JEE MAIN 2023
APRIL ATTEMPT
PAPER-1 (B.Tech / B.E.)

QUESTIONS & SOLUTIONS
Reproduced from Memory Retention

📅 13 APRIL, 2023
⏰ 9:00 AM to 12:00 Noon

Duration : 3 Hours
Maximum Marks : 300

SUBJECT - PHYSICS

LEAGUE OF TOPPERS (Since 2020)
TOP 100 AIRs IN JEE ADVANCED

AIR 5
MAYANK MOTWANI
Roll No. : 20277637
JEE ADV. 2020

AIR 15
DHANANJAY KEJRIWAL
Roll No. : 20192328
JEE ADV. 2019

AIR 29
SANKALP PARASHAR
Roll No. : 20397666
JEE Adv. 2020

AIR 30
AARYAN GUPTA
Roll No. : 1937600
JEE Adv. 2020

AIR 67
ANKAN SARKAR
Roll No. : 207712420
JEE Adv. 2020

Admission Announcement for JEE Advanced (For Session 2023-24)

VIKAAS
For Class X to XI
Moving Students
TARGET 2025

VISHWAAS
For Class XI to XII
Moving Students
TARGET 2024

VISHESH
For Class XII
Passed Students
TARGET 2024

Starting From : 12 & 19 APRIL’23
Avail Scholarship up to 90% through R- NET on EVERY SUNDAY

Reliable Institute : A-10, Road No.1, IPIA, Kota-324005 (Rajasthan), India
Tel. : 0744-3535544, 2665544 | Website : www.reliablekota.com | E-mail : info@reliablekota.com
PHYSICS

1. Find the ratio of heat loss.

\[
\begin{align*}
\text{P}_1 &= \frac{v^2}{R} = \frac{2v^2}{R} \\
\text{P}_2 &= \frac{v^2}{2R}
\end{align*}
\]

\[
\frac{H_1}{H_2} = \frac{\text{P}_1 t}{\text{P}_2 t} = \frac{4}{1}
\]

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

Ans. (2)

2. Two spheres of density \( \rho \) and \( \frac{\rho}{3} \) of radius \( R \) and \( 4R \) respectively. Find the ratio of magnitude of gravitational field at the surface respectively.

\[
\begin{align*}
\text{g}_1 &= \frac{G \rho \left( \frac{4}{3} \pi R^3 \right)}{R^2} \\
\text{g}_2 &= \frac{G \left( \frac{4}{3} \pi (4R)^3 \right)}{(4R)^2}
\end{align*}
\]

\[
\frac{\text{g}_1}{\text{g}_2} = \frac{3}{4}
\]

(1) \( \frac{3}{4} \)  (2) \( \frac{4}{3} \)  (3) \( \frac{2}{3} \)  (4) \( \frac{1}{4} \)

Ans. (1)
3. A projectile is projected at an angle 30° from horizontal, the height of projectile is same at 
t = 3 sec and t = 5 sec. Find the initial speed of the projectile ?

(1) 80 m/s   (2) 100 m/s   (3) 120 m/s   (4) 140 m/s

Ans. (1)

Sol.

\[ T = t_A + t_B = 8 \text{ seconds} \]

\[ \frac{2u \sin 30°}{g} = 8 \]

\[ u = 80 \text{ m/s} \]

4. A person is firing 'n' bullets per second, the speed of each bullet is 250 m/s. The thrust force 
experienced by the person is 125 N, mass of each bullet 10 grams. Find n.

(1) 50   (2) 60   (3) 70   (4) 120

Ans. (1)

Sol. \[ \Delta P = mv \]

\[ F_{\text{Thrust}} = \frac{\Delta p}{\Delta t} \{\text{due to each bullet}\} \]

\[ F_{\text{net}} = nF_{\text{thrust}} = n(mv) \]

\[ 125 = (n) \times \frac{10}{1000} \times 250 \]

\[ 50 = n \]
5. Two identical charge of mass 20 gm and charge 2 \( \mu \)C are on smooth inclined plane if they are in equilibrium find out \( h \).

\[ m \sin \theta = \frac{kq^2 \sin^2 \theta}{h^2} \]

\[ h = \sqrt{\frac{kq^2 \sin \theta}{mg}} = \sqrt{\frac{9 \times 10^9 \times 4 \times 10^{-12}}{2 \times 10^{-2} \times 10 \times 2}} \]

\[ h = 30 \text{ cm} \]

Ans. (1)

6. \( F = (2 + 3x) \text{N} \)

Find work done by force \( F \) in between \( x = 0 \) to \( x = 4 \)m.

