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CAMBRIDGE
International Education

Cambridge International AS & A Level

PHYSICS **9702/13**

Paper 1 Multiple Choice **May/June 2026**

1 hour 15 minutes

You must answer on the multiple choice answer sheet.

You will need: Multiple choice answer sheet
Soft clean eraser
Soft pencil (type B or HB is recommended)

INSTRUCTIONS

- There are **forty** questions on this paper. Answer **all** questions.
- For each question there are four possible answers **A**, **B**, **C** and **D**. Choose the **one** you consider correct and record your choice in soft pencil on the multiple choice answer sheet.
- Follow the instructions on the multiple choice answer sheet.
- Write in soft pencil.
- Write your name, centre number and candidate number on the multiple choice answer sheet in the spaces provided unless this has been done for you.
- Do **not** use correction fluid or tape.
- Do **not** write on any bar codes.
- You may use a calculator.

INFORMATION

- The total mark for this paper is 40.
- Each correct answer will score one mark.
- Any rough working should be done on this question paper.

This document has **20** pages. Any blank pages are indicated.

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[Turn over

Data

acceleration of free fall	$g = 9.81\,\text{m s}^{-2}$
speed of light in free space	$c = 3.00 \times 10^{8}\,\text{m s}^{-1}$
elementary charge	$e = 1.60 \times 10^{-19}\,\text{C}$
unified atomic mass unit	$1\,\text{u} = 1.66 \times 10^{-27}\,\text{kg}$
rest mass of proton	$m_\text{p} = 1.67 \times 10^{-27}\,\text{kg}$
rest mass of electron	$m_\text{e} = 9.11 \times 10^{-31}\,\text{kg}$
Avogadro constant	$N_\text{A} = 6.02 \times 10^{23}\,\text{mol}^{-1}$
molar gas constant	$R = 8.31\,\text{J K}^{-1}\,\text{mol}^{-1}$
Boltzmann constant	$k = 1.38 \times 10^{-23}\,\text{J K}^{-1}$
gravitational constant	$G = 6.67 \times 10^{-11}\,\text{N m}^2\,\text{kg}^{-2}$
permittivity of free space	$\varepsilon_0 = 8.85 \times 10^{-12}\,\text{F m}^{-1}$ $\left(\frac{1}{4\pi\varepsilon_0} = 8.99 \times 10^{9}\,\text{m F}^{-1}\right)$
Planck constant	$h = 6.63 \times 10^{-34}\,\text{J s}$
Stefan–Boltzmann constant	$\sigma = 5.67 \times 10^{-8}\,\text{W m}^{-2}\,\text{K}^{-4}$

Formulae

uniformly accelerated motion	$s = ut + \frac{1}{2}at^2$ $v^2 = u^2 + 2as$
hydrostatic pressure	$\Delta p = \rho g \Delta h$
upthrust	$F = \rho g V$
Doppler effect for sound waves	$f_\text{o} = \frac{f_\text{s} v}{v \pm v_\text{s}}$
electric current	$I = Anvq$
resistors in series	$R = R_1 + R_2 + \ldots$
resistors in parallel	$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \ldots$

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1 Which quantity is a vector quantity?

A density

B mass

C pressure

D weight

2 What are the advantages of taking repeat measurements and calculating a mean in an experiment?

	taking repeat measurements	calculating a mean
A	shows if the results are accurate	reduces the effects of random errors
B	shows if the results are accurate	reduces the effects of systematic errors
C	shows if the results are precise	reduces the effects of random errors
D	shows if the results are precise	reduces the effects of systematic errors

3 The value of a quantity X is calculated from the values of quantities Y and Z by using the equation shown.

$$X = \frac{Y^2}{Z}$$

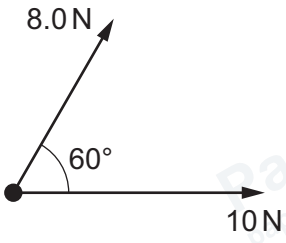
The percentage uncertainty in the value of Y is twice the percentage uncertainty in the value of Z.

What is the ratio $\frac{\text{percentage uncertainty in the value of } X}{\text{percentage uncertainty in the value of } Z}$?

A 1 **B** 3 **C** 4 **D** 5

4 Two coplanar forces act on a small object.

One force has magnitude 10 N. The other force has magnitude 8.0 N and acts at an angle of 60° to the first force.



What is the magnitude of the resultant of the two forces?

