CBSE Class 11 Physics Sample Paper Solution Set 3

Q. No **Marks**

Ans1. Yes (example angle) (1)

Ans2. Motion of a body thrown vertically/obliquely under constant g. (1)

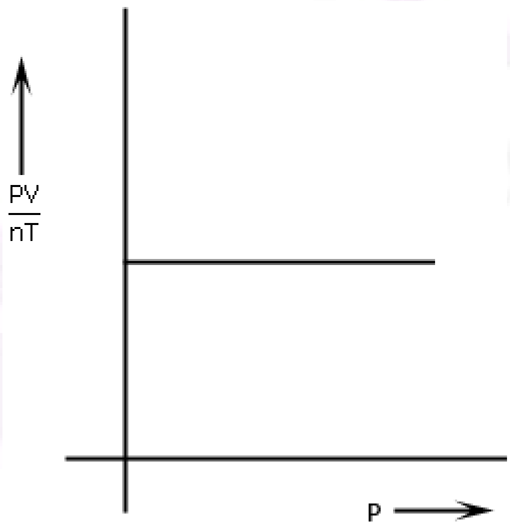
Ans3. - x-axis (1)

Ans4. Work (1)

Ans5. Since $\vec{\tau} = \vec{r} \times \vec{F}$, (1/2)
Larger arm means larger $\vec{r}$ which requires less $\vec{F}$ for same $\vec{\tau}$. (1/2)

Ans6. 3 (1)

Ans7.



(1)

Ans8. No process is possible whose sole result is the absorption of heat from a reservoir and the conversion of all of this heat into work. (1)

Ans9.

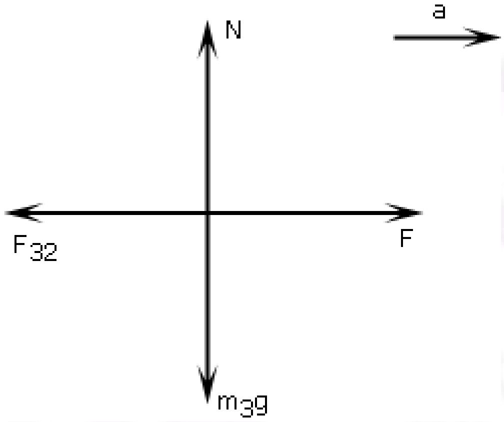
Systematic Errors	Random Errors
1. Errors in which the deviation from true value tends to have fixed size and sign. (1/2) 2. They can be attributed to a	Deviation from true value is irregular in size as well as sign. (1/2) Irregular pattern does not allow

fixed cause and can be eliminated. (1/2)	them to be attributed to any fixed cause and hence cannot be eliminated, only minimized. (1/2)

Q10. Two blocks of mass 3 kg and 2 kg are in contact with each other on a frictionless table. Find the force exerted by the smaller block on bigger block if a force of 5 N is applied on the bigger block.

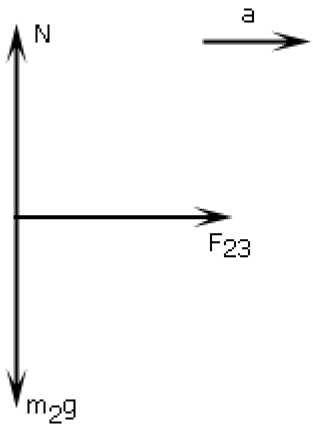
(2)

Ans10. For 3 kg



$F - F_{32} = m_3 a$ eq.(1) (1/2)

For 2 kg



$F_{23} = m_2 a$ eq.(2) (1/2)

But from Newton's third law
$\Rightarrow F_{23} = F_{32}$ (1/2)

Therefore, putting in (1), $F - m_2a = m_3a$

$$F = (m_2 + m_3)a$$

$$\Rightarrow a = \frac{5}{5} = 1\ m/s^2$$

Therefore, $F_{32} = m_2a = 2.1 = 2N$ (1/2)

OR

1. Friction adjusts its direction to be always opposite to applied force. (1/2)

2. Friction adjusts its magnitude up to a certain limit, to be equal to the applied force. (1/2)

$$F_{ms} = \mu_s N = \mu_s mg = 0.2 \times 2 \times 10 = 4N$$ (1/2)

