Chapter 3 Problem 37 [†]

Given
$\vec{r} = \left\{(3.2t + 1.8t^2)\hat{i} + (1.7t - 2.4t^2)\hat{j}\right\}\ m$

Solution
Find the magnitude and direction of the acceleration.

The acceleration is the second derivative of the position vector with respect to time.

$$\vec{a} = \frac{d^2\vec{r}}{dt^2} = \frac{d^2\left\{(3.2t + 1.8t^2)\hat{i} + (1.7t - 2.4t^2)\hat{j}\right\}\ m}{dt^2}$$

$$\vec{a} = \left\{2(1.8)\hat{i} + 2(-2.4)\hat{j}\right\}\ m/s^2 = \left\{3.6\hat{i} - 4.8\hat{j}\right\}\ m/s^2$$

The magnitude of the acceleration is then

$$a = \sqrt{(a_x)^2 + (a_y)^2} = \sqrt{(3.6)^2 + (-4.8)^2}\ m/s^2$$

$$a = 6.0\ m/s^2$$

The direction is in the fourth quadrant.

$$\theta = tan^{-1}\left(\frac{-4.8}{3.6}\right) = -53^\circ$$

[†]Problem from Essential University Physics, Wolfson