A 14 N **B** 16 N **C** 17 N **D** 18 N

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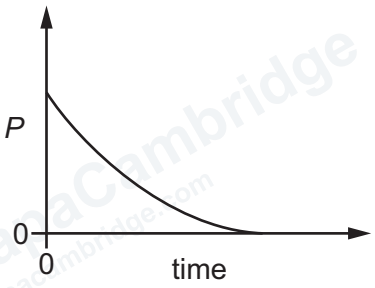
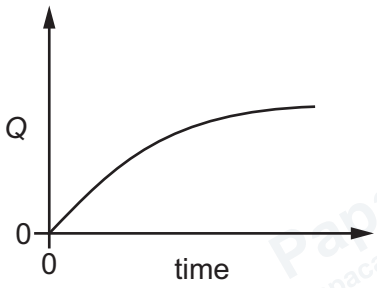
5 An object falls from a large height. The air resistance acting on the object is significant.

The graphs show the variation of two quantities *P* and *Q* with time.

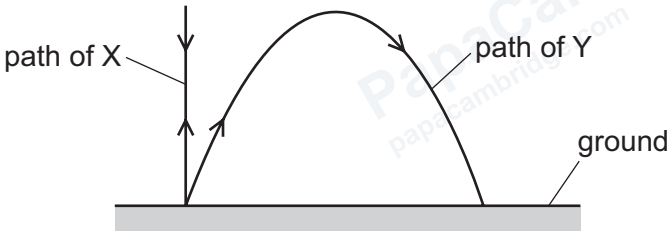




Which quantities could *P* and *Q* represent?

	P	***Q***
A	speed	acceleration
B	acceleration	speed
C	distance fallen	speed
D	speed	distance fallen

6 Two projectiles, X and Y, are fired into the air from the same place on level ground and reach the same maximum height, as shown.



Projectile X is fired vertically upwards and projectile Y is fired at an angle to the horizontal.

Air resistance is negligible.

Which statement is correct?

A X and Y are at rest at their maximum heights.

B X and Y are fired with the same speed.

C X and Y take the same time to return to the ground.

D X and Y travel the same distance.

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7 A lead sphere is released from rest at point X, a long way above the surface of a planet. The sphere falls in a vacuum. After a time of 4.0 s, it has fallen through a vertical distance of 3.0 m. Assume the acceleration of free fall is constant.

How far will the sphere have fallen from point X at a time of 20 s after its release?

A 15 m **B** 75 m **C** 80 m **D** 2000 m

8 The forces acting on an object are in equilibrium at one instant.

Which quantity related to the object's motion **must** have zero magnitude at this instant?

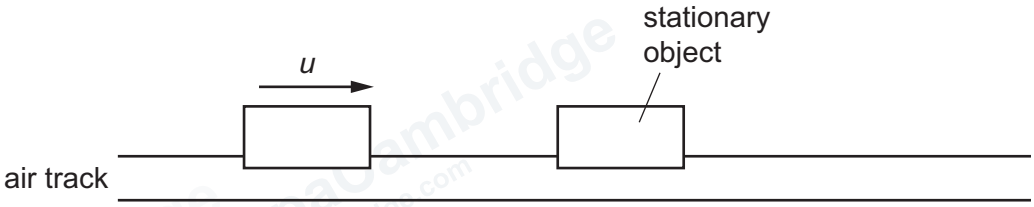
A acceleration

B displacement

C momentum

D velocity

9 The diagram shows an object on a horizontal air track moving with velocity u towards a stationary identical object.



The objects collide and stick together. The objects then move along the track with velocity v.

Assume there is no friction between the objects and the track.

What is the effect of the collision on the total momentum and the total kinetic energy of the objects?

	total momentum	**total kinetic energy**
A	conserved	changed
B	conserved	unchanged
C	not conserved	changed
D	not conserved	unchanged

10 A rock of mass $2m$, travelling in deep space at velocity v, explodes into two parts of equal mass, one of which is then stationary.

What is the kinetic energy of the moving part after the explosion?

A $\frac{1}{2}mv^2$ **B** mv^2 **C** $\frac{3}{2}mv^2$ **D** $2mv^2$

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11 Which statement describes the mass of an object?

