

1. (1 point) True or false: I hate limits which contain square roots.

2. (a) (6 points) State carefully the definition of the derivative of a function.

(b) (14 points) If $f(x) = 5x - x^2$, compute the derivative $f'(4)$ *directly from the definition*. (You should check your answer using the differentiation formula, but no credit will be given for just using the formula.)

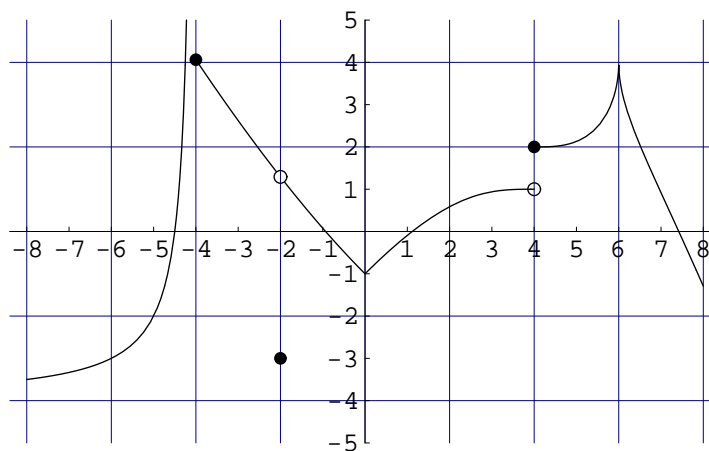
3. (9 points) Let c be a constant. Find the equation of the tangent line to the graph of $p(x) = 16/x + c$ at $x = 2$. You need not calculate the derivative directly from the definition.

4. (9 points/part) Differentiate the following functions. (You need not compute the derivatives directly from the definition.)

(a) $w(t) = \frac{\cos(t)}{t} - \frac{8}{\sqrt{t}} + e^2.$

(b) $s(x) = e^{7x-3x^4}.$

5. For the function $y = r(x)$ graphed below, answer the following questions:



(a) (4 points.) Find $\lim_{x \rightarrow 4^-} r(x).$

(b) (4 points.) Which of the following best describes $r'(6)$?

- (1) $r'(6)$ does not exist.
- (2) $r'(6)$ is close to 0.
- (3) $r'(6)$ is positive and not close to 0.
- (4) $r'(6)$ is negative and not close to 0.
- (5) None of the above.

6. (9 points/part) Find the exact values of the following limits (possibly including ∞ or $-\infty$), or explain why they do not exist or there is not enough information to evaluate them. Give reasons in all cases.

(a) $\lim_{x \rightarrow -\infty} \frac{7x^3 + 817x + 42}{19x^3 - 9x^2 + 42}$. (Be sure to show your work!)

(b) $\lim_{x \rightarrow 3^-} \frac{x^2 - 4}{x - 3}$.

(c) $\lim_{x \rightarrow 2} \frac{\sqrt{2x} - 2}{3(x - 2)}$.

7. (4 points/part) A mosquito takes off from a log and buzzes above a pool of stagnant water. Its height $h(t)$ above the surface of the water, measured in millimeters, at time t , measured in seconds after it takes off, is modelled by $h(t) = 200 + 10t^2 - t^3$, until it hits the water (sometime between 11 and 12 seconds after it takes off).

(a) Find a time after the mosquito takes off but before it hits the water when it is neither rising nor falling.

(b) What is the average upwards velocity of the mosquito in the period between 1 and 3 seconds after it takes off?

8. (9 points) If $x^2y = (3x + y)^5 + \cos(11)$, find $\frac{dy}{dx}$ by implicit differentiation. (You must solve for $\frac{dy}{dx}$.)