PHYSICS

DPP

DAILY PRACTICE PROBLEMS

DPP No. 10

Total Marks : 31

Max. Time : 32 min.

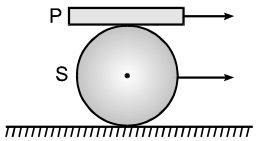
Topics : Sound Waves, Rigid Body Dynamics, Projectile Motion, Geometrical Optics, Simple Harmonic Motion

Type of Questions		**M.M., Min.**
Single choice Objective ('–1' negative marking) Q.1 to Q.6	**(3 marks, 3 min.)**	**[18, 18]**
Subjective Questions ('–1' negative marking) Q.7	**(4 marks, 5 min.)**	**[4, 5]**
Comprehension ('–1' negative marking) Q.8 to Q.10	**(3 marks, 3 min.)**	**[9,9]**

1. A stationary observer receives sonic oscillations from two tuning forks, one of which approaches and the other recedes with same speed. As this takes place the observer hears the beat frequency of 2 Hz. Find the speed of each tuning fork, if their oscillation frequency is 680 Hz and the velocity of sound in air is 340 m/s. [Use g = 10 m/s^2]

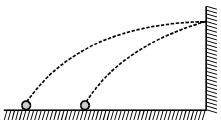
(A) 1 m/s (B) 2 m/s (C) 0.5 m/s (D) 1.5 m/s

2. A plank P is placed on a solid cylinder S, which rolls on a horizontal surface. The two are of equal mass. There is no slipping at any of the surfaces in contact. The ratio of the kinetic energy of P to the kinetic energy of S is:



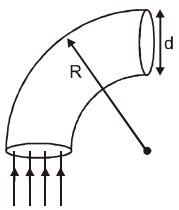
(A) 1: 1 (B) 2: 1 (C) 8: 3 (D) 1: 4

3. A stone is projected from ground and hits a smooth vertical wall after 1 sec. and again falls back on the ground. The time taken by stone to reach the ground after the collision is 3 secs. The maximum height reached by the same stone if the vertical wall were not to be present is. (g = 10 m/s^2)



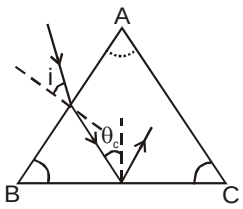
(A) 10 m (B) 12.5 m (C) 15 m (D) 20 m

4. A cylinde rical optical fibre (quarter circular shape) of refractive index n = 2 and diameter d = 4mm is surrounded by air. A light beam is sent into the fibre along its axis as shown in figure. Then the smallest outer radius R (as shown in figure) for which m



(A) 2mm (B) 4mm (C) 8 mm (D) 6 mm

5. A light is incident on face AB of an equilateral glass prism ABC. After refraction at AB, the ray is incident on face BC at the angle slightly greater than critical angle so that it gets reflected from face BC and finally emerges out from face AC. Net deviation angle of the ray is 112° anticlockwise. The angle of incidence 'i' has value :



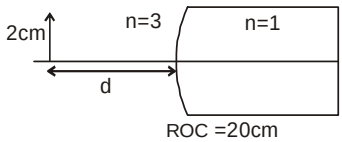
(A) 22° (B) 24° (C) 26° (D) 28°

6. In a compound microscope
(A) the objective has a shorter focal length (B) the objective has a shorter aperture
(C) (A) and (B) (D) the aperture of objective and eyepiece are same.

7. A particle initially at rest experiences a force F = a sin(ωt) where a and ω are positive constants. The direction of force is always towards positive x-axis. State with reason or explanation or derivation whether the particle will change its direction of velocity or not.

COMPREHENSION

An extended object of size 2 cm is placed at a distance of d (cm) in medium (refractive index n = 3) from pole, on the principal axis of a spherical curved surface.The medium on the other side of refracting surface is air (refractive index n = 1).



