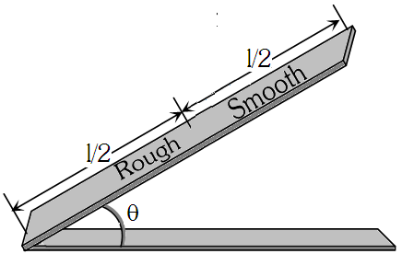
Sharath Gore

Physics Mock test 2 2022-23		
Time : 75 Min	**Phy : Full Portion Paper**	**Marks : 200**
	Hints and Solutions	

01) Ans: **A)** $\mu = 2\tan\theta$



Sol:
From the figure, For upper half

$v^2 = u^2 + 2a\,l/2 = 2(g\sin\theta)\,l/2 = g\,l\sin\theta$

For lower half $\Rightarrow 0 = u^2 + 2g(\sin\theta - \mu\cos\theta)\frac{1}{2}$

$\Rightarrow -g\,l\sin\theta = g\,l(\sin\theta - \mu\cos\theta)$

$\Rightarrow \mu\cos\theta = 2\sin\theta \Rightarrow \mu = 2\tan\theta$

02) Ans: **B)** Both Statement 1 and Statement 2 are true and the Statement 2 is correct explanation of the Statement 1

Sol: Copper being a metal possesses positive temperature coefficient, whereas the germanium being a semiconductor possesses negative temperature coefficient. Therefore, if they are cooled from room temperature to 100 K, the resistance of copper will decrease and that of germanium will increase. In other words, the conductivity of copper increases and that of germanium decreases.

03) Ans: **A)** 200P

Sol: de Broglie wavelength associated with an electron is

$\lambda\frac{h}{P}$ or, $P = \frac{h}{\lambda}$

$\frac{\Delta P}{P} = -\frac{\Delta\lambda}{\lambda}$; $\frac{P}{P_{initial}} = \frac{0.5}{100}$

$P_{initial} = 200\,P$

04) Ans: **C)** 17.3 MeV

Sol: The binding energy of $Li^7 = 39.20$ MeV and $He^4 = 28.24$ MeV

Thus, binding energy of $2He^4 = 56.48$ MeV

$\therefore$ Energy of reaction $= 56.48 - 39.20 = 17.28$ MeV

05) Ans: **C)** 9.8 Joule

Sol: If there is no air drag, then maximum height

$H = \frac{u^2}{2g} = \frac{14\times14}{2\times9.8} = 10$ m

But because of air drag ball reaches up to height 8 m only.

$\therefore$ loss in energy $= m\,g\,(10-8) = 0.5\times9.8\times2 = 9.8$ J

06) Ans: **C)** $0.166\times10^{-8}\ N/m^2$

Sol: Intensity or power per unit area of the radiations is given by $P = fv$.

$\Rightarrow f = \frac{P}{v} = \frac{0.5}{3\times10^8} = 0.166\times10^{-8}\ N/m^2$

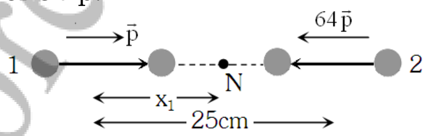
07) Ans: **B)** 6.9×10^{-3} kg

Sol: Heat transferred in one minute is utilized in melting the ice, therefore $\frac{KA(\theta_1-\theta_2)t}{l} = m\times L$

$\Rightarrow m = \frac{10^{-3}\times92\times(100-0)\times60}{1\times8\times10^4} = 6.9\times10^{-3}$ kg

08) Ans: **C)** 5 cm

Sol: Let neutral point N lies at a distance x from dipole of moment p or at a distance x_2 from dipole of 64 p.



At N,

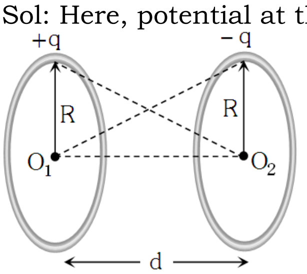
|E. F. due to dipole (1)| = |E. F. due to dipole (2)|

$\Rightarrow \frac{1}{4\pi\varepsilon_0}\cdot\frac{2p}{x^3} = \frac{1}{4\pi\varepsilon_0}\cdot\frac{2(64p)}{(25-x)^3} \Rightarrow \frac{1}{x^3} = \frac{64}{(25-x)^3}$

$\Rightarrow$ x = 5 cm.

