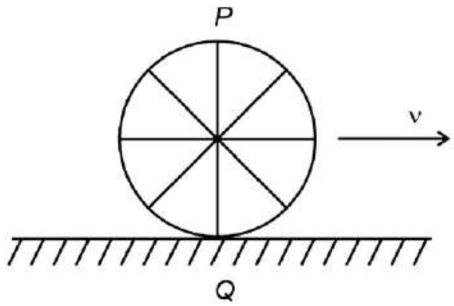
PHYSICS NEET 2024

TEST PAPER WITH ANSWER

1. 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)?



(1) Point P moves faster than point Q

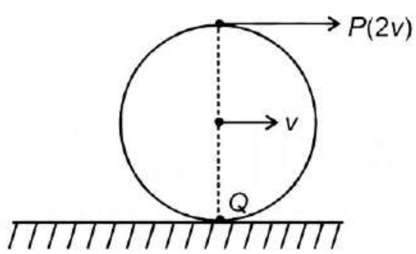
(2) Both the points P and Q move with equal speed

(3) Point P has zero speed

(4) Point P moves slower than point Q

Answer (1)

Sol. In the case of pure rolling,



The topmost point will have velocity $2v$ while point Q i.e. lowest point will have zero velocity.

Hence point P moves faster than point Q.

2. 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:

(1) A-III, B-IV, C-II, D-I

(2) A-IV, B-III, C-I, D-II

(3) A-I, B-II, C-III, D-IV

(4) A-II, B-I, C-IV, D-III

Answer (1)

Sol. Energy difference $\Delta E = \dfrac{hc}{\lambda}$

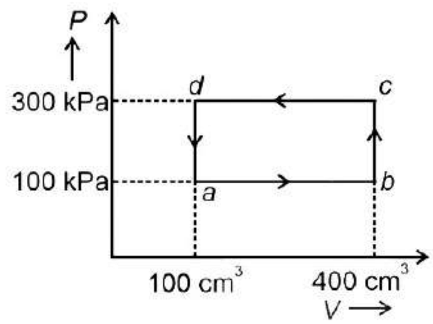
$\therefore \lambda \propto \dfrac{1}{\Delta E}$

$(\Delta E)_{6-2} > (\Delta E)_{5-2} > (\Delta E)_{4-2} > (\Delta E)_{3-2}$

$\lambda_{6-2} < \lambda_{5-2} < \lambda_{4-2} < \lambda_{3-2}$

A-III, B-IV, C-II, D-I

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



(1) 30 J

(2) –90 J

(3) –60 J

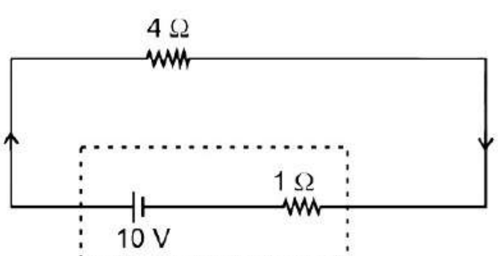
(4) Zero

Answer (4)

Sol. Path *bc* is an isochoric process.

$\therefore$ Work done by gas along path *bc* is zero.

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



(1) 6 V

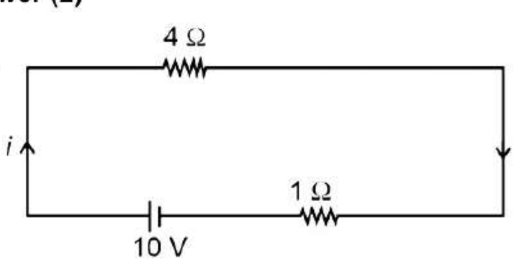
(2) 8 V

(3) 10 V

(4) 4 V

Answer (2)

Sol.



Current in circuit $i = \dfrac{10}{4+1} = 2\,\text{A}$

Terminal voltage $= E - iR$

$= 10 - 2 \times 1 = 8\text{ V}$

5. In an ideal transformer, the turns ratio is $\dfrac{N_P}{N_S} = \dfrac{1}{2}$. The ratio $V_S : V_P$ is equal to (the symbols carry their usual meaning) :

(1) 2 : 1 (2) 1 : 1

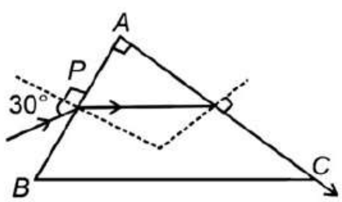
(3) 1 : 4 (4) 1 : 2

Answer (1)

Sol. According to transformer ratio,

$$\frac{V_S}{V_P} = \frac{N_S}{N_P} = 2:1$$

6. 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:

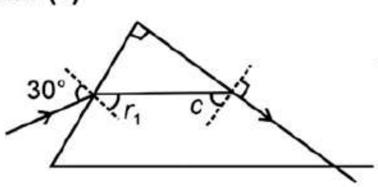


(1) $\dfrac{\sqrt{5}}{2}$ (2) $\dfrac{\sqrt{3}}{4}$

(3) $\dfrac{\sqrt{3}}{2}$ (4) $\dfrac{\sqrt{5}}{4}$

Answer (1)

Sol.



