

Full Name: _____ Instructor & Section: _____

Instructions: Answer each question completely. Show all work. No credit is allowed for mere answers with no work shown. Show the steps of calculations. State the reasons that justify conclusions. Give exact values in results.

1. (14 points) Use the definition

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

to find $f'(x)$ if $f(x) = \frac{1}{3x+2}$.

2. (13 points) Find the equation of the tangent line to $y = \sqrt{25 - x^2}$ at the point $(3, 4)$.

3. (13 points) Pouring sand forms a conical pile on the ground whose height is always $\frac{1}{3}$ the radius of the base. If sand is being added to the pile at the rate of 6 cubic meters per second, how fast is the height of the pile increasing when the pile is 2 meters high? [Recall that a cone with base radius r and height h has volume $V = \frac{1}{3}\pi r^2 h$.]

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4. (13 points) Identify the critical points and find the maximum value and the minimum value of the function $f(x) = x^2 + 4x + 4$ on the interval $[-4, 0]$.

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5. (14 points) Determine where the function $f(x) = x^3 + 3x^2 - 12$ is increasing, decreasing, concave up, and concave down. Use this information to sketch the graph of f ; find and show all inflection points.