Cambridge Assessment International Education

Cambridge International AS & A Level

PHYSICS **9702/14**

Paper 1 Multiple Choice **October/November 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 **20** pages. Any blank pages are indicated.

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 is essential to accurately represent all physical quantities?

A a base unit and a number

B a unit and a number expressed in standard form (scientific notation)

C a unit and a numerical magnitude

D an SI unit and a numerical magnitude

2 A steel rule can be read to the nearest millimetre. It is used to measure the length of a bar whose true length is 895 mm. Repeated measurements give the following readings.

length / mm 892, 891, 892, 891, 891, 892

Are the readings accurate and precise to within 1 mm?

	results are accurate to within 1 mm	results are precise to within 1 mm
A	no	no
B	no	yes
C	yes	no
D	yes	yes

3 A stone is released from rest and falls vertically to the ground.

The time taken to fall to the ground and the distance travelled are measured. The measurements are used to determine the acceleration of free fall.

The percentage uncertainty in the measured time is 0.05%. The percentage uncertainty in the measured distance fallen is 0.6%.

What is the percentage uncertainty in the calculated value of the acceleration of free fall?

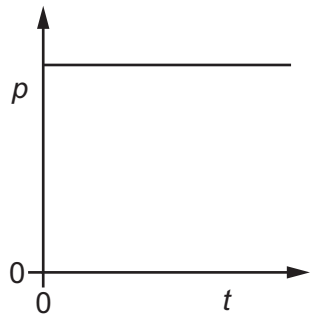
A 0.5% **B** 0.7% **C** 1.1% **D** 1.3%

4 An object falls from rest towards the ground.

Air resistance is negligible.

Which graph shows the variation of the momentum p of the object with time t until it hits the ground?

A



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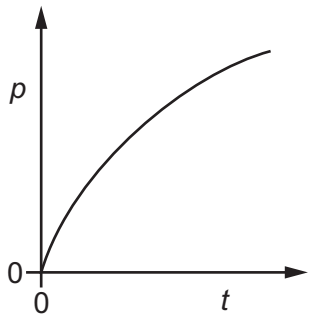

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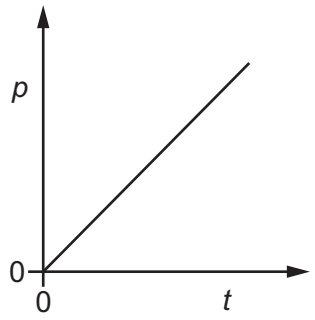
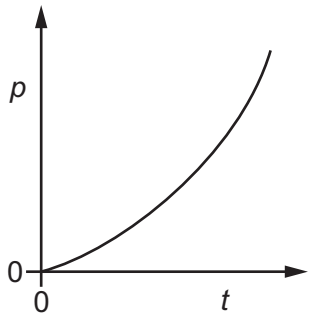


D



5 A projectile is fired at an angle of 45° upwards from horizontal ground. Air resistance is negligible.

Which row describes the horizontal motion and the vertical motion of the projectile after it is fired until immediately before it reaches the ground again?

	horizontal motion	vertical motion
A	constant velocity	constant acceleration
B	constant velocity	varying acceleration
C	varying velocity	constant acceleration
D	varying velocity	varying acceleration

6 An aircraft on a runway accelerates uniformly from rest to its take-off speed of $58\,m\,s^{-1}$.

The acceleration of the aircraft is $4.2\,m\,s^{-2}$, and the aircraft uses 74% of the length of the runway to reach its take-off speed.

What is the length of the runway?

A 300 m **B** 540 m **C** 590 m **D** 800 m

7 How can the acceleration of an object be determined?

A from the area under a displacement–time graph

B from the area under a velocity–time graph

C from the gradient of a displacement–time graph

D from the gradient of a velocity–time graph

8 The acceleration of free fall on the Earth is different to the acceleration of free fall on the Moon.

How do the mass and weight of an object on the Earth compare to its mass and weight on the Moon?

	mass	weight
A	different	different
B	different	same
C	same	different
D	same	same

9 A sphere moves vertically downwards at terminal (constant) velocity in a liquid.

Which statement about the magnitude of the upthrust acting on the sphere is correct?