09) Ans: **C)** $\frac{Q}{2\pi\varepsilon_0}\left[\frac{1}{R} - \frac{1}{\sqrt{R^2+d^2}}\right]$

Sol: Here, potential at the center of rings are



$V_{O_1} = \frac{k.q}{R} + \frac{k(-q)}{\sqrt{R^2+d^2}}$, $V_{O_2} = \frac{k(-q)}{R} + \frac{kq}{\sqrt{R^2+d^2}}$

$\Rightarrow V_{O_1} - V_{O_2} = 2kq\left[\frac{1}{R} - \frac{1}{\sqrt{R^2+d^2}}\right]$

$\Rightarrow V_{O_1} - V_{O_2} = \frac{q}{2\pi\varepsilon_0}\left[\frac{1}{R} - \frac{1}{\sqrt{R^2+d^2}}\right]$

10) Ans: **A)** Both Statement 1 and Statement 2 are true but Statement 2 is not the correct

explanation of Statement 1
Sol: Energy density in electric field is

$u_E = \frac{1}{2}\varepsilon_0 E^2$

Energy density in magnetic field is

$u_B = \frac{1}{2\mu_0} B^2$

We know, E=c and $c = \frac{1}{\sqrt{\mu_0 \varepsilon_0}}$

$\therefore \mu_E = \frac{1}{2}\varepsilon_0 E^2 = \frac{1}{2}\varepsilon_0 (cB)^2$

$= \frac{1}{2}\varepsilon_0 \times \frac{1}{\mu_0 \varepsilon_0} \times B^2 = \frac{B^2}{2\mu_0} = u_B$

$\therefore u_E = u_B$

11) Ans: **C)** 3/8

Sol: Kinetic energy, $K_{particle} = \frac{1}{2}mv^2$. Also, $\lambda = \frac{h}{mv}$

$\Rightarrow K_{particle} = \frac{1}{2}\left(\frac{h}{\lambda v}\right).v^2 = \frac{vh}{2\lambda}$ ...(i)

and $K_{photon} = \frac{hc}{\lambda}$

...(ii)

$\therefore \frac{K_{particle}}{K_{photon}} = \frac{v}{2c} = \frac{2.25\times10^8}{2\times3\times10^8} = \frac{3}{8}$

12) Ans: **D)** the mass is at the lowest point
Sol: In vertical circular motion, tension in the wire is maximum at the lowermost point, so the wire is mst likely to break when the mass is at the lowermost point.

13) Ans: **A)** 49° to the vertical.
Sol: The ray from setting sun will be refracted at an angle equal to critical angle.

14) Ans: **B)** greater when switched on.

Sol: We know, $R \propto \frac{1}{\tau}$; where τ = Relaxation time.

When lamp is switched on, temperature of filament increase, thus τ decrease so R increases.

15) Ans: **A)** Both statement 1 and statement 2 are true and the statement 2 is the correct explanation of the statement 1.
Sol: A bridge during its use undergoes alternating strains for a large number of times each day, depending upon the movement of vehicles on it. When a bridge is used for long time, it loses its elastic strength. Because of which the amount of strain in the bridge for a given stress will become large and ultimately, the bridge may collapse. This may not happen, if the bridges are declared unsafe after long use.

16) Ans: **A)** Both statement 1 and statement 2 are true and the statement 2 is the correct explanation of the statement 1.
Sol: Melting point of ice decreases with rise in pressure. Also ice contracts on melting.

17) Ans: **D)** equal to heat given to the system.
Sol: As for cyclic forces $\Delta U = 0$, therefore $\Delta Q = \Delta W$.

18) Ans: **B)** 4 A

Sol: We have, $\frac{N_s}{N_p} = \frac{V_s}{V_p} \Rightarrow \frac{1}{20} = \frac{V_s}{2400}$

$\Rightarrow V_s = 120$ V

For 100% efficiency, $V_s i_s = V_p i_p$

$\Rightarrow 120\times80 = 2400\ i_p \Rightarrow i_p = 4$ A

19) Ans: **A)** alloy semiconductor.

