Newton's 2nd Law

This tutorial will examine methods of using Newton's Second Law in solving kinetics and kinematics problems.

1) The acceleration of the 20-lb collar A is \(2\hat{i} + 3\hat{j} - 3\hat{k}\) ft/sec\(^2\). What is the magnitude of the force \(\vec{F}\)?

The acceleration of the 20-lb collar A is \(2\hat{i} + 3\hat{j} - 3\hat{k}\) (ft/s\(^2\)). The bar is smooth. What is the force \(\vec{F}\)?

![Diagram of a collar with forces](image)

i. Draw a FBD of the collar, showing the vector forces acting on it.

ii. Symbolically describe the solution to this problem by using Newton's Second Law, \(\sum \vec{F} = m\vec{a}\). (That is, write the relevant forces, mass, and acceleration in symbolic vector form.) Hint: dot products and unit vectors may be useful here, because you need to resolve the forces and acceleration in a direction parallel to the bar.
iii. Solve for the magnitude of $\vec{F}$.

2) A 4 lb ball revolves in a horizontal circle as shown. Knowing that $L=3$ ft. and that the maximum allowable tension in the cord is 10 lb, find a) the maximum allowable speed, and b) the corresponding angle of $\theta$. (Hint: solve using normal and tangential components.)

i. Draw a FBD of the ball. It is suggested that you show a "side" view, with the origin of a Cartesian reference frame at the center of the ball.

ii. Ask yourself: What is the tangential acceleration in this case? Why?
iii. Is there a normal acceleration component? Normal acceleration $a_n = \frac{v^2}{p}$. Write an expression for $a_n$.

iv. Using Newton's Second Law, solve for the maximum allowable speed, $v$, and for the corresponding angle, $\theta$. 