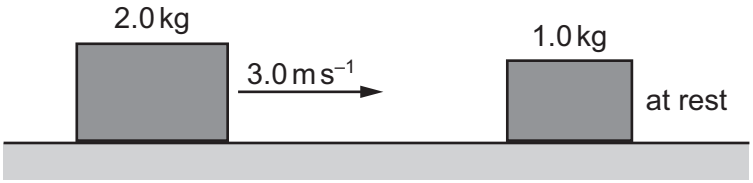
A It is proportional to the acceleration of free fall.

B It is equal to the weight of the sphere.

C It is proportional to the density of the sphere.

D It is proportional to the square of the radius of the sphere.

10 An object of mass 2.0 kg is travelling at a speed of 3.0 $m\,s^{-1}$ on a horizontal frictionless surface. This object collides head-on with a stationary object of mass 1.0 kg. The two objects stick together on impact.



How much kinetic energy is lost on impact?

A zero **B** 2.0 J **C** 2.4 J **D** 3.0 J

11 A moving object X collides with a stationary object Y.

The objects separate after the collision.

The collision is perfectly elastic and there are no external forces acting.

Which word equation is **not** correct?

A during the collision, (force acting on object X) + (force acting on object Y) = zero

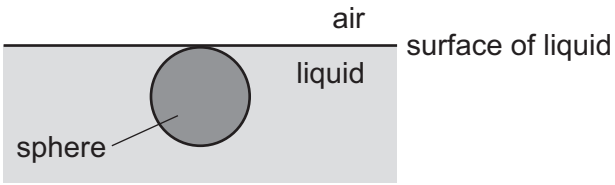
B (relative speed of approach of X and Y) + (relative speed of separation of X and Y) = zero

C (total kinetic energy before collision) = (total kinetic energy after collision)

D (total momentum before collision) = (total momentum after collision)

12 The diagram shows a stationary sphere that is just fully submerged in a liquid. The radius of the sphere is r and the density of the liquid is ρ. The acceleration of free fall is g.

The air exerts pressure P_A on the surface of the liquid.



What is the pressure at the lowest point of the sphere?

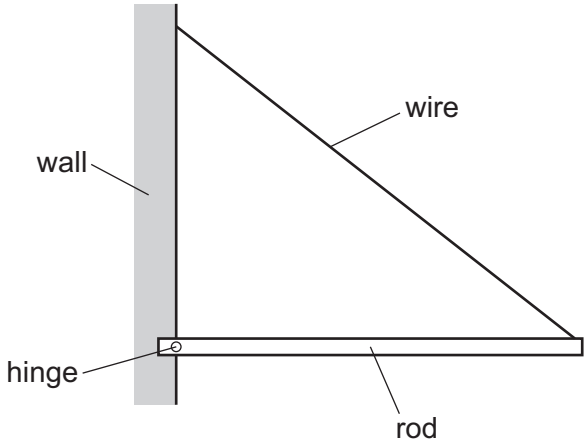
A $P_A + \frac{4}{3}\pi r^3 \rho g$

B $P_A - \frac{4}{3}\pi r^3 \rho g$

C $2r\rho g + P_A$

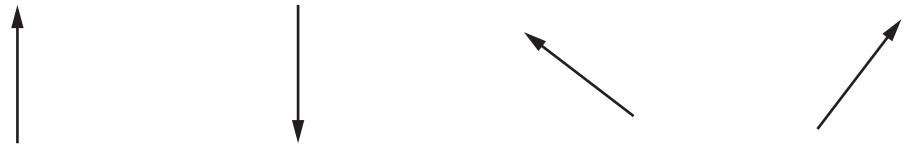
D $2r\rho g - P_A$

13 A uniform rod is attached by a hinge at one end to a wall. The other end of the rod is supported by a wire so that the rod is horizontal and in equilibrium.

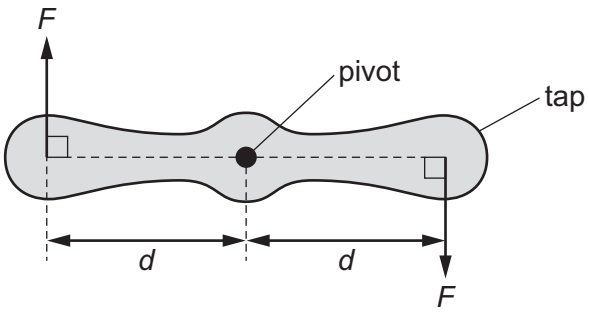


Which arrow shows the direction of the force on the rod from the hinge?

