Catholic Junior College

JC2 Preliminary Examinations

Higher 2

CANDIDATE NAME	
CLASS	**2T**

PHYSICS

9749/01

Paper 1 Multiple Choice Questions

September 2025

1 hour

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write your name and class in the spaces at the top of this page.
Write in soft pencil.
Do not use staples, paper clips, glue or correction fluid.
Write and shade your name, NRIC / FIN number and HT group on the Answer Sheet (OMR sheet), unless this has been done for you.

There are **thirty** 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 separate Answer Sheet (OMR sheet).

Read the instructions on the Answer Sheet carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this booklet.
The use of an approved scientific calculator is expected, where appropriate.

DATA

speed of light in free space	c	=	3.00×10^{8} m s^{-1}
permeability of free space	μ_0	=	$4\pi \times 10^{-7}$ H m^{-1}
permittivity of free space	ε_0	=	8.85×10^{-12} F m^{-1}
			$(1/(36\pi)) \times 10^{-9}$ F m^{-1}
elementary charge	e	=	1.60×10^{-19} C
the Planck constant	h	=	6.63×10^{-34} J s
unified atomic mass constant	u	=	1.66×10^{-27} kg
rest mass of electron	m_e	=	9.11×10^{-31} kg
rest mass of proton	m_P	=	1.67×10^{-27} kg
molar gas constant	R	=	8.31 J K^{-1} mol^{-1}
the Avogadro constant	N_A	=	6.02×10^{23} mol^{-1}
the Boltzmann constant	k	=	1.38×10^{-23} mol^{-1}
gravitational constant	G	=	6.67×10^{-11} N m^2 kg^{-2}
acceleration of free fall	g	=	9.81 m s^{-2}

FORMULAE

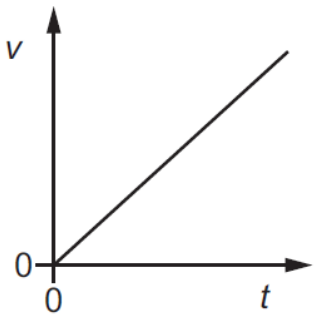
uniformly accelerated motion	s	=	$ut + \frac{1}{2}at^2$
	v^2	=	$u^2 + 2as$
work done on / by a gas	W	=	$p\,\Delta V$
hydrostatic pressure	p	=	ρgh
gravitational potential	ϕ	=	$-\frac{Gm}{r}$
temperature	T / K	=	$T / {}^{\circ}C + 273.15$
pressure of an ideal gas	p	=	$\frac{1}{3}\frac{Nm}{V}\langle c^2 \rangle$
mean translational kinetic energy of an ideal gas molecule	E	=	$\frac{3}{2}kT$
displacement of particle in s.h.m.	x	=	$x_0 \sin \omega t$
velocity of particle in s.h.m.	v	=	$v_0 \cos \omega t$
		=	$\pm \omega\sqrt{x_0^{\,2} - x^2}$
electric current	I	=	$Anvq$
resistors in series	R	=	$R_1 + R_2 + \ldots$
resistors in parallel	$1/R$	=	$1/R_1 + 1/R_2 + \ldots$
electric potential	V	=	$\frac{Q}{4\pi\varepsilon_o r}$
alternating current / voltage	x	=	$x_0 \sin \omega t$
magnetic flux density due to a long straight wire	B	=	$\frac{\mu_o I}{2\pi d}$
magnetic flux density due to a flat circular coil	B	=	$\frac{\mu_o N I}{2r}$
magnetic flux density due to a long solenoid	B	=	$\mu_o n I$
radioactive decay	x	=	$x_0 \exp(-\lambda t)$
decay constant	λ	=	$\frac{\ln 2}{t_{\frac{1}{2}}}$

1 Which length is equal to 1 dm?

A 1×10^0 mm **B** 1×10^1 mm **C** 1×10^0 cm **D** 1×10^1 cm

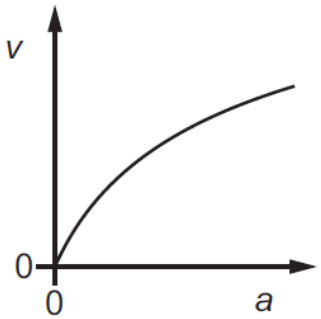
2 A particle accelerates from rest.

The graph shows the variation of the velocity v of the particle with time t.

