

At the top of your bluebook, in BOLD letters, write EXAM 1 MAKEUP. On the front of your bluebook, please write: a grading key, your name, student ID, and section and instructor. This exam is worth 100 points and has 5 questions. Show all work! Answers with no justification will receive no points. Please begin each problem on a new page. No notes, calculators, or electronic devices are permitted.

1. (18 points) Find the requested limit, if it exists. If it does not exist, state this. JUSTIFY each of your answers.

(a)  $\lim_{x \rightarrow 5^-} \frac{(3x)^{1/2}}{(10 - 2x)^{1/2}}$

(b)  $\lim_{v \rightarrow 4} \frac{v|4 - v|}{4 - v}$

(c)  $\lim_{x \rightarrow 0^+} \sqrt{x} \sin(1/x)$

2. (26 points) Let  $y = x - \frac{1}{2x}$ .

(a) Calculate  $dy/dx$  using the definition of the derivative.

(b) Find the equation of the tangent and normal lines to the curve at  $x = 3$ .

(c) Does the curve  $y = x - \frac{1}{2x}$  have any horizontal tangents? If so, find this tangent. If not, why not?

(d) Find  $\lim_{x \rightarrow 0^-} \left(x - \frac{1}{2x}\right)$  and  $\lim_{x \rightarrow 0^+} \left(x - \frac{1}{2x}\right)$

3. (16 points) Suppose  $y = f(x)$  and  $y = g(x)$  are functions that are differentiable at  $x = 1$  and that

$$f(1) = 1, \quad f'(1) = -5, \quad g(1) = 2, \quad g'(1) = 3$$

Find the values of the following derivatives at  $x = 1$ .

(a)  $\frac{d}{dx}(8fg)$

(b)  $\frac{d}{dx} \left(\frac{f}{g}\right)$

(c)  $\frac{d}{dx} \left(\frac{g}{2f}\right)$

(d)  $\frac{d}{dx}(-2f + 10g)$

4. (20 points) On Planet X, in the absence of an atmosphere, a rock thrown vertically upward, with an initial velocity of 24 m/s, will reach a height of  $s(t) = 24t - 3t^2$  meters in  $t$  seconds. (Include the correct units in your answer to each of the following questions.)

(a) Find the rock's velocity and acceleration at time  $t$ .

(b) How long would it take the rock to reach its highest point?

(c) How high would the rock go?

(d) How long is the rock in the air?

5. (20 points) The curve  $y = ax^2 + bx + c$  passes through the point  $(1, 2)$  and is tangent to the line  $y = x$  at the origin. Find the values of  $a$ ,  $b$ , and  $c$ .