PHYSICS

DPP

DAILY PRACTICE PROBLEMS

DPP No. 24

Total Marks : 38

Max. Time : 48 min.

Topics : Projectile Motion, Sound Wave, Relative Motion, Center of Mass, Geometrical Optics, Simple Harmonic Motion, Circular Motion, Fluid

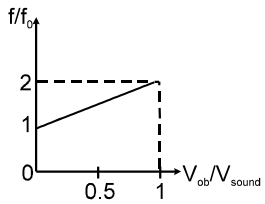
Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.6	(3 marks, 3 min.)	[18, 18]
Multiple choice objective ('–1' negative marking) Q.7	(4 marks, 4 min.)	[4, 4]
Subjective Questions ('–1' negative marking) Q.8 to Q.9	(4 marks, 5 min.)	[8, 10]
Match the Following (no negative marking) (2 × 4) Q.10	(8 marks ,10 min.)	[8, 10]

1. Two stones are projected simultaneously from a tower at different angles of projection with same speed 'u'. The distance between two stones is increasing at constant rate 'u'. Then the angle between the initial velocity vectors of the two stones is :

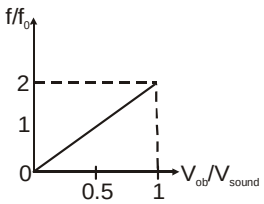
(A) 30° (B) 60° (C) 45° (D) 90°

2. A curve is plotted to represent the dependence of the ratio of the received frequency f to the frequency f_0 emitted by the source on the ratio of the speed of observer V_{ob} to the speed of sound V_{sound} in a situation in which an observer is moving towards a stationary sound source. The curve is best represented by :

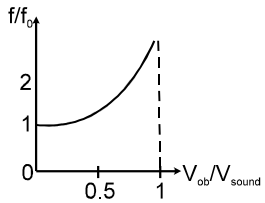
(A)



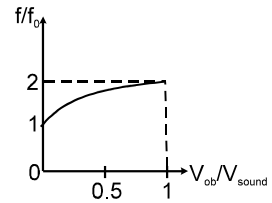
(B)



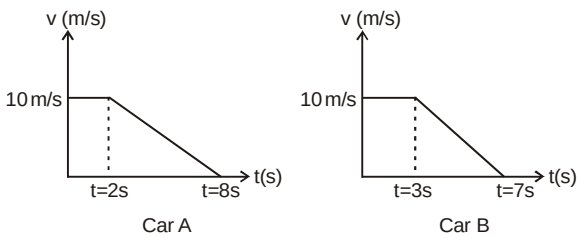
(C)



(D)

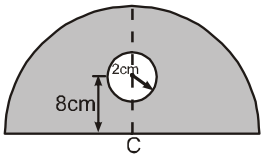


3. Car A and car B move on a straight road and their velocity versus time graphs are as shown in figure. Comparing the motion of car A in between t = 0 to t = 8 sec. and motion of car B in between t = 0 to t = 7 sec., pick up the correct statement.



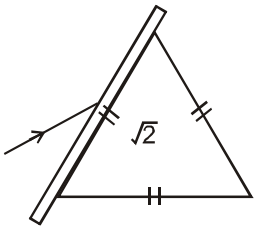
(A) Distance travelled by car A is less than distance travelled by car B.
(B) Distance travelled by car A is greater than distance travelled by car B.
(C) Average speed of both cars are equal.
(D) Average speed of car A is less than average speed of car B.

4. In the figure shown a hole of radius 2 cm is made in a semicircular disc of radius 6π cm at a distance 8 cm from the centre C of the disc. The distance of the centre of mass of this system from point C is:



(A) 4 cm (B) 8 cm (C) 6 cm (D) 12 cm

5. A parallel glass slab of refractive index $\sqrt{3}$ is placed in contact with an equilateral prism of refractive index $\sqrt{2}$. A ray is incident on left surface of slab as shown. The slab and prism combination is surrounded by air. The magnitude of minimum possible deviation of this ray by slab-prism combination is



(A) 30° (B) 45° (C) 60° (D) $60° - \sin^{-1}\sqrt{\frac{2}{3}}$

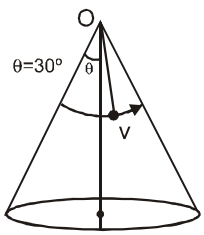
6. The amplitude of a particle due to superposition of following S.H.Ms. Along the same line is

$X_1 = 2 \sin 50\pi t$; $X_2 = 10 \sin (50\pi t + 37°)$

$X_3 = -4 \sin 50\pi t$; $X_4 = -12 \cos 50\pi t$

(A) $4\sqrt{2}$ (B) 4 (C) $6\sqrt{2}$ (D) none of these

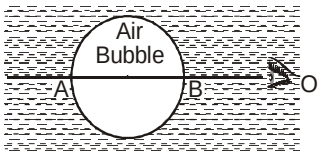
7. A bob of mass 2 kg is suspended from point O of a cone with an inextensible string of length $\sqrt{3}$ m. It is moving in horizontal circle over the surface of cone as shown in the figure. Then : ($g = 10$ m/s^2)