A **B** **C** **D**



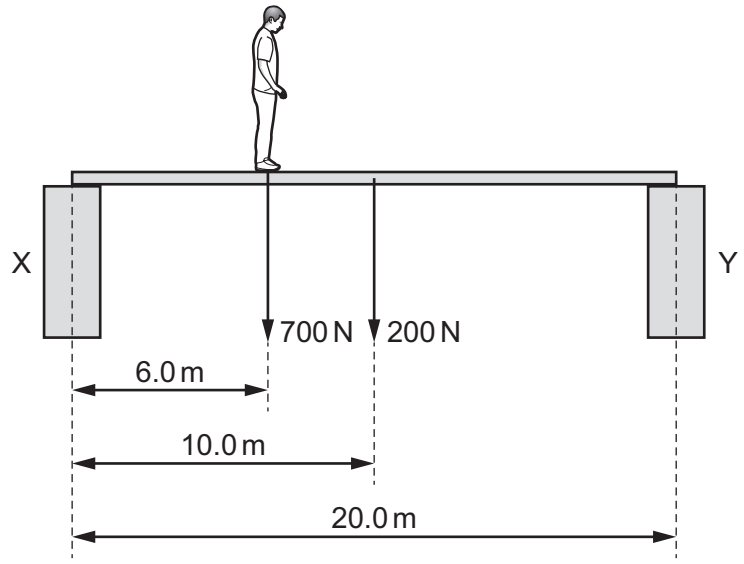
14 A couple is applied to a tap, as shown.



What is the torque of the couple?

A $\frac{Fd}{2}$ **B** Fd **C** $2Fd$ **D** $4Fd$

15 A uniform beam rests on two supports, X and Y, as shown.



not to scale

The beam has length 20.0 m and weight 200 N.

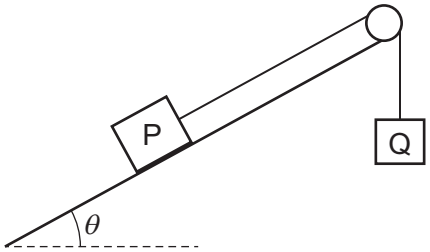
A man of weight 700 N stands on the beam at a distance of 6.0 m from support X.

The beam is in equilibrium.

What is the contact force of support X on the beam?

A 310 N **B** 450 N **C** 590 N **D** 900 N

16 The diagram shows a block P of mass M connected by a string over a frictionless pulley to a block Q of mass m.



Block P moves up the slope with a constant velocity v. The slope is at angle θ to the horizontal.

The acceleration of free fall is g.

The resistive forces on the blocks are negligible.

Which expressions give the energy transferred per unit time to block P?

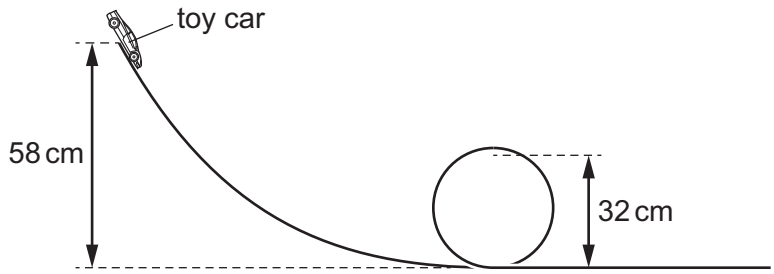
1 mgv

2 $Mgv\sin\theta$

3 $(M + m)gv$

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

17 A toy car travels around a vertical loop track.



The toy car is released from rest at a height of 58 cm above the bottom of the vertical loop.

The car is at a height of 32 cm when it is at the top of the vertical loop.

Assume that no resistive forces act on the car.

What is the speed of the car at the top of the vertical loop?