Since, applied force < F_{ms}, the static friction acting = f_s = 2 N. (1/2)

Ans11. Since $p = \sqrt{2mk}$ (1/2)

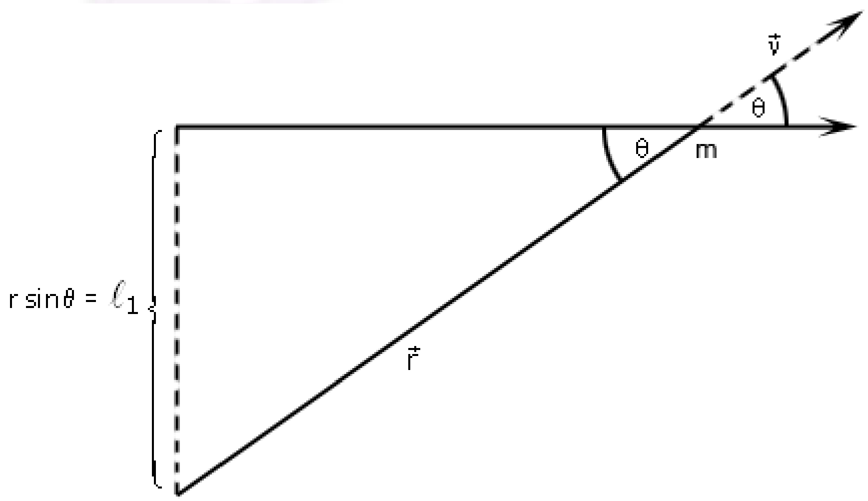
and $p' = \sqrt{2mk'} = \sqrt{2m\left(k + \frac{21}{100}k\right)} = \frac{11}{10}\sqrt{2mk} = \frac{11}{10}p$ (1/2)

Therefore, $\frac{\Delta p}{p} = \frac{\frac{11}{10}p - p}{p} = \frac{1}{10}$ (1/2)

Therefore, $\frac{\Delta p}{p} \times 100 = 10\%$ (1/2)

Ans12. $|\vec{\ell}| = rp\sin\theta = \ell mv$ (1/2)

Direction of $\vec{r} \times \vec{p}$ = direction of $\vec{\ell}$ (1/2)



(1)

Ans13. Polar satellites - Their orbit is perpendicular to the orbit of geostationary satellites. These are used for communication purpose. Also, the height above the Earth's surface is lower. Negative sign of total energy indicates attractive nature of force between the satellite and the Earth.

(2)

Ans14. The stress required to fracture a material whether by compression, tension, or shear is called breaking stress. (1)

Yes, the wire is under stress as its own weight acts as load. (1)

Ans15. For adiabatic expression PV^{γ} = const. (1/2)

Therefore, $PV^{\gamma} = P'V'^{\gamma} \Rightarrow 1600\, V^{5/3} = P'(8V)^{5/3} = 2^5 P'V^{5/3}$ (1/2)

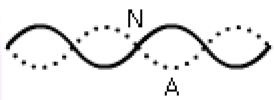
or $P' = \frac{1600}{32} = 50P_a$ (1/2)

Therefore, fall is pressure = 1600 – 500 = 1550 P_a (1/2)

Ans16. (i) For isothermal expansion $\Delta T = 0$, hence $\Delta U = 0$ (1)

(ii) For adiabatic expansion $\Delta U = \Delta Q - \Delta W = -\Delta W = -P\Delta V$ as $\Delta Q = 0$. (1)

Ans17. A stationary wave is a wave that remains in a constant position. This phenomenon can occur because the medium is moving in the opposite direction to the wave, or it can arise in a stationary medium as a result of interference between two waves traveling in opposite directions. (1)



(1)

Where A – Antinodes; N - Nodes

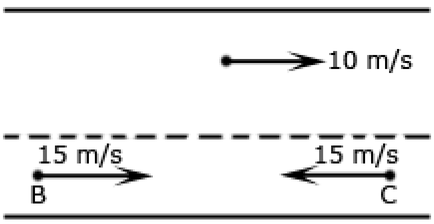
Ans18.