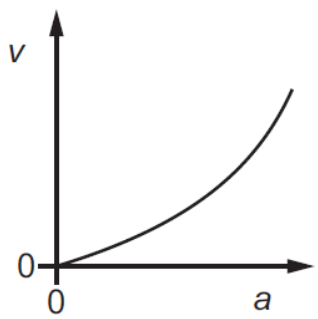


Which graph shows the variation of the velocity v with the acceleration a of the particle?

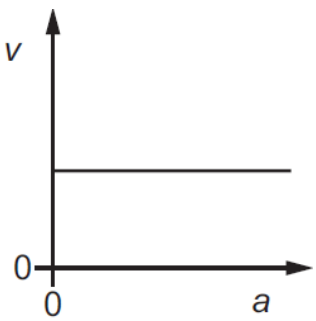
A



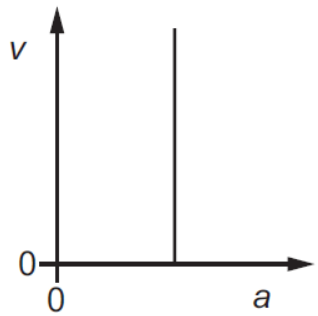
B



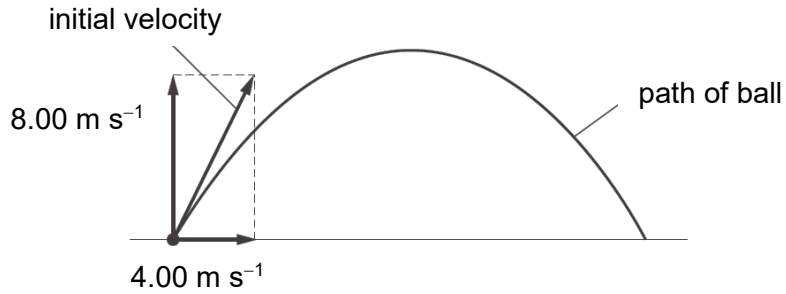
C



D



3 An astronaut on the Moon, where there is no air resistance, throws a ball. The ball's initial velocity has a vertical component of 8.00 m s^{-1} and a horizontal component of 4.00 m s^{-1}, as shown.

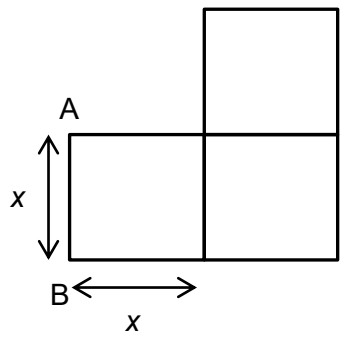


The acceleration of free fall on the Moon is 1.62 m s^{-2}.

What will be the speed of the ball 9.00 s after being thrown?

A 6.60 m s^{-1} **B** 7.70 m s^{-1} **C** 10.6 m s^{-1} **D** 14.6 m s^{-1}

4 A uniform square metal sheet of length *x* is cut into an 'L' shape.



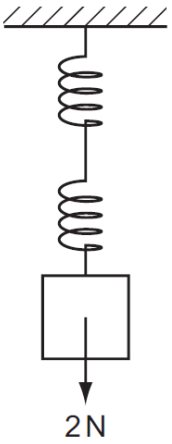
What is the distance of the centre of gravity of the sheet of metal from side AB?

A 1.0 *x* **B** 1.2 *x* **C** 1.5 *x* **D** 1.8 *x*

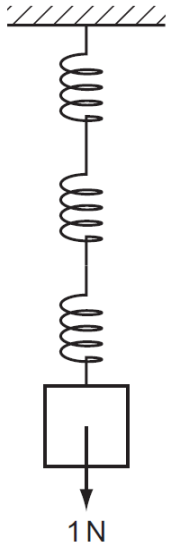
5 Several identical springs, each having the same spring constant, are joined in four arrangements. A different load is applied to each arrangement.

Which arrangement has the largest extension?

