SAMPLE HINTS AND SOLUTIONS

INSTITUTE NAME & LOGO

NEET – EXAM YEAR		
Time : 45 Min	**Phy : Full Portion Paper**	**Marks : 180**

Hints and Solutions

01) Ans: **3)** Statement 1 is true but statement 2 is false.
Sol: The velocity of sound in a gas is directly proportional to the square root of its absolute temperature because $v=\sqrt{\frac{\gamma RT}{M}}$. As temperature of a hot day is more than cold winter day, therefore sound would travel faster on a hot summer day than on a cold winter day.

02) Ans: **1)** $-\frac{1}{2}mgR_e$
Sol: From the given problem,
$$\Delta U = U_2 - U_1 = \frac{mgh}{1+\frac{h}{R_e}} = \frac{mgR_e}{1+\frac{R_e}{R_e}} = \frac{mgR_e}{2}$$
$$\Rightarrow U_2 - (-mgR_e) = \frac{mgR_e}{2} \Rightarrow U_2 = -\frac{1}{2}mgR_e$$

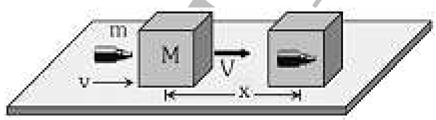
03) Ans: **3)** $3\times10^6 m/s$
Sol: In this case, $\Delta\lambda = \lambda\frac{v}{c}$
$$\Rightarrow (3737-3700) = 3700\times\frac{v}{3\times10^8}$$
$$\Rightarrow v = 3\times10^6 m/s$$

04) Ans: **2)** 12000 N
Sol: Lift is moving upward with acceleration a at 11th second. $\therefore a = \frac{0-3.6}{2} = -1.8\ m/s^2$
Tension in rope, $T = m(g-a)$
$= 1500(9.8-1.8) = 12000\ N$

05) Ans: **2)** $2(\sqrt{3})$ cm
Sol: As $v_{max} = a\omega$, $\therefore \omega = \frac{v_{max}}{a} = \frac{10}{4}$
Now, $v = \omega\sqrt{a^2-y^2} \Rightarrow v^2 = \omega^2(a^2-y^2)$
$$\Rightarrow y^2 = a^2 - \frac{v^2}{\omega^2} \Rightarrow y = \sqrt{a^2-\frac{v^2}{\omega^2}}$$
$$\Rightarrow y = \sqrt{4^2-\frac{5^2}{(10/4)^2}} = 2\sqrt{3}\ cm$$

06) Ans: **1)** 0.62×10^{-4}
Sol: From the relation, $B_H = B\cos\phi$ and $B_V = B\sin\phi$
$$\therefore \frac{B_V}{B_H} = \tan\phi \Rightarrow B_V = B_H\tan\phi$$
$$\Rightarrow B_V = 0.36\times10^{-4}\times\tan60^o$$
$$\Rightarrow B_V = 0.623\times10^{-4}\ Wb/m^2$$

07) Ans: **4)** $\sqrt{2\mu gx}\left(\frac{M+m}{m}\right)$

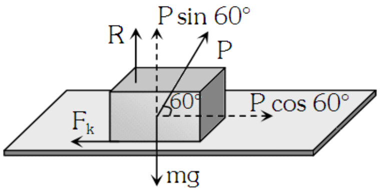
Sol:


Consider speed of the bullet = v
Speed of the system after the collision = V
$\therefore$ According to the law of conservation of momentum, mv = (m + M) V $\Rightarrow$ $V=\frac{mv}{M+m}$
So the initial K.E. acquired by the system,
$$=\frac{1}{2}(M+m)V^2 = \frac{1}{2}(m+M)\left(\frac{mv}{M+m}\right)^2 \Rightarrow = \frac{1}{2}\frac{m^2v^2}{(m+M)}$$
This kinetic energy goes against friction.
Work done by friction = $\mu R\times x = \mu(m+M)g\times x$
From the law of conservation of energy,
$$\frac{1}{2}\frac{m^2v^2}{(m+M)} = \mu(m+M)g\times x \Rightarrow v^2 = 2\mu gx\left(\frac{m+M}{m}\right)^2$$
$$\therefore v = \sqrt{2\mu gx}\left(\frac{M+m}{m}\right)$$

