# JEE MAIN 2023
## Paper with Solution

**PHYSICS | 1st Feb 2023 _ Shift-1**

# Umeed **Rank** Ki Ho Ya **Selection** Ki,
# JEET NISCHIT HAI!

## Most Promising **RANKS**
**Produced by MOTION Faculties**

### NEET / AIIMS

**AIR-1 to 10**
25 Times

**AIR-11 to 50**
83 Times

**AIR-51 to 100**
81 Times

### JEE MAIN+ADVANCED

**AIR-1 to 10**
8 Times

**AIR-11 to 50**
32 Times

**AIR-51 to 100**
36 Times

## Nation's Best **SELECTION**
**Percentage (%) Ratio**

**Student Qualified in NEET**

(2022)
4837/5356 = **90.31%**
(2021)
3276/3411 = **93.12%**

**Student Qualified in JEE ADVANCED**

(2022)
1756/4818 = **36.45%**
(2021)
1256/2994 = **41.95%**

**Student Qualified in JEE MAIN**

(2022)
4818/6653 = **72.41%**
(2021)
2994/4087 = **73.25%**

NITIN VIIJAY (NV Sir)
Founder & CEO

## SECTION - A

**1.** A child stands on the edge of the cliff 10 m above the ground and throws a stone horizontally with an initial speed of 5 $ms^{-1}$. Neglecting the air resistance, the speed with which the stone hits the ground will be ___ $ms^{-1}$ (given, $g = 10\ ms^{-2}$ ).

(1) 15 (2) 20 (3) 30 (4) 25

**Sol.** **(1)**

Along vertical direction

$u_y = 0$

$a_y = +g$

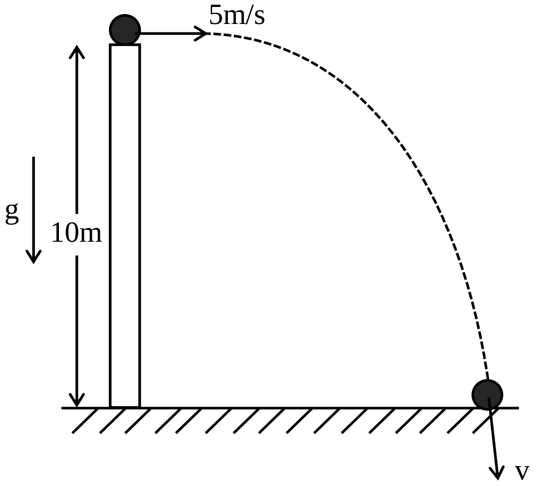
$v_y = ?$

$s_y$ = 10 m

$v_y^2 = u_y^2 + 2a_y g_y$

$= (0)^2 + 2\times10\times10$

$v_y^2 = 200$



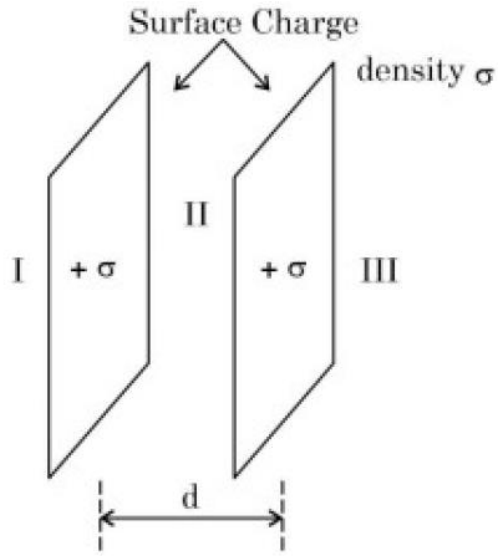

$\boxed{v_y^2 = 200}$

$\therefore \quad v = \sqrt{v_x^2 + v_y^2}$

$= \sqrt{25+200} \quad = \quad \sqrt{225}$

= 15 m/s

**2.** Let $\sigma$ be the uniform surface charge density of two infinite thin plane sheets shown in figure. Then the electric fields in three different region $E_I, E_{II}$ and $E_{III}$ are:



