SAMPLE HINTS AND SOLUTIONS

INSTITUTE NAME & LOGO

MHT-CET – EXAM YEAR		
Time : 45 Min	**Phy : Full Portion Paper**	**Marks : 50**

Hints and Solutions

01) Ans: **D)** greater than 40 N/m².

Sol: Here, change in pressure, $\Delta P = \frac{4T}{r} = 40\ N/m^2$

02) Ans: **C)** 250 K

Sol: Closed vessel means volume is constant.

$\therefore \frac{P_1}{P_2} = \frac{T_1}{T_2} \Rightarrow \frac{P}{P + \left(\frac{0.4}{100}\right)P} = \frac{T}{T+1} \Rightarrow T = 250K$

03) Ans: **A)** 7 : 5

Sol: We have, $\frac{I_{max}}{I_{min}} = \left(\frac{\frac{a_1}{a_2}+1}{\frac{a_1}{a_2}-1}\right)^2 \Rightarrow \frac{a_1+a_2}{a_1-a_2} = 6$

$\therefore \frac{a_2}{a_1} = 7:5$

04) Ans: **D)** 10^{15} cycles/s

Sol: Here, frequency $v = \frac{c}{\lambda} = \frac{3\times10^8}{3000\times10^{-10}}$

$\Rightarrow v = 10^{15}$ cycles / s

05) Ans: **B)** 2.66 eV

Sol: The energy of incident light

$E\,(eV) = \frac{12375}{3320} = 3.72\ eV \quad (332\ nm = 3320\ A^o)$

From the relation, $E = W_0 + eV_0$

$\Rightarrow V_0 = \frac{(E - W_0)}{e} = \frac{3.72\ eV - 1.07\ eV}{e}$

$= 2.65$ Volt.

06) Ans: **B)** 1.44 x 10^{11} newton/coulomb

Sol: Because of deuteron, intensity of electric field at 1 Å distance is $E = \frac{1}{4\pi\varepsilon_0}.\frac{e}{r^2}$

$\Rightarrow E = \frac{9\times10^9\times1.6\times10^{-19}}{10^{-20}} = 1.44\times10^{11}\ N/C.$

07) Ans: **B)** decreasing, same.

Sol: We know, $\lambda = \frac{h}{mv}$. As v is increasing in case (i) but it is not changing in case (ii), so in the first case de-Broglie wavelength will change, but it second case it remains the same.

08) Ans: **A)** 1728×10^{10} J

Sol: The energy generated is

$\frac{Energy}{Day} = 200\times10^6\times24\times3600$

$\Rightarrow \frac{Energy}{Day} = 2\times2.4\times3.6\times10^{12} = 1728\times10^{10}$ J

09) Ans: **D)** A and B

Sol: In the given wave equations, waves A and B satisfies the conditions required for a standing wave.

10) Ans: **A)** 0.125 mg

Sol: In this case,

$N = N_0\left(\frac{1}{2}\right)^n \Rightarrow N = N_0\left(\frac{1}{2}\right)^{t/T_{1/2}}$

$\Rightarrow N = 1\times\left(\frac{1}{2}\right)^{\frac{8.1}{2.7}} = \left(\frac{1}{2}\right)^3 = \frac{1}{8}$

$\Rightarrow N = \frac{1}{8}mg = 0.125\ mg$

11) Ans: **A)** 1×10^{-3} V in vertical position and zero is horizontal position.

Sol: If player is running with rod in vertical position towards east, then rod cuts the magnetic field of earth perpendicularly (The magnetic field of earth is south to north).

Therefore Maximum e. m. f. induced is

$e = Bvl = 4\times10^{-5}\times\frac{30\times1000}{3600}\times3 = 1\times10^{-3}$ volt

When he is running with rod in horizontal position, no field is cut by the rod,

$\therefore$ e = 0.

