Answer on Question #44866-Physics-Mechanics-Kinematics-Dynamics

1. A bucket of water of mass 5 kg is tied with a rope of length 50cm is rotated in a vertical circle. If the bucket rotates 10 rotations i 1 min, calculate the maximum velocity with which it can be rotated without spilling the water at the highest point

Solution

$$mg = \frac{mv^2}{r} \rightarrow v = \sqrt{gr} = \sqrt{0.50 \cdot 9.8} = 2.2 \frac{m}{s}.$$

2. The centripetal force acting on a body of mass $m = 500g = 0.5kg$ is $F = 10 \cdot 10^{-2} \, Newton = 0.1N$. If the radius of the path is 10m, calculate the velocity with which the body moves

Solution

$$F = \frac{mv^2}{r} \rightarrow v = \sqrt{\frac{Fr}{m}} = \sqrt{\frac{0.1 \cdot 10}{0.5}} = \sqrt{2} \frac{m}{s}.$$

3. Two forces of magnitude 5N and 10N are inclined with each other by 30 degree. What is the magnitude and direction of the resultant?

Solution

$$R^2 = 5^2 + 10^2 + 2 \cdot 5 \cdot 10 \cos 30 = 125 + 50\sqrt{3} \rightarrow R = 211.6 \text{ N}$$

Direction

$$\tan \alpha = \frac{Q \sin 30}{P + Q \cos 30} = \frac{10 \cdot 0.5}{5 + \frac{10\sqrt{3}}{2}} \rightarrow \alpha = 20.1°.$$

The resultant makes $\alpha = 20.1°$ with the line of force $5 \, N$, towards the $10 \, N$ force.

4. A cyclist travel in a circular orbit of radius 200m.the angle of baking is 30 degree, what is the maximum velocity with which he can travel without skidding

Solution

N is normal force from ground supplies centripetal force and balances weight, m is mass of vehicle and person.

$$N \cos 30 = m \, g \rightarrow N = \frac{2mg}{\sqrt{3}}$$

$$N \sin 30 = \frac{mv^2}{R} \rightarrow v^2 = \frac{2mg}{2\sqrt{3}} \cdot \frac{R}{m} = \frac{Rg}{\sqrt{3}} = \frac{200 \cdot 9.8}{\sqrt{3}}.$$

$$v = 33.6 \frac{m}{s}.$$

5. A car of weight 1000kg travel with a speed of 25km/h in a curved path of radius 100m.what is the angle through which the outer track is raised so as to have a safe turn

Solution

$$N \sin \theta = \frac{mv^2}{r}.$$

$$N \cos \theta = mg.$$

$$\tan \theta = \frac{\frac{mv^2}{r}}{mg} = \frac{v^2}{rg}. \; \theta = \tan^{-1} \frac{v^2}{rg} = \tan^{-1} \frac{\left(\frac{25}{3.6} \frac{m}{s}\right)^2}{100m \cdot 9.8 \frac{m}{s^2}} = 2.8°.$$

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