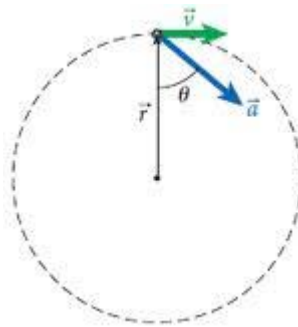**Answer on Question #40674, Physics, Mechanics**

A BALL SUSPENDED BY A THREAD SWINGS IN A VERTICAL PLANE SO THAT IT'S ACCELERATION IN THE EXTREME POSITION AND LOWEST POSITION ARE EQUAL THE ANGLE θ OF THREAD DEFLECTION IN THE EXTREME POSITION WILL BE :

1. $\tan^{-1} 2$

2. $\tan^{-1} 2^{\frac{1}{2}}$

3. $\tan^{-1} \frac{1}{2}$

4. $2 \tan^{-1} \frac{1}{2}$

**Solution.**



Projection of Newton's second law gives the direction of the tangent

$$Mg \sin \alpha = Ma_1$$

$$a_1 = g \sin \alpha$$

In the lowest point

$$a_2 = \frac{v^2}{\ell}$$

where $l - length\ of\ the\ filament$

According to the law of conservation of energy

$$\frac{Mv^2}{2} = Mgh = Mgl(1 - \cos \theta)$$

Then

$$a_2 = 2g(1 - \cos \theta)$$

Since $a_1 = a_2$, we get

$$\sin \theta = 2(1 - \cos \theta)$$

$$\tan \theta = 2(\frac{1}{\cos \theta} - 1)$$

$$\tan\theta = 2 \cdot \tan^2\theta$$

$$\tan\theta = \frac{1}{2}$$

$$\theta = \tan^{-1}\frac{1}{2}$$

Answer: 4. $\theta = \tan^{-1}\frac{1}{2}$