

A small sphere is hung by a string from the ceiling of a van. When the van is stationary, the sphere hangs vertically. However, when the van accelerates, the sphere swings backward so that the string makes an angle of θ with respect to the vertical. Find the acceleration of the van when $\theta = 13.2^\circ$.

Solution:

a – acceleration of the van ;

$\theta = 13.2^\circ$ – angle that the string makes with respect to the vertical;

m – mass of the sphere

When the van accelerates, the ball relative to the van is in a non-inertial reference frame, because $V \neq \text{const}$. Because of this on the sphere begins to act inertial force directed against the motion of the van:

$$F_i = ma \quad (1)$$

Right triangle ABC:

$$\tan \theta = \frac{F_i}{mg} \quad (2)$$

(1)in(2):

$$\tan \theta = \frac{ma}{mg}$$

$$a = g \cdot \tan \theta = 9.8 \frac{\text{m}}{\text{s}^2} \cdot \tan 13.2^\circ = 2.3 \frac{\text{m}}{\text{s}^2}$$

Answer: acceleration of the van is $2.3 \frac{\text{m}}{\text{s}^2}$

