8) An acorn drops from a tree branch 20 feet above the ground. The function $h = -16t^2 + 20$ gives the height h of the acorn (in feet) after t seconds.

At about what time does the acorn hit the ground?

$h = 0$

$x = 1.12$ sec

9) During half-time of a basketball game, a slingshot launches T-shirts at the crowd. A T-shirt is launched 5 ft. off the gymnasium floor with an initial upward velocity of 72 ft/s. The t-shirt is caught 35-ft above the court. $h = -16t^2 + 72t + 5$

How long will it take the T-shirt to reach its maximum height?

Vertex

$$x = \frac{-72}{2(-16)} = 2.25 \text{ sec}$$

What is its maximum height?

$$-16(2.25)^2 + 72(2.25) + 5 = 86 \text{ ft}$$

How long does it take for the shirt to get caught? $(y = 35)$

$x = 4.04$ sec

What is the range of the function that models the height of the T-shirt over time?

$[0, 86]$

Calculator Tips:

$\boxed{Y=}$ $\boxed{X,T,\theta,n}$ for X

Reset: $\boxed{2^{nd}}$ $\boxed{+}$ $\boxed{7}$ $\boxed{1}$ $\boxed{2}$

$y = \#$ for intersecting a y-value

$\boxed{\text{WINDOW}}$

$\boxed{2^{nd}}$ $\boxed{\text{TRACE}}$ → 2: zero (x-int) 5: intersect

Summary:

12.3 EQ: How do quadratic functions relate to the real world?

1) The data in this table represent the height of an object (in meters) at different times (in seconds) during flight.

Object

L_1	Time (s) x	0	1	2	3	4	5	6
L_2	Height (m) y	4	63.1	112.4	151.9	181.6	201.5	211.6

a) Write a polynomial function to model the data set (Do a regression.)

Step 1: Clear your calculator

2nd + 7 1 2

Step 2: Enter the data in a list.

STAT 1

Use enter or ↓

Step 3: Calculate the quadratic regression.

STAT → 5: Quad Reg

Calculate

$y = -4.9x^2 + 64x + 4$

~~**Step 4 (Optional):** Graph your data and regression.~~

Y= Highlight Plot 1

ZOOM 9: Stat

b) What is the maximum height of the object? 212.98 m

$x = \frac{-64}{2(-4.9)} = 6.53$ $y = -4.9(6.53)^2 + 64(6.53) + 4 = 212.98$

c) When did the object hit the ground? 13.12 sec

zero $x = 13.12$

(set window x_{max} higher)

d) What is the initial height of the object? 4 m

$x = 0$ $y = 4$

2) The table below shows the number of calories burned in 1 hour when running at various speeds.

L1 Running Speed (mph)	L2 Calories Burned
10	1126
10.9	1267
5	563
5.2	633
6	704
6.7	774
7	809
8	950
8.6	985
9	1056
7.5	880

a) Write a quadratic function to model the data set.

$y = -0.71x^2 + 124.47x - 19.45$

~~$y = -12.78x^2 + 247.7x - 307.68$~~

b) How many calories does this model predict a person who runs at 9.5 mph for 1 hour will burn? Round to the nearest calorie.

~~$-12.78(9.5)^2 + 247.7(9.5) - 307.68 = 640.49$ cal~~

$-0.71(9.5)^2 + 124.47(9.5) - 19.45 = \boxed{1098.94 \text{ cal}}$

3) The fuel efficiency, in miles per gallon, for a certain midsize car at various speeds, in miles per hour, is given in the table below.

L1 mph	L2 mpg
25	29
30	32
35	33
40	35
45	34
50	33
55	31
60	28
65	24
70	19
75	17

a) Find a quadratic model for these data.

$y = -0.02x^2 + 1.37x + 5.69$

b) Use the model to predict the fuel efficiency of this car when it is traveling at 57 mph.

$= -0.02(57)^2 + 1.37(57) + 5.69 = 18.8$ mpg

c) Use the model to predict the fuel efficiency of this car when it is traveling at 78 mph.

