

This is a 3-D problem involving instantaneous acceleration.

The position of a particle is given by $\vec{r} = t^2 \hat{i} + (t^3 - 5t) \hat{j} - 3.0t \hat{k}$. What is the instantaneous acceleration of the particle? } in meters

Solution:

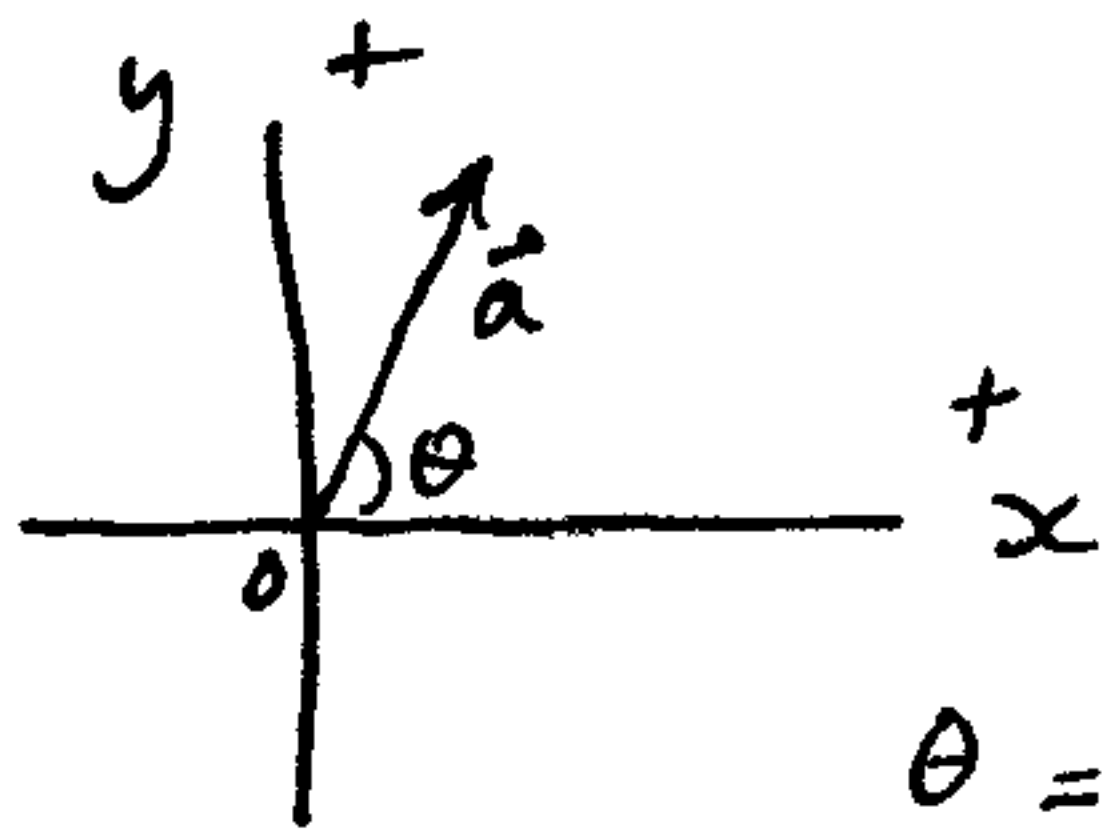
What is the orientation of the instantaneous acceleration at $t = 1.0\text{ s}$?

$$a_x = \frac{d^2}{dt^2}(t^2) = 2$$

$$a_y = \frac{d^2}{dt^2}(t^3 - 5t) = 6t$$

$$a_z = \frac{d^2}{dt^2}(-3.0t) = 0$$

$$\vec{a} = 2 \hat{i} + 6t \hat{j} \quad (\text{answer})$$



$$|\vec{a}| = \sqrt{(2)^2 + (6)^2}, \quad \text{at } t = 1.0\text{ s}$$

$$|\vec{a}| = 6.3 \text{ m/s}^2 \quad (\text{answer})$$

$$\theta = \tan^{-1}\left(\frac{6}{2}\right)$$

$$\theta = 71.6^\circ \quad (\text{answer})$$