

# Worksheet #3 Solution

Given  $x = 3.0\text{ m} + 4.0\text{ m/s } t$  ;  $y = 10\text{ m/s } t - 4.9\text{ m/s}^2 t^2$   
 $(x = 3 + 4t)$   $(y = 10t - 4.9t^2)$

a.  $v_x = \frac{dx}{dt} = \frac{d}{dt}(3 + 4t) = 4\text{ m/s}$

$v_y = \frac{dy}{dt} = \frac{d}{dt}(10t - 4.9t^2) = (10 - 9.8t)\text{ m/s}$

b.  $a_x = \frac{dv_x}{dt} = \frac{d}{dt}(4) = 0\text{ m/s}^2$

$a_y = \frac{dv_y}{dt} = \frac{d}{dt}(10 - 9.8t) = -9.8\text{ m/s}^2$

c.  $v = \sqrt{v_x^2 + v_y^2} = \sqrt{(4)^2 + (10 - 9.8t)^2}$

$= \sqrt{16 + 100 - 196t + 96.04t^2}$

$= \sqrt{116 - 196t + 96.04t^2}$

d.  $a = \sqrt{a_x^2 + a_y^2} = \sqrt{(0)^2 + (-9.8)^2} = \sqrt{(-9.8)^2} = 9.8\text{ m/s}^2$

e.  $\frac{dv}{dt} = \frac{d}{dt}(\sqrt{116 - 196t + 96.04t^2}) = \frac{1}{2\sqrt{116 - 196t + 96.04t^2}} \cdot (-196 + 192.08t)$   
 $= \frac{192.08t - 196}{2\sqrt{116 - 196t + 96.04t^2}} = \frac{96.04t - 98}{\sqrt{116 - 196t + 96.04t^2}}\text{ m/s}^2$

g. (not f.)

$$\begin{aligned} a_{||} &= \frac{\vec{a} \cdot \vec{v}}{v} = \frac{a_x v_x + a_y v_y}{v} \\ &= \frac{(0)(4) + (-9.8)(10 - 9.8t)}{\sqrt{116 - 196t + 96.04t^2}} \\ &= \boxed{\frac{96.04t - 98}{\sqrt{116 - 196t + 96.04t^2}} \text{ m/s}^2} \end{aligned}$$

h.  $\frac{dv}{dt}$  and  $a_{||}$  should be the same, and they are.

$\frac{dv}{dt}$  and  $a$  should not necessarily be the same, as  $\frac{dv}{dt} = \frac{d|\vec{v}|}{dt}$

while  $a = |\vec{a}| = \left| \frac{d\vec{v}}{dt} \right|$  and  $\frac{d|\vec{v}|}{dt} \neq \left| \frac{d\vec{v}}{dt} \right|$ .