JEE (Main) PHYSICS SOLVED PAPER

2021

16th March Shift 1

Time : 1 Hour **Total Marks : 100**

General Instructions :

1. *In Chemistry Section, there are 30 Questions (Q. no. 1 to 30).*
2. *In Chemistry, Section A consists of 20 multiple choice questions & Section B consists of 10 numerical value type questions. In Section B, candidates have to attempt any five questions out of 10.*
3. *There will be only one correct choice in the given four choices in Section A. For each question for Section A, 4 marks will be awarded for correct choice, 1 mark will be deducted for incorrect choice questions and zero mark will be awarded for not attempted question.*
4. *For Section B questions, 4 marks will be awarded for correct answer and zero for unattempted and incorrect answer.*
5. *Any textual, printed or written material, mobile phones, calculator etc. is not allowed for the students appearing for the test.*
6. *All calculations / written work should be done in the rough sheet is provided with Question Paper.*

Physics

Section A

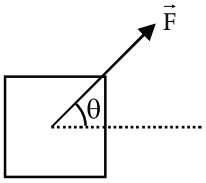
Q. 1. A 25 m long antenna is mounted on an antenna tower. The height of the antenna tower is 75 m. The wavelength (in meter) of the signal transmitted by this antenna would be :

(1) 200 **(2)** 400

(3) 100 **(4)** 300

Q. 2. A block of mass m slides along a floor while a force of magnitude F is applied to it at an angle θ as shown in figure. The coefficient of kinetic friction is μ_K. Then, the block's acceleration 'a' is given by :

(g is acceleration due to gravity)



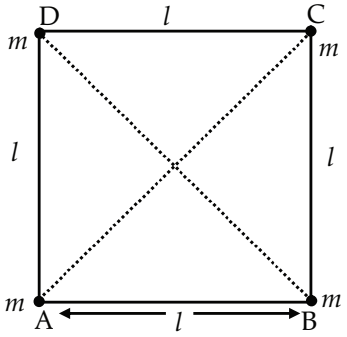
(1) $\frac{F}{m}\cos\theta - \mu_K\left(g - \frac{F}{m}\sin\theta\right)$

(2) $\frac{F}{m}\cos\theta - \mu_K\left(g + \frac{F}{m}\sin\theta\right)$

(3) $\frac{F}{m}\cos\theta + \mu_K\left(g - \frac{F}{m}\sin\theta\right)$

(4) $-\frac{F}{m}\cos\theta - \mu_K\left(g - \frac{F}{m}\sin\theta\right)$

Q. 3. Four equal masses, m each are placed at the corners of a square of length (l) as shown in the figure. The moment of inertia of the system about an axis passing through A and parallel to DB would be :



(1) ml^2 **(2)** $3\,ml^2$

(3) $\sqrt{3}\,ml^2$ **(4)** $2\,ml^2$

Q. 4. The stopping potential in the context of photoelectric effect depends on the following property of incident electromagnetic radiation :

(1) Amplitude **(2)** Phase

(3) Frequency **(4)** Intensity

Q. 5. One main scale division of a vernier callipers is 'a' cm and n^{th} division of the vernier scale coincide with $(n-1)^{th}$ division of the main scale. The least count of the callipers in mm is :

(1) $\left(\frac{n-1}{10n}\right)a$ **(2)** $\frac{10a}{n}$

(3) $\frac{10na}{(n-1)}$ **(4)** $\frac{10a}{(n-1)}$

Q. 6. A plane electromagnetic wave of frequency 500 MHz is travelling in vacuum along y–direction.

At a particular point in space and time, $\vec{B} = 8.0\times10^{-8}\,\hat{z}\,T$. The value of electric field at this point is :

(speed of light = 3×10^8 ms^{-1})

$\hat{x}, \hat{y}, \hat{z}$ are unit vectors along x, y and z directions.

(1) $2.6\hat{x}\,\frac{V}{m}$ **(2)** $-2.6\hat{y}\,\frac{V}{m}$

(3) $24\hat{x}\,\frac{V}{m}$ **(4)** $-24\hat{x}\,\frac{V}{m}$

Q. 7. The maximum and minimum distances of a comet from the Sun are 1.6×10^{12} m and 8.0×10^{10} m respectively. If the speed of the comet at the nearest point is 6×10^4 ms^{-1}, the speed at the farthest point is :

(1) 1.5×10^3 m/s **(2)** 4.5×10^3 m/s

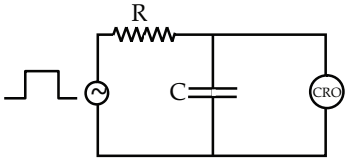
(3) 3.0×10^3 m/s **(4)** 6.0×10^3 m/s

Q. 8. A block of 200 g mass moves with a uniform speed in a horizontal circular groove, with vertical side walls of radius 20 cm. If the block takes 40 s to complete one round, the normal force by the side walls of the groove is :

