Reliable INSTITUTE
*Unleashing Potential*

# JEE MAIN 2023

## JAN ATTEMPT

## PAPER-1 (B.Tech / B.E.)

SHIFT - 1

# QUESTIONS & SOLUTIONS

Reproduced from Memory Retention

31 JANUARY, 2023

9:00 AM to 12:00 Noon

Duration : 3 Hours

Maximum Marks : 300

## SUBJECT - PHYSICS




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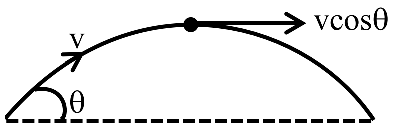
# PHYSICS

**1.** A particle is projected with velocity 'v' and at the top most point has velocity $\sqrt{3}\frac{v}{2}$, then find the time of flight of particle.

(1) $\frac{v}{g}$ (2) $\frac{2v}{g}$ (3) $\frac{3v}{g}$ (4) $\frac{v}{2g}$

**Ans.** **(1)**

**Sol.**




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

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

$\theta = 30°$

$T = \frac{2v\sin 30°}{g} = \frac{v}{g}$

**2.** If we increase temperature of semi-conductor material then effect on resistance and number of electron in conduction band, then

(1) Resistance increases and number of electrons also increases.

(2) Resistance decreases and number of electrons increases.

(3) Resistance increases and number of electrons decreases.

(4) Resistance and number of electrons do not change.

**Ans.** **(2)**

**Sol.** Basic theory.

**3.** 1000 identical liquid drops of radius 1 mm and surface tension 0.07 N/m are combined to form a single drop and then heat released during the process is

(1) 250 μJ (2) 264 μJ (3) 270 μJ (4) 300 μJ

**Ans.** **(2)**

**Sol.** $\Delta U = U_i - U_f = T(A_i - A_f)$

Using volume conservation, R = 10r

$$10^3 \times \frac{4}{3}\pi r^3 = \frac{4}{3}\pi R^3$$

$$\Delta U = 0.07 \times \frac{4}{3} \times \frac{22}{7}[10^3 \times 10^{-6} - 10^2 \times 10^{-6}]$$

$$10^{-2} \times \frac{4}{3} \times 22[10^3 - 10^{-4}] = 10^{-5} \times \frac{4}{3} \times 22 \times 0.9 = 264\mu J$$

**4.** If a particle is performing SHM of amplitude A and the maximum potential energy of a particle is 25J, then find the kinetic energy at x = $\frac{A}{2}$.

(1) 20 J (2) 18.75 J (3) 16.75 J (4) 18 J

**Ans. (2)**

**Sol.** Maximum P.E = $\frac{1}{2}m\omega^2A^2 = 25$

$\frac{3}{4}\times 25 = 18.75$

**5.** At height h = 3R from the earth surface value of acceleration due to gravity is $g_1$ and at depth 'd' acceleration due to gravity is $g_2$. If $g_2 = 4g_1$. Find depth d (Given : radius of earth = 6400 km)

(1) 3600 km (2) 4800 km (3) 1200 km (4) 3200 km

**Ans. (2)**

**Sol.** $g_n = \frac{GM}{(R+h)^2} = \frac{GM}{(4R)^2} = \frac{g_s}{16} = g_1$

$g_2 = g_d = g_s\left(1-\frac{d}{R}\right)$; $g_2 = 4g_1 = \frac{g_s}{4}$

$\frac{g_s}{4} = g_s\left(1-\frac{d}{R}\right)$

$\frac{d}{R} = \frac{3}{4}$

$d = \frac{3R}{4} = \frac{3}{4}\times 6400 = 4800$ km

**6.** The relation between $\gamma = \frac{C_p}{C_v}$ and temperature is?

(1) $\gamma$ is proportional to $T^0$

(2) $\gamma$ is proportional to $\frac{1}{T}$

(3) $\gamma$ is proportional to $\frac{1}{\sqrt{T}}$

(4) $\gamma$ is proportional to T

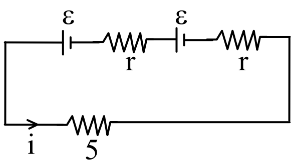
**Ans. (1)**

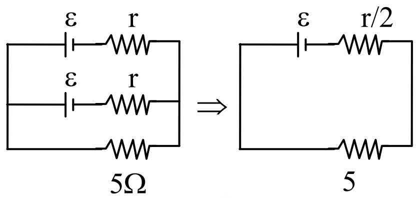
**Sol.** $\gamma$ is independent of temperature.

