NAME _____ CLASS 2T

Catholic Junior College

JC2 Preliminary Examinations

Higher 2

PHYSICS 9749/1

Paper 1: Multiple Choice Questions **16 September 2022**

1 hour

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write your name and tutorial group on this cover 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.

This document consists of **20** printed pages and **2** blank pages.

[Turn over

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}

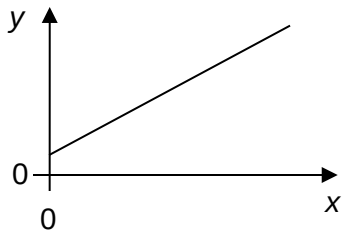
Formulae

uniformly accelerated motion	$s = u\,t + \frac{1}{2}\,a\,t^2$ $v^2 = u^2 + 2as$
work done on / by a gas	$W = p\,\Delta V$
hydrostatic pressure	$p = \rho g h$
gravitational potential	$\phi = -\frac{Gm}{r}$
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	$\lambda = \frac{\ln 2}{t_{\frac{1}{2}}}$

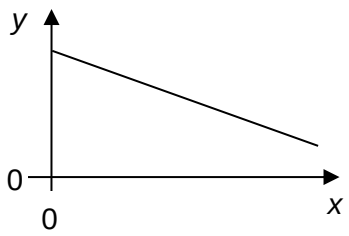
1 In an experiment, the perpendicular distance of a point from a long straight conductor carrying a constant current is measured and the perpendicular distance is used to calculate the magnetic flux density due to the long straight current-carrying conductor at that point. The experiment is repeated for a few points.

Which graph shows how the percentage uncertainty in the magnetic flux density of the long straight current-carrying conductor, *y*, varies with the percentage uncertainty in the perpendicular distance from the conductor, *x*?

A



B



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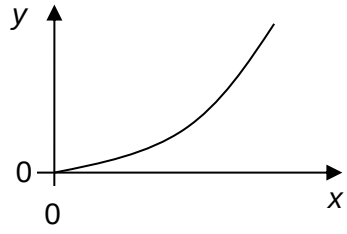
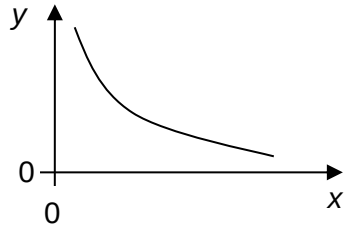
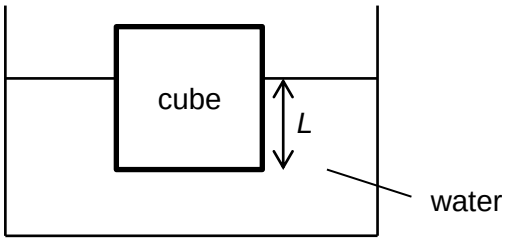


D



2 A cube of side 5.0 cm is floating on a tank of water as shown in the figure below. The density of the cube is 450 kg m^{-3} and the density of water is 1000 kg m^{-3}.



What is the submerged depth *L* of the cube?

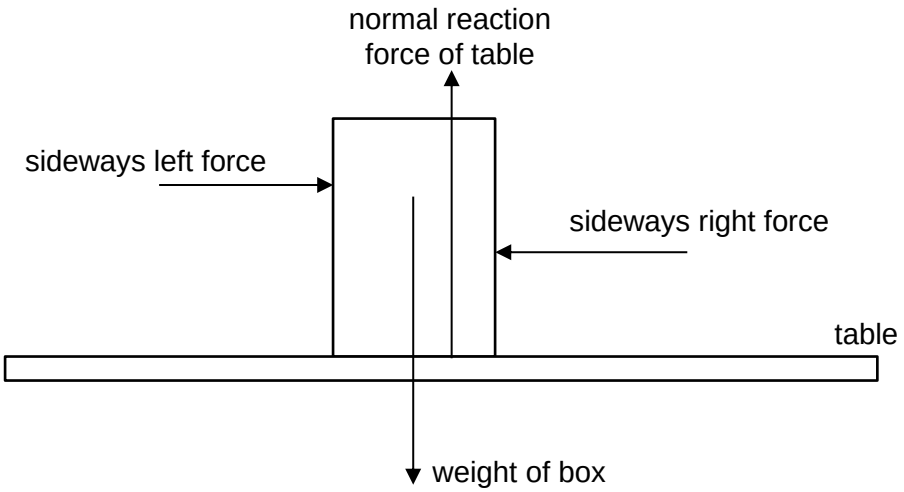
A 2.3 cm **B** 2.8 cm **C** 4.0 cm **D** 4.5 cm

3 Water is ejected from the nozzle of a hose at a speed of 2.0 m s^{-1}. The density of water is 1000 kg m^{-3} and the diameter of the nozzle is 0.50 cm.

What is the force exerted on the nozzle by the ejected water?

A 0.039 N **B** 0.079 N **C** 0.31 N **D** 7.9 N

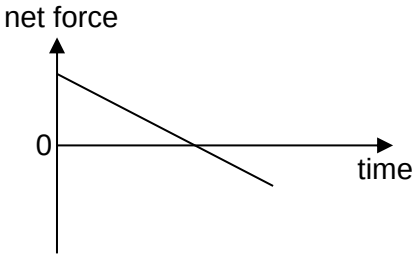
4 A box resting on a table has two vertical and two horizontal forces acting on it as shown in the diagram below. The box is in equilibrium.



