

Class XI (2024-25)

PHYSICS

SAMPLE PAPER MARKING SCHEME

Q.No.	Hints to the Answers	Value Point	Total Marks
SECTION A			
1	d) 5	1	1
2	d) Figures A, B and C	1	1
3	d) in all options (A, B, C and D)	1	1
4	d) $\vec{r}_4 = 3.0 t \hat{i} - 4.0t^3 \hat{j}$	1	1
5	c) - 300 W	1	1
6	b) $\frac{2MR^2}{5}$	1	1
7	c) $\frac{2}{3}$	1	1
8	b) 120 J/s	1	1
9	b) B only	1	1
10	b) $T_1 < T_2 < T_3$	1	1
11	d) + 10 π m/s	1	1
12	d) $y_4(x,t) = -a \sin(kx + \omega t)$	1	1
13	Option (a) Both Assertion and Reason are true and Reason is the correct explanation of Assertion	1	1
14	Option : (C) Assertion is true but Reason is false	1	1
15	Option (a) Both Assertion and Reason are true and Reason is the correct explanation of Assertion	1	1
16	Option : (b) Both Assertion and Reason are true but Reason is not the correct explanation of Assertions	1	1
SECTION B			
17	<p>L.H.S. = $V = [L^3 T^{-1}]$</p> <p>R.H.S. = $\frac{\pi \rho r^4}{8 \eta l}$</p> <p>= $\frac{[M^1 L^{-1} T^{-2}] [L]^4}{[M^1 L^{-1} T^{-1}] [L]^1}$</p> <p>= $[M^0 L^3 T^{-1}]$</p> <p>As LHS = RHS, dimensionally \therefore The relation is correct</p>	<p>$\frac{1}{2}$</p> <p>$\frac{1}{2}$</p> <p>$\frac{1}{2}$</p> <p>$\frac{1}{2}$</p>	2
18	<p>Let after breaking, masses of two parts are $m_1 = \frac{2}{5}m$ and $m_2 = \frac{3}{5}m$</p> <p>Acc. to law of conservation of linear momentum $m(0) = m_1 \vec{v}_1 + m_2 \vec{v}_2$</p>	<p>$\frac{1}{2}$</p> <p>$\frac{1}{2}$</p>	2

	$\therefore \frac{2}{5}m(8\hat{i} + 6\hat{j}) + \frac{3}{5}m\vec{v}_2 = 0$ $16\hat{i} + 12\hat{j} + 3\vec{v}_2 = 0$ $\vec{v}_2 = \left(-\frac{16}{3}\hat{i} - 4\hat{j}\right) \text{ m/s}$	1/2	
19	<p>A projectile will have same horizontal range R for two angles of projection θ and $(90^\circ - \theta)$.</p> $R = \frac{u^2 \sin 2\theta}{g}$ $t_1 = \frac{2u \sin \theta}{g}, t_2 = \frac{2u \cos \theta}{g}$ $t_1 t_2 = \left(\frac{2u \sin \theta}{g}\right) \left(\frac{2u \cos \theta}{g}\right)$ $t_1 t_2 = \frac{2u^2 \sin 2\theta}{g^2}$ $t_1 t_2 = \frac{2R}{g}$ <p style="text-align: center;">OR</p> <p>$(\vec{A} + \vec{B})$ and $(\vec{A} - \vec{B})$ are perpendicular to each so their dot product is Zero</p> $(\vec{A} + \vec{B}) \cdot (\vec{A} - \vec{B}) = 0$ $\vec{A} \cdot \vec{A} - \vec{A} \cdot \vec{B} + \vec{B} \cdot \vec{A} - \vec{B} \cdot \vec{B} = 0$ $A^2 - \vec{A} \cdot \vec{B} + \vec{A} \cdot \vec{B} - B^2 = 0$ $A^2 - B^2 = 0$ $A^2 = B^2$ $\therefore A = B$	1/2 1/2 1/2 1/2 1/2 1/2 1/2	2 2
20	$\frac{\Delta Q}{\Delta t} = KA \frac{\Delta T}{\Delta x}$ $As, \frac{\Delta Q_1}{\Delta t} = \frac{\Delta Q_2}{\Delta t}$ $K_1 A_1 \frac{(T_1 - T_2)}{L} = \frac{K_2 A_2 (T_1 - T_2)}{L}$ $\therefore \frac{A_1}{A_2} = \frac{K_2}{K_1}$	1/2 1/2 1/2 1/2	2
21	<p>Pressure required to blow a hemispherical bubble at its end in water = $P_{\text{outside}} + \frac{2S}{R}$</p> $= 1.0 \times 10^5 + \frac{2 \times 7.30 \times 10^{-2}}{1 \times 10^{-3}}$ $= 10^5 + 14.6 \times 10^1$ $= 10^5 + 0.00146 \times 10^5$ $= 1.00146 \times 10^5 \text{ Pa}$	1/2 1/2 1/2 1/2	2

