PHYSICS

SECTION - A

Multiple Choice Questions: This section contains 20 multiple choice questions. Each question has 4 choices (1), (2), (3) and (4), out of which **ONLY ONE** is correct.

Choose the correct answer:

1. The time period of a satellite of earth is 24 hours. If the separation between the earth and the satellite is decreased to one fourth of the previous value, then its new time period will become.

(1) 6 hours (2) 4 hours

(3) 3 hours (4) 12 hours

Answer (3)

Sol. $\because \quad T^2 \propto R^3$

$$\therefore \quad \frac{T_1^2}{T_2^2} = \frac{R_1^3}{R_2^3}$$

$$\frac{24^2}{T_2^2} = \frac{R_1^3}{\left(\frac{R_1}{4}\right)^3}$$

$$\frac{24^2}{T_2^2} = 4^3$$

$$T_2 = \frac{24}{2^3}$$

= 3 hours

2. A force acts for 20 s on a body of mass 20 kg, starting from rest, after which the force ceases and then body describes 50 m in the next 10 s. The value of force will be:

(1) 10 N (2) 5 N

(3) 20 N (4) 40 N

Answer (2)

Sol. $m = 20$ kg

$t = 20$ sec.

Acceleration $= \frac{F}{20}$ m/s^2

$\therefore \quad v = u + at$

$$v = 0 + \left(\frac{F}{20}\right)(20)$$

$= F$ ms^{-1}

Now for next 10 sec.

$S = ut$

$50 = F(10)$

$\boxed{F = 5}$

3. The ratio of de-Broglie wavelength of an α particle and a proton accelerated from rest by the same potential is $\frac{1}{\sqrt{m}}$, the value of m is

(1) 16

(2) 2

(3) 8

(4) 4

Answer (3)

Sol. $$\frac{\lambda_\alpha}{\lambda_{proton}} = \frac{1}{\sqrt{2(4m)(2eV)}} \times \frac{\sqrt{2(m)(e)V}}{1}$$

$$= \frac{1}{\sqrt{8}}$$

$m = 8$

4. At 300 K, the rms speed of oxygen molecule is $\sqrt{\frac{\alpha+5}{\alpha}}$ times to that of its average speed in the gas. Then, the value of α will be

(used $\pi = \frac{22}{7}$)

(1) 28

(2) 27

(3) 32

(4) 24

Answer (1)

Sol. $$v_{rms} = \sqrt{\frac{\alpha+5}{\alpha}} v_{avg}$$

$$\sqrt{\frac{3RT}{m}} = \sqrt{\frac{\alpha+5}{5}} \sqrt{\frac{8RT}{\pi m}}$$

$$\frac{3 \times \pi}{8} = \frac{\alpha+5}{\alpha}$$

$$\frac{33}{28} = \frac{\alpha+5}{\alpha}$$

$\boxed{\alpha = 28}$

5. Heat energy of 184 kJ is given to ice of mass 600 g at –12°C. Specific heat of ice is 2222.3 J kg^{-1}°C^{-1} and latent heat of ice in 336 kJ/kg^{-1}

A. Final temperature of system will be 0°C.

B. Final temperature of the system will be greater than 0°C.

C. The final system will have a mixture of ice and water in the ratio of 5 : 1.

D. The final system will have a mixture of ice and water in the ratio of 1 : 5.

E. The final system will have water only.

Choose the correct answer from the options given below:

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

(3) B and D only (4) A and E only

Answer (2)

Sol. Heat required to raise the temperature of ice to 0°C is

$= \frac{60}{1000}(2222.3)(12)$

= 16000.5 J

≈ 16 kJ

Heat required to melt ice completely

$= \left(\frac{600}{1000}\right)(336)$ kJ

= 201.6 kJ

Energy left = (184 – 16) = 168 kJ

$\therefore$ Partial ice will melt

$\therefore$ $168 = (m_{\text{ice melted}})336$

0.5 kg = ($m_{\text{ice melted}}$)

$\therefore$ $m_{\text{ice}} : m_{\text{water}} = 1 : 5$

6. With the help of potentiometer, we can determine the value of emf of a given cell. The sensitivity of the potentiometer is