Which statement about the forces is **not** correct?

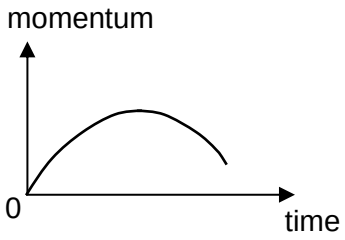
A The sideways left force is equal and opposite to the sideways right force on the box.
B The resultant of all the four forces is zero.
C The torque provided by the vertical forces is equal to the torque provided by the horizontal forces.
D The normal reactional force from the table is equal and opposite to the weight of the box.

5 A vehicle starts from rest and a net force acts on it. The figure below shows how the net force varies with time.

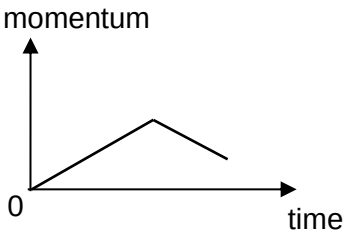


Which graph shows how the momentum of the vehicle varies with time?

A



B



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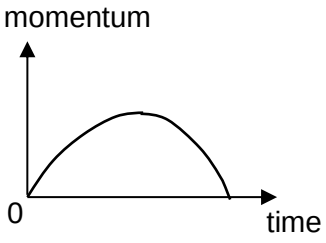

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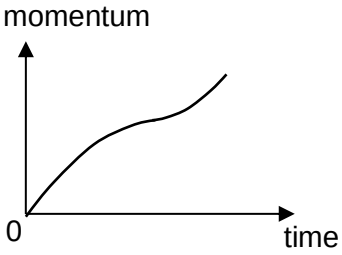
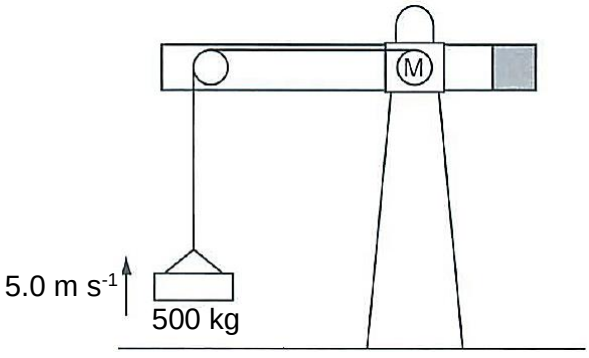


6 The motor M in a crane is used to lift a load of 500 kg vertically upwards at a constant speed of 5.0 m s^{-1}. During the lifting of the load, energy is supplied to motor M at a constant rate of 3.0×10^4 J s^{-1}.



Which of the following statement is **not** correct?

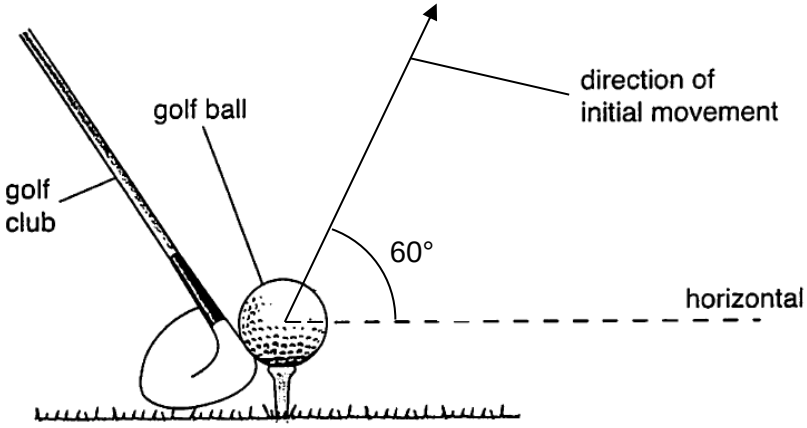
A The efficiency of motor M is 82%.

B The kinetic energy of the load is 6.3 kJ.

C The work done on the load by gravity is positive during the lifting of the load.

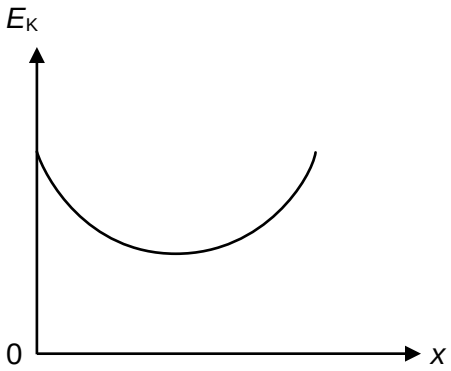
D The rate of gravitational potential energy gained by the load is about 2.5×10^4 W.