12) Ans: **D)** $\frac{1}{2}$

Sol: As, $F \propto xm\times(1-x)m = xm^2(1-x)$,

therefore for maximum force $\frac{dF}{dx} = 0$

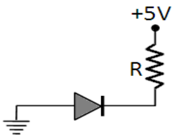
$\Rightarrow \frac{dF}{dx} = m^2 - 2xm^2 = 0 \Rightarrow x = 1/2$

13) Ans: **B)** Diatomic, $\frac{7}{2}R, \frac{5}{2}R$

Sol: From the given problem, $\gamma = 1 + \frac{2}{f} \Rightarrow 1.4 = 1 + \frac{2}{f}$

It means degree of freedom $f = 5$.
Therefore, degree of freedom of diatomic gas is 5 and it's $C_P = \frac{7}{2}R$ and $C_V = \frac{5}{2}R$.

14) Ans: **C)**



Sol: As N-side is more positive than P-side.

15) Ans: **A)** 0.5 ampere

Sol: Current, $i = \frac{|e|}{R} = \frac{N}{R}.\frac{\Delta B}{\Delta t} A \cos\theta$

$\Rightarrow i = \frac{20}{100} \times 1000 \times (25 \times 10^{-4}) \cos 0^{\circ} \;\; \Rightarrow i = 0.5\ A$

16) Ans: **A)** 1.5 hrs

Sol: Here, angular momentum of spin $= I\,\omega$

$\therefore$ According to the law of conservation of angular momentum,

$\frac{2}{5}MR^2.\frac{2\pi}{T} = \frac{2}{5}M\left(\frac{R}{4}\right)^2.\frac{2\pi}{T'} \Rightarrow T' = \frac{T}{16} = \frac{24}{16} = 1.5\ \text{hrs.}$

17) Ans: **C)** 0.99 g

Sol: As given that, $h = 32\ km$, $R = 6400\ km$,

$\therefore\ h << R$

$g' = g\left(1 - \frac{2h}{R}\right) = g\left(1 - \frac{2 \times 32}{6400}\right) \Rightarrow g' = \frac{99}{100} g = 0.99\ g$

18) Ans: **C)** $2.7\ m/s^2$

Sol: In non-uniform circular motion, the net acceleration is given as,

$a = \sqrt{a_t^2 + a_c^2} = \sqrt{(2)^2 + \left(\frac{900}{500}\right)^2} = 2.7\ m/s^2$

where, $a_t =$ tangential acceleration

$a_c =$ centripetal acceleration $= \frac{v^2}{r}$

19) Ans: **C)** 1.5 cm

Sol: Distance of third maxima from central maxima is given by

$x = \frac{3\lambda D}{d} = \frac{3 \times 5000 \times 10^{-10} \times (200 \times 10^{-2})}{0.2 \times 10^{-3}} = 1.5\ cm$

20) Ans: **B)** $2\pi\sqrt{\left(\frac{3L}{2g}\right)}$

Sol: In this case, the effective acceleration in a lift descending with acceleration $\frac{g}{3}$ is $g_{eff} = g - \frac{g}{3} = \frac{2g}{3}$

$\therefore\ T = 2\pi\sqrt{\left(\frac{L}{g_{eff}}\right)} = 2\pi\sqrt{\left(\frac{L}{2g/3}\right)} = 2\pi\sqrt{\left(\frac{3L}{2g}\right)}$

21) Ans: **D)** bandwidth.

22) Ans: **A)** 1/3 times.

Sol: According to the ideal gas equation,

$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$. And here,

$\frac{E_2}{E_1} = \frac{P_2}{P_1} = \frac{V_1}{V_2} \times \frac{T_2}{T_1} = \left(\frac{1}{4}\right) \times \left(\frac{400}{300}\right) = \frac{1}{3} \Rightarrow E_2 = \frac{E_1}{3}$

From the equation, elasticity will become $\frac{1}{3}$ times.

23) Ans: **B)** microwave.

Sol: Microwaves are used in telecommunication.

24) Ans: **B)** 0.4 A

Sol: The current rating of the secondary is

$i_s = \frac{P_s}{V_s} = \frac{4.4 \times 10^3}{11 \times 10^3} = 0.4\ A$

25) Ans: **C)** 2×10^{-2} A-m

Sol: We have, $\tau = MB\sin\theta \;\Rightarrow \tau = (m\,L)B\sin\theta$

$\Rightarrow 25 \times 10^{-6} = (m \times 5 \times 10^{-2}) \times 5 \times 10^{-2} \times \sin 30$

$\Rightarrow m = 2 \times 10^{-2} A - m.$

26) Ans: **A)** behaves like a paramagnetic material.

