Cambridge Assessment International Education

Cambridge International AS & A Level

PHYSICS **9702/12**

Paper 1 Multiple Choice **May/June 2025**

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.
- 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 **16** pages.

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

1 What must all physical quantities have?

A a direction and a magnitude

B a direction and a unit

C a magnitude and a prefix

D a magnitude and a unit

2 What is $0.25\,\text{kN}\,\text{mm}^{-2}$ expressed in $\text{N}\,\text{m}^{-2}$?

A $0.00025\,\text{N}\,\text{m}^{-2}$

B $0.25\,\text{N}\,\text{m}^{-2}$

C $250\,000\,\text{N}\,\text{m}^{-2}$

D $250\,000\,000\,\text{N}\,\text{m}^{-2}$

3 A student calculates the density of a solid steel cube in an experiment.

The measured mass is $975\,\text{g} \pm 10\,\text{g}$ and the measured length of side is $50\,\text{mm} \pm 1\,\text{mm}$.

What is the density of the steel?

A $7.8\,\text{g}\,\text{cm}^{-3} \pm 3.0\%$

B $7.8\,\text{g}\,\text{cm}^{-3} \pm 7.0\%$

C $7.8\,\text{g}\,\text{cm}^{-3} \pm 11\%$

D $7.8\,\text{g}\,\text{cm}^{-3} \pm 13\%$

4 The time period T of a pendulum is given by

$$T = 2\pi\left(\frac{L}{g}\right)^{n}$$

where L is the length of the pendulum and g is the acceleration of free fall.

The equation is homogeneous.

What is the value of n?

A -2 **B** $-\frac{1}{2}$ **C** $\frac{1}{2}$ **D** 2

5 Radio waves can be used to measure the distance between Earth and the planet Jupiter.

A pulse of radio waves is emitted from the surface of Earth. The pulse reflects from the surface of Jupiter and is detected again on Earth.

The time between emitting and receiving the pulse is 3960 s.

What is the distance between Earth and Jupiter?

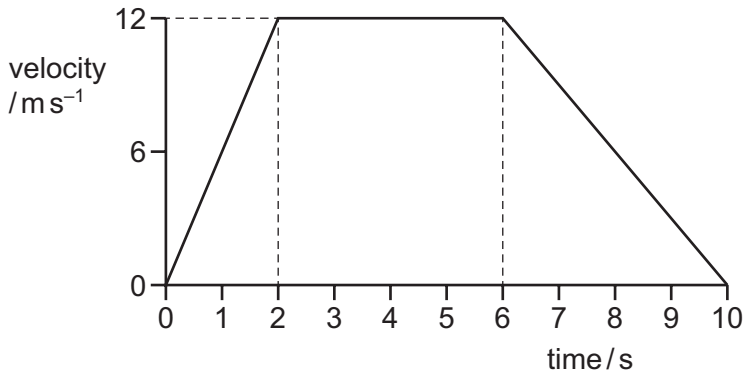
A 5.94×10^{8} km

B 1.19×10^{9} km

C 5.94×10^{11} km

D 1.19×10^{12} km

6 The graph shows the variation with time of the velocity of a car.



Which statement is correct?

A The car accelerates for 2 s, then stops for 4 s and then reverses.

B The car accelerates at 12 m s^{-2} for 2 s.

C The car travels a distance of 36 m in the first 4 s.

D The car travels a distance of 48 m in the last 4 s.

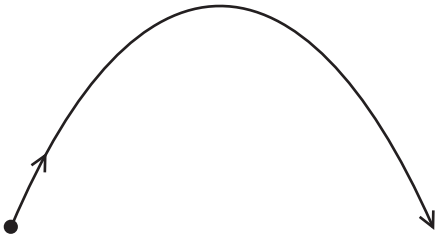
7 A solid object of mass 1.0 kg falls vertically downwards in a vacuum.

When the speed of the object is 60 m s^{-1}, an additional constant force of 50 N suddenly starts to act vertically upwards on the object.

What is the speed of the object 2.0 s after the additional force starts to act?

