Studentpad

NEET 2021-22

Time : 90 Min	Phy : Full Portion Paper	Marks : 180

Hints and Solutions

01) Ans: **4)** $[M^0L^0T^3I^0]$

Sol: $C^2LR = [C^2L^2]\times\left[\frac{R}{L}\right] = [T^4]\times\left[\frac{1}{T}\right] = [T^3]$

As $\left[\frac{L}{R}\right] = T$ and $\sqrt{LC} = T$

02) Ans: **1)** energy.

03) Ans: **2)** $\frac{5}{2}\sqrt{17}$ sq. unit

Sol: It is given. $\overrightarrow{OA}=\vec{a}=3\hat{i}-6\hat{j}+2k$ and $\overrightarrow{OB}=\vec{b}=2\hat{i}+\hat{j}-2k$

$$\therefore (\vec{a}\times\vec{b})=\begin{vmatrix}\hat{i} & \hat{j} & k\\ 3 & -6 & 2\\ 2 & 1 & -2\end{vmatrix}$$

$$= (12-2)\hat{i}+(4+6)\hat{j}+(3+12)k$$

$$= 10\hat{i}+10\hat{j}+15k \Rightarrow |\vec{a}\times\vec{b}| = \sqrt{10^2+10^2+15^2}$$

$$= \sqrt{425} = 5\sqrt{17}$$

Thus, area of $\Delta OAB = \frac{1}{2}|\vec{a}\times\vec{b}| = \frac{5}{2}\sqrt{17}$ sq. unit.

04) Ans: **3)** $y = 3x$

Sol: Particle is starting from rest and moving with constant acceleration, then in successive equal interval of time the ratio of distance covered by it, will be $1:3:5:7 \ldots..(2n-1)$

It means ratio of x and y will be 1 : 3

i.e. $\frac{x}{y} = \frac{1}{3} \Rightarrow y = 3x$

05) Ans: **2)** 1 : 3

Sol: As, $H = \frac{u^2\sin^2(\theta)}{2g} \quad \therefore \frac{H_1}{H_2} = \frac{\sin^2 30^\circ}{\sin^2 60} = \frac{1/4}{3/4} = \frac{1}{3}$

06) Ans: **2)** 0.7 kg/s

Sol: As, $F = u\left(\frac{dm}{dt}\right) \Rightarrow \frac{dm}{dt} = \frac{F}{u} = \frac{210}{300} = 0.7 \text{ kg/s}$

07) Ans: **1)** the ground exerts on it.

08) Ans: **1)** 6000 N

Sol: As per the problem given,

Net force in forward direction = Accelerating force + Friction

$$= ma + \mu mg = m(a+\mu g) = (1500+500)(1+0.2\times10)$$

$$= 2000\times3 = 6000 \text{ N}$$

09) Ans: **1)** 1 : 3

Sol: As $\frac{P_1}{P_2} = \sqrt{\frac{m_1}{m_2}} \Rightarrow = \sqrt{\frac{1}{9}} = \frac{1}{3}$

10) Ans: **4)** 0 J

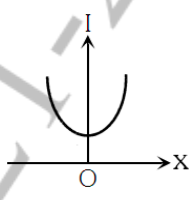
Sol: From the given equation of time,

$x = (t-3)^2 \Rightarrow v = \frac{dx}{dt} = 2(t-3)$

At $t = 0$; $v_1 = -6$ m/s and at $t = 6$ s, $v_2 = 6$ m/s

Therefore, change in kinetic energy

$$= W = \frac{1}{2}mv_2^2 - \frac{1}{2}mv_1^2 = 0$$



11) Ans: **1)**

Sol: From the equation given in the problem, graph should be parabola symmetric to I - axis, but it should not pass from origin, as a constant value I_{cm} is present for x = 0.

12) Ans: **2)** Angular momentum

13) Ans: **4)** The statement 1 and statement 2 both are false.

Sol: We know, escape velocity $= \sqrt{\frac{2GM}{R}}$, thus its value depends on mass of planet and radius of the planet. The two different planets have same escape velocity, when these quantities (mass and radius) are equal.

