Exam 3b **Calc 1** **10/31/25**

Each problem is worth 10 points. For full credit provide good justification for your answers.

1. State the formula for Newton's Method.

2. Use interval notation to express where $f(x) = x^3 - 6x + 5$ is increasing.

3. Use interval notation to express where $f(x) = x^3 - 3x^2 + 5$ is concave up.

4. Let $f(x) = 2x^3 - 15x^2 + 24x + 1$. Find the absolute minimum and absolute maximum values of f on the interval $[0, 3]$.

5. Use Newton's Method with the function $f(x) = x^3 - 5$ and initial value $x_0 = 1.6$ to calculate x_1.

6. Evaluate $\lim_{x \to 0^+} \dfrac{\ln x}{1 + (\ln x)^2}$.

7. Bunny is a calculus student at Enormous State University, and she's having some trouble. Bunny says "OMG! Why do they make it so unfair? I really like the Hospital Rule thingy, but then the test question was totally messed up! It was like cos over $x - 1$, and I did the derivatives just like you're supposed to, but they said I got the wrong answer and got no partial credit at all because I was invalid. How can they call me invalid?"

   Help Bunny by explaining as clearly as you can why her approach might not have been a good choice for a problem like this.

8. [WW]A 12 foot ladder is leaning against a wall. If the top slips down the wall at a rate of 3 ft/s, how fast will the foot be moving away from the wall when the top is 11 feet above the ground?

9. [WW]A box is to be made out of a 12 in by 18 in piece of cardboard. Squares of side length x in will be cut out of each corner, and then the ends and sides will be folded up to form a box with an open top. Find the maximum volume possible for the box.

10. A smokestack deposits soot on the ground with a concentration inversely proportional to the square of the distance from the stack. With two smokestacks d miles apart, the concentration of the combined deposits on the line joining them, at a distance x from one stack, is given by

$$S = \frac{c}{x^2} + \frac{k}{(d-x)^2}$$

where c and k are positive constants which depend on the quantity of smoke each stack is emitting. If $k = 4c$, find the point on the line joining the stacks where the concentration of the deposit is a minimum.

Extra Credit (5 points possible): Where does the function $f(x) = \dfrac{x^2}{x^2 + (1 - nx)^2}$ have its maximum value?