20) Ans: **A)** four times

Sol: Since, $F \propto \frac{1}{r^2}$, therefore when r is halved the force becomes four times.

21) Ans: **D)** Statement 1 is false but statement 2 is true.
Sol: As we know, isothermal processes are very slow and therefore the different isothermal curves have different slopes thus they cannot intersect each other.

22) Ans: **B)** $x = v\sqrt{m/k}$
Sol: Using conservation of mechanical energy,

$\frac{1}{2}kx^2 = \frac{1}{2}mv^2 \Rightarrow x = v\sqrt{m/k}$

23) Ans: **A)** Both Statement 1 and Statement 2 are true but Statement 2 is not the correct explanation of Statement 1
Sol: In stationary wave, total energy associated with it is twice the energy of each of incidence and reflected wave. Large amount of energy are stored equally in standing waves and became trapped with the waves. Hence, there is no transmission of energy through the waves.

24) Ans: **A)** 50 Hz

Sol: Resistance of coil, $R = \frac{200\ V}{1\ A} = 200\ \Omega$

With ac source, $I = \frac{200}{\sqrt{R^2 + X_L^2}}$

or $R^2 + (2\pi\upsilon L)^2 = (400)^2$

or $\left(2\pi\upsilon \times \frac{2\sqrt{3}}{\pi}\right)^2 = (400)^2 - (200)^2 = 200 \times 600$

or $4\sqrt{3}\upsilon = 2\sqrt{3}\times100$ or $\upsilon = 50$ Hz

25) Ans: **A)** $T_{sp} < T_{is}$

Sol: Here, all the time periods are given as

(i) $T_{st} = 2\pi\sqrt{\frac{(R+h)^3}{GM}} = 2\pi\sqrt{\frac{R}{g}}$

(As $h << R$ and $GM = gR^2$)

(ii) $T_{ma} = 2\pi\sqrt{\dfrac{R}{g}}$

(iii) $T_{sp} = 2\pi\sqrt{\dfrac{1}{g\left(\dfrac{1}{l}+\dfrac{1}{R}\right)}} = 2\pi\sqrt{\dfrac{R}{2g}}$ (As l = R)

(iv) $T_{is} = 2\pi\sqrt{\dfrac{R}{g}}$ (As $l = \infty$)

26) Ans: **D)** $W\,m^{-2}\,K^{-4}$

Sol: Stefan's law is $E = \sigma(T^4) \Rightarrow \sigma = \dfrac{E}{T^4}$

where, $E = \dfrac{\text{Energy}}{\text{Area} \times \text{Time}} = \dfrac{\text{Watt}}{m^2}$

$\sigma = \dfrac{\text{Watt-m}^{-2}}{K^4} = \text{Watt} - m^{-2}K^{-4} = W\,m^{-2}\,K^{-4}$.

27) Ans: **C)** white.
Sol: All the colours are reflected.

28) Ans: **C)** fall at the rate of 1 cm/hr.

29) Ans: **C)** Statement 1 is true but statement 2 is false.
Sol: If two vectors equal in magnitude are in opposite direction, then their sum will represent a null vector.
A null vector has direction which depends on direction of initial vectors even its magnitude is zero.

30) Ans: **D)** $\dfrac{3}{2}\dfrac{h^2}{r^2}$

Sol: The field at the center,

$B_1 = \dfrac{\mu_0}{4\pi} \times \dfrac{2\pi i n}{r} = \dfrac{\mu_0}{2} \cdot \dfrac{ni}{r}$

The field at a distance h from the center

$B_2 = \dfrac{\mu_0}{4\pi} \cdot \dfrac{2\pi n i r^2}{(r^2+h^2)^{3/2}} = \dfrac{\mu_0}{2} \cdot \dfrac{n i r^2}{r^3\left(1+\dfrac{h^2}{r^2}\right)^{3/2}}$

$\Rightarrow B_2 = B_1\left(1+\dfrac{h^2}{r^2}\right)^{-3/2} = B_1\left(1-\dfrac{3}{2}\cdot\dfrac{h^2}{r^2}\right)$

(By binomial theorem)

