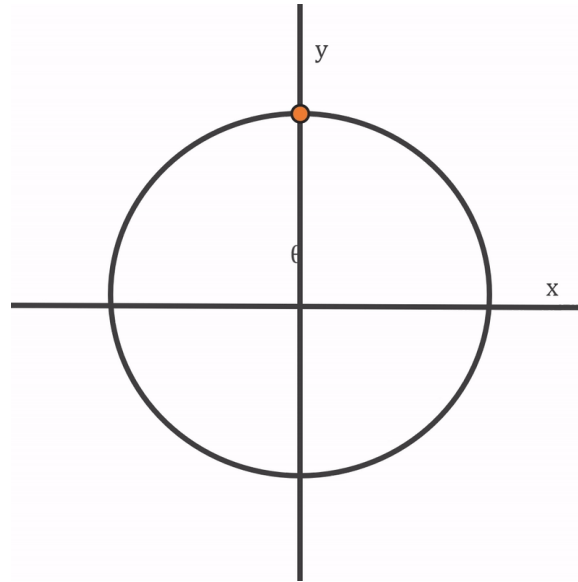


## Ball in Circular Motion



Which of the following equations gives the correct relation for  $\vec{a}$  in Cartesian coordinates for this ball following a circular motion with radius  $R$ ?

Define  $x$  and  $y$  to be:

$$x = R \cdot \cos \theta \quad (1)$$

$$y = R \cdot \sin \theta \quad (2)$$

Take the first and second derivatives of both to get relations for the velocity and acceleration:

$$\dot{x} = -R \cdot \sin \theta \cdot \dot{\theta} \quad (3)$$

$$\dot{y} = R \cdot \cos \theta \cdot \dot{\theta} \quad (4)$$

$$\ddot{x} = -R \cdot (\cos \theta \cdot \dot{\theta} \cdot \dot{\theta} + \sin \theta \cdot \ddot{\theta}) \quad (5)$$

$$\ddot{y} = R \cdot (-\sin \theta \cdot \dot{\theta} \cdot \dot{\theta} + \cos \theta \cdot \ddot{\theta}) \quad (6)$$

Combining both results in an acceleration vector  $\vec{a} = \ddot{x} \cdot \mathbf{i} + \ddot{y} \cdot \mathbf{j}$ :

$$\mathbf{a} = (-R\ddot{\theta} \sin \theta - R\dot{\theta}^2 \cos \theta)\mathbf{i} + (R\ddot{\theta} \cos \theta - R\dot{\theta}^2 \sin \theta)\mathbf{j} \quad (7)$$