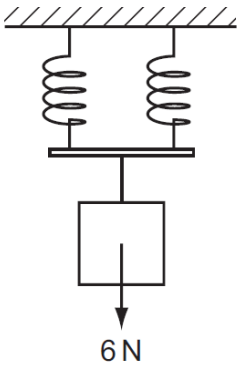
A



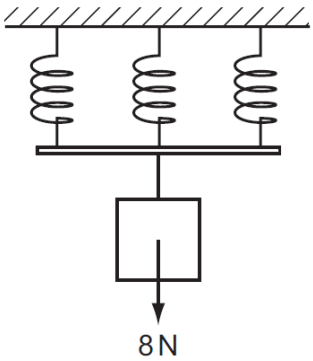
B



C



D



6 The energy conversions inside a power station burning fossil fuel can be simplified as shown.

chemical energy W ➤ thermal energy X ➤ electrical energy Y

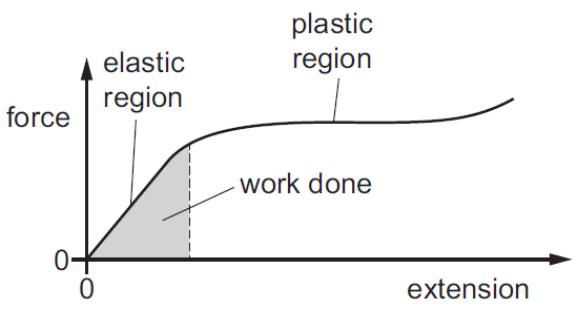
Which expression gives the efficiency of the power station?

A $\frac{Y}{W}$ **B** $\frac{Y}{(W+X)}$ **C** $\frac{Y}{X}$ **D** $\frac{Y}{(W+X+Y)}$

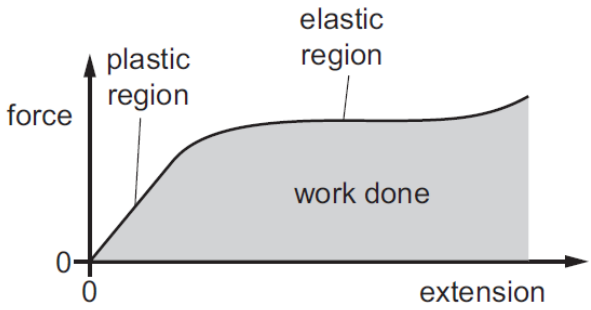
7 A metal wire is stretched to breaking point and the force–extension graph is plotted.

Which graph is correctly labelled with the elastic region, the plastic region and the area representing the work done to stretch the wire until it breaks?

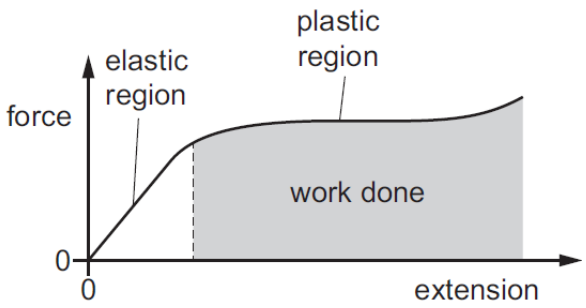
A



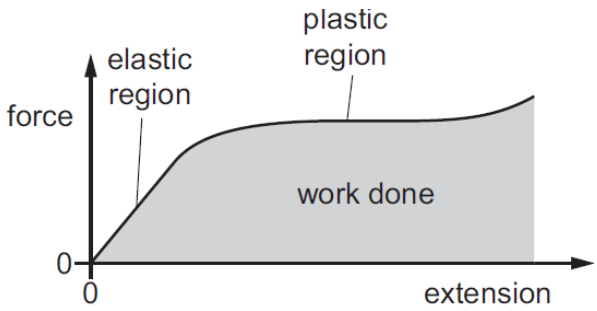
B



C



D



8 The Earth takes 24 hours to complete one rotation on its axis.

What is the angular velocity of the Earth as it rotates on its axis?

A 1.75×10^{-3} rad s^{-1}

B 1.99×10^{-7} rad s^{-1}

C 4.36×10^{-3} rad s^{-1}

D 7.27×10^{-5} rad s^{-1}

9 A stone is attached to a string. The stone is then caused to swing in a vertical circular motion at a constant speed.

Which of the following statements is **incorrect**?

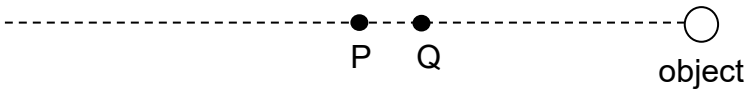
A The magnitude of resultant force acting on the stone is constant throughout the circular motion.

