NEET 2024 - Paper Code R3

Physics

Question 1: At any instant of time t, the displacement of any particle is given by 2t - 1 (SI unit) under the influence of force of 5N. The value of instantaneous power is (in SI unit):

Options:

(a) 5

(b) 7

(c) 6

(d) 10

Answer: (d)

Solution: $x = 2t - 1$

$\frac{dx}{dt} = v = 2$

$P = Fv\cos\theta$

$= 5 \times 2 = 10W$

Question 2: If the monochromatic source in Young's double slit experiment is replaced by white light, then

Options:

(a) There will be a central dark fringe surrounded by a few coloured fringes

(b) There will be a central bright fringe surrounded by a few coloured fringes.

(c) All bright fringes will be of equal width

(d) Interference pattern will disappear.

Answer: (b)

Solution: Central maxima will coincide for all the wavelengths → Hence central Bright white fringe after that, each wavelength will make their own maxima as per their fringe width.

Question 3: ${}^{290}_{82}X \xrightarrow{\alpha} Y \xrightarrow{e^+} Z \xrightarrow{\beta^-} P \xrightarrow{e^-} Q$

In the nuclear emission stated above, the mass number and atomic number of the product Q respectively, are:

Options:

(a) 286, 80

(b) 288, 82

(c) 286, 81

(d) 280, 81

Answer: (c)

Solution: ${}^{290}_{82}X \xrightarrow{\alpha} {}^{286}_{80}X \xrightarrow{e^+} {}^{286}_{79}X \xrightarrow{\beta^-} {}^{286}_{80}X \xrightarrow{e^-} {}^{286}_{81}X$

Question 4: Match List – I with List – II.

List – I (Material)	**List – II (Susceptibility) (χ)**
A. Diamagnetic	I. $\chi = 0$
B. Ferromagnetic	II. $0 > \chi \geq -1$

C. Paramagnetic	III. $\chi >> 1$
D. Non-magnetic	IV. $0 < \chi < \varepsilon$ (a small positive number)

Choose the correct answer from the options given below

Options:

(a) A – II, B – I, C – III, D - IV

(b) A – III, B – II, C – I, D - IV

(c) A – IV, B – III, C – II, D - I

(d) A – II, B – III, C – IV, D – I

Answer: (d)

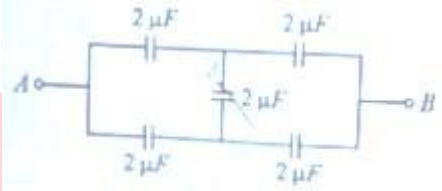
Solution: Diamagnetic $\rightarrow 0 > \chi \geq -1$

Ferromagnetic $\rightarrow \chi >>> 1$

Paramagnetic $\rightarrow 0 < \chi <$ small positive number

Non-magnetic $\rightarrow \chi = 0$

Question 5: In the following circuit, the equivalent capacitance between terminal A and terminal B is:



Options:

(a) $1\mu F$

(b) $0.5\mu F$

(c) $4\mu F$

(d) $2\mu F$

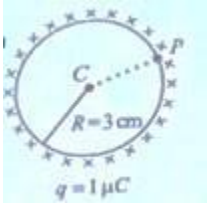
Answer: (d)

Solution: Whetstone bridge is balanced

$$C_{eq} = \frac{2\times 2}{2+2} + \frac{2\times 2}{2+2} = 1+1 = 2\mu F$$

Question 6: A thin spherical shell is charged by some source. The potential difference between the two points C and P (in V) shown in the figure is

(Take $\frac{1}{4\pi \in_0} = 9\times 10^9$ SI units)



Options:

(a) 1×10^5

(b) 0.5×10^5

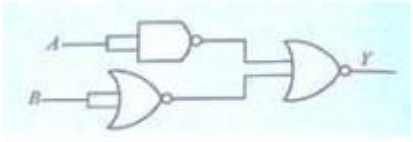
(c) Zero

(d) 3×10^5

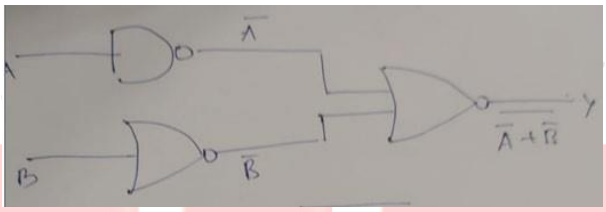
Answer: (c)

Solution: The entire charge will be on spherical surface
So, $E_{inside} = 0$
$\Delta V = 0$

Question 7: The output (Y) of the given logic gate is similar to the output of an/a:



Options:
(a) NOR gate
(b) OR gate
(c) AND gate
(d) NAND gate
Answer: (c)
Solution:



$Y = \overline{\overline{A} + \overline{B}}$
$= \overline{\overline{A}}.\overline{\overline{B}}$
$= A.B$
= AND GATE