A $0.87\,m\,s^{-1}$ **B** $2.3\,m\,s^{-1}$ **C** $2.5\,m\,s^{-1}$ **D** $3.4\,m\,s^{-1}$

18 The total energy supplied to an electric motor is E. Energy Q is wasted and the remaining energy does useful work.

What is the efficiency of the motor?

A $\frac{Q}{E}$ **B** $\left(\frac{Q}{E}\right) - 1$ **C** $1 - \left(\frac{Q}{E}\right)$ **D** $\frac{(1-Q)}{E}$

19 An object travels between two points. The change in gravitational potential energy ΔE_p of the object is given by

$$\Delta E_p = mg\Delta h$$

where m is the mass of the object, Δh is its change in height and g is the acceleration of free fall.

What is a necessary condition in order for the above equation to be valid?

A The object must have a constant acceleration of $9.81\,m\,s^{-2}$.

B The object must be travelling in a uniform gravitational field.

C The object must be travelling only in a vertical direction.

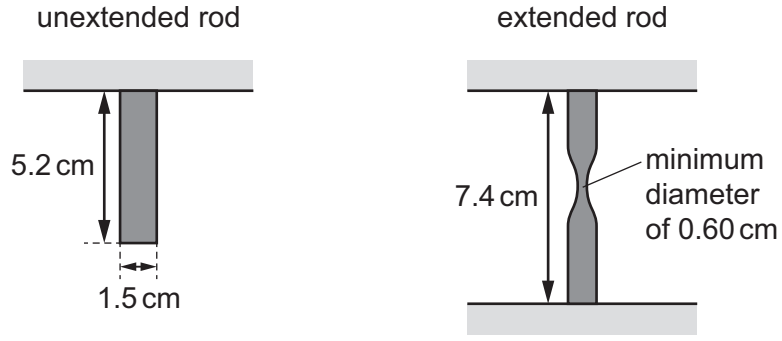
D The resultant force on the object must be equal to its weight.

20 A cylindrical steel rod with negligible weight has a diameter of 1.5 cm and a length of 5.2 cm.

The rod is firmly attached at the top end.

The rod is firmly attached to a machine at the other end that applies a constant force of 363 N to the rod.

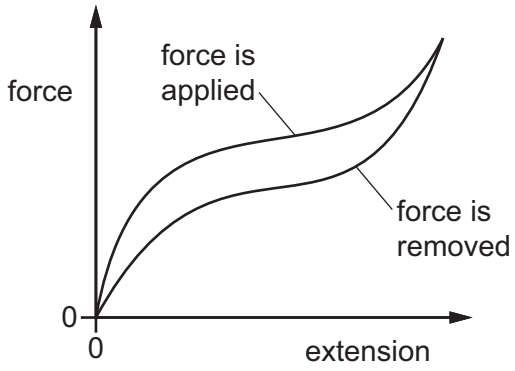
This causes the rod to extend to a length of 7.4 cm and to have a minimum diameter of 0.60 cm in the position shown.



What is the maximum stress acting on the steel rod when the length is 7.4 cm?

A $2.1 \times 10^6\,Pa$ **B** $3.2 \times 10^6\,Pa$ **C** $5.7 \times 10^6\,Pa$ **D** $1.3 \times 10^7\,Pa$

21 The graph shows the variation in extension with force for a sample of rubber.



The top line shows the variation in extension as a force is applied.

The bottom line shows the variation in extension as the force is removed.

What is represented by the area between the two lines?

A the work done as the force is applied

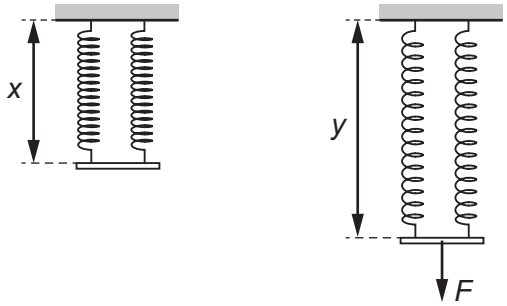
B the work done as the force is applied minus the work done as the force is removed

C the work done as the force is removed

D the work done as the force is removed plus the work done as the force is applied

22 Two identical springs have the same spring constant k. The springs are connected in parallel. The length of the unstretched springs is x.

A force F is applied to the spring combination. The length of the springs is now y.