B The acceleration is always directed towards the centre of the circle throughout the circular motion.

C The kinetic energy of the stone is constant throughout the circular motion.

D The tension in the string when the stone is at the highest point of the circular motion is higher than that when the stone is at the lowest point.

10 Two points P and Q are located a fixed distance apart on a straight line joining them to an object considered as a point mass.



The two points P and Q are moved closer to the point mass, while keeping the separation between them constant.

What happens to the magnitudes of their individual gravitational potentials and to the magnitude of the gravitational field strength between the two points?

	magnitudes of gravitational potentials	magnitudes of gravitational field strength difference
A	both decrease	decreases
B	both decrease	increases
C	both increase	stays the same
D	both increase	increases

11 A gas molecule of mass m moves with velocity v and collides elastically with a wall perpendicular to that direction.

If the molecule makes N such collisions per second with the wall, what is the average force F exerted by the molecule on the wall?

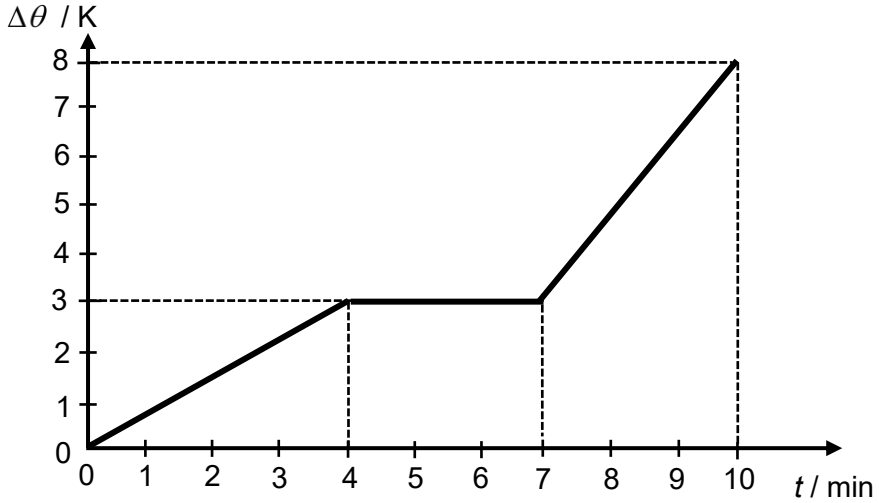
A $F = mvN$ **B** $F = 2mvN$ **C** $F = \frac{mv^2}{2}$ **D** $F = \frac{mv}{N}$

12 A piece of metal of mass *m*, specific heat capacity *c* and temperature 20 ^{0}C is placed into a liquid of temperature 100 ^{0}C. The liquid, which is in a well-insulated container, has mass 3*m* and specific heat capacity 2.5*c*.

What is the temperature of the liquid when thermal equilibrium is reached?

A 56 ^{0}C **B** 60 ^{0}C **C** 85 ^{0}C **D** 91 ^{0}C

13 The graph shows the variation with time *t* of temperature change $\Delta\theta$ for 1 kg of a substance, initially solid at room temperature. The substance receives heat at a uniform rate of 2000 J min^{-1}.



What can be deduced from this graph?

A The specific heat capacity of the substance is greater when liquid than when solid.

B The specific latent heat of fusion of the substance is 6000 J kg^{-1}.

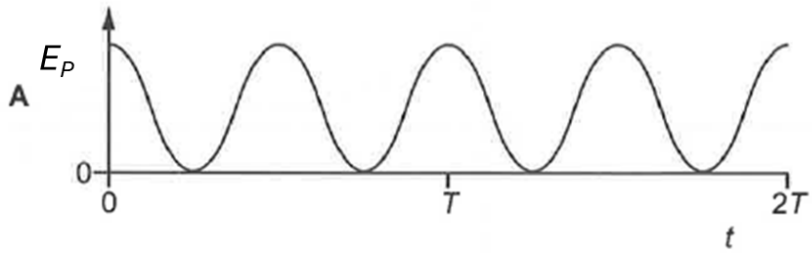
C The substance melts at a temperature of 3 K.

D After 10 min, the substance is all gaseous.

