PHYSICS

DPP

DAILY PRACTICE PROBLEMS

DPP No. 70

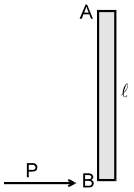
Total Marks : 22

Max. Time : 22 min.

Topics : Rigid Body Dynamics, 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]
Multiple choice objective ('–1' negative marking) Q.7	(4 marks, 4 min.)	[4, 4]

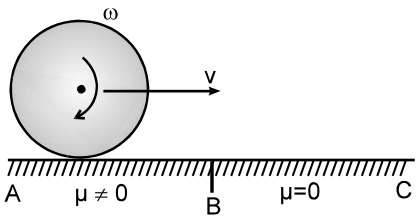
1. A uniform rod AB of mass m and length l at rest on a smooth horizontal surface. An impulse P is applied to the end B. The time taken by the rod to turn through a right angle is:



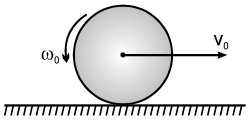
(A) $\frac{2\ ml}{P}$ (B) $\frac{m\ l}{3P}$ (C) $\frac{ml}{12P}$ (D) $\frac{2\ ml}{3P}$

2. As shown in the figure, a disc of mass m is rolling without slipping a angular velocity ω. When it crosses point B disc will be in:

(A) translational motion only
(B) pure rolling motion
(C) rotational motion only
(D) none of these



3. A uniform circular disc placed on a horizontal rough surface has initially a velocity v_0 and an angular velocity ω_0 as shown in the figure. The disc comes to rest after moving some distance in the direction of motion. Then v_0/ω_0 is:



(A) r/2 (B) r (C) 3 r/2 (D) 2

4. The equation of motion of a particle of mass 1 gm is $\frac{d^2x}{dt^2} + \pi^2 x = 0$ where x is displacement (in m) from mean position. The frequency of oscillation is (in Hz):

(A) $\frac{1}{-}$ (B) 2 (C) $5\sqrt{10}$ (D) $\frac{1}{5\sqrt{10}}$

5. A man of mass 60 kg standing on a platform executing S.H.M. in the vertical plane. The displacement from the mean position varies as y = 0.5 sin (2πft). The value of f, for which the man will feel weightlessness at the highest point is: (y is in metres)

(A) $\frac{g}{4\pi}$ (B) $4\pi g$ (C) $\frac{\sqrt{2g}}{2\pi}$ (D) $2\pi\sqrt{2g}$

6. A particle executes SHM in a straight line. In the first second starting from rest it travels a distance 'a' and in the next second a distance 'b' in the same direction. The amplitude of S.H.M will be

(A) $\frac{2a^2}{-}$ (B) a – b (C) 2a – b (D) a / b

7. A particle performing S.H.M. undergoes displacement of A/2 (where A = amplitude of S.H.M.) in one second. At t = 0 the particle was located at either extreme position or mean position. The time period of S.H.M. can be : (consider all possible cases)

(A) 12s (B) 2.4 (C) 6s (D) 1.2s

Answers Key

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1. (C) **2.** (B) **3.** (A) **4.** (A) **5.** (C)
6. (A) **7.** (A) (B) (C) (D)

Hint & Solutions

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1. **(C)** Impulse = change in momentum

$$\therefore\ P.\frac{\ell}{2} = \frac{m\ell^2}{12}.\omega \quad \text{(about centre of AB)}$$

$$\Rightarrow\ \omega = \frac{6P}{m\ell}$$

For $\theta = \frac{\pi}{2}$ के लिए ; $\frac{\pi}{2} = \omega t$

$$\Rightarrow\ t = \frac{\pi}{2\omega} = \frac{\pi m\ell}{2\times 6p}$$

$$\Rightarrow\ t = \frac{\pi m\ell}{12p}$$ **Ans.**

3. $mV_0R - \frac{mR^2}{2}.\omega_0 = 0$

$$\frac{V_0}{\omega_0} = \frac{R}{2}$$

4. $\frac{d^2x}{dt^2} + \pi^2 x = 0$

$\Rightarrow$ Compare with $\frac{d^2x}{dt^2} + \omega^2 x = 0$

so $\omega = \pi$

so $f = \frac{\omega}{2\pi} = \frac{\pi}{2\pi} = \frac{1}{2}$ Hz **[Soln. made by SSI Sir]**

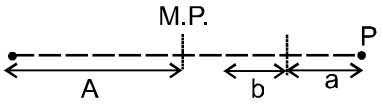
5. If he feels weightlessness then at the highest point, acceleration must be g.

$\Rightarrow\ g = \omega^2 A$

$\Rightarrow\ \omega = 2\pi f = \sqrt{2g}$

$f = \sqrt{2g}$

6. $x = A \cos wt$ (as it starts from rest at t = 0)



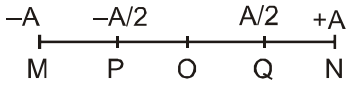
$A - a = A \cos w$ ....(1)

$A - (a + b) = A\cos 2w$ ....(2)

Solving (1) and (2) for A we get $A = \frac{2a^2}{3a - b}$

7. It T be the time period ; time to go from O to Q is $\frac{T}{12}$

and from M to P is $\frac{T}{6}$.



The displacement is $\frac{A}{2}$ when particle goes from O to Q, from O to N to Q,
from O to N to O to P, and so on

$\therefore \quad t = \frac{T}{12}$ or $t = \frac{T}{4} + \frac{T}{6} = \frac{5T}{12}$

or $t = \frac{T}{2} + \frac{T}{12} = \frac{7T}{12}$

Hence possible time period T is

$T = 12$ s or $T = \frac{12 \times 1}{5} = 2.4$ s or $T = \frac{12 \times 1}{7}$ s

similarly displacement is $\frac{A}{2}$ when particle goes from M to P or M to N to P
Hence the possible time period T is

$T = 1 \times 6 = 6$ s or $T = \frac{6 \times 1}{5}$ s $= 1.2$ s

Ans. T = 1.2 s, 6s, 2.4s, 12s