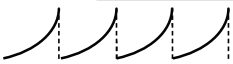
(1) 6.28×10^{-3} N **(2)** 0.0314 N

(3) 9.859×10^{-2} N **(4)** 9.859×10^{-4} N

Q. 9. An RC circuit as shown in the figure is driven by a AC source generating a square wave. The output wave pattern monitored by CRO would look close to :



(1)



(2)

(3)

(4)

Q. 10. In thermodynamics, heat and work are :

(1) Intensive thermodynamics state variables

(2) Extensive thermodynamics state variables

(3) Path functions

(4) Point functions

Q. 11. A conducting wire of length 'l', area of cross–section A and electric resistivity ρ is connected between the terminals of a battery. A potential difference V is developed between its ends, causing an electric current. If the length of the wire of the same material is doubled and the area of cross–section is halved, the resultant current would be :

(1) $\frac{1}{4}\frac{\rho l}{VA}$ **(2)** $\frac{3}{4}\frac{VA}{\rho l}$

(3) $4\frac{VA}{\rho l}$ **(4)** $\frac{1}{4}\frac{VA}{\rho l}$

Q. 12. The pressure acting on a submarine is 3×10^5 Pa at a certain depth. If the depth is doubled, the percentage increase in the pressure acting on the submarine would be :

(Assume that atmospheric pressure is 1×10^5 Pa density of water is 10^3 kg m^{-3}, g = 10 ms^{-2})

(1) $\frac{200}{3}\%$ **(2)** $\frac{5}{200}\%$

(3) $\frac{200}{5}\%$ **(4)** $\frac{3}{200}\%$

Q. 13. A bar magnet of length 14 cm is placed in the magnetic meridian with its north pole pointing towards the geographic north pole. A neutral point is obtained at a distance of 18 cm from the center of the magnet. If B_H = 0.4 G, the magnetic moment of the magnet is (1 G = 10^{-4} T)

(1) 28.80 J T^{-1} **(2)** 2.880 J T^{-1}

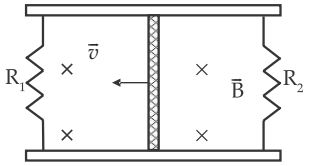
(3) 2.880×10^3 J T^{-1} **(4)** 2.880×10^2 J T^{-1}

Q. 14. The volume V of an enclosure contains a mixture of three gases, 16 g of oxygen, 28 g of nitrogen and 44 g of carbon dioxide at absolute temperature T. Consider R as universal gas constant. The pressure of the mixture of gases is :

(1) $\frac{4RT}{V}$ **(2)** $\frac{88RT}{V}$

(3) $\frac{5}{2}\frac{RT}{V}$ **(4)** $\frac{3RT}{V}$

Q. 15. A conducting bar of length L is free to slide on two parallel conducting rails as shown in the figure.



Two resistors R_1 and R_2 are connected across the ends of the rails. There is a uniform magnetic field $\vec{B}$ pointing into the page. An external agent pulls the bar to the left at a constant speed *v*.

The correct statement about the directions of induced currents I_1 and I_2 flowing through R_1 and R_2 respectively is :

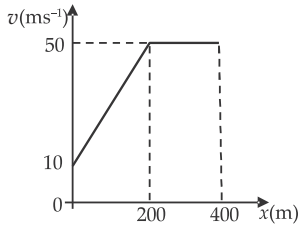
(1) I_1 is in clockwise direction and I_2 is in anticlockwise direction

(2) Both I_1 and I_2 are in clockwise direction

(3) I_1 is in anticlockwise direction and I_2 is in clockwise direction

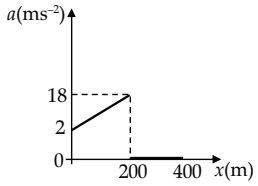
(4) Both I_1 and I_2 are in anticlockwise direction

Q. 16. The velocity–displacement graph describing the motion of a bicycle is shown in the figure.



The acceleration–displacement graph of the bicycle's motion is best described by :

(1)



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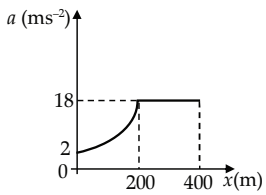
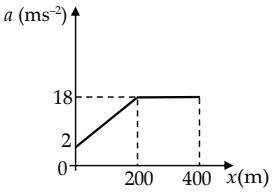
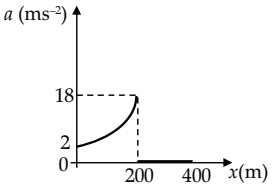


(3)



(4)



Q. 17. For changing the capacitance of a given parallel plate capacitor, a dielectric material of dielectric constant K is used, which has the same area as the plates of the capacitor. The thickness of the dielectric slab is $\frac{3}{4}d$, where '*d*' is the separation between the plate of parallel plate capacitor.