14) Ans: **3)** $2\,v_e$

Sol: Here, $v = \sqrt{2gR}$. Thus, if acceleration due to gravity and radius of the planet both are double that of earth, then escape velocity will be two times. It means $v_p = 2v_e$.

15) Ans: **4)** reduce by 0.02%

Sol: Here, Poisson's ratio $= \frac{\text{Lateral strain}}{\text{Longitudinal strain}}$

$\therefore$ Lateral strain $= 0.4\times\frac{0.05}{100}$

Therefore reduced by 0.02%.

16) Ans: **1)** radius of the vessel.

Sol: Here, pressure at the bottom = h p g

and pressure on the vertical surface = $\frac{1}{2}h\rho g$

Now, as per the given problem,

Force at the bottom = Force on the vertical surface

$\Rightarrow h\rho g\times\pi r^2 = \frac{1}{2}h\rho g\times2\pi rh \Rightarrow h = r$

17) Ans: **4)** 12.5×10^{-2} m

Sol: From the given problem,

$6\times10^{-2}\times$ Circumference = Force

$\therefore$ Circumference $=\dfrac{75\times10^{-4}}{6\times10^{-2}}=12.5\times10^{-2}$ m

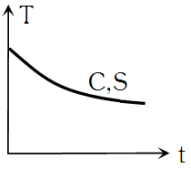
18) Ans: **2)** 3.75 J

Sol: From the energy conservation, change in kinetic energy appears in the form of heat (i.e. thermal energy).

$\Rightarrow$ Thermal energy $=\dfrac{1}{2}m(v_1^2-v_2^2)$ $\left[\text{As } \underset{\text{(Joule)}}{W}=\underset{\text{(Joule)}}{Q}\right]$

$=\dfrac{1}{2}(100\times10^{-3})(10^2-5^2)=3.75$ J

19) Ans: **3)**



Sol: Here, $\dfrac{d\theta}{dt}=\dfrac{\varepsilon A\sigma}{mc}4\theta_0^3\,\Delta\theta$

For given sphere and cube $\dfrac{\varepsilon A\sigma}{mc}4\theta_0^3\,\Delta\theta$ is constant, therefore for both rate of fall of temperature,

$\dfrac{d\theta}{dt}=$ constant

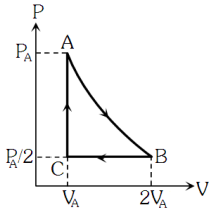
20) Ans: **3)** η

Sol: As per the problem,

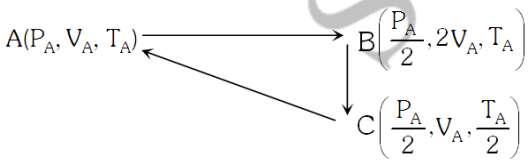
In first case, $\eta_1=\dfrac{T_1-T_2}{T_1}$

In second case, $\eta_2=\dfrac{2T_1-2T_2}{2T_1}=\dfrac{T_1-T_2}{T_1}=\eta$

21) Ans: **4)**



Sol: Suppose the process start from initial pressure P_A, volume V_A and temperature T_A.



(i) Isothermal expansion, PV=constant at temperature T_A to twice the initial volume V_A.

(ii) Compression at constant pressure $\dfrac{P_A}{2}$ to original volume V_A (i.e. $V\propto T$)

(iii) Isochoric process (at volume V_A) to initial condition (i.e. $P\propto T$)

22) Ans: **2)** 60 cal

Sol: Here, work done

$W=P\Delta V=nR\Delta T=0.1\times2\times300=60$ cal

23) Ans: **3)** which obeys gas equation at every temperature and pressure.

Sol: We know, ideal gases cannot be liquified easily.

24) Ans: **4)** $(V_{rms})_1<(V_{rms})_2<(V_{rms})_3$ and $(\bar{K})_1=(\bar{K})_2=(\bar{K}_3)$

Sol: We know that,

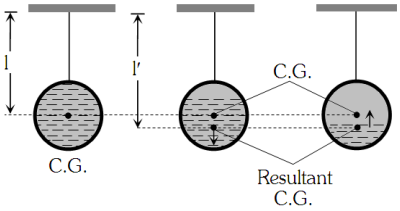
$v_{rms}\dfrac{1}{\sqrt{M}}\Rightarrow(v_{rms})_1<(v_{rms})_2<(v_{rms})_3$ also in mixture, temperature of each gas will be same, therefore kinetic energy also remains same.