**7.** Two identical cells are first connected in series and then connected in parallel to external load of 5Ω. If the current through load in each case is same. Find internal resistance r (in ohm)?

**Ans.** **5**

**Sol.**



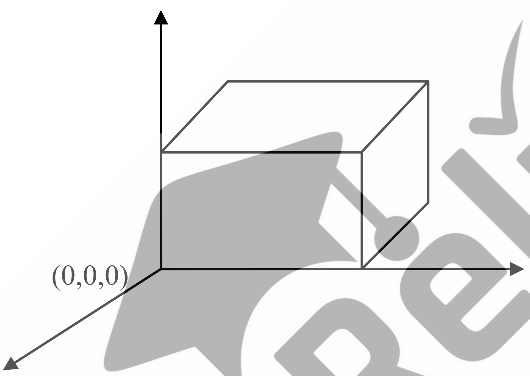

$$i = \frac{2E}{5+2r} = \frac{E}{5+\frac{r}{2}}$$

$$i = \frac{E}{5+\frac{r}{2}}$$

$10 + r = 5 + 2r$

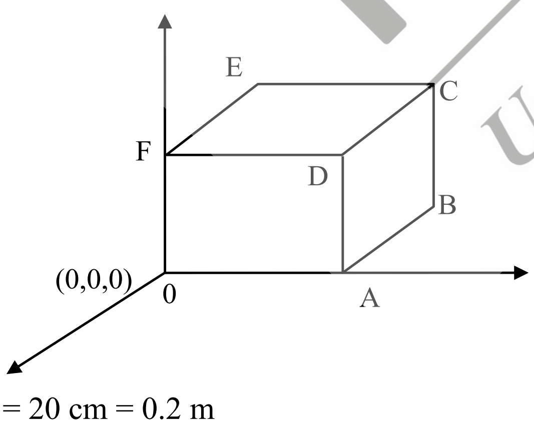
$5\Omega = r$

**8.** If a cube of side a = 20 cm is placed as shown and $E = 400x^2\hat{i}$ N/C, then find the flux $\phi$ $\left(\text{in} \frac{N-m^2}{C}\right)$ through the cube.




**Ans.** **0.64**

**Sol.**




a = 20 cm = 0.2 m

$\phi_{ABCD} = Ea^2 \quad = 400 \times (0.2)^2 \times (0.2)^2$

$= 0.64 \ \frac{N-m^2}{C}$

Flux through all surface except ABCD is zero

$\phi_{total} = 0.64$ weber

**9.** A message wave $x_m(t) = 10 \sin 4\pi t$ is superimposed on carrier wave $x_c(t) = 15 \sin (1000\ \pi t)$ then frequency of modulated wave is :

(a) 500 Hz (b) 502 Hz (c) 498 Hz (d) 2 Hz

(1) a, b, d (2) a, c, d (3) a, b, c (4) b, c, d

**Ans. (3)**

**Sol.** $\omega_c = 1000\ \pi = 2\pi f_c$

$f_c = 500$ Hz

$\omega_m = 4\pi = 2\pi\ f_m$

$f_m = 2$Hz

**10.** Neutron will break into proton but proton will not break into neutron, because?

(1) Neutron is composed of proton and electron.

(2) Rest mass of neutron is greater than rest mass of proton.

(3) Neutron is neutral

(4) Proton is positively charged.

**Ans. (2)**

**Sol.** Basic theory

**11.** An electron of H-atom makes transition from n = 3 to n = 1 emits photon of wavelength $\lambda_1$ and for transition from n = 2 to n = 1 it is $\lambda_2$. If $\frac{\lambda_1}{\lambda_2} = \frac{x}{32}$. Find x = ?

**Ans. 27**

**Sol.** $\frac{1}{\lambda_1} = R \times 1^2\left(\frac{1}{1^2} - \frac{1}{3^2}\right)$

$\lambda_1 = \frac{9}{8R}$

$\frac{1}{\lambda_2} = R \times 1^2\left(\frac{1}{1^2} - \frac{1}{2^2}\right)$

$\lambda_2 = \frac{4}{3R}$

$\frac{\lambda_1}{\lambda_2} = \frac{27}{32}$

x = 27

**12.** A magnetic dipole of magnetic moment 5 $Am^2$ is parallel to uniform magnetic field of 0.4 T. If it is rotated slowly by 180º. Find out work done by external agent.

