

**Queens College
Department of Mathematics**

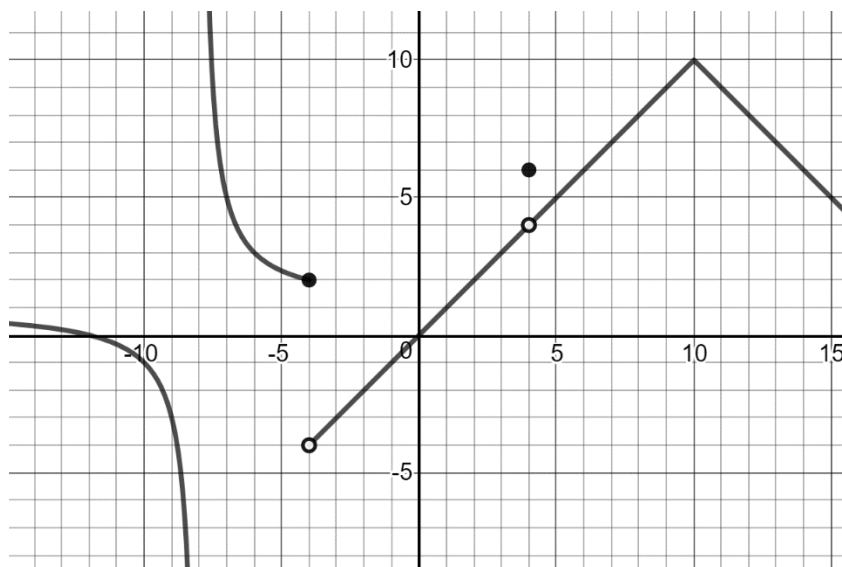
**Final Examination
2.5 hours**

Mathematics 131

Spring 2018

INSTRUCTIONS: SHOW ALL WORK IN YOUR BLUE BOOK FOR ALL QUESTIONS

1. The graph of a function f is shown below:



a) Evaluate each of the following ($\pm\infty$, and DNE are also acceptable answers.)

(i) $\lim_{x \rightarrow -8^-} f(x)$ (ii) $\lim_{x \rightarrow -4} f(x)$ (iii) $f(4)$ (iv) $f'(10)$

b) Is function f continuous at $x = 4$? Explain.

2. If $f(x) = \frac{x^2 - 4}{x^2 - x - 6}$, evaluate each limit:

a) $\lim_{x \rightarrow 2} f(x)$

b) $\lim_{x \rightarrow -2} f(x)$

c) $\lim_{x \rightarrow \infty} f(x)$

3. Find the derivative for each of the following functions (You need not simplify.):

a) $f(x) = 3x^2 + 3e^2 + x^e + e^x$

b) $f(x) = e^{-x} \ln(x^2)$

c) $f(x) = \frac{\sqrt{x+4}}{(2x+3)^3}$ (Use Quotient Rule)

d) $f(x) = \frac{\sqrt{x+4}}{(2x+3)^3}$ (Use Logarithmic Differentiation)

4. Consumer demand indicates that consumers buy x units of a product when the price is p dollars per unit, where $x^2 + 4px + p^2 = 334$. Consumers buy 13 units when the price is \$3 per unit. If the price is increasing at \$1 per year, at what rate is quantity demanded x (the quantity consumers buy) changing per year?
5. A manufacturer determines that the profit derived from selling x units of an item is given by $P(x) = -x^2 + 1000x - 90000$
- Use marginal analysis to estimate the profit from the sale of the 201st unit.
 - Find the actual profit from the sale of the 201st unit.
 - Use calculus to find the number of units that will maximize the profit.
6. Suppose \$1000 is invested at the interest rate of 3% per year.
- Compute the balance after 4 years if interest is compounded monthly.
 - How long will it take the investment to double if interest is compounded continuously?
7. Let $f(x) = \frac{x}{x^2 - 25}$.
- Find any and all intercepts of the graph of f .
 - Find any and all horizontal asymptotes and vertical asymptotes of the graph of f .
 - Use $f'(x)$ to find the critical numbers of f and the intervals on which f is increasing and those on which f is decreasing.
 - Find the coordinates of all relative maximum and relative minimum points.
 - Use $f''(x)$ to find the intervals of upward concavity, the intervals of downward concavity, and any and all inflection points.
 - Use the information found in parts a) – e) to sketch the graph of $f(x)$.