$A = 90°$

In prism, $r_1 + c = A$

$r_1 = 90° - c$ ...(1)

$$\sin c = \frac{1}{\mu} \Rightarrow \cos c = \frac{\sqrt{\mu^2 - 1}}{\mu}$$

$\Rightarrow$ Apply Snell's law, on incidence surface

$$1 \cdot \sin 30° = \mu \sin(r_1) \Rightarrow 1 \times \frac{1}{2} = \mu \times \sin(90° - c)$$

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

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

$$\Rightarrow \quad \mu^2 = \frac{5}{4} \quad \Rightarrow \quad \mu = \frac{\sqrt{5}}{2}$$

7. The quantities which have the same dimensions as those of solid angle are:

(1) stress and angle
(2) strain and arc
(3) angular speed and stress
(4) strain and angle

Answer (4)

Sol. Solid angle $d\Omega = \frac{dA}{r^2}$ has dimensions $[M^0L^0T^0]$

Strain $= \frac{\Delta l}{l}$ has dimensions $[M^0L^0T^0]$

Angle measured in radians is also dimensionless $[M^0L^0T^0]$

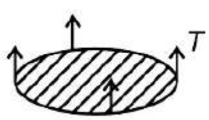
$\theta = \frac{l}{r}$

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

(1) 198 N
(2) 1.98 mN
(3) 99 N
(4) 19.8 mN

Answer (4)

Sol.



Excess force = $T \times 2\pi R$

$= \frac{7}{100} \times 2 \times 3.14 \times \frac{4.5}{100}$

$= 197.82 \times 10^{-4}$

$= 19.8 \times 10^{-3}$ N

= 19.8 mN

9. 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 2 m distance (r) from the centre of the dipole of dipole moment vector $\vec{P}$ of magnitude, 4×10^{-6} C m, is $\pm 9 \times 10^3$ V.

(Take $\frac{1}{4\pi \epsilon_0}$ = 9×10^9 SI units)

Reason R: $V = \pm \frac{2P}{4\pi \epsilon_0 r^2}$, where r is the distance of any axial point, situated at 2 m from the centre of the dipole.

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

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

(2) A is true but R is false.

(3) A is false but R is true.

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

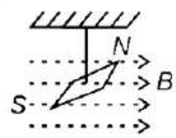
Answer (2)

Sol. The potential V at any point, at distance r from centre of dipole $= \frac{KP\cos\theta}{r^2}$

At axial point where $\theta = 0°$, $V = \frac{KP}{r^2} = \frac{9 \times 10^9 \times 4 \times 10^{-6}}{2^2} = 9 \times 10^3$ V

At axial point where $\theta = 180°$, $V = \frac{-KP}{r^2} = -9 \times 10^3$ V

10. In a uniform magnetic field of 0.049 T, a magnetic needle performs 20 complete oscillations in 5 seconds as shown. The moment of inertia of the needle is 9.8×10^{-6} kg m^2. If the magnitude of magnetic moment of the needle is $x \times 10^{-5}$ Am^2, then the value of 'x' is :



(1) $128\pi^2$

(2) $50\pi^2$

(3) $1280\pi^2$

(4) $5\pi^2$

Answer (3)

Sol. Time period of Oscillation, $T = 2\pi\sqrt{\frac{I}{MB}}$

$$\Rightarrow \frac{1}{4} = 2\pi\sqrt{\frac{9.8\times10^{-6}}{M\times0.049}}$$

$$\Rightarrow \frac{1}{16} = 4\pi^2 \times \frac{9.8\times10^{-6}}{M\times49\times10^{-3}}$$

$$\Rightarrow M = \frac{4\pi^2\times9.8\times10^{-6}}{49\times10^{-3}}\times16$$

$$= \frac{4\pi^2\times9.8\times16\times10^{-3}}{49}$$

$= 12.8\pi^2 \times 10^{-3} \times 10^{-2} \times 10^2$

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

11. If the monochromatic source in Young's double slit experiment is replaced by white light, then

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

(2) There will be a central bright white fringe surrounded by a few coloured fringes

(3) All bright fringes will be of equal width

(4) Interference pattern will disappear

Answer (2)

Sol. At central point on screen, path difference is zero for all wavelength. So, central bright fringe is white and other fringes depend on wavelength as $\beta = \frac{\lambda D}{d}$.