The new capacitance (C′) in terms of original capacitance (C_0) is given by the following relation :

(1) $C' = \frac{4K}{K+3}C_0$ **(2)** $C' = \frac{4}{3+K}C_0$

(3) $C' = \frac{3+K}{4K}C_0$ **(4)** $C' = \frac{4+K}{3}C_0$

Q. 18. For an electromagnetic wave travelling in free space, the relation between average energy densities due to electric (U_e) and magnetic (U_m) fields is :

(1) $U_e \neq U_m$ **(2)** $U_e = U_m$

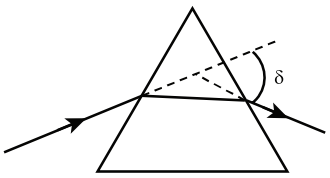
(3) $U_e > U_m$ **(4)** $U_e < U_m$

Q. 19. Time period of a simple pendulum is T inside a lift when the lift is stationary. If the lift moves upwards with an acceleration $\frac{g}{2}$, the time period of pendulum will be :

(1) $\sqrt{\frac{3}{2}}T$ **(2)** $\frac{T}{\sqrt{3}}$

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

Q. 20. The angle of deviation through a prism is minimum when



(A) Incident ray and emergent ray are symmetric to the prism

(B) The refracted ray inside the prism becomes parallel to its base

(C) Angle of incidence is equal to that of the angle of emergence

(D) When angle of emergence is doubled the angle of incidence

Choose the correct answer from the options given below :

(1) Only statement (D) is true

(2) Statements (A), (B) and (C) are true

(3) Statements (B) and (C) are true

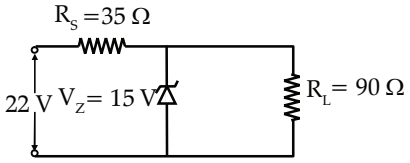
(4) Only statements (A) and (B) are true

Section B

Q. 21. A fringe width of 6 mm was produced for two slits separated by 1 mm apart. The screen is placed 10 m away. The wavelength of light used is 'x' nm.

The value of 'x' to the nearest integer is _____.

Q. 22. The value of power dissipated across the zener diode (V_z = 15 V) connected in the circuit as shown in the figure is $x \times 10^{-1}$ watt.



The value of x, to the nearest integer, is _____.

Q. 23. The resistance $R = \frac{V}{I}$, where V = (50 ± 2) V and I = (20 ± 0.2) A. The percentage error in R is 'x' %.

The value of x to the nearest integer is

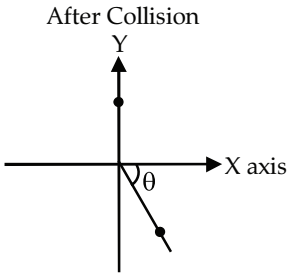
Q. 24. A sinusoidal voltage of peak value 250 V is applied to a series LCR circuit, in which R = 8 Ω, L = 24 mH and C = 60 μF. The value of power dissipated at resonant conditions is 'x' kW.

The value of x to the nearest integer is _____.

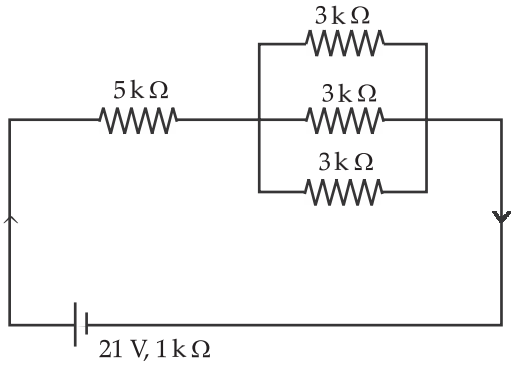
Q. 25. A ball of mass 10 kg moving with a velocity $10\sqrt{3}$ ms^{-1} along X–axis, hits another ball of mass 20 kg which is at rest. After collision, the first ball comes to rest and the second one disintegrates into two equal pieces. One of the pieces starts moving along Y–axis at a speed of 10 m/s. The second piece starts moving at a speed of 20 m/s at an angle θ (degree) with respect to the X–axis.

The configuration of pieces after collision is shown in the figure.

The value of θ to the nearest integer is _____.