Thus, B_2 is less than B_1 by a fraction $= \dfrac{3}{2}\dfrac{h^2}{r^2}$

31) Ans: **C)** $\Delta Q = \Delta U - \Delta W$

Sol: From FLOT, $\Delta Q = \Delta U + \Delta W$

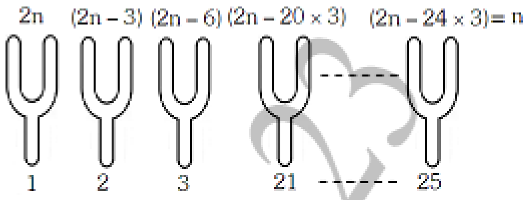
As heat is supplied to the system,
so $\Delta Q \rightarrow$ Positive.
and work is done on the system,
so $\Delta W \rightarrow$ Negative.
$\therefore +\Delta Q = \Delta U - \Delta W$

32) Ans: **C)** 172.6 ml
Sol: Here, $V \propto T$

$\Rightarrow \dfrac{V_1}{V_2} = \dfrac{T_1}{T_2} \Rightarrow \dfrac{200}{V_2} = \dfrac{(273+20)}{(273-20)} = \dfrac{293}{253}$

$\Rightarrow V_2 = \dfrac{200 \times 253}{293} = 172.6\text{ ml}$

33) Ans: **B)** 84 Hz
Sol: As per the question, frequencies of first and last tuning forks are 2n and n respectively.
Therefore frequency in given arrangement are as follows



$\Rightarrow 2n - 24 \times 3 = n \Rightarrow n = 72$ Hz
$\therefore$ Frequency of 21st tuning fork
i.e. $n_{21} = (2 \times 72 - 20 \times 3) = 84$ Hz

34) Ans: **C)** $-9\,m/s$

Sol: Displacement (s) $= t^3 - 6t^2 + 3t + 4m$

Velocity (v) $= \dfrac{ds}{dt} = 3t^2 - 12t + 3$

Acceleration $(a) = \dfrac{dv}{dt} = 6t - 12$

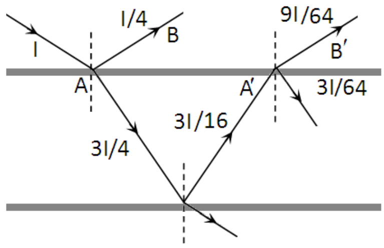
When $a = 0$, we get $t = 2$ seconds.
Therefore velocity when the acceleration is zero is
$v = 3\times(2)^2 - (12\times2) + 3 = -9\,m/s$

35) Ans: **A)** Both statement 1 and statement 2 are true and the statement 2 is the correct explanation of the statement 1.
Sol: Intermolecular force exist in real gas. Work has to be done in changing the distance between the molecules. Thus, internal energy of real gas is sum of internal kinetic as well as potential energy which are function of temperature and volume respectively. Also change in internal energy of a system depends only on initial and final sates of the system.

36) Ans: **D)** 49 : 1

Sol: From following figure, $I_1 = \dfrac{I}{4}$ and $I_2 = \dfrac{9I}{64}$.

$\Rightarrow \dfrac{I_2}{I_1} = \dfrac{9}{16}$



Using, $\dfrac{I_{max}}{I_{min}} = \left(\dfrac{\sqrt{\dfrac{I_2}{I_1}}+1}{\sqrt{\dfrac{I_2}{I_1}}-1}\right) = \left(\dfrac{\sqrt{\dfrac{9}{16}}+1}{\sqrt{\dfrac{9}{16}}-1}\right) = \dfrac{49}{1}$

37) Ans: **C)** have zero resultant

38) Ans: **A)** 4I

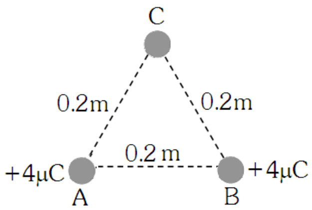
Sol: The moment of inertia of a thin uniform rod of mass M and length l about an axis perpendicular to the rod through its centre is $I = \frac{Ml^2}{12}$ ...(i)

The moment of inertia of the rod through its end point is $I' = \frac{Ml^2}{3} = 4\left(\frac{Ml^2}{12}\right) = 4I$ (Using (i))

39) Ans: **B)** 36×10^4 V

Sol: Potential at point $C = \left(9 \times 10^9 \times \frac{4 \times 10^{-6}}{0.2}\right) \times 2$