Question 8: An unpolarized light beam strikes a glass surface at Brewster's angle. Then
Options:
(a) The refracted light will be completely polarised
(b) Both the reflected and refracted light will be completely polarised
(c) The reflected light will be completely polarized but the refracted light will be partially polarized
(d) The reflected light will be partially polarized.
Answer: (c)
Solution: Fact Based

Question 9: A tightly wound 100 turns coil of radius 10 cm carries a current of 7 A. The magnitude of the magnetic field at the centre of the coil is (Take permeability of free space as $4\pi \times 10^{-7}$ SI units):
Options:
(a) 4.4 T
(b) 4.4 mT
(c) 44 T
(d) 44 mT
Answer: (b)
Solution: $B = \dfrac{\mu_0 Ni}{2a}$

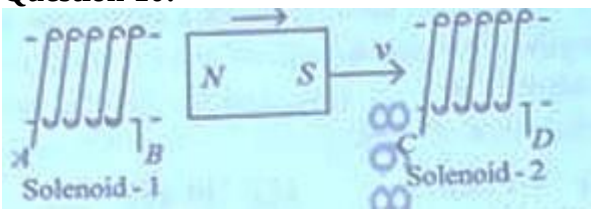
$$= \frac{4\pi \times 10^{-7} \times 120 \times 7}{2 \times 10 \times 10^{-2}}$$

$$= 140\pi \times 10^{-5}$$

$$= 439.6 \times 10^{-5}$$

$$= 4.4 \times 10^{-3} = 4.4mT$$

Question 10:



In the above diagram, 1 strong bar magnet is moving towards solenoid – 2 from solenoid – 1. The direction of induced current in solenoid – 1 and that in solenoid – 2, respectively, are through the directions:

Options:

(a) BA and CD

(b) AB and CD

(c) BA and DC

(d) AB and DC

Answer: (d)

Solution: When observed from the magent:

For Solenoid – 1

Magnetic field is inside the plane and decreasing

$\downarrow$

$i_{ind} \rightarrow$ Clockwise

For Solenoid – 2

Magnetic field is outside the plane and increasing

$\downarrow$

$i_{ind} \rightarrow$Clockwise

Question 11: Two bodies A and B of same mass undergo completely inelastic one-dimensional collision. The body A moves with velocity v_1 while body B is at rest before collision. The velocity of the system after collision is v_2. The ratio $v_1 : v_2$ is:

Options:

(a) 2 : 1

(b) 4 : 1

(c) 1 : 4

(d) 1 : 2

Answer: (a)

Solution:

$m_1 = m \quad m_2 = m$

$(A) \rightarrow V_1$

Applying COM

$mv_1 + m(0) = (m+m)v_2$

$mv_1 = 2mv_2$

$$v_2 = \frac{v_1}{2}$$

$$v_1 : v_2 = v_1 : \frac{v_1}{2} = 1 : \frac{1}{2} = 2 : 1$$

Question 12: Given below are two statements: One is labelled as Assertion A and the other is labelled as Reason R.

Assertion A: The potential (V) at any axial point, at 2m distance (r) from the centre of the dipole of dipole moment vector P of magnitude, $4\times10^{-6} Cm$, is $\pm9\times10^{3} V$

(Take $\frac{1}{4\pi \in_0} = 9\times10^{9}$ SI units)

Reason R: $V = \pm\frac{2P}{4\pi \in_0 r^2}$, where r is the distance of any axial point, situated at 2m from the centre of the dipole.

In the light of the above statements, choose the correct answer from the options given below:

Options:

(a) Both A and R are true and R is NOT the correct explanation of A.

(b) A is true but R is false

(c) A is false but R is true

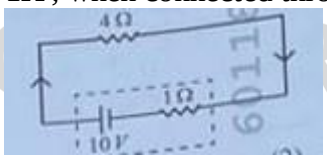
(d) Both A and R are true and R is the correct explanation of A.

Answer: (b)

Solution: Potential due to dipole at axial position is $= \frac{kP\cos\theta}{r^2}$ (where $\theta = 0°$ or $180°$)

$$V_{axial} = \pm\frac{9\times10^{9}\times4\times10^{-6}}{(2)^2} = \pm9\times10^{3} V$$

Question 13: The terminal voltage of the battery, whose emf is 10V and internal resistance 1Ω , when connected through an external resistance of 4Ω as shown in the figure is:



Options:

(a) 6 V

(b) 8 V

(c) 10 V

(d) 4 V

Answer: (b)

Solution: $i = \frac{10}{4+1} = \frac{10}{5} = 2amp$

$$V = \in -ir$$

$$= 10 - 2\times1 = 10 - 2 = 8volt$$

Question 14: A particle moving with uniform speed in a circular path maintains:

Options:

(a) Constant acceleration

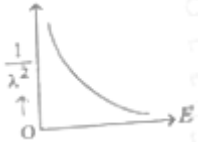
(b) Constant velocity but varying acceleration

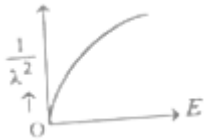
—

— –

(c) Varying velocity and varying acceleration
(d) Constant velocity.
Answer: (c)
Solution: Direction of both velocity and acceleration are changing.