A the force the object experiences due to gravity

B the momentum of the object before a collision

C the resistance of the object to changes in motion

D the weight of the object as measured by a balance

12 An object is in equilibrium.

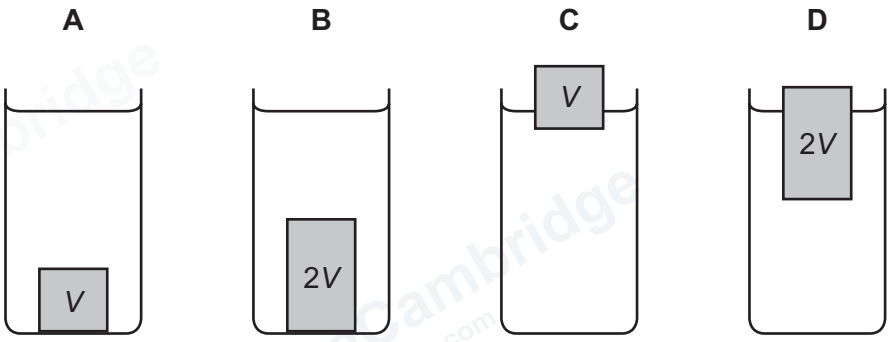
Which row about the resultant force and the resultant torque acting on the object must be correct?

	resultant force	**resultant torque**
A	zero	zero
B	zero	not zero
C	not zero	zero
D	not zero	not zero

13 Four different objects are in equilibrium in identical beakers of water as shown.

Two of the objects have volume V and the other two objects have volume $2V$.

Which object is acted upon by the greatest upthrust?



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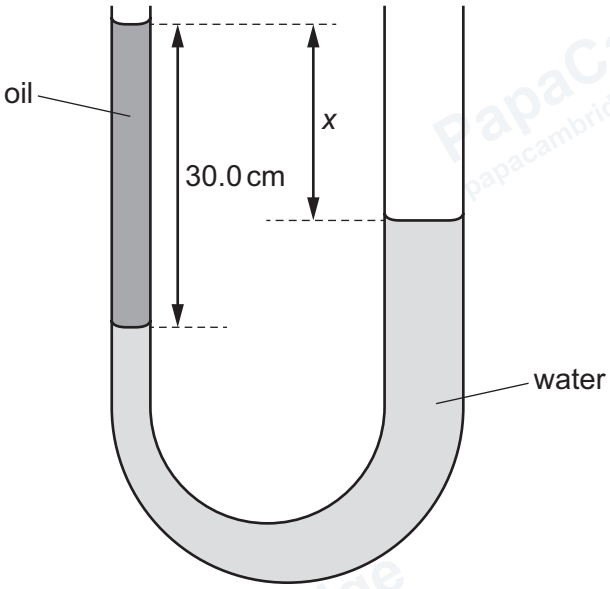
14 A U-tube has a left arm of cross-sectional area A and a right arm of cross-sectional area $4A$. The tube contains water of density $1000\,\text{kg}\,\text{m}^{-3}$ and oil of density $850\,\text{kg}\,\text{m}^{-3}$ as shown.

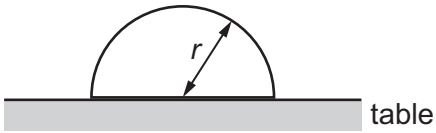


The column of oil on top of the water in the left-hand arm is of length 30.0 cm.

What is the difference in height x between the levels in the two arms of the tube?

A 4.5 cm **B** 6.2 cm **C** 23.8 cm **D** 25.5 cm

15 An object shaped as a hemisphere rests with its flat surface on a table. The object has radius r and density ρ.



The volume of a sphere is $\frac{4}{3}\pi r^3$.

What is the average pressure that the object exerts on the table?

A $\frac{1}{3}\rho r^2$ **B** $\frac{1}{3}\rho r^2 g$ **C** $\frac{2}{3}\rho r$ **D** $\frac{2}{3}\rho r g$

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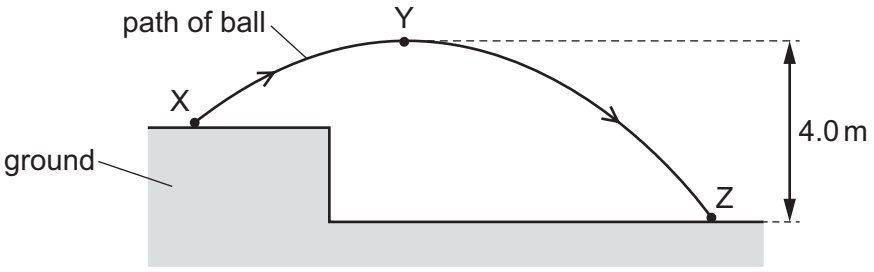
16 A ball is projected from the ground at point X. The ball then reaches its maximum height at point Y before landing on lower ground at point Z. The diagram shows the path of the ball.



not to scale

The ball leaves the ground at X with a kinetic energy of 5.2 J. The ball has a kinetic energy of 9.6 J when it hits the ground at Z.