\( W = \int_0^4 (2 + 3x) \, dx \)

\[ W = \left[ 2x + \frac{3x^2}{2} \right]_0^4 = 32 \text{ J} \]
7. A coin is placed on disc at 1 cm from centre of disk which is moving with maximum Angular velocity 'ω' without slipping. If angular velocity of disc is $\frac{\omega}{2}$, then at what maximum distance coin should be placed without slipping.

(1) 2 cm  (2) 4 cm  (3) 6 cm  (4) 8 cm

Ans. (2)

Sol. $\mu mg = m \omega^2 r_1$  

$\mu mg = m \left(\frac{\omega}{2}\right)^2 r_2$  

From (i) and (ii)

$m \omega^2 r_1 = m \left(\frac{\omega}{2}\right)^2 r_2$

$r_2 = 4r_1$

$r_2 = 4 \times 1$

$r_2 = 4$ cm

8. If current passing through 3Ω resistor is $\frac{x}{3}$ amp, then find the value of x?

Ans. 1
Sol. Equivalent emf is \( E_{eq} = 8V - 4V = 4V \)

\[
\begin{array}{c}
4V, 0.5\Omega \\
\downarrow \\
8V, 1\Omega \\
\uparrow \\
4\Omega \\
\downarrow \\
I_1 \\
3\Omega \\
\uparrow \\
4.5\Omega \\
\end{array}
\]

Equivalent resistance \( R_{eq} = \frac{6 \times 3}{6 + 3} + 4.3 + 0.5 + 1 = 8\Omega \)

Current in circuit \( I = \frac{E_{eq}}{R_{eq}} = \frac{4}{8} = 0.5\Omega \)

Current passing through 3\( \Omega \) resistor \( I_1 = \frac{6}{3+6} \times I \)

\[ I_1 = \frac{6}{9} \times \frac{1}{2} = \frac{1}{3} \text{ amp} \]

Value of x is 1.

9. Find out which logic gate is represented by following setup

\begin{align*}
\text{A} & \rightarrow \text{B} \\
\text{AND} & \\
\text{OR} & \\
\text{NAND} & \\
\text{NOR} & 
\end{align*}

Ans. (1)

Sol. \( \overline{A + B} = \overline{A} \overline{B} = \overline{A} \overline{B} \)

AND GATE

10. A particle under SHM is moving from mean position to extreme position. Plot graph of KE v/s position x.

\begin{align*}
(1) & \quad \text{KE} \quad x \\
(2) & \quad \text{KE} \quad x \\
(3) & \quad \text{KE} \quad x \\
(4) & \quad \text{None of these}
\end{align*}

Ans. (2)
Sol.  K.E. = $\frac{1}{2} mv^2$

K.E. = $\frac{1}{2} m\omega^2 (A^2 - x^2)$

11. If signals from an antenna can be received upto 4 km along the ground and it is found that height of antenna is $x \times 10^{-2}$ m. Find the value of $x$. (Assume radius of Earth to be 6400 km)

Ans. 125

Sol.  $d = \sqrt{2Rh}$

\[4000 = \sqrt{2 \times 6400 \times 10^3 \times h} \]

$h = 1.25$ m

$h = 125 \times 10^{-2}$ m

12. The equation of a travelling wave is given as $g = A \sin 20 (160t - 0.5x + \phi)$. Find the velocity of wave is (Km/hr).

Ans. 1125

Sol.  $v = \frac{\omega}{K} = \frac{160}{0.5} = 320$ m/s

$= 320 \times \frac{18}{5} = 1125$ Km/hr
13. When a rod of length $\ell$ is stretched by 100 N force its length becomes $\ell_1$ and when it is stretched by 120 N force its length becomes $\ell_2$. If $\frac{\ell_1}{\ell_2} = \frac{10}{11}$, then original length ($\ell$) of rod is $\frac{\ell}{x}$. Find value of $x$?