(A) Directly proportional to the length of the potentiometer wire

(B) Directly proportional to the potential gradient of the wire

(C) inversely proportional to the potential gradient of the wire

(D) inversely proportional to the length of the potentiometer wire

Choose the correct option for the above statements:

(1) C only

(2) B and D only

(3) A and C only

(4) A only

Answer (3)

Sol. Sensitivity $\propto \frac{1}{k(\text{potential gradient})}$

$\propto$ length

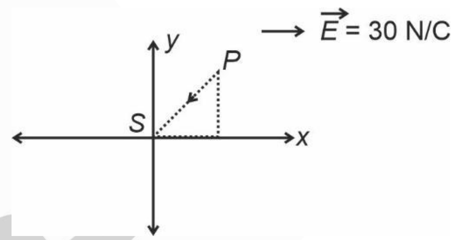
7. A point charge 2 × 10^{-2} C is moved from *P* to *S* in a uniform electric field of 30 NC^{-1} directed along positive *x*-axis. If coordinates of *P* and *S* are (1, 2, 0) m and (0, 0, 0) m respectively, the work done by electric field will be

(1) –1200 mJ (2) 600 mJ

(3) –600 mJ (4) 1200 mJ

Answer (3)

Sol.



$w = \int F \cdot ds$

$\vec{F} = q\vec{E} = 2\times10^{-2}\times 30\hat{i} = 0.6\text{N}\hat{i}$

$w = \vec{F}\cdot\vec{d} = (0.6\hat{i})\cdot(-\hat{i},-2\hat{j})$

= – 0.6 J

= – 600 mJ

8. A square loop of area 25 cm^2 has a resistance of 10 Ω. The loop is placed in uniform magnetic field of magnitude 40.0 T. The plane of loop is perpendicular to the magnetic field. The work done in pulling the loop out of the magnetic field slowly and uniformly in 1.0 sec, will be

(1) 2.5 × 10^{-3} J

(2) 1.0 × 10^{-4} J

(3) 5 × 10^{-3} J

(4) 1.0 × 10^{-3} J

Answer (4)

Sol. From energy conservation.

Work done to pull the loop out

= Energy lost is resistance

Emf in the loop $= \frac{d\phi}{dt} = \frac{B \times A}{t} = \frac{40 \times 25 \times 10^{-4}}{1\text{ s}}$

$= 0.1$ V

Energy lost $= \frac{emf^2}{R} = \ = \frac{(0.1)^2}{10} = 10^{-3}$ J

9. The time taken by an object to slide down 45° rough inclined plane is n times as it takes to slide down a perfectly smooth 45° incline plane. The coefficient of kinetic friction between the object and the incline plane is:

(1) $1 - \frac{1}{n^2}$

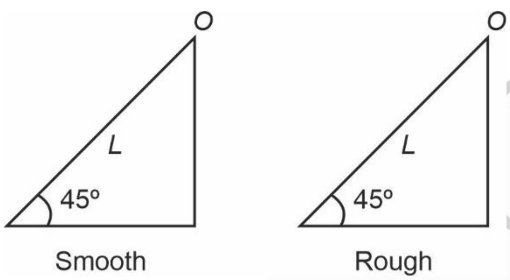
(2) $\sqrt{1 - \frac{1}{n^2}}$

(3) $\sqrt{\frac{1}{1-n^2}}$

(4) $1 + \frac{1}{n^2}$

Answer (1)

Sol.