The weight of the ball is 2.0 N. The vertical height of Y above Z is 4.0 m.

Air resistance is negligible.

What is the vertical height of Y above X?

A 1.8 m **B** 2.0 m **C** 2.2 m **D** 2.6 m

17 An object of mass m has a constant acceleration due to a constant resultant force F.

In a distance s, the speed of the object is increased from u to v.

What is the relationship between s, m, F, u and v?

A $Fs = mv^2 - mu^2$

B $2Fs = mv^2 - mu^2$

C $v^2u = u^2 - \left(\frac{F}{m}\right)s$

D $v^2 = u^2 - 2\left(\frac{F}{m}\right)s$

18 An object is displaced horizontally to the right in a uniform vertical gravitational field.

Which statement describes the change in the gravitational potential energy of the object?

A It decreases in direct proportion to the displacement.

B It does not change with the displacement.

C It increases in direct proportion to the displacement.

D It increases in direct proportion to the square of the displacement.

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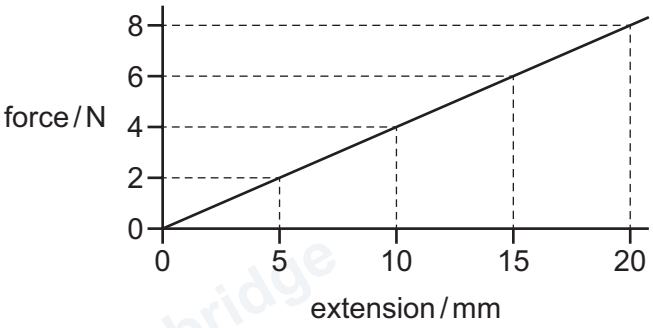
19 A small diesel engine uses a volume of $1.5 \times 10^4\,\text{cm}^3$ of fuel per hour to produce a useful power output of 40 kW. Assume that 34 kJ of energy is transferred to the engine when it uses $1.0\,\text{cm}^3$ of fuel.

What is the rate of transfer from the engine of energy that is wasted?

A 102 kW **B** 142 kW **C** 182 kW **D** 470 kW

20 The graph shows the relationship between the applied force and the extension for a spring.



X is the work done by the force in extending the spring from 0 to 10 mm. *Y* is the work done by the force in extending the spring from 10 mm to 20 mm.

What is the ratio *X* : *Y*?

A 1 : 1 **B** 1 : 2 **C** 1 : 3 **D** 1 : 4

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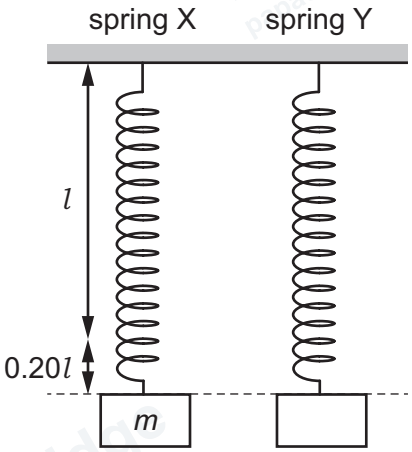
21 Two springs X and Y are attached to a fixed surface. Blocks are attached to their free ends. The blocks hang vertically in equilibrium from the springs as shown.



The stretched lengths of X and Y are equal.

Spring X has spring constant k, unstretched length l and extension 0.20l.

Spring Y has spring constant 3.0k and extension 0.10l.

The mass of the block attached to spring X is m.

What is the mass of the block attached to spring Y?

A 0.67m **B** 1.0m **C** 1.5m **D** 3.0m

22 A wire is being stretched by a tensile force.

Which statement about the elastic limit **must** be correct?

A The deformation is plastic after the elastic limit has been reached.

B The deformation is plastic until the elastic limit is reached.

C The extension is proportional to the tensile force after the elastic limit has been reached.

D The extension is proportional to the tensile force until the elastic limit is reached.

23 Which statement about waves is correct?

A All transverse waves are electromagnetic waves.