08) Ans: **4)** $2\pi\times10^{-2}$ N-m
Sol: Here,
$$\alpha = \frac{2\pi(n_2-n_1)}{t} = \frac{2\pi(0-20)}{10} = -4\pi\ rad/s^2$$
The negative sign means retardation.
Now, Torque $\tau = I\alpha = 5\times10^{-3}\times4\pi = 2\pi\times10^{-2}$ Nm

09) Ans: **2)** 0.6, 4.8 W
Sol: Impedance, $Z=\sqrt{R^2+\left(\frac{1}{2\pi\nu C}\right)^2}$
$$=\sqrt{(3000)^2+\frac{1}{\left(2\pi\times50\times\frac{2.5}{\pi}\times10^{-6}\right)^2}}$$
$$\Rightarrow Z = \sqrt{(3000)^2+(4000)^2} = 5\times10^3\ \Omega$$
$$\therefore \text{Power factor, } \cos\phi = \frac{R}{Z} = \frac{3000}{5\times10^3} = 0.6$$
and power, $P = V_{rms}i_{rms}\cos\phi = \frac{V_{rms}^2\cos\phi}{Z}$
$$\Rightarrow P = \frac{(200)^2\times0.6}{5\times10^3} = 4.8\ W$$

10) Ans: **3)** 315 joules
Sol: Suppose body is dragged with force P, making an angle 60° with the horizontal.



Let, F_k = Kinetic friction in the motion = $\mu_k R$

From the figure, $F_k = P\cos 60^\circ$ and

$R = mg - P\sin 60^\circ$

$\therefore\ P\cos 60^\circ = \mu_k(mg - P\sin 60^\circ)$

$$\Rightarrow \frac{P}{2} = 0.5\left(60\times 10 - \frac{P\sqrt{3}}{2}\right) \Rightarrow P = 315.1\,N$$

$$\therefore\ F_k = P\cos 60^\circ = \frac{315.1}{2}N$$

Therefore, Work done

$$= F_k \times s = \frac{315.1}{2}\times 2 = 315\ \text{Joule}$$

11) Ans: **4)** 1.2
Sol: The efficiency of a carnot engine is given by,

$$\eta = 1 - \frac{T_2}{T_1} \text{ or } \frac{W}{Q} = 1 - \frac{T_2}{T_1}$$

$$\Rightarrow \frac{W}{6} = 1 - \frac{(273+127)}{(273+227)} \Rightarrow W = 1.2\ k\ cal$$

12) Ans: **1)** Both statement 1 and statement 2 are true and the statement 2 is the correct explanation of the statement 1.
Sol: Woolen fiber encloses a large amount of air in them. Both wool as well as air are the bad conductors of heat and the coefficient of thermal conductivity is small. Therefore, they prevent any loss of heat from our body.

13) Ans: **3)** 15.2 cc
Sol: Because of volume expansion of both liquid and vessel, the change in volume of liquid relative to container is given by $\Delta V = V_0[\gamma_L - \gamma_g]\Delta\theta$ Given that, V_0 = 1000 cc, a_g = 0.1×10^{-4}/°C.

$\therefore\ \gamma_g = 3\alpha_g = 3\times 0.\times 10^{-4}/^\circ C = 0.3\times 10^{-4}/^\circ C$

$\therefore\ \Delta V$ = 1000 [1.82×10^{-4} - 0.3×10^{-4}] × 100 = 15.2 cc

14) Ans: **2)** 2×10^4 joules
Sol: Work done, $W = P\times\Delta V = 2\times 10^5(150-50)\times 10^{-3}$

$\Rightarrow W = 2\times 10^4\ J$

15) Ans: **4)** E_x, B_y
Sol: E_x and B_y would generate a plane electromagnetic wave travelling in z-direction. $\vec{E}$, $\vec{B}$ and $\vec{k}$ form a right handed system and $\vec{k}$ is along z-axis. As $\hat{i}\times\hat{j} = \hat{k} \Rightarrow E_x\hat{i}\times B_y\hat{j} = C\hat{k}$ means E is along x-axis and B is along y-axis.