Smooth case:

$$a = g\sin 45^\circ = \frac{9}{\sqrt{2}}$$

$$t_1 = \sqrt{\frac{2L}{a}} = \sqrt{\frac{2L}{g/\sqrt{2}}} = \sqrt{\frac{2\sqrt{2}L}{g}} \quad \text{....(1)}$$

Rough case:

$$a = g\sin 45^\circ - \mu g\cos 45^\circ$$

$$= \frac{g}{\sqrt{2}}(1-\mu)$$

$$t_2 = \sqrt{\frac{2L}{a}} = \sqrt{\frac{2\sqrt{2}L}{g(1-\mu)}} \quad \text{....(2)}$$

From (1) to (2) and $t_1 = \frac{t_2}{n}$ we have

$$\sqrt{\frac{2\sqrt{2}L}{g}} = \frac{1}{n}\sqrt{\frac{2\sqrt{2}L}{g(1-\mu)}} \Rightarrow \boxed{\mu = 1 - \frac{1}{n^2}}$$

10. A fully loaded boeing aircraft has a mass of 5.4×10^5 kg. Its total wing area is 500 m^2. It is in level flight with a speed of 1080 km/h. If the density of air ρ is 1.2 kg m^{-3}, the fractional increase in the speed of the air on the upper surface of the wing relative to the lower surface in percentage will be. (g = 10 m/s^2)

(1) 16

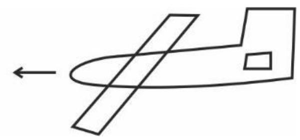
(2) 6

(3) 10

(4) 8

Answer (3)

Sol.



Velocity of aircraft = 1080 km/h

= 300 m/s

Now, weight of aircraft $= \Delta PA$

$$\Delta P = \frac{5.4 \times 10^5 \times g}{500} = 10800 \text{ Pa}$$

From Bernoulli's principle

$$\Delta P = \frac{1}{2}\rho\left[V_{upper}^2 - V_{lower}^2\right]$$

$$10800 = \frac{1}{2} \times 1.2 \times V_{lower}^2\left[\left(\frac{V_{upper}}{V_{lower}}\right)^2 - 1\right]$$

$$\left(\frac{V_{upper}}{V_{lower}}\right)^2 = 1 + \frac{10800 \times 2}{1.2 \times (300)^2} = 1.2$$

$$\frac{V_{upper}}{V_{lower}} = 1.096$$

$\Rightarrow$ Fractional increases = 9.6%.

11. Given below are two statements:

Statement I : Electromagnetic waves are not deflected by electric and magnetic field.

Statement II : The amplitude of electric field and the magnetic field in electromagnetic waves are related to each other as $E_0 = \sqrt{\frac{\mu_0}{\varepsilon_0}}B_0$.

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

(1) Both statement I and statement II are false

(2) Both statement I and statement II are true

(3) Statement I is true but statement II is false

(4) Statement I is false but statement II is true

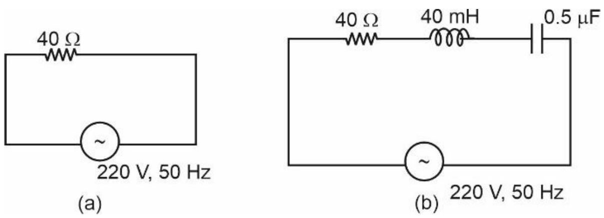
Answer (3)

Sol. Statement I is correct as photon do not carry any charge, hence cannot feel force from either fields.

Statement II is wrong as $E_0 = cB_0$

$$E_0 = \frac{B_0}{\sqrt{\mu_0 \varepsilon_0}}$$

12. For the given figures, choose the correct options:



(1) The rms current in circuit (b) can be larger than that in (a)

(2) At resonance, current in (b) is less than that in (a)

(3) The rms current in figure (a) is always equal to that in figure (b)

(4) The rms current in circuit (b) can never be larger than that in (a)

Answer (4)

Sol. For (a), $i = \frac{V}{R} = \frac{220}{40} = 5.5\text{ A}$

for (b), $X_C = \frac{1}{2\pi fC} = \frac{1}{2\pi 50 \times 0.5 \times 10^{-6}} = \frac{10^6}{50\pi}\ \Omega$

$X_L = 2\pi fL = 2\pi \times 50 \times 50 \times 10^{-3} = 50\pi\ \Omega$

$X_C > X_L$, hence impedance is greater than 40 Ω.

$$i_{\text{rms}} = \frac{220}{Z}$$

$$\therefore\ i_{\text{rms}}\big|_b < i_{\text{rms}}\big|_a$$

13. Identify the correct statements from the following:

A. Work done by a man in lifting a bucket out of a well by means of rope tied to the bucket is negative.

B. Work done by gravitational force in lifting a bucket out of a well by a rope tied to the bucket is negative.

C. Work done by friction on a body sliding down an inclined plane is positive.

D. Word done by an applied force on a body moving on a rough horizontal plane with uniform velocity is zero.

E. Work done by the air resistance on an oscillating pendulum is negative.

Choose the correct answer from the options given below:

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

(3) B, D and E only (4) B and D only

Answer (2)

Sol. B. Work done by gravitation will be negative if something is lifted upward.

