PHYSICS

DPP

DAILY PRACTICE PROBLEMS

DPP No. 9

Total Marks : 30

Max. Time : 32 min.

Topics : Rigid Body Dynamics, Relative Motion, Sound Waves, Geometrical Optics

Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.2	(3 marks, 3 min.)	[6, 6]
Multiple choice objective ('–1' negative marking) Q.3	(4 marks, 4 min.)	[4, 4]
Subjective Questions ('–1' negative marking) Q.4 to Q.5	(4 marks, 5 min.)	[8, 10]
Comprehension ('–1' negative marking) Q.6 to Q.9	(3 marks, 3 min.)	[12, 12]

1. A uniform disk of mass 300kg is rotating freely about a vertical axis through its centre with constant angular velocity ω. A boy of mass 30kg starts from the centre and moves along a radius to the edge of the disk. The angular velocity of the disk now is

(A) $\frac{\omega_0}{6}$ (B) $\frac{\omega_0}{5}$ (C) $\frac{4\omega_0}{5}$ (D) $\frac{5\omega_0}{6}$

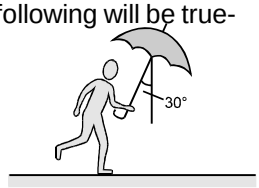
2. A man is holding an umbrella at angle 30° with vertical with lower end towards himself, which is appropriate angle to protect him from rain for his horizontal velocity 10 m/s. Then which of the following will be true-

(A) rain is falling at angle 30° with vertical, towards the man

(B) rain may be falling at angle 30° with vertical, away from the man

(C) rain is falling vertically

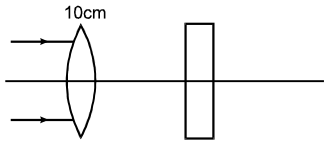
(D) none of these



3. In Resonance tube experiment, if 400 Hz tuning fork is used, the first resonance occurs when length of air column in the tube is 19 cm. If the 400 Hz. tuning fork is replaced by 1600 Hz tuning fork then to get resonance, the water level in the tube should be further lowered by (take end correction = 1 cm)

(A) 5 cm (B) 10 cm (C) 15 cm (D) 20 cm

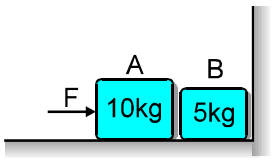
4 A parallel beam of light is incident on a lens of focal length 10 cm. A parallel slab of refractive index 1.5 and thickness 3 cm is placed on the other side of the lens. Find the distance of the final image from the lens.



5. A small object stuck on the surface of a glass sphere (n = 1.5) is viewed from the diametrically opposite position. Find transverse magnification.

COMPREHENSION

Two bodies A and B of masses 10 kg and 5 kg are placed very slightly separated as shown in figure. The coefficient of friction between the floor and the blocks is $\mu = 0.4$. Block A is pushed by an external force F. The value of F can be changed. When the welding between block A and ground breaks, block A will start pressing block B and when welding of B also breaks, block B will start pressing the vertical wall –



6. If F = 20 N, with how much force does block A presses the block B

(A) 10 N (B) 20 N (C) 30 N (D) Zero

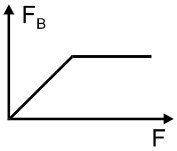
7. What should be the minimum value of F, so that block B can press the vertical wall

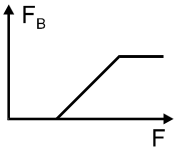
(A) 20 N (B) 40 N (C) 60 N (D) 80 N

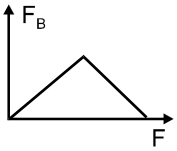
8. If F = 50 N, the friction force (shear force) acting between block B and ground will be :

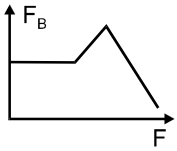
(A) 10 N (B) 20 N (C) 30 N (D) None

9. The force of friction acting on B varies with the applied force F according to curve :

(A) 

(B) 

(C) 

(D) 

Answers Key

1.	(D)	**2.**	(B)	**3.**	(A,C)	**4**	11 cm
5.	3	**6.**	(D)	**7.**	(C)	**8.**	(A)
9.	(B)						

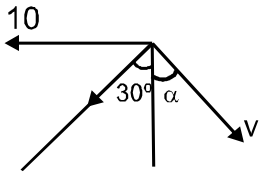
Hints & Solutions

1. As $\Sigma\tau = 0$, angular momentum remains conseved :

$$\therefore \quad L = \left(0 + \frac{300R^2}{2}\right)\omega_0 = \left(\frac{300R^2}{2} + 30R^2\right).\omega$$

$$\Rightarrow \quad 150\ \omega_0 = 180\ \omega \qquad \Rightarrow \quad \omega = 5/6\ \omega_0 \qquad \textbf{Ans.}$$

2.