SECTION C			
22	<p>a) Node (N) is a point, where the amplitude of oscillation is zero and pressure is maximum i.e. antinode.</p> <p>Antinode (A) is a point where the amplitude of oscillation is maximum and pressure is minimum, hence node.</p> <p>b) Though the violin and sitar note have the same frequency, yet the overtones produced and their relative strengths are different in the two notes.</p> <p>c) Solids have both, the elasticity of volume and elasticity of shape, whereas gases have only the elasticity of volume.</p>	<p>½</p> <p>½</p> <p>1</p> <p>1</p>	<p>1</p> <p>1</p> <p>=03</p>
23	<p>a) $\omega = \frac{2\pi}{T}$ $= 2 \times \frac{22}{7} \times \frac{7}{44}$ $= 1 \text{ rad/s}$</p> <p>b) Since, direction of velocity changes continuously acceleration is not a constant vector.</p> <p>c) $a = \omega^2 R$ $= (1)^2 \times (10 \text{ cm})$ $= 10 \text{ cm s}^{-2}$</p>	<p>½</p> <p>½</p> <p>1</p> <p>½</p> <p>½</p>	<p>1</p> <p>1</p> <p>1</p> <p>= 03</p>
24	<p>a) The deformation between elastic limit and fracture point for material (Q) is more as compared to material (P). Hence (Q) is more ductile.</p> <p>b) $Y = \frac{\text{stress}}{\text{strain}}$ Slope of graph = $\frac{1}{Y}$</p> <p>(slope)_P < (slope)_Q $\therefore Y_P > Y_Q$</p> <p>c) Material (Q) has higher tensile strength as it sustains more stress after elastic limit.</p>	<p>1</p> <p>½</p> <p>½</p> <p>1</p>	<p>1</p> <p>1</p> <p>=03</p>
25	<p>Law of areas- The radius vector drawn from the sun to a planet sweeps out equal areas in equal intervals of time, i.e., the areal velocity (area covered per unit time) of a planet around the sun is constant.</p> <p>Consider a planet moving in an elliptical orbit with the sun at focus S. Let \vec{r} be the position vector of the planet w.r.t the sun and \vec{F} be the gravitational force on the planet due to the sun. Torque exerted on the planet by this force about the sun is $\vec{\tau} = \vec{r} \times \vec{f} = 0$ (As \vec{r} & \vec{f} are oppositely directed)</p> <div style="text-align: center;"> </div> <p>But $\vec{\tau} = \frac{d\vec{L}}{dt}$</p>		<p>3</p>

$$\therefore \frac{d\vec{L}}{dt} = 0 \text{ or } \vec{L} = \text{constant}$$

Suppose the planet moves from position P to P' in time Δt . The area swept by the radius vector \vec{r} is $\Delta\vec{A} = \frac{1}{2} \vec{r} \times \overrightarrow{PP'}$

$$\text{But } \overrightarrow{PP'} = \Delta\vec{r} = \vec{v}\Delta t = \frac{\vec{p}}{m} \Delta t$$

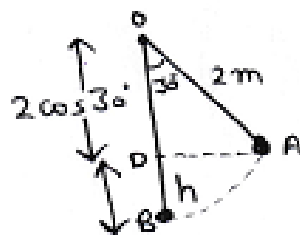
$$= \Delta\vec{A} = \frac{1}{2} \vec{r} \times \frac{\vec{p}}{m} \Delta t$$

$$= \frac{\Delta\vec{A}}{\Delta t} = \frac{1}{2m} (\vec{r} \times \vec{p}) = \frac{\vec{L}}{2m}$$

or $\frac{\Delta A}{\Delta t} = \text{constant}$ (As \vec{l} and \vec{m} are constant)

