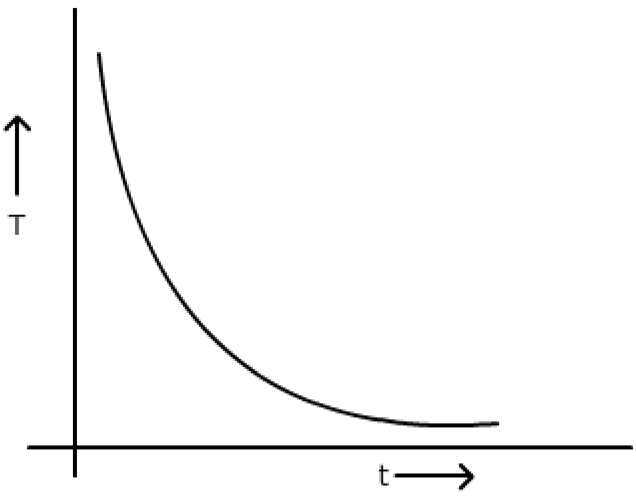
TOPPER SAMPLE PAPER 2

PHYSICS –XI

Q. No	Value Points	Marks
Ans1.	(i) $[ML^2T^{-2}]$	1/2
	(ii) Dimensionless	1/2
Ans2.	Reaction is the force applied by the block on the Earth.	1
Ans3.	Two advantages of ‘I’ shape of iron beams are	
	(i) minimizes sagging	1/2
	(ii) minimizes buckling	1/2
Ans4.	Wire B.	1
Ans5.	Natural Convection: Trade winds/Land and sea breeze	1/2
	Forced Convection: Human circulatory system.	1/2

Ans6.



1

Ans7. Because of a very small coefficient of linear expansion. 1

Ans8. The frequency of free oscillations of a vibrating system.
1

Ans9. Absolute error is the magnitude of difference between the value of individual measurement and the true value of the quantity.
1

$\Delta t = t_2 - t_1$
$= (50 \pm 0.5) - (20 \pm 0.5)$
1/2

$= 30°C \pm 1°C$ 1/2

Ans10. (i) Velocity is negative as the slope of x-t graph is negative.
1

(ii) Acceleration is negative. The increasing slope indicates speeding up, hence the sign of acceleration and velocity are same.
1

Ans11. $T = \frac{2u\sin\theta}{g}$ 1/2

$\Rightarrow u\sin\theta = \frac{gT}{2}$

Max. Height $H = \frac{u^2\sin^2\theta}{2g}$ 1/2

$= \frac{(u\sin\theta)^2}{2g}$

$= \frac{\left(\frac{gT}{2}\right)^2}{2g}$ 1/2

$= \frac{gT^2}{8}$

1/2

Ans12. (i) Because no reaction from any surface underneath is available which can make the horse move forward.
1

(ii) Due to inertia of motion, the upper part of the body continues to move along the tangent to the circular path of the bus. 1

Ans13. Concurrent forces are the forces whose lines of action intersect at a common point. 1

Conditions:

1. $\sum\vec{F} = 0$

1/2

2. $\sum\vec{\tau} = 0$

1/2

Ans14. Because the gravitational force between the satellite and the earth provides the necessary centripetal force required to keep it in its orbit. 1

No, because New Delhi is not on the equatorial plane. 1

Ans15. (a) All have same average K.E. as K_{av} depends only on temperature. 1

(b) C, B and A as $v_{rms} \; \alpha \frac{1}{\sqrt{m}}$ 1

OR

(i) $P = \frac{1}{3}\frac{mn}{V} v_{rms}^2$ 1/2

$\frac{P_i}{P_f} = \frac{1}{2}$ 1/2

(ii) $P = \frac{2}{3}E$ 1/2

$\Rightarrow E = \frac{3}{2}P = 3 \times 10^5 \; J/m^3$ 1/2

Ans16. (i) $\frac{Q_1}{Q_2} = \frac{T_1}{T_2}$ 1/2

$\Rightarrow T_2 = 320$ K 1/2

(ii) $\eta = 1 - \frac{T_2}{T_1}$ 1/2

$\Rightarrow \eta = 0.2$ 1/2

Ans17. Motion in which the restoring force is always proportional to the displacement from the mean position and is directed against it. 1