7 A golf ball, on level ground, is hit and starts to move at an angle of 60° to the horizontal.

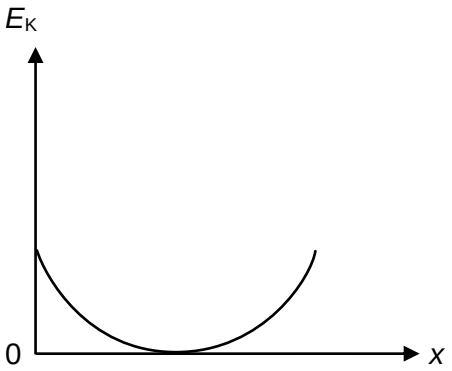


Which graph best represents the variation with horizontal distance x of the kinetic energy E_K of the golf ball? Ignore any effects of air resistance.

A



B



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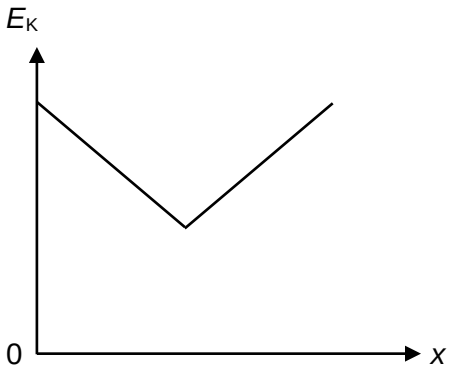

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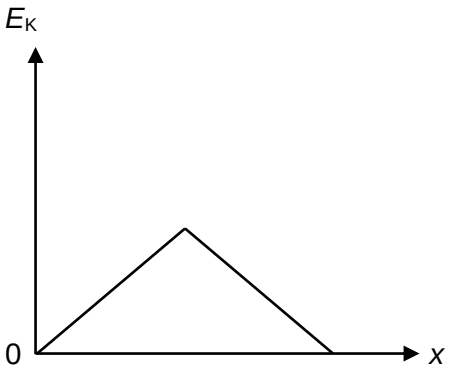
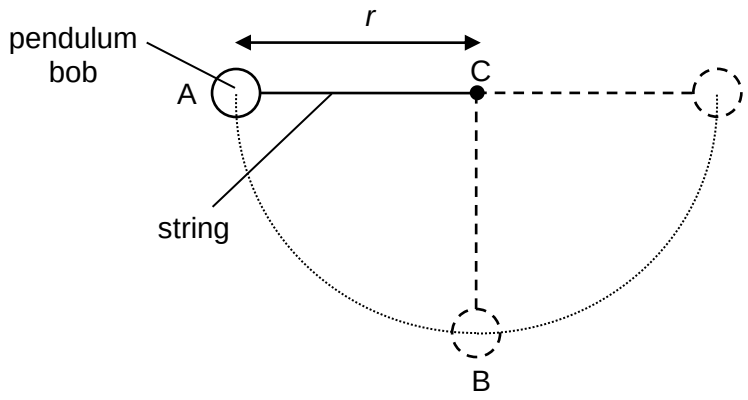


8 A body of mass m moves in a horizontal circle of radius r at constant angular speed ω.

What is the work done on the body by the centripetal force in one revolution?

A zero **B** $mr^2\omega^2$ **C** $2mr^3\omega$ **D** $4mr^2\omega^3$

9 A pendulum bob of mass 0.100 kg is supported by a string and swung along a circular path of radius r about the fixed point C. The bob is momentarily at rest at point A, with the string horizontal and just taut.



What is the tension in the string when the bob is at point B which is vertically below point C?

A 0.981 N **B** 1.96 N **C** 2.94 N **D** 3.92 N

10 At a point on the surface of a uniform sphere of diameter d, the gravitational field strength due to the sphere is X.

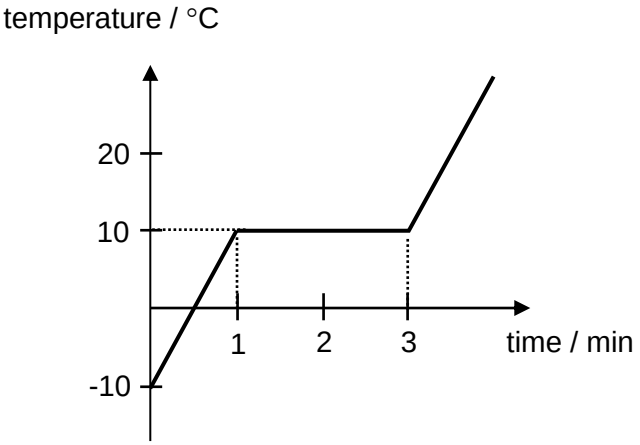
What would be the gravitational field strength on the surface of a uniform sphere of the same density but of diameter $3d$?

A $2X$ **B** $3X$ **C** $5X$ **D** $8X$

11 Which of the following statement about a geostationary satellite around Earth is true?

A Its linear speed is equal to the speed of a point on the Earth's equator.
B It experiences zero net force as it orbits around Earth.
C It moves from East to West.
D It must remain directly above the equator.

12 A student heats a 500 g solid sample at an initial temperature of -10°C. The rate of heat absorbed by the sample is constant at 200 W. The graph below shows how the temperature of the sample varies with time.



What is the specific latent heat of fusion of the solid sample?