26

Ball A will not rise after collision. When two bodies of same mass undergo an elastic collision, their velocities are interchanged. After collision, ball A will come to rest and the ball B would move with the velocity of A.



$$\text{Height } BD = OB - OD = 2 - 2\cos 30^\circ$$

$$= 2 - 2(\sqrt{3}/2) = 2 - 1.73$$

$$= 0.27 \text{ m}$$

By law of conservation of energy

$$\frac{1}{2} mv^2 = mgh$$

$$\text{So, } v = \sqrt{2gh} = \sqrt{2 \times 0.27 \times 10}$$

$$v = \sqrt{5.4} = 2.32 \text{ m/s}$$

27

$$\text{MOI of hollow cylinder } I_1 = Mr^2$$

$$\text{MOI of solid cylinder, } I_2 = \frac{2}{5} Mr^2$$

$$\text{For hollow sphere, } \tau = I_1 \alpha_1$$

$$\text{For solid sphere, } \tau = I_2 \alpha_2$$

$$\therefore \frac{\alpha_2}{\alpha_1} = \frac{I_1}{I_2} = \frac{Mr^2}{\frac{2}{5}Mr^2} = \frac{5}{2}$$

$$\text{As } \omega = \omega_0 + \alpha t \text{ and } \omega_0 = 0$$


$$\therefore \frac{\omega_2}{\omega_1} = \frac{\alpha_2}{\alpha_1} = \frac{5}{2}$$

28

We assume perfect contact between bodies A and B and the rigid portion

	<p>(reaction) equals 200 N. There is no impending motion and no friction. The action-reaction forces between A and B are also 200 N. When the partition is removed, kinetic friction comes into play.</p> <p>Acceleration of A+B = $\frac{[200 - (150 \times 0.15)]}{15}$</p> <p>= 11.8 m/s²</p> <p>Friction on A = 0.15 x 50 = 7.5N</p> <p>200 – 7.5 – F_{AB} = 5x 11.8</p> <p>F_{AB} = 1.3 x 10² N opposite to motion</p> <p>F_{BA} = 1.3 x 10² N in the direction of motion</p> <p style="text-align: center;">OR</p> <p>a) For t < 0 and t > 6, the position of the particle is not changing hence no force is acting on the particle. For 0 < t < 6, position of the particle changes uniformly hence no force acts during this interval also.</p> <p>b) t=0 u=0</p> <p>After t=0, v = slope of OA = $\frac{3}{6}$ m/s</p> <p>At t = 0,</p> <p>Impulse = change in momentum</p> <p>= m (v – u) = 8 ($\frac{3}{6}$ – 0)</p> <p>= 4 kgm/s</p> <p>At t = 6s,</p> <p>u = $\frac{3}{6}$, v = 0</p> <p>Impulse = m (v – u) = 8 (0 – $\frac{3}{6}$)</p> <p>= - 4 kgm/s</p>	<p>½</p> <p>½</p> <p>½</p> <p>½</p> <p>½+½</p> <p>1</p> <p>½</p> <p>½</p>	
	SECTION D (Case study)		
29	<p>i) a) $x_0 \hat{i} + \hat{k}$</p> <p>ii) b) remains constant</p> <p>iii) d) $\frac{L}{4}$ OR iii) d) 3:1</p> <p>iv) b) 24 kg m²s⁻¹</p>	1x4	4
30	<p>i) c) At high temperature and low pressure</p> <p>ii) a) Ideal gas behavior</p> <p>iii) b) T₁ > T₂ OR a) 8.31 J/K</p> <p>iv) a)</p>	1x4	4
	SECTION E		
31(a)	<p>Work done in an adiabatic change of an ideal gas from the state (P₁V₁T₁) to the state (P₂V₂T₂).</p> <p>$W = \int_{V_1}^{V_2} P dV$ - (1)</p> <p>Using PV^γ = constant</p> <p>1) $W = \text{constant} \int_{V_1}^{V_2} \frac{dV}{V^\gamma}$</p>	<p>½</p> <p>½</p>	