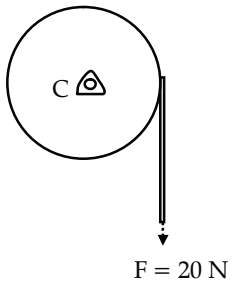


Q. 26. In the figure given, the electric current flowing through the 5 kΩ resistor is 'x' mA.



The value of x to the nearest integer is _____.

Q. 27. Consider a 20 kg uniform circular disk of radius 0.2 m. It is pin supported at its center and is at rest initially. The disk is acted upon by a constant force F=20 N through a massless string wrapped around its periphery as shown in the figure



Suppose the disk makes n number of revolutions to attain an angular speed of 50 rad s^{-1}.

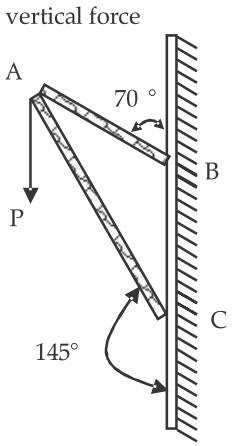
The value of n, to the nearest integer is _____.

In one complete revolution, the disk rotates by 6.28 rad

Q. 28. The first three spectral lines of H–atom in the Balmer series are given $\lambda_1, \lambda_2, \lambda_3$ considering the Bohr atomic model, the wavelengths of first and third spectral lines $\left(\frac{\lambda_1}{\lambda_3}\right)$ are related by a factor of approximately 'x' $\times 10^{-1}$.

The value of x, to the nearest integer, is _____.

Q. 29. Consider a frame that is made up of two thin massless rods AB and AC as shown in the figure. A vertical force $\vec{P}$ of magnitude 100 N is applied at point A of the frame.



Suppose the force is $\vec{P}$ resolved parallel to the arms AB and AC of the frame.

The magnitude of the resolved component along the arm AC is x N.

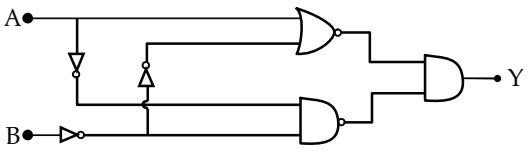
The value of x, to the nearest integer, is _____.

[Given: sin(35°)=0.573, cos(35°)=0.819

sin(110°)=0.939, cos(110°)=–0.342]

Q. 30. In the logic circuit shown in the figure, if input A and B are 0 to 1 respectively, the output at Y would be 'x'.

The value of x is _____.



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Answer Key

Q. No.	Answer	Topic Name	Chapter Name
1	3	Antenna Analysis	Communications
2	1	Friction	Newton's Laws of Motion
3	2	MOI System of Particles	Rotational Mechanics
4	3	Photoelectric Effect	Dual Nature of Radiation and Matter
5	2	Vernier Callipers	Units and Measurements
6	4	Electromagnetic Wave	Electromagnetic Wave
7	3	Keplers Second Law	Gravitations
8	4	Horizontal Circular Motion	Circular Motions
9	2	RC Circuit	AC Circuit Analysis
10	3	Heat and Work	Thermodynamics
11	4	Electric Current	Current Electricity
12	1	Pressure	Fluid Mechanics
13	2	Magnet Moment	Magnetism
14	3	Mixture of Gases	Kinetic Theory of Gases
15	1	Induced Current	Electromagnet Inductions
16	1	Graphs	Motion in One Dimensions
17	1	Charging Capacitor	Capacitor
18	2	Energy Density	Electromagnetic Wave
19	3	Time Period	Simple Harmonic Motion
20	2	Minimum Angle of Deviations Optics	Prism
21	600	Fringe Width	Wave Optics
22	5	Zener Diode	Semiconductor Devices
23	5	Percentage Error	Units And Measurements
24	4	LCR Circuit	AC Circuit Analysis
25	30	Collisions	System of Particles
26	3	Electric Circuit	Current Electricity
27	20	Angular Displacement	Rotational Mechanics
28	15	Spectral Lines	Atomic Structure
29	82	Resolved Component	Newton's Laws of Motion
30	0	Logic Gates	Electronic Circuit

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ANSWERS WITH EXPLANATIONS

Physics

Section A

1. Option (3) is correct.

Given,

Height of the antenna is

$H = 25$ m

Since, the length of the antenna is 1/4 of the wavelength, the transmission and reception conversion efficiency of the antenna is the highest.