Both springs are deformed within their limits of proportionality.

Which expression gives the elastic potential energy stored in **one** of the springs?

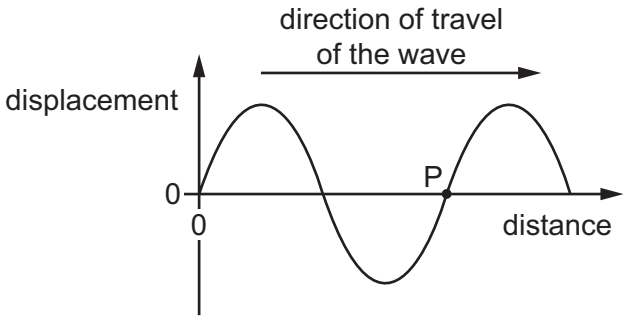
A $\frac{1}{4}F(y-x)$ **B** $\frac{1}{2}F(y-x)$ **C** $\frac{1}{4}k(y-x)^2$ **D** $k(y-x)^2$

23 Which expression gives the formula for the spring constant?

A Fx **B** $2Fx^2$ **C** $\frac{F}{x}$ **D** $\frac{F}{x^2}$

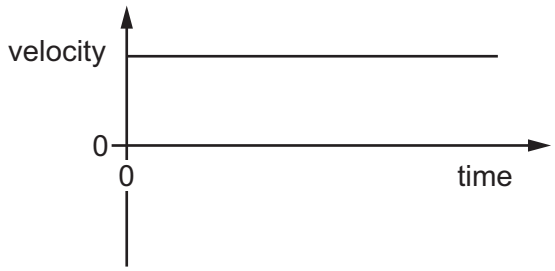
24 A transverse progressive wave travels along a string.

The graph shows the variation with distance of the displacement of the string at time $t = 0$.

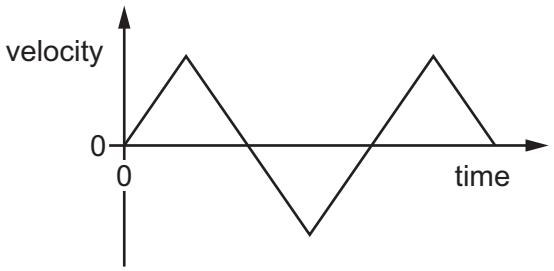


Which graph represents the variation with time of the velocity of point P on the string?

A



B



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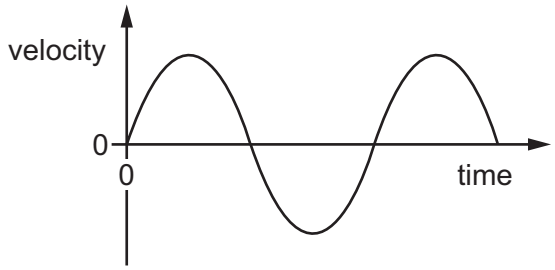

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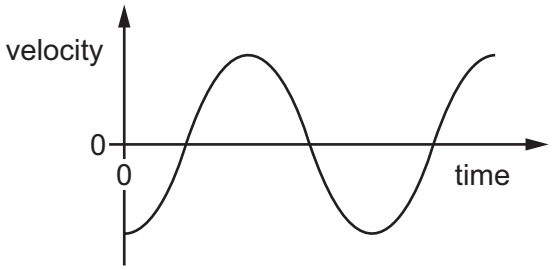


25 Which statement about electromagnetic waves is correct?

A A wave of wavelength 5.0×10^{-6} m is invisible to the human eye.

B They can all travel at different speeds in free space.

C They **cannot** be polarised.

D They consist of vibrating atoms.

26 For a progressive transverse wave, what describes the term diffraction?

A the change in observed frequency of a wave due to a movement of the wave source

B the spreading of a wave as it passes through a gap or around an obstacle

C when oscillations of a wave are confined to one plane

D the resultant displacement of two waves is equal to the sum of the displacements of the individual waves when the waves meet

27 An aircraft flies at a velocity v_s directly away from a stationary observer.

The aircraft emits a sound of constant frequency.

The speed of sound in air is v.

The frequency of the sound heard by the observer on the ground is 500 Hz.