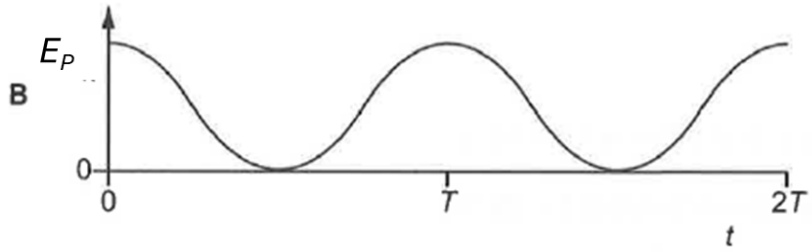
14 A small pendulum bob is displaced to one side and released from rest at time $t = 0$. The bob then swings with simple harmonic motion with period T.

Which graph represents the variation with time t of the gravitational potential energy E_P?

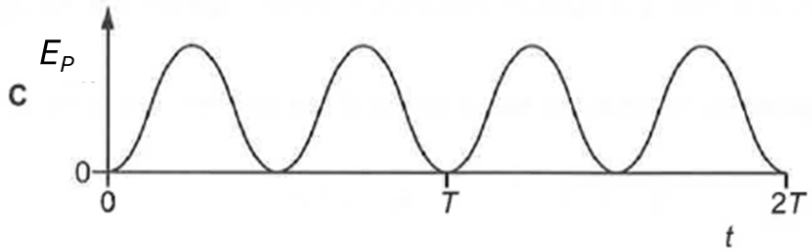
A



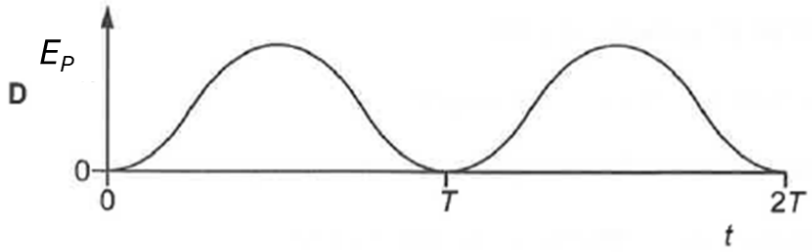
B



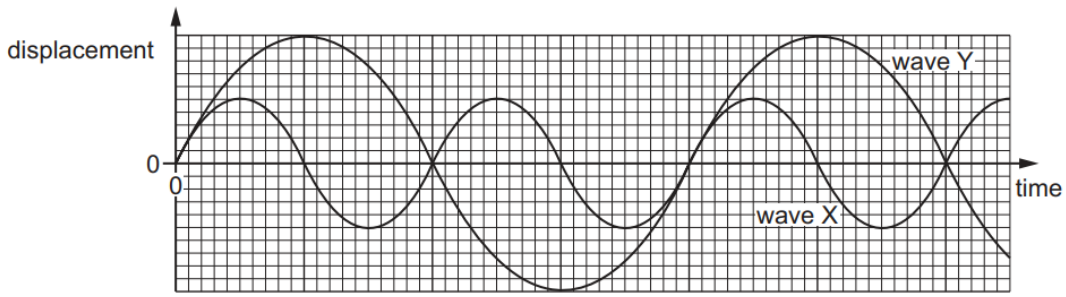
C



D



15 The graph shows the variation with time of displacement for two transverse waves X and Y travelling through the same medium. For such mechanical waves, intensity is proportional to the square of frequency.



Wave X has frequency f and intensity I.

What is the frequency and intensity of wave Y?

	frequency	intensity
A	$\frac{f}{2}$	$4I$
B	$\frac{f}{2}$	I
C	$2f$	I
D	$2f$	$4I$

16 Two polarising filters are placed next to each other so that their planes are parallel. The first polarising filter has its transmission axis at an angle of 50° to the vertical.

The second polarising filter has its transmission axis at an angle of 20° to the vertical. The angle between the transmission axes of the two polarising filters is 30°.

A beam of vertically polarised light of intensity 8.0 W m^{-2} is incident normally on the first polarising filter.

What is the intensity of the light that is transmitted from the second polarising filter?

