Math 220 (section AD?) **Quiz 6** **Spring 2016**

Name Solutions

- You have 15 minutes
- No calculators
- Show sufficient work

1. (3 points) A bullet is shot upward from the surface of a planet so that its height in meters until coming to rest is given by the equation $s(t) = 210t - 3.5t^2$ where t is measured in seconds. Answer the following questions and be sure to use proper units in each answer.

(a) What is the acceleration due to gravity on this planet?

(pos.) $s(t) = 210t - 3.5t^2$

(vel.) $s'(t) = 210 - 7t$

(acc.) $s''(t) = -7$

-7 m/s^2

(b) What is the bullet's initial velocity?

$s'(0) = 210 \text{ m/s}$

(c) How long does it take for the bullet to reach its maximum height?

set $s'(t) = 0$

$210 - 7t = 0 \Rightarrow t = 30 \text{ s}$

values of $s'(t)$

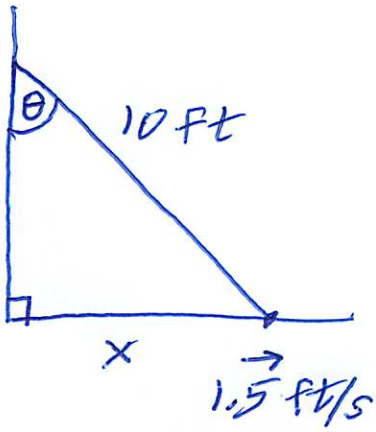
+++ 0 −−− t

0 30

s incr. s decr.

max at $t = 30$ s

2. (4 points) A ladder 10 feet long rests against a vertical wall. If the bottom of the ladder slides away from the wall at a rate of 1.5 feet per second, how quickly in radians per second is the angle between the ladder and the wall increasing when the bottom of the ladder is 8 feet from the wall?



Given: $\frac{dx}{dt} = 1.5 \text{ ft/s}$

want: $\left.\frac{d\theta}{dt}\right|_{x=8\text{ ft}}$

$\sin(\theta) = \frac{x}{10}$

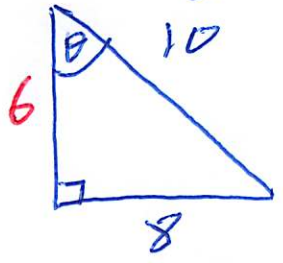
$\frac{d}{dt}(\sin(\theta)) = \frac{d}{dt}\left(\frac{x}{10}\right)$

$\cos(\theta) \cdot \frac{d\theta}{dt} = \frac{1}{10}\frac{dx}{dt}$

$\frac{6}{10} \cdot \frac{d\theta}{dt} = \frac{1}{10} \cdot (1.5)$

$\frac{d\theta}{dt} = \frac{1.5}{6} = \frac{15}{60} = \frac{1}{4}$

at moment $x = 8$ ft, Pyth. Thm. gives



$6^2 + 8^2 = 10^2$

The angle is increasing at $\frac{1}{4}$ rad/s

3. (3 points) Suppose that A represents the number of grams of a radioactive substance at time t seconds. Given that $\frac{dA}{dt} = -0.2A$, how long does it take 18 grams of this substance to be reduced to 6 grams?

$\frac{dA}{dt} = -0.2A \Rightarrow \boxed{A = Ce^{-0.2t}}$

At $t=0$, $A=18g$

Thus, $18 = Ce^{-0.2(0)} \Rightarrow C = 18$

$\boxed{A = 18e^{-0.2t}}$

set $A = 6g$

$6 = 18e^{-0.2t}$

$\frac{1}{3} = e^{-0.2t}$

$\ln(1/3) = \ln(e^{-0.2t})$

$\ln(1/3) = -0.2t$

$t = \frac{\ln(1/3)}{-0.2} = 5\ln(3)$ seconds