D. Work done by air resistance is negative.

14. Substance A has atomic mass number 16 and half life of 1 day. Another substance B has atomic mass number 32 and half life of $\frac{1}{2}$ day. If both A and B simultaneously start undergo radio activity at the same time with initial mass 320 g each, how many total atoms of A and B combined would be left after 2 days.

(1) 6.76×10^{24}

(2) 3.38×10^{24}

(3) 6.76×10^{23}

(4) 1.69×10^{24}

Answer (2)

Sol. $n_A = 20$ moles

$n_B = 10$ moles

$N = N_0 e^{-\lambda t}$

$$N_A = (20\text{ N})e^{-\left(\frac{\ln 2}{1} \times 2\right)}$$

$$= \frac{20\text{ N}}{4} = 5\text{ N} \qquad \text{(N = Avogadro's Number)}$$

$$N_B = 10\,N\,e^{-4\ln 2}$$

$$= \left(\frac{10\text{ N}}{16}\right)$$

$$N_A + N_B = 5\text{ N} + \frac{10\text{ N}}{16} = \left(\frac{90\text{ N}}{16}\right) = 3.38 \times 10^{24}$$

15. A scientist is observing a bacteria through a compound microscope. For better analysis and to improve its resolving power he should. (Select the best option)

(1) Decrease the diameter of the objective lens

(2) Decrease the focal length of the eye piece

(3) Increase the refractive index of the medium between the object and objective lens

(4) Increase the wavelength of the light

Answer (3)

Sol. Resolving power of microscope = $\left(\frac{2n\sin\theta}{\lambda}\right)$

$n\sin\theta$ = Numerical aperture

n is the refractive index of medium.

16. The modulation index for an A.M. wave having maximum and minimum peak-to-peak voltages of 14 mV and 6 mV respectively is

(1) 1.4

(2) 0.6

(3) 0.4

(4) 0.2

Answer (3)

Sol. $A_c + A_m = 14$ mV

$A_c - A_m = 6$ mV

$\Rightarrow 2A_c = 20$ mV

$A_c = 10$ mV

$A_m = 4$ mV

Modulation Index = $\frac{A_m}{A_c} = \left(\frac{4}{10}\right) = 0.4$

17. The equation of a circle is given by $x^2 + y^2 = a^2$, where a is the radius. If the equation is modified to change the origin other than (0, 0), then find out the correct dimensions of A and B in a new equation $(x - At)^2 + \left(y - \frac{t}{B}\right)^2 = a^2$. The dimension of t is given as $[T^{-1}]$.

(1) A = $[LT]$, B = $[L^{-1}T^{-1}]$

(2) A = $[L^{-1}T]$, B = $[LT^{-1}]$

(3) A = $[L^{-1}T^{-1}]$, B = $[LT]$

(4) A = $[L^{-1}T^{-1}]$, B = $[LT^{-1}]$

Answer (1)

Sol. $[At] = [x] = [L]$

$$[A] = \frac{[x]}{[t]} = [LT]$$

$$\left[\frac{t}{B}\right] = [y] = [L]$$

$$\Rightarrow [B] = \left[\frac{t}{L}\right] = \left[L^{-1}T^{-1}\right]$$

18. An object moves at a constant speed along a circular path in a horizontal plane with centre at the origin. When the object is at x = +2 m, its velocity is $-4\hat{j}$ m/s. The object's velocity (v) and acceleration (a) at x = –2 m will be