A zero **B** 2.5 W m^{-2} **C** 2.9 W m^{-2} **D** 6.0 W m^{-2}

17 Which of the following is **not** an application of the Rayleigh criterion?

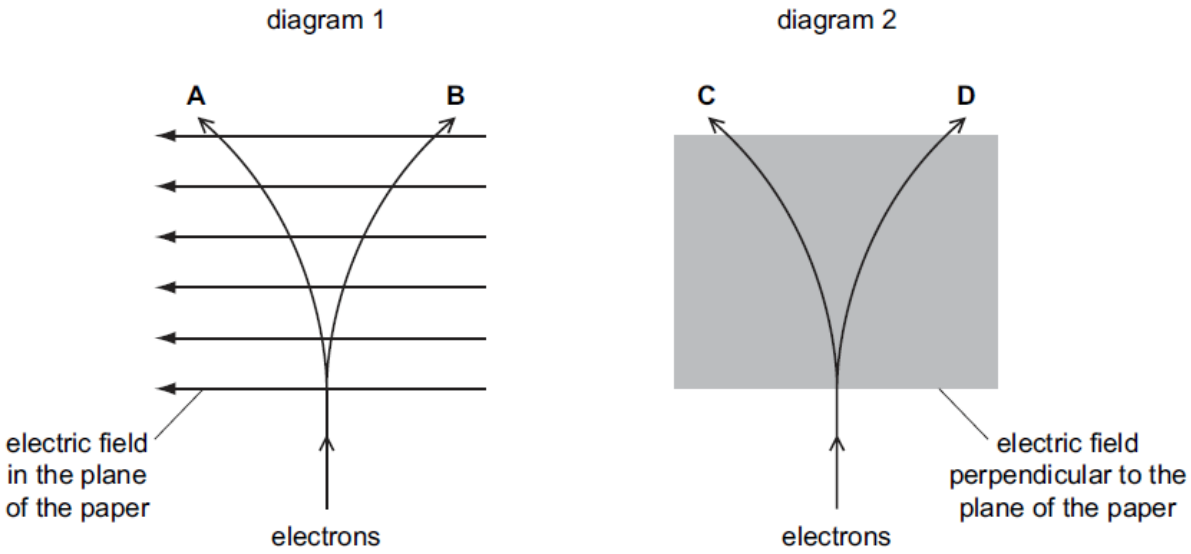
A Assessing the resolving power of a telescope or microscope.
B Calculating the minimum angular separation between two point sources to distinguish them.
C Determining the angular position of the first minima in single slit diffraction.
D Predicting whether two stars appear distinct in astronomical observations.

18 A beam of electrons is directed into an electric field and is deflected by it.

Diagram 1 represents an electric field in the plane of the paper. Diagram 2 represents an electric field directed perpendicular to the plane of the paper.

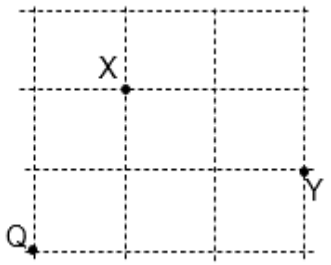
The lines A, B, C and D represent possible paths of the electron beam. All paths are in the plane of the paper.

Which line best represents the path of the electrons inside the field?



19 An isolated point charge is placed at point Q. The electric potential at point X is measured to be 720 V.

The relative positions of the three points Q, X, and Y are shown on the grid of squares below.



If the electric potential at X is 720 V, what is the electric potential at Y?

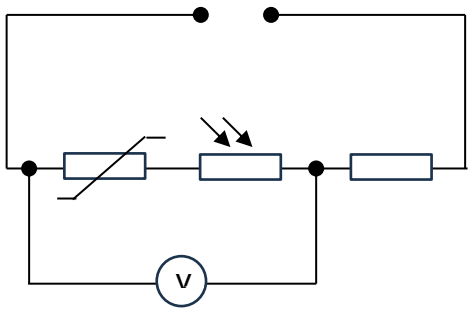
A 509 V **B** 581 V **C** 720 V **D** 936 V

20 A cylindrical piece of wire has resistance R. It is stretched uniformly so that its length becomes three times longer, but its volume remains constant.

What is its new resistance in terms of R?