B Longitudinal waves include sound waves and microwaves.

C The equation $v = f\lambda$ applies only to transverse waves and **not** to longitudinal waves.

D Transverse waves and longitudinal waves can both be progressive waves.

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24 A loudspeaker moves with a constant speed relative to a stationary observer.

The loudspeaker emits a sound of constant frequency.

The frequency of sound observed depends on the speed and the direction of motion of the loudspeaker.

Which motion of the loudspeaker will cause the highest observed frequency?

	direction of motion of loudspeaker	speed / m s^{-1}
A	away from observer	10
B	away from observer	5
C	towards observer	10
D	towards observer	5

25 Plane polarised light of intensity I is incident normally on a set of polarising filters.

The transmission axis of the first filter is at 30° to the plane of polarisation of the incident light.

The transmission axis of each successive filter is at 30° to the transmission axis of the previous filter.

The intensity of the light emerging from the final filter is $0.24I$.

How many polarising filters are in the set?

A 3 **B** 5 **C** 6 **D** 10

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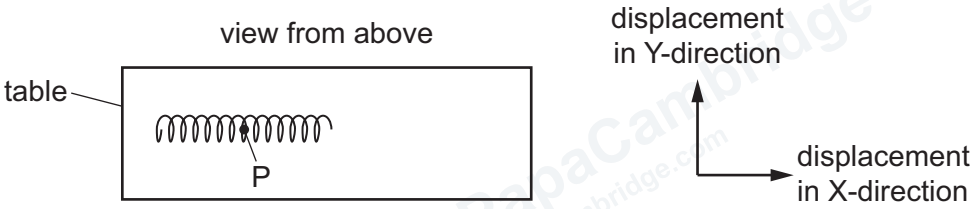
26 A student demonstrates a longitudinal wave using a spring that lies on a table.

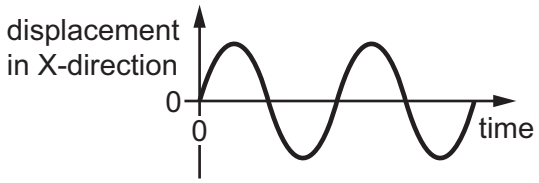


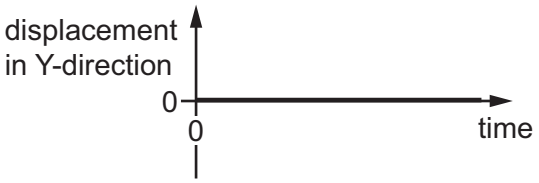
The X- and Y-directions are shown.

P is a point on the spring.

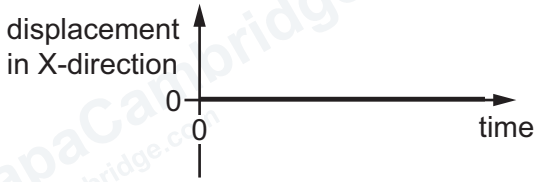
Which pair of graphs could show the variation with time of the displacement of point P in the X- and Y-directions?

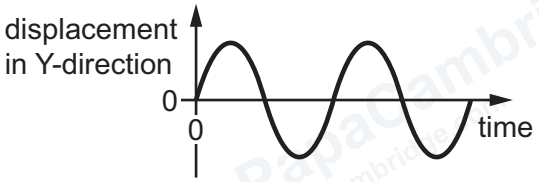
A



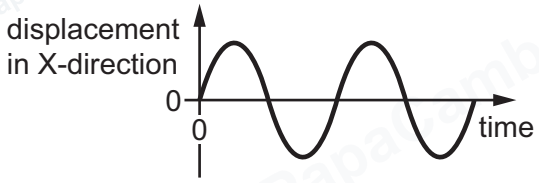


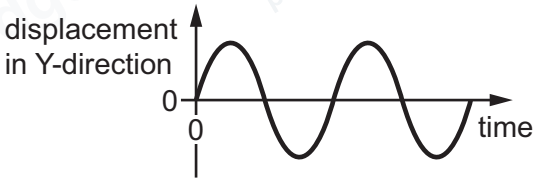
B



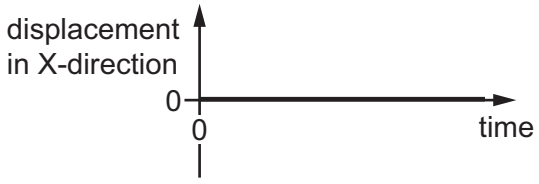


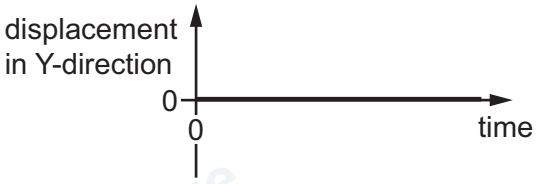
C





D





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27 Light from a laser is incident normally on a double slit. A wave of light emerges from each slit.