Question 15: The graph which shows the variation of $\left(\frac{1}{\lambda^2}\right)$ and its kinetic energy, E is (where λ is de Broglie wavelength of a free particle):
Options:

(a) 

(b) 

(c) 

(d) 

Answer: (c)
Solution: $\lambda_D = \frac{h}{mv} = \frac{h}{p}$

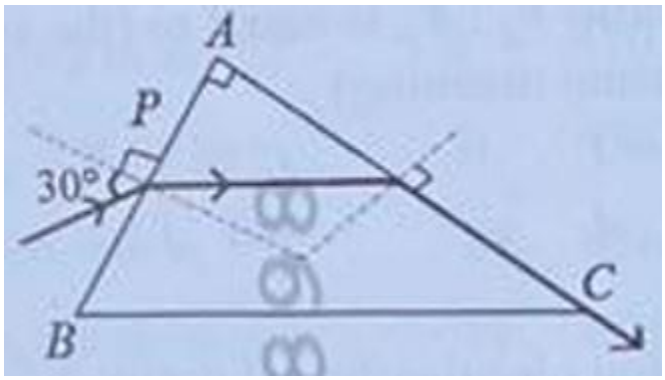
$$K = \frac{p^2}{2m} = \left(\frac{h}{\lambda D}\right)^2 \frac{1}{2m}$$

$$K = \frac{h^2}{2m}\frac{1}{\lambda_D^2}$$

$$\frac{1}{\lambda_D^2} = \frac{2mK}{h^2}$$

$Y = Mx$
Slant straight line.

Question 16: A light ray enters through a right angled prism at point P with the angle of incidence 30° as shown in figure. It travels through the prism parallel to its base BC and emerges along the face AC. The refractive index of the prism is:



Options:

(a) $\frac{\sqrt{5}}{2}$

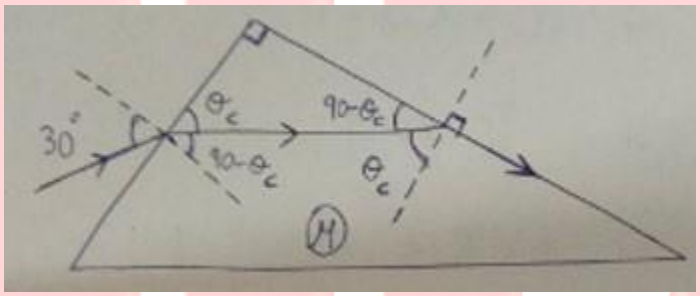
(b) $\frac{\sqrt{3}}{4}$

(c) $\frac{\sqrt{3}}{2}$

(d) $\frac{\sqrt{5}}{4}$

Answer: (a)

Solution:



$\sin 30° = \mu \sin(90 - \theta_c)$

$\frac{1}{2} = \mu \cos\theta_c$

Also, $\sin\theta_c = \frac{1}{\mu}$

$\cos\theta_c = \frac{\sqrt{\mu^2 - 1}}{\mu}$

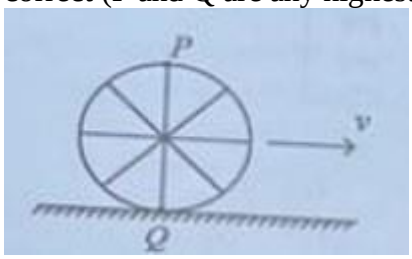
$\frac{1}{2} = \mu \frac{\sqrt{\mu^2 - 1}}{\mu}$

$\frac{1}{4} = \mu^2 - 1$

$\mu^2 = \frac{5}{4}$

$\boxed{\mu = \frac{\sqrt{5}}{2}}$

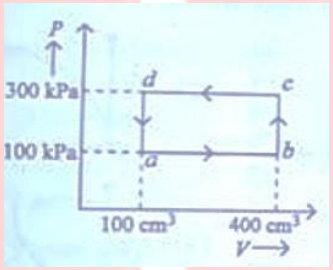
Question 17: A wheel of a bullock cart is rolling on a level road as shown in the figure below. If its linear speed is v in the direction shown, which one of the following options is correct (P and Q are any highest and lowest points on the wheel, respectively)?



Options:
(a) Point P moves faster than point Q
(b) Both the points P and Q move with equal speed
(c) Point P has zero speed
(d) Point P moves slower than point Q
Answer: (a)
Solution: At P $v_P = v + r\omega$
At Q $v_Q = v - r\omega$

Answer (a) Point P moves faster than point Q

Question 18: A thermodynamic system is taken through the cycle abcda. The work done by the gas along the path bc is:



Options:
(a) 30 J
(b) -90 J
(c) -60 J
(d) Zero
Answer: (d)
Solution: bc is an isochoric process
Work done = 0.

