e. Smallest feasible amount of $X$-Rations is 28 pounds. This is on the $x$-axis.

f. It is not feasible to take only Yummies since the $y$-axis is not in the feasible region.

g. $d = 3x + 2y$

h. $d \le 60$: $3x + 2y \le 60 \Rightarrow y \le -\frac{3}{2}x + 30$

See region on graph.

i. See optimum point on graph.

j. Optimum point is at the intersection of the boundaries of regions i and ii.
$400x + 100y = 4000$
$800x + 700y = 16800$
Solving this system gives $x = 5.6$, $y = 17.6$.
Optimum point is (5.6, 17.6).

k. Minimum feasible cost is:
$d = 3(5.6) + 2(17.6) = \$52.00$.

l. From the graph, the integer optimum point is (7, 16).
$d = 3(7) + 2(16) = \$53.00$

CONCEPTS TEST 2

a. $f(x) = ax^2 + bx + c$
$f(3) = a(3^2) + b(3) + c$
$= 9a + 3b + c$
If $f(3) = 7$, then $9a + 3b + c = 7$, QED.

b. $f(2) = 4a + 2b + c = 6$
$f(1) = a + b + c = 3$

c. $9a + 3b + c = 7$ — ①
$4a + 2b + c = 6$ — ②
$a + b + c = 3$ — ③
Subtract ③ from ② and ② from ①:
$3a + b = 3$ — ④
$5a + b = 1$ — ⑤
Subtract ④ from ⑤:
$2a = -2$
$a = -1$

Substitute $-1$ for $a$ in ⑤:
$b = 6$

Substitute $-1$ for $a$ and 6 for $b$ in ③:
$c = -2$

d. Particular equation is $f(x) = -x^2 + 6x - 2$

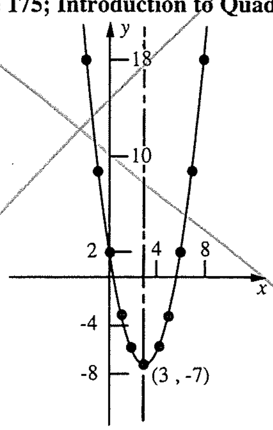
e. $f(6) = -36 + 36 - 2 = -2$

# Chapter 5 | QUADRATIC FUNCTIONS

## EXERCISE 5-1, page 175; Introduction to Quadratic Functions

1. $y = x^2 - 6x + 2$

| $x$ | $y$ |
|---|---|
| −2 | 18 |
| −1 | 9 |
| 0 | 2 |
| 1 | −3 |
| 2 | −6 |
| 3 | −7 |
| 4 | −6 |
| 5 | −3 |
| 6 | 2 |
| 7 | 9 |
| 8 | 18 |




2. Vertex: (3, −7) 3. Graph.

4. $y$-intercept equals 2.
It is "$c$" in $y = ax^2 + bx + c$.

5. $x$-intercepts are about 5.6 and 0.4.
(More precisely, $x = 5.645751\ldots$ and $0.354248\ldots$)

6. The function is called "quadratic" because $y$ = a *quadratic* trinomial.

7. If $y = ax^2 + bx + c$, then the only operations performed are adding (or subtracting) and multiplying. The closure axioms let you conclude that $y$ is a *unique* real number for each real value of $x$. So the relation is a function.

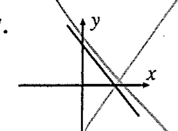
## EXERCISE 5-2, page 179; Graphs of Quadratic Function

Q1. $y = 0.37x$ Q2. $7(-3)^2 = 63$

Q3. $17 - 7(x - 8) = 73 - 7x$ Q4. $y = mx + b$

Q5. $A = \frac{1}{2}(10)(9) = 45 \text{ cm}^2$ Q6. $11^2 = 121$

Q7.




Q8. $\frac{47}{8} = 5\frac{7}{8}$

Q9. If $x$, $y$, and $z$ are real numbers, then $(xy)z = x(yz)$.

Q10. $8x - 13 = 47 \rightarrow S = \{7.5\}$

1. $(x - 8)^2 = x^2 - 16x + 64$ 2. $(x + 7)^2 = x^2 + 14x + 49$

3. $(5x + 6)^2 = 25x^2 + 60x + 36$

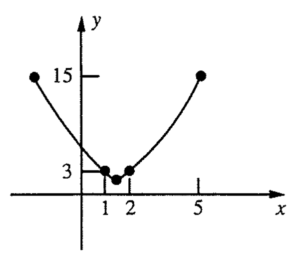
4. $(3x - 9)^2 = 9x^2 - 54x + 81$ 5. $x^2 + 20x + 100$