When angular displacement θ is very small. 1

Ans18. Fraction = $\frac{KE}{TE} = \frac{\frac{1}{2}m\omega^2(A^2 - y^2)}{\frac{1}{2}m\omega^2A^2}$ 1

$= 1 - \frac{1}{4} = \frac{3}{4}$ 1

Ans19. $x(t) = \int \upsilon \, dt = \int (-12t + 12)dt$ 1/2

$= -12\frac{t^2}{2} + 12t + c$

$= -6t^2 + 12t + c$ ½

Since, at t = 0, x(0) = 5, therefore, c = 5 1/2

Therefore, $x(t) = -6t^2 + 12t + 5$ m 1/2

Also, $a = \frac{dv}{dt}$ 1/2

$= -12\ m/s^2$ 1/2

Ans20. $\vec{F}_1 = 2\hat{j}$ N

$\vec{F}_2 = 2\cos 60^0\,\hat{i} - 2\sin 60^0\,\hat{j}$ 1/2

$= \hat{i} - \sqrt{3}\hat{j}$ N 1/2

$\vec{F}_3 = -1\sin 60^0\,\hat{i} + 1\cos 60^0\,\hat{j}$ 1/2

$= -\frac{\sqrt{3}}{2}\hat{i} + \frac{1}{2}\hat{j}$ N 1/2

$\vec{F}_1 + \vec{F}_2 - \vec{F}_3 = 2\hat{j} + (\hat{i} - \sqrt{3}\hat{j}) - \left(-\frac{\sqrt{3}}{2}\hat{i} + \frac{1}{2}\hat{j}\right)$ 1/2

$= \left(1 + \frac{\sqrt{3}}{2}\right)\hat{i} + \left(\frac{3}{2} - \sqrt{3}\right)\hat{j}$ N 1/2

Ans21. (i) Conservative: spring force, gravitational force 1

Non-conservative: Human push, viscous drag 1

(ii) $F = -\frac{dU}{dr}$ 1

Ans22. Definition: Ratio of relative speed of separation to relative speed of approach. 1

No, not for each body separately. Total energy and total momentum of the whole isolated system will be conserved. 1

Because collision between fast neutron and near stationary deutrons in heavy water results in maximum exchange of kinetic energy as their masses are comparable. 1

Ans23. (a) $\vec{F} = 7\hat{i} + 3\hat{j} - 5\hat{k}$, $\vec{r} = \hat{i} - \hat{j} + \hat{k}$

$\vec{\tau} = \vec{r} \times \vec{F}$

$= \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 1 & -1 & 1 \\ 7 & 3 & -5 \end{vmatrix}$ 1/2

$= (5-3)\hat{i} + (5+7)\hat{j} + (3+7)\hat{k}$ 1

$\vec{\tau} = 2\hat{i} + 12\hat{j} + 10\hat{k}$ 1/2

(b) Curl the fingers of right hand along the direction of rotation, the out stretched thumb points along the direction of angular velocity. 1

Ans24. If we define perpendicular axes X, Y, and Z (which meet at origin O) so that the body lies in the XY plane, and the Z axis is perpendicular to the plane of the body and

- I_X be the moment of inertia of the body about the X axis;
- I_Y be the moment of inertia of the body about the Y axis; and
- I_Z be the moment of inertia of the body about the Z axis.

The perpendicular axis theorem states that

$I_Z = I_X + I_Y$ 1

$I = MR^2$ 1/2

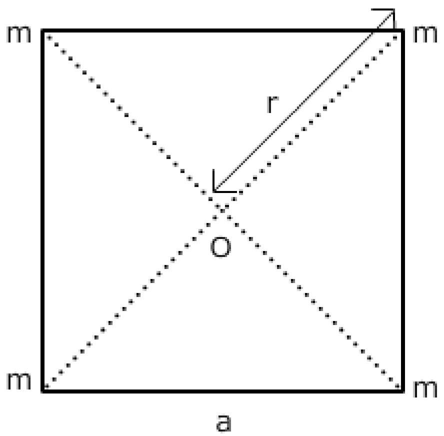
$= 2 \times (.50)^2 = 0.5$ kg m^2 1/2

$I' = MR^2 + MR^2$ 1/2

$= 2MR^2 = 2 \times 0.5$

$= 1$kg m^2 1/2

Ans25.