Question 19: In an ideal transformer, the turns ratio is $\frac{N_p}{N_s} = \frac{1}{2}$. The ratio $V_s : V_p$ is equal to (the symbols carry their usual meaning):
Options:
(a) 2 : 1
(b) 1 : 1
(c) 1 : 4
(d) 1 : 2
Answer: (a)

Solution: $\frac{e_s}{e_p} = \frac{N_s}{N_p} = \frac{2}{1}$

Question 20: A thin flat circular disc of radius 4.5 cm is placed gently over the surface of water. If surface of water. If surface tension of water is $0.07 Nm^{-1}$, then the excess force required to take it away from the surface is:

Options:

(a) 198 N

(b) 1.98 mN

(c) 99 N

(d) 19.8 mN

Answer: (d)

Solution: Excess Force $= T.2\pi R$

$= 007 \times 2 \times \frac{22}{7} \times \frac{4.5}{100} = 19.8mN$

Question 21: The maximum elongation of a steel wire of 1m length if the elastic limit of steel and its Young's modulus, respectively, are $8 \times 10^8 Nm^{-2}$ and $2 \times 10^{11} Nm^{-2}$, is

Options:

(a) 0.4mm

(b) 40 mm

(c) 8 mm

(d) 4 mm

Answer: (d)

Solution: Stress = Y . strain

$$\text{Stress} = \frac{Y(\Delta L)_{\max}}{L}$$

$$8 \times 10^8 = \frac{2 \times 10^{11} \times (\Delta L)_{\max}}{1}$$

$$(\Delta L)_{\max} = 4 \times 10^{-3} meter = 4mm$$

Question 22: The mass of a planet is $\frac{1}{10}^{th}$ that of the earth and its diameter is half that of the earth. The acceleration due to gravity on that planet is:

Options:

(a) $9.8 ms^{-2}$

(b) $4.9 ms^{-2}$

(c) $3.92 ms^{-2}$

(d) $19.6 ms^{-2}$

Answer: (c)

Solution: $g = \frac{GM}{R^2} \propto \frac{M}{R^2}$

$$\frac{g}{g^1} = \left(\frac{M}{\frac{M}{10}}\right)\left(\frac{R^2}{\frac{R^2}{4}}\right)$$

$$g_2 = \frac{4g}{10} = 3.92 m/s^2$$

Question 23: In a vernier calipers, $(N+1)$ divisions of vernier scale coincide with n divisions of main scale. If 1MSD represents 0.1mm, the vernier constant (in cm) is:

Options:

(a) $\frac{1}{100(N+1)}$

(b) 100 N

(c) $10(N+1)$

(d) 10 N

Answer: (a)

Solution: $(N+1)$ of V.S.D = N div of M.S.D

$$1 \text{ V.S.D} = \frac{N}{N+1} M.S.D$$

$$L.C = 1M.S.D - 1V.S.D$$

$$= 1M.S.D - \frac{N}{N+1} M.S.D$$

$$= \left(\frac{N+1-N}{N+1}\right) M.S.D$$

$$= \frac{1}{N+1} M.S.D$$

$$= \frac{0.1}{N+1} mm$$

$$= \frac{0.01}{N+1} c.m$$

$$= \frac{1}{100(N+1)} c.m$$

Question 24: Given below are two statements:

Statement I: Atoms are electrically neutral as they contain equal number of positive and negative charges.

Statement II: Atoms of each element are stable and emit their characteristic spectrum.

In the light or the above statements, choose the most appropriate answer front the options given below:

Options:

(a) Both Statement I and Statement II are incorrect.

(b) Statement I is correct hut Statement II is incorrect.

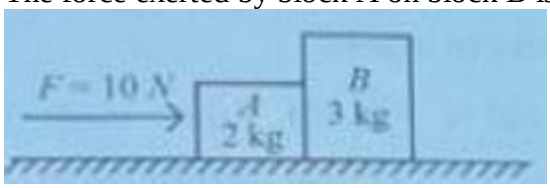
(c) Statement I is incorrect but Statement II is correct

(d) Both Statement I and Statement II are correct

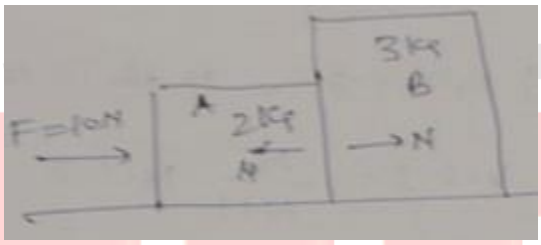
Answer: (b)

Solution: Fact based

Question 25: A horizontal force 10N is applied to a block A as shown in figure. The mass of blocks A and B are 2 kg and 3kg, respectively. The blacks side over a frictionless surface. The force exerted by block A on block B is:



Options:
(a) 4 N
(b) 6 N
(c) 10 N
(d) Zero
Answer: (b)
Solution:



For A $10 - N = 2a \quad .....(1)$

$N = 3a \ldots\ldots (2)$

$(1) + (2)$

$10 = 5a$

$a = 2m/s^2$

From (2) $N = 3 \times 2 = 6N$

Question 26: The quantities which have the same dimensions as those of solid angle are:
Options:
(a) Stress and angle
(b) Strain and arc
(c) Angular speed and stress
(d) strain and angle
Answer: (d)
Solution: Solid angle is dimensionless
Strain and angle are dimensionless as well.