Therefore, other fringes will be coloured.

12. 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 of the above statements, choose the *most appropriate* answer from the options given below.

(1) Both Statement I and Statement II are incorrect

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

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

(4) Both Statement I and Statement II are correct

Answer (2)

Sol. Statement I is true as atoms are electrically neutral because they contain equal number of positive and negative charges.

Statement II is wrong as atom of most of the elements are stable and emit characteristic spectrum. But this statement is not true for every atom.

13. The maximum elongation of a steel wire of 1 m length if the elastic limit of steel and its Young's modulus, respectively, are 8×10^8 N m^{-2} and 2×10^{11} N m^{-2}, is:

(1) 0.4 mm (2) 40 mm

(3) 8 mm (4) 4 mm

Answer (4)

Sol. In the case for maximum elongation,

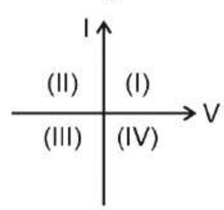
Stress = Elastic limit

$$\delta_{max} = \frac{\sigma_{elastic} \times L}{\text{Young's modulus}} = \frac{8 \times 10^8 \times 1}{2 \times 10^{11}} = 4 \times 10^{-3}$$

$$= 4 \text{ mm}$$

i.e. maximum elongation is 4 mm

14. Consider the following statements A and B and identify the correct answer:



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

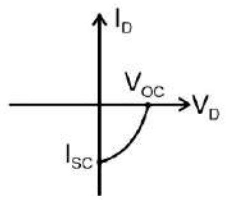
B. In a reverse biased *pn* junction diode, the current measured in (μA), is due to majority charge carriers.

(1) A is incorrect but B is correct (2) Both A and B are correct

(3) Both A and B are incorrect (4) A is correct but B is incorrect

Answer (4)

Sol. A: Solar cell characteristics



B: In reverse biased *pn* junction diode, the current measured in (μA), is due to minority charge carrier.

15. A particle moving with uniform speed in a circular path maintains:

(1) Constant acceleration
(2) Constant velocity but varying acceleration
(3) Varying velocity and varying acceleration
(4) Constant velocity

Answer (3)

Sol. A particle moving with uniform speed in a circular path maintains varying velocity and varying acceleration. It is because direction of both velocity as well as acceleration will change continuously.

16. 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 $E = h\nu$.

B. The velocity of a photon is c.

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

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:

(1) A, B, C and D only
(2) A, C and D only
(3) A, B, D and E only
(4) A and B only

Answer (1)

Sol. (A) If c is the velocity of light

so, $E = h\nu$ (Energy of photon)

(B) Velocity of photon is equal to velocity of light i.e. c.

(C) $\lambda = \frac{h}{p}$

$$p = \frac{h}{\lambda}$$

$$p = \frac{h\nu}{c}$$

(D) In photon-electron collision both total energy and total momentum are conserved.

17. 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

(1) 2 : 1
(2) 4 : 1
(3) 1 : 4
(4) 1 : 2

Answer (1)

Sol. Before collision $\Rightarrow$ Ⓐ $\rightarrow v_1$ Ⓑ rest

It undergoes completely inelastic collision

Using conservation of linear momentum

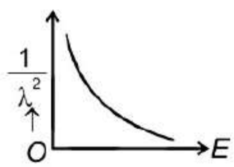
Initial momentum = Final momentum

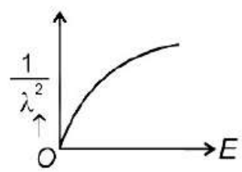
$\Rightarrow \; mv_1 = mv_2 + mv_2$

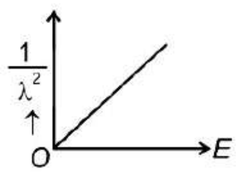
$\Rightarrow \; mv_1 = 2mv_2$

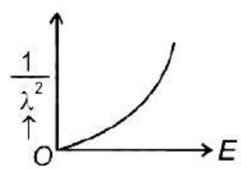
$\Rightarrow \; \dfrac{v_1}{v_2} = \dfrac{2}{1}$

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

(1) 

(2) 

(3) 

(4) 

Answer (3)

Sol. de-Broglie wavelength $\lambda = \dfrac{h}{P} = \dfrac{h}{mv} = \dfrac{h}{\sqrt{2\,mE}}$ where $E = \dfrac{1}{2}mv^2$

Squaring both sides,

$$\lambda^2 = \frac{h^2}{4m^2E}$$

$$\Rightarrow \; \frac{1}{\lambda^2} = (\text{constant})\,E$$

Graph passes through origin with constant slope.