(A) bob looses contact with cone if $v > \sqrt{5}$ m/s (B) normal force on bob is 19 N when v = 2 m/s

(C) tension in string is $\frac{38}{\sqrt{3}}$ N when v = 2 m/s (D) normal force on bob is $\frac{17}{\sqrt{3}}$ N when v = 2m/s

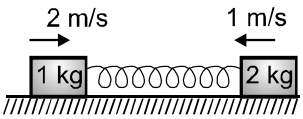
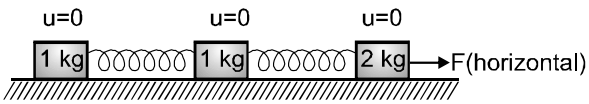
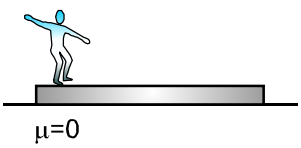
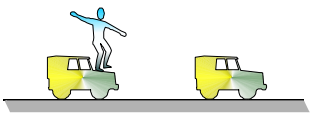
8. Inside water $\left(\mu = \frac{4}{3}\right)$ there is an air bubble of radius 4 cm as shown an observer O is looking into the diametrical axis AB of bubble. Find the distance in cm of a point object from point A on the axis in water which appears to be at point A as seen by observer.



9. A wooden cube (density 0.5 gm/cc) of side 10 cm is floating in water kept in a cylindrical beaker of base area 1500 cm^2. When a mass m is kept on the wooden block the level of water rises in the beaker by 2mm. Find the mass m.

10. **Match the column:**

In all cases in column–I, the blocks are placed on the smooth horizontal surface.

Column–I	**Column–II**
(A) When spring is relaxed. the initial velocities given to the blocks are as shown (friction is absent) 	(p) Centre of mass of the complete system shown will not move horizontally
(B) A constant force is applied on 2 kg block. Springs are initially relaxed and friction is absent 	(q) Centre of mass of the complete system shown will move horizontally
(C) There is no friction between plank and ground and initially system is at rest. Man starts moving on a large plank with constant velocity. 	(r) Mechanical energy of the system will be conserved
(D) Two trolleys are resting on a smooth horizontal surface and a man standing on one of the trolleys jumps to the other with relative velocity of 4 m/s 	(s) Mechanical energy of the system will increase
	(t) Linear momentum of the complete system will always remain constant

Answers Key

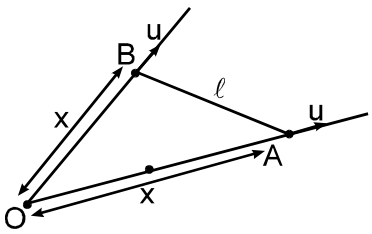
1. (B) **2.** (A) **3.** (D) **4.** (B)
5. (A) **6.** (C) **7.** (A,C) **8.** 8
9. 300 gm
10. **(A)** – p,r,t, ; **(B)** – q, s ; **(C)** – p,s,t ; (D) – p,s,t

Hints & Solutions

1. **(B)** To an observer who starts falling freely under gravity from rest at the instant stones are projected, the motion of stone A and B is seen as

$\frac{dx}{dt} = u$ .....(1)

$\frac{d\ell}{dt} = u$ .....(2)



$\therefore$ $x = \ell$ and $\angle BOA = 60°$

2. $f = f_0\left(1+\frac{V_{ob}}{V_{sound}}\right)$

$\Rightarrow \frac{f}{f_0} = 1+\frac{V_{ob}}{V_{sound}}$ (straight line) ;

when $\frac{V_{ob}}{V_{sound}} = 0$; $\frac{f}{f_0} = 1.$

and as $\frac{V_{ob}}{V_{sound}} \to 1 \quad \Rightarrow \quad \frac{f}{f_0} \to 2$

3. Distance travelled by

$A = s = 10 \times 2 + \frac{1}{2} \times 10 \times 8 = 60$

Distance travelled by

$B = s = 10 \times 3 + \frac{1}{2} \times 10 \times 4 = 50$

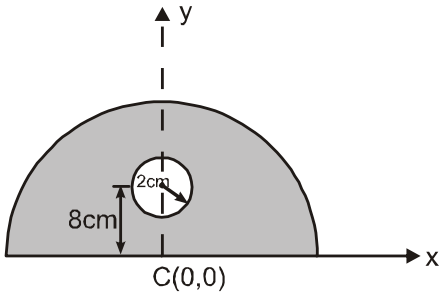
Average speed of $A = \frac{60}{8} = 7.5$

Average speed of $B = \frac{50}{7} = 7.1$

4. Taking C as origin and x & y–axes as shown in figure.

Due to symmetry about y–axis

$x_{cm} = 0$



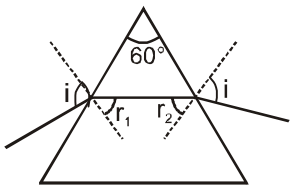
$$y_{cm} = \left(\frac{m_1y_1 - m_2y_2}{m_1 - m_2}\right)$$

$$= \frac{\left(\frac{\pi(6\pi)^2}{2}\right)\left(\frac{4(6\pi)}{3\pi}\right) - [\pi(2)^2(8)]}{\frac{\pi(6\pi)^2}{2} - \pi(2)^2}$$

(m $\propto$ Area)

$$= \frac{8(18\pi^2 - 4)}{(18\pi^2 - 4)} = 8 \text{ cm.}$$

5.



