

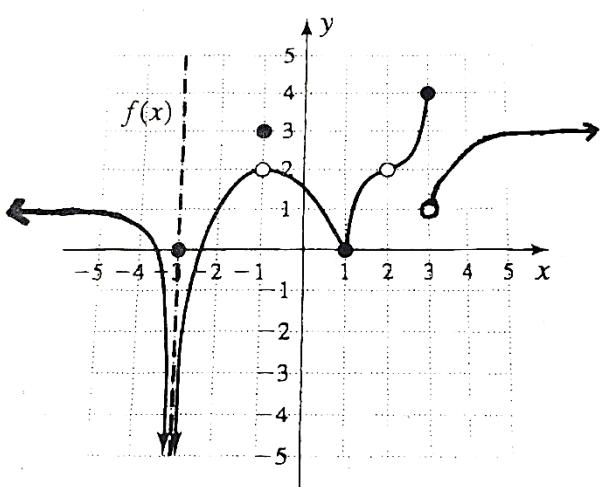
**QUEENS COLLEGE**  
**DEPARTMENT OF MATHEMATICS**  
**FINAL EXAMINATION**  
 **$2\frac{1}{2}$  HOURS**

**Mathematics 141**

**Fall 2025**

**Instructions: Answer all questions. Show all work.**

1. Refer to the graph of  $f(x)$  shown here. Evaluate each of the following. If the result is  $+\infty$ ,  $-\infty$ , or does not exist, so state.



a) $\lim_{x \rightarrow 3^-} f(x)$	g) $\lim_{x \rightarrow -\infty} f(x)$
b) $\lim_{x \rightarrow 3} f(x)$	h) $\lim_{x \rightarrow +\infty} f(x)$
c) $\lim_{x \rightarrow -1} f(x)$	i) $f(3)$
d) $\lim_{x \rightarrow 1} f(x)$	j) $f(2)$
e) $\lim_{x \rightarrow -3} f(x)$	k) $f(-3)$
f) $\lim_{x \rightarrow 2} f(x)$	l) $f(-1)$

2. Use analytical methods (not your calculator) to find each of the following limits. If the limit is  $+\infty$ ,  $-\infty$  or does not exist, explain why. You must show all your work for these examples, showing how you arrived at your answer.

a)  $\lim_{x \rightarrow -1^+} \frac{x^2 - x - 2}{x^2 + 2x + 1}$

b)  $\lim_{x \rightarrow 0} \frac{\tan 7x}{2 \sin 3x}$

c)  $\lim_{x \rightarrow 5} \frac{\frac{2x}{x+4} - \frac{10}{9}}{x-5}$

d)  $\lim_{x \rightarrow -\infty} \frac{4x^6 + 9x^7 - 10}{5x^6 - 3x^2 - 2x^7}$

3. Using your calculator construct a table to find  $\lim_{x \rightarrow 0^+} \frac{x + 7^x - 1}{x + \sin x}$  correct to three decimal places. Include at least five appropriately-chosen  $x$ -values to justify your answer and copy the resulting table into your booklet.

4. a) Using only the definition of derivative, find  $f'(x)$  if  $f(x) = \sqrt{7x - 5}$ .  
 b) Find an equation of the tangent line to the curve  $f(x)$  at the point where  $x = 3$ .

5. Show that the equation  $\sin x - 4x = -15$  has at least one real root. Then use your calculator to estimate this root, accurate to three decimal places.

6. In each of the following, find  $\frac{dy}{dx}$ . (Algebraic simplification is not needed.)

a)  $y = \sqrt[3]{x^5} - \frac{7}{\sqrt[3]{x^5}} - \sin x + 3\pi^5 - 11x + 7$

b)  $y = (\tan(4x^2)) \left(\frac{3}{x} - 15x\right)^{10}$

c)  $y = \frac{\sec^2 x}{10\sqrt[5]{x} - 7\pi}$

d)  $y = \cot(\sin(6x^4))$

e)  $y \cos x = 2x^3y^5$

7. Man A is 30 miles due north of man B. Man B starts walking due east at the rate of 3 miles per hour. At the same time, Man A starts bicycling due south at the rate of 11 miles per hour. How fast will the distance between Man A and Man B be changing 2 hours later? Interpret your answer.

8. A box with an open top is to be constructed from a 12 ft. x 12 ft. square piece of cardboard by cutting out a square from each of the four corners and bending up the sides. Find the largest volume that such a box can have and the dimensions of the box of largest volume. (Use calculus and show all necessary work.)

9. Let  $f(x) = 4x^3 - x^4 - 15$ . Using calculus and showing all necessary work,

- a) find the intervals of increase and intervals of decrease of  $f$ .
- b) find the local maximum and minimum values of  $f$ , if any.
- c) find the intervals where  $f$  is concave up and those where  $f$  is concave down.
- d) find any and all inflection points of  $f$ .
- e) Use the information found in parts a) through d) to sketch the graph of  $y = f(x)$ .

**This material is the property of Queens College and may not be reproduced in whole or in part, for sale or free distribution, without the written consent of Queens College, Flushing, NY 11367.**