Damped oscillations are oscillations in which dissipative forces act as additional restoring forces to continuously decrease the amplitude of oscillation. (1/2)

Forced oscillations are oscillations whose amplitude is maintained by an external periodic force which compensates for the energy loss in damped oscillations. (1/2)

Resonant oscillations are those forced oscillations in which the frequency of driver force matches with the natural frequency of the system resulting in large increase in amplitude. (1)

Ans19.



$v_A = 36 \text{ km/h} = \frac{36 \times 1000}{60 \times 60} = 10 \text{ m/s}$

$|v_A| = |v_C| = 54 \text{ km/h} = 15 \text{ m/s}$

$v_{BA} = v_B - v_A = 15 - 10 = 5 \text{ m/s}$ (1/2)

$v_{CA} = v_C - v_A = 15 - (-10) = 25 \text{ m/s}$ (1/2)

Time taken by C to cover 1 km = $\frac{1000}{25} = 40\text{s}$ (1/2)

To avoid accident B should cover 1 km is less than 40s.

$s = ut + \frac{1}{2}at^2$ (1/2)

$\Rightarrow 1000 = 5 \times 40 + \frac{1}{2}a\,.\,(40)^2$ (1/2)

$= 200 + 800\,a$

800a = 1000 – 200 = 800

$\Rightarrow$ a = 1 m/s^2 (1/2)

Ans20. a = -kx (1/2)

$a = v\frac{dv}{dx} = -kx$ (1/2)

$v\,dv = -kx\,dx$

Integrating both sides,

$\int_u^v v\,dv = -\int_0^x kx\,dx$ (1/2)

$\frac{1}{2}(v^2 - u^2) = -\frac{1}{2}kx^2$ (1/2)

or $\frac{1}{2}m(v^2 - u^2) = -\frac{1}{2}m\,kx^2$ (1/2)

Therefore, loss in K.E. = $\frac{1}{2}m\,kx^2$ (1/2)

Ans21. (a) During free fall acceleration of thief = g = acceleration of load (1/2)

So that load is unable to apply any force.

Let the force by load be N.

mg – N $\Rightarrow$ N = 0 = force applied by load on man (1/2)

(b) Along horizontal direction, $\sum \overrightarrow{F_{ext}} = 0$. Net linear momentum is conserved.
Before firing system is at rest. (1/2)

Therefore, 0 = $m_b v_b + m_g v_g$

Therefore, $v_g = -\frac{m_b}{m_g} v_b$ (1/2)

So, to conserve linear momentum, the gun recoils.

(c) The sand yields but the cemented floor doesn't.
Hence, the time taken by man to come to rest increases in case of sand.

Since, $\frac{\Delta p}{\Delta t} = F$, force on man is less. (1)

Ans22. Moment of inertia depends on:

1. axis of rotation (1/2)
2. distribution of mass about the axis (1/2)

L = $I\omega$, k = $\frac{1}{2} I\omega^2$

$\Rightarrow \quad I = \frac{2k}{\omega^2}$ (1/2)

Therefore, $L = \frac{2k}{\omega^2} . \omega = \frac{2k}{\omega}$ (1/2)

Therefore, $L' = \frac{2k'}{\omega'} = \frac{2 . \frac{1}{2} k}{2\omega}$ (1/2)

$= \frac{1}{4} . \frac{2k}{\omega} = \frac{1}{4} L$ (1/2)

Ans23. $Q = \frac{KA(T_1 - T_2)t}{x}$ (1/2)

A = area of 6 faces = 6 × $(3 \times 10^{-1})^2$ = 54 × 10^{-3} (1/2)

m L = $\frac{KA(T_1 - T_2)t}{x}$ (1/2)

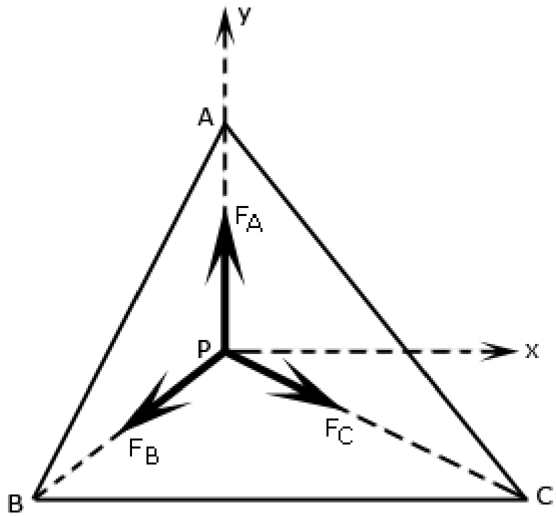
or $m = \frac{KA(T_1 - T_2)t}{xL}$

$= \frac{0.01 \times 54 \times 10^{-2} (45 - 0) \times 6 \times 3600}{5 \times 10^{-2} \times 335 \times 10^3}$ (1/2)

