Math 141 (Sections 4 – 6) **Test 1** **September 19, 2003**

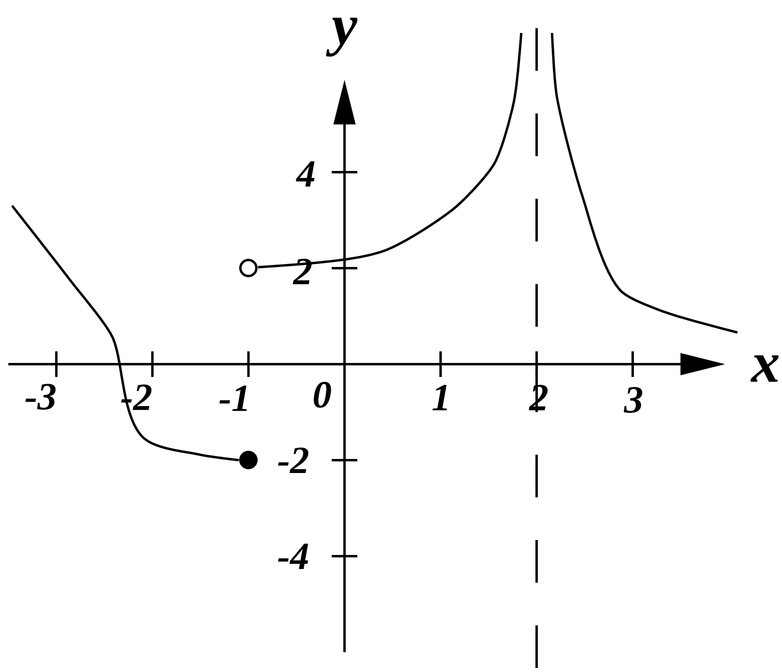
Name ______________________________

1. (16 points) An engineer tests the strength of a material as its temperature changes over a 40-MINUTE PERIOD from below freezing to slightly above the temperature of a typical oven. During her test, the material's temperature, in degrees Fahrenheit ($°F$), is approximated by the function $f(t) = 0.006t^3 + 0.14t^2 + 25.3$ where t represents the number of minutes since she began testing.

   (a) What was the average rate of change in temperature of the material on the interval $10 \leq t \leq 30$? Your answer should be rounded off to one place after the decimal point.

   (b) At what rate is the temperature of the material increasing at $t = 10$? Your answer should be rounded off to one place after the decimal point.

2. (30 points) The graph of $f(x)$ has a vertical asymptote at $x = 2$ as shown below. Evaluate the following quantities.



(a) $\lim_{x\to 2^-} f(x)$

(b) $\lim_{x\to -1^+} f(x)$

(c) $\lim_{x\to -1^-} f(x)$

(d) $f(-1)$

(e) $f(1)$

(f) $f'(1)$

3. (14 points) Let $f(x) = 5x^2 + 3$. Use the definition of a derivative (i.e. limits) to show that $f'(x) = 10x$. Show each step in your calculation and be sure to use proper terminology.

4. (15 points) Complete each boxed equation with the appropriate formula for the derivative. You cannot use a calculator here, but you may use the derivative rules from section 3.3 in order to avoid using limits.

(a) If $y = 4x^6 - 3x + 2,$ then

$D_x y =$

(b) If $y = \frac{3}{x^4},$ then

$\frac{dy}{dx} =$

(c) If $f(x) = (x^2 - 4)(x^3 + 1),$ then

$f'(x) =$

5. (25 points) Evaluate the following limits without the use of a calculator. Give a clear explanation as to how you arrived at your answer, showing each step in your calculation using proper terminology.

(a) $\lim_{x \to 3} \dfrac{x^2 - 10x + 21}{x^2 - 9}$

(b) $\lim_{x \to \infty} \dfrac{16x^2}{(4 - 2x)(3 + 4x)}$

(c) $\lim_{x \to \infty} \frac{\sin(2x)}{x}$

(d) $\lim_{x \to \pi/4} \frac{\sin(2x)}{x}$

(e) $\lim_{x \to 0} \frac{\sin(2x)}{x}$