

**QUEENS COLLEGE
DEPARTMENT OF MATHEMATICS**

Final Examination

$2\frac{1}{2}$ Hours

Mathematics 131

Fall 2019

Instructions: Answer all the questions. Show all work.

1. Find the indicated limits. If a limit is $+\infty$, $-\infty$ or does not exist, so state.
 - a) $\lim_{x \rightarrow -2} \frac{x^2 + 4x + 4}{x^2 + x - 2}$
 - b) $\lim_{x \rightarrow 16} \frac{x - 16}{\sqrt{x} - 4}$
 - c) $\lim_{x \rightarrow -\infty} \frac{x^5 + 4x^3 + 2x + 3}{-3x^5 + 8x^2 - 4x + 1}$
 - d) $\lim_{x \rightarrow 3^+} \frac{x^2 + 9}{x - 3}$
2. Use the Intermediate Value Theorem to show $f(x) = x^2 - x - 1 - \frac{1}{x+1}$ has a zero on $[1,2]$.
3. Use the definition of the derivative to find $f'(x)$ if $f(x) = -x^2 + 2x + 5$.
4. Write an equation of the line tangent to the graph of $y = \frac{x^2 - 1}{x^2 + x + 1}$ at the point $(1,0)$.
5. Find the derivative of each of the following:
 - a) $f(x) = -\frac{1}{2}x^3 + \frac{7}{x^2} - \frac{5}{\sqrt[3]{x^2}} + 2e$
 - b) $f(x) = e^{5x} \ln 2x$
 - c) $f(x) = \frac{e^x \sqrt{5x + 3}}{(x - 2)^4}$ (use logarithmic differentiation)
6. The cost function for producing x cellphones is $C(x) = 0.008x^3 - 0.01x^2 + 12x + 1000$.
 - a) Use marginal analysis to estimate the cost of manufacturing the 201st cellphone.
 - b) What is the actual cost incurred for the 201st cellphone?
7. The altitude, in feet, of a rocket t seconds into flight is $s(t) = -t^3 + 96t^2 + 5$. Find the velocity and acceleration of the rocket after 10 seconds.
8. Find $\frac{dy}{dx}$ if $xy^2 + x^3 = x^2y - 6$.
9. Let $f(x) = x^3 - 3x^2 + 5$. Use calculus to find the intervals of increase/decrease, concavity, relative extrema, and inflection points of f . Then sketch the graph of $f(x)$ and label relative extrema and inflection points.
10. Find the maximum volume of a box with an open top to be constructed from a square piece of cardboard 8 in. wide by cutting out a square from each corner and bending up the sides.
11. What is the accumulated amount if \$ 5,000 is invested at 7% compounded daily for 10 years?
12. What is the doubling time of an investment account compounded continuously at 7%?