A $\frac{R}{3}$ **B** R **C** $3R$ **D** $9R$

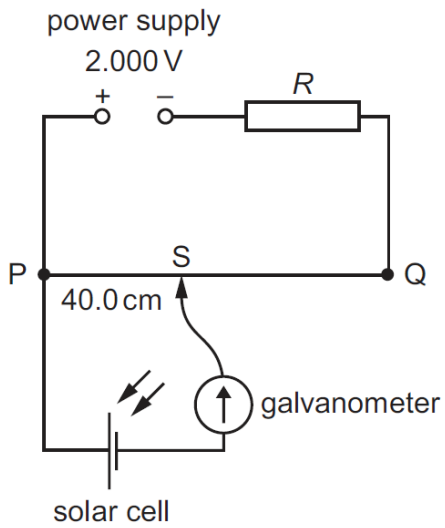
21 A negative temperature coefficient thermistor, an LDR and a fixed resistor are connected in series to a power supply. A voltmeter is placed across the thermistor-LDR combination.



Which conditions of brightness and temperature will produce the smallest reading on the voltmeter?

	temperature	brightness
A	high	high
B	high	low
C	low	high
D	low	low

22 A power supply and a solar cell are compared using the potentiometer circuit shown.



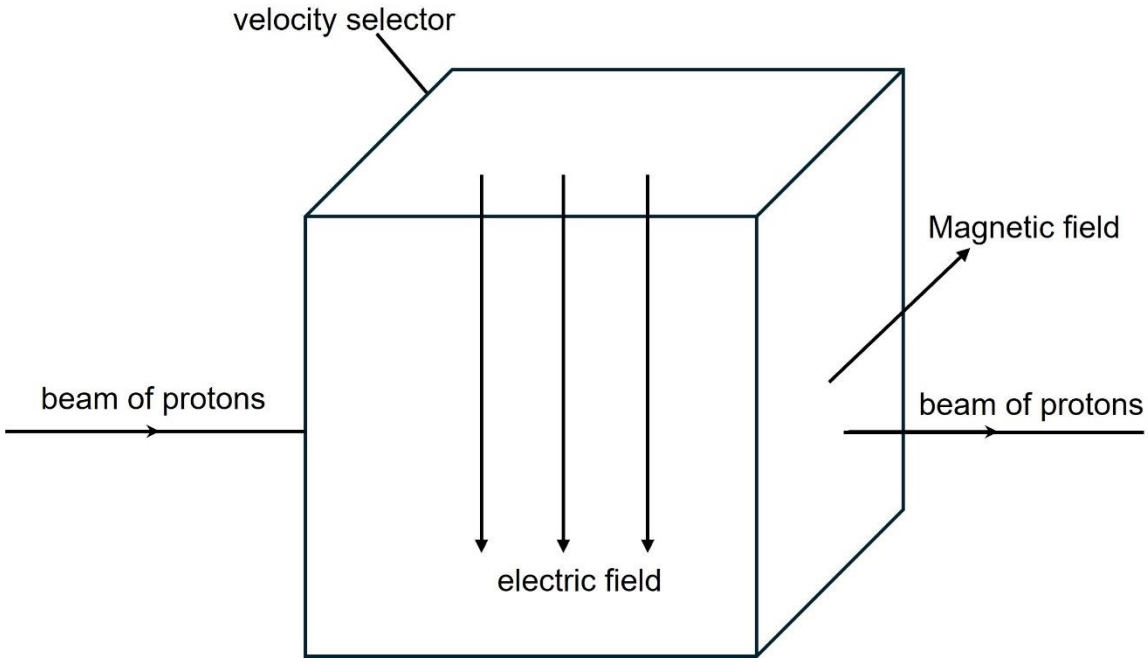
The potentiometer wire PQ is 100.0 cm long and has a resistance of 5.00 Ω. The power supply has an e.m.f. of 2.000 V and the solar cell has an e.m.f. of 5.00 mV.

When the galvanometer shows zero deflection, the balance length PS is found to be 40.0 cm.

What is the resistance of *R* so that the galvanometer reads zero at this balance length?

A 395 Ω **B** 795 Ω **C** 995 Ω **D** 1055 Ω

23 A beam of protons enters a velocity selector as shown. The electric field *E* acts vertically downwards, and the magnetic field *B* is directed into the page.



If only protons with a particular speed emerge undeflected, which change would result in the protons being deflected downwards?

