Name: ______________________ **Section**: __________

Clear your desk of everything excepts pens, pencils and erasers. **Show all your work.**
If you have a question raise your hand and I will come to you.

1. (2 points) **Fill-in-the-Blank. No partial credit available**

   A particle moves according to the law of motion $s = \dfrac{30}{t+2}$, $\quad t \geq 0$, where t is measured in seconds and s is in feet.

   (a) The average velocity over the interval $[0, 3]$ is: -3 ________ ft/sec

   Solution: Find the slope of the secant line between $t = 0$ and $t = 3$:

   $$\frac{s(3) - s(0)}{3 - 0} = \frac{6 - 15}{3} = -3$$

   (b) The velocity at $t = 1$ seconds is: $-10/3$ ________ ft/sec

   Solution: The instantaneous velocity is the derivative, which is

   $$s'(t) = \frac{-30}{(t+2)^2}$$

   At $t = 1$, this is

   $$s'(1) = \frac{-30)}{(1+2)^2} = \frac{-30}{9} = \frac{-10}{3}$$

   (c) For $t \geq 0$ the particle is moving in the negative direction during: $[0, \infty)$ ________

   Solution: We already saw that $s'(t) = \dfrac{-30}{(t+2)^2}$, which is always negative. So the particle is *always* moving in the negative direction.

Continue on to back side

2. (3 points) A ball is thrown upwards, and its height in feet at time t (in seconds) is given by

$$h(t) = 5 + 4t - 16t^2$$

(a) What is the velocity of the ball at time $t = \frac{1}{4}$?

Solution: The velocity is the derivative of h:

$$h'(t) = 4 - 32t$$

So the velocity at $t = \frac{1}{4}$ is

$$h'\left(\frac{1}{4}\right) = 4 - \frac{32}{4} = -4$$

(b) At what time does the ball attain its maximum height?

Solution: The maximum height happens when $h'(t) = 0$. So we solve $4 - 32t = 0$ to get $t = \frac{1}{8}$.

(c) What is the acceleration of the ball at time $t = \frac{1}{2}$?

Solution: The acceleration is the second derivative of h:

$$h''(t) = -32$$

Since h'' is constant, it is *always* -32 feet per second per second. In particular, it is -32 when $t = \frac{1}{2}$.

_____ / 5