Real-World Applications – Day 3

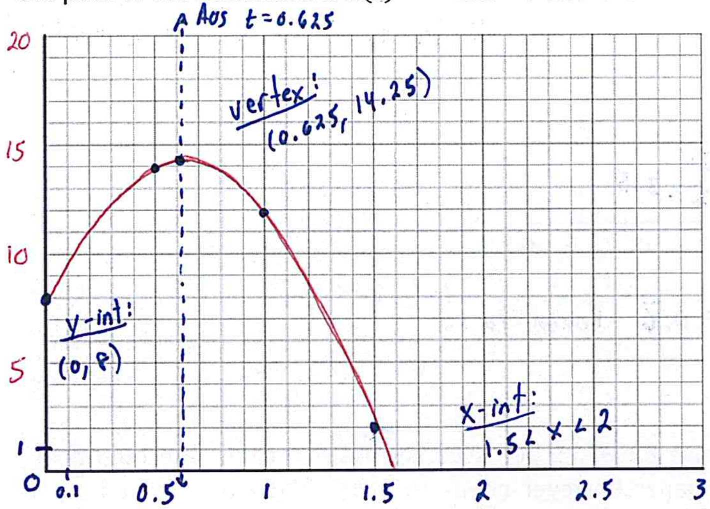
Unit 2B: Quadratic Functions - Modeling

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. Brennan shoots a basketball at 20 feet per second from a height of 8 foot. The equation that shows the path of the basketball is $h(t) = -16t^2 + 20t + 8$.

Scale: $\frac{\text{y-value vertex}}{4} = \frac{14.25}{4} = 3.5625$ Round to 5



Scale: $\frac{\text{Bottom value}}{6} = \frac{2}{6} = 0.\overline{3}$ Round to 0.5

AOS: $t = \frac{-b}{2a} = \frac{-20}{-32} = 0.625$

t	$h(t) = -16t^2 + 20t + 8$	
0	$h(0) = -16(0)^2 + 20(0) + 8$	(0, 8)
0.5	$h(0.5) = -16(0.5)^2 + 20(0.5) + 8$	(0.5, 14)
0.625	$h(0.625) = -16(0.625)^2 + 20(0.625) + 8$	(0.625, 14.25
1	$h(1) = -16(1)^2 + 20(1) + 8$	(1, 12)
1.5	$h(1.5) = -16(1.5)^2 + 20(1.5) + 8$	(1.5, 2)
2	$h(2) = -16(2)^2 + 20(2) + 8$	(2, -16)

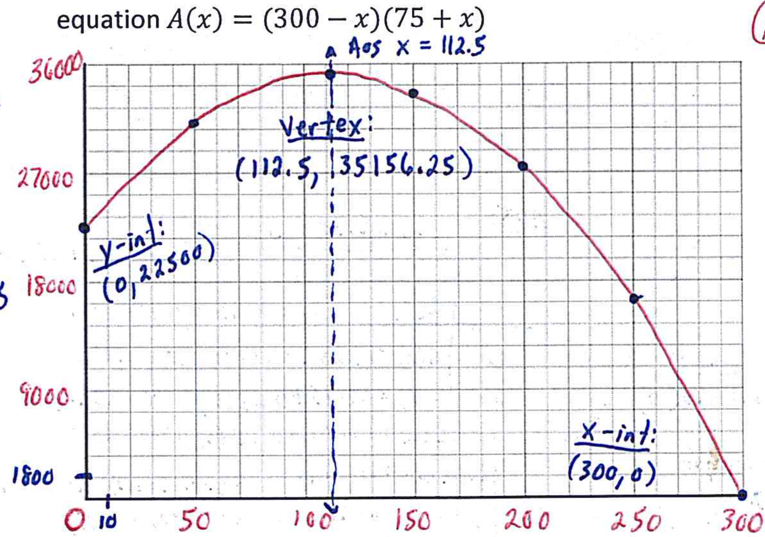
A) $1.5 < x < 2$ The ball takes between 1 and a half and 2 seconds to hit the ground.