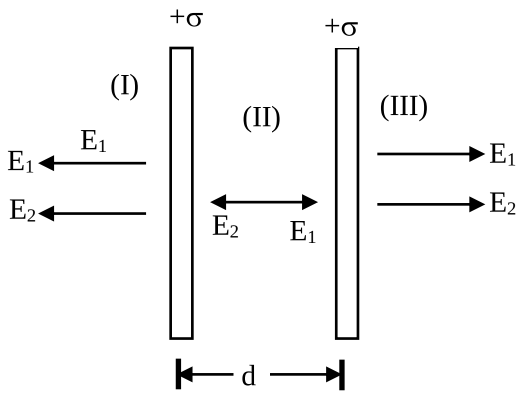

(1) $\vec{E}_I = \frac{2\sigma}{\epsilon_0}\hat{n}, \vec{E}_{II} = 0, \vec{E}_{III} = \frac{2\sigma}{\epsilon_0}\hat{n}$

(2) $\vec{E}_I = \frac{\sigma}{2\epsilon_0}\hat{n}, \vec{E}_{II} = 0, \vec{E}_{III} = \frac{\sigma}{2\epsilon_0}\hat{n}$

(3) $\vec{E}_I = -\frac{\sigma}{\epsilon_0}\hat{n}, \vec{E}_{II} = 0, \vec{E}_{III} = \frac{\sigma}{\epsilon_0}\hat{n}$

(4) $\vec{E}_I = 0, \vec{E}_{II} = \frac{\sigma}{\epsilon_0}\hat{n}, E_{III} = 0$

**Sol.** **(3)**




$\therefore E_I = -\frac{\sigma}{E_0}\hat{n}$

$\therefore E_{II} = 0$

$\therefore E_{III} = -\frac{\sigma}{E_0}\hat{n}$

**3.** A mercury drop of radius $10^{-3}$ m is broken into 125 equal size droplets. Surface tension of mercury is $0.45 Nm^{-1}$. The gain in surface energy is:

(1) $28 \times 10^{-5}$ J (2) $17.5 \times 10^{-5}$ J (3) $5 \times 10^{-5}$ J (4) $2.26 \times 10^{-5}$ J

**Sol.** **(4)**

[Volume of bigger drop] = [volume of smaller drop] × 125

$\frac{4}{3}\pi R^3 = 125 \times \frac{4}{3}\pi r^3$

$R^3 = 125 r^3$

$\boxed{\therefore R = 5 \times r}$

$\Rightarrow$ Gain in sinface energy = TdA

$= 0.45 \times [A_2 - A_1]$

$= 0.45 \times [125 \times 4\pi r^2 - 4\pi R^2]$

$= 0.45 \times \left[125 \times 4\pi\left(\frac{R}{5}\right)^2 - 4\pi R^2\right]$

$= 0.45 \times [20\pi R^2 - 4\pi R^2]$

$= 0.45 \times 16\pi R^2$

$= 0.45 \times 16 \times 3.14 \times (10^{-3})^2$

$= 2.26 \times 10^{-5}$ J

**4.** If earth has a mass nine times and radius twice to that of a planet P. Then $\frac{v_e}{3}\sqrt{x}\ ms^{-1}$ will be the minimum velocity required by a rocket to pull out of gravitational force of P, where $v_e$ is escape velocity on earth. The value of $x$ is

(1) 1 (2) 3 (3) 18 (4) 2

**Sol. (4)**

$M_E = 9M_P$

$R_E = 2R_P$

$$V_c^1 = \sqrt{\frac{2GM_P}{R_P}} = \sqrt{\frac{2G\frac{M_E}{9}}{\frac{R_E}{2}}}$$

$$= \sqrt{\frac{2GM_E}{R_E}} \times \sqrt{\frac{2}{9}}$$

$$\boxed{V_c^1 = \frac{V_e}{3}\sqrt{2}}$$

**5.** A sample of gas at temperature $T$ is adiabatically expanded to double its volume. The work done by the gas in the process is $\left(\text{given, } \gamma = \frac{3}{2}\right)$ :

(1) $W = \frac{T}{R}[\sqrt{2} - 2]$ (2) $W = RT[2 - \sqrt{2}]$ (3) $W = TR[\sqrt{2} - 2]$ (4) $W = \frac{R}{T}[2 - \sqrt{2}]$