8. For d = 20 cm, the distance of the image from the pole is
(A) 2 cm (B) 3 cm (C) 4 cm (D) 5 cm

9. For d = 20 cm, The size of image is

(A) $\frac{1}{6}$ cm (B) $\frac{2}{15}$ cm (C) $\frac{6}{5}$ cm (D) $\frac{3}{2}$ cm

10. For all nonzero and finite values of d (the object is placed to the left of pole as shown), the nature of image formed always is
(A) Image is real and erect (B) Image is real and inverted
(C) Image is virtual and erect (D) None of these

Answers Key

1. (C) **2.** (C) **3.** (D) **4.** (C)
5. (C) **6.** (C) **7.** Will not change
8. (C) **9.** (C) **10.** (C)

Hints & Solutions

1. (C) $\left[\left(\frac{v}{v-v_s}\right)-\left(\frac{v}{v+v_s}\right)\right]f_0 = 2$ Hz

$v_s = 0.5$ m/s

2. Let velocity of c.m. of sphere be v. The velocity of the plank = 2v.

Kinetic energy of plank = $\frac{1}{2} \times m \times (2v)^2 = 2mv^2$

Kinetic energy of cylinder = $\frac{1}{2}mv^2$

$+ \frac{1}{2}+\left(\frac{1}{2}mR^2\omega^2\right)$

$= \frac{1}{2}mv^2\left(1+\frac{1}{2}\right) = \frac{3}{2}.\frac{1}{2}mv^2$

$\therefore \frac{\text{K.E. of plank}}{\text{K.E. of sphere}} = \frac{2mv^2}{\frac{3}{4}mv^2} = \frac{8}{3}.$

3. Time of flight of projectile depends on vertical component of velocity and not on the horizontal component. Collision of the stone with the vertical wall changes only the horizontal component of velocity of stone.
Thus the total time of flight in absence of wall is also T = 1 + 3 = 4sec

$\therefore \frac{2u_y}{g} = 4$

or $u_y = 20$ m/s

or $H_{max} = \frac{u_y^2}{2g} = \frac{400}{20} = 20$ metres.

4.

$\theta_{min} > C$

$\sin \theta_{min} > \sin C$

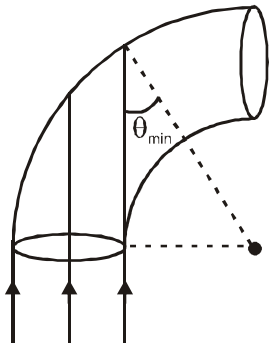
$$\frac{R-d}{R} > \frac{1}{n}$$

$$\Rightarrow \quad R\,n - dn > R$$

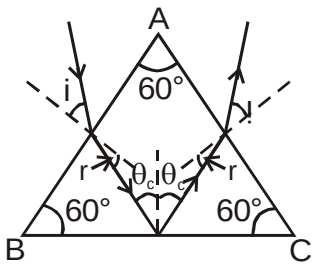
$$\Rightarrow \quad R > \frac{nd}{n-1}$$

$$R > \frac{2\,.\,4mm}{2-1}$$

$R > 8$ mm



5.



Total Deviation = $(i - r) + (180 - 2\theta_c) + (i - r) = 112°$

as $r = 60 - \theta_c$

$2i - 120 + 2\theta_c + 180 - 2\theta_c = 112°$

$\Rightarrow \quad 2i = 52°, \quad i = 26°$

7. $F = a \sin \omega t$

$$m\frac{dv}{dt} = a \sin \omega t \qquad \Rightarrow \quad \frac{dv}{dt} = \frac{a}{m} \sin \omega t \sin \omega t$$

$$\int_0^v dv = \int_0^t \sin \omega t.dt$$

$$v = \frac{a}{\omega m} - \frac{a}{\omega m} \cos \omega t = \frac{a}{\omega m} [1 - \cos \omega t]$$

since $\cos \omega t \leq 1$

hence direction of velocity will not change.

Ans. Will not change

8. From formula for refraction at curved surface

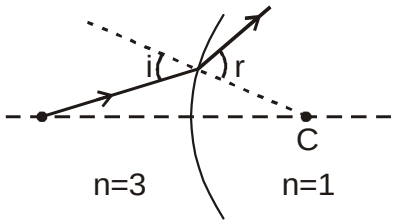
$$\frac{n^2}{v} - \frac{n_1}{u} = \frac{n_2 - n_1}{R} \qquad v = -4 \text{ cm}$$

$\therefore$ image is formed in denser medium at a distance 4 cm from pole.

9. Size of image = $\frac{v}{u} \times \frac{n_1}{n_2}$ × size of object

$= \frac{4}{20} \times \frac{3}{1} \times 2 = \frac{6}{5}$ cm.

10.



40 cm from pole in the medium of refractive index 1, virtual, erect and 4 cm in size.

A ray incident from object O is in denser medium and is refracted into rarer medium.

$\therefore$ r > i Hence always virtual image is formed.