19. An unpolarised light beam strikes a glass surface at Brewster's angle. Then

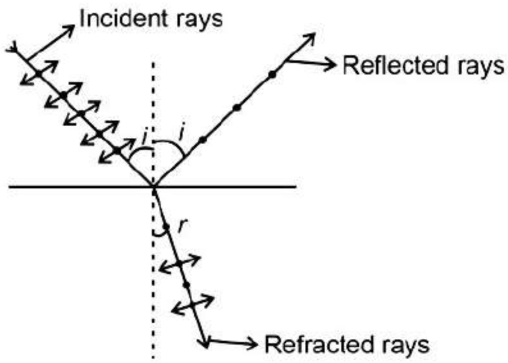
(1) The refracted light will be completely polarised.

(2) Both the reflected and refracted light will be completely polarised.

(3) The reflected light will be completely polarised but the refracted light will be partially polarised.

(4) The reflected light will be partially polarised.

Answer (3)

Sol. 

According to Brewster's law, reflected rays are completely polarized and refracted rays are partially polarized.

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

(1) 5 (2) 7

(3) 6 (4) 10

Answer (4)

Sol. $x = 2t - 1$

$$v = \frac{dx}{dt} = 2\ \text{m s}^{-1}$$

$P = F.v$

$= 2 \times 5 = 10$ W

21. 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):

(1) 4.4 T (2) 4.4 mT

(3) 44 T (4) 44 mT

Answer (2)

Sol. The magnitude of magnetic field due to circular coil of N turns is given by

$$B_C = \frac{\mu_0 iN}{2R}$$

$$= \frac{4\pi \times 10^{-7} \times 7 \times 100}{2 \times 0.1}$$

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

$= 4.4$ mT

22. The moment of inertia of a thin rod about an axis passing through its mid point and perpendicular to the rod is 2400 g cm^2. The length of the 400 g rod is nearly:

(1) 17.5 cm (2) 20.7 cm

(3) 72.0 cm (4) 8.5 cm

Answer (4)

Sol. Moment of inertia of rod = $I = \dfrac{m\ell^2}{12}$

$\Rightarrow \quad 2400 = 400\dfrac{\ell^2}{12}$

$\Rightarrow \quad 72 = \ell^2$

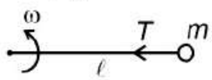
$\Rightarrow \quad \ell = \sqrt{72} = 8.48 \text{ cm } \simeq 8.5 \text{ cm}$

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

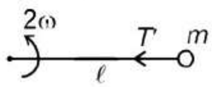
(1) $4T$ (2) $\dfrac{T}{4}$

(3) $\sqrt{2}T$ (4) T

Answer (1)

Sol. 

$T = m\ell\omega^2$



$T' = m\ell(2\omega)^2$

$T' = 4T$

24. 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

(1) A-II, B-I, C-III, D-IV (2) A-III, B-II, C-I, D-IV

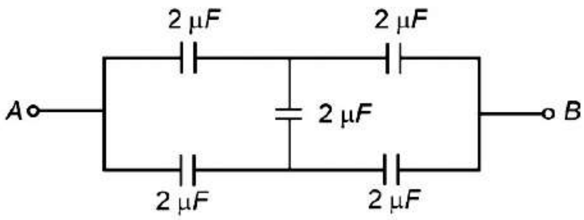
(3) A-IV, B-III, C-II, D-I (4) A-II, B-III, C-IV, D-I

Answer (4)

Sol.

(Material)		(Susceptibility (χ))
Diamagnetic	(II)	$0 > \chi \geq -1$
Ferromagnetic	(III)	$\chi >> 1$
Paramagnetic	(IV)	$0 < \chi < \varepsilon$
Non-magnetic	(I)	$\chi = 0$

25. In the following circuit, the equivalent capacitance between terminal A and terminal B is :



(1) 1 μF

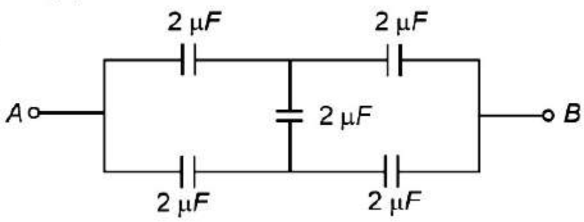
(2) 0.5 μF

(3) 4 μF

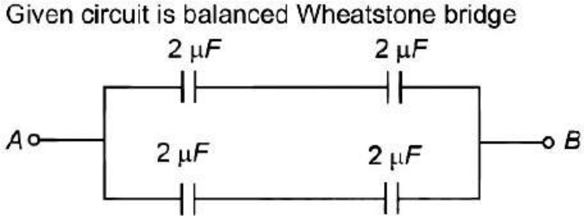
(4) 2 μF

Answer (4)

Sol.