A 12 kJ kg^{-1} **B** 18 kJ kg^{-1} **C** 36 kJ kg^{-1} **D** 48 kJ kg^{-1}

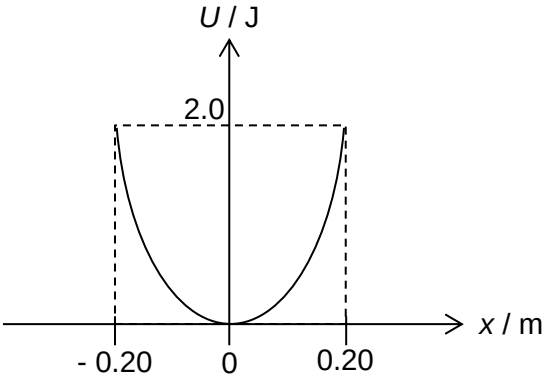
13 The density of argon gas at a pressure of 1.00×10^5 Pa is 1.60 kg m^{-3}.

What is the root-mean-square speed of the argon molecules?

A 216 m s^{-1} **B** 250 m s^{-1} **C** 306 m s^{-1} **D** 433 m s^{-1}

14 A particle of mass 5.0 kg is moving in simple harmonic motion.

The variation of the potential energy U with the displacement from the equilibrium position x is as shown in the figure below.



What is the period of oscillation of the particle?

A 0.89 s **B** 1.4 s **C** 2.2 s **D** 2.8 s

15 A sound wave propagates from left to right through a gas.

Fig. 15(a) shows the positions of some gas molecules at a particular instant of time.
Fig. 15(b) shows the variation with time *t* of the displacement *s* of one of these particles.

The distance between particles P and Q is 0.26 m.

Fig. 15(a)

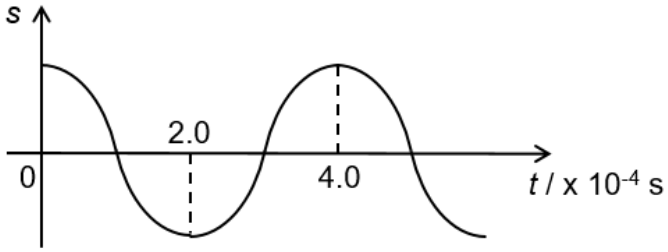


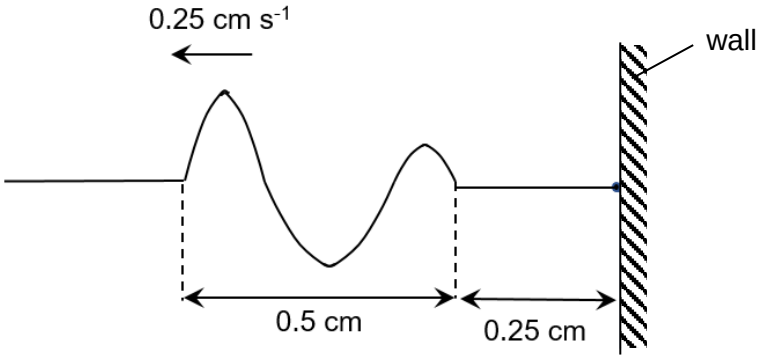
Fig. 15(b)

What is the speed of sound in this gas?

A 300 m s^{-1} **B** 330 m s^{-1} **C** 380 m s^{-1} **D** 660 m s^{-1}

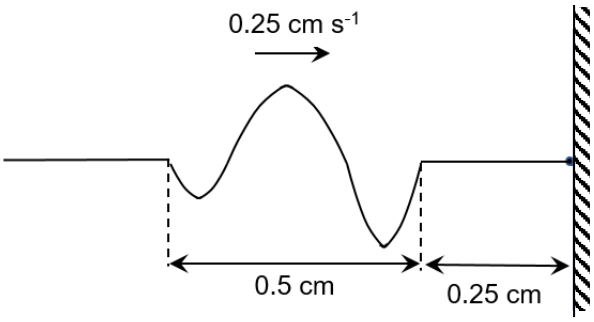
16 A rope is rigidly fixed to a wall. A wave pulse of length 0.5 cm moves at a constant speed of 0.25 cm s^{-1} along the rope towards the wall and is reflected back.

The figure below shows the waveform at time t = 4 s.

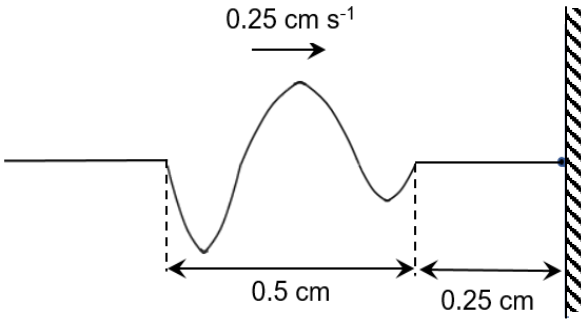


Which of the following correctly shows the waveform at t = 0 s?