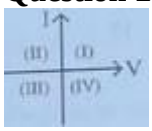
Question 27: The moment of inertia of an thin rod about an axis passing through its mid point and perpendicular to the rod is $2400g\ cm^2$. The length of the 400g rod is nearly:
Options:
(a) 17.5 cm
(b) 20.7 cm
(c) 72.0 cm
(d) 8.5 cm
Answer: (d)

Solution: $I = \dfrac{ML^2}{12}$

$$2400 = \frac{400L^2}{12}$$

$$L^2 = 72 = 36 \times 2$$
$$L = 6\sqrt{2}$$
$$= 6 \times 1.4 = 8.5cm$$

Question 28: Consider the following statements A and B and identify the correct answer:



A. For a solar cell, the I-V characteristic lies in the IV quadrant of the given graph.

B. In a reverse biased pn junction diode, the current measured in (μA) , is due to majority. Charge carriers.

Options:

(a) A is incorrect but B is correct
(b) Both A and B are correct
(c) Both A and B are incorrect
(d) A is correct but B is incorrect.

Answer: (d)

Solution: NCERT based Face

Question 29: A wire of length ' l ' and resistance 100Ω is divided into 10 equal parts. The first 5 parts are connected in series while the next 5 parts are connected in parallel. The two combinations are again connected in series. The resistance of this final combination is:

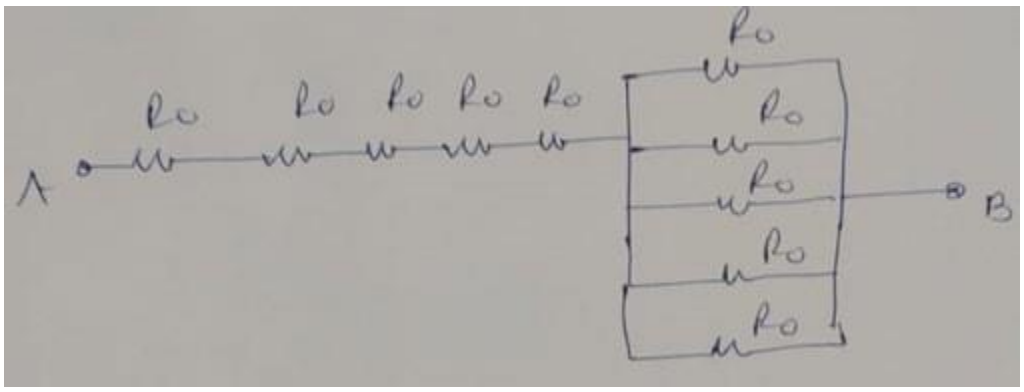
Options:

(a) 52Ω
(b) 55Ω
(c) 60Ω
(d) 26Ω

Answer: (a)

Solution: After dimension of 10 equal parts

Resistance of each part $= \dfrac{100}{10} = 10\Omega = R$



Equivalent between A & B $= 5R_0 + \dfrac{R_0}{5}$

$= 5\times 10 + \frac{10}{5} = 50 + 2 = 52\Omega$

Question 30: If $x = 5\sin\left(\pi t + \frac{\pi}{3}\right)m$ represents the motion of a particle executing simple harmonic motion, the amplitude and time period of motion, respectively, are:

Options:

(a) 5m, 2s

(b) 5 cm, 1s

(c) 5m, 1s

(d) 5cm, 2s

Answer: (a)

Solution: $x = 5\sin\left(\pi t + \frac{\pi}{3}\right)m$

Amplitude = 5m

$\omega = \frac{2\pi}{T}$

$\pi = \frac{2\pi}{T}$

$T = 2\,\text{sec}$

Question 31: If c is the velocity of light in free space, the correct statements about photon among the following are;

A. The energy of a photon is $E = hv$

B. The velocity of a photon is c.

C. The momentum of a photon, $p = \frac{hv}{c}$

D. In a photon-electron collision, both total energy and total momentum are conserved.

E. Photon possesses positive charge.

Choose the correct answer from the options given below:

Options:

(a) A, B, C and D only

(b) A, C and D only

(c) A, B, D and E only

(d) A and B only

Answer: (a)