Bright and dark interference fringes are observed on a screen that is placed parallel to the double slit.

Which statement explains the formation of a dark fringe?

A A dark fringe is formed where none of the light reaches the screen because it was blocked at the double slit.

B A dark fringe is formed where the waves of light from the two slits do **not** overlap and so **cannot** superpose.

C A dark fringe is formed where a trough from one wave of light meets a trough from the other wave of light.

D A dark fringe is formed where the two waves of light meet and have a phase difference of 180°.

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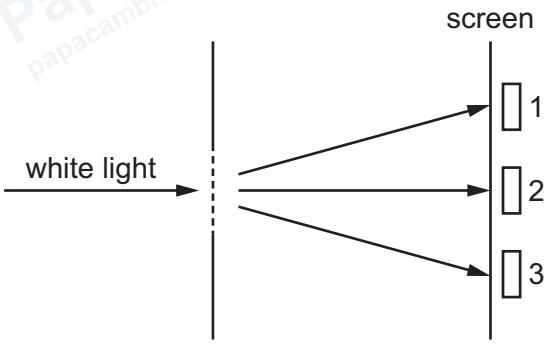
28 A beam of white light is incident normally on a diffraction grating.

Three bands of bright fringes are formed on a screen, labelled 1, 2 and 3 as shown.



What are the colours of the fringes seen on the screen?

	1	2	3
A	continuous spectrum red ⟷ violet	white	continuous spectrum violet ⟷ red
B	continuous spectrum violet ⟷ red	white	continuous spectrum red ⟷ violet
C	continuous spectrum red ⟷ violet	continuous spectrum red – violet – red	continuous spectrum violet ⟷ red
D	continuous spectrum violet ⟷ red	continuous spectrum violet – red – violet	continuous spectrum red ⟷ violet

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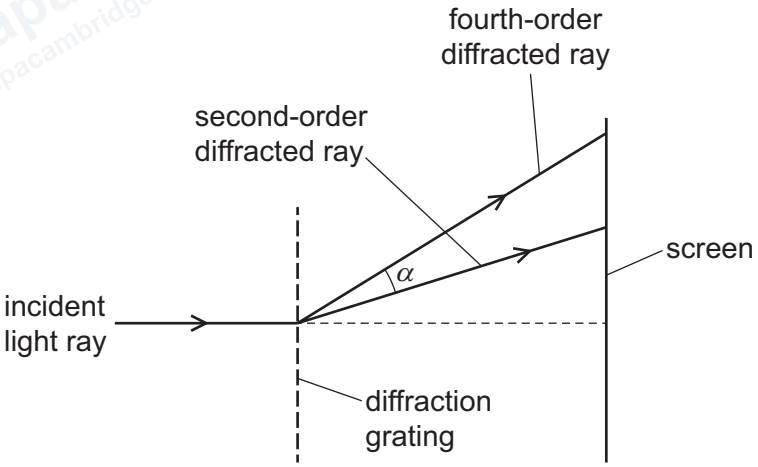
29 Light of wavelength 400 nm passes normally through a diffraction grating with a line spacing of 2.0×10^{-6} m and forms a diffraction pattern on a screen.



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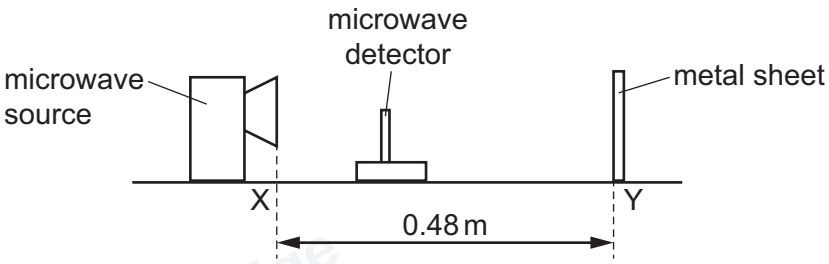
What is the angle α between the second-order and the fourth-order diffracted rays?