B) (0, 8) The ball left Brennan's hand at 8 feet.

C) 14.25 ft is the highest the ball will go before falling back to the floor.

2. The local car dealership is having a massive tent sale and wants to enclose the area in which they will be selling cars to provide all of their customers shade. The area they want to cover is given by the equation $A(x) = (300 - x)(75 + x)$

Scale: $\frac{\text{y-value vertex}}{4} = \frac{35156.25}{4} = 8789.0625$ Round to 9000



Scale: $\frac{\text{Pos x-int}}{6} = \frac{300}{6} = 50$

A) x-int:

$300 - x = 0$
$+x \quad +x$
$300 = x$
(300, 0)

$75 + x = 0$
$-75 \quad -75$
$x = -75$
(-75, 0)

AOS: $x = \frac{300 + (-75)}{2} = \frac{225}{2} = 112.5$

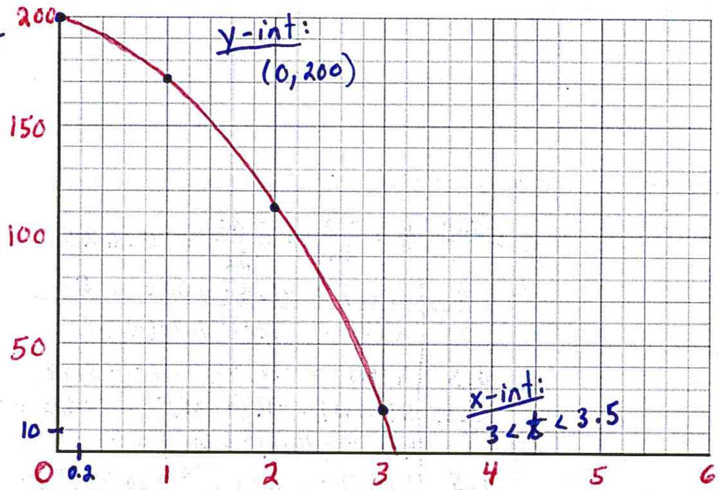
x	$A(x) = (300 - x)(75 + x)$	
0	$A(0) = (300 - 0)(75 + 0)$	(0, 22500)
50	$A(50) = (300 - 50)(75 + 50)$	(50, 31250)
100	$A(100) = (300 - 100)(75 + 100)$	(100, 35000)
112.5	$A(112.5) = (300 - 112.5)(75 + 112.5)$	(112.5, 35156.
150	$A(150) = (300 - 150)(75 + 150)$	(150, 33750)
200	$A(200) = (300 - 200)(75 + 200)$	(200, 27500)
250	$A(250) = (300 - 250)(75 + 250)$	(250, 16250.
300	$A(300) = (300 - 300)(75 + 300)$	(300, 0)

B) (0, 22500) Before moving anything we already have 22500 ft² of space for vehicles.

C) 35156.25 ft² is the amount of area possible by shifting 112.5 ft from the length to the width.

3. A coach was sitting up in the stands at the game and realizes that they have something in their pocket that they meant to give to the students before the game. To get the item to the students as quick as possible the coach throws it downward at 12 feet per second and from a height of 200 feet. This is modeled by the equation $h(t) = -16t^2 - 12t + 200$

Scale: $\frac{\text{release height}}{4} = \frac{200}{4} = 50$



Scale: $\frac{\text{Bottom table value}}{6} = \frac{4}{6} = 0.\overline{6}$ Round to 1.