A 20 m s^{-1} **B** 40 m s^{-1} **C** 80 m s^{-1} **D** 100 m s^{-1}

8 A stone is thrown upwards and follows a curved path.



Air resistance is negligible.

Why does the path have this shape?

A The stone has a constant horizontal acceleration and constant vertical velocity.

B The stone has a constant horizontal velocity and constant vertical acceleration.

C The stone has a constant upward acceleration followed by a constant downward acceleration.

D The stone has a constant upward velocity followed by a constant downward velocity.

9 A rocket engine ejects 90 kg of exhaust gas per second at a velocity of 190 $m\,s^{-1}$ relative to the rocket.

What is the force acting on the rocket due to the ejected gas?

A 2.1 kN **B** 17 kN **C** 18 kN **D** 162 kN

10 Which statement does **not** describe an elastic collision between two objects?

A The relative speed of approach of the two objects equals the relative speed of separation.

B The total kinetic energy of the objects is conserved.

C The total kinetic energy of the objects is reduced.

D The total linear momentum of the objects is conserved.

11 A cyclist is riding at a constant speed on a level road.

According to Newton's third law of motion, what is equal and opposite to the backward push of the back wheel on the road?

A the force exerted by the cyclist on the pedals

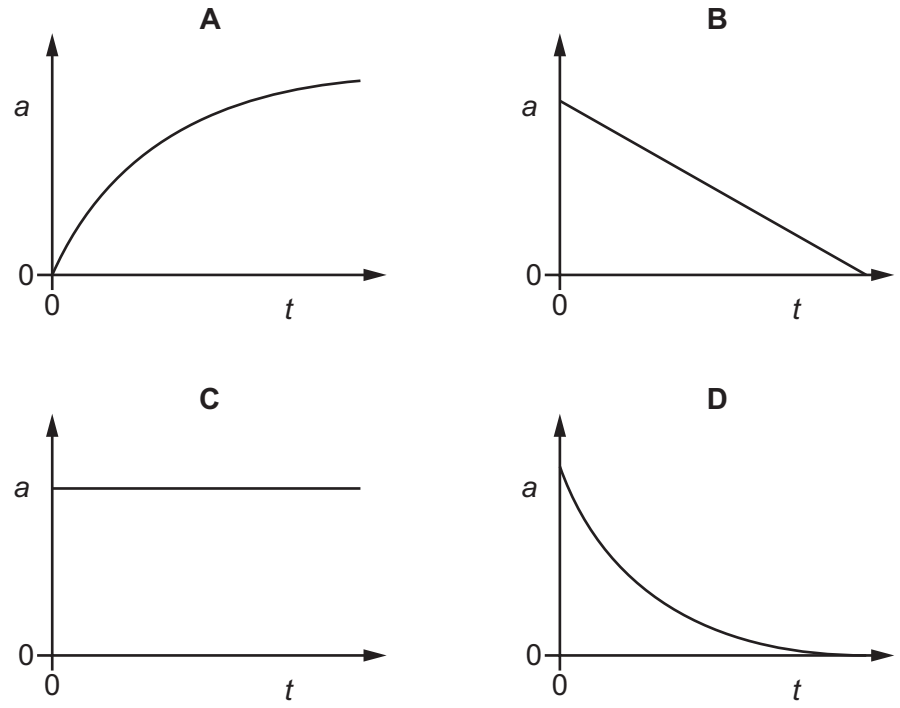
B the forward push of the road on the back wheel

C the tension in the cycle chain

D the total air resistance and friction force

12 A stone is released from rest and falls a long distance in air.

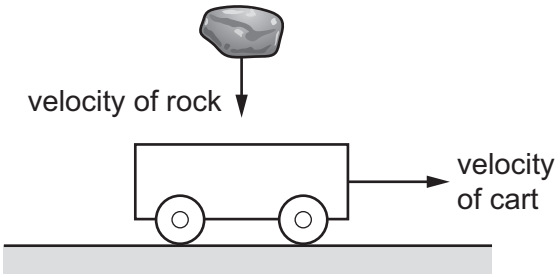
Which graph could show the variation with time *t* of the acceleration *a* of the stone?



