from the tree) would not have reduced significantly/measurably in 100 years.	**1**	

Question			Expected response	Max mark	Additional guidance
11.	(a)		High frequency electromagnetic radiation	**1**	Accept short wavelength in place of high frequency.
	(b)		$D = \frac{E}{m}$ **(1)** $50 \times 10^{-6} = \frac{E}{0.10}$ **(1)** $E = 5 \times 10^{-6}$ J **(1)**	**3**	Accept: 5.0, 5.00
	(c)		Lead can absorb (some of) the gamma rays.	**1**	

[END OF SPECIMEN MARKING INSTRUCTIONS]

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Change since last published:

The duration of the paper has been shortened and the number of marks reduced. Some questions have been removed from the previous specimen question paper, some have been edited or updated, and some have been replaced.