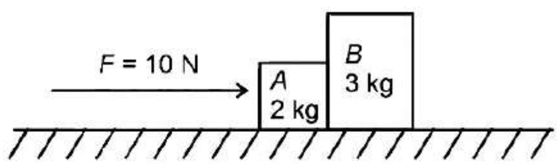
Given circuit is balanced Wheatstone bridge



$C_{AB} = 1 + 1$

$= 2\ \mu F$

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



(1) 4 N

(2) 6 N

(3) 10 N

(4) Zero

Answer (2)

Sol. $F = (M_1 + M_2)a$

$$a = \frac{10}{2+3} = 2\ \text{ms}^{-2}$$

$F' = M_2(2) = 3 \times 2\ \text{N} = 6\ \text{N}$

27. $${}^{290}_{82}X \xrightarrow{\alpha} Y \xrightarrow{e^+} Z \xrightarrow{\beta^-} P \xrightarrow{e^-} Q$$

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

(1) 286, 80

(2) 288, 82

(3) 286, 81

(4) 280, 81

Answer (3)

Sol. $^{290}_{82}X \xrightarrow{\alpha} {}^{286}_{80}Y \xrightarrow{e^+} {}^{286}_{79}Z \xrightarrow{\beta^-} {}^{286}_{80}P \xrightarrow{e^-} {}^{286}_{81}Q$

$A \rightarrow 286$

$Z = 81$

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

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

(2) $100N$

(3) $10(N + 1)$

(4) $\frac{1}{10N}$

Answer (1)

Sol. $V.C = \text{MSD} - \text{VSD}$ ...(1)

given : $(N + 1)$ VSD = N MSD

$$\text{VSD} = \left(\frac{N}{N+1}\right) \text{MSD} \quad ...(2)$$

From (1) and (2)

$$V.C = (\text{MSD}) - \frac{N}{N+1}(\text{MSD})$$

$$= \text{MSD}\left(1 - \frac{N}{N+1}\right) = \frac{\text{MSD}}{N+1}$$

$$= \frac{0.01}{N+1} = \frac{1}{100(N+1)}$$

29. 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

(1) 5 m, 2 s

(2) 5 cm, 1 s

(3) 5 m, 1 s

(4) 5 cm, 2 s

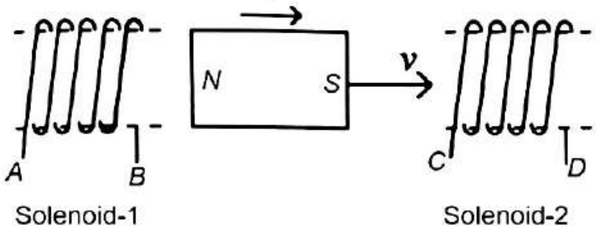
Answer (1)

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

Amplitude = 5 m

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

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

30. 

In the above diagram, a 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:

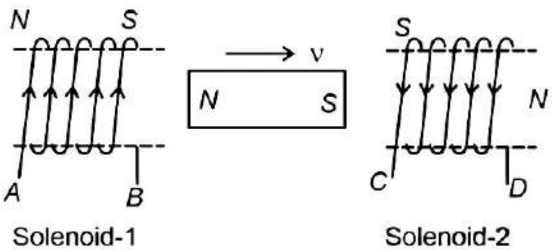
(1) BA and CD

(2) AB and CD

(3) BA and DC

(4) AB and DC

Answer (4)

Sol. 

North of magnet is moving away from solenoid 1 so end B of solenoid 1 is South and as south of magnet is approaching solenoid 2 so end C of solenoid 2 is South.

31. 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 :

(1) $A.\bar{B}+\bar{A}$

(2) $\bar{B}$

(3) B

(4) $A.B+\bar{A}$

Answer (2)

Sol.

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

According to given truth table, output is independent on value of A

$\therefore$ Output $Y=\bar{B}$

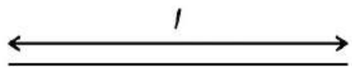
32. A wire of length 'l' and resistance 100 Ω is divided into 10 equal parts. The first 5 parts are connected in series while the next 5 parts are connected in parallel. The two combinations are again connected in series. The resistance of this final combination is:

(1) 52 Ω (2) 55 Ω

(3) 60 Ω (4) 26 Ω

Answer (1)

Sol.