Ans. (x = 2)

Sol.

\[ \Delta \ell = \frac{F \ell}{Ay} \]

\[ \ell_1 - \ell = \frac{100L}{Ay} \quad \ldots(i) \]

When stretched by 120 N

\[ \ell_2 - \ell = \frac{120x}{Ay} \quad \ldots(ii) \]

\[
\begin{align*}
(i) \quad & \frac{\ell_1 - \ell}{\ell_2 - \ell} = \frac{10}{12} = \frac{5}{6} \\
(ii) \quad & \ell_1 - 6\ell = 5\ell_2 - 5\ell \\
6\ell_1 - 6\ell &= 5\ell_2 - 5\ell \\
\ell_1 &= \frac{10}{11} \Rightarrow \ell_2 = \frac{10}{11} \ell_1 \\
6\ell_1 - \left( \frac{11}{10} \ell_1 \right) &= \ell \\
\frac{5}{10} \ell_1 &= \ell \Rightarrow \ell = \frac{\ell_1}{2}
\end{align*}
\]

14. A charged capacitor has potential energy $U_1$. An identical uncharged capacitor is connected across it. The potential energy stored in the combination now is $U_2$. Find $U_1/U_2$?

Ans. 2
Sol. \( U_1 = \frac{1}{2} CV^2 \)

\[
\begin{array}{c}
\text{Before} \\
CV \quad CV
\end{array}
\]

\[
\begin{array}{c}
\text{After} \\
\frac{CV}{2} \quad \frac{CV}{2}
\end{array}
\]

\[ U_2 = \frac{1}{2} \frac{CV^2}{4} \times 2 = \frac{CV^2}{4} \]

\[ \frac{U_1}{U_2} = 2 \]

15. Area of loop is 4 m² and magnetic field which is passing through is varying according to graph. Find out induced emf?

Ans. 8

Sol. \( \phi = BA \) \( \{B(t) = 2t\} \)

\[ \phi(t) = 2t \times 4 = 8t \]

\[ \left( \frac{d\phi}{dt} \right) = e = 8 \text{ volt} \]

16. Half life of nuclei A is equal to average life of nuclei of B, then correct relationship between decay constants

\( (1) \ \lambda_A = 2\lambda_B \) \( (2) \ 2\lambda_A = \lambda_B \) \( (3) \ \lambda_A \ \ell n2 = \lambda_B \) \( (4) \ \lambda_A = \lambda_B / \ell n2 \)

Ans. (4)

Sol. \[ \frac{\ell \text{n}2}{\lambda_A} = \frac{1}{\lambda_B} \quad \Rightarrow \quad \ell \text{n}2 \ \lambda_B = \lambda_A \]
17. If current sensitivity is increased by 25 % on increasing number of turns by N. Then voltage sensitivity increases by : (consider resistance constant)

(1) 25%  (2) 0 %  (3) –25 %  (4) 50 %

Ans. (1)

Sol. C.S \propto N
R \rightarrow \text{constant}
⇒ V.S \propto N

18. When light of wavelength \( \lambda \) is incident on a metallic surface its stopping potential become \( V_0 \). If wavelength of light becomes \( 2\lambda \) its stopping potential becomes \( \frac{V_0}{4} \). Then find threshold wavelength.

(1) \( \frac{3\lambda}{2} \)  (2) \( \frac{\lambda}{2} \)  (3) \( 3\lambda \)  (4) \( \frac{5\lambda}{4} \)

Ans. (3)

Sol. \( eV_s = \frac{hc}{\lambda} - \phi \)
\( eV_0 = \frac{hc}{\lambda} - \phi \) ....(i)
\( \frac{eV_0}{4} = \frac{hc}{2\lambda} - \phi \) ....(ii)
\[
\begin{align*}
\frac{(i)}{(ii)} &\Rightarrow \frac{2hc}{\lambda} - 4\phi = \frac{hc}{\lambda} - \phi \\
\frac{hc}{\lambda} - 3\phi &\Rightarrow \phi = \frac{hc}{3\lambda} = \frac{hc}{\lambda_{th}} \Rightarrow \lambda_{th} = 3\lambda
\end{align*}
\]

19. An uniform solid sphere is rotating with angular velocity 10 rad/s. Moment of inertia about tangent is \( (x \times 10^{-2}) \times \) angular momentum about diameter. Find out x ?