Sol: As a ferromagnetic material in heated above its curie temperature, then it behaves like a paramagnetic material.

27) Ans: **A)** $\frac{4\pi q}{6(4\pi\varepsilon_0)}$

Sol: Here, $\phi_{face} = \frac{q}{6\varepsilon_0} = \frac{4\pi q}{6\,(4\pi\varepsilon_0)}$.

28) Ans: **B)** 36°56'

Sol: We know, $\theta_P + r = 90^{\circ}$

$\Rightarrow r = 90^{\circ} - \theta_P = 90^{\circ} - 53^{\circ}4' = 36^{\circ}56'.$

29) Ans: **A)** $10\sqrt{10}$

Sol: The ratio of the periodic times is

$\frac{T_1}{T_2} = \left(\frac{R_1}{R_2}\right)^{3/2} = \left(\frac{10^{13}}{10^{12}}\right)^{3/2} = (1000)^{1/2} = 10\sqrt{10}$

30) Ans: **C)** 4 B

Sol: Here, $B' = n^2B = (2)^2B = 4\,B$.

31) Ans: **D)** Obtuse (More than 90°)

32) Ans: **D)** Zero

Sol: The given circuit is a balanced Wheatstone bridge, it implies that potential difference between B and D is zero. So, no current flows between B and D.

33) Ans: **A)** $k_1k_2/(k_1+k_2)$
Sol: As given in the problem, in series combination,
$$\frac{1}{k_S}=\frac{1}{k_1}+\frac{1}{k_2}=\frac{k_2+k_1}{k_1k_2}\Rightarrow k_S=\frac{k_1k_2}{k_1+k_2}.$$

34) Ans: **B)** 5 : 8
Sol: Resistance,
$$R=\rho\frac{l}{A}\Rightarrow\ \frac{R_1}{R_2}=\frac{\rho_1}{\rho_2}\times\frac{l_1}{l_2}\times\frac{A_2}{A_1}=\frac{2}{3}\times\frac{3}{4}\times\frac{5}{4}=\frac{5}{8}$$

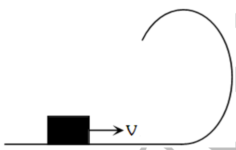
35) Ans: **A)** 8 : 1
Sol: Force, $F=Y\times A\times\frac{l}{L}\Rightarrow F\propto\frac{r^2}{L}$
(Y and l are constant)
$$\therefore\frac{F_A}{F_B}=\left(\frac{r_A}{r_B}\right)^2\times\left(\frac{L_B}{L_A}\right)=\left(\frac{2}{1}\right)^2\times\left(\frac{2}{1}\right)=\frac{8}{1}$$

36) Ans: **B)** 1.1×10^{-7} s
Sol: Here, $T=\frac{2\pi m}{qB}=\frac{2\pi r}{v}$
$$\Rightarrow T=\frac{2\times3.14\times0.45}{2.6\times10^7}=1.08\times10^{-7}s$$

37) Ans: **C)** 2
Sol: From the problem, $F_{12}=\frac{1}{4\pi\varepsilon_0}\cdot\frac{q^2}{a^2}$ and
$$F_{13}=\frac{1}{4\pi\varepsilon_0}\cdot\frac{q^2}{(a\sqrt{2})^2}\ \Rightarrow\frac{F_{12}}{F_{13}}=2$$

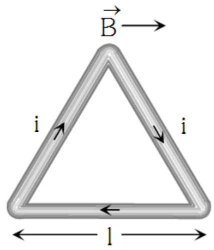
38) Ans: **B)** there is a relative motion between the source and the observer.