13 An empty cart is moving along a horizontal track at a constant velocity.

Resistive forces acting on the cart are negligible.

A heavy rock is dropped vertically into the cart.



The cart continues to move horizontally with the rock inside.

How does the momentum and kinetic energy of the cart with the rock inside compare with the momentum and kinetic energy of the empty cart?

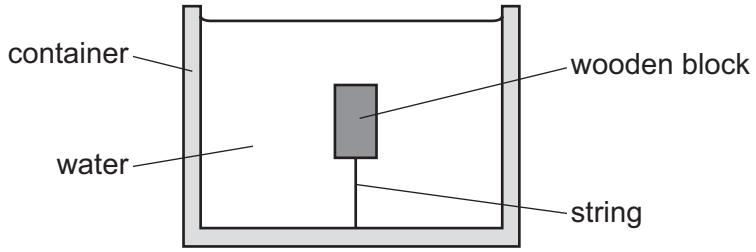
A The cart with the rock inside has a smaller momentum and a smaller kinetic energy.

B The cart with the rock inside has a smaller momentum and the same kinetic energy.

C The cart with the rock inside has the same momentum and a smaller kinetic energy.

D The cart with the rock inside has the same momentum and the same kinetic energy.

14 A wooden block is held stationary in a container of water using a string that is attached to both the wooden block and the bottom of the container.



The wooden block has mass m and volume V. The water has density ρ. The acceleration of free fall is g.

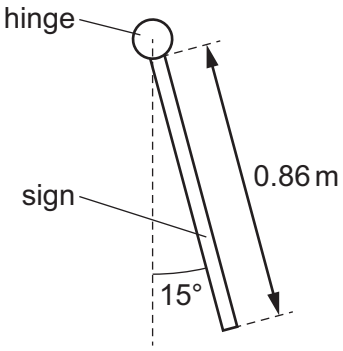
What is the magnitude of the force acting on the block due to the tension in the string?

A ρgV **B** $mg + \rho gV$ **C** mg **D** $\rho gV - mg$

15 A square shop sign of uniform density has mass 2.4 kg and sides of length 0.86 m.

The sign is supported by a hinge along its top edge.

There is friction in the hinge so that the sign hangs from it in equilibrium at an angle of 15° to the vertical, as shown.

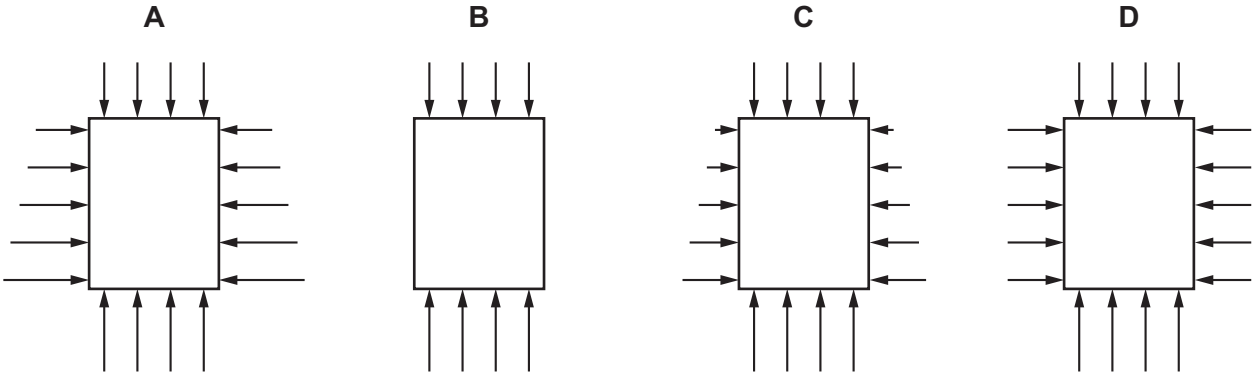


What is the moment about the hinge of the weight of the sign?