**Sol. (2)**

Work done in the process is given by

$$W = \frac{R}{\gamma - 1}(T_1 - T_2)$$

For adiabatic process:

$$T_1V_1^{\gamma-1} = T_2V_2^{\gamma-1}$$

$$TV^{\frac{3}{2}-1} = T_2(2V)^{\frac{3}{2}-1}$$

$$TV^{\frac{1}{2}} = T_2(2V)^{\frac{1}{2}}$$

$$T^2V = T_2^2 \times 2V$$

$$\therefore T_2 = \frac{T}{\sqrt{2}}$$

$$\therefore W = \frac{R}{\gamma - 1} \times \left(T - \frac{T}{\sqrt{2}}\right)$$

$$= 2RT\left[1 - \frac{1}{\sqrt{2}}\right]$$

$$= RT\left[2 - \frac{2}{\sqrt{2}}\right]$$

$$= RT[2 - \sqrt{2}]$$

$$\boxed{W = RT\left[2 - \sqrt{2}\right]}$$

**6.** $\left(P+\frac{a}{V^2}\right)(V-b)=RT$ represents the equation of state of some gases. Where P is the pressure, $V$ is the volume, $T$ is the temperature and $a, b, R$ are the constants. The physical quantity, which has dimensional formula as that of $\frac{b^2}{a}$, will be:

(1) Compressibility
(2) Energy density
(3) Modulus of rigidity
(4) Bulk modulus

**Sol.** **(1)**

$[b]=[L^3]$

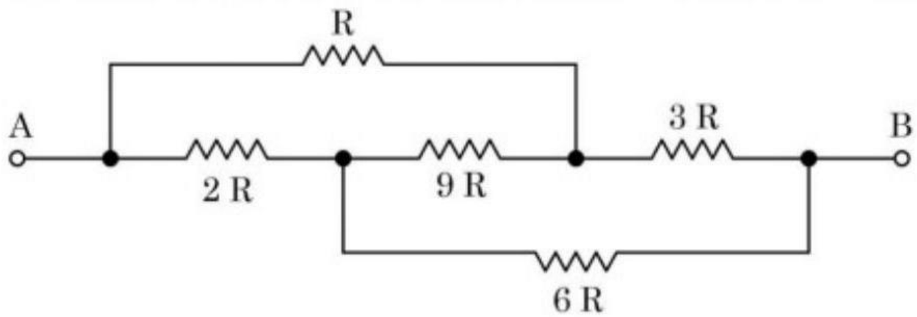
$[a]=[PV^2]$

$=[ML^{-1}T^{-2}][L^6]$

$=[ML^5T^{-2}]$

$$\frac{[b^2]}{[a]}=\frac{[L^6]}{[ML^5T^{-2}]}=[M^{-1}L^1T^2]$$

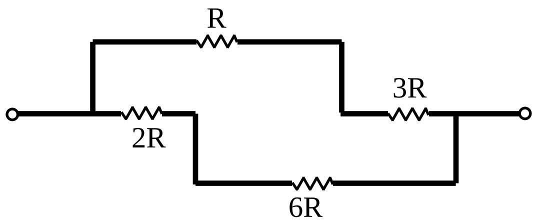
**7.** The equivalent resistance between $A$ and $B$ of the network shown in figure:




(1) $\frac{8}{3}R$ (2) $21R$ (3) $14R$ (4) $11\frac{2}{3}R$

**Sol.** **(1)**

$\because$ The given network is wheat-stone network




$$\therefore \quad R_{eq}=\frac{4R\times 8R}{4R+8R}$$

$$=\frac{4R\times 8R}{12R}$$

$$\boxed{R_{eq}=\frac{8}{3}R}$$

**8.** Match List I with List II:

| List I | List II |
|---|---|
| A. AC generator | I. Presence of both L and C |
| B. Transformer | II. Electromagnetic Induction |
| C. Resonance phenomenon to occur | III. Quality factor |
| D. Sharpness of resonance | IV. Mutual Induction |

Choose the correct answer from the options given below:

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

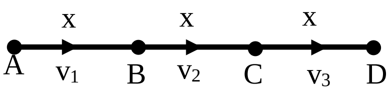
**Sol.** **(3)**

(A) A.C. generator $\rightarrow$ II. Electro-magnetic induction
(B) transformer $\rightarrow$ IV Mutual induction
(C) Resonance phenomenon to occur $\rightarrow$ (I) presence of both L and C
(D) Sharpness of resonance $\rightarrow$ (III) Quality factor

**9.** An object moves with speed $v_1, v_2$ and $v_3$ along a line segment $AB, BC$ and $CD$ respectively as shown in figure. Where $AB = BC$ and $AD = 3AB$, then average speed of the object will be:


(1) $\frac{(v_1+v_2+v_3)}{3v_1v_2v_3}$
(2) $\frac{(v_1+v_2+v_3)}{3}$
(3) $\frac{3v_1v_2v_3}{(v_1v_2+v_2v_3+v_3v_1)}$
(4) $\frac{v_1v_2v_3}{3(v_1v_2+v_2v_3+v_3v_1)}$

