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# 4 Applications of the Derivative

## 4.1 Maxima and Minima

23. Find the absolute maximum and minimum of the functions on the given interval and identify where they occur.

(a) $f(x) = -1/x^2$ on $[1/2, 2]$ (b) $f(t) = |t - 5|$ on $[4, 7]$ (c) $f(x) = e^{-x^2}$ on $[-2, 1]$

## 4.2 What Derivatives Tell Us

1. (a) Suppose $c$ is a critical point of $f$, what do know about $f'(c)$?
   (b) How does knowing the critical points of a function help us understand its graph?

2. Determine whether the following statements are true or false. Provide an explanation or a counterexample.

   (a) The function $f(x) = \sqrt{x}$ has an absolute maximum.
   (b) The function $f(x) = \sqrt{x}$ has an absolute maximum on the interval [0,1].

3. Determine whether the following statements are true or false. Provide an explanation or a counterexample.

   (a) If a function has an absolute maximum, the function must be continuous on a closed interval.
   (b) If a function has the property $f'(2) = 0$, then $f$ has a local minimum or local maximum at $x = 2$.
   (c) Absolute extreme values on an interval always occur at a critical point or an endpoint of the interval.
   (d) If a function has the property that $f'(3)$ does not exist, then $x = 3$ is a critical point of $f$.
   (e) If $f$ is continuous on the closed interval $[a, b]$ and the absolute maximum of $f$ occurs at $x = c$ with $a < c < b$, then $f'(c) = 0$.

4. For the following functions, locate the critical values, intervals where the function is increasing/decreasing, local maxima and minima (if any), and absolute maxima and minima (if any).

   (a) $f(x) = 2x - x^2$ on $(-\infty, 2]$
   (b) $f(x) = \sqrt{25 - x^2}$ on $[-5, 5]$
   (c) $f(x) = \dfrac{x^2}{4 - x^2}$ on $(-2, 1]$
   (d) $f(x) = \sqrt{3}\cos x + \sin x$ on $[0, 2\pi]$

**Note:** The following four-page document is a collection of 22 exercises that you can do to help you prepare for our first midterm. Although these exercises address a wide range of topics that we have studied so far this semester, they do not touch on every subject. As with every midterm and the final exam, you are always responsible for all of the material that we cover in class as well as all of the designated material from your text. The best way to study for our exams is to be sure that you are very comfortable with the homework assignments, the worksheets, and the theory and examples that we present in lecture.

There is a one-page document posted on MML that includes a paragraph about the material that is covered on the first midterm. It is posted as an announcement.