The speed of the aircraft is increased so that it flies away from the observer at a greater velocity.

The observer now hears a sound of frequency 250 Hz.

Which expression gives the new velocity of the aircraft?

A $2(v + v_s)$ **B** $\frac{v + v_s}{2}$ **C** $2v_s + v$ **D** $2v_s - v$

28 What may be observed with light waves but **not** with sound waves?

A diffraction

B interference

C polarisation

D reflection

29 A wire is fixed at both ends and is vibrated by a source of frequency f. A stationary wave is formed on the wire with a total of two antinodes.

The frequency of the source is increased to $3f$ and a new stationary wave is formed.

What is the total number of antinodes on the new wave?

A 4 **B** 5 **C** 6 **D** 9

30 A parallel beam of red light of wavelength 700 nm is incident normally on a diffraction grating that has 400 lines per millimetre.

What is the total number of intensity maxima from the grating?

A 6 **B** 7 **C** 8 **D** 9

31 Two light sources are used to produce an interference pattern.

Interference fringes appear when the two sources emit waves that are coherent.

What is meant by coherent waves?

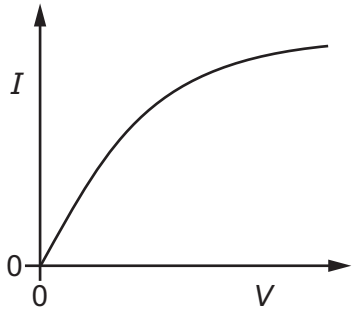
A The two waves are emitted with the same frequency.

B The two waves are emitted with constant phase difference.

C The two waves are emitted with the same intensity.

D The two waves are emitted with zero phase difference.

32 Which component has the I–V graph shown?



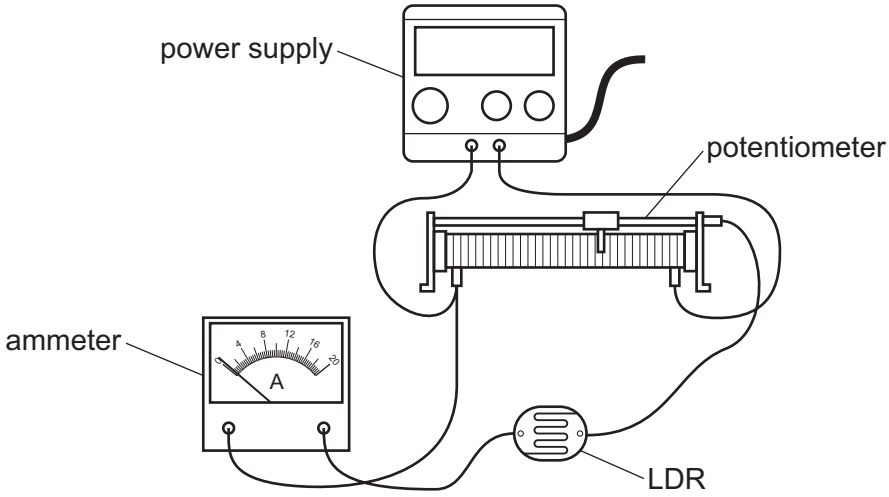
A filament lamp

B metallic conductor at constant temperature

C resistor of fixed resistance

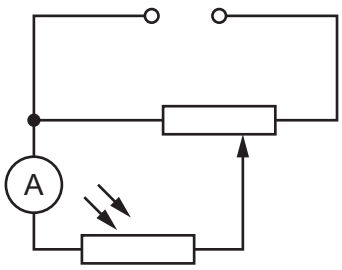
D semiconductor diode

33 The diagram shows an electrical circuit containing a light-dependent resistor (LDR).



What is the circuit diagram for this circuit?