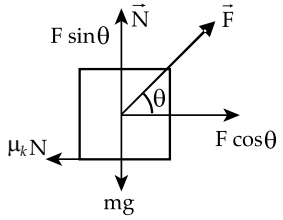
$$H = \frac{\lambda}{4} \Rightarrow \lambda = 4H$$

Therefore,

$\lambda = 4 \times 25 = 100$ m

2. Option (1) is correct.

Free body diagram of the block



For equilibrium in the vertical direction

$F \sin\theta + N = mg$

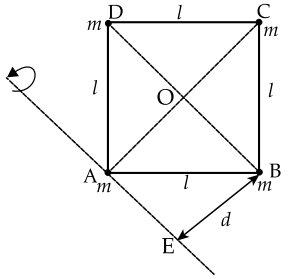
$N = mg - F\sin\theta$ ...(i)

Also, $F\cos\theta - \mu_k N = ma$ ...(ii)

Solving (i) and (ii)

$$a = \frac{F}{m}\cos\theta - \mu_k\left[g - \frac{F}{m}\sin\theta\right]$$

3. Option (2) is correct.



In ΔABC, $\angle B = 90°$

$AC^2 = AB^2 + BC^2$

$AC^2 = l^2 + l^2$

$AC = \sqrt{2l^2} \Rightarrow \sqrt{2}l$

Length of the diagonal of a square

$$d = BE = AO = \frac{AC}{2} = \frac{l}{\sqrt{2}}$$

Moment of Inertia about the axis passing through A.

$$I = m(0)^2 + m(d)^2 + m(d)^2 + m(AC)^2$$

$$I = 2md^2 + m(AC)^2 = 2m\left[\frac{l}{\sqrt{2}}\right]^2 + m\left[\sqrt{2}l\right]^2$$

$$\Rightarrow \quad 2m\frac{l^2}{2} + 2ml^2 \Rightarrow 3ml^2$$

4. Option (3) is correct.

Using Einstein's photoelectric equation

$h\nu = h\nu_0 + eV$

$$V = \frac{h\nu}{e} - \frac{h\nu_0}{e}$$

Where $V \rightarrow$ Stopping potential

V depends on frequency

5. Option (2) is correct.

Given

1 MSD $= a$ cm

n VSD $= (n-1)$MSD

$$1 \text{ VSD} = \frac{(n-1)}{n}\text{ MSD}$$

Since,

$$LC = 1\text{ MSD} - 1\text{ VSD}$$

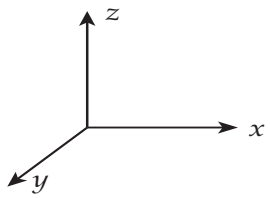
$$= 1\text{ MSD} - \frac{(n-1)}{n}\text{ MSD} \Rightarrow \frac{\text{MSD}}{n}$$

$$LC = \frac{a}{n}\text{cm} = \frac{10a}{n}\text{ mm}$$

6. Option (4) is correct.

Given,

$\vec{B} = 8\times10^{-8}\hat{z}\ T$ and $c = 3\times10^{8}$m/s



Using the relation

$E = Bc = (8\times10^{-8})(3\times10^{8}) = 24$

Given: Electromagnetic wave travels in a direction along y-axis.

Since, E x B = c;

Magnetic Field B is along z axis and wave travels along y axis.

So, $(\hat{-x})\times(\hat{z}) = \hat{y}$

The electric field, E will be along negative x direction.

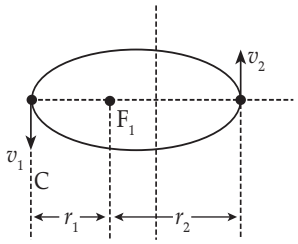
Hence, $\vec{E} = -24\hat{x}$ V/m

7. Option (3) is correct.

$r_2 = 1.6\times10^{12}m$

$r_1 = 8\times10^{10}m$

$v_1 = 6\times10^{4}$ m/s



Apply conservation of angular momentum

$$mv_1r_1 = mv_2r_2$$

$$\Rightarrow (6\times10^{4})(8\times10^{10}) = v_2(1.6\times10^{12})$$

$$v_2 = 3\times10^{3}\text{ m/s}$$

8. Option (4) is correct.

Given,

$m = 200$ g, $r = 20$ cm, T = 40 s

Using the expression

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

$$\omega = \frac{2\pi}{40} = \frac{\pi}{20} = \frac{3.14}{20}\text{ radian/second}$$

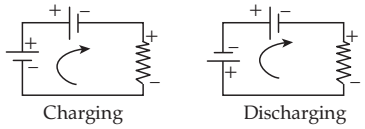
Normal force will provide the necessary centripetal force.