6. $x^2 - 24x + 144$ 7. $x^2 - 13x + 42.25$

8. $x^2 + 11x + 30.25$

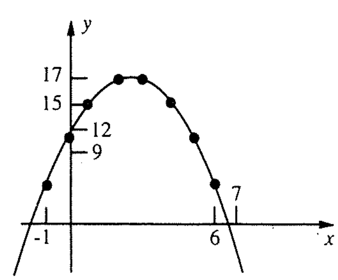
9. $y = x^2 - 3x + 5$

| $x$ | $y$ |
|---|---|
| −2 | 15 |
| −1 | 9 |
| 0 | 5 |
| 1 | 3 |
| 2 | 3 |
| 3 | 5 |
| 4 | 9 |
| 5 | 15 |



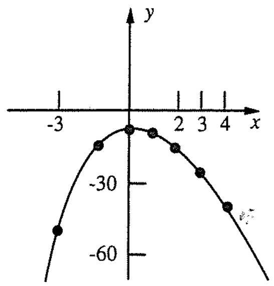

10. $y = -x^2 + 5x + 11$

| $x$ | $y$ |
|---|---|
| −2 | −3 |
| −1 | 5 |
| 0 | 11 |
| 1 | 15 |
| 2 | 17 |
| 3 | 17 |
| 4 | 15 |
| 5 | 11 |
| 6 | 5 |
| 7 | −3 |



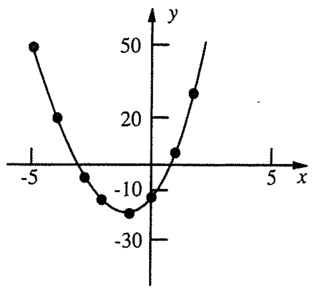
**11.** $y = -3x^2 + 5x - 10$

| $x$ | $y$ |
|---|---|
| −3 | −52 |
| −2 | −32 |
| −1 | −18 |
| 0 | −10 |
| 1 | −8 |
| 2 | −12 |
| 3 | −22 |
| 4 | −38 |
| 5 | −60 |

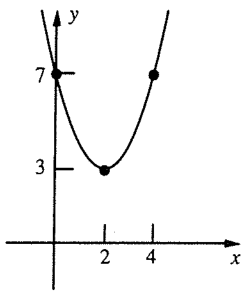



**12.** $y = 5x^2 + 12x - 13$

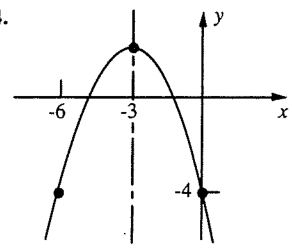
| $x$ | $y$ |
|---|---|
| −6 | 95 |
| −5 | 52 |
| −4 | 19 |
| −3 | −4 |
| −2 | −17 |
| −1 | −20 |
| 0 | −13 |
| 1 | 4 |
| 2 | 31 |
| 3 | 68 |



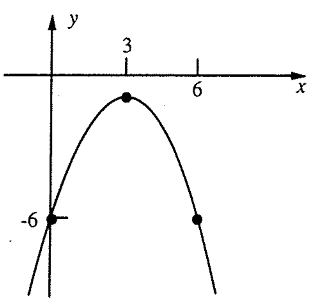

**13.**



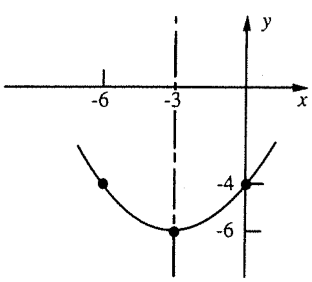

**14.**



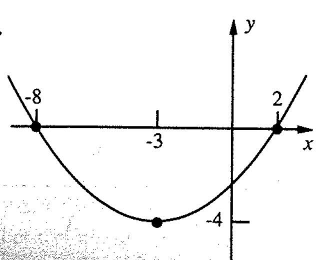

**15.**



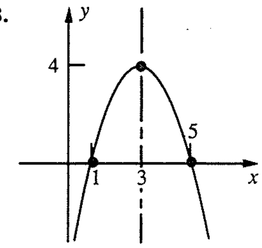

**16.**




**17.**

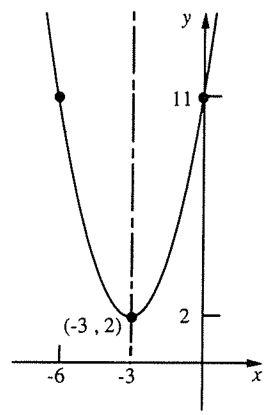



**18.**



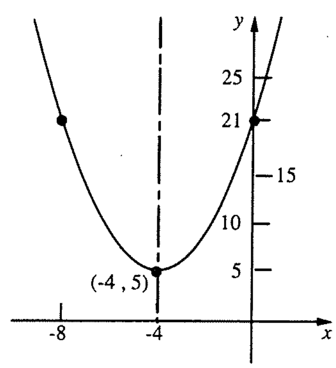

**19.** $y - 2 = (x + 3)^2$

Vertex: (-3 , 2)