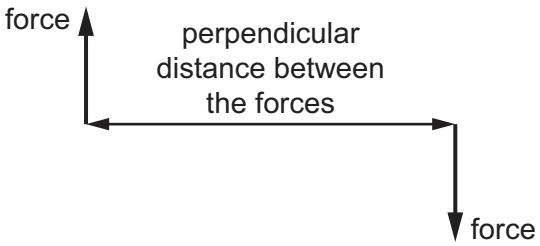
A 2.6 N m **B** 4.0 N m **C** 5.2 N m **D** 9.8 N m

16 A block is submerged vertically in a liquid. The four diagrams show the block viewed from the side.

Which diagram shows, to scale, the forces exerted on equal areas of the block by the liquid?



17 The diagram shows a couple.



How is the torque of the couple calculated?

A $\frac{1}{2}$ × perpendicular distance between the forces × magnitude of one of the forces

B perpendicular distance between the forces × magnitude of one of the forces

C perpendicular distance between the forces × magnitude of the sum of the forces

D 2 × perpendicular distance between the forces × magnitude of one of the forces

18 A ball of mass 1.2 kg travels horizontally at a speed of 3.0 m s^{-1}.

The ball hits a cushion and comes to rest over a horizontal distance of 0.020 m.

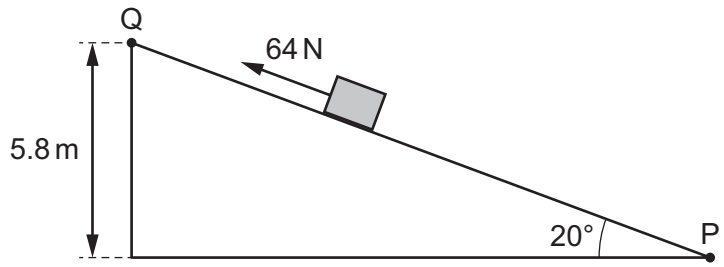
What is the work done by the cushion on the ball to bring the ball to rest?

A 0.24 J **B** 1.8 J **C** 5.4 J **D** 11 J

19 A box of mass 4.9 kg is pushed at a constant velocity from point P at the bottom of an inclined plane to point Q at the top.

The box is pushed by a force of 64 N acting parallel to the slope.

The slope is inclined at an angle of 20° to the horizontal and the box moves through a vertical height of 5.8 m.



What is the work done against the frictional force acting on the block between P and Q?

A 280 J **B** 810 J **C** 960 J **D** 1100 J

20 Which expression gives the efficiency of a system?

A $\frac{\text{total energy input}}{\text{useful energy output}}$

B $\frac{\text{useful energy output + wasted energy output}}{\text{total energy input}}$

C $\frac{\text{useful energy output}}{\text{total energy input}}$

D $\frac{\text{wasted energy output}}{\text{total energy input}}$

21 A student has a copper wire and a steel wire with equal lengths and cross-sectional areas.

The student hangs identical loads on the two wires.

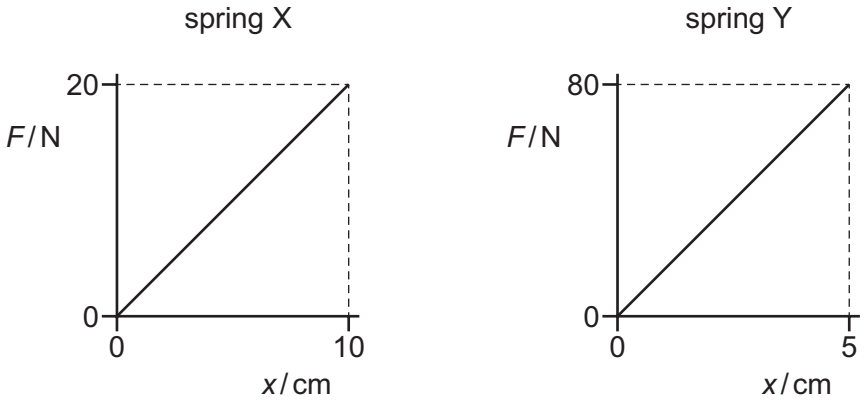
The extensions of the two wires are different.

The student calculates the stress, strain and Young modulus of each wire.

