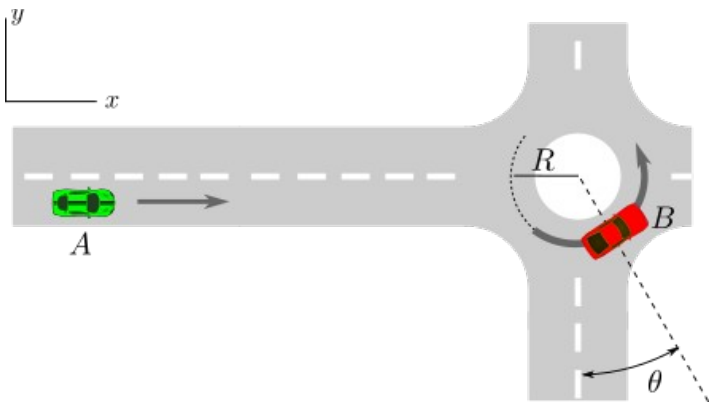
1. A rockets lifts off the ground vertically with an acceleration given by $a(t) = At$, where $A = 0.10$ m/s^3. After 45 seconds the rocket changes to stage 2, in which it accelerates vertically at a constant rate of 4.5 m/s^2. Determine the rocket's speed v and elevation h one minute after liftoff.

   $v =$ _____

   $h =$ _____

2. While car *B* is turning in a circle of radius $R = 10$ m, car *A* is slowing down. At the moment shown, when $\theta = 30$ °, the speed of both cars is 3 m/s. The speed of car *A* is decreasing at a rate of 1 m/s², while the speed of car *B* is increasing at a rate of 1 m/s².

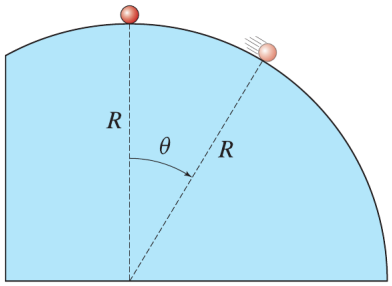


Using the coordinate system shown (with $\hat{\imath}, \hat{\jmath}, \hat{k}$ notation), give the velocity and acceleration vectors of car *B* relative to car *A*.

answers: $\vec{v}_{B/A} =$ _____

$\vec{a}_{B/A} =$ _____

3. A small mass m (500 g) slides frictionlessly along the hemisphere of radius R = 0.5 m. If the mass begins at $\theta = 0$ with initial speed v_0 = 0.20 m/s to the right, determine the angle θ at which the mass leaves the surface of the hemisphere (this is where the normal force becomes zero).

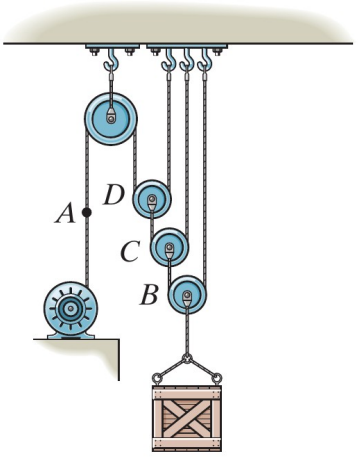


A free-body diagram for the mass must be part of your solution.

answer:

_____

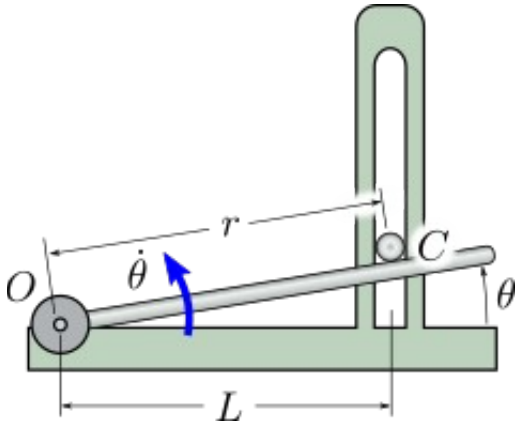
4. The motor draws in the cable at A, starting from rest at time $t = 0$, with an acceleration given by $a(t) = At^2$, where $A = 2$ cm/s^4. What is the speed of the crate (in cm/s) when it has moved upward 10 cm?



answer:

$v =$ _____

5. In a soda can dispenser, a mechanical arm lifts can C up a vertical channel by rotating at a constant rate of $\dot{\theta} = 1.5$ rad/s. The can has a mass of 500 g. Determine the magnitude of the force the arm exerts on the can at the moment $\theta = 15$ °. Friction is negligible, and horizontal distance $L = 50$ cm.



Your work must include a free-body diagram of the can.

answer:

$F =$ _____