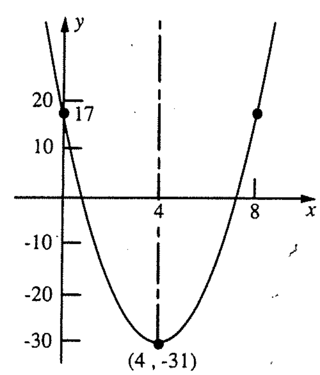

**20.** $y - 5 = (x + 4)^2$

Vertex: (-4 , 5)



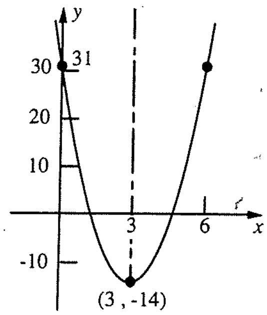

**21.** $y + 31 = 3(x - 4)^2$

Vertex: (4, −31)



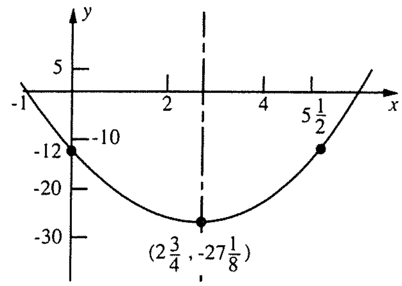
**22.** $y + 14 = 5(x - 3)^2$

Vertex: $(3, -14)$



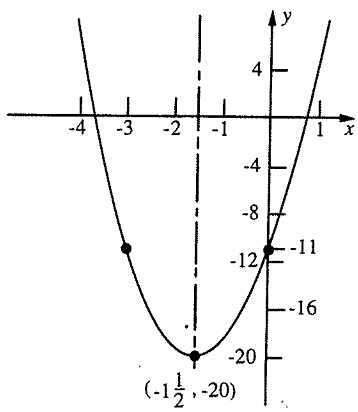

**25.** $y + 27\frac{1}{8} = 2(x - \frac{11}{4})^2$

Vertex: $(2\frac{3}{4}, -27\frac{1}{8})$



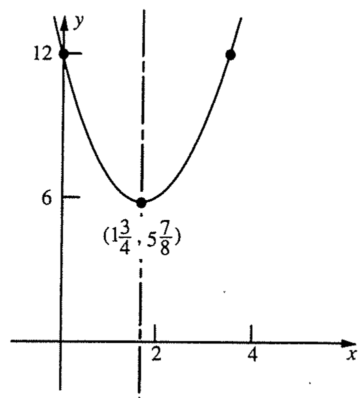

**23.** $y + 20 = 4(x + \frac{3}{2})^2$

Vertex: $(-1\frac{1}{2}, -20)$



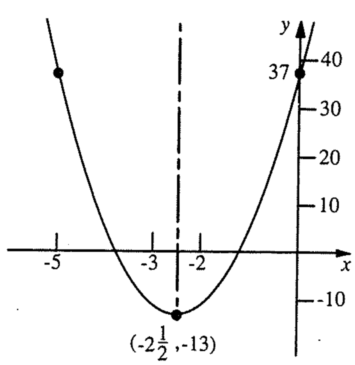

**26.** $y - 5\frac{7}{8} = 2(x - \frac{7}{4})^2$

Vertex: $(1\frac{3}{4}, 5\frac{7}{8})$



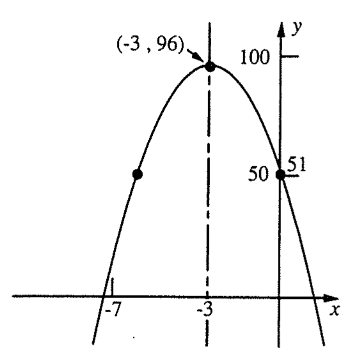

**24.** $y + 13 = 8(x + \frac{5}{2})^2$

Vertex: $(-2\frac{1}{2}, -13)$



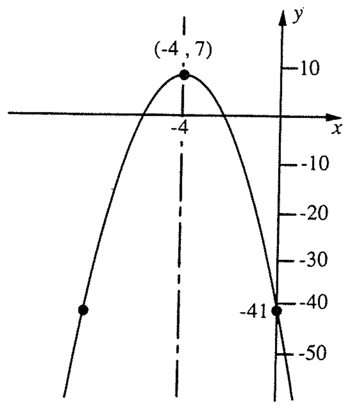

**27.** $y - 96 = -5(x + 3)^2$

Vertex: $(-3, 96)$



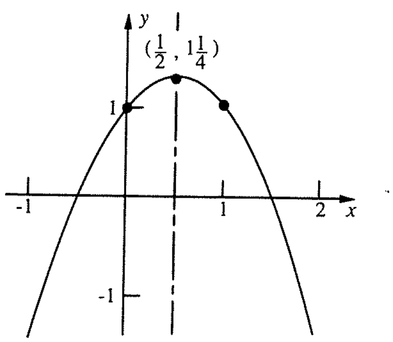
**28.** $y - 7 = -3(x + 4)^2$

Vertex: $(-4, 7)$



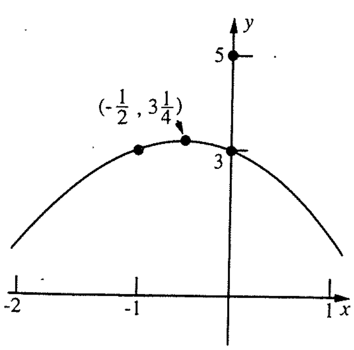

**29.** $y - 1\frac{1}{4} = -(x - \frac{1}{2})^2$

Vertex: $(\frac{1}{2}, 1\frac{1}{4})$