A Increasing the electric field strength only

B Increasing the magnetic field strength only

C Increasing both *E* and *B* by the same factor

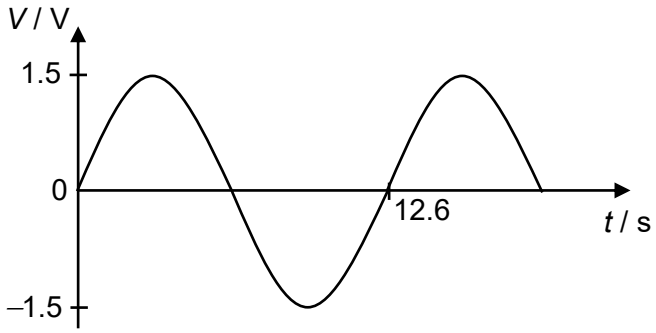
D Increasing the proton's speed

24 A rectangular coil of wire lies in a uniform magnetic field of 0.30 T. The field is perpendicular to the plane of the coil. The coil is stretched from dimensions 0.20 m × 0.50 m to 0.20 m × 0.80 m in 2.0 seconds.

What is the average emf induced in the coil during this time?

A 0.009 V **B** 0.018 V **C** 0.027 V **D** 0.036 V

25 The variation of an alternating voltage V with time t is shown in the graph below.



Which expression best represents V in terms of t ?

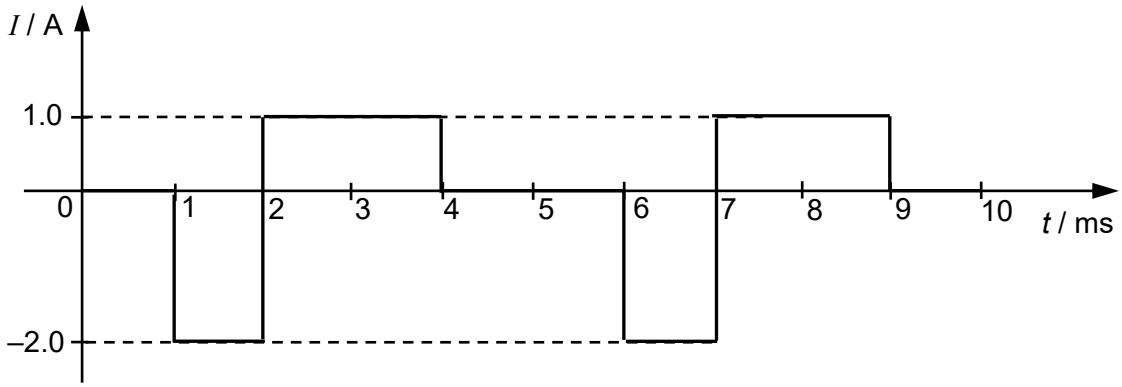
A $V = 1.5\sin(0.499t)$

B $V = 1.5\sin(2.01t)$

C $V = 3.0\sin(0.249t)$

D $V = 1.5\sin(12.6t)$

26 An alternating current with a rectangular waveform as shown in the diagram below flows through a 10 Ω resistor.



What is the average power dissipated by the resistor?

A 0 W **B** 8 W **C** 12 W **D** 28 W

27 A photon of light has frequency f, momentum p, and speed c. The Planck constant is h.

Which expressions for the momentum and the energy of the photon are correct?

	momentum	energy
A	hf	pc
B	hf	$\frac{pc}{2}$
C	$\frac{hf}{c}$	pc
D	$\frac{hf}{c}$	$\frac{pc}{2}$

28 An electron in an atom transitions from –25.0 eV to –80.0 eV. A photon is emitted in the process.

What is the wavelength of the emitted photon?

A 15.5 nm **B** 22.6 nm **C** 49.7 nm **D** 300 nm

29 Which of the following best describes the Heisenberg's uncertainty principle?

A The uncertainty principle applies only to microscopic particles like electrons.

B The uncertainty principle only applies to particles moving close to the speed of light.

C The product of the uncertainties in position and momentum of a particle has a minimum value.

D It is possible to reduce the uncertainty in both position and momentum of a particle to zero with advanced measuring techniques.

30 Thorium-232 undergoes the following fission reaction:

$$^{232}_{90}\text{Th} \rightarrow {}^{140}_{54}\text{Xe} + {}^{90}_{36}\text{Kr} + 2\,{}^{1}_{0}\text{n}$$

The binding energy per nucleon for the nuclei involved are:

Thorium-232: 7.6 MeV
Xenon-140: 8.3 MeV
Krypton-90: 8.5 MeV

What is the energy released by this fission reaction?

A 1.64×10^{8} J **B** 2.63×10^{-11} J **C** 1.47×10^{-12} J **D** 2.63×10^{-17} J

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