25) Ans: **1)** first increase and then decrease to original value.

Sol: Given system is like a simple pendulum, whose effective length (l) is equal to the distance between point of suspension and C.G. (Centre of Gravity) of the hanging body.

When water slowly flows out the sphere, the C. G. of the system is lowered, and thus l increases, which in turn increases time period (since $T\propto\sqrt{l}$). After some time, weight of water left in sphere become less than the weight of sphere itself, therefore the resultant C.G. gets clear the C. G. of sphere itself means l decreases and hence T increases.

Finally when the sphere becomes empty, the resulting C. G. is the C. G. of sphere means length becomes equal to the original length and thus the time period becomes equal to the same value as when it was full of water.



26) Ans: **4)** 60 cm ; 30 cm ; 20 cm

Sol: From given, $l_1+l_2+l_3=110$ cm and $n_1l_1=n_2l_2=n_3l_3$

As given, $n_1:n_2:n_3::1:2:3$

$\because\ \dfrac{n_1}{n_2}=\dfrac{1}{2}=\dfrac{l_2}{l_1}\Rightarrow l_2=\dfrac{l_1}{2}$ and $\dfrac{n_1}{n_3}=\dfrac{1}{3}=\dfrac{l_3}{l_1}\Rightarrow l_3=\dfrac{l_1}{3}$

$\therefore\ l_1+\dfrac{l_1}{2}+\dfrac{l_1}{3}=110$

$\Rightarrow\ l_1=60\text{cm}, l_2=30\text{cm}, l_3=20$ cm.

27) Ans: **4)** + 2

Sol: Here, $\int_{-\infty}^{0}-\vec{E}\cdot\vec{dl}$ = potential at center of non-conducting ring

$\Rightarrow\int_{-\infty}^{0}-\vec{E}\cdot\vec{dl}$

$=\dfrac{1}{4\pi\varepsilon_0}\times\dfrac{q}{r}=\dfrac{9\times10^9\times1.11\times10^{-10}}{0.5}=2$ volt

28) Ans: **4)** None of these

Sol: Here, $C_1 = \dfrac{K_1\varepsilon_0\dfrac{A}{2}}{\left(\dfrac{d}{2}\right)} = \dfrac{K_1\varepsilon_0 A}{d}$,

$C_2 = \dfrac{K_2\varepsilon_0\left(\dfrac{A}{2}\right)}{\left(\dfrac{d}{2}\right)} = \dfrac{K_2\varepsilon_0 A}{d}$ and $C_3 = \dfrac{K_3\varepsilon_0 A}{2d} = \dfrac{K_3\varepsilon_0 A}{2d}$

$\therefore C_{eq} = C_3 + \dfrac{C_1C_2}{C_1 + C_2} \Rightarrow C_{eq} = \left(\dfrac{K_3}{2} + \dfrac{K_1K_2}{K_1 + K_2}\right).\dfrac{\varepsilon_0 A}{d}$

29) Ans: **4)** Zero
Sol: The net flux is zero, because there is no charge residing inside the cube.

30) Ans: **1)** 10
Sol: Here, $V = x1 \Rightarrow iR = x1$

$\Rightarrow i \times 10 = \left(\dfrac{2\times10^{-3}}{10^{-2}}\right) \times 50 \times 10^{-2} = 0.01$

$\Rightarrow i = 10 \times 10^{-3} A = 10\ mA$

31) Ans: **3)** R
Sol: We know, $R \propto \dfrac{1}{A} \propto \dfrac{1}{d^2}$

$\Rightarrow \dfrac{R_1}{R_2} = \dfrac{l_1}{l_2} \times \left(\dfrac{d_2}{d_1}\right)^2 = \dfrac{L}{4L}\left(\dfrac{2d}{d}\right)^2 = 1 \Rightarrow R_2 = R_1 = R.$