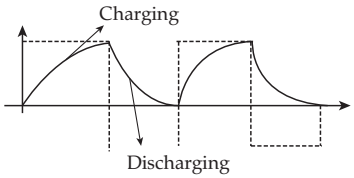
$$N = mr\omega^2 = \left(\frac{200}{1000}\right)\left(\frac{20}{100}\right)\left[\frac{3.14}{20}\right]^2$$

$$= 9.859\times10^{-4}\text{N}$$

9. Option (2) is correct.

The capacitor starts charging when initially (+) voltage across input than the capacitor will reach upto saturation level, where (-) voltage of AC appears across output the capacitor starts discharge and this process keeps on going alternatively.





10. Option (3) is correct.

Heat and work are not state variables, therefore, it is neither extensive nor intensive. It is dependent on path. Heat and work are path functions.

11. Option (4) is correct.

Given,

length of wire = l

Area of cross section = A

Resistivity of wire = ρ

Therefore, resistance of wire

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

Now, new length of the wire is

$l' = 2l$

New cross- section of wire is

$$A' = \frac{A}{2}$$

New resistance

$$R' = \frac{\rho(2l)}{\frac{A}{2}} = 4\frac{\rho l}{A}$$

Resultant current,

$$I' = \frac{V}{R'} = \frac{V}{4\frac{\rho l}{A}}$$

$$= \frac{1}{4}\frac{VA}{\rho l}$$

12. Option (1) is correct.

According to Hydrostatic's Law

$$P = P_0 + h\rho g$$

Given

$$P_1 = 3 \times 10^5 \text{Pa}$$

So, $P_1 = P_0 + h\rho g$

$$h\rho g = [3 \times 10^5 - 10^5] \text{ Pa} = 2 \times 10^5 \text{Pa}$$

If depth is doubled

$$2h\rho g = 2 \times 2 \times 10^5 \Rightarrow 4 \times 10^5 \text{ Pa}$$

So, $P_2 = P_0 + 4 \times 10^5 \Rightarrow 5 \times 10^5 \text{Pa}$

% increase in pressure

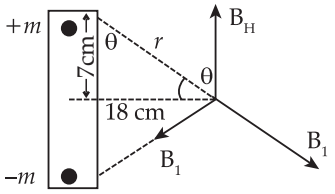
$$= \frac{P_2 - P_1}{P_1} \times 100 = \left(\frac{2\times10^5}{3\times10^5}\right) \times 100$$

$$= \frac{200}{3} \%$$

13. Option (2) is correct.

Given

Length of bar Magnet = 14 cm



$$B_H = 0.4G$$

From the diagram we observe

$$B_H = 2B_1 \sin\theta$$

$$0.4 \times 10^{-4} = 2\left[\frac{\mu_0 m}{4\pi r^2}\right]\left[\frac{7}{r}\right]$$

$$0.4 \times 10^{-4} = 2\left[\frac{7\times10^{-7} m}{\left[7^2+18^2\right]^{\frac{3}{2}}} \times 10^4\right]$$

$$m = \frac{4\times10^{-2}\times(373)^{\frac{3}{2}}}{14}$$

Magnetic Moment, $M = m \times \frac{14}{100}$

$$\Rightarrow \quad \frac{4\times10^{-2}\times(373)^{\frac{3}{2}}}{14}\left[\frac{14}{100}\right]$$

$$M = 2.880 \text{ J/T}$$

14. Option (3) is correct.

Here we are using ideal gas equation

$$PV = nRT$$

$n \rightarrow$ total number of moles of the mixture of gases

Number of moles of O_2 'n_1' $= \frac{16}{32} = 0.5$ mole

Number of moles of N_2 'n_2' $= \frac{28}{28} = 1$ mole

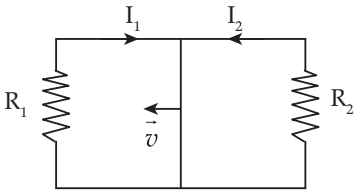
Number of moles of CO_2 'n_3' $= \frac{44}{44} = 1$ mole

$$n = n_1 + n_2 + n_3 = \frac{5}{2} \text{ moles}$$

Hence, $PV = \frac{5}{2} RT$ or $P = \frac{5RT}{2V}$

15. Option (1) is correct.

When bar slides towards left area of loop 1 decreases to increase the magnetic flux current flow in clockwise direction, and area of loop 2 increases so current flow in anticlockwise direction.



16. Option (1) is correct.

Using the relation

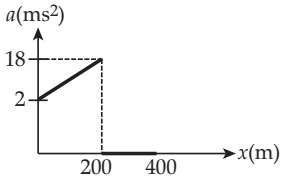
$$a = v\frac{dv}{dx}$$

From $x = 0$ to 200m, slope of velocity vs displacement graph is constant but velocity is increasing.

So, acceleration will increase.