Which row identifies with a tick (✓) the calculated values that are equal for both wires?

	stress	strain	Young modulus
A	✓		
B		✓	
C		✓	✓
D	✓		✓

22 Two springs X and Y stretch elastically. The graphs show the variation with extension x of the force F applied to each spring.



Which statement is correct?

A When each spring is given the same extension, the energy stored in Y is 4 times the energy stored in X.

B When each spring is given the same extension, the energy stored in Y is 8 times the energy stored in X.

C When the same force is applied to each spring, the energy stored in Y is 4 times the energy stored in X.

D When the same force is applied to each spring, the energy stored in Y is 8 times the energy stored in X.

23 Which phrase describes the strain at the elastic limit on a stress–strain graph?

A the maximum strain below which Hooke's law is obeyed

B the maximum strain below which the deformation is plastic

C the minimum strain above which Hooke's law is obeyed

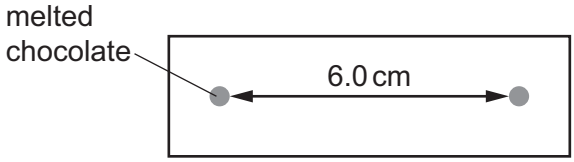
D the minimum strain above which the deformation is plastic

24 A teacher removes the turntable from a microwave oven and places a bar of chocolate in the oven. She then switches the oven on for a short time.

A stationary wave is formed in the oven.

When the chocolate is removed, the teacher observes that there are two small sections of melted chocolate 6.0 cm apart with unmelted chocolate in between.

Each section of melted chocolate is located at an antinode.



Assume that the speed of the microwaves is $3.0 \times 10^8\,\text{m s}^{-1}$.

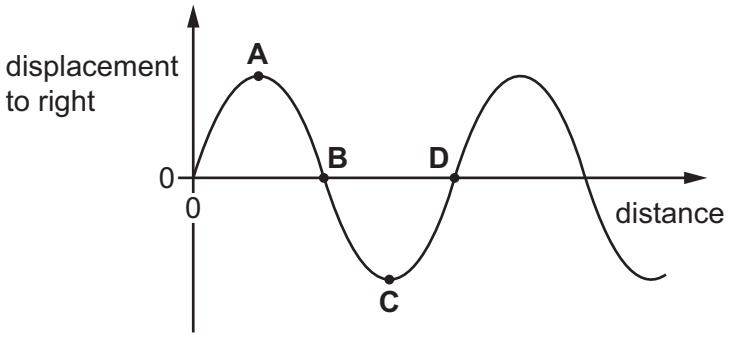
What is the frequency of the microwaves emitted by the oven?

A 25 MHz **B** 50 MHz **C** 2.5 GHz **D** 5.0 GHz

25 A sound wave travels from the left to the right.

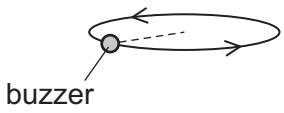
The graph shows the variation of the displacement to the right of particles in the sound wave with distance, at one instant.

Which letter represents the centre of a compression?



26 A buzzer emitting sound of frequency 846 Hz is attached to a string and rotated in a horizontal circle. The linear speed of the buzzer is 25.0 m s^{-1}.

observer



The speed of sound is 340 m s^{-1}.

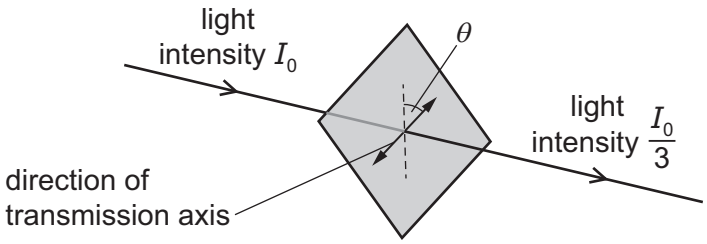
What is the maximum frequency heard by the observer?

A 783 Hz **B** 788 Hz **C** 908 Hz **D** 913 Hz

27 Vertically polarised light of intensity I_0 is incident normally on a polarising filter.

The transmission axis of the filter is at an angle θ to the plane of polarisation of the light.