Solution: E: photons have no change

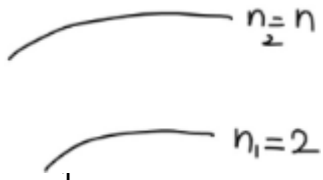
Question 32: Match List I with List II:

List – I (Spectral Lines of Hydrogen for transitions from)	**List II (Wavelengths (nm)**
A. $n_2 = 3$ to $n_1 = 2$	I. 410.2
B. $n_2 = 4$ to $n_1 = 2$	II.. 434.1
C. $n_2 = 5$ to $n_1 = 2$	III. 656.3
D. $n_2 = 6$ to $n_1 = 2$	IV. 486.1

Choose the correct answer from the options given below:

Options:

(a) A – III, B – IV, C – II, D - I
(b) A – IV, B – III, C – I, D - II
(c) A – I, B – II, C – III, D – IV
(d) A – II, B – I, C – IV, D - III
Answer: (a)
Solution:



$E \propto \frac{1}{\lambda}$

$n \uparrow E \uparrow$

So, more n less λ

A – III, B – IV, C – II, D – I

Question 33: A logic circuit provides the output Y as per the following truth table:

A	B	Y
0	0	1
0	1	0
1	0	1
1	1	0

The expression for the output Y is:

Options:

(a) $A.\overline{B} + \overline{A}$

(b) $\overline{B}$

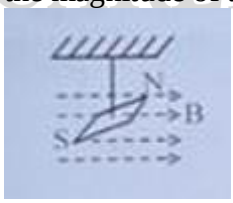
(c) B

(d) $A.B + \overline{A}$

Answer: (b)

Solution: $\left(\overline{B}\right)$

Question 34: In a uniform magnetic field of 0.049T, a magnetic needle performs 20 complete oscillations in 5 seconds as shown. The moment of inertia of the needle is $9.8\times10^{-6}\,kg\,m^2$. If the magnitude of the needle is $x\times10^{-5}\,Am^2$; then the value of 'x' is:



Options:

(a) $128\pi^2$

(b) $50\pi^2$

(c) $1280\pi^2$

(d) $5\pi^2$

Answer: (c)

Solution: $\tau = -BM\sin\theta = I\alpha$

For small θ

$$\alpha = -\frac{BM}{I}\theta$$

So, $T = 2\pi\sqrt{\frac{I}{BM}} \Rightarrow M = \frac{4\pi^2 I}{BT^2} = \frac{4\pi^2 \times 9.8\times10^{-6}}{0.049\times\left(\frac{1}{4}\right)^2}$

$= 1280\pi^2 \times 10^{-5}$

Question 35: A bob is whirled in a horizontal plane by means of a string will an initial speed of ω rpm. The tension in the string is T. If speed becomes 2 ω while keeping the same radius, the tension in the string becomes:

Options:

(a) 4T

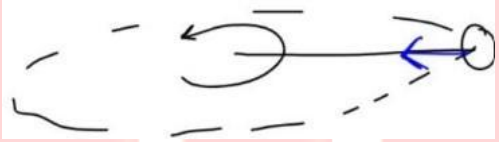
(b) $\frac{T}{4}$

(c) $\sqrt{2T}$

(d) T

Answer: (a)

Solution:



$T = m\omega^2 r$

$T \propto \omega^2$

$\frac{T'}{T} = \left(\frac{2\omega}{\omega}\right)^2$

$T' = 4T$

Question 36: A metallic bar of Young's modulus, 0.5×10^{11} Nm^{-2} and coefficient of linear thermal expansion 10^{-5} $^oC^{-1}$. Length 1m and area of cross-section 10^{-3} m^2 is heated from $0^\circ C$ to $100^\circ C$ without expansion or bending. The compressive force developed in it is:

Options:

(a) 50×10^3 N

(b) 100×10^3 N

(c) 2×10^3 N

(d) 5×10^3 N

Answer: (a)

Solution:

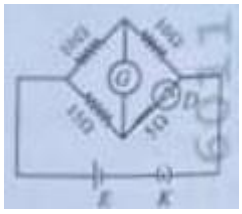
$$F = AY\frac{\Delta L}{L} = AY(\alpha\Delta T)$$

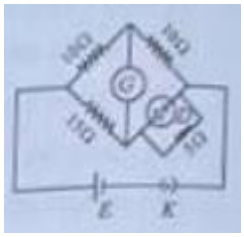
$F = 10^{-3}\times0.5\times10^{11}\times10^{-5}\times(100-0)$

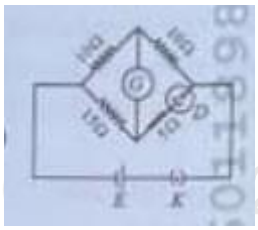
$= 0.5\times10^{13-5-3} = 0.5\times10^5 = 50\times10^3$

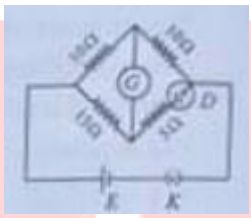
Question 37: Choose the correct circuit which can achieve the bridge balance.