16) Ans: **3)** $2.7\ m/s^2$
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 = $\frac{v^2}{r}$

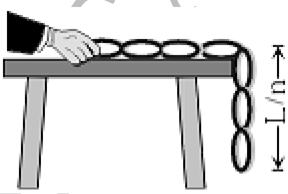
17) Ans: **1)** p and r $^{-3}$

Sol: We know, $E_{equatorial} = \frac{kp}{r^3}$

$\Rightarrow\ E \propto p$ and $E \propto r^{-3}$.

18) Ans: **4)** 3.6 J
Sol: From the figure below,
Fraction of length of the chain hanging from the table $= \frac{1}{n} = \frac{60cm}{200cm} = \frac{3}{10}$

$\Rightarrow n = \frac{10}{3}$



$\therefore$ Work done in pulling the chain on the table is given as

$$W = \frac{mgL}{2n^2} = \frac{4\times 10\times 2}{2\times(10/3)^2} = 3.6\ J$$

19) Ans: **4)** 0.11 s

Sol: Avg. value $= \frac{2.63+2.56+2.42+2.71+2.80}{5}$

Avg. value = 2.62 sec
Now
$|\Delta T_1| = 2.63 - 2.62 = 0.01$
$|\Delta T_2| = 2.62 - 2.56 = 0.06$
$|\Delta T_3| = 2.62 - 2.42 = 0.20$
$|\Delta T_4| = 2.71 - 2.62 = 0.09$
$|\Delta T_5| = 2.80 - 2.62 = 0.18$
Mean absolute

$$\text{error } \Delta T = \frac{|\Delta T_1| + |\Delta T_2| + |\Delta T_3| + |\Delta T_4| + |\Delta T_5|}{5}$$

$$\Delta T = \frac{0.01+0.06+0.20+0.09+0.18}{5}$$

$$\text{Avg. absolute error} = \frac{0.54}{5} = 0.108 = 0.11\,s$$

20) Ans: **2)** Steel, brass and rubber respectively.
Sol: We know that, $Y = \tan\theta$. Therefore from the figure $\theta_A > \theta_B > \theta_C$,
$\Rightarrow \tan\theta_A > \tan\theta_B > \tan\theta_C$ or $Y_A > Y_B > Y_C$.
Hence, A, B, and C graph are for steel, brass and rubber respectively.

21) Ans: **2)** $x=-\frac{1}{2}, y=\frac{1}{2}$

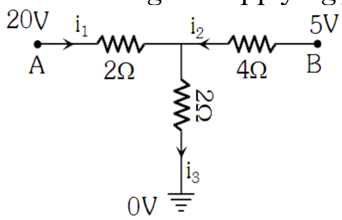
Sol: By using the dimensions of each quantity both the sides, we get $[T^{-1}]=[M]^x[MT^{-2}]^y$

Now comparing the dimensions of quantities in both sides, we get $x+y=0$ and $2y=1$

$\therefore x=-\frac{1}{2}, y=\frac{1}{2}$

22) Ans: **2)** 4.5 A

Sol: Suppose, V be the potential of the junction as shown in figure. Applying junction law, we have



$\Rightarrow \frac{20-V}{2}+\frac{5-V}{4}=\frac{V-0}{2} \Rightarrow$ 40 - 2 V + 5 - V = 2 V

$\Rightarrow$ 5 V = 45 $\Rightarrow$ V = 9 V $\quad \therefore i_3=\frac{V}{2}=4.5$ A

23) Ans: **1)** - 123°C

Sol: Here, $v_{rms} \propto \sqrt{\frac{3RT}{M}}, \quad \therefore T \propto v^2{}_{rms}$

