Real-World Applications – Day 2

Unit 2B: Quadratic Functions - Modeling

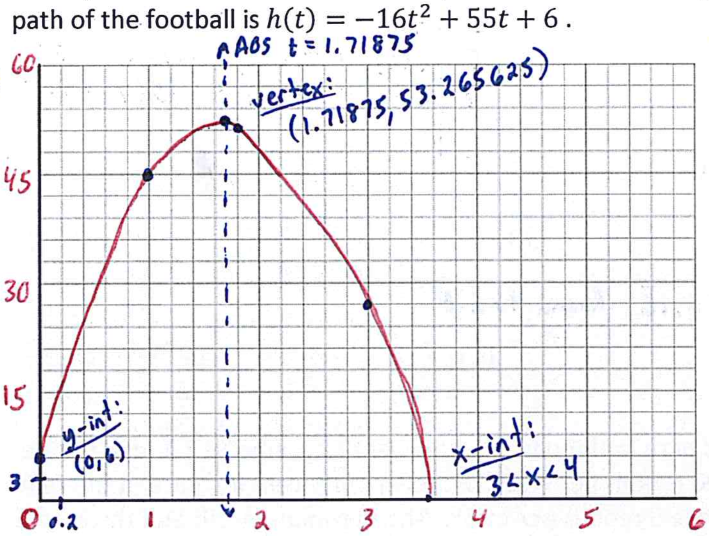
For each of the following:

A. Identify the x-intercept(s) and tell what they mean
B. Identify the y-intercept and tell what it means
C. Identify the maxima/minima of the function and tell what it means
D. Graph and label the function

1. Coty throws a football at 55 feet per second from a height of 6 foot. The equation that shows the path of the football is $h(t) = -16t^2 + 55t + 6$.

Scale: $\frac{\text{y-value of vertex}}{4} = \frac{53.265625}{4} = 13.31640625$

Round to 15



Scale: $\frac{4}{6} = 0.\overline{6}$ Round up to 1

AOS: $t = \frac{-b}{2a} = \frac{-55}{-32} = 1.71875$

t	$h(t) = -16t^2 + 55t + 6$	
0	$h(0) = -16(0)^2 + 55(0) + 6$	(0, 6)
1	$h(1) = -16(1)^2 + 55(1) + 6$	(1, 45)
1.71875	$h(1.71875) = -16(1.71875)^2 + 55(1.71875) + 6$	(1.71875, 53.26
2	$h(2) = -16(2)^2 + 55(2) + 6$	(2, 52)
3	$h(3) = -16(3)^2 + 55(3) + 6$	(3, 27)
4	$h(4) = -16(4)^2 + 55(4) + 6$	(4, -30

A) $3 < x < 4$ The football hit the ground after 3 sec, but before 4 sec.

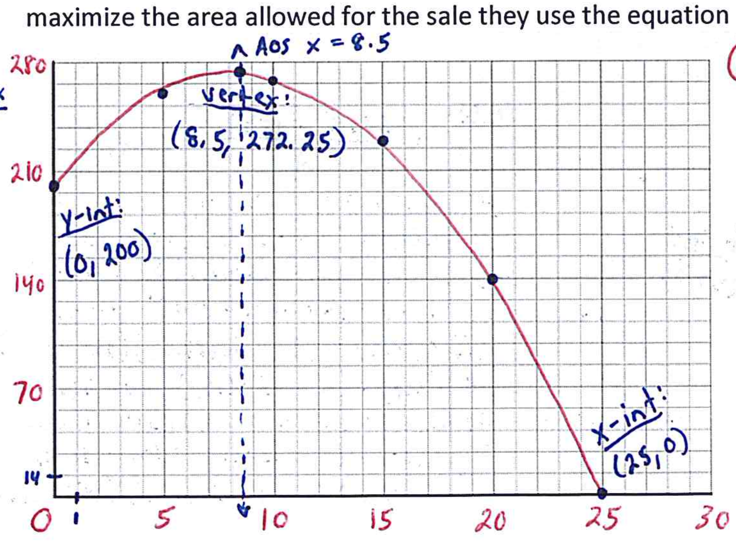
B) (0, 6) The football was released from 6 ft in the air.