$-0.02(78)^2 + 1.37(78) + 5.69 = \boxed{-9.13}$

Not a good model.

Summary:

12.1/12.2/12.3 Review **Name** Key

Order the group of quadratic functions from widest to narrowest graph.

a closer to zero = wider

1. $y = x^2,\ y = \frac{1}{3}x^2,\ y = -2x^2$

$\boxed{y=\frac{1}{3}x^2, y=x^2, y=-2x^2}$

2. $y = \frac{1}{6}x^2,\ y = \frac{1}{4}x^2,\ y = \frac{1}{2}x^2$

$\boxed{y=\frac{1}{6}x^2, y=\frac{1}{4}x^2, y=\frac{1}{2}x^2}$

For each quadratic function identity the following:

a) vertex b) whether it is a maximum or minimum c) domain and range

d) axis of symmetry

3. $f(x) = 2x^2 + 0x + 0$ (a = 2, b = 0, c = 0)

a) $x=\frac{-b}{2a}=\frac{-0}{2(2)}=0$

$y=2(0)^2=0$ $\boxed{(0,0)}$

b) a > 0 → concave up ∪ $\boxed{\text{minimum}}$

c) D: All real #s

R: $[0, \infty)$

d) $x=0$

4. $f(x) = 1x^2 + 0x - 1$ (a = 1, b = 0, c = -1)

a) $x=\frac{-b}{2a}=\frac{-0}{2(1)}=0$

$y=(0)^2-1=-1$ $\boxed{(0,-1)}$

b) a > 0 → concave up ∪ $\boxed{\text{minimum}}$

c) D: All real #s

R: $[-1, \infty)$

d) $x=0$

5. $y = -2x^2 - 12x - 7$ (a, b, c)

a) $x=\frac{-b}{2a}=\frac{-(-12)}{2(-2)}=-3$

$y=-2(-3)^2-12(-3)-7=11$ $\boxed{(-3,11)}$

b) a < 0 → concave down ∩ $\boxed{\text{maximum}}$

c) D: All real #s

R: $(-\infty, 11]$

d) $x=-3$

6. **For a Physics experiment, the class drops a golf ball off a bridge toward the pavement below. The bridge is 75 feet high. The function $h = -16t^2 + 75$ gives the golf ball's height *h* above the pavement (in feet) after *t* seconds. How many seconds does it take for the golf ball to hit the pavement?**

h = 0

$0=-16t^2+75$

$-75 \qquad -75$

$\frac{-75}{-16}=\frac{-16t^2}{-16}$

$\sqrt{4.6875}=\sqrt{t^2}$

$\boxed{2.17\text{ sec} \approx t}$

7. **A punter kicked the football into the air with an upward velocity of 62 ft/sec. Its height *h* in feet after *t* seconds is given byt the function $h = -16t^2 + 62t + 2$. a) What is the maximum height the ball reaches? b) How long will it take the football to reach the maximum height?**

vertex y-value

vertex x-value

$x=\frac{-b}{2a}=\frac{-(62)}{2(-16)}=1.9375$

$y=-16(1.9375)^2+62(1.9375)+2$

$y=62.0625$

a) $\boxed{62.0625\text{ ft}}$ b) $\boxed{1.9375\text{ sec}}$

8. **Explain how you can determine if the parabola opens up or down by simply examining the equation.**

If $a>0$, then it opens up.