**Sol.** **(3)**




$$<v> = \frac{\text{Total distance}}{\text{Total time}}$$

$$= \frac{3x}{\frac{x}{v_1} + \frac{x}{v_2} + \frac{x}{v_3}}$$

$$= \frac{3}{\left[\frac{1}{v_1} + \frac{1}{v_2} + \frac{1}{v_3}\right]} = \frac{3}{\left[\frac{v_2v_3 + v_1v_3 + v_1v_2}{v_1v_2v_3}\right]}$$

$$<v> = \frac{3v_1v_2v_3}{[v_3v_2 + v_1v_2 + v_1v_2]}$$

**10.** '$n$' polarizing sheets are arranged such that each makes an angle 45° with the preceeding sheet. An unpolarized light of intensity I is incident into this arrangement. The output intensity is found to be $I/64$. The value of $n$ will be:

(1) 4 (2) 3 (3) 5 (4) 6

**Sol.** **(D)**

According to Malus law:

$$I = \frac{I_0}{2}\left[\cos^2 45 \times \cos^2 45 \times \cos^2 45 \times \ldots (n-1)\,\text{times}\right]$$

$$\frac{I_0}{64} = \frac{I_0}{2} \times \left(\frac{1}{2}\right)^{n-1}$$

$$\frac{1}{32} = \frac{1}{2^{n-1}} \Rightarrow \frac{1}{(2)^5} = \frac{1}{2^{n-1}}$$

$\therefore\ n - 1 = 5$

$\boxed{\therefore n = 6}$

**11.** Match List I with List II:

| List I | List II |
|---|---|
| A. Microwaves | I. Radio active decay of the nucleus |
| B. Gamma rays | II. Rapid acceleration and deceleration of electron in aerials |
| C. Radio waves | III. Inner shell electrons |
| D. X-rays | IV. Klystron valve |

Choose the correct answer from the options given below:

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

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

**Sol.** **(B)**

(A) Micro-wave (IV) Klystron valve

(B) Gamma rays (I) Radio-active decay of nucleus

(C) Radio-waves (II) Rapid acceleration and deceleration of electrons in aerials

(D) X-rays (III) Inner shell electron

**12.** A proton moving with one tenth of velocity of light has a certain de Broglie wavelength of $\lambda$. An alpha particle having certain kinetic energy has the same de-Brogle wavelength $\lambda$. The ratio of kinetic energy of proton and that of alpha particle is:

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

**Sol.** **(C)**

The wavelength of matter is given by

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

$$\frac{\lambda_p}{\lambda_\alpha} = \frac{p_\alpha}{p_p} = \frac{\sqrt{2k_\alpha m_\alpha}}{\sqrt{2k_p m_p}} = 1$$

$$\therefore \frac{k_\alpha}{k_p} \times \frac{m_\alpha}{m_p} = 1 \Rightarrow \frac{k_\alpha}{k_p} = \frac{m_p}{m_\alpha}$$

$$\boxed{\frac{k_\alpha}{k_p} = \frac{1}{4}}$$

**13.** A block of mass 5 kg is placed at rest on a table of rough surface. Now, if a force of 30 N is applied in the direction parallel to surface of the table, the block slides through a distance of 50 m in an interval of time 10 s. Coefficient of kinetic friction is (given, $g = 10\ ms^{-2}$ ):