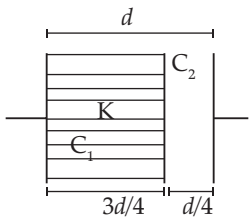
From $x = 200$ to 400m slope of velocity vs displacement graph is zero.

Hence, acceleration will be zero.



17. Option (1) is correct.

The expression of a parallel place capacitor



Here, $C_0 = \frac{A\varepsilon_0}{d}$

So, $C_1 = \frac{KA\varepsilon_0}{\frac{3d}{4}}$ .....at $d \to \frac{3d}{4}$

And $C_2 = \frac{A\varepsilon_0}{\frac{d}{4}}$ ..... at $d \to \frac{d}{4}$

Now equivalent capacitance

$$C' = \frac{C_1C_2}{C_1+C_2}$$

$$\Rightarrow \frac{\left(4K\frac{A\varepsilon_0}{3d}\right)\left(4\frac{A\varepsilon_0}{d}\right)}{4K\frac{A\varepsilon_0}{3d}+4\frac{A\varepsilon_0}{d}}$$

$$\Rightarrow \frac{\frac{4KA^2\varepsilon_0^2}{3d^2}\times 4}{\frac{4A\varepsilon_0}{d}\left[\frac{K}{3}+1\right]} \Rightarrow \frac{4K}{(3+K)}C_0$$

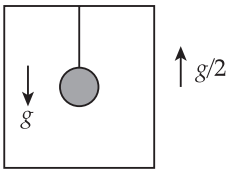
18. Option (2) is correct.

For an electromagnetic wave, average energy density due to electric field (U_e) and magnetic field (U_m) is same.

19. Option (3) is correct.

Using the expression

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



When the lift moves with an acceleration $\frac{g}{2}$ in upward direction, a pseudo force is acting downwards.

Effective acceleration

$g_{eff} = g + \frac{g}{2}$

$= 3g/2$

Therefore, new time period

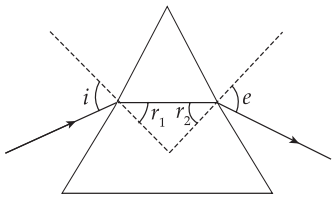
$$T' = 2\pi\sqrt{\frac{l}{g_{eff}}}$$

$$= 2\pi\sqrt{\frac{l}{3g/2}} = \sqrt{\frac{2}{3}}T$$

20. Option (2) is correct.

Condition for minimum angle of deviation

$i = e$ [angle of incidence = angle of emergence]



$r_1 = r_2$ [refracted ray is parallel to the base of prism]

Incident ray and emergent ray are symmetric to the prism. The refracted ray inside the prism becomes parallel to its base Angle of incidence is equal to that of the angle of emergence.

Section B

21. Correct answer is [600].

Given,

Fringe width (β) = 6 mm = 6×10^{-3} m

d = 1 mm = 1×10^{-3} m

D = 10 m

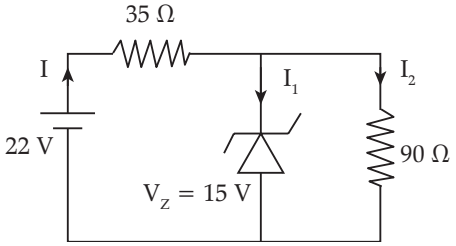
Using the expression

$$\beta = \frac{D\lambda}{d}$$

$$6 \times 10^{-3} = \frac{\lambda \times 10}{10^{-3}}$$

So, λ = 600 nm

22. Correct answer is [5].



Voltage across 35Ω = (22 − 15) = 7V

Current across R_S, $I = \frac{7}{35} = \frac{1}{5}$ A

Current across R_L, $I_2 = \frac{15}{90} = \frac{1}{6}$ A

So, $I_1 = I - I_2 = \frac{1}{5} - \frac{1}{6} = \frac{1}{30}$ A

Power dissipated across the zener diode = $15 \times \frac{1}{30} = 0.5\text{W} = 5 \times 10^{-1}$ W

