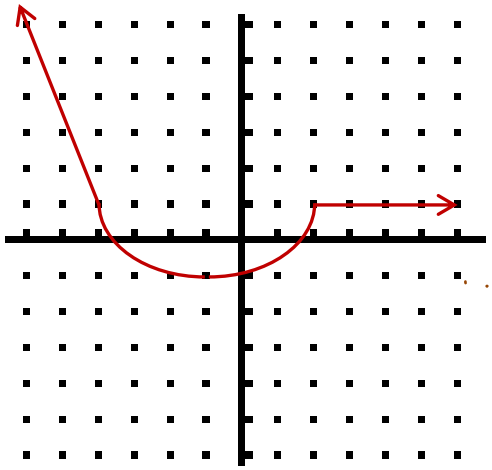
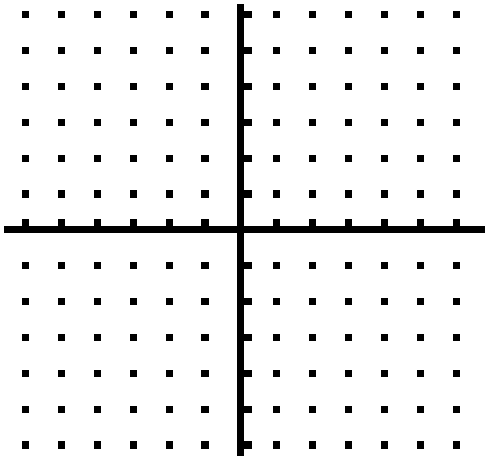
1. (6 points) The graph of ***y = f(x)*** (with domain *all real numbers*) is given below and to the left. Sketch a graph of its **derivative function** below and to the right. Note that each axis is scaled by ones.





2. (4 points) The Use the limit definition of the derivative (no other method accepted) to determine the derivative function of $g(x) = -4x - 1 + 2(x+5)^2 - 3x(x-1)$.

3. (4 points) Determine $\frac{dy}{dx}$ by implicit differentiation, simplifying as much as possible. Your final answer must be written as a "simple fraction"—that is, without fractions within a fraction.

$x^2 - 4\ln(y) + xy^2 = 10x - 3$

4. (4 points) Determine $\frac{d^2y}{dx^2}$ by implicit differentiation, simplifying as much as possible. Your final answer must be written as a "simple fraction" —that is, without fractions within a fraction.

$y^5 - x^5 = y$

5. (4 points) Use logarithmic differentiation (no other method accepted) to determine the derivative of $f(x) = \left(\frac{e^x}{x^6 - x}\right)^4$.

6. (2 points) Let $f(x) = \frac{1}{4}x^3 + x - 1$. Evaluate $\left(f^{-1}\right)'(3)$.

7. (2 points each; **No Partial Credit** per function) Determine the derivative function of each of the following functions. Simplify as much as possible, *and factor all polynomials*, if possible.

(i) $f(x)=\left(\dfrac{x-4}{x^2-5}\right)^6$

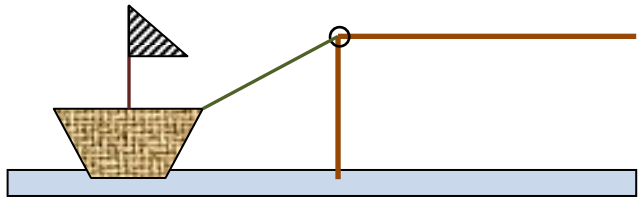
(ii) $g(x)=\sqrt[9]{e^{-3x}+e^{3x}}$

(iii) $y=\sin\left(\ln\left(\arcsin(3x^5)\right)\right)$

(iv) $p(x)=\left(x^2-1\right)^{12}(8x+1)^9$

(v) $h(x)=x^4\arctan(7x)$

8. (6 points) A boat is pulled toward a dock by a taut **chain** from the bow of the boat through a ring on the dock 14 feet above (higher in elevation than) the bow. The chain is hauled in at the rate of 3 feet per second. How fast is the boat approaching the dock at the moment when 50 feet of chain are out?



9. (4 points) Determine the equation of the line that is ***normal*** to the graph of $f(x)=\arctan\left(e^x\right)$ at the *y*-intercept of *f*. Note that a normal line is *perpendicular* to the tangent line. (As usual, per the *Rules for Graded Assignments and Exams* document, exact values are expected.)

10. (2 points each; **No Partial Credit** per limit) <u>As usual, read the directions carefully</u>: If L'Hôpital's Rule can be used, explain why and use it to calculate the exact value of the limit. If L'Hôpital's Rule cannot be used, explain why and evaluate the limit by some other method. No credit for using another method if L'Hôpital's Rule can be used.

(i) $\lim\limits_{x\to 1}\dfrac{\ln\left(x^{\sqrt{2}}\right)}{\sin(\pi x)}$

(ii) $\lim\limits_{x\to -2}\dfrac{9x^2+17x-2}{8x^2+19x+6}$

(iii) $\lim\limits_{x\to \infty}\dfrac{9x^2+17x-2}{8x^2+19x+6}$

Graded Textbook Problems

Each of the following problems is worth a maximum of two points: two points for absolutely perfect work (**including all steps shown**); one point if there is at least one error and/or a significant step is missing; zero points for major error(s) and/or significant step(s) missing. These problems are from the official course textbook; substitutes and alternatives will not be considered.

3.1 44

3.2 64

3.3 88

3.4 34

3.4 68

3.5 48

3.5 70

3.6 31

3.7 28

8.7 18