(1) 0.60 (2) 0.25 (3) 0.75 (4) 0.50

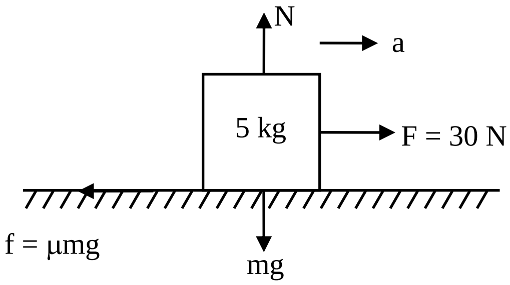
**Sol.** **(D)**

$S = ut + \frac{1}{2}at^2$

$50 = 0 \times t + \frac{1}{2} \times a \times (10)^2$

$50 = \frac{1}{2} \times a \times 100$

$a = \frac{100}{100} \Rightarrow \boxed{a = 1\ m/s^2}$




$\sum F_x = ma_x$

$30 - \mu mg = ma$

$30 - \mu \times 50 = 5$

$50\mu = 25$

$\mu = \frac{25}{50}$

$= \frac{1}{2}$

$\Rightarrow \boxed{\mu = 0.5}$

**14.** Given below are two statements:

**Statement I:** Acceleration due to gravity is different at different places on the surface of earth.

**Statement II:** Acceleration due to gravity increases as we go down below the earth's surface.

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

(1) Statement I is false but Statement II is true

(2) Statement I is true but Statement II is false

(3) Both Statement I and Statement II are false

(4) Both Statement I and Statement II are true

**Sol.** **(B)**
Statement (I) is true But
Statement (II) is false

**15.** Which of the following frequencies does not belong to FM broadcast.
(1) 64MHz (2) 89MHz (3) 99MHz (4) 106MHz

**Sol.** **(A)**
The Frequencies for FM Broadcast is between 87.5 MHz to 108 MHz.

**16.** The mass of proton, neutron and helium nucleus are respectively $1.0073u$, $1.0087u$ and $4.0015u$. The binding energy of helium nucleus is:
(1) 28.4MeV (2) 56.8MeV (3) 14.2MeV (4) 7.1MeV

**Sol.** **(A)**
$2P + 2n = {}_2^4He + E$
$\therefore$ B.E $= [2 \times (1.0073 + 1.0087) - 4.0015] \times 931$
$= 0.0305 \times 931$
$= 28.3955$ MeV

**17.** A steel wire with mass per unit length $7.0 \times 10^{-3}$ kg m$^{-1}$ is under tension of 70 N. The speed of transverse waves in the wire will be:
(1) 100 m/s (2) 10 m/s (3) 50 m/s (4) $200\pi$m/s

**Sol.** **(A)**
The velocity of Transverse wave on string is given by

$$V = \sqrt{\frac{T}{\mu}}$$

$$= \sqrt{\frac{70}{7 \times 10^{-3}}} = \sqrt{\frac{70 \times 10^3}{7}}$$

$$= \sqrt{10^4} = 100 \text{ m/s}$$

**18.** Match List I with List II:

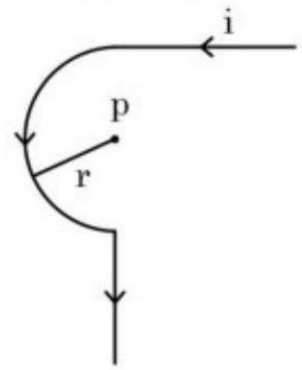
| List I | List II |
|---|---|
| A. Intrinsic semiconductor | I. Fermi-level near the valence band |
| B. n-type semiconductor | II. . Fermi-level in the middle of valence and conduction band |
| C. p-type semiconductor | III. Fermi-level near the conduction band |
| D. Metals | IV. Fermi-level inside the conduction band |

Choose the correct answer from the options given below:
(1) A-II, B-III, C-I, D-IV (2) A-I, B-II, C-III, D-IV
(3) A-II, B-I, C-III, D-IV (4) A-III, B-I, C-II, D-IV

**Sol.** **(A)**

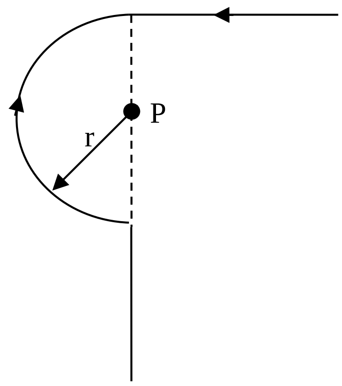
(A) Intrinsic — (II) Fermi-level in the middle of valence and conduction band
(B) n-type semiconductor — (III) Fermi-level near conduction band
(C) p-type semiconductor — (I) Fermi-level near valence band
(D) Metals — (IV) Fermi-level inside the conduction band

**19.** Find the magnetic field at the point P in figure. The curved portion is a semicircle connected to two long straight wires.