$\Rightarrow \frac{T_2}{T_1}=\left(\frac{v_2}{v_1}\right)^2=\frac{1}{4}$

$\Rightarrow T_2=\frac{T_1}{4}=\frac{(273+327)}{4}=150\,K=-123^oC$

24) Ans: **2)** 2×10^{-4} m/s

Sol: Here using,

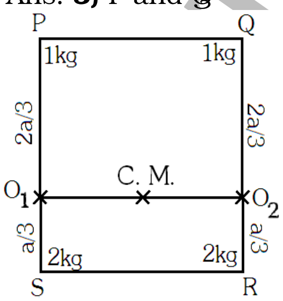
$v_d=\frac{i}{neA}=\frac{100}{10^{28}\times1.6\times10^{-19}\times\frac{\pi}{4}\times(0.02)^2}$

$\Rightarrow v_d=2\times10^{-4}$ m/s

25) Ans: **1)** Both statement 1 and statement 2 are true and the statement 2 is the correct explanation of the statement 1.

Sol: C_V is used in increasing the internal energy of the gas whereas C_P is used both to change the internal energy and to do expansion of gas. Therefore $C_P > C_V$.

26) Ans: **3)** P and Q



Sol:

From the figure,

Centre of mass of P and S will be at $O_1$and Q and R will be at O_2. Thus, the centre of mass of the system is at the midpoint of O_1 and O_2 which is farthest from P and Q.

27) Ans: **1)** 0.9 Ns

Sol: Given, $F=600-2\times10^5t=0 \Rightarrow t=3\times10^{-3}$ s

and Impulse $I=\int_0^t F\,dt=\int_0^{3\times10^{-3}}(600\text{-}2\times10^3t)\,dt$

$=[600t-10^5t^2]_0^{3\times10^{-3}}=0.9\,N\times s$

28) Ans: **2)** 0.3 volt

Sol: Here, $e=Bvl=3\times10^{-3}\times10^2=0.3$ volt

29) Ans: **4)** - 48, - 40

Sol: When the final image is at the least distance of distinct vision, then

$m=-\frac{f_o}{f_e}\left(1+\frac{f_e}{D}\right)=-\frac{200}{5}\left(1+\frac{5}{25}\right)=-\frac{200\times6}{5\times5}=-48$

When the final image is at infinity, then

$m=\frac{-f_o}{f_e}=-\frac{200}{5}=-40$

30) Ans: **1)** the masses of the two nuclei are different.

31) Ans: **4)** $2\sqrt{10}$

Sol: $\vec{r}=\vec{r}_2-\vec{r}_1=(-2\hat{i}-2\hat{j}+0\hat{k})-(4\hat{i}-4\hat{j}+0\hat{k})$

$\vec{r}=-6\hat{i}+2\hat{j}+0\hat{k}$

$\therefore\ |\vec{r}|=\sqrt{(-6)^2+(2)^2+0^2}=\sqrt{36+4}=\sqrt{40}=2\sqrt{10}$

32) Ans: **2)** 8 TL

Sol: Here, Force on each side $=2\,TL$. It is because of two surfaces are there.

$\therefore$ Force on the frame $=4\,(2\,TL)=8\,TL$

33) Ans: **3)** 3.32 x 10^{-27} Å

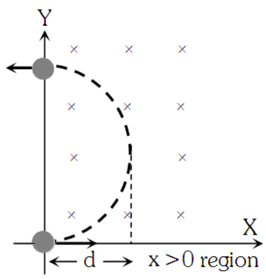
Sol: Here, $\lambda=\frac{h}{mv}=\frac{6.6\times10^{-34}}{1\times2000}=3.3\times10^{-37}m$