The intensity of the light after passing through the filter is $\frac{I_0}{3}$.



What is θ?

A 8.4° **B** 55° **C** 71° **D** 84°

28 Which statement compares the behaviour of transverse and longitudinal waves?

A Only longitudinal waves can be diffracted.

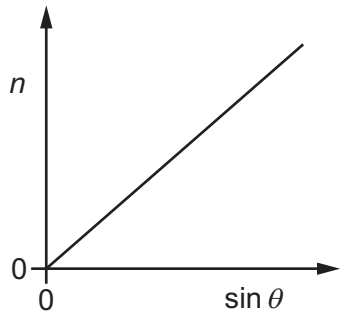
B Only longitudinal waves can travel in free space.

C Only transverse waves can be coherent.

D Only transverse waves can be polarised.

29 A student uses a diffraction grating to determine the wavelength of visible light from a source.

The diffraction grating has 300 lines per mm. The student measures the angle θ of each order n of the intensity maxima. A graph of n against $\sin\theta$ is plotted. The line of best fit for the plotted points is shown and has gradient G.



Which expression represents the wavelength, in m, of the visible light in terms of G?

A $3 \times 10^{5} G$ **B** $3.3 \times 10^{-6} G$ **C** $\dfrac{3.3 \times 10^{-6}}{G}$ **D** $\dfrac{300}{G}$

30 Two waves meet.

What is **not** a necessary condition for the waves to produce a stationary wave?

A They must be of the same type.

B They must have the same period.

C They must have the same wavelength.

D They must travel in the same direction.

31 Light of a single wavelength is incident normally on a double slit. Interference fringes are observed on a screen.

The distance from the double slit to the screen is 0.60 m and the fringe separation is 1.8 mm.

The distance from the double slit to the screen increases by 0.90 m.

What is the new fringe separation?

A 1.2 mm **B** 2.7 mm **C** 4.5 mm **D** 5.4 mm

32 A wire is made from a metal of constant resistivity. There is a constant current in the wire.

Which statement about the potential difference across the wire is correct?

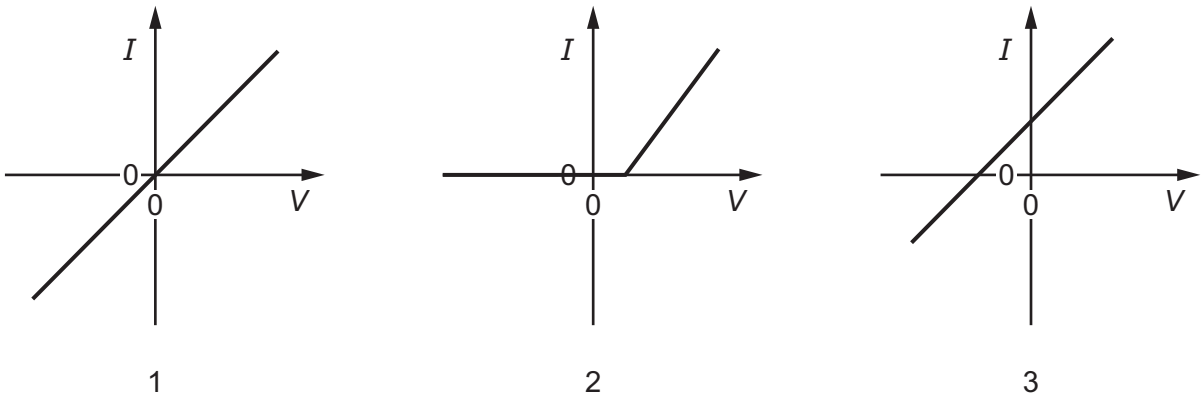
A It is directly proportional to the length of the wire.

B It is inversely proportional to the length of the wire.

C It is directly proportional to the diameter of the wire.

D It is inversely proportional to the diameter of the wire.

33 The I–V characteristics for three electrical components are shown.



1 2 3

Which components obey Ohm's law?

