

Name: \_\_\_\_\_

\_\_\_\_\_ / 25

There are 25 points possible on this quiz. *You should be able to complete it without using your notes or textbook – this is practice for your exams!* If you needed to look something up, you should to me about questions you might have. **Show all work for full credit** and use some words or sentences to help communicate your answers. **Do not use a calculator.**

1. [8 points] Use the **limit definition** of the derivative to find the derivative of  $g(x) = x + \frac{3}{x}$ . **No credit will be awarded a solution that does not use the definition below.** Show all your work clearly, step by step, using correct notation.

$$g'(x) := \lim_{h \rightarrow 0} \frac{g(x+h) - g(x)}{h}$$

$$g'(x) = \lim_{h \rightarrow 0} \frac{g(x+h) - g(x)}{h} = \lim_{h \rightarrow 0} \frac{1}{h} \left( (x+h) + \frac{3}{x+h} - x + \frac{3}{x} \right)$$

$$= \lim_{h \rightarrow 0} \frac{1}{h} \left( x+h-x + \frac{3x - 3(x+h)}{x(x+h)} \right) = \lim_{h \rightarrow 0} \frac{1}{h} \left( h + \frac{3x - 3x - 3h}{x(x+h)} \right)$$

$$= \lim_{h \rightarrow 0} \left( h + \frac{-3h}{x(x+h)} \right) = \lim_{h \rightarrow 0} \left( 1 - \frac{3}{x(x+h)} \right) = 1 - \frac{3}{x^2}$$

2. [6 points] A ball is thrown upwards into the air. Its height, in feet, after  $t$  seconds is given by the function  $s(t) = 40t - 16t^2$

- a. Find the average velocity of the ball over the time interval from  $t = 1$  to  $t = 2$ . Include units with your answer.

$$\text{average velocity} = \frac{s(2) - s(1)}{2 - 1} = \frac{[40(2) - 16(2)^2] - [40(1) - 16(1)^2]}{2 - 1}$$

$$= \frac{80 - 64 - 40 + 16}{1} = -8 \text{ ft/s}$$

$$\begin{array}{r} 2 \\ 16 \\ 4 \\ \hline 64 \\ 96 \\ - 104 \\ \hline -8 \end{array}$$

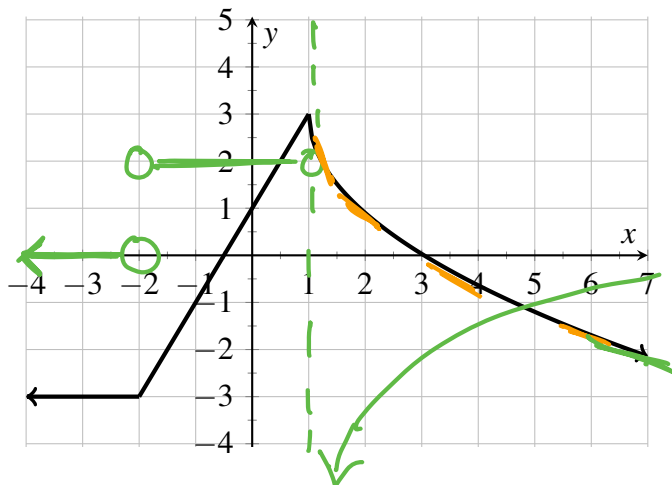
- b. Find the instantaneous velocity of the ball when  $t = 2$ . Include units with your answer.

$$v(t) = s'(t) = 40 - 32t$$

$$s'(2) = 40 - 32(2) = 40 - 64 = -24 \text{ ft/s}$$

$$\begin{array}{r} 32 \\ 2 \\ \hline 64 \\ - 40 \\ \hline -24 \end{array}$$

3. [5 points] The graph of  $f(x)$  is below. On the same set of axes, make a rough sketch of the graph of  $f'(x)$ . If they exist, indicate any asymptotes with dashed lines. Use open circles to show points where the derivative is not defined, if any. *Make sure you are writing darkly enough that I can see your graph clearly! (Double-check your scan before you submit.)*



4. [6 points] Use the derivative rules to find the derivative for each function below. **Do not simplify your answer.**

a.  $f(x) = (\sin x)(3x^2 - 5x + 6)$

$$\begin{aligned} f'(x) &= \sin(x) \frac{d}{dx}(3x^2 - 5x + 6) + (3x^2 - 5x + 6) \frac{d}{dx}(\sin(x)) \\ &= \sin(x)(6x - 5) + (3x^2 - 5x + 6)(\cos(x)) \end{aligned}$$

b.  $g(x) = 4x^{1/5} + \frac{9}{x^3} + \sqrt{3} + 10x = 4x^{1/5} + 9x^{-3} + \sqrt{3} + 10x$

$$g'(x) = 4\left(\frac{1}{5}x^{-4/5}\right) + 9(-3x^{-4}) + 0 + 10$$