

**Math 224 Midterm Examination Fall 2015, 11:20 am version**

Name (print)\_\_\_\_\_

Name (sign)\_\_\_\_\_

Bing ID number \_\_\_\_\_

(Your instructor may check your ID during or after the test)

No books, no notes, no electronic devices (calculators, cell phones, smart watches, etc.) Write all your work on the test – nothing else will be graded. **You must show all your work.** Your work must be legible, and the final answers must be reasonably simplified.

On some problems you are asked to use a specific method to solve the problem (for instance, “Use the definition of the derivative to find...”). On all other problems, you may use any method we have covered. **You may not use methods that we have not covered. For instance, use of L’Hospital’s Rule will receive no credit.**

**Wandering Eyes Policy**

You must keep your eyes on your own work at all times. If you are found looking around, you will be warned once, and only once. A second infraction may result in automatic zero on this test, and possibly a referral to the Harpur College Academic Honesty Committee.

**Duration of the Test**

This is a timed test designed for one class period. You will start the test when your instructor tells the entire section to start, and you will finish the test when your instructor tells you to stop, when the class period is over.

1. (15 points) Find the limit. If the limit does not exist, because it is infinite, indicate positive or negative infinity.

a)

$$\lim_{x \rightarrow 0} \frac{\sin(5x)}{x^2 - 8x}$$

b)

$$\lim_{x \rightarrow 2^-} \frac{x^2 + x - 6}{|x - 2|}$$

2. (15 points) Find the limit. If the limit does not exist because it is infinite, indicate positive or negative infinity.

a)

$$\lim_{x \rightarrow -3^-} \frac{3 - \sqrt{6 - x}}{x^2 + 3x}$$

b)

$$\lim_{x \rightarrow -3^-} \frac{3x + 1}{x^2 + 3x}$$

3. (10 points) An object moves along a line so that its position at time  $t$  (seconds) is given by  $s(t) = 5t^2 - 3t$  (meters).

(a) Find the velocity and acceleration of the object at time  $t$ .

(b) Find the position of the object when the velocity is 27 m/s.

4. (10 points) Find the equation of the tangent line to the graph of  $h$  at the point  $(1, h(1))$ .

$$h(x) = x^2 \cdot \sqrt{3x + 1}$$

You may leave your answer in point-slope form.

5. (20 points) Function  $f(x)$  is defined below.

$$f(x) = \begin{cases} x^2 + 1, & \text{if } x \leq 0 \\ \frac{\sin x}{x}, & \text{if } 0 < x < 2 \\ 0, & \text{if } 2 \leq x \end{cases}$$

a) Find, with explanation, **all** real numbers  $a$ , such that  $f(x)$  is not continuous at  $a$ .

b) For each such  $a$ , find  $\lim_{x \rightarrow a} f(x)$  or explain why it does not exist.

6. (15 points) Find the derivatives (by any method). You do not need to simplify your answer.

a)  $f(x) = x^5 \cdot \sqrt{x^4 + 3 \cos(x)}$ .  $f'(x) =$

b)  $f(x) = \frac{3x + 5}{\sin^2(x)}$ .  $f'(x) =$

c)  $f(x) = \tan\left(\frac{2x - 1}{x^3 + x}\right)$ .  $f'(x) =$

7. (15 points) Find the derivative of the function

$$f(x) = \frac{1}{3x + 2}$$

using the limit definition of the derivative.