$\Rightarrow$ C = 36 x 10^4 V



40) Ans: **D)** $\frac{3T}{J}\left(\frac{1}{r} - \frac{1}{R}\right)$

Sol: Here rise in temperature, $\Delta\theta = \frac{3T}{JSd}\left(\frac{1}{r} - \frac{1}{R}\right)$

$\therefore \Delta\theta = \frac{3T}{J}\left(\frac{1}{r} - \frac{1}{R}\right)$ ($\because$ For water S = 1 and d = 1)

41) Ans: **A)** $\frac{220}{\sqrt{2}}$ V

Sol: Diode D will conduct for positive half cycle of a.c. supply since this is forward biased. For negative half cycle of a. c. supply, this is reverse biased and will not conduct. Therefore out put would be half wave rectified and for half wave rectified out put, $V_{rms} = \frac{V_0}{2} = \frac{200\sqrt{2}}{2} = \frac{200}{\sqrt{2}}$

42) Ans: **C)** 100

Sol: For no current through galvanometer,

$\left(\frac{E_1}{500 + X}\right)X = E \Rightarrow \left(\frac{12}{500 + X}\right)X = 2 \Rightarrow X = 100\,\Omega$

43) Ans: **B)** T/2

Sol: When magnet of length l is cut into four equal parts, then $m' = \frac{m}{2}$ and $l' = \frac{l}{2}$,

$\therefore M' = \frac{m}{2} \times \frac{l}{2} = \frac{ml}{4} = \frac{M}{4}$

New moment of inertia

$I' = \frac{wl^2}{12} = \frac{\frac{w}{4}\cdot\left(\frac{l}{2}\right)^2}{12} = \frac{1}{16}\cdot\frac{wl^2}{12}$

Here, w is the mass of magnet.

$\therefore I' = \frac{1}{16} I$;

The time period of each part, $T' = 2\pi\sqrt{\frac{I'}{M'B_H}}$

$\Rightarrow T' = 2\pi\sqrt{\frac{I/16}{(M/4)B_H}} = 2\pi\sqrt{\frac{I}{4MB_H}} = \frac{T}{2}$

44) Ans: **C)** The Statement 1 is true, but the Statement 2 is false

Sol: $gh = \frac{g}{(1 + \frac{h}{R})^2} = g(1 + \frac{h}{R})^{-2}$

or $gh = g\left(1 - \frac{2h}{R}\right)$ or $g - g_h = \frac{2gh}{R}$ ...(1)

and $gd = g\left(1 - \frac{d}{R}\right)$ or $g - gd = \frac{gd}{R}$ ...(2)

For same change in value of g,

$g - gh = g - gd$ or $\frac{2gh}{R} = \frac{gd}{R}$ or $d = 2h$

From Eqs. (1) and (2), it is obvious that g changes less with depth than with height.

45) Ans: **A)** $\frac{n^2}{Z}$

Sol: As we know, $r = \frac{\varepsilon_0 n^2 h^2}{\pi Z m e^2}$ $\therefore r \propto \frac{n^2}{Z}$

46) Ans: **D)** $\left[ML^2T^{-2}\right]$

Sol: Calorie is the unit of heat i.e., energy.

Thus, dimensions of energy $= \left[ML^2T^{-2}\right]$

47) Ans: **A)** falls to earth behind the aeroplane.

Sol: Because of the air resistance, it's horizontal velocity will decrease so it will fall behind the aeroplane.

48) Ans: **C)** 67 cm

Sol: Given : $m_1 = 5\,kg$, $m_2 = 10\,kg$ and $L = 1\,m$

Here centre of mass, $X_{cm} = \frac{m_1x_1 + m_2x_2}{m_1 + m_2}$

$= \frac{5 \times 0 + 10 \times 1}{15} = \frac{10}{15} = \frac{2}{3}$

$= 0.666\,m$; $0.67\,m = 67\,m$

49) Ans: **A)** $n\lambda$

Sol: By the Bohr's theory, $mvr = n\frac{h}{2\pi}$

$\Rightarrow$ Circumference, $2\pi r = n\left(\frac{h}{mv}\right) = n\lambda$

50) Ans: **D)** 39200 dyne

Sol: Here, Force on the table = mg

$\Rightarrow$ = $40 \times 980 =$ 39200 dyne