32) Ans: **4)** 8.0 A
Sol: We know, $B = \mu_0 n i \Rightarrow i = \dfrac{B}{\mu_0 n}$

$\Rightarrow i = \dfrac{20\times10^{-3}}{4\pi\times10^{-7}\times20\times100} \Rightarrow i = 7.9\ amp = 8\ amp$

33) Ans: **1)** 1.5
Sol: We know, $\tau = MB\sin\theta = m \times (2l) \times B\sin\theta$

$\Rightarrow \tau = 10^{-4} \times 0.1 \times 30\sin30^\circ \Rightarrow \tau = 1.5\times10^{-4} Nm$

34) Ans: **2)** $\pi\times10^{-2}$ V
Sol:

$e = \dfrac{1}{2}B\omega r^2 = \dfrac{1}{2}\times0.1\times2\pi\times10\times(0.1)^2 = \pi\times10^{-2}$ V

35) Ans: **2)** 50 μF
Sol: From, $X_C = \dfrac{1}{2\pi vC}$,

$C = \dfrac{1}{2\pi v X_C} = \dfrac{1}{2\times\pi\times\dfrac{400}{\pi}\times25} = 50\ \mu F$

36) Ans: **3)** - z axis
Sol: The direction of wave propagation can be given by $\vec{E}\times\vec{B}$.

37) Ans: **2)** light waves.

38) Ans: **3)** 40 cm
Sol: From the formula, $\dfrac{1}{f} = (\mu - 1)\left(\dfrac{1}{R_1} - \dfrac{1}{R_2}\right)$

$\Rightarrow \dfrac{1}{f} = (1.5-1)\left(\dfrac{1}{40} + \dfrac{1}{40}\right) = 0.5\times\dfrac{1}{20} = \dfrac{1}{40}$

$\therefore f = 40$ cm

39) Ans: **1)** E-ray is polarised in the plane of incidence and O-ray perpendicular to the plane of incidence.

40) Ans: **3)** < 179 pm
Sol: We have, $\lambda_{k\alpha} \propto \dfrac{1}{(Z-1)^2}$

$\Rightarrow \dfrac{\lambda_{Ni}}{\lambda_{Co}} = \left(\dfrac{Z_{Co}-1}{Z_{Ni}-1}\right)^2 = \left(\dfrac{27-1}{28-1}\right)^2 \Rightarrow \lambda_{Ni} = \left(\dfrac{26}{27}\right)^2 \times \lambda_{Co}$

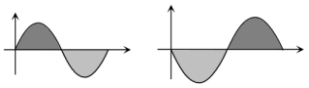
$\Rightarrow \lambda_{Ni} = \left(\dfrac{26}{27}\right)^2 \times 179 = 165.9\ pm < 179\ pm$

41) Ans: **3)** The Statement 1 is true, but the Statement 2 is false
Sol: A tube light is a gas discharge tube which can emit light of different colours. This colour mainly depends upon the nature of the gas inside the tube and the nature of the glass. The light emitted is due to fluorescence emission of light when argon is filled in tube. It takes place at low pressure but not at high temperature.

42) Ans: **4)** $_5B^{10}$
Sol: Here, $X(n,\alpha)\ {}^7_3Li \Rightarrow {}_ZX^A + {}_0n^1 \rightarrow 3Li^7 + {}_2He^4$
Thus, $Z = 3 + 2 = 5$ and A = 7 + 4 - 1 = 10
$\therefore {}_5X^{10} = {}_5B^{10}$

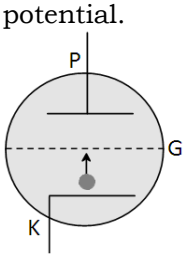
43) Ans: **4)** The Statement 1 is false but the Statement 2 is true
Sol: The atomic number (number of electrons or protons) remains same in an isotope. Isotopes of an element can be separated on account of their different atomic weights by using mass spectrometer.

44) Ans: **4)**



Sol: In triode amplifier the output signal voltage has phase difference of 180° with respect to input.

45) Ans: **1)** the grid is positive and plate is positive.
Sol: More electrons will cross the grid to reach the positive plate P, when grid is given positive potential.



Therefore current increases.