C) 53.265625 ft. is the height of the ball before falling back down.

2. A local department store is running a sidewalk sale that they want to expand to their parking lot. To enclose the area that the sale will be contained in they have to purchase the fencing. In order to maximize the area allowed for the sale they use the equation $A(x) = (25 - x)(8 + x)$

Scale: $\frac{\text{y-value of vertex}}{4} = \frac{272.25}{4} = 68.0625$

Round to 70



Scale: $\frac{\text{Pos x-int}}{6} = \frac{25}{6} = 4.1\overline{6}$ Round to 5

A) x-int: $25 - x = 0$, $+x \quad +x$, $25 = x$, (25, 0) $\qquad 8 + x = 0$, $-8 \quad -8$, $x = -8$, (−8, 0)

AOS: $x = \frac{25 + (-8)}{2} = \frac{17}{2} = 8.5$

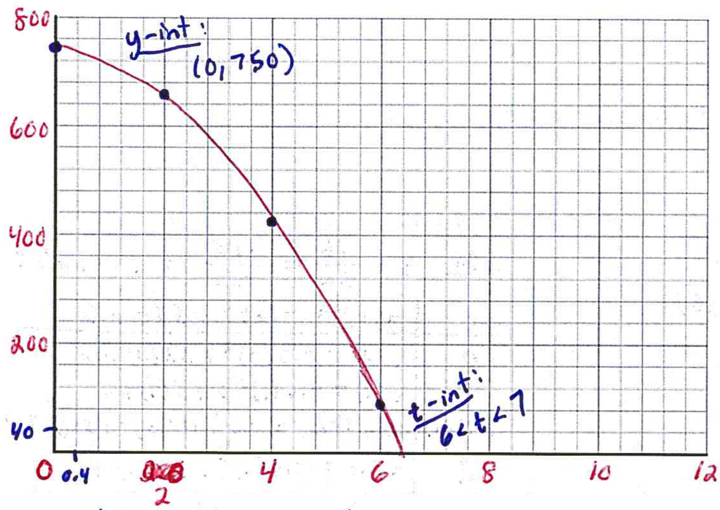
x	$A(x) = (25 - x)(8 + x)$	
0	$A(0) = (25 - 0)(8 + 0)$	(0, 200)
5	$A(5) = (25 - 5)(8 + 5)$	(5, 260)
8.5	$A(8.5) = (25 - 8.5)(8 + 8.5)$	(8.5, 272.25)
10	$A(10) = (25 - 10)(8 + 10)$	(10, 270)
15	$A(15) = (25 - 15)(8 + 15)$	(15, 230)
20	$A(20) = (25 - 20)(8 + 20)$	(20, 140)
25	$A(25) = (25 - 25)(8 + 25)$	(25, 0)

B) (0, 200) The fencing encloses 200 ft^2 of parking lot prior to any adjustments.

C) 272.25 ft^2 is possible by shifting 8.5 ft from the length to the width creating a square with sides 16.5 ft.

3. Standing at the top of a building a child decides to throw a water balloon at someone's head. They throw the water balloon downward at 15 feet per second from a height of 750 foot. This is modeled by the equation $h(t) = -16t^2 - 15t + 750$

Scale: $\frac{\text{release height}}{4} = \frac{750}{4} = 187.5$ Round to 200



Scale: $\frac{\text{Bottom Chart value}}{6} = \frac{7}{6} = 1.1\overline{6}$ Round to 2.0

AOS: $t = \frac{-b}{2a} = \frac{15}{-32} = -0.46875$

t	$h(t) = -16t^2 - 15t + 750$	
0	$h(0) = -16(0)^2 - 15(0) + 750$	(0, 750)
1	$h(1) = -16(1)^2 - 15(1) + 750$	(1, 719)
2	$h(2) = -16(2)^2 - 15(2) + 750$	(2, 656)
3	$h(3) = -16(3)^2 - 15(3) + 750$	(3, 561)
4	$h(4) = -16(4)^2 - 15(4) + 750$	(4, 434)
5	$h(5) = -16(5)^2 - 15(5) + 750$	(5, 275)
6	$h(6) = -16(6)^2 - 15(6) + 750$	(6, 84)
7	$h(7) = -16(7)^2 - 15(7) + 750$	(7, -139)