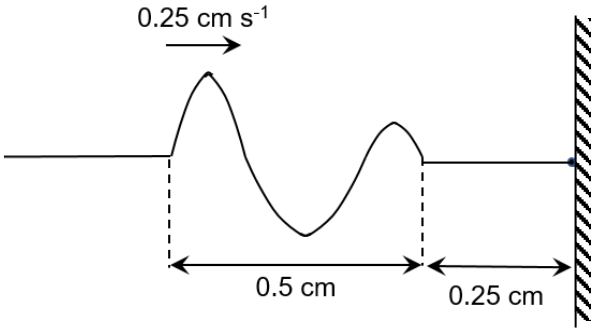
A



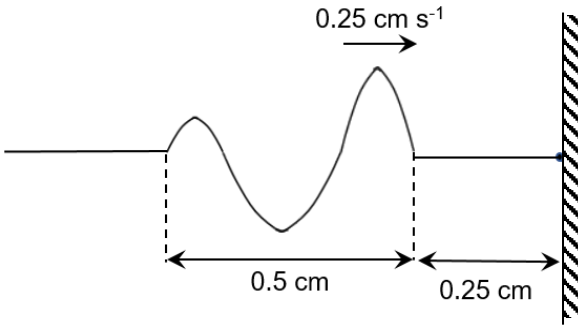
B



C

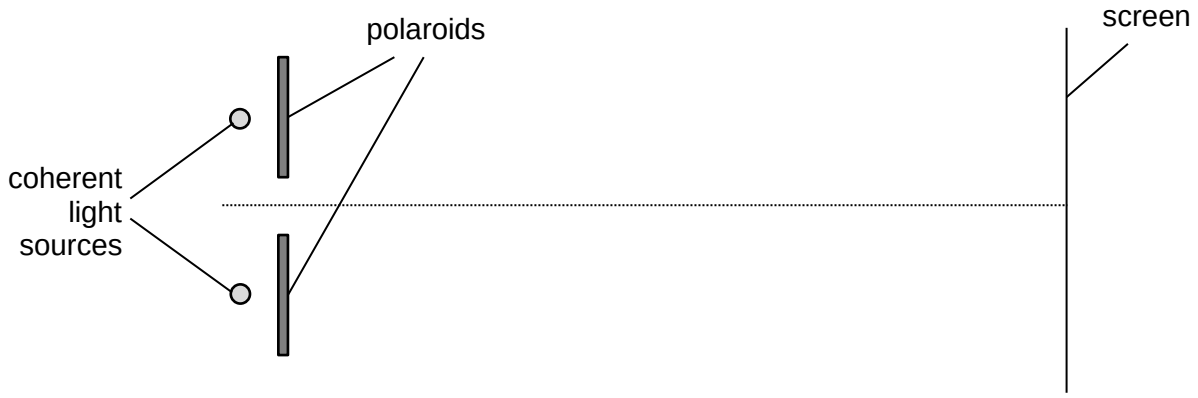


D



17 Light is polarised when it passes through a sheet of material known as polaroid.

Two sources producing coherent light waves are placed at an equal distance away from an observation screen. Each source was covered with a polaroid.



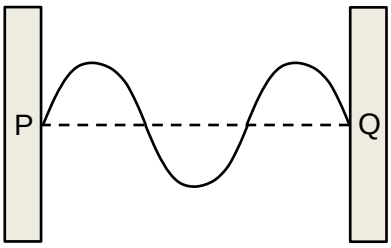
Initially, both polaroids had their transmission axes in the same direction. The intensity of the central maximum fringe formed from the interference of the two light waves was measured to be I.

One of the polaroids is rotated by 60°.

What is the new intensity of the central maximum fringe?

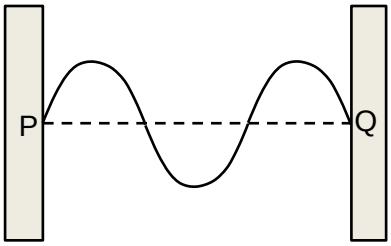
A $\frac{1}{2}I$ **B** $\frac{9}{16}I$ **C** $\frac{3}{2}I$ **D** $\frac{9}{4}I$

18 The diagram shows a stationary wave of frequency 50 Hz formed between two points P and Q at a time $t = 0$.

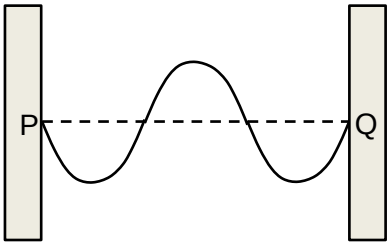


Which of the diagrams correctly shows a possible position of the string at a time $t = 0.010$ s?

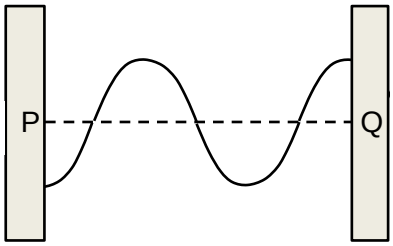
A



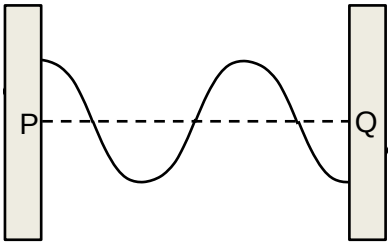
B



C



D



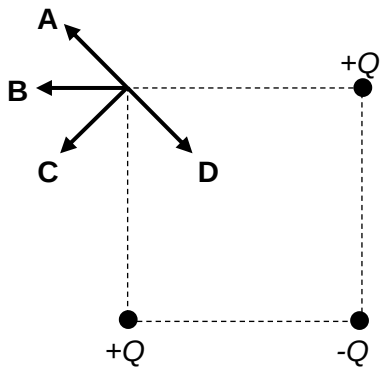
19 In a spectrometer experiment, light of wavelength 400 nm is incident normally on a diffraction grating having 400 lines per millimeters.

