

**Objective:** to identify key features of graphs.

**Warm-up:** Explain how the graph of  $f(x) = x^2$  and the graph of  $f(x) = (x + 2)^2 + 3$  are different.

The second graph moves to the left 2 units and up 3 units from the parent graph.

**Example 1:** Use the graph provided to find each of the following

a. x-intercept(s)

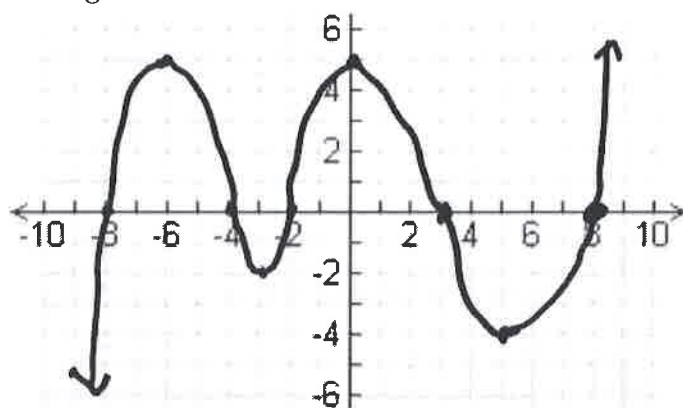
$(-8, 0), (-4, 0),$   
 $(-2, 0), (3, 0),$   
 $(8, 0)$

b. y-intercept

$(0, 5)$

c. relative maximum(s)

$(-6, 5), (0, 5)$



d. relative minimum(s)

$(-3, -2), (5, -4)$

e. maximum

none

f. minimum

none

g. increasing interval(s)

$(-\infty, -6), (-3, 0),$   
 $(5, \infty)$

h. decreasing interval(s)

$(-6, -3), (0, 5)$

i. end behavior

$x \rightarrow \infty, f(x) \rightarrow \infty$   
 $x \rightarrow -\infty, f(x) \rightarrow -\infty$

j. average rate of change from  $-8$  to  $0$

$\frac{y_2 - y_1}{x_2 - x_1} = \frac{5 - 0}{0 - (-8)} = \frac{5}{8}$

**Example 2:** Use the graph provided to find each of the following

a. x-intercept(s)

$$\left(-\frac{3\pi}{2}, 0\right), \left(-\frac{\pi}{2}, 0\right),$$

$$\left(\frac{\pi}{2}, 0\right), \left(\frac{3\pi}{2}, 0\right)$$

b. y-intercept

$$(0, 1)$$

c. relative maximum(s)

$$(-2\pi, 1), (0, 1),$$

$$(2\pi, 1)$$

d. relative minimum(s)

$$(-\pi, -1), (\pi, -1)$$

e. maximum

$$(-2\pi, 1), (0, 1),$$

$$(2\pi, 1)$$

f. minimum

$$(-\pi, -1), (\pi, -1)$$

g. increasing interval(s)

$$(-\pi, 0), (\pi, 2\pi)$$

h. decreasing interval(s)

$$(-2\pi, -\pi),$$

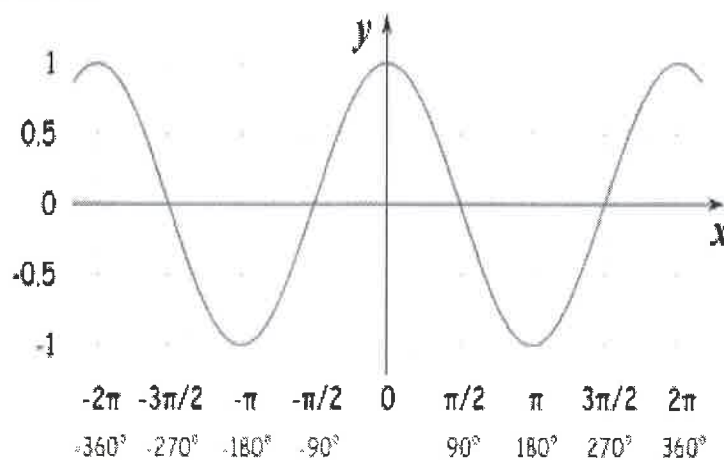
$$(0, \pi)$$

i. periodicity

$$\text{Period} = 2\pi$$

j. symmetry

Even



k. average rate of change from  $-\frac{3\pi}{2}$  to  $\frac{\pi}{2}$

$$\left(-\frac{3\pi}{2}, 0\right) \quad \left(\frac{\pi}{2}, 0\right)$$

$$\frac{y_2 - y_1}{x_2 - x_1} = \frac{0 - 0}{\frac{\pi}{2} - \left(-\frac{3\pi}{2}\right)} = \frac{0}{2\pi} = 0$$