= 0.313 kg (1/2)

Therefore, mass left = 4 - 0.313 = 3.687 kg (1/2)

Ans24.



(1/2)

$\vec{F}_A = \frac{Gm\,.\,2m}{1}\hat{j} = 2\,Gm^2\hat{j}$ (1/2)

$\vec{F}_B = \frac{Gm\,.\,2m}{1}(-\hat{i}\cos 30° - \hat{j}\sin 30°) = 2Gm^2\left(-\frac{\sqrt{3}}{2}\hat{i} - \frac{1}{2}\hat{j}\right)$ (1/2)

$\vec{F}_C = \frac{Gm\,.\,2m}{1}(\hat{i}\cos 30° - \hat{j}\sin 30°) = 2Gm^2\left(\frac{\sqrt{3}}{2}\hat{i} - \frac{1}{2}\hat{j}\right)$ (1/2)

$\vec{F} = \vec{F}_A + \vec{F}_B + \vec{F}_C = 2Gm^2\hat{j} + 2Gm^2\left(-\frac{\sqrt{3}}{2}\hat{i} - \frac{1}{2}\hat{j} + \frac{\sqrt{3}}{2}\hat{i} - \frac{1}{2}\hat{j}\right)$ (1/2)

$= 2Gm^2\hat{j} - 2Gm^2\hat{j} = 0$ (1/2)

Ans25. (a) $E = \frac{3}{2}NkT = \frac{3}{2}nRT$

$= \frac{3}{2}(2)(8.31)(293)$

$= 7.3 \times 10^3\,J$ (1.5)

(b) Average kinetic energy per molecule

$= \frac{3}{2}(1.38 \times 10^{-23})(292)$

$= 6.07 \times 10^{-21}\,J$ (1.5)

OR

(a) Average speed

$\vec{v} = \frac{5.00 + 8.00 + 12.00 + 12.00 + 14.00 + 14.00 + 17.00 + 20.00}{9}$ (1/2)

= 12.70 m/s (1/2)

(b)

$$v^2 = \frac{(5.0)^2 + (8.0)^2 + (12.0)^2 + (12.0)^2 + (14.0)^2 + (14.0)^2 + (17.0)^2 + (20.0)^2}{9}$$

(1/2)

$= 178\ m^2/s^2$ (1/2)

Therefore, $v_{rms} = \sqrt{\overline{v^2}} = \sqrt{178} = 13.3\ m/s$ (1/2)

(c) 3 out of 9 have speed 12 m/s, 2 have 14 m/s and the rest have different speeds.

So, most probable speed is 12 m/s. (1/2)

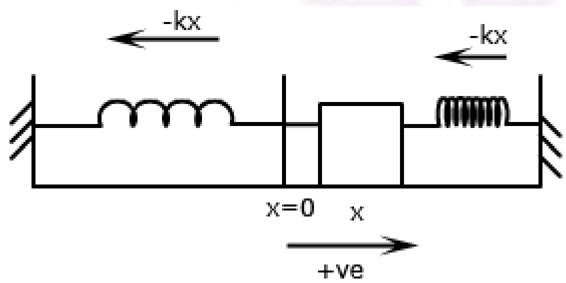
Ans26. (a) Frequency (1)

(b) 2π corresponds to path difference λ.

Therefore, $\frac{3\pi}{4}$ corresponds to path difference $\frac{\lambda \times \frac{3\pi}{4}}{2\pi} = \frac{3\pi}{8}$ (1)

(c) Both waves should not have frequency difference greater than 16 Hz. (1)

Ans27.