(1) $v = 4\hat{i}$ m/s, $a = 8\hat{j}$ m/s^2

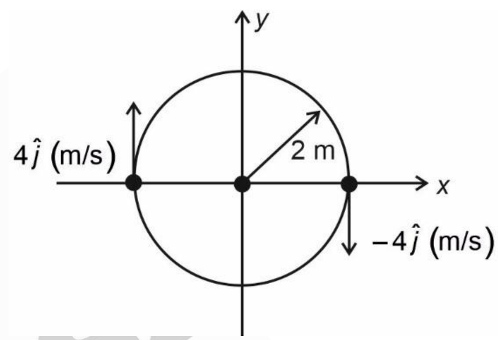
(2) $v = 4\hat{j}$ m/s, $a = 8\hat{i}$ m/s^2

(3) $v = -4\hat{i}$ m/s, $a = -8\hat{j}$ m/s^2

(4) $v = -4\hat{j}$ m/s, $a = 8\hat{i}$ m/s^2

Answer (2)

Sol.

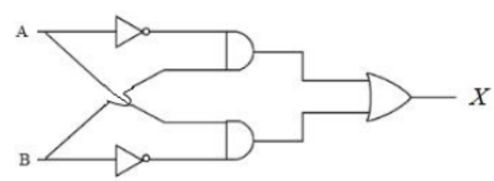


$\vec{v} = 4\hat{j}$ (m/s)

$a = \frac{v^2}{R} = \frac{16}{2} = 8$ m/s^2

$\vec{a} = 8\left(\text{m/s}^2\right)\left(\hat{i}\right)$

19. For the given logic gates combination, the correct truth table will be



(1)

A	B	X
0	0	0
0	1	1
1	0	1
1	1	0

(2)

A	B	X
0	0	1
0	1	0
1	0	0
1	1	0

(3)

A	B	X
0	0	0
0	1	1
1	0	1
1	1	1

(4)

A	B	X
0	0	1
0	1	0
1	0	1
1	1	0

Answer (1)

Sol. As per the circuit,

$X = A'B + AB'$

If: $A = 0, B = 0 \Rightarrow X = 0$

$A = 0, B = 1 \Rightarrow X = 1$

$A = 1, B = 0 \Rightarrow X = 1$

$A = 1, B = 1 \Rightarrow X = 0$

20. The electric current in a circular coil of four turns produces a magnetic induction 32 T at its centre. The coil is unwound and is rewound into a circular coil of single turn, the magnetic induction at the centre of the coil by the same current will be

(1) 4 T (2) 16 T

(3) 8 T (4) 2 T

Answer (4)

Sol. By given information

$$32 = 4 \times \frac{\mu_0 i}{2r} \quad \ldots(i)$$

Also, $r' = 4r$ …(ii)

$$\text{and } B' = 1 \times \frac{\mu_0 i}{2r'} \quad \ldots(iii)$$

$$\Rightarrow B' = \frac{\mu_0 i}{2(4r)} = \frac{\mu_0 i}{8r} = \frac{1}{8} \times 16 = 2\text{ T}$$

SECTION - B

Numerical Value Type Questions: This section contains 10 questions. In Section B, attempt any five questions out of 10. The answer to each question is a **NUMERICAL VALUE.** For each question, enter the correct numerical value (in decimal notation, truncated/rounded-off to the second decimal place; e.g. 06.25, 07.00, –00.33, –00.30, 30.27, –27.30) using the mouse and the on-screen virtual numeric keypad in the place designated to enter the answer.

21. When two resistances R_1 and R_1 connected in series and introduced into the left gap of a meter bridge and a resistance of 10 Ω is introduced into the right gap, a null point is found at 60 cm from left side. When R_1 and R_2 are connected in parallel and introduced into the left gap, a resistance of 3 Ω is introduced into the right gap to get null point at 40 cm from left end. The product of R_1R_2 is _______ Ω^2

Answer (30)

Sol. As per given information

$$\frac{R_1 + R_2}{10} = \frac{0.6}{0.4} \quad \ldots(1)$$

$$\& \ \frac{\frac{R_1R_2}{R_1+R_2}}{3} = \frac{0.4}{0.6} \quad \ldots(2)$$

$$\Rightarrow \left.\begin{matrix} R_1 + R_2 = 15 \\ \& \ R_1R_2 = 30 \end{matrix}\right] \Rightarrow R_1R_2 = 30\ \Omega^2$$

22. For a charged spherical ball, electrostatic potential inside the ball varies with r as $V = 2ar^2 + b$.

Here a and b are constant and r is the distance from the center. The volume charge density inside the ball is $-\lambda a\varepsilon$. The value of λ is _____.