(1) 0J (2) 2J (3) 4J (4) 8J

**Ans.** **(3)**

**Sol.** $W_{ext} = U_f - U_i$

$U = - MB \cos \theta$

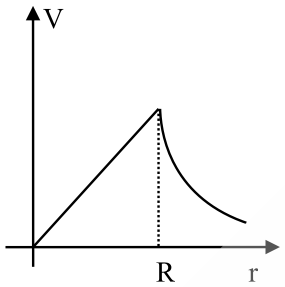
$W_{ext} = - MB \cos 180º + MB \cos 0º$

$W_{ext} = 2MB$

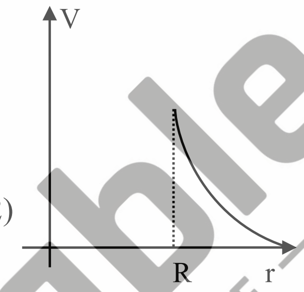
$= 2 \times 5 \times 0.4 = 4J$

**13.** A conducting sphere of radius R is charged with charge Q. It's potential with distance from centre is best represented by :

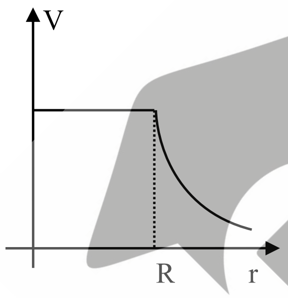
(1)



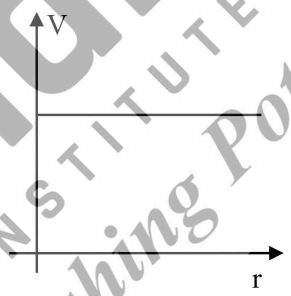

(2)




(3)




(4)




**Ans.** **(3)**

**Sol.** Electric field inside a conducting sphere is 0. Hence potential remains constant inside the sphere.

**14.** Two conductors are made up of same material and has equal lengths. But area of the conductor is A and that of $2^{nd}$ conductor is 2A. If drift velocity of electron is $V_d$ in first conductor, then find drift velocity of electron in $2^{nd}$ conductor is?

(1) $\frac{V_d}{2}$ (2) $2V_d$ (3) $V_d$ (4) None of these

**Ans.** **(3)**

**Sol.** $V_d = \frac{eE\tau}{m} = \frac{e\tau}{m}\frac{\Delta V}{\ell}$

Independent of area.

So $V_{d_2} = V_{d_1} = V_d$

**15.** Speed of light in air is v. If its speed is 0.2v in given medium, then refractive index of given medium is

**Ans.** **5**

**Sol.** $\mu = \frac{c}{v} = \frac{v}{0.2v} = 5$

**16.** 100 balls of mass 'm' collide elastically on floor with speed v, if collision lasts for t sec. Find force applied by floor.

(1) $\frac{200mv}{t}$ (2) $\frac{100mv}{t}$ (3) 0 (4) $\frac{50mv}{t}$

**Ans.** **(1)**

**Sol.** Force on 1 ball = $\frac{\Delta\vec{P}}{\Delta t}$

Force on 100 balls = $100\frac{\Delta\vec{P}}{\Delta t}$

$= \frac{100(2mv)}{t}$

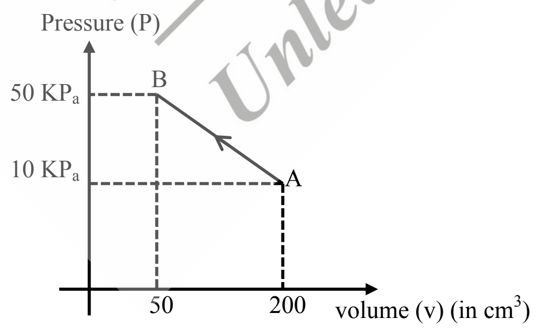
**17.** If kinetic energy of solid sphere in pure rolling is 7000 J. If Mass of sphere is 1 kg, then calculate velocity of centre of mass?

**Ans.** **100**

**Sol.** $K.E = \frac{1}{2}\times\frac{7}{5}mv^2 = 7000$

v = 100 m/s

**18.** In the shown P-V graph, if gas do not absorb or release the heat throughout the process, then find change in internal energy ($\Delta U$).



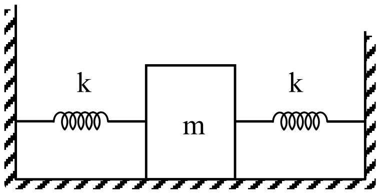

(1) 6 J (2) 0 (3) – 4.5 J (4) 4.5 J

**Ans.** **(4)**

**Sol.** Area = $150 \times 10^{-6} \times 10^{4} + \frac{1}{2}(150 \times 10^{-6})(40 \times 10^{3}) = 1.5 + 3 = 4.5$

work = – 4.5 J

$\Delta Q = 0, \Delta Q = \Delta U + W \Rightarrow \Delta U = 4.5$ J

**19.** 


If k = 2 N/m, m = 490 gm, then find the number of complete oscillations in 14π sec.

