Solutions

Name:

Math 221, Section 3

Quiz number 5

Show all work. How you get your answer is just as important, if not more important, than the answer itself. If you think it, write it!

1. A 2 kg projectile is fired vertically into the air with an initial velocity of 98 m/sec; air resistance on the way up is negligible. When it reaches its highest point, a radio-controlled parachute pops out, which provides a coefficient of air resistance of 4.9 kg/sec on the way down. At what time will the parachute pop out? How high will it be at that time? Find the velocity at each time t after it begins to fall.

up:

$v_0 = 98$, no air resist, highest

$mv' = -mg \qquad 2v' = -2 \cdot 9.8 \qquad v' = -9.8$

$v(t) = -9.8t + C \qquad v_0 = 98 = C \qquad v(t) = 98 - 9.8t$

$v(t) = 0 = 98 - 9.8t \qquad 9.8t = 98$ $\boxed{t = 10 \text{ sec}}$

$x(t) = \int v(t)\,dt = \int 98 - 9.8t = 98t - 4.9t^2 + C$

$x(0) = 0 = C \qquad x(t) = 98t - 4.9t^2$

$x(10) = 98 \cdot 10 - 4.9(10)^2 = 980 - 490 =$ $\boxed{490 \text{ meters}}$

down:

0

490

$mv' = mg - kv^2 \qquad 2v' = 2 \cdot 9.8 - 4.9v^2$

$v' = 9.8 - \frac{4.9}{2}v^2 = \frac{4.9}{2}\left(\frac{4}{3} - v^2\right)$

$\frac{dv}{\frac{4}{3} - v^2} = \frac{4.9}{2}\,dt \qquad -\ln\left|\frac{4}{3} - v\right| = \frac{4.9}{2}t + C$

$\frac{4}{3} - v = Ae^{\frac{-4.9}{2}t} \qquad v = \frac{4}{3} - Ae^{\frac{-4.9}{2}t} \qquad v(0) = 0 = \frac{4}{3} - A$

$A = \frac{4}{3}$ $\boxed{v(t) = \frac{4}{3} - \frac{4}{3}e^{\frac{-4.9t}{2}}}$