	$= \text{constant} \left[\frac{V^{-\gamma+1}}{1-\gamma} \right]_{V_1}^{V_2}$ $= \frac{\text{constant}}{1-\gamma} \frac{1}{V_2^{\gamma-1}} - \frac{1}{V_1^{\gamma-1}}$ $= \frac{1}{1-\gamma} \frac{P_2 V_2^\gamma}{V_2^{\gamma-1}} - \frac{P_1 V_1^\gamma}{V_1^{\gamma-1}} \quad (\text{As } P_1 V_1^\gamma = P_2 V_2^\gamma = \text{constant})$ $= \frac{1}{1-\gamma} [P_2 V_2 - P_1 V_1]$ $\text{W.D.} = \frac{\mu R (T_1 - T_2)}{\gamma - 1}$	<p>1/2</p> <p>1/2</p> <p>1</p>	<p>3</p>
31(b)	<p>For adiabatic process</p> <p>(i) $T V^{\gamma-1} = \text{constant}$</p> <p>$T_2 V_2^{\gamma-1} = T_1 V_1^{\gamma-1}$</p> $\therefore T_2 = \left(\frac{V_1}{V_2} \right)^{\gamma-1} = 300 \left(\frac{V}{2\sqrt{2}V} \right)^{\frac{5}{3}-1}$ $= 300 \times \frac{1}{(2^{3/2})^{2/3}}$ $= \frac{300}{2} \text{ K}$ <p>$T_2 = 150 \text{ K}$</p> <p>(ii) $\Delta U = \mu C_v dt$ for all processes</p> $= 2 \times \frac{3}{2} R \times (150 - 300) \text{ J}$ $= -3 \times 8.3 \times 150 \text{ J}$ $= -3735 \text{ J}$	<p>1/2</p> <p>1/2</p> <p>1/2</p>	<p>2</p> <p>3 + 2 = 5</p>
31(a)	<p style="text-align: center;">OR</p> <p>Let there be n drops (small) combine to form a big drop.</p> <p>Then, $n \times \frac{4}{3} \pi r^3 = \frac{4}{3} \pi R^3$ or $n = \frac{R^3}{r^3}$</p> <p>Mass of bigger drop of water $M = \frac{4}{3} \pi R^3 \times 1$ ($\rho = 1 \text{ g/cc}$)</p> <p>Energy released = S.T x decrease in surface area</p> $E = S \times 4 \pi (nr^2 - R^2)$ $= S \times 4 \pi \left(\frac{R^3}{r^3} r^2 - R^2 \right)$ $= 4 \pi S R^3 \left(\frac{1}{r} - \frac{1}{R} \right)$ $= 3 \times \frac{4}{3} \pi R^3 S \left[\frac{R-r}{Rr} \right]$	<p>1</p> <p>1/2</p> <p>1/2</p>	

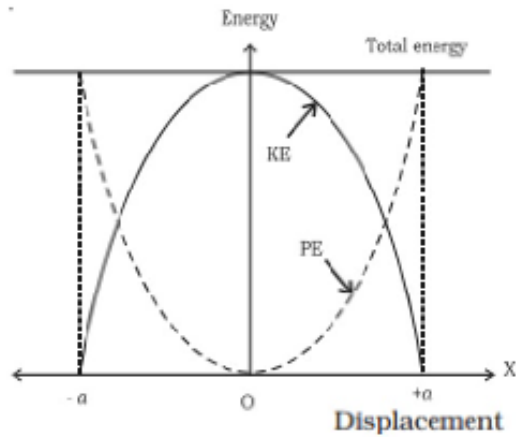
	$= 3 MS \left[\frac{R-r}{Rr} \right]$ <p>\therefore K.E. produced = E</p> $\therefore \frac{1}{2} mv^2 = 3MS \left[\frac{R-r}{Rr} \right]$ $V = \sqrt{\frac{6S(R-r)}{Rr}}$	$\frac{1}{2}$ $\frac{1}{2}$	3
31(b)	$V_1 = 180 \text{ km/h} = 50 \text{ m/s}$ $V_2 = 234 \text{ km/h} = 65 \text{ m/s}$ $A = 2 \times 25 = 50 \text{ m}^2$ $\rho = 1 \text{ kg/m}^3$ $P_1 - P_2 = \frac{1}{2} \rho (V_2^2 - V_1^2)$ $= \frac{1}{2} \times 1 \times (65^2 - 50^2)$ <p>\therefore Upward force = $(P_1 - P_2) A$</p> $= \frac{1}{2} \times (65^2 - 50^2) \times 50 \text{ N}$ <p>As the plane is in level flight, so</p> $mg = (P_1 - P_2) A$ <p>or, $m = \frac{(P_1 - P_2) A}{g}$</p> $= \frac{1 \times (65^2 - 50^2) \times 50}{2 \times 9.8}$ $= 4.4 \times 10^3 \text{ kg}$	$\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$	2
32 (a)	<p>Let the wave pulse moving from left to right (i.e. along +ve x -axis) be</p> $y_1(x,t) = r \sin(\omega t - kx)$ <p>As there is a phase change of π radian on reflection at the rigid boundary,</p> <p>\therefore Reflected wave pulse travelling from right to left is</p> $y_2(x,t) = r \sin(\omega t + kx + \pi)$ $y_2(x,t) = -r \sin(\omega t + kx)$  <p>According to superposition principle, the resultant displacement y at time t and position x is given by</p> $y(x,t) = y_1(x,t) + y_2(x,t)$ $y(x,t) = r \sin(\omega t - kx) - r \sin(\omega t + kx)$ $y(x,t) = -r [\sin(\omega t + kx) - \sin(\omega t - kx)]$ <p>Using the relation</p> $\sin C - \sin D = 2 \cos \frac{C+D}{2} \sin \frac{C-D}{2}$ $y(x,t) = -2r \cos \omega t \sin kx$ $y(x,t) = -(2r \sin kx) \cos \omega t$	$\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$	2
32(b)	<p>At the closed end of the pipe , $x=0$</p> $\sin kx = \sin 0^\circ = 0$ <p>$\therefore y=0$ i.e. a node is formed.</p> <p>At the open end of the pipe of length L</p>	$\frac{1}{2}$	
			3 + 2 = 5