Options:

(a) 

(b) 

(c) 

(d) 

Answer: (d)

Solution:

Question 38: A small telescope has an objective of focal length 140 cm and an eye piece of focal length 5.0 cm. The magnifying power of telescope for viewing a distant object is:

Options:

(a) 28

(b) 17

(c) 32

(d) 34

Answer: (a)

Solution:

$$m = \frac{fo}{fe} = \frac{140}{5} = 28$$

Question 39: An iron bar of length L has magnetic moment M. It is bent at the middle of its length such that the two arms make angle 60° with each other. The magnetic moment of this new magnet is.

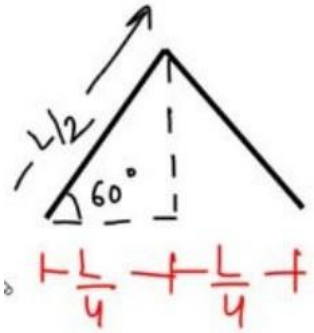
Options:

(a) $\frac{M}{2}$

(b) 2M

(c) $\frac{M}{\sqrt{3}}$

(d) M
Answer: (a)
Solution:

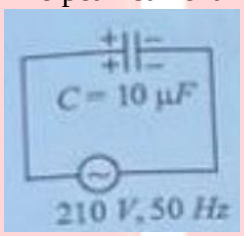


M = mL

$$M^1 = m\left(\frac{L}{4} + \frac{L}{4}\right) = \frac{mL}{2}$$

$$M^1 = \frac{M}{2}$$

Question 40: A 10μF capacitor is connected to a 210 V, 50 Hz source as shown in figure. The peak current in the circuit is nearly (π = 3.14):



Options:
(a) 0.93A
(b) 1.20A
(c) 0.35A
(d) 0.58A
Answer: (a)
Solution:

$$x_c = \frac{1}{\omega c} = \frac{1}{2\pi \times 50 \times 10 \times 10^{-6}}$$

$$x_c = \frac{1000}{\pi}$$

$$i_0 = \sqrt{2}\left(\frac{v_{rms}}{x_c}\right) = \frac{\sqrt{2} \times 210}{\left(\frac{1000}{\pi}\right)}$$

= 0.93 A

Question 41: Two heaters A and B have power rating of 1kW and 2kW, respectively. Those two are first connected in series and then in parallel to a fixed power source. The ratio of power outputs for these two cases is:
Options:
(a) 2 : 9

(b) 1 : 2
(c) 2 : 3
(d) 1 : 1
Answer: (a)

Solution: $R = \frac{V^2}{P}$ so $R_1 = \frac{V^2}{1}, R_2 = \frac{V^2}{2}$

$$P_s = \frac{V^2}{R_1 + R_2} = \frac{V^2}{V^2 + \frac{V^2}{2}} = \frac{2}{3}$$

$$\frac{1}{R_P} = \frac{1}{R_1} + \frac{1}{R_2} = \frac{1}{V^2} + \frac{2}{V^2} = \frac{3}{V^2} \Rightarrow R_p = \frac{V^2}{3}$$

So, $P_P = \frac{V^2}{\frac{V^2}{3}} = 3$

So, $\frac{P_s}{P_p} = \frac{2}{9}$

Question 42: If the mass of the bob in a simple pendulum is increases to thrice its original mass and its length is made half its original length, then the new time period of oscillation is $\frac{x}{2}$ times its original time period. Then the value of x is

Options:
(a) $\sqrt{2}$
(b) $2\sqrt{3}$
(c) 4
(d) $\sqrt{3}$
Answer: (a)

Solution: $T = 2\pi\sqrt{\frac{L}{g}}$

$$\frac{T}{T'} = \sqrt{\frac{L}{L/2}} = \sqrt{2} \Rightarrow T' = \frac{T}{\sqrt{2}}$$

But $T' = \frac{x}{2}T$

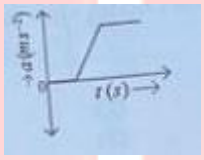
$$\frac{x}{2} = \frac{1}{\sqrt{2}}$$
$$x = \sqrt{2}$$

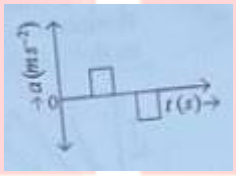
Question 43: The property which is not of an electromagnetic wave travelling in free space is that:
Options:
(a) The energy density in electric field is equal to energy density in magnetic field
(b) They travel with a speed equal to $\frac{1}{\sqrt{\mu_0 \in_0}}$

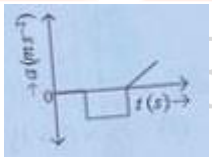
(c) They originate from charges moving with uniform speed
(d) They are transverse in nature.
Answer: (c)
Solution: EM wave needs acc. change