A



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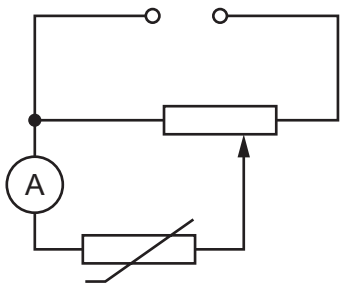

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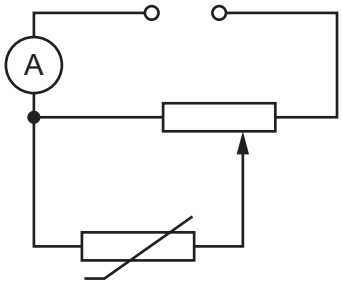

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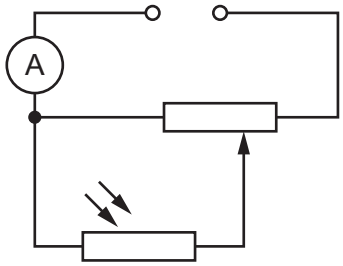


34 A copper wire of length 2 m has a circular cross-section. There is a constant current in the wire when it is connected to a mobile phone in order to charge the battery.

The wire has a fault. A 1 m length of the wire has half the diameter of the other 1 m length.

The power dissipated in the thicker length of wire is P.

What is the power dissipated in the thinner length of wire?

A $\frac{1}{4}P$ **B** $\frac{1}{2}P$ **C** $2P$ **D** $4P$

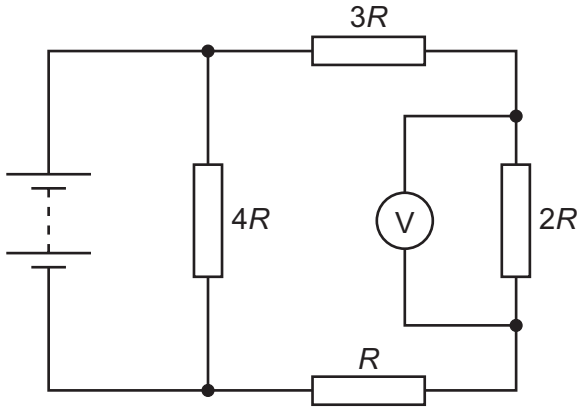
35 A wire carries a current of 5.6 A.

What is the number of conduction electrons that pass a point on the wire in a time of 20 s?

A 1.8×10^{18} **B** 2.2×10^{19} **C** 3.5×10^{19} **D** 7.0×10^{20}

36 Four resistors of resistance R, $2R$, $3R$ and $4R$ are connected to form a network.

A battery of negligible internal resistance and a voltmeter are connected to the resistor network as shown.

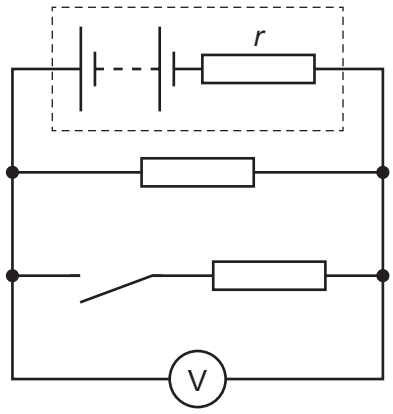


The voltmeter reading is 2 V.

What is the electromotive force (e.m.f.) of the battery?

A 2 V **B** 4 V **C** 6 V **D** 10 V

37 The circuit diagram shows a battery with internal resistance *r*, two resistors, a switch and a voltmeter. The switch is open.



The switch is now closed.

What happens to the current in the battery, and what happens to the reading on the voltmeter, when the switch is closed?

	current in battery	reading on voltmeter
A	increases	decreases
B	increases	remains the same
C	remains the same	decreases
D	remains the same	remains the same

38 What is the correct equation for β^+ decay?

A neutron $\rightarrow$ proton + electron + electron antineutrino

B neutron $\rightarrow$ proton + electron + electron neutrino

C proton $\rightarrow$ neutron + positron + electron antineutrino

D proton $\rightarrow$ neutron + positron + electron neutrino

39 A nucleus of polonium, $^{214}_{84}$Po, decays by emitting an α-particle to become a nucleus of lead.

The nucleus of lead is also unstable and decays by emitting a β^- particle to form a nucleus of bismuth which then decays by emitting a β^- particle to produce a nucleus X.

What is the number of neutrons in nucleus X?

A 126 **B** 128 **C** 130 **D** 210

40 Which combination of three quarks has no overall charge?

A down, strange, strange

B up, charm, strange

C up, charm, top

D up, down, strange

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