	<p>$y = L$ an antinode is formed i.e. $y = \text{Max}$.</p> <p>When $\sin kL = \text{Max} = \pm 1$ $= \sin (2n - 1) \frac{\pi}{2}$</p> <p>$\therefore kL = (2n - 1) \frac{\pi}{2}$ where, $n = 1, 2, 3$</p> <p>$\frac{2\pi}{\lambda} L = (2n - 1) \frac{\pi}{2}$</p> <p>$\therefore \lambda = \frac{4L}{(2n-1)}$</p> <p>As $v = \nu \lambda$</p> <p>$\therefore \nu = \frac{v}{\lambda} = \frac{(2n-1)V}{4L}$</p> <p>$\therefore$ For frequency of n^{th} mode of vibration is $\nu_n = \frac{(2n-1)V}{4L}$</p>	<p>$\frac{1}{2}$</p> <p>$\frac{1}{2}$</p> <p>$\frac{1}{2}$</p>	<p>2</p>
<p>32(c)</p>	<p>For first mode of vibration $n=1$ $\nu_1 = \frac{V}{4L}$</p> <p>For second mode of vibration $n = 2$ $\therefore \nu_2 = \frac{(2 \times 2 - 1)V}{4L} = \frac{3V}{4L} = 3\nu_1$</p> <p>For third mode of vibration $n = 3$ $\nu_3 = \frac{(2 \times 3 - 1)V}{4L} = \frac{5V}{4L} = 5\nu_1$</p> <p>$\nu_1 : \nu_2 : \nu_3 = 1 : 3 : 5$</p> <p>$\therefore$ only odd harmonics are present in a closed end organ pipe.</p>	<p>$\frac{1}{2}$</p> <p>$\frac{1}{2}$</p>	<p>1</p> <p>2+2+1 = 5</p>
<p>32</p>	<p style="text-align: center;">OR</p> <p><u>Kinetic Energy</u> of the particle at the instant t, is</p> <p>$K = \frac{1}{2} m v^2 = \frac{1}{2} m (a \omega \cos \omega t)^2$</p> <p>$K = \frac{1}{2} m \omega^2 a^2 \cos^2 \omega t$</p> <p>$K = \frac{1}{2} m \omega^2 a^2 (1 - \sin^2 \omega t)$</p> <p>$K = \frac{1}{2} m \omega^2 (a^2 - y^2)$</p> <p><u>Potential Energy</u></p> <p>Work done for small displacement dy against the restoring force is</p> <p>$dW = - F dy = - (-ky) dy$ $dW = ky dy$</p> <p>Total work done for displacing the particle from the mean position to a position of displacement y will be</p>	<p>$\frac{1}{2}$</p> <p>$\frac{1}{2}$</p> <p>$\frac{1}{2}$</p> <p>$\frac{1}{2}$</p> <p>$\frac{1}{2}$</p> <p>$\frac{1}{2}$</p>	

$$W = \int_0^y ky \, dy = \frac{1}{2} ky^2$$

This work done appears as PE.

