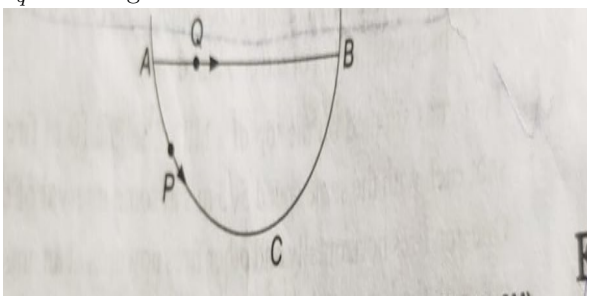
1. A particle P is sliding down a frictionless hemispherical bowl. It passes the point A at $t = 0$. At this instant of time, the horizontal component of its velocity is v. A bead Q of the same mass as P is ejected from A at $t = 0$ along the string AB, with speed v. Friction between the bead and the string may be neglected. Let t_p and t_q be the respective times taken by P and Q. Then

   (a) $t_p < t_q$

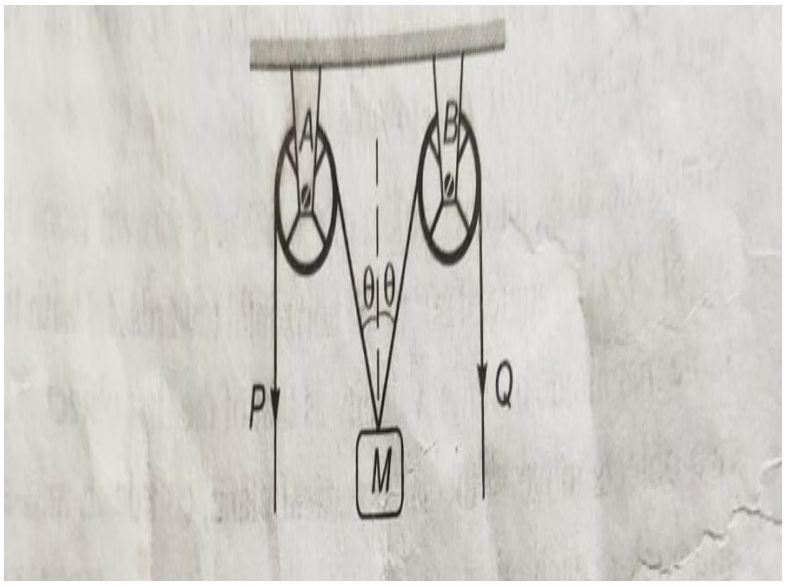
   (b) $t_p > t_q$

   (c) $t_p = t_q$

   (d) $\frac{t_p}{t_q} = \frac{\text{length of arch(ACB)}}{\text{length of chord AB}}$



2. In the arrangement shown in the following figure, the ends P and Q of an unstretchable string move downwards with uniform speed U. Pulleys A and B are fixed. Then the mass M moves with the speed



   (a) $2Ucos\theta$

   (b) $\frac{U}{cos\theta}$

   (c) $\frac{2U}{cos\theta}$

   (d) $Ucos\theta$

3. The coordinates of a particle moving in a plane are given by $x(t) = acos(pt)$ and $y(t) = bsin(pt)$ where a and $b(< a)$ and p are positive constants of appropriate dimensions. Then

   (a) The path of the particle is an ellipse

   (b) The velocity and acceleration of the particle are normal to each other at $t = \frac{\pi}{2p}$

   (c) the acceleration of the particle is always directed towards a focus

   (d) the distance travelled by the particle in time interval $t = 0$ to $t = \frac{\pi}{2p}$ is a