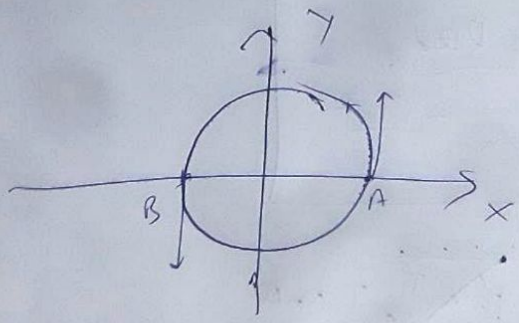
(3) Medium A particle moves in a circle with a uniform speed, when it goes from point A to a diametrically opposite point B, the momentum of the particle changes by $\vec{P}_A - \vec{P}_B = 2\text{kg m/s}\,\hat{j}$. and the centripetal force changes by $\vec{F}_A - \vec{F}_B = 8N\,\hat{i}$ where $\hat{i}, \hat{j}$ are unit vector. Find the angular velocity of the particle.

Sol:- Let radius be R and angular velocity be ω.

The corresponding diagram should be



Concepts Used

① Circular motion

Formulae Used

① $\vec{v} = \vec{\omega} \times \vec{r}$

② $|\vec{F}_{centripetal}| = m\omega^2 r$

So $|\vec{v}_A| = |\vec{v}_B| = \omega R$

$\Rightarrow$ change in momentum $= 2m\omega R = 2$ — ①

Also, $\left|\left(\vec{F}_{centripetal}\right)_A\right| = m\omega^2 R = \left|\left(\vec{F}_{centripetal}\right)_B\right|$

$\Rightarrow$ change in centripetal acceleration $= 2m\omega^2 R = 8$ — ②

From ①

$\Rightarrow m\omega R = 1$ — ③

From (2) $M\omega^2 R = 4$

$\Rightarrow (M\omega R)\omega = 4$

$\Rightarrow \boxed{\omega = 4}$ [From (3)].

(4) (Hard) A car is moving in a circular horizontal track of radius 40m with a constant speed of 10 m/s. A plumb bob is suspended from the roof of the car by a light rigid rod. The angle made by the rod with the track is ($g = 10 m/s^2$)

(A) 0 (B) 30° (C) 45° (D) 60°

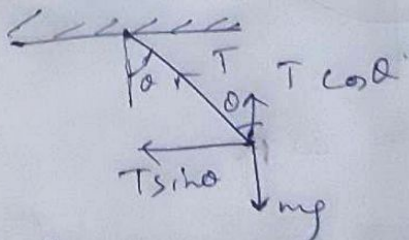
Ans (C)

Concepts Used :-

(1) Circular motion.

Formulae Used

(1) $F_{centripetal} = \frac{mv^2}{R}$.



$T\sin\theta = \frac{mv^2}{R}$ ⟶ Radius of circular track

$T\cos\theta = mg$

$\therefore \tan\theta = \frac{v^2}{Rg} = 1 \Rightarrow \boxed{\theta = 45^\circ}$