A 24° **B** 30° **C** 53° **D** 77°

30 A microwave source is placed on a horizontal surface at position X.

A shiny metal sheet is placed at position Y that is a distance of 0.48 m from X.



The microwaves are reflected back from the metal sheet towards the source.

A microwave detector is moved from X to Y and all positions of minimum microwave intensity are recorded.

Intensity minima were detected at X and Y and also at 15 positions in between X and Y.

The speed of the microwaves is 3.0×10^{8} m s^{-1}.

What is the frequency of the microwaves emitted by the source?

A 4.7×10^{9} Hz **B** 5.0×10^{9} Hz **C** 9.4×10^{9} Hz **D** 1.0×10^{10} Hz

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31 A resistor with a resistance R is connected to a cell.

The current in the resistor is I and the potential difference (p.d.) across the resistor is V.

Which equations can be used to calculate the power dissipated in the resistor?

1 $P = I^2R$

2 $P = VI$

3 $P = \frac{V^2}{R}$

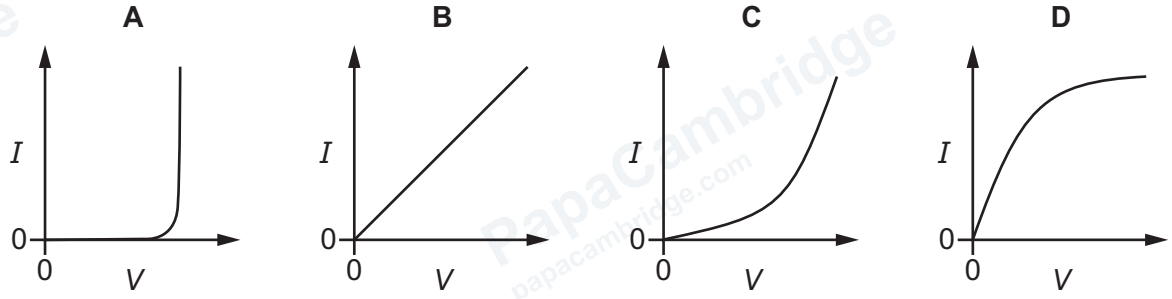
A 1, 2 or 3 **B** 1 or 2 only **C** 1 only **D** 2 only

32 A wire carries a current of 2.0 A for 1.0 hour.

How many electrons pass a point in the wire in this time?

A 1.2×10^{-15} **B** 7.2×10^{3} **C** 1.3×10^{19} **D** 4.5×10^{22}

33 Which graph shows the I–V characteristic of a filament lamp?



34 A straight copper wire, of diameter 4.2×10^{-4} m, has a number density of free electrons of 8.5×10^{28} m^{-3}. In a given time interval, a charge of 0.15 C moves through the wire.

What is the average displacement of the free electrons along the wire in this time interval?

A 3.3×10^{-8} m **B** 2.0×10^{-5} m **C** 8.0×10^{-5} m **D** 2.5×10^{-4} m

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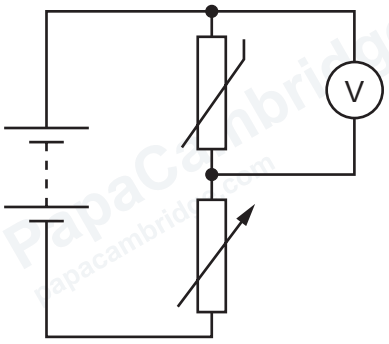
35 The diagram shows a thermistor and a variable resistor connected to a battery.

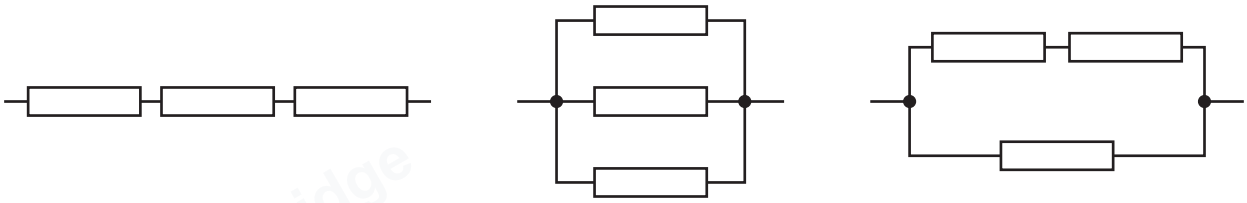


The temperature of the thermistor decreases.