What is the angle of diffraction of the third order diffracted beam?

A 13.9° **B** 18.7° **C** 28.7° **D** 56.1°

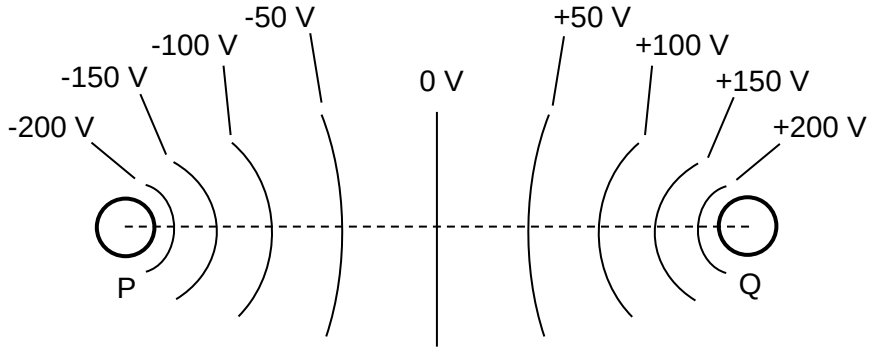
20 Three point charges, each of magnitude Q, are placed at the three corners of a square as shown in the diagram.

What is the direction of the resultant electric field at the fourth corner?



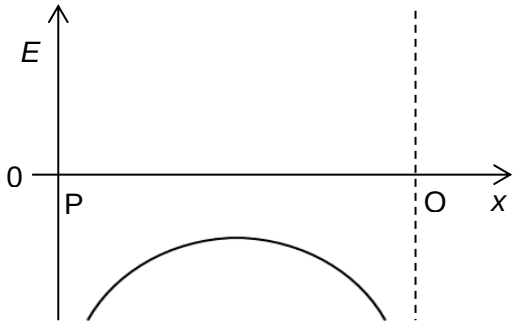
21 A charged object is placed at point P and another charged object is placed at point Q.

The diagram shows a number of solid lines along which the electric potential has a constant value.

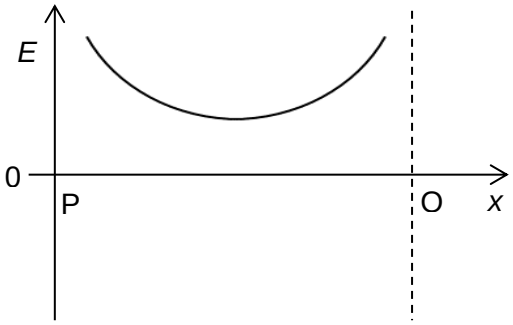


Taking vectors to the right as positive, which graph shows the variation with distance *x* along the line PQ of the electric field strength *E*?

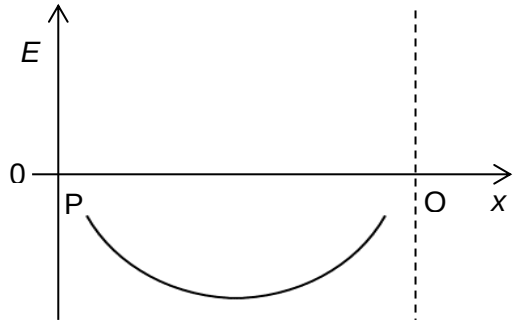
A



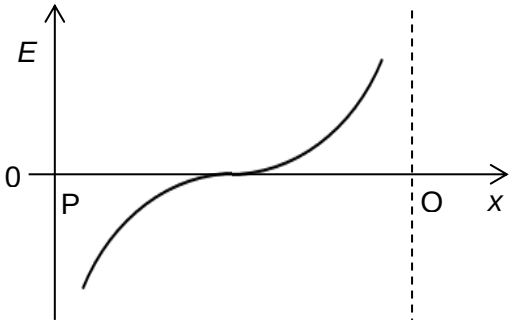
B



C



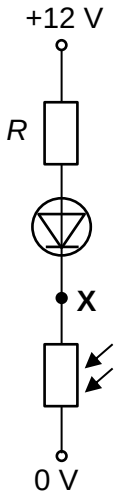
D



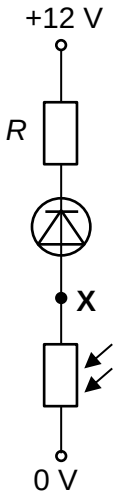
22 In bright light, a light-dependent resistor (LDR) has a resistance of *R*. It is connected in series with an ideal diode and a fixed resistor of resistance *R*. An ideal diode has zero resistance in the forward direction and infinite resistance in the reverse direction.