Divided into 10 parts

$$R = \frac{\rho l}{A}$$

$$R' = \frac{\rho l}{10A} = \frac{R}{10}$$

$$R_S = 5 \times \frac{R}{10} \quad \text{[series]}$$

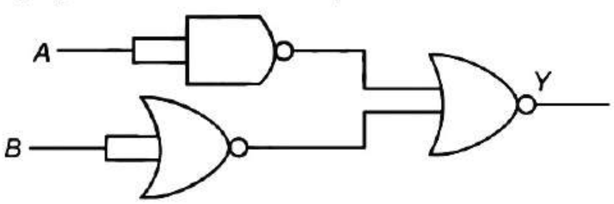
$R_S = 50$

$$R_P = \frac{R}{50} \quad \text{[parallel]}$$

$R_{eq} = R_S + R_P$

$= 52\ \Omega$

33. The output (Y) of the given logic gate is similar to the output of an/a

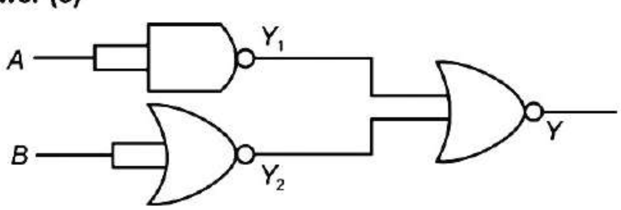


(1) NOR gate (2) OR gate

(3) AND gate (4) NAND gate

Answer (3)

Sol.



$Y_1 = \overline{A \cdot A}$

$= \overline{A}$

$Y_2 = \overline{B + B}$

$= \overline{B}$

$Y = \overline{Y_1 + Y_2}$

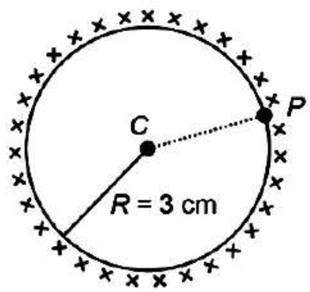
$= \overline{\overline{A} + \overline{B}}$

$= \overline{\overline{A}} \cdot \overline{\overline{B}}$

$= A.B$ is similar to output of AND Gate

34. 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 $\frac{1}{4\pi\varepsilon_0} = 9 \times 10^9$ SI units)



$q = 1\ \mu C$

(1) 1×10^5

(2) 0.5×10^5

(3) Zero

(4) 3×10^5

Answer (3)

Sol. For uniformly charged spherical shell,

$V = \frac{kq}{R}$ (For $r \le R$)

$\therefore$ $V_C = V_P$

$V_C - V_P = \text{Zero}$

35. 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:

(1) $9.8\ m\ s^{-2}$

(2) $4.9\ m\ s^{-2}$

(3) $3.92\ m\ s^{-2}$

(4) $19.6\ m\ s^{-2}$

Answer (3)

Sol. $g' = \frac{GM'}{R'^2} = \frac{GM}{10\left(\frac{R}{2}\right)^2}$

$= \frac{4}{10}\frac{GM}{R^2} = 0.4 \times 9.8$

$= 3.92\ m\ s^{-2}$

36. 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:

(1) $\frac{2GmM}{3R}$

(2) $\frac{GmM}{2R}$

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

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

Answer (4)

Sol. Apply energy conservation,

$U_i + K_i = U_f + K_f$

$$\Rightarrow \quad -\frac{GMm}{R} + K_i = -\frac{GMm}{3R} + \frac{1}{2}mv^2$$

$$\Rightarrow \quad -\frac{GMm}{R} + K_i = -\frac{GMm}{3R} + \frac{1}{2} \times m \times \frac{GM}{3R}$$

$$\Rightarrow \quad K_i = -\frac{1}{6}\frac{GMm}{R} + \frac{GMm}{R}$$

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

37. 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:

(1) 28 (2) 17

(3) 32 (4) 34

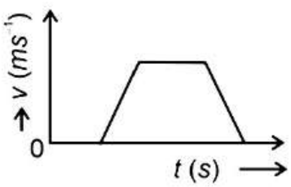
Answer (1)

Sol. $f_0 = 140$ cm and $f_e = 5$ cm

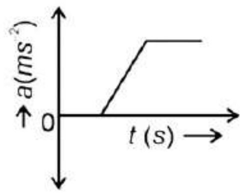
For distant object,

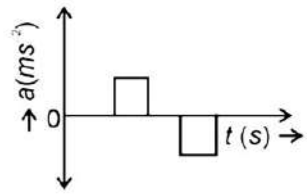
$$m = \frac{f_0}{f_e} = \frac{140}{5} = 28$$

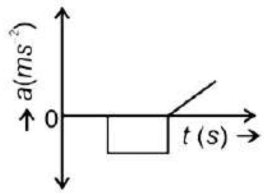
38. The velocity (v) – time (t) plot of the motion of a body is shown below:

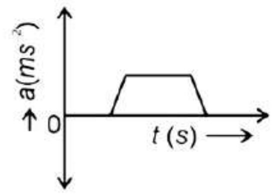


The acceleration (a) – time (t) graph that best suits this motion is :

(1) 

(2) 

(3) 

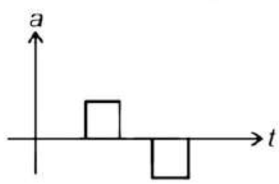
(4) 

Answer (2)

Sol. Initially, the body has zero velocity and zero slope. Hence the acceleration would be zero initially. After that, the slope of v-t curve is constant and positive.