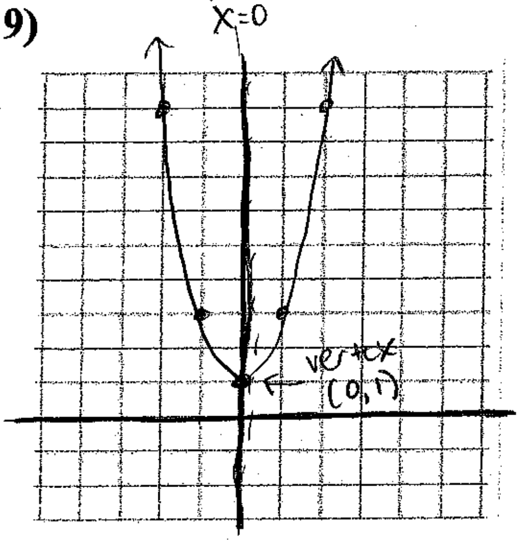
If $a<0$, then it opens down.

Graph each function. Label the axis of symmetry and the vertex. Set up your table, too.

9) $f(x) = \overset{a}{2}x^2 \overset{b}{+0x} + \overset{c}{1}$ **10)** $f(x) = \overset{a}{1}x^2 - \overset{b}{2}x - \overset{c}{1}$ **11)** $f(x) = \overset{a}{-3}x^2 - \overset{b}{6}x - \overset{c}{8}$

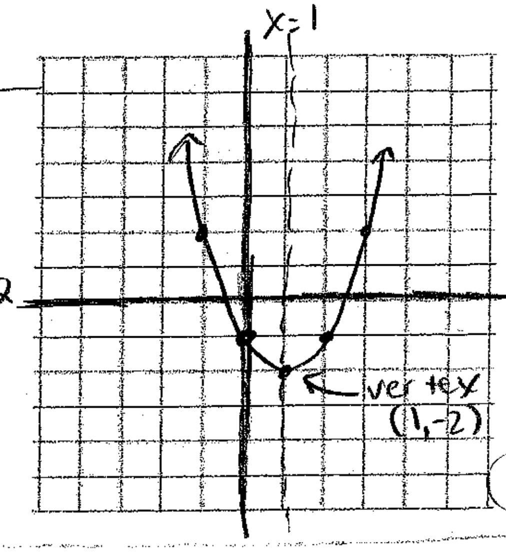
9)

x	y
-2	9
-1	3
0	1
1	3
2	9

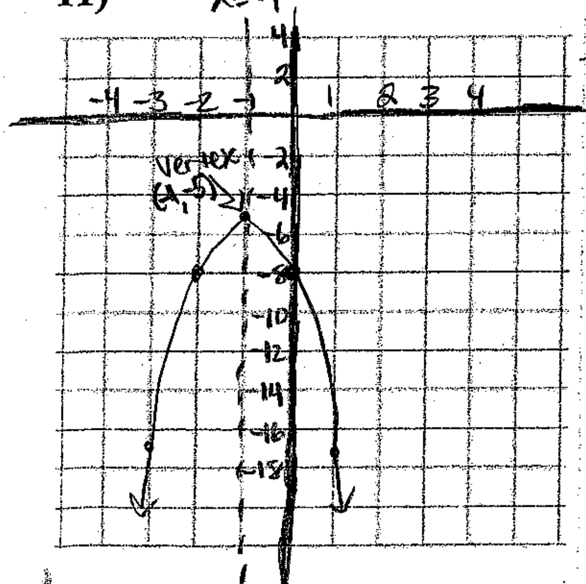


10)

x	y
-1	2
0	-1
1	-2
2	-1
3	2



11)



x	y
-3	-17
-2	-8
-1	-5
0	-8
1	-17

9) vertex $x = \frac{-b}{2a} = \frac{-0}{2(2)} = 0$ $(0,1)$

$y = 2(0)^2 + 1 = 1$

y-int = $(0,c) = (0,1)$

10) vertex $x = \frac{-b}{2a} = \frac{-(-2)}{2(1)} = 1$ $(1,-2)$

$y = (1)^2 - 2(1) - 1 = -2$

y-int = $(0,c) = (0,-1)$

11) vertex $x = \frac{-b}{2a} = \frac{-(-6)}{2(-3)} = -1$ $(-1,-5)$

$y = -3(-1)^2 - 6(-1) - 8 = -5$

y-int = $(0,c) = (0,-8)$