(1/2)

If the block is pulled to straight by distance x, restoring force in each spring is –kx.
Therefore, for block F = ma

$\Rightarrow -kx - kx = m\frac{d^2x}{dt^2}$ (1/2)

or $m\frac{d^2x}{dt^2} + 2kx = 0$

or $\frac{d^2x}{dt^2} + \frac{2k}{m}x = 0$ (1/2)

which is in form $\frac{d^2x}{dt^2} + \omega^2 x = 0$ (1/2)

Hence the motion is SHM

also $T = \frac{2\pi}{\omega} = \frac{2\pi}{\sqrt{\frac{2k}{m}}}$ (1/2)

$= 2\pi\sqrt{\frac{m}{2k}}$ (1/2)

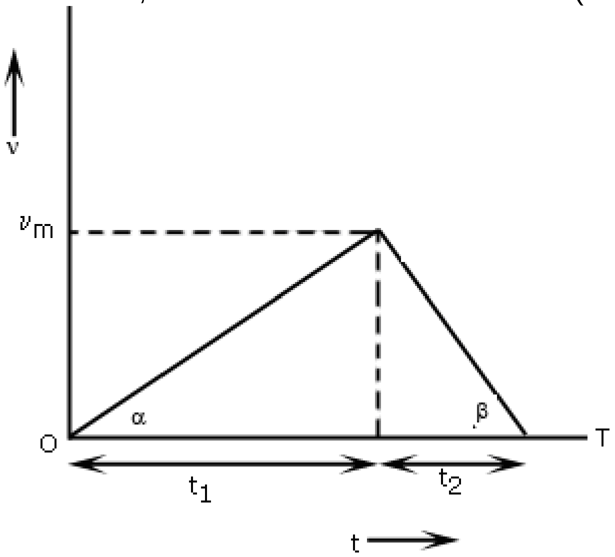
Ans28. $x \propto t^3$

$\Rightarrow x = kt^3$ (1/2)

$\Rightarrow v = \frac{dx}{dt} = 3kt^2$ (1/2)

$\Rightarrow a = \frac{dv}{dt} = 6kt$ (1/2)

Therefore, acceleration is non-uniform ($a \propto t$) (1/2)



(1)

Slop of $v - t$ graph = acceleration

Therefore, $\alpha = \frac{v_m}{t_1}$, $\beta = \frac{v_m}{t_2}$ (1/2)

Therefore, $\frac{1}{\alpha} = \frac{t_1}{v_m}$, $\frac{1}{\beta} = \frac{t_2}{v_m}$ (1/2)

Therefore, $\frac{1}{\alpha} + \frac{1}{\beta} = \frac{t_1 + t_2}{v_m} = \frac{\alpha + \beta}{\alpha\beta}$ (1/2)

Therefore, $v_m = \frac{(t_1 + t_2)\alpha\beta}{\alpha + \beta} = \frac{\alpha\beta T}{\alpha + \beta}$ (1/2)

OR

(a) (i) Both at same time since vertical motion of both are identical
$v_y = 0$, $a_y = g$ and $S_y = H$ (1)

(ii) Second one $v_1 = \sqrt{2gH}$ but $v_2 = \sqrt{u^2 + 2gH}$ (1)

(b) For max range $\theta = 45°$. (1/2)

at highest point = $v = v_x = u\cos 45° = \frac{u}{\sqrt{2}}$ (1/2)

(c) $R = \frac{u^2 \sin 2\theta}{g}$ (1/2)

$= n . \frac{u^2 \sin^2 \theta}{2g} = nH$ (1/2)

$2 \sin\theta \cos\theta = \frac{n \sin^2 \theta}{2}$ (1/2)

$\frac{\sin\theta}{\cos\theta} = \frac{4}{n}$

$\theta = \tan^{-1} \frac{4}{n}$ (1/2)

Ans29. (a) No, because action and reaction cannot act on the same body. (1)

(b) No effect (1)