Ans. 35

Sol. \[ \frac{7}{2} \ mR^2 = x \times 10^{-2} \times \frac{2}{5} \ mR^2 \times 10 \]
\[ 7 = x \times 10^{-2} \times 20 \]
\[ x = \frac{70}{2} = 35 \]
20. 1 kg of water at 100°C is converted to 1 kg of steam at 100°C. Change in volume is $10^{-3}$ m$^3$. Find change in potential energy.

(Given $P_0 = 10^5$ N/m$^2$)

$P_0 \rightarrow$ Atmospheric pressure

$L_v = 2257$ J/kg

Ans. 2157 J

Sol. $\Delta Q = mL_v = 1 \times 2257$

$\Delta Q = 2257$ J

$W = 10^5 \times 10^{-3} = 100$ J

$\Delta Q = W + \Delta U$

$\Delta U = \Delta Q - W$

$\Delta U = 2257 - 100$

$\Delta U = 2157$ J

21. The variation of impedance ($z$) with angular frequency ($\omega$) for two electrical elements is shown in graph given. If $x_L$, $x_C$ and $R$ are inductive reactance, capacitive reactance and resistance respectively, then

(1) A is resistor, B is inductor  
(2) A is inductor, B is capacitor  
(3) A is inductor, B is resistor  
(4) A is capacitor, B is inductor

Ans. (2)

Sol. $X_L = \omega L$

$X_C = \frac{1}{\omega C}$
22. If light is passed through rarer to denser medium of critical angle 45°, then the speed of wave in denser medium is:

(1) $3 \times 10^8$ m/s  
(2) $\frac{3 \times 10^8}{\sqrt{2}}$ m/s  
(3) $3\sqrt{2} \times 10^8$ m/s  
(1) $1.5 \times 10^8$ m/s

Ans. (2)

Sol. $\sin \theta_c = \frac{\mu_r}{\mu_d} = \frac{1}{\mu} = \frac{1}{\sqrt{2}}$

$\mu = \sqrt{2}$

$v = \frac{C}{\mu} = \frac{3 \times 10^8}{\sqrt{2}}$ m/s

23. An equiconvex lens of radius of curvature 20 cm and refractive index 1.5 has power $P_1$ in air. If this lens is immersed in liquid of refractive index $\frac{4}{3}$, it has power $P_2$ find out $\frac{P_1}{P_2}$.

Ans. 4

Sol. $P_1 = \left(\frac{3}{2} - 1\right) \left(\frac{2}{R}\right)$

$P_2 = \left(\frac{3/2}{4/3} - 1\right) \left(\frac{2}{R}\right)$

$\frac{P_1}{P_2} = \left(\frac{1}{2}\right) = 4$

24. Temperature scale boiling point = 65°C. Melting point = 15°C. Find 95º in Fahrenheit.

Ans. 320

Sol. $\frac{x - x_m}{x_H - x_m} = \frac{F - 32}{180}$

$\frac{95 - 15}{65 - 15} = \frac{F - 32}{180}$

$F = 320$
25. In EMW wave amplitude of electric field is 20 v/m. Find out energy in $4 \times 10^{-4}$ m$^3$ volume.

(1) $4.42 \times 10^{-13}$ J/m$^3$
(2) $8.85 \times 10^{-13}$ J/m$^3$
(3) $15 \times 10^{-13}$ J
(4) $1.52 \times 10^{-13}$ J/m$^3$

Ans. (2)

Sol. 

\[ U = 2 \times \frac{1}{2} \varepsilon_0 \left( \frac{E_0}{\sqrt{2}} \right)^2 \times \text{volume} \]

\[ = \frac{\varepsilon_0 E_0^2}{2} \times V \]

\[ = \frac{8.85 \times 10^{-12} \times 400}{2} \times 5 \times 10^{-4} = 8.85 \times 10^{-13} \text{ J/m}^3 \]
SATYAM CHAKRAVORTY
(Classroom) selected for
- ASIAN PACIFIC MATHEMATICS OLYMPIAD (APMO) 2023
- IMOTC 2023 Camp (Conducted by HBCSE)
- BRONZE MEDAL IN INOI (Indian National Olympiad in Informatics 2023)

Success Delivered to the Deserving