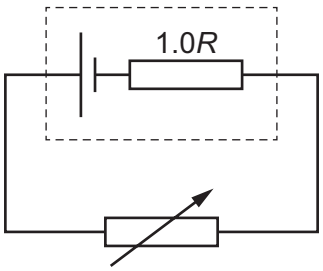
A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 1 only

34 A resistor of resistance 200 Ω is connected to a supply that has a p.d. of 4.00 V.

How many electrons enter the resistor in 4.00 s?

A 3.13×10^{16} **B** 1.25×10^{17} **C** 5.00×10^{17} **D** 1.25×10^{21}

35 The diagram shows a cell of internal resistance $1.0R$ connected to a variable resistor.



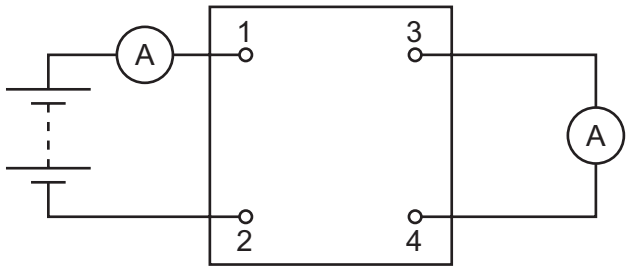
When the variable resistor has an initial resistance of $2.0R$, the current in the cell is I_1 and the terminal potential difference (p.d.) across the cell is V_1.

The variable resistor is now adjusted to a new resistance of $4.0R$.

What is the new current in the cell and the new terminal p.d. across the cell?

	current	terminal p.d.
A	$0.50I_1$	$1.0V_1$
B	$0.50I_1$	$1.2V_1$
C	$0.60I_1$	$1.0V_1$
D	$0.60I_1$	$1.2V_1$

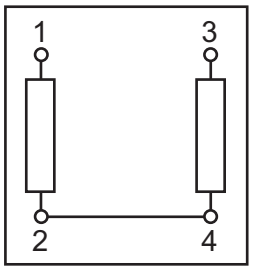
36 The diagram shows a four-terminal box connected to a battery and two ammeters.



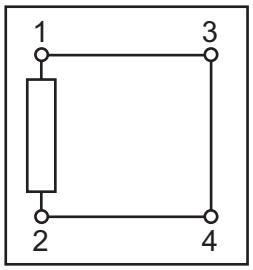
The currents in the two ammeters are identical.

Which circuit, within the box, gives this result?

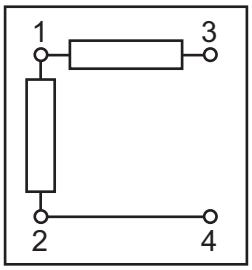
A



B



C



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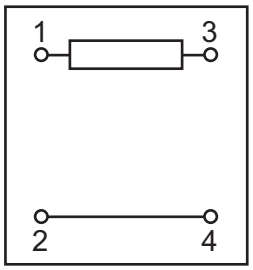

37 Each of Kirchhoff's two laws presumes that some quantity is conserved.

Which row states Kirchhoff's **first** law and names the quantity that is conserved?

	statement	quantity
A	The algebraic sum of currents at a junction is zero.	charge
B	The algebraic sum of currents at a junction is zero.	energy
C	The e.m.f. in a loop is equal to the algebraic sum of the product of current and resistance round the loop.	charge
D	The e.m.f. in a loop is equal to the algebraic sum of the product of current and resistance round the loop.	energy

[Turn over

38 Two neutral atoms are isotopes of the same element.

Which statement about the atoms is correct?

A They have a different number of neutrons and a different number of electrons.

B They have a different number of neutrons and the same number of protons.

C They have the same number of neutrons and a different number of electrons.

D They have the same number of neutrons and the same number of protons.

39 What is the composition of a meson?

A 1 quark and 1 antiquark

B 1 quark and 2 antiquarks

C 2 quarks and 1 antiquark

D 3 quarks

40 A nucleus of carbon-11 contains 6 protons and 5 neutrons.

The nucleus of carbon-11 decays by β^+ emission.

What is the total number of up and down quarks in the product of the decay of this nucleus?

	up quarks	down quarks
A	15	18
B	16	17
C	17	16
D	18	15