In which arrangement will the potential at **X** increase when the circuit is moved to a darker environment?

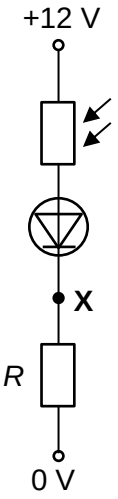
A



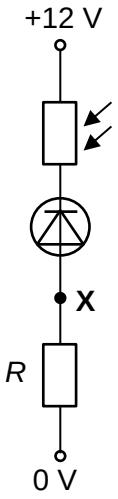
B



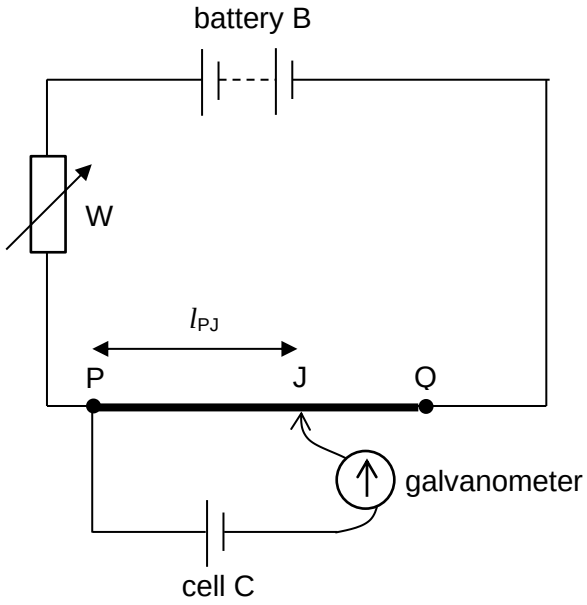
C



D



23 A battery B, a variable resistor W and a uniform resistance wire PQ are connected in series. A cell C and a galvanometer are connected to the wire PQ with a contact J as shown.

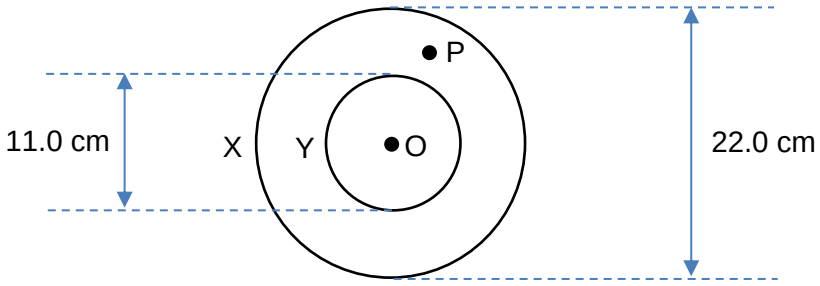


The contact J is moved along wire PQ until the galvanometer reads zero. The distance of J from P, l_{PJ} is then measured.

Which of the following changes will increase the measured distance l_{PJ}?

A Removing W from the circuit.
B Adjusting W to a higher resistance.
C Connecting a resistor parallel to the galvanometer.
D Replacing wire PQ with another wire of similar length and resistivity but smaller diameter.

24 X and Y are two coaxial flat circular coils lying on a table. Coil X has 120 turns and a diameter of 22.0 cm. Coil Y has 80 turns and a diameter of 11.0 cm. O and P are two points on the table, and O is at the centre of the two coils.



Initially, there is a constant current of 1.2 A in coil X and no current in coil Y.

A current of 1.2 A is now passed through coil Y, which increases the magnitude of the magnetic flux density at P.

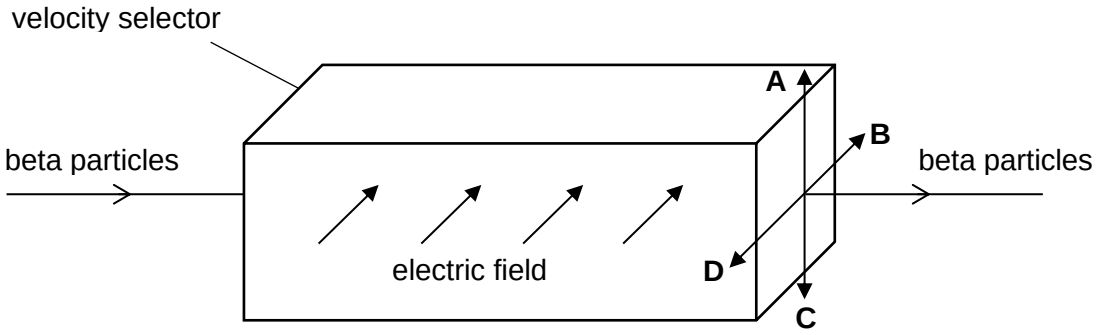
What is the final magnitude of the resultant magnetic flux density at O?

A 0.14 mT **B** 0.27 mT **C** 0.96 mT **D** 1.9 mT

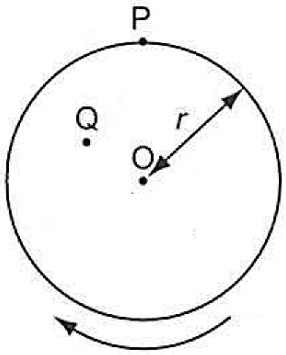
25 A beam of beta particles enters a velocity selector. An electric field is applied in a horizontal direction, perpendicular to the beam of beta particles, as shown in the diagram below.