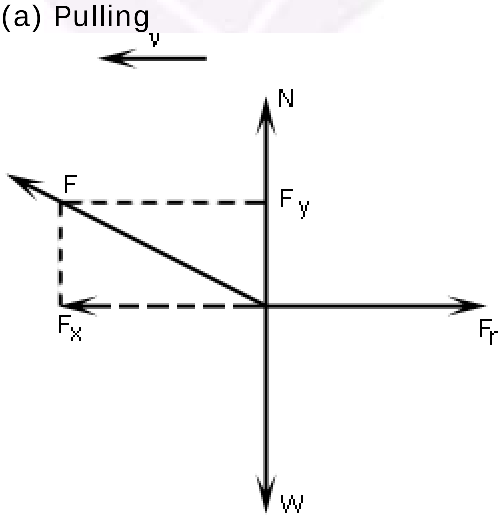
(c) The sideways friction between the road and car tyres. (1)

(d) The angle by which the outer edge of a curved road is raised over the inner edge. (1)

(e) Banking results in additional contribution to centripetal force by a component of normal reaction. So, the vehicles can negotiate a turn at a higher speed without skidding. (1)

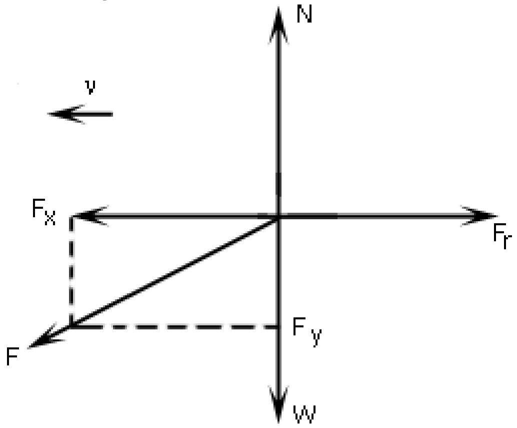
OR

(a) Pulling



(1)

Pushing



(1)

In case of pushing, vertical component of applied force F adds to the weight, thus increasing the friction $F_r = \mu N = \mu\gamma(F_y + W)$ (1/2)

But in case of pulling, vertical component of applied force reduces the downward force,

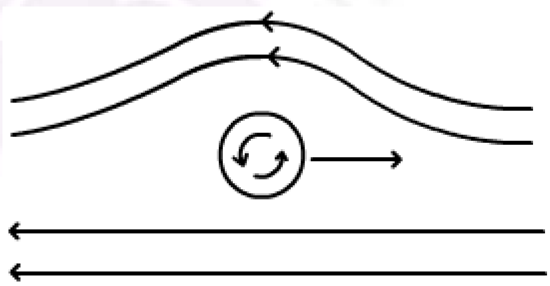
Thus decreasing the friction $F = \mu N = \mu(W - F_y)$ (1/2)

(b) Because it changes sliding friction to rolling friction which is smaller. (1)

(c) (i) Car tyres have grooves to increase the friction and hence their grip on the road for perfect rolling. (1/2)

(ii) To enable walking on slippery ice, sand is sprinkled to increase friction. (1/2)

Ans30.



(1/2)

Magnus effect: If a moving ball is given a spin, the air layers at the top acquire higher velocity than those at the bottom. So, as per Bernoulli's theorem, pressure below the ball becomes greater than that at the top. Due to net upward force, the ball follows a curved path. (2)

Viscosity is a measure of the resistance of a fluid which is being deformed by either shear stress or extensional stress. (1/2)

Dimension: $[ML^{-1}T^{-1}]$ (1/2)

SI unit: Poiseulli / decapoise (1/2)

Depends on: 1. Temperature (1/2)
2. Nature of liquid (1/2)

OR

Stokes' Law is written as,

$$F_d = 6\pi\mu\ Vd$$

Where F_d is the drag force of the fluid on a sphere, m is the fluid viscosity, V is the velocity of the sphere relative to the fluid, and d is the diameter of the sphere. (1)

Reason: The viscous drag $F_{\nu}\gamma\alpha\gamma\nu$, hence it increases as the body falls. At a certain instant the weight gets neutralized by the buoyant force and the viscous drag. Hence, in absence of any net force, the speed becomes constant. (1)

Terminal speed depends on: 1. radius of the body (1/2)
2. coefficient of viscosity of the fluid (1/2)
3. density of body (1/2)
4. density of fluid. (1/2)

Positive terminal velocity ($+\nu_t$): motion of parachute (1/2)

Negative terminal velocity ($-\nu_t$): motion of air bubbles in water(1/2)