**30.** $y - 3\frac{1}{4} = -(x + \frac{1}{2})^2$

Vertex: $(-\frac{1}{2}, 3\frac{1}{4})$

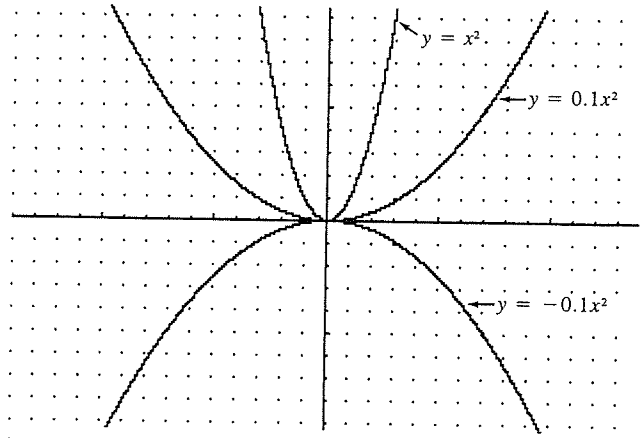



**31.** *Parabola Proportions Problem*

**a.** $y = x^2$. Graph, below.
Graph opens *upward.*

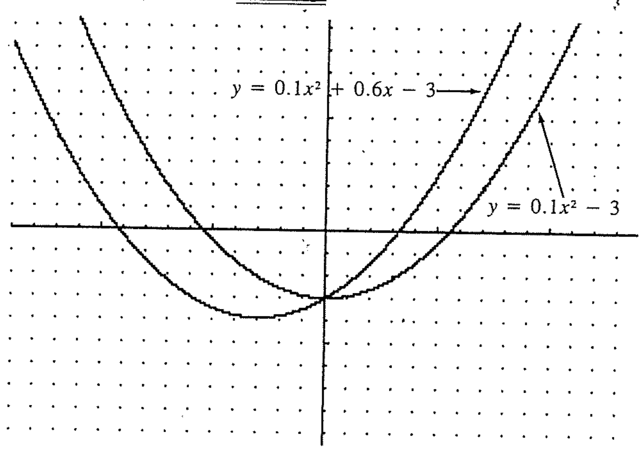
**b.** $y = 0.1x^2$. Graph, below.
Graph opens *wider.*

**c.** $y = -0.1x^2$. Graph.
Making the $x^2$-coefficient negative makes the graph *open downward.*




**d.** $y = 0.1x^2 - 3$. Graph, below.
Graph *moves downward* by 3 units, and keeps the *same proportions.*

**e.** $y = 0.1x^2 + 0.6x - 3$. Graph.
Adding an $x$-term moves the graph *sideways, without* changing its proportions or y-intercept.




**f.** $y = -0.3x^2 + 2x - 4$
Predictions:

**i.** It will open *downward* because the $x^2$-coefficient is negative.

**ii.** It will open *wider* than $y = x^2$ because the $x^2$-coefficient is less than 1 in absolute value.

**iii.** Vertex will *not* be on the $y$-axis since there is a non-zero $x$-term.

**iv.** The graph will cross the $y$-axis *below* the origin, at $-4$, since this is the value of $y$ when $x$ is zero.

**g.** Graph. Predictions are *confirmed.*