$$U = \frac{1}{2} ky^2 = \frac{1}{2} m\omega^2 y^2$$



½

½

1

5

33

$$u = 0, a = 10 \text{ m/s}^2, s = 100 \text{ m}, t = ?, v = ?$$

$$\text{Using } v^2 - u^2 = 2as$$

$$v^2 - 0^2 = 2 \times 10 \times 100$$

$$v^2 = 2000$$

$$v = \sqrt{2000}$$

$$= 44.72 \text{ m/s}$$

$$\text{Using } s = ut + \frac{1}{2} at^2$$

$$100 = 0 \times t + \frac{1}{2} \times 10 \times t^2$$

$$100 = 5t^2$$

$$t^2 = \sqrt{20}$$

$$\therefore t = 4.472 \text{ s}$$

$$\text{Rebound velocity} = \left(1 - \frac{1}{10}\right) \times 44.72$$

$$= \frac{9}{10} \times 44.72$$

$$= 40.24 \text{ m/s}$$

Time taken to reach highest point

$$v = u + at$$

$$0 = 40.24 - 10 \times t$$

$$t = \frac{40.24}{10} = 4.024 \text{ s}$$

$$\therefore \text{Total time} = 4.472 + 4.024$$

$$= 8.496 \text{ s}$$

$$= 8.5 \text{ s}$$

½

5

½

½

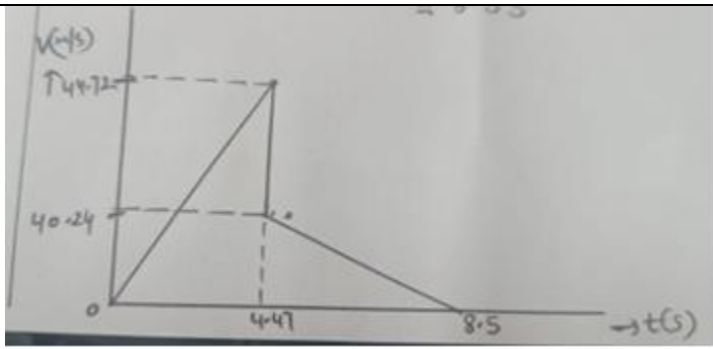
½

½

½

½

½



1

33

OR

Let the speed of ball 1 = $u_1 = 2u$ m/s

Then the speed of ball 2 = $u_2 = u$ m/s

Let the height covered by ball 1 before coming to rest = h_1

Let the height covered by ball 2 before coming to rest = h_2

At the top their velocities becomes zero

$$u^2 = 2gh \Rightarrow h = \frac{u^2}{2g} \Rightarrow h_1 = \frac{u_1^2}{2g}$$

$$h_1 = \frac{4u^2}{2g}$$

$$\text{and } h_2 = \frac{u^2}{2g}$$

$\frac{1}{2} + \frac{1}{2}$

A.T.Q $h_1 - h_2 = 15$ m (given)

$\frac{1}{2}$

$$\frac{4u^2}{2g} - \frac{u^2}{2g} = 15$$

$$\frac{u^2}{2g} [4-1] = 15$$

$$\Rightarrow u^2 = \frac{15 \times 2 \times 10}{3}$$

1

$$\Rightarrow u^2 = 100$$

$$u = 10 \text{ m/s}$$

$\frac{1}{2}$

\therefore For ball 1, $v_1 = u_1 + gt$

$$0 = 20 - 10 t_1$$

$$t_1 = 2\text{s}$$

$\frac{1}{2}$

For ball 2, $v_2 = u_2 + gt_2$

$$0 = 10 - 10 t_2$$

$$t_2 = 1\text{s}$$

\therefore Velocities of ball 1 and 2 are 20 m/s and 10m/s respectively.

$\frac{1}{2}$

Time interval between two balls

$$= t_1 - t_2$$

$$= (2-1)$$

$$= 1 \text{ second}$$

1

5