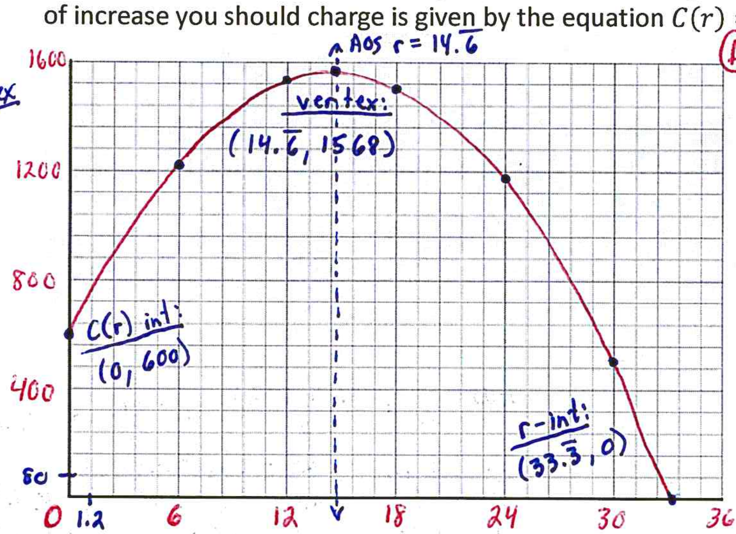
(A) $6 < t < 7$ The balloon took between 6 and 7 sec to hit the ground.

(B) (0, 750) The water balloon was thrown from 750 ft.

(C) 750 since the balloon was thrown down it would never be higher than the release height.

4. You want to run a movie-rental business here in Hoopeston. You want to charge \$2 per day to rent a movie and believe that you will average 300 rentals per week. For every fifty-cent increase in the rental price, the average business can expect to lose 9 rentals per week. The maximum profit and the amount of increase you should charge is given by the equation $C(r) = (2 + 0.50r)(300 - 9r)$

Scale: $\frac{\text{y-value of vertex}}{4} = \frac{1568}{4} = 392$ Round to 400



Scale: $\frac{\text{Pos X-int}}{6} = \frac{33.\overline{3}}{6} = 5.\overline{5}$ Round to 6

(A) r-int: $2 + 0.50r = 0$, $-2 \quad -2$, $\frac{0.50r}{0.50} = \frac{-2}{0.50}$, $r = -4$, $(-4, 0)$

$300 - 9r = 0$, $+9r \quad +9r$, $\frac{300}{9} = \frac{9r}{9}$, $r = 33.\overline{3}$, $(33.\overline{3}, 0)$

AOS: $r = \frac{33.\overline{3} + (-4)}{2} = 14.\overline{6}$

r	$C(r) = (2 + 0.50r)(300 - 9r)$	
0	$C(0) = (2 + 0.50(0))(300 - 9(0))$	(0, 600)
6	$C(6) = (2 + 0.50(6))(300 - 9(6))$	(6, 1230)
12	$C(12) = (2 + 0.50(12))(300 - 9(12))$	(12, 1536)
$14.\overline{6}$	$C(14.\overline{6}) = (2 + 0.50(14.\overline{6}))(300 - 9(14.\overline{6}))$	$(14.\overline{6}, 1568)$
18	$C(18) = (2 + 0.50(18))(300 - 9(18))$	(18, 1518)
24	$C(24) = (2 + 0.50(24))(300 - 9(24))$	(24, 1176)
30	$C(30) = (2 + 0.50(30))(300 - 9(30))$	(30, 510)
$33.\overline{3}$	$C(33.3) = (2 + 0.50(33.\overline{3}))(300 - 9(33.\overline{3}))$	$(33.\overline{3}, 0)$

(B) (0, 600) without raising current prices you are bringing in \$600 per week.

(C) \$1568 is how much you can make if you adjust the cost to \$2 + \$7.33 = \$9.33/movie [$14.\overline{6}$ increases of \$0.50 = \$7.33]