$\Rightarrow \lambda=3.3\times10^{-27}$ Å

34) Ans: **1)** $\frac{mv}{qB}$

Sol: From the following figure,

d = radius of path $=\frac{mv}{qB}$



35) Ans: **2)** 6.67×10^8

Sol: Here,

Mean life $=\frac{1}{\lambda}=6.67\times10^8$ s

36) Ans: **3)** $\Delta Eg_{insulator} > \Delta Eg_{sc} > \Delta Eg_{conductor}$

37) Ans: **3)** 39°C

Sol: Coefficient of performance is given by

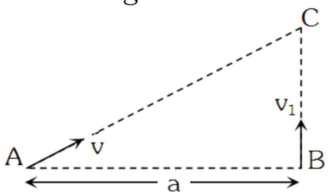
$$K = \frac{T_2}{T_1 - T_2} \Rightarrow 5 = \frac{(273-13)}{T_1-(273-13)} = \frac{260}{T_1 - 260}$$

$$\Rightarrow 5T_1 - 1300 = 260 \Rightarrow 5T_1 = 1560$$

$$\Rightarrow T_1 = 312\,K \to 39^{\circ}C$$

38) Ans: **4)** $\sqrt{a^2/(v^2 - v_1^2)}$

Sol: Consider, two boys meet at point C after time 't' from the starting as shown in fig. Then $AC = vt$,



$BC = v_1 t$

$$(AC)^2 = (AB)^2 + (BC)^2 \;\Rightarrow\; v^2t^2 = a^2 + v_1^2t^2$$

Solving, we get $t = \sqrt{\dfrac{a^2}{v^2 - v_1^2}}$

39) Ans: **1)** Zero

Sol: Since, $\phi = \dfrac{\Sigma q}{\varepsilon_0} = 0$, thus it means that net charge on dipole is zero.

40) Ans: **2)** 1.062×10^{-2} amp

Sol: Displacement current, $I_D = \varepsilon_0 \dfrac{d\phi_E}{dt}$

$$\Rightarrow I_D = \varepsilon_0 \frac{EA}{t} = \varepsilon_0 \left(\frac{V}{d}\right)\frac{A}{t}$$

$$= \frac{8.85\times10^{-12}\times400\times60\times10^{-4}}{2\times10^{-3}\times10^{-6}} = 1.602\times10^{-2} \text{ amp}$$

41) Ans: **3)** 2×10^{-3}

Sol: Here, $E = \dfrac{1}{4\pi\varepsilon_0}\times\dfrac{q}{r^2} = 9\times10^9\times\dfrac{q}{r^2}$

$$\Rightarrow\; q = \frac{E\times r^2}{9\times10^9} = \frac{3\times10^6\times(2.5)^2}{9\times10^9} = 2.0833\times10^{-3}$$

q should be less than 2.0833 x 10^{-3}. In the given set of options 2 x 10^{-3} is the maximum charge which is smaller than 2.0833 x 10^{-3}.

42) Ans: **1)** 664 minutes

Sol: For the first satellite, $r_1 = R$ and $T_1 = 83$ minute and for second satellite, $r_2 = 4R$

$$\therefore T_2 = T_1\left(\frac{r_2}{r_1}\right)^{3/2} = T_1(4)^{3/2} = 8T_1 = 8\times83$$

= 664 minutes

43) Ans: **2)** $1.8\times10^6\ ms^{-1}$

Sol: Here, $\dfrac{1}{2}mv_{max^2} = eV_0 \;\Rightarrow v_{max} = \sqrt{2\left(\dfrac{e}{m}\right)V_0}$

$$\Rightarrow v_{max} = \sqrt{2\times1.8\times10^{11}\times9} = 1.8\times10^6\,m/s.$$

44) Ans: **1)** 4 × 5 × 5 × 5 g f

Sol: Here, Apparent weight

$$= V(\rho-\sigma)g = l\times b\times h\times(5-1)\times g$$

$$= 5\times5\times5\times4\times g \text{ Dyne} = 4\times5\times5\times5 \text{ gf}.$$

45) Ans: **3)** Zero

Sol: According to the principle of superposition of coulomb forces, the net force on electron placed at the center of bcc structure is zero.