ε = permittivity of the medium

Answer (12)

Sol. $V = 2ar^2 + b$

$$\Rightarrow E = -\frac{dV}{dr} = -4ar$$

$$\Rightarrow \frac{1}{4\pi\varepsilon}\frac{Q}{r^2} = -4ar$$

$$\Rightarrow \frac{Q}{\frac{4}{3}\pi r^3} = 3 \times \varepsilon \times (-4a) = -12a\varepsilon$$

$\Rightarrow \lambda = 12$

23. A car is moving on a circular path of radius 600 m such that the magnitudes of the tangential acceleration and centripetal acceleration are equal. The time taken by the car to complete first quarter of revolution, if it is moving with an initial speed of 54 km/hr is $t(1 - e^{-\pi/2})$ s. The value of t is_____.

Answer (40)

Sol. $$\frac{dv}{dt} = \frac{v^2}{R} \Rightarrow \frac{v^2}{R} = v\frac{dv}{ds}$$

$$\Rightarrow \frac{dv}{v} = \frac{ds}{R} \Rightarrow \ln v\Big|_{15}^{v} = \frac{s}{R}$$

$$\Rightarrow v = 15e^{\Delta/R} = \frac{ds}{dt} \Rightarrow dt = \frac{1}{15}e^{-\Delta/R}ds$$

$$\Delta t = \frac{R}{15}[1 - e^{-\Delta/R}]$$

$$= 40[1 - e^{-\pi/2}] \text{ seconds}$$

$\Rightarrow$ $t = 40$

24. Unpolarised light is incident on the boundary between two dielectric media, whose dielectric constants are 2.8 (medium – 1) and 6.8 (medium – 2), respectively . To satisfy the condition, so that the reflected and refracted rays are perpendicular to each other, the angle of incidence should be $\tan^{-1}\left(1+\frac{10}{\theta}\right)^{\frac{1}{2}}$ the value of θ is ____.

(Given for dielectric media, $\mu_r = 1$)

Answer (7)

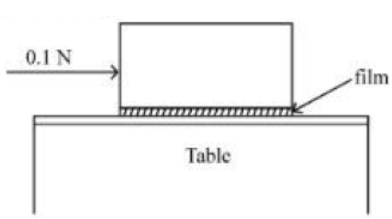
Sol We know that

$$\tan\theta_0 = \frac{\mu_2}{\mu_1}$$

$$\tan\theta_0 = \sqrt{\frac{6.8}{2.8}} = \sqrt{\frac{17}{7}}$$

$$\theta_0 = \tan^{-1}\sqrt{1+\frac{10}{7}} \Rightarrow \theta = 7$$

25. A metal block of base area 0.20 m^2 is placed on a table as shown in figure. A liquid film of thickness 0.25 mm is inserted between the block and the table. The block is pushed by a horizontal force of 0.1 N and moves with a constant speed. If the viscosity of the liquid is 5.0×10^{-3} Pl, the speed of block is ______ $\times 10^{-3}$ m/s



Answer (25)

Sol. As the block moves with constant speed, the horizontal force is balanced by viscous force thus

$$F = \eta A\frac{\Delta v}{\Delta z}$$

$$0.1 = 5\times10^{-3}\times0.2\times\frac{v}{.25\times10^{-3}}$$

$\Rightarrow$ $v = 25 \times 10^{-3}$ m/s

26. A particle of mass 250 g executes a simple harmonic motion under a periodic force F = (– 25 x) N. The particle attains a maximum speed of 4 m/s during its oscillation. The amplitude of the motion is _______ cm.