Let v = velo. of rain
Possible values of α are
$-30° < \alpha < 90°$.

3. For first resonance with 400 Hz tuning fork

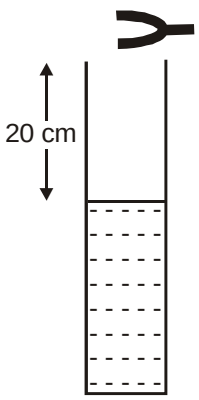
$$\ell_{eq} = \frac{V}{4f_0} = \frac{V}{4(400)} = (19 + 1) = 20 \text{ cm}$$

If we use 1600 Hz tuning fork

$$\frac{V}{4f_0} = \frac{V}{4\times(1600)} = \frac{20}{4} = 5 \text{ cm}$$

for Resonance

$$\ell_{eq} = \frac{V}{4f_0}, \frac{3V}{4f_0}, \frac{5V}{4f_0}, \frac{7V}{4f_0}, \ldots.$$



1 cm + ℓ = 5 cm , 15 cm , 25 cm , 35 cm , 45 cm .....

ℓ = 4 cm , 14 cm , 24 cm , 34 cm , 44 cm .....

water level should be further lowered by

24 – 19 = 5 cm $\Rightarrow$ 34 – 19 = 15 cm

4 As rays are parallel to the principal axis, image is created by lens at the focus.

By placing of glass-slab,

$$\text{Shift} = \left(1-\frac{1}{\mu}\right).t$$

$$= \left(1-\frac{1}{1.5}\right)\ 3 = 1 \text{ cm.}$$

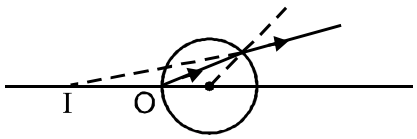
Irrespective of separation,

Image is shifted to the right by 1 cm.

Total distance from lens 10 + 1 = **11 cm**

Ans.

5.



$$\frac{n_2}{v}-\frac{n_1}{u}=\frac{n_2-n_1}{R}$$

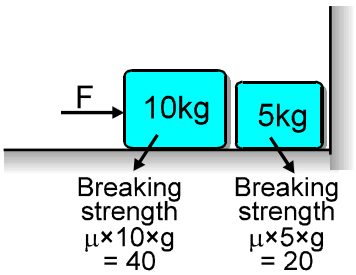
$$\frac{1}{v}-\frac{1.5}{-2R}=\frac{1-1.5}{-R}$$

$$\Rightarrow \quad v=-4R$$

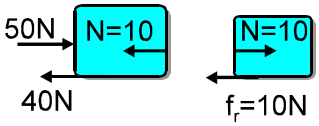
$$m=\frac{n_1 v}{n_2 u}=\frac{1.5\times(-4R)}{1\times-(2R)}$$

m = 3.

6. If F = 20 N, 10 kg block will not move and it would not press 5 kg block So N = 0.

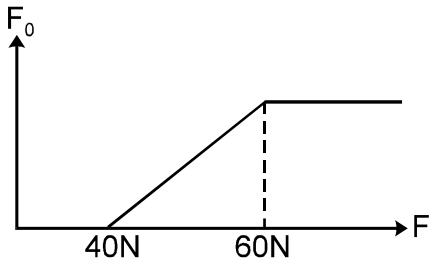


8. If F = 50 N, force on 5 kg block = 10 N



So friction force = 10 N

9. Until the 10 kg block is sticked with ground (... F = 40 N),
No force will be flet by 5 kg block. After F = 40 N, the friction
force on 5 kg increases, till F = 60 N, and after that, the kinetic friction start acting on 5 kg block,



which will be constant (20N)