The slab does not contribute to deviation.

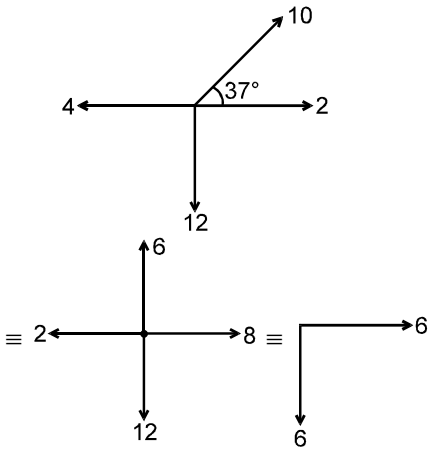
For minimum deviation by prism,

$r_1 = r_2 = 30°$ as shown in figure.

$\Rightarrow \sin i = \sqrt{2} \sin 30° \text{ or } \quad i = 45°$

$\therefore$ Minimum deviation = 2i – A = 90° – 60° = 30°

6. Amplitude phasor diagram :



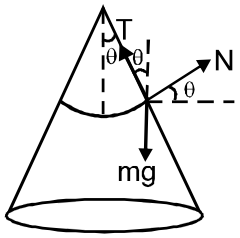
7. $T\cos30^\circ + N\sin30^\circ = mg$

$\Rightarrow \quad \sqrt{3}\,T + N = 2\,mg \quad$ .....(i)

$$T\sin30^\circ - N\cos30^\circ = \frac{mv^2}{(\sqrt{3}/2)}$$

$\Rightarrow \quad T\sin30^\circ - 3N = 4mv^2 \quad \sqrt{3}T - 3N$

$= 4mv^2 \quad$ .....(ii)



by (i),)(ii)

$$\Rightarrow \quad N = \frac{2mg - 4mv^2}{4} \quad ;$$

$$T = \frac{6mg - 4mv^2}{4\sqrt{3}}$$

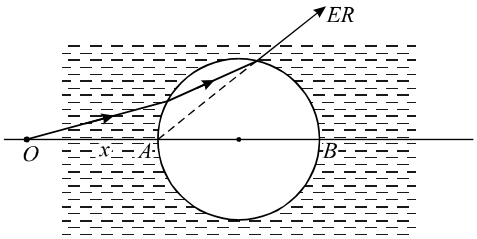
for $N > 0$

$\Rightarrow \quad v < \sqrt{5}$ m/s

at v = 2 पर $\quad T = \frac{38}{\sqrt{3}}$ N $\quad ; \quad N = 2N.$

8. **8**

For the given case Ray diagram will be as given here



Here say ER will be seen by observer which appear to becoming from point A. To find x, the distance of object from A we reverse the light rays by considering ER as incident ray & find the position of image after two refractions.

For I refraction we use

$$\frac{1}{v} - \frac{4/3}{2R} = \frac{1 - 4/3}{-R}$$

$\Rightarrow \quad v = -3R$

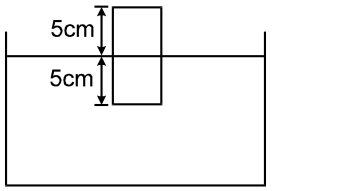
For II refraction we use

$$\frac{4/3}{x} - \frac{1}{-R} = \frac{4/3 - 1}{R}$$

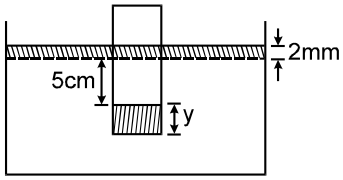
$\Rightarrow \quad x = -2R$

Hence OA $= 2\times 4 = 8$ cm.

9. Let the cube dips further by y cm and water level rises by 2 mm.



Initial situation



Final situation

Then equating the volumes
(/// volume = \\\ volume in figure)
$\Rightarrow$ volume of water raised
= volume of extra depth of wood

$$\Rightarrow \quad 100\ y = (1500 - 100)\ \frac{2}{10} = 1400 \times \frac{2}{10}$$

$$= 280$$

$\therefore$ $y = 2.8$ cm
$\therefore$ Extra upthrust
$\rho_{water} \times (2.8 + 0.2) \times 100\ g = mg$
$\Rightarrow$ $m = 300$ gm.
m = 300 gm. ....Ans.

10. A – p,r,t
$\Sigma F = 0$
So, linear momentum conservation and centre of mass will not move.
B – q,s
So, linear momentum will not be conserved and centre of mass will accelerate $W_{ext} = \Delta E$.
C – p,s,t
D – p,s,t