$U(r) = -\frac{Gm_1m_2}{r_{12}}$

Therefore, total $U = -4\frac{Gm^2}{a} - 2\frac{Gm^2}{a\sqrt{2}}$ 1

$$= -\frac{2Gm^2}{a}\left(2 + \frac{1}{\sqrt{2}}\right)$$ ½

$$= -5.41\frac{Gm^2}{a}$$

1/2

Potential $V(r) = -\frac{Gm_1}{r_1}$

1/2

Total $V = -4\frac{Gm}{\left(\frac{a\sqrt{2}}{2}\right)} = -4\sqrt{2}\frac{Gm}{a}$ 1/2

Ans26. Main features of kinetic theory of an ideal gas are about

(i) Molecules
(ii) Motion
(iii) Collisions
(iv) Forces
(v) Time
(vi) Path

1/2 × 6

Ans27. The first law of thermodynamics is an expression of the conservation of energy. It states:

The increase in the internal energy of a system is equal to the amount of energy added by heating the system, minus the amount lost as a result of the work done by the system on its surroundings.

1/2

Derivation: 1. Expression for dU_1 at constant volume

1/2

2. Expression for dU_2 at constant pressure

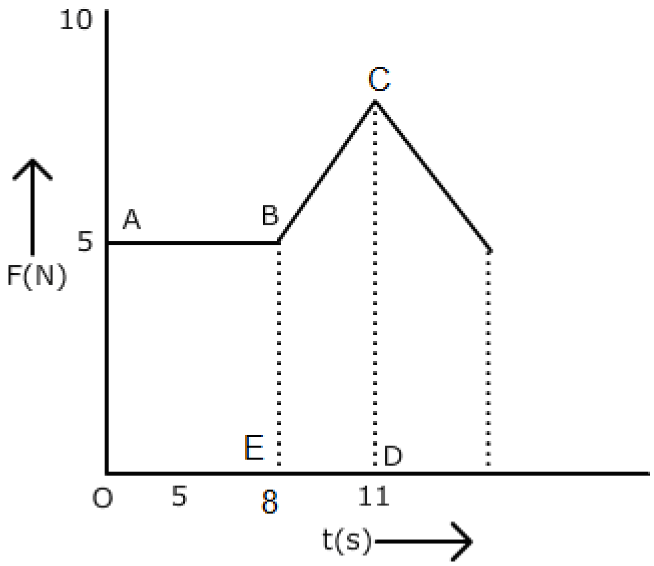
1/2

3. $PdV = n R dT$ 1/2

4. $dU_1 = dU_2$ with reason 1/2

5. $C_p - C_v = R$ 1/2

Ans28. (a)



Impulse = Area under F(t) graph ½

$= \text{area OABE} + \text{area BCDE}$

$= 5 \times 8 + \frac{1}{2} \times 3 \times (10 + 5)$ ½

$= 40 + \frac{45}{2}$

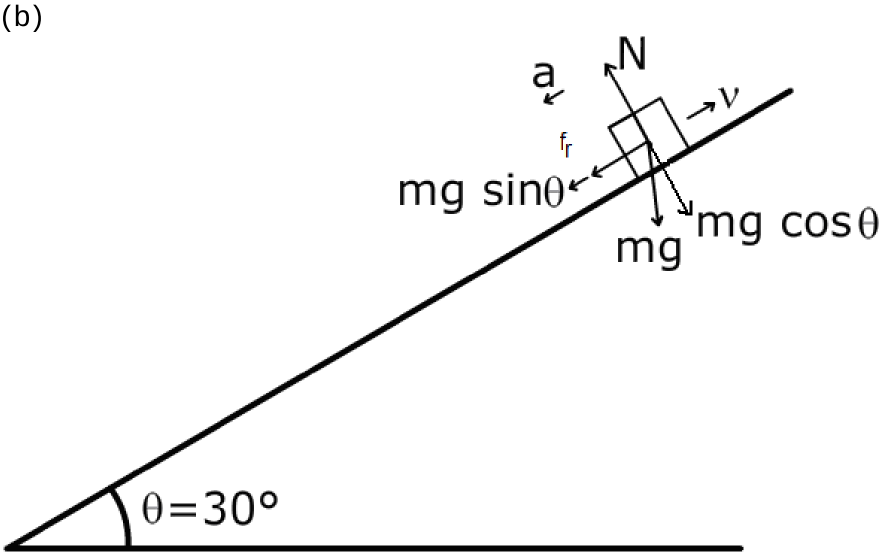
$= 62.5 \text{ kg m/s}$ 1/2

$\Delta p = m(\upsilon - u) = \text{Impulse}$ 1/2

Therefore, $7(\upsilon - 0) = 62.5$

$\upsilon = \frac{62.5}{7} \approx 9 \text{ m/s}$ ½

(b)