(1) $\frac{\mu_0 i}{2r}\left(1+\frac{2}{\pi}\right)$ (2) $\frac{\mu_0 i}{2r}\left(\frac{1}{2}+\frac{1}{2\pi}\right)$ (3) $\frac{\mu_0 i}{2r}\left(1+\frac{1}{\pi}\right)$ (4) $\frac{\mu_0 i}{2r}\left(\frac{1}{2}+\frac{1}{\pi}\right)$

**Sol.** **(B)**




$B_P = B_1 + B_2$

$= \frac{\mu_0 i}{4\pi r} + \frac{\mu_0 i}{4r}$

$= \frac{\mu_0 i}{4r}\left[\frac{1}{\pi}+1\right]$

$\boxed{B_P = \frac{\mu_0 i}{2r}\left[\frac{1}{2\pi}+\frac{1}{2}\right]}$

**20.** The average kinetic energy of a molecule of the gas is
(1) proportional to absolute temperature (2) proportional to pressure
(3) proportional to volume (4) dependent on the nature of the gas

**Sol.** **(A)**

The average kinetic energy of gas molecule is given by,

$K.E_{avg} = \frac{3}{2}KT$

$\boxed{\therefore K.E_{avg} \propto T}$

## SECTION - B

**21.** A small particle moves to position $5\hat{\imath} - 2\hat{\jmath} + \hat{k}$ from its initial position $2\hat{\imath} + 3\hat{\jmath} - 4\hat{k}$ under the action of force $5\hat{\imath} + 2\hat{\jmath} + 7\hat{k}$ N. The value of work done will be __________ J.

**Sol.** **40**

$\Delta\vec{r} = \vec{r}_f - \vec{r}_i$


$= (5\hat{i} - 2\hat{j} + \hat{k}) - (2\hat{i} + 3\hat{j} - 4\hat{k})$

$\overrightarrow{\Delta r} = 3\hat{i} - 5\hat{j} + 5\hat{k}$

$\therefore W = \vec{F} \cdot \overrightarrow{\Delta r}$

$= (5\hat{i} + 2\hat{j} + 7\hat{k}) \cdot (3\hat{i} - 5\hat{j} + 5\hat{k})$

$= 15 - 10 + 35$

$= 5 + 35$

$\boxed{W = 40J}$

**22.** A certain pressure 'P' is applied to 1 litre of water and 2 litre of a liquid separately. Water gets compressed to 0.01% whereas the liquid gets compressed to 0.03%. The ratio of Bulk modulus of water to that of the liquid is $\frac{3}{x}$.

The value of $x$ is __________.

**Sol.** **1**

Bulk Modulus = $V\dfrac{dP}{dV}$

$$\frac{(B)_{water}}{(B)_{liquid}} = \frac{V\ dP/dV}{V\ dP/dV} = \frac{dP/0.01}{dP/0.03}$$

$$\therefore \frac{(B)_{water}}{(B)_{liquid}} = \frac{0.03}{0.01} = \frac{3}{1}$$

$$\boxed{\frac{(B)_{water}}{(B)_{liquid}} = \frac{3}{1}}$$

$\therefore$ On comparing with $\frac{3}{x}$, The value of "x" will be "1'.

**23.** A light of energy 12.75eV is incident on a hydrogen atom in its ground state. The atom absorbs the radiation and reaches to one of its excited states. The angular momentum of the atom in the excited state is $\frac{x}{\pi} \times 10^{-17}$eVs. The value of $x$ is __________ (use $h = 4.14 \times 10^{-15}$eVs, $c = 3 \times 10^{8}\ ms^{-1}$ ).

**Sol.** **x = 828**

The energy of electron in ground state = –13.6 eV

$E_n - E_1 = 12.75$

$\therefore E_n = 12.75 - 13.6$

$E_n = -0.85$

So "n" is given by

$$E_n = -\frac{13.6}{n^2}$$

$$n^2 = \frac{-13.6}{-0.85}$$

$n^2 = 16 \Rightarrow \boxed{n = 4}$

$\Rightarrow L = \frac{nh}{2\pi} = \frac{x}{\pi} \times 10^{-17}$

$\Rightarrow 4 \times \frac{h}{2\pi} = \frac{x}{\pi} \times 10^{-17}$

$4 \times \frac{4.14 \times 10^{-15}}{2\pi} = \frac{x}{\pi} \times 10^{-17} \Rightarrow \frac{2 \times 4.14 \times 10^{-15}}{10^{-17}} = x$

$x = 8.28 \times 10^2 \Rightarrow \boxed{x = 828}$

**24.** A charge particle of $2\mu C$ accelerated by a potential difference of 100 V enters a region of uniform magnetic field of magnitude 4mT at right angle to the direction of field. The charge particle completes semicircle of radius 3 cm inside magnetic field. The mass of the charge particle is ________ $\times 10^{-18}$ kg.