What happens to the reading on the voltmeter, and which change to the resistance of the variable resistor is needed to cause the voltmeter reading to return to its initial value?

	voltmeter reading	**change needed to resistance of variable resistor**
A	decreases	decrease
B	decreases	increase
C	increases	decrease
D	increases	increase

36 Three resistor networks, X, Y and Z, are formed from identical resistors as shown.



X Y Z

What is the order of the networks from smallest total resistance to largest total resistance?

A X → Z → Y **B** Y → X → Z **C** Y → Z → X **D** Z → Y → X

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37 Which piece of apparatus is represented by the circuit symbol shown?



A galvanometer

B generator

C microphone

D oscilloscope

38 What is **not** a fundamental particle?

A electron

B neutrino

C neutron

D positron

39 A nucleus undergoes β^+ decay.

A neutrino and two other particles are produced in this decay.

Which other two particles are produced?

	positron	electron	proton	neutron
A	✓	✗	✗	✓
B	✗	✓	✓	✗
C	✗	✓	✗	✓
D	✓	✗	✓	✗

key

✓ = produced

✗ = not produced

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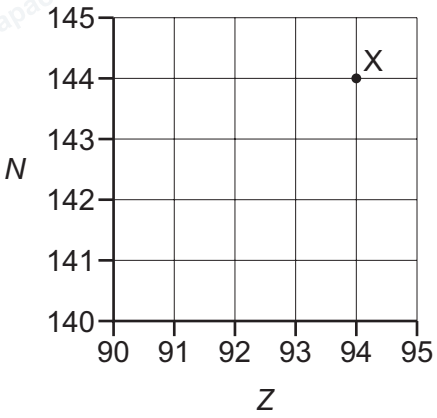
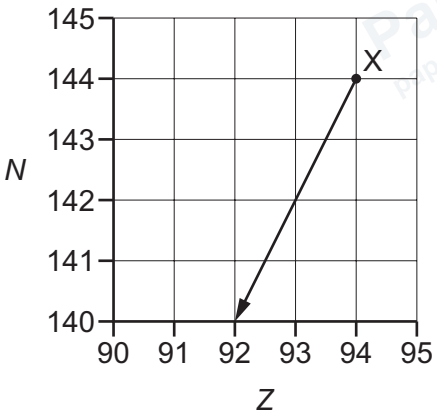
40 A nucleus X is plotted on a graph of neutron number *N* against proton number *Z*.



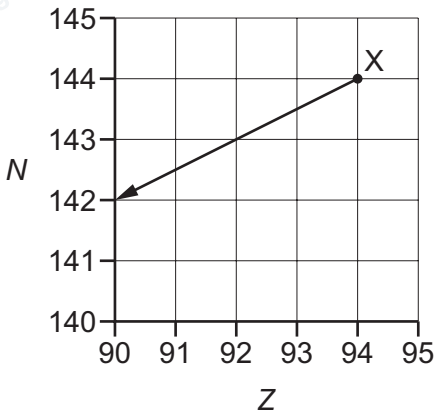
The nucleus undergoes α-decay.

Which arrow shows the changes in *N* and *Z*?

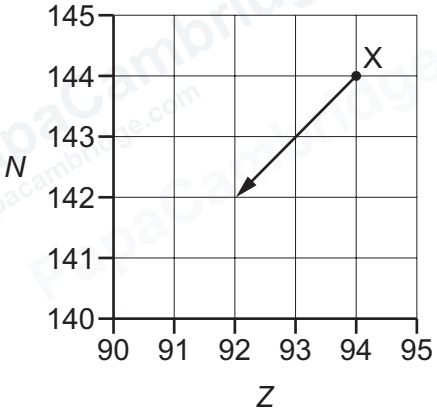
A



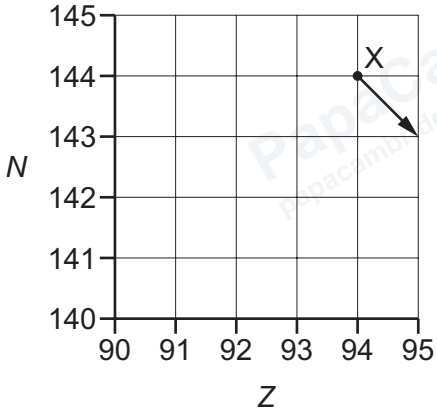
B



C



D



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