After some time, velocity becomes constant and acceleration is zero.

After that, the slope of v-t curve is constant and negative.



39. Two heaters A and B have power rating of 1 kW and 2 kW, 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:

(1) 2 : 9
(2) 1 : 2
(3) 2 : 3
(4) 1 : 1

Answer (1)

Sol. Power Consumed = $P = \frac{V^2}{R}$

$$\frac{P_A}{P_B} = \frac{R_B}{R_A}$$

$R_A = 2R_B$

For Series Combination

$$P_S = \frac{V^2}{3R_B}$$

For Parallel Combination

$$P_P = \frac{3V^2}{2R_B}$$

$$\frac{P_S}{P_P} = \frac{2}{9}$$

40. 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:

(1) $\alpha t/\beta$ (2) $\alpha\beta t$

(3) $\alpha\beta/t$ (4) $\beta t/\alpha$

Answer (1)

Sol. From principle of homogeneity

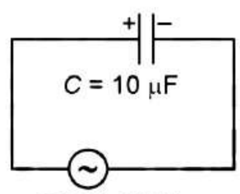
$[F] = [\alpha t^2] = [\beta t]$

$$[\alpha] = \frac{[F]}{[t^2]} \text{ and } [\beta] = \frac{[F]}{[t]}$$

$\therefore\ [\alpha]\,[t] = [\beta]$

$$\therefore\ \frac{\alpha t}{\beta} = \text{dimensionless}$$

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



(1) 0.93 A (2) 1.20 A

(3) 0.35 A (4) 0.58 A

Answer (1)

Sol. Capacitive Reactance $X_C = \dfrac{1}{\omega C} = \dfrac{1}{2\pi f C} = \dfrac{1}{2\times 3.14\times 50\times 10\times 10^{-6}}$

$$= \frac{1000}{3.14}$$

$V_{rms} = 210$ V

$$i_{rms} = \frac{V_{rms}}{X_C} = \frac{210}{X_C}$$

Peak current $= \sqrt{2} i_{rms} = \sqrt{2}\times\dfrac{210}{1000}\times 3.14 = 0.932$

$\simeq 0.93$ A

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

(1) 50×10^3 N (2) 100×10^3 N

(3) 2×10^3 N (4) 5×10^3 N

Answer (1)

Sol. Thermal strain = Longitudinal strain = $\alpha \Delta T$

$\Rightarrow$ Longitudinal strain, $\delta = 10^{-5} \times 10^{2} = 10^{-3}$

$\Rightarrow$ Compressive stress = δ × Young's Modulus

$= 10^{-3} \times 0.5 \times 10^{11}$

$= 0.5 \times 10^{8}$

$\Rightarrow$ Compressive force = $0.5 \times 10^{8} \times 10^{-3} = 0.5 \times 10^{5}$

$= 5 \times 10^{4} \times \frac{10}{10}$

$= 50 \times 10^{3}$ N

43. 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:

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

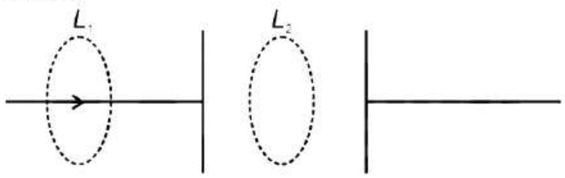
(2) Displacement current of magnitude equal to I flows in a direction opposite to that of I

(3) Displacement current of magnitude greater than I flows but can be in any direction

(4) There is no current

Answer (1)

Sol.



According to modified Ampere's law

$\oint B.\,dl = \mu_0 (I_C + I_D)$

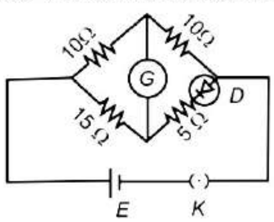
For Loop L_1 $\quad I_C \neq 0$ and $I_D = 0$

For Loop L_2 $\quad I_C = 0$ and $I_D \neq 0$

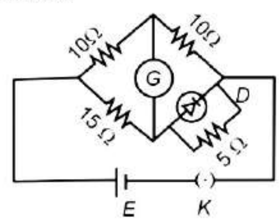
Due to KCL $\quad I_C = I_D$

44. Choose the correct circuit which can achieve the bridge balance.

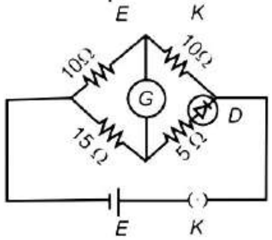
(1)