**Sol.** **144**

$R = \frac{mv}{qB} = \frac{p}{qB}$

$R = \frac{\sqrt{2mq\Delta V}}{qB}$

$3 \times 10^{-2} = \frac{\sqrt{2m \times 2 \times 10^{-6} \times 10^2}}{2 \times 10^{-6} \times 4 \times 10^{-3}}$

$3 \times 10^{-2} \times 2 \times 10^{-6} \times 4 \times 10^{-3} = \sqrt{4m \times 10^{-4}}$

$24 \times 10^{-11} = \sqrt{4m \times 10^{-4}}$

$m = \frac{24 \times 24 \times 10^{-22}}{4 \times 10^{-4}}$

$\boxed{m = 144 \times 10^{-18}\,Kg}$

**25.** The amplitude of a particle executing SHM is 3 cm. The displacement at which its kinetic energy will be 25% more than the potential energy is: __________ cm.

**Sol.** **2**

$K.E = P.E + \frac{25}{100} \times P.E.$

$K.E = P.E + \frac{1}{4} P.E$

$K.E = \frac{5}{4} P.E$

$\frac{1}{2} K\left(A^2 - x^2\right) = \frac{5}{4} \times \frac{1}{2} Kx^2$

$4(A^2 - x^2) = 5x^2$

$4A^2 - 4x^2 = 5x^2$

$9x^2 = 4A^2$

$x^2 = \frac{4}{9} \times (3)^2$

$\boxed{\therefore x = \pm 2}$

**26.** In an experiment to find emf of a cell using potentiometer, the length of null point for a cell of emf 1.5 V is found to be 60 cm. If this cell is replaced by another cell of emf E, the length-of null point increases by 40 cm. The value of $E$ is $\frac{x}{10}V$. The value of $x$ is ________.

**Sol.** **25**

$E_1 = K\ell_1$ ...(i)

$E_2 = K\ell_2$ ...(ii)

$\therefore \frac{E_2}{E_1} = \frac{\ell_2}{\ell_1}$

$\frac{E}{1.5} = \frac{100}{60}$

$\therefore E = 1.5 \times \frac{10}{6}$

$= \frac{3}{2} \times \frac{10}{6}$

$= \frac{5}{2}$

$= 2.5$

$= \frac{25}{10}$

$\boxed{\therefore x = 25}$

**27.** A thin cylindrical rod of length 10 cm is placed horizontally on the principle axis of a concave mirror of focal length 20 cm. The rod is placed in a such a way that mid point of the rod is at 40 cm from the pole of mirror. The length of the image formed by the mirror will be $\frac{x}{3}$ cm. The value of $x$ is ________.

**Sol.** **32**

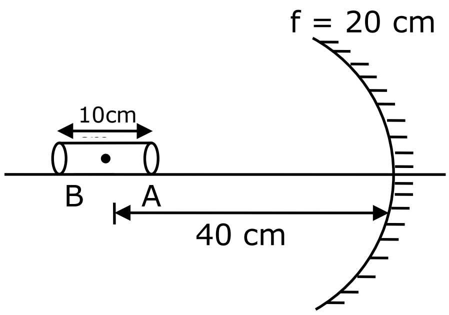



Image of end A:

u = –35 cm

f = –20 cm

v = ?

$v = \frac{uf}{u-f}$

$= \frac{-35 \times -20}{-35 + 20}$

$= \frac{-35 \times -20}{-15}$

$$\boxed{v = -\frac{140}{3}}$$

Image of end B:

u = –45 cm

v = ?

