

Rules of differentiation (ROD)

- **The Power Rule:** For any real number n , $\frac{d}{dx}x^n = nx^{n-1}$.
- **The Natural Exponential Function:** $\frac{d}{dx}e^x = e^x$.
- **The Sine Function:** $\frac{d}{dx}\sin(x) = \cos(x)$.
- **The Sum Rule:** If $f(x)$ and $g(x)$ are differentiable functions and c is a constant, then:
 - $\frac{d}{dx}(f(x) + g(x)) = f'(x) + g'(x)$,
 - $\frac{d}{dx}(f(x) - g(x)) = f'(x) - g'(x)$,
 - $\frac{d}{dx}(c \cdot f(x)) = c \cdot f'(x)$.

Recitation Questions

Problem 1 For each of the following functions, use the "short cut derivative rules" to compute their derivative.

(a) $f(x) = \sqrt{x}$

(b) $s(u) = \frac{5}{u^2}$

(c) $p(t) = t^5 + 4t^3 + \pi$

Problem 2 Given the polynomial function q defined by $q(v) = 2v^3 - 5v^2 + 7v - 9$ find:

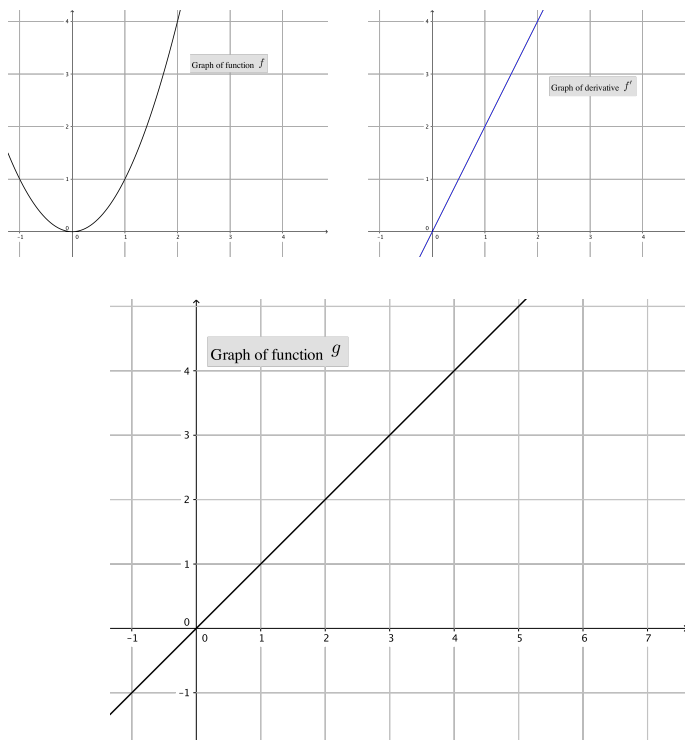
(a) The slope of the tangent line to the graph of q at the point where $v = 3$ using the limit definition of a derivative.

(b) The slope of the tangent line to the graph of q at the point where $v = 3$ using the “short-cut derivative rules” to find a formula for q' and evaluating $q'(3)$.

(c) The equation of the tangent line to the graph of q at $v = 3$.

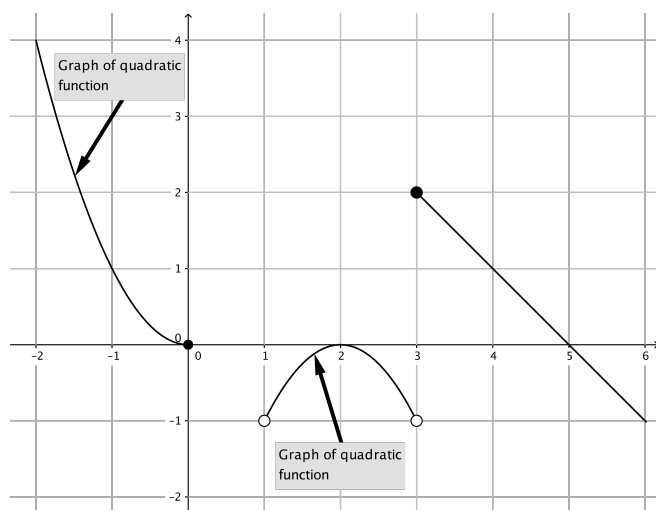
Problem 3 Find s' of the function s defined by $s(t) = 3t^2 + 5e^t - \frac{1}{t}$.

Problem 4 Use the given graphs of f and g and their accompanying derivatives to answer the following questions.



- (a) Write an equation for the tangent line to f at $x = 2$.
- (b) Draw the graph of g'
- (c) Compute the value of the $(5f + 3g)'(2)$.
- (d) Find the equation of the tangent line to the graph of $(5f + 3g)$ at the point where $x = 2$.
- (e) Use the given graph of f' and g' to find the following:
 - (i) A formula for f'
 - (ii) A formula for g'
- (f) Find the expression for $(5f + 3g)'(x)$.

Problem 5 Sketch the graph of the derivative of the given function:



Problem 6 A company is producing cell phones. The cost of producing x cell phones is given by $C(x)$, defined by

$$C(x) = -0.01x^2 + 40x + 400, \text{ for } 0 \leq x < 1000.$$

AVERAGE cost of producing the first x cell phones is given by

$$C_{AVG} = \frac{C(x)}{x}$$

If the company has produced x cell phones, the cost of producing one more item is given by

$$\text{COST of producing one more item} = C(x+1) - C(x)$$

MARGINAL COST is approximation of the cost of producing one more cell phone

$$\text{MARGINAL COST} = C'(x)$$

- (a) Compute the average cost of the first 300 cellphones that the company produces.

- (b) Compute the cost of producing one more cell phone, if the company has produced 300 cell phones.
- (c) Compute the marginal cost, if 300 cell phones have been produced.

- (d) Why is the marginal cost a good approximation of the cost of producing one more item? Explain!