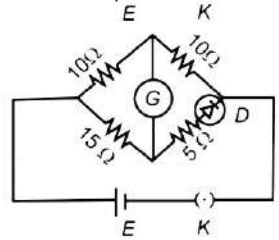
(2)



(3)



(4)



Answer (4)

Sol. In option (4),

$$\frac{10}{15} = \frac{10}{5 + R_D}$$

The diode can conduct and have resistance $R_D = 10\ \Omega$ because diode have dynamic resistance. In that case bridge will be balanced.

45. 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:

(1) A and C only (2) A, C and D only

(3) C only (4) B and D only

Answer (1)

Sol.

A. A magnetic pole will repel or attract magnetic sheet so force is need.

B. If sheet is non-magnetic, no force needed.

C. If it is conducting, then there will be addy current in sheet, which opposes the motion. So forces is needed move sheet with uniform speed.

D. The non-conducting and non-polar sheet do not interact with magnetic field of magnet.

46. 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:

(1) A, C and E only (2) B, D and E only

(3) A, B and C only (4) A, B and E only

Answer (1)

Sol. Given $V' = V =$ Constant

(i) $C' = \frac{\varepsilon_0 A}{d'}, C = \frac{\varepsilon_0 A}{d}$

$d' < d$

$C' > C$

Hence, final capacitance greater than initial capacitance,

(ii) $U' = \frac{1}{2}C'V^2$

$U = \frac{1}{2}CV^2$

$U' > U$

Hence final energy is greater than initial energy

(iii) $\frac{Q'}{V'} = C'$ and $\frac{Q}{V} = C$

$\frac{Q'}{V'} \neq \frac{Q}{V}$

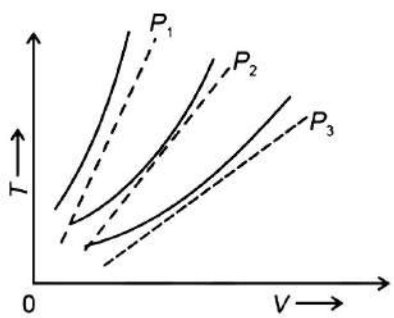
(iv) Product of charge and voltage

$X' = Q'V = C'V^2$

$X = QV = CV^2$

$X' > X$

47. 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:

(1) $P_1 > P_3 > P_2$

(2) $P_2 > P_1 > P_3$

(3) $P_1 > P_2 > P_3$

(4) $P_3 > P_2 > P_1$

Answer (3)

Sol. At same temperature, curve with higher volume corresponds to lower pressure.

$V_3 > V_2 > V_1$

$\Rightarrow P_1 > P_2 > P_3$

(We draw a straight line parallel to volume axis to get this)

48. The property which is not of an electromagnetic wave travelling in free space is that:

(1) The energy density in electric field is equal to energy density in magnetic field

(2) They travel with a speed equal to $\frac{1}{\sqrt{\mu_0 \varepsilon_0}}$

(3) They originate from charges moving with uniform speed

(4) They are transverse in nature

Answer (3)

Sol. The EM waves originate from an accelerating charge. The charge moving with uniform velocity produces steady state magnetic field.

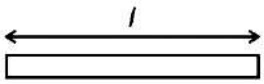
49. An iron bar of length L has magnetic moment M. It is bent at the middle of its length such that the two arms make an angle 60° with each other. The magnetic moment of this new magnet is :

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

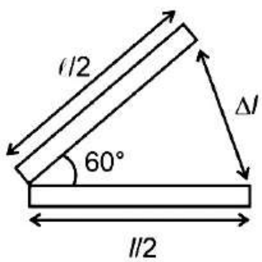
(3) $\frac{M}{\sqrt{3}}$ (4) M

Answer (1)

Sol.



$M = ml.$



$\Delta l = 2\frac{l}{2}\sin 30°$

$= \frac{l}{2}$

$M' = ml/2$

$= M/2$

50. If the mass of the bob in a simple pendulum is increased 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:

(1) $\sqrt{2}$ (2) $2\sqrt{3}$

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

Answer (1)

Sol. $T' = 2\pi\sqrt{\frac{\ell'}{g}}$ where $\ell' = \frac{\ell}{2}$

$T = 2\pi\sqrt{\frac{\ell}{g}}$

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

$2\pi\sqrt{\frac{\ell}{2g}} = \frac{x}{2}2\pi\sqrt{\frac{\ell}{g}}$

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