f = – 20 cm

$$v = \frac{uf}{u-f}$$

$$= \frac{-45 \times -20}{-45+20}$$

$$= \frac{-45 \times -20}{-25}$$

v = -36

$$\therefore \text{ length of image } = \left|-36 + \frac{140}{3}\right|$$

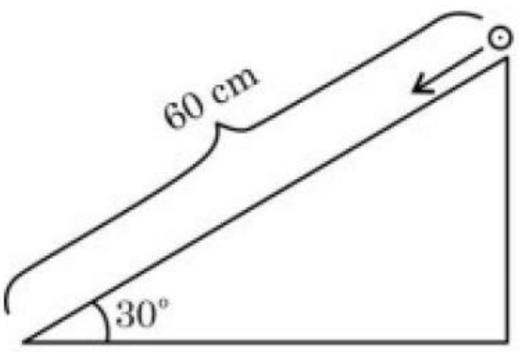
$$= \left|-\frac{108+140}{3}\right|$$

$$= \frac{32}{3}$$

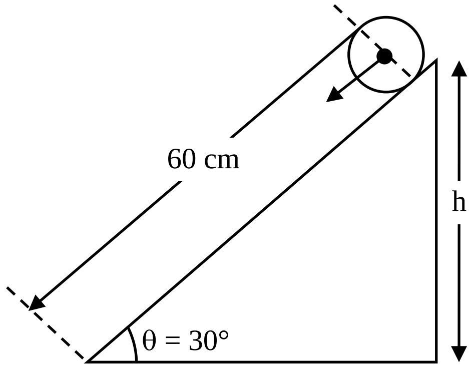
∴ The value of x = 32

**28.** A solid cylinder is released from rest from the top of an inclined plane of inclination 30° and length 60 cm. If the cylinder rolls without slipping, its speed upon reaching the bottom of the inclined plane is __________ $ms^{-1}$.

(Given $g = 10\ ms^{-2}$ )



**Sol.**




h = 60 sin 30

$\boxed{\therefore\ h = 30\text{ cm}}$

The velocity of by linder upon reaching the ground is given by

$$V = \sqrt{\frac{2gh}{1+\frac{K^2}{R^2}}}$$

$$\therefore V = \sqrt{\frac{2\times10\times30\times10^{-2}}{1+\frac{1}{2}}}$$

$$= \sqrt{\frac{6\times2}{3}}$$

$$\boxed{V = 2\text{ m/s}}$$

**29.** A series LCR circuit is connected to an ac source of $220\text{ V}, 50\text{ Hz}$. The circuit contain a resistance $R = 100\Omega$ and an inductor of inductive reactance $X_L = 79.6\Omega$. The capacitance of the capacitor needed to maximize the average rate at which energy is supplied will be ________ $\mu$F.

**Sol.** **40**

For maximum power, the LCR must be in resonance.

$\therefore X_L = X_C$

$$79.6 = \frac{1}{\omega C}$$

$$C = \frac{1}{\omega\times79.6}$$

$$= \frac{1}{2\pi\times50\times79.6}$$

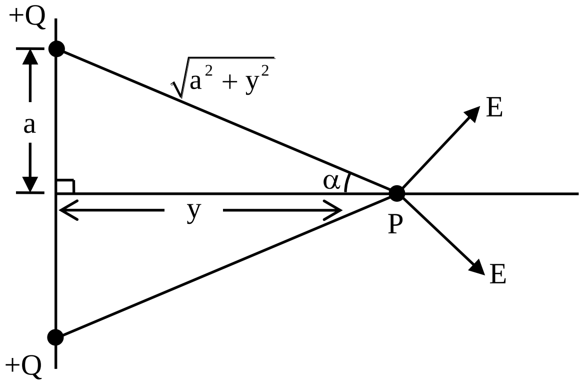
$$= \frac{1}{100\pi\times79.6}$$

$= 40 \times 10^{-6}$

$$\boxed{C = 40\mu F}$$

**30.** Two equal positive point charges are separated by a distance $2a$. The distance of a point from the centre of the line joining two charges on the equatorial line (perpendicular bisector) at which force experienced by a test charge $q_0$ becomes maximum is $\frac{a}{\sqrt{x}}$. The value of $x$ is _________.

**Sol.** 2




Electric field at point "P" due to any one change = $\frac{KQ}{a^2+y^2}$

$\therefore$ Net electric field at point "P" will be

$E_{net} = 2E\cos\alpha$

$= \frac{2KQ}{a^2+y^2} \times \frac{y}{\sqrt{a^2+y^2}}$

$E_{net} = \frac{2KQy}{(a^2+y^2)^{3/2}}$

$\Rightarrow$ Electric force (F) = $E_{net}\, q_0$

$= \frac{2K\,Qq_0 y}{\left(a^2+y^2\right)^{3/2}}$

For F = max $\Rightarrow \frac{dF}{dy} = 0$

By solving, we get $\boxed{y = \frac{a}{\sqrt{2}}}$

$\therefore$ the value of $\boxed{x = 2}$


मोशन है, तो
भरोसा है।
#RankBhiSelectionBhi
ADMISSION ANNOUNCEMENT
Session 2023-24 (English & हिन्दी Medium)
Target: JEE/NEET 2025
Nurture & प्रयास Batch
Class 10th to 11th Moving
Target: JEE/NEET 2024
Enthuse & प्रयास Batch
Class 11th to 12th Moving
Target: JEE/NEET 2024
Dropper & प्रयास Batch
Class 12th to 13th Moving
Target: PRE FOUNDATION
SIP, Evening & Tapasya Batch
Class 6th to 10th Students
Motion