Hence, $x = 5$

23. Correct answer is [5].

We can find % error in R by using expression,

$R = \frac{V}{I}$

$$\frac{\Delta R}{R} \times 100 = \frac{\Delta V}{V} \times 100 + \frac{\Delta I}{I} \times 100$$

$$= \frac{2}{50} \times 100 + \frac{0.2}{20} \times 100$$

$$= (4 + 1) = 5\%$$

24. Correct answer is [4].

Peak voltage $[V_0] = 250$ V

So, $V_{RMS} = \frac{V_0}{\sqrt{2}} = \frac{250}{\sqrt{2}}$ V

Resistance [R] $= 8\ \Omega$

Inductor [L] $= 24$ mH

Capacitor [C] $= 60\ \mu$F

The dissipated power at resonant condition

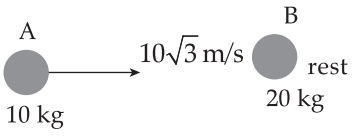
$$P = \frac{[V_{RMS}]^2}{R} \Rightarrow \frac{\left(\frac{250}{\sqrt{2}}\right)^2}{8}$$

$$\Rightarrow 3906.25 \text{ W}$$

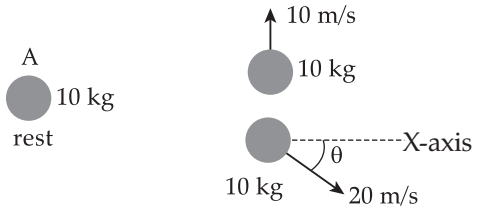
Approx. P = 4 kW

25. Correct answer is [30].

Before collision



After collision



Apply conservation of momentum along X-axis

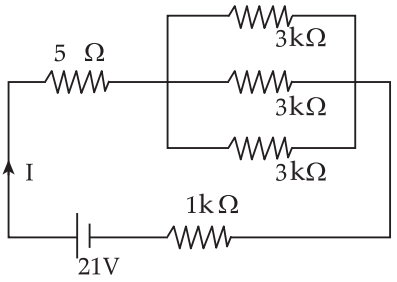
$10 \times 10\sqrt{3} = 20 \cos\theta \times 10$

$$\cos\theta = \frac{\sqrt{3}}{2}$$

$$\theta = 30°$$

26. Correct answer is [3].

All 3 k Ω are in parallel so,



$$\frac{1}{R_1} = \frac{1}{3} + \frac{1}{3} + \frac{1}{3} = \frac{3}{3}\ \text{k}\Omega$$

$R_1 = 1\ \text{k}\Omega$

$R_{eq} = 1\ \text{k}\Omega + 5\ \text{k}\Omega + 1\ \text{k}\Omega \Rightarrow 7\ \text{k}\Omega$

So, $I = \frac{21}{7000} \Rightarrow 3$ mA

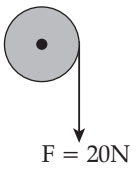
$x = 3$

27. Correct answer is [20].

Mass of a disk $= 20$ kg

Radius of a disk $= 0.2$ m

Torque due to force, F = 20 N is τ



Since, $\tau = I\alpha$

$$F = \frac{mr^2}{2}\alpha$$

$$\alpha = \frac{2F}{mr} = \frac{2 \times 20}{20 \times 0.2}$$

$$\Rightarrow 10 \text{ rad/s}^2$$

Using kinematic equation for rotational motion

$$\omega^2 = \omega_0^2 + 2\alpha\theta$$

$$(50)^2 = 0 + 2(10)\theta$$

$$\theta = \frac{2500}{20} = 125 \text{ radian}$$

$$\text{No. of revolution} = \frac{125}{6.28} \approx 20 \text{ revolution}$$

28. Correct answer is [15].

Using the expression for Balmer series for 1st line

$$\frac{1}{\lambda_1} = Rz^2\left[\frac{1}{4}-\frac{1}{9}\right] = \frac{5}{36}Rz^2$$

For 3rd line

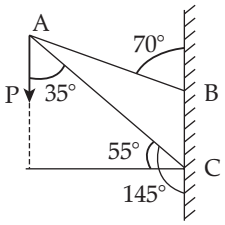
$$\frac{1}{\lambda_3} = Rz^2\left[\frac{1}{4}-\frac{1}{25}\right] = \frac{21}{100}Rz^2$$

$$\frac{\lambda_1}{\lambda_3} = \frac{21}{100}\times\frac{36}{5} \Rightarrow 15.12\times10^{-1}$$

So, $x = 15$

29. Correct answer is [82].

Component of P along AC is P cos 35°



Given : P = 100 N and cos 35° = 0.819

The magnitue of force along the arm AC

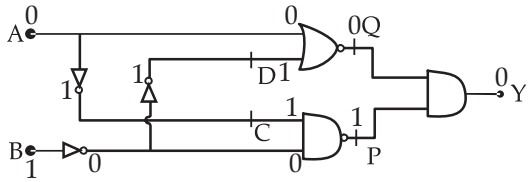
F_{AC} = P cos 35°

= 100 × 0.819 N

= 81.9 N

≈ 82 N

30. Correct answer is [0].



TRUTH TABLE

A	B	C	D	P	Q	Y
0	1	1	1	1	0	0

Final answer is 0

❐❐❐