## DPP-2

## SOLUTION

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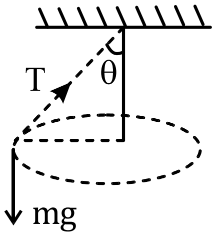
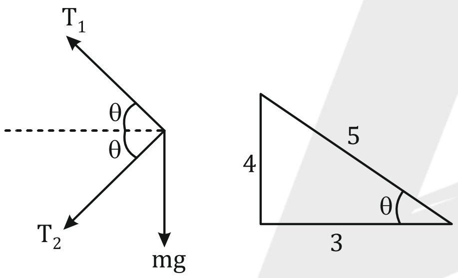
**1.** 


mass of sphere $= 200\text{ g} = 0.2\text{ kg}$

$l = 130\text{ cm}$

$T = 2\pi\sqrt{\frac{l\cos\theta}{g}} = 2\pi\sqrt{\frac{1.2}{\pi^2}} = 2\sqrt{\frac{6}{5}}$

**2.** 


$T_1\cos\theta + T_2\cos\theta = mr\omega^2$

$\omega = (2n\pi)$

Here, $n =$ number of revolutions per second. Substituting the proper values in Eq. (i),

$200\left(\frac{3}{5}\right) + T_2 \times \left(\frac{3}{5}\right) = (4)(3)(2n\pi)^2$

or $600 + 3T_2 = 240n^2\pi^2$

Further, $T_1\sin\theta = T_2\sin\theta + mg$

or $200 \times \frac{4}{5} = T_2 \times \frac{4}{5} + 4 \times 10$

or $800 = 4T_2 + 200$

Solving Equations, we get,

$T_2 = 150\text{ N}$ and $n = 0.66\text{rps}$

$= 39.6\text{rpm}$

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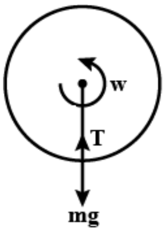
**3.** $V_{max} = \sqrt{g\pi\left(\frac{\tan\ \theta+M}{1-M\tan\ \theta}\right)}$

$= \sqrt{1000 \times 10\left(\frac{1+0.5}{1-0.5\times1}\right)}$

$= 100\sqrt{3}$ m/s

**4.**




Tension is maximum at lower point.

$T - mg = m\omega^2 R$

$30 - 0.5 \times 10 = 0.5 \times 2 \times \omega^2$

$\omega = 5 rad/s$

**5.** angular velocity $\omega$ is same for all

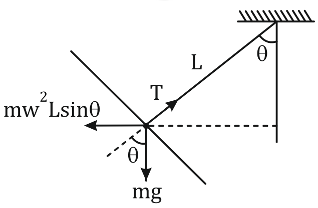
$T_C = m\omega^2(3\ell)$

$T_B = T_c + m\omega^2(2\ell) = m\omega^2(5\ell)$

$T_A = T_B + m\omega^2(\ell) = m\omega^2(6\ell)$

$\therefore T_C : T_B : T_A :: 3 : 5 : 6$

**6.** REF. Image.




$m\omega^2\ L\sin\ \theta\cos\ \theta = mg\sin\ \theta$

$\Rightarrow \cos\ \theta = \frac{g}{\omega^2\ L}$

$\therefore \sin\ \theta = \frac{1}{\omega^2\ L}\sqrt{(\omega^2\ L)^2 - g^2}$

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$T = mg\cos\,\theta + m\omega^2\,L\sin^2\,\theta$

$= mg\frac{g}{\omega^2 L} + \frac{m\omega^2 L}{(\omega^2 L)^2}((\omega^2 L)^2 - g^2)$

$= \frac{m}{\omega^2 L}[g^2 + (\omega^2 L)^2 - g^2]$

$= mw^2\,L = 324(\text{ given })$

$\Rightarrow \omega = \sqrt{\frac{324}{0.5\times0.5}}$

$\omega = 36\text{ rad/s}$

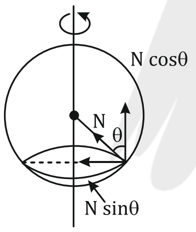
**7.** $N\sin\,\theta = m\frac{r}{2}\omega^2$ ...(i)

$N\cos\,\theta = mg$ ...(ii)

$\tan\,\theta = \frac{r\omega^2}{2\,g}$

$\frac{r}{2\frac{\sqrt{3}r}{2}} = \frac{r\omega^2}{2g}$

$\omega^2 = \frac{2g}{\sqrt{3}r}$




**8.** $R = \left(\frac{20}{\pi}\right)m$

$a_t = \text{ constant}$

$v = 80\text{ m/s}$

$\omega_0 = 0,\ \omega_f = \frac{v}{R} = \frac{80}{20/\pi} = 4\pi\text{rad/s}$

$\theta = 2\pi\times2 = 4\pi\ \ \alpha = 2\pi\text{rad/s}^2$

$\Rightarrow \omega^2 = \omega_0^2 + 2d\theta$

$d\ = \ 2\pi\text{ rad/s}^2$

$a_T = 40\text{ m/s}$

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**9.** $a_c = \frac{v^2}{r}$

Radius is constant in case (a) & Radius is increases in case (b)

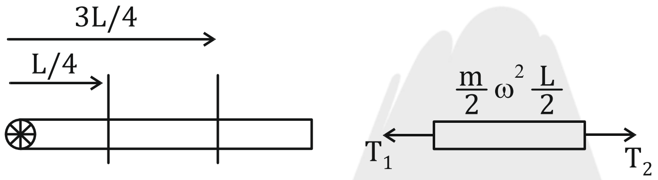
**10.** $R_1 = R$

$R_2 = 2R$

$F_c = \frac{mv_1^2}{R} = \frac{mv_2^2}{2R}$

$\frac{v_1}{v_2} = \frac{1}{\sqrt{2}}$

**11.**




$T_1 - T_2 = \frac{M}{2}\omega^2\frac{L}{2}$

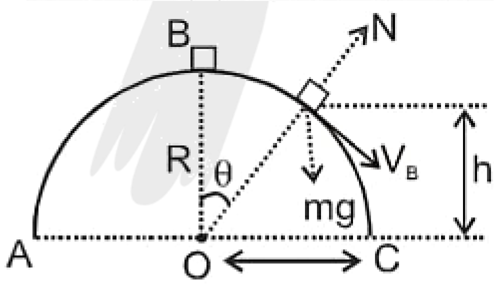
$T_1 > T_2$

**12.** As we know that in circular motion force will always act perpendicular to velocity after that a body can maintain circular motion. Direction of velocity will act tangentially and force will act away from center.

So $F = \frac{mv^2}{r}$

$r = \frac{mv^2}{F}$

**13.**




Let the car looses the contact at angle θ with vertical

$mg\cos\,\theta - N = \frac{mv^2}{R} \Rightarrow \quad N = mg\cos\,\theta - \frac{mv^2}{R}$

During descending on overbridge θ is incerese. So cos θ is decrease therefore normal reaction is decrease.