A magnetic field is applied perpendicular to the beam such that beta particles of a particular speed leave the selector undeflected.

In which direction is the magnetic field?



26 A copper disc of radius *r* rotates about its centre O at a constant speed. It is placed in a uniform magnetic field perpendicular to its surface. P is a point on the rim of the disc, while Q is a point at distance $\frac{r}{2}$ from O.

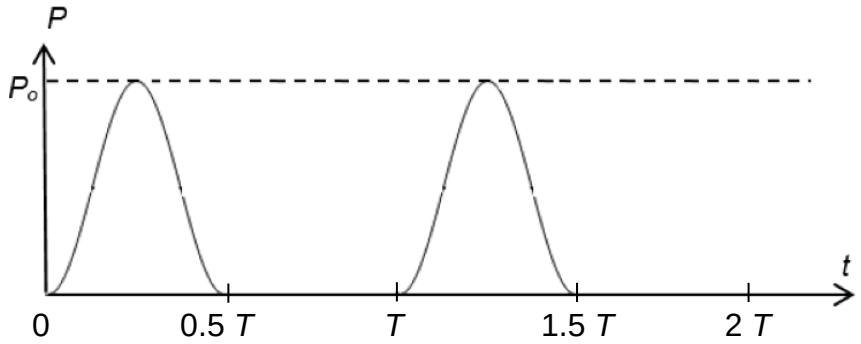


A steady electromotive force (e.m.f.) *E* is generated between points O and P.

What is the e.m.f. generated between points P and Q?

A zero **B** ¼ *E* **C** ½ *E* **D** ¾ *E*

27 A half-wave rectified sinusoidal alternating current flows through a light bulb. The graph shows the variation of the power dissipated in the light bulb with time t, where T is the period of the current.



What is the average power consumption of the light bulb?

A 0.25 P_o **B** 0.40 P_o **C** 0.50 P_o **D** 0.70 P_o

28 To observe diffraction rings by a carbon film, a beam of electrons is accelerated from rest across a potential difference of V so that the de Broglie wavelength of the electrons is 0.10 nm.

What is the value of V?

A 90 V **B** 150 V **C** 270 V **D** 330 V

29 At time t, a sample of a radioactive substance contains N atoms of a particular nuclide. At time $(t + \Delta t)$, where Δt is a short period of time, the number of atoms of the nuclide is $(N - \Delta N)$.

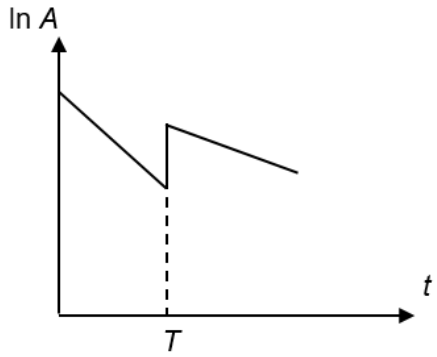
Which expression is equal to the decay constant of the nuclide?

A $\frac{N\Delta N}{\Delta t}$ **B** $\frac{\Delta N}{N\Delta t}$ **C** $\frac{\Delta N}{\Delta t}$ **D** $\frac{\Delta N}{N}$

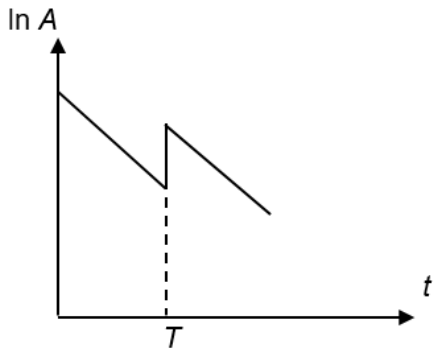
30 At time $t = 0$, some radioactive gas is injected into a sealed vessel. At time T, a different radioactive gas with a half-life very much shorter than the first is injected into the same vessel.

Which one of the following graphs best represents how activity A varies with t?

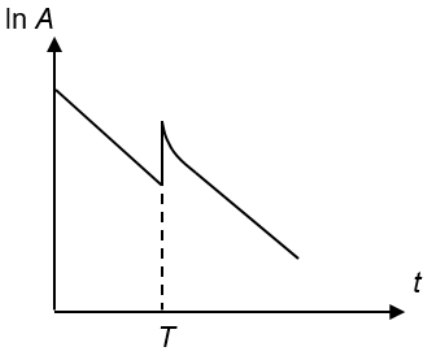
A



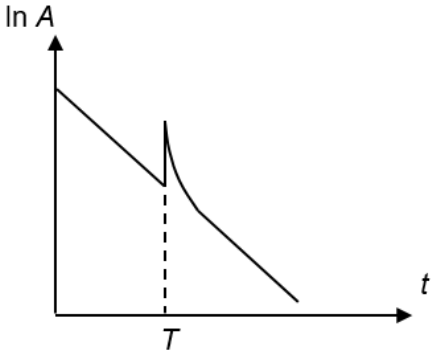
B



C



D



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