Chapter 2

Applications of Differentiation

Exercise Set 2.1

1. $f'(x) = x^2 + 4x + 5$

First, find the critical points.

f''(x) = 2x + 4

f''(x) exists for all real numbers. We solve

 $f^*(x) = 0$

2x + 4 = 0

2x = -4

x = -2

The only critical value is -2. We use -2 to divide the real number line into two intervals, A: $(-\infty, -2)$ and B: $(-2, \infty)$:



We use a test value in each interval to determine the sign of the derivative in each interval.

A: Test -3, f'(-3) = 2(-3) + 4 = -2 < 0

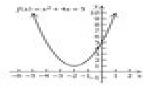
B: Test 0, f'(0) = 2(0) + 4 = 4 > 0

We see that f(x) is decreasing on $(-\infty, -2)$ and increasing on $(-2, \infty)$, and the change from decreasing to increasing indicates that a relative minimum occurs at x = -2. We substitute into the original equation to find f(-2):

$$f(-2) = (-2)^2 + 4(-2) + 5 = 1$$

Thus, there is a relative minimum at (-2,1). We use the information obtained to sketch the graph. Other function values are listed below.

20	f(x)
-5	10
-4	5
-3	2
-2	1
-1	2
. 0	5
100	10



2. $f'(x) = x^2 + 6x - 3$

f''(x) = 2x + 6

f'(x) exists for all real numbers. Solve

 $f^*(x)=0$

2x + 6 = 0

2x = -6

x = -3

The only critical value is -3. We use -3 to divide the real number line into two intervals,

A: $(-\infty, -3)$ and B: $(-3, \infty)$.

A: Test -4, f'(-4) = 2(-4) + 6 = -2 < 0

B: Test 0, f'(0) = 2(0) + 6 = 6 > 0

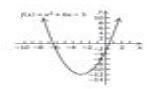
We see that f(x) is decreasing on $(-\infty, -3)$ and increasing on $\{-3, \infty\}$, there is a relative minimum at x = -3.

$$f(-3) = (-3)^2 + 6(-3) - 3 = -12$$

Thus, there is a relative minimum at (-3,-12).

We sketch the graph.

N.	f(x)
6	-3
5	-8
-4	-11
-3	-12
-2	-1.1
-1	-8
0	-3



3. $f(x) = 5 - x - x^2$

First, find the critical points.

f''(x) = -1 - 2x

f'(x) exists for all real numbers. We solve

 $f^*(x) = 0$

-1-2x=0

-2x = 1

 $x = -\frac{1}{2}$

The solution is continued on the next page.

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JA Banks

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