39) Ans: **A)** 750π dynes
Sol: Here, the total length of the circular plate on which the force will act $=2\pi R$
$\therefore$ Force to pull $=2\pi RT=2\times\pi\times5\times75=750\pi$ dynes

40) Ans: **B)** 

Sol: Normal reaction at the highest point is given as, $R=\frac{mv^2}{r}-mg$
From the above equation, reaction is inversely proportional to the radius of the curvature of path and radius is minimum for path depicted in (2).

41) Ans: **A)** $\frac{\sqrt{3}}{4}IBl^2$
Sol: As, $\theta=90°$,
$$\therefore\ \tau=NIAB=1\times I\times\left(\frac{\sqrt{3}}{4}l^2\right)B$$
$$\Rightarrow\tau=\frac{\sqrt{3}}{4}Il^2B$$

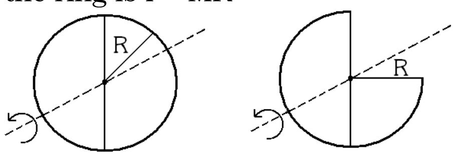


42) Ans: **C)** $\frac{e^2}{2r}$
Sol: The potential energy of electron in n[th] orbit of radius r in H-atom is $U=-\frac{e^2}{r}$ (in CGS)
As, K. E. $=\frac{1}{2}|P.E.|$ $\therefore$ K. E. $=\frac{e^2}{2r}$

43) Ans: **B)** $\frac{\pi}{15}N-m$
Sol: Here,
$$\alpha=\frac{2\pi(n_2-n_2)}{t}=\frac{2\pi(0-\frac{60}{60})}{60}=\frac{-2\pi}{60}=\frac{-\pi}{30}\ \ rad/s^2$$
Therefore, torque, $\tau=I\alpha=\frac{2\times\pi}{30}=\frac{\pi}{15}$N-m.

44) Ans: **B)** 5 m/s
Sol: From the given equation,
$$v=\frac{Co-efficent\ of\ t}{Co-efficent\ of\ x}\ \Rightarrow v=\frac{\omega}{k}=\frac{100}{20}=5\ m/s.$$

45) Ans: **C)** 3/4
Sol: Here, Moment of inertia of a ring about an axis passing through the centre and perpendicular to the ring is $I=MR^2$



(i) (ii)

From the figure (ii),
Mass of the remaining portion of the ring is $M-\frac{M}{4}=\frac{3M}{4}$
$\therefore$ Moment of inertia of the remaining portion of the ring about a given axis is
$$I'=\frac{3}{4}MR^2\quad .....(i)$$
In the problem given that, $I'=kMR^2$ ...(ii)
Thus, from (i) and (ii), we get k = 3/4.

46) Ans: **B)** 375 Hz
Sol: We know, $n_1l_1=n_2l_2$
$\Rightarrow 250\times0.6=n_2\times0.4\Rightarrow n_2=375\ Hz$

47) Ans: **D)** $10^6:1$
Sol: As $n=\frac{v}{\lambda}\Rightarrow n\propto v\ \Rightarrow\frac{n_{MW}}{n_{US}}\approx\frac{3\times10^8}{3\times10^2}\approx10^6:1$

48) Ans: **D)** 10 m/s^2

Sol: From the given equation, $a = 10 \times 10^{-2} m$ and $\omega = 10\ rad/s$

$\therefore A_{max} = \omega^2 a = 10 \times 10^{-2} \times 10^2 = 10\ m/s^2$

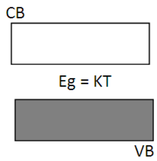
49) Ans: **A)** 1 kms^{-1}

Sol: As, $\frac{(V_{rms})_1}{(v_{rms})_2} = \sqrt{\frac{T_1}{T_2}}$,

$\therefore$ From the given problem,

$$\frac{500}{(v_{rms})_2} = \sqrt{\frac{0+273}{819+273}} = \sqrt{\frac{273}{1092}}$$

$$\Rightarrow (v_{rms})_2 = 500\sqrt{\frac{1092}{273}} = 500\sqrt{4} = 1000\frac{m}{s} = 1\frac{km}{s}$$



50) Ans: **B)**

Sol: The forbidden energy gap between the valence band and conduction band is very small, almost equal to kT in semiconductors. Moreover, valence band is completely filled while conduction band is empty.