Answer (40)

Sol. $F = -25x$

$$.250\frac{d^2x}{dt^2} = -25x$$

$$\frac{d^2x}{dt^2} = -100x$$

$\Rightarrow \omega = 10$ rad/sec

& $\omega A = v_{max}$

10 A = 4

$\Rightarrow$ A = 0.4 m

= 40 cm

27. In an experiment of measuring the refractive index of a glass slab using travelling microscope in physics lab, a student measures real thickness of the glass slab as 5.25 mm and apparent thickness of the glass slab as 5.00 mm. Travelling microscope has 20 divisions in one cm on main scale and 50 divisions on vernier scale is equal to 49 divisions on main scale. The estimated uncertainty in the measurement of refractive index of the slab is $\frac{x}{10}\times10^{-3}$, where x is __________.

Answer (41)

Sol. $\mu = \frac{\text{real depth }(l_1)}{\text{apparent depth}(l_2)}$

$$= \frac{5.25}{5} = 1.05$$

$$\frac{d\mu}{\mu} = \frac{dl_1}{l_1} + \frac{dl_2}{l_2}$$

$$d\mu = \left(\frac{dl_1}{l_1} + \frac{dl_2}{l_2}\right)\mu$$

$$= \left(\frac{0.01}{5.25} + \frac{0.01}{5.00}\right) \times 1.05$$

$$= \frac{41}{10} \times 10^{-3}$$

so x = 41

28. A null point is found at 200 cm in potentiometer when cell in secondary circuit is shunted by 5Ω. When a resistance of 15Ω is used for shunting, null point moves to 300 cm. The internal resistance of the cell is __________ Ω.

Answer (05)

Sol. Let the emf is E and internal resistance is r of this secondary cell so

$$\frac{RE}{r+R} \propto l$$

so $\frac{R_1E}{r+R_1} \propto l_1$

& $\frac{R_2E}{r+R_2} \propto l_2$

$$\Rightarrow \frac{R_1(r+R_2)}{R_2(r+R_1)} = \frac{l_1}{l_2}$$

OR $\frac{5(r+15)}{15(r+5)} = \frac{200}{300}$

$\Rightarrow r = 5\ \Omega$

29. An inductor of inductance 2 μH is connected in series with a resistance, a variable capacitor and an AC source of frequency 7 kHz. The value of capacitance for which maximum current is drawn into the circuit is $\frac{1}{x}F$, where the value of x is _______.

(Take $\pi = \frac{22}{7}$)

Answer (3872)

Sol. Current drawn is maximum when circuit is in resonance.

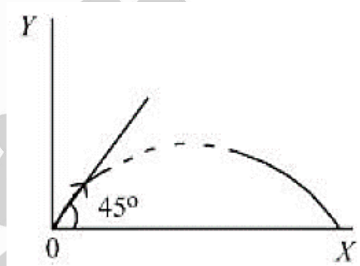
$$\omega = \frac{1}{\sqrt{LC}}$$

$$2\pi(7000) = \frac{1}{\sqrt{2\times10^{-6}C}}$$

$$\Rightarrow C = \frac{1}{3872}F$$

30. A particle of mass 100 g is projected at time t = 0 with a speed 20 ms^{-1} at an angle 45° to the horizontal as given in the figure. The magnitude of the angular momentum of the particle about the starting point at time t = 2 s is found to be $\sqrt{K}$ kg m^2/s. The value of K is __________.

(Take g = 10 ms^{-2})



Answer (800)

Sol. Horizontal displacement $x = v\cos\theta t$

$$= 10\sqrt{2}t$$

So torque of weight about point of projection is

$$\tau = mgx\cdot(-\hat{k})$$

$$\frac{d\vec{L}}{dt} = mgx(-\hat{k})$$

$$\int_0^{\vec{L}} d\vec{L} = 0.1\times10\times10\sqrt{2}\int_0^2 t\,dt(-\hat{k})$$

$$\vec{L} = -20\sqrt{2}\hat{k}$$

$$|\vec{L}| = 20\sqrt{2} = \sqrt{800}\ \text{kg m}^2/\text{s}$$