1/2

$ma = f_r + mg\sin\theta$ 1/2

$ma = \mu\, mg\cos\theta + mg\sin\theta$

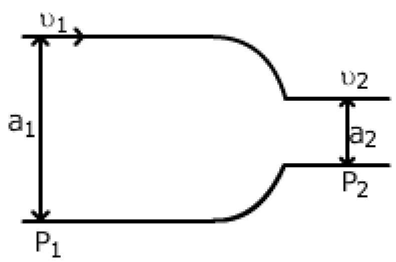
1/2

$a = (\mu\cos\theta + \sin\theta)g = (0.1\cos 30° + \sin 30°)10$

1/2

$= \frac{\sqrt{3}}{2} + 5 = 5.87\ \ m/s^2$ 1/2

Ans29. Laminar flow occurs when a fluid flows in parallel layers, with no disruption between the layers.



2

$P_1 + \frac{1}{2}\rho {v^2}_1 = P_2 + \frac{1}{2}\rho {v^2}_2$ and $a_1 v_1 = a_2 v_2$

Therefore, $P_2 = P_1 + \frac{1}{2}\rho\left(v_1^2 - v_2^2\right)$ 1/2

$= P_1 + \frac{1}{2}\rho\left[v_1^2 - \left(\frac{a_1}{a_2}\right)^2 v_1^2\right]$ 1/2

$= P_1 + \frac{1}{2}\rho v_1^2\left[1 - \left(\frac{a_1}{a_2}\right)^2\right]$

$= 4\times10^4 + \frac{1}{2}\times10^3\times4\left[1-\frac{4\times10^{-4}}{1\times10^{-4}}\right]$ 1

$= 4\times10^4 - 0.6\times10^4$ 1/2

$= 3.4\times10^4\ P_a$ 1/2

OR

Definition: The contact angle is the angle at which a liquid/vapor interface meets the solid surface. The contact angle is specific for any given system and is determined by the interactions across the three interfaces.

2

For acute angle of contact.

$n\,.\,\frac{4}{3}\pi r^3 = \frac{4}{3}\pi R^3 \Rightarrow r = \frac{R}{n^{\frac{1}{3}}}$ 1/2

$= \frac{4\times10^{-3}}{(1000)^{\frac{1}{3}}} = 4\times10^{-4}$ m 1/2

$\Delta A = n\,.\,4\pi r^2 - 4\pi R^2$

1/2

$= 4\pi\frac{R^2}{n^{\frac{2}{3}}}\,.\,n - 4\pi R^2 = 4\pi R^2\left(n^{\frac{1}{3}} - 1\right)$

1/2

$= 4\times3.14\times16\times10^{-16}(10-1) = 9\times64\times3.14\times10^{-6}\ m^2$

Therefore, $\Delta E = \sigma\,\Delta A$

1/2

$= 0.07\times9\times64\times3.14\times10^{-6} \approx 1.23\times10^{-2}$ J

1/2

Ans30. (i) –z direction 1

(ii) $f = \frac{w}{2\pi}$ 1/2

$= \frac{500}{2\pi} = \frac{250}{\pi}$ Hz 1/2

(iii) $\lambda = \frac{2\pi}{R}$ 1/2

$= \frac{2\pi}{0.025} = 80\pi$ m 1/2

(iv) $v = \frac{\omega}{R}$ 1/2

$= \frac{500}{0.025} = 2\times10^4$ m / s ½

(v) $v_{p\,max} = \omega A$ 1/2

$= 0.25 \times 10^{-3} \times 500 = 0.125$ cm/s 1/2

OR

(a) Definition: The Doppler effect is the change in frequency and wavelength of a wave for an observer moving relative to the source of the waves. 1

(i) For the listener standing outside the circle, the whistle moves towards him as well as away from him. Therefore, the frequency will appear to increase as well as decrease.

2

(ii) For the listener at the centre, the distance between him and the whistle remains constant. So, there will be no change in frequency.

1

(b) Beat frequency = 5 Hz 1

application = tuning of musical instruments.

1