

**CIRCULAR MOTION**

1. A box weighs 196 N on a spring balance at the north pole. Its weight recorded on the same balance if it is shifted to the equator is close to (Take  $g = 10 \text{ ms}^{-2}$  at the north pole and the radius of the earth = 6400 km):

- (1) 195.66 N                      (2) 194.66 N
- (3) 194.32 N                      (4) 195.32 N

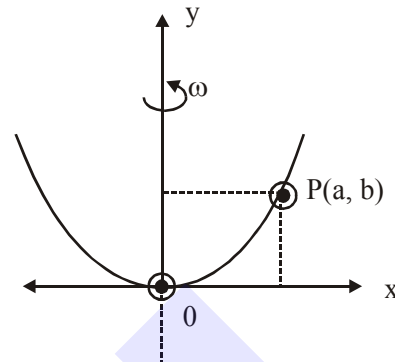
2. A particle of mass  $m$  is fixed to one end of a light spring having force constant  $k$  and unstretched length  $l$ . The other end is fixed. The system is given an angular speed  $\omega$  about the fixed end of the spring such that it rotates in a circle in gravity free space. Then the stretch in the spring is :

- (1)  $\frac{m\ell\omega^2}{k + m\omega^2}$                       (2)  $\frac{m\ell\omega^2}{k - m\omega^2}$
- (3)  $\frac{m\ell\omega^2}{k - \omega m}$                       (4)  $\frac{m\ell\omega^2}{k + m\omega}$

3. A spring mass system (mass  $m$ , spring constant  $k$  and natural length  $l$ ) rest in equilibrium on a horizontal disc. The free end of the spring is fixed at the centre of the disc. If the disc together with spring mass system, rotates about it's axis with an angular velocity  $\omega$ , ( $k \gg m\omega^2$ ) the relative change in the length of the spring is best given by the option :

- (1)  $\frac{2m\omega^2}{k}$                               (2)  $\frac{m\omega^2}{3k}$
- (3)  $\sqrt{\frac{2}{3}} \left( \frac{m\omega^2}{k} \right)$                       (4)  $\frac{m\omega^2}{k}$

4. A bead of mass  $m$  stays at point  $P(a, b)$  on a wire bent in the shape of a parabola  $y = 4Cx^2$  and rotating with angular speed  $\omega$  (see figure). The value of  $\omega$  is (neglect friction) :



- (1)  $\sqrt{\frac{2gC}{ab}}$                               (2)  $2\sqrt{2gC}$
- (3)  $\sqrt{\frac{2g}{C}}$                               (4)  $2\sqrt{gC}$

5. A clock has a continuously moving second's hand of 0.1 m length. The average acceleration of the tip of the hand (in units of  $\text{ms}^{-2}$ ) is of the order of :

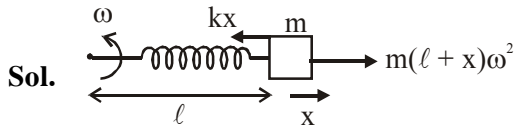
- (1)  $10^{-3}$                               (2)  $10^{-2}$
- (3)  $10^{-4}$                               (4)  $10^{-1}$

## SOLUTION

1. NTA Ans. (4)

Sol.  $W = 196 - m\omega^2 R$ 

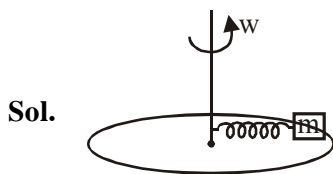
2. NTA Ans. (2)



$$kx = m\ell\omega^2 + mx\omega^2$$

$$x = \frac{m\ell\omega^2}{k - m\omega^2}$$

3. NTA Ans. (4)



FBD of m in frame of disc/-

$$k\Delta\ell \leftarrow m \rightarrow m\omega^2(\ell_0 + \Delta\ell)$$

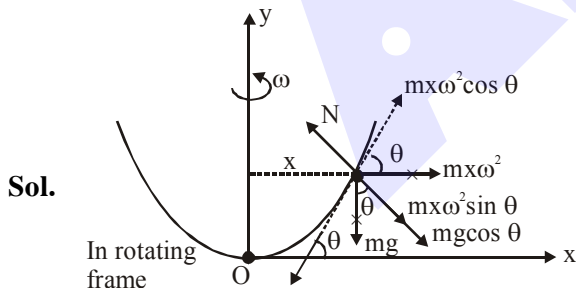
$$k\Delta\ell = m\omega^2(\ell_0 + \Delta\ell)$$

$$\Delta\ell = \frac{m\omega^2\ell_0}{k - m\omega^2} \approx \frac{m\omega^2\ell_0}{k}$$

$$\frac{\Delta\ell}{\ell_0} = \text{Relative change} = \frac{m\omega^2}{k}$$

∴ Correct answer (4)

4. Official Ans. by NTA (2)



In rotating frame

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

$$x\omega^2 = g \tan \theta$$

$$x\omega^2 = g \frac{dy}{dx}$$

$$x\omega^2 = g(8cx)$$

$$\omega^2 = 8gc$$

$$\omega = 2\sqrt{2gc}$$

5. Official Ans. by NTA (1)

Sol.  $R = 0.1 \text{ m}$ 

$$\omega = \frac{2\pi}{T} = \frac{2\pi}{60} = 0.105 \text{ rad/sec}$$

$$\begin{aligned} a &= \omega^2 R \\ &= (0.105)^2 (0.1) \\ &= 0.0011 \\ &= 1.1 \times 10^{-3} \end{aligned}$$

Average acceleration is of the order of  $10^{-3}$ 

∴ correct option is (1)