**Ans.** **20**

**Sol.** $T = 2\pi\sqrt{\frac{m}{2K}}$

$= 2\pi\sqrt{\frac{490}{1000\times2\times2}} = \frac{14\pi}{20}\text{sec}$

No. of complete oscillations = $\frac{14\pi}{T} = \frac{14\pi}{14\pi}\times20 = 20$

**20.** In L-C-R series circuit current and voltage are in same phase. Resistance of circuit is 20Ω. Potential difference of A.C. source is 220 volt. Current in circuit is $\sqrt{x}$ A. The value of 'x' is

**Ans.** **121**

**Sol.** z = R

$i = \frac{v}{z} = \frac{220}{20} = 11\text{A}$

x = 121

**21.** Statement-I : Beam of electron contains wave nature.

Statement-II : The above fact is discovered by davission-Germar

(1) S-I is false, S-II is true
(2) S-I is true, S-II is false
(3) S- I is true, S-II is true
(4) S –I is false, S-II is false

**Ans.** **(3)**

**Sol.** Basic theory

**22.** Which of the following is dimensionless quantity. Given 'R' resistance, $x_L$ is inductive reactance and $x_C$ is capacitive reactance

(1) $\frac{R}{\sqrt{x_L x_C}}$
(2) $\frac{R}{x_L x_C}$
(3) $\frac{Rx_C}{x_L}$
(4) $R\sqrt{x_L x_C}$

**Ans.** **(1)**

**Sol.** $[R] = [X_L] = [X_C]$

**23.** Unpolarised light of intensity $I_0$ is incident on polaroid combination A, C & B such that transmission axis of A and B are perpendicular and 'C' is at angle bisector of A & B. Choose the intensity of final light coming out.

(1) $\frac{I_0}{8}$ (2) $\frac{I_0}{4}$ (3) $\frac{I_0}{2}$ (4) $\frac{I_0}{16}$

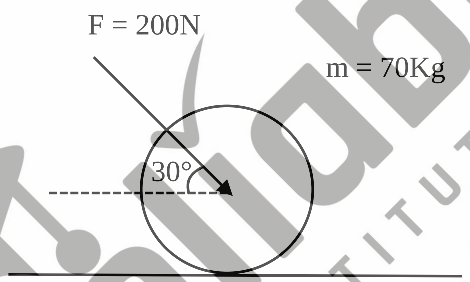
**Ans.** **(1)**

**Sol.** $I_A = \frac{I_0}{2}$

$I_C = I_A \cos^2(45°) = \frac{I_0}{2} \times \frac{1}{2} = \frac{I_0}{4}$.

$I_B = I_C \cos^2(45°) = \frac{I_0}{8}$

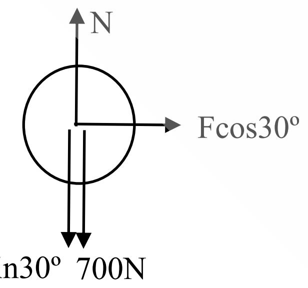
**24.** Find normal reaction between ground & roller. If force on roller is passing through centre as shown. Given mass of roller is 70 kg




(1) 800 N (2) 600 N (3) $600\sqrt{3}$ N (4) 900 N

**Ans.** **(1)**

**Sol.**




$N = 700 + 200 \times \frac{1}{2}$

$N = 800$ N

**25.** A non – conducting and a conducting balls are released from same height from the earth surface, (air resistance is neglected) then choose the correct option:

(1) Metal ball will reach first
(2) Both will reach simultaneously
(3) Non- conducting will reaches first.
(4) Time is independent of material used

**Ans.** **(3)**

**Sol.** Due to earth's magnetic field there will be eddy current generation in the conducting ball due to which the motion will be damped for conducting ball. Hence, non-conducting ball will reach first.

**26.** A source of power 1.6 KW emits $10^{17}$ photons/sec then emitted wave is.

(1) x-ray
(2) Ultraviolet ray
(3) Infrared ray
(4) Microwave

**Ans.** **(1)**

**Sol.** $\frac{N}{\tau} = \frac{P}{\varepsilon}$

$$E = \frac{1.6 \times 10^3}{10^{17}} = 1.6 \times 10^{-14} J$$

$$E = \frac{1.6 \times 10^{-14}}{1.6 \times 10^{-19}} eV = 10^5 eV$$

$$\lambda = \frac{12400}{10^5} Å = 0.124 Å$$