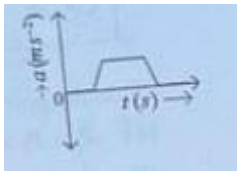
Question 44: A sheet is placed on a horizontal surface in front of a strong magnetic pole. A force is needed to:
A. hold the sheet there if it is magnetic
B. hold the sheet there if it is non-magnetic.
C. Move the sheet away from the pole with uniform velocity if it is conducting.
D. Move the sheet away from the pole with uniform velocity if it is both, non-conducting and non-polar
Choose the correct statement(s) from the options given below
Options:
(a) A and C only
(b) A, C and D only
(c) C only
(d) B and D only
Answer: (a)
Solution: A and C only

Question 45: The velocity (v) – time (t) plot of the motion of a body is shown below:

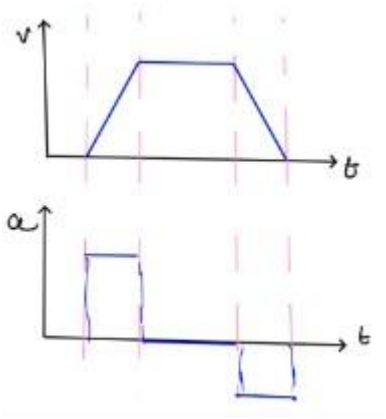
The acceleration (a) – time (t) graph that best suits this motion is:
Options:
(a) 

(b) 

(c) 

(d) 

Answer: (b)
Solution: $a = \frac{dv}{dt}$



Question 46: A parallel plate capacitor is charged by connecting it to a battery through a resistor. If I is the current in the circuit, then in the gap between the plates:

Options:

(a) Displacement current of magnitude equal to I flows in the same direction as I.

(b) Displacement current of magnitude equal to I flows in a direction opposite to that of I.

(c) Displacement current of magnitude greater then I flows but can be in any direction.

(d) There is no current.

Answer: (a)

Solution: Displacement current of magnitude equal to I flows in the same direction as I.

Question 47: A force defined by $F = \alpha t^2 + \beta t$ acts on a particle at a given time t. The factor

which is dimensionless. If α and β are constants, is:

Options:

(a) $\frac{\alpha t}{\beta}$

(b) $\alpha\beta t$

(c) $\frac{\alpha\beta}{t}$

(d) $\frac{\beta t}{\alpha}$

Answer: (a)

Solution: $F = \alpha t^2 = \beta t$

$$\left[M^1L^1T^2\right] = [\alpha]\left[T^2\right] = [\beta][T]$$

So, $\frac{\alpha T^2}{\beta T}$ is dimensionless

So, $\frac{\alpha T}{\beta}$

Question 48: If the plates of a parallel plate capacitor connected to a battery are moved close to each other, then

A. The charge stored in it, increases.

B. The energy stored in it decreases.

C. Its capacitance increases.

D. The ratio of charge to its potential remains the same.

E. The product of charge and voltage increases.
Choose the most appropriate answer from the options given below:
Options:
(a) A, C and E only
(b) B, D and E only
(c) A, B and C only
(d) A, B and E only
Answer: (a)
Solution: $c = \frac{\varepsilon_0 A}{d} \quad d \downarrow c \uparrow$

$\square$V = constant

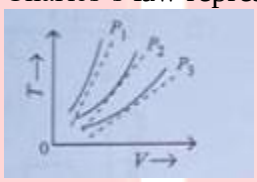
$q = cv\left(q \uparrow\right)$

$U = \frac{1}{2}CV^2\left(U \uparrow\right)$

$\frac{q}{V} = c \times$ not constant

$qv = cv.v = cv^2$

Question 49: The following graph represents the T-V curves of an ideal gas (where T is the temperature and V the volume) at three pressures P_1, P_2 and P_3 compared with those of Charles's law represented as dotted lines.



Then the correct relation is:
Options:

(a) $P_1 > P_3 > P_2$
(b) $P_2 > P_1 > P_3$
(c) $P_1 > P_2 > P_3$
(d) $P_3 > P_2 > P_1$

Answer: (c)
Solution: $\frac{T}{V} \propto P$
More slope more P
$P_1 > P_2 > P_3$

Question 50: The minimum energy required to launch a satellite of mass m from the surface of earth of mass M and radius R in a circular orbit at an altitude of 2R from the surface of the earth is:
Options:
(a) $\frac{2GmM}{3R}$
(b) $\frac{GmM}{2R}$

(c) $\frac{GmM}{3R}$

(d) $\frac{5GmM}{6R}$

Answer: (d)

Solution: $W = \in_f - U_i$

$$= -\frac{GMm}{6R} - \left(-\frac{GMm}{R}\right)$$

$$= \frac{GMm}{R}\left[1 - \frac{1}{6}\right]$$

$$= \frac{5}{6}\frac{GMm}{R}$$