

#1. (20 points) Differentiate the following functions:

- $(5x^4 + 3x^2) \ln(x)$

- $\sqrt{x} + 3^x$

- $\sqrt{\ln(x)}$

- $e^{(7x^2 - 4x)^6}$

#2. (10 points) Find the equation of the line tangent to $y = 2x^5 - 4x^3 + 3x^2$ at $(1, 1)$.

#3. (15 points) Find all local maximums, local minimums, and inflection points of $y = x^4 - 8x^3 + 35$. Make sure to clearly label your answers.

#4. (10 points) The cost function and revenue function (in millions of dollars) for a company are found to be

$$C(q) = e^{-q} \quad R(q) = qe^{-q}$$

Find the quantity at which the maximum profit occurs. What is the profit at this quantity?

#5. (12 points) Use the following choices to fill in the blanks below.

$f'(c) < 0$	$f'(c) = 0$	$f'(c) > 0$
$f''(c) < 0$	inflection point	$f''(c) = 0$
local minimum		local maximum

- If $f(x)$ has a critical point at $x = c$, then _____.
- If $x = c$ is a critical point and _____, then $x = c$ is neither a maximum nor a minimum.
- If $x = c$ is a critical point and _____, then $f(x)$ is concave up around $x = c$ and thus $(c, f(c))$ is a _____.
- If $x = c$ is a critical point and _____, then $f(x)$ is concave down around $x = c$ and thus $(c, f(c))$ is a _____.

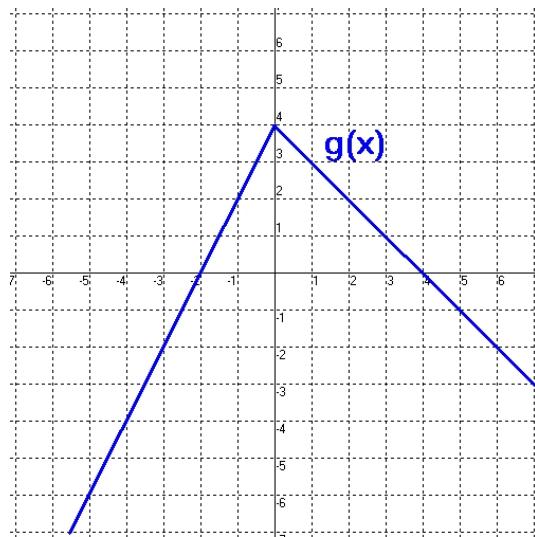
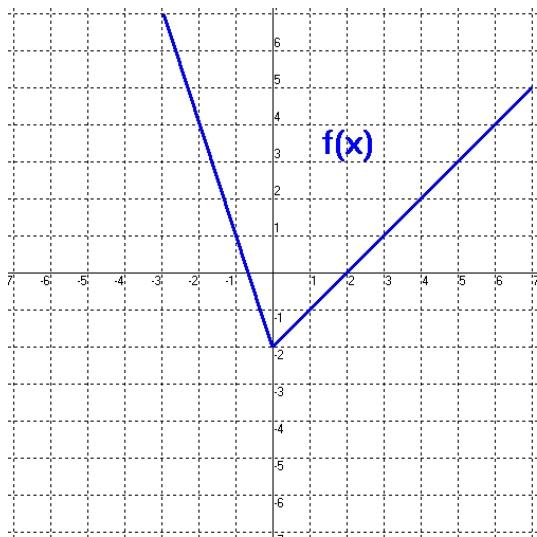
#6. (13 points) Insider analysts predict that the price of stock in the company SeerAll will follow the function

$$P(t) = -3t^4 + 28t^3 - 84t^2 + 96t + 3$$

(where t is the number of days past today) for the next 5 days. You want to buy the stock when it's at its lowest price and sell when it's at its highest price. When should you buy and when should you sell?
(Hint: $-12t^3 + 84t^2 - 168t + 96 = -12(t - 4)(t - 2)(t - 1)$.)

#7. (10 points) The cost of producing q items is given by $C(q) = 30q^4 - 2q^3$. At what production level is average cost minimized and what is the average cost at that production level?

#8. (10 points) Given the following graphs:



Compute

- $\frac{d}{dx}f(g(x))|_{x=5}$

- $\frac{d}{dx}g(f(x))|_{x=1}$