AOS: $t = \frac{-b}{2a} = \frac{12}{-32} = -0.375$

t	$h(t) = -16t^2 - 12t + 200$	$(t, h(t))$
0	$h(0) = -16(0)^2 - 12(0) + 200$	(0, 200)
1	$h(1) = -16(1)^2 - 12(1) + 200$	(1, 172)
2	$h(2) = -16(2)^2 - 12(2) + 200$	(2, 112)
3	$h(3) = -16(3)^2 - 12(3) + 200$	(3, 20)
4	$h(4) = -16(4)^2 - 12(4) + 200$	(4, -104)

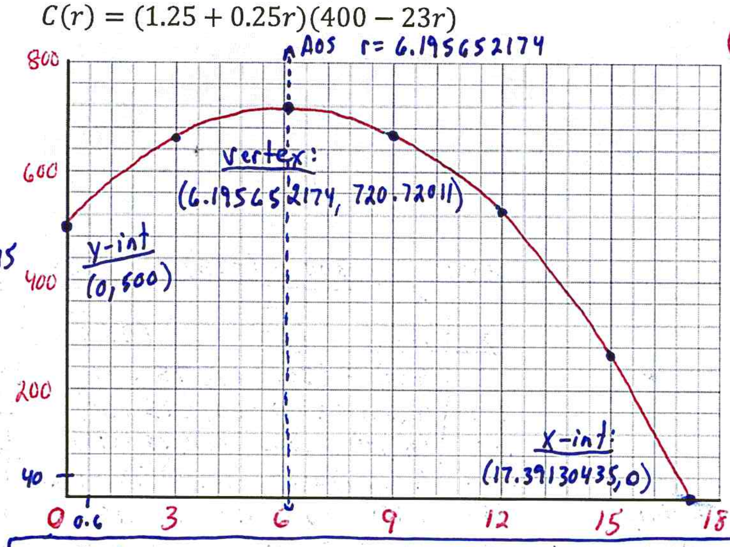
(A) $3 < t < 3.5$ It takes between 3 and 3 and a half seconds for the item to hit the ground.

(B) (0, 200) Original height of release of the object.

(C) 200 ft is the highest the object will reach since it is being thrown downward.

4. The Hoopeston Chronicle sells their papers for \$1.25 per issue currently. At this rate the paper is selling about 400 papers per week. The paper however needs to increase the price that they are charging for the paper to accommodate for problems that have come up in their office. For every quarter they increase the price of the paper it has been projected that they will lose 23 papers per week in sales. The maximum profit and the amount of increase you should charge is given by the equation $C(r) = (1.25 + 0.25r)(400 - 23r)$

Scale: $\frac{\text{y-value vertex}}{4} = \frac{720.72011}{4} = 180.1800275$ round to 200



(A) r-int: $1.25 + 0.25r = 0$; $-1.25 \quad -1.25$; $\frac{0.25r}{0.25} = \frac{-1.25}{0.25}$; $r = -5$; $(-5, 0)$

$400 - 23r = 0$; $+23r \quad +23r$; $\frac{400}{23} = \frac{23r}{23}$; $r = 17.39130435$; $(17.39130435, 0)$

AOS: $r = \frac{17.39130435 + (-5)}{2} = 6.195652174$

r	$C(r) = (1.25 + 0.25r)(400 - 23r)$	
0	$C(0) = (1.25 + 0.25(0))(400 - 23(0))$	(0, 500)
3	$C(3) = (1.25 + 0.25(3))(400 - 23(3))$	(3, 662)
6	$C(6) = (1.25 + 0.25(6))(400 - 23(6))$	(6, 720.5
6.2	$C(6.195652174) = (1.25 + 0.25(AOS))(400 - 23(AOS))$	(AOS, 720.7
9	$C(9) = (1.25 + 0.25(9))(400 - 23(9))$	(9, 675.5
12	$C(12) = (1.25 + 0.25(12))(400 - 23(12))$	(12, 527)
15	$C(15) = (1.25 + 0.25(15))(400 - 23(15))$	
17.391304	$C(17.391304) = (1.25 + 0.25(17.39))(400 - 23(17.39))$	(15, 275) (17.39130435, 0)

$\boxed{\text{Scale: } \frac{\text{Pos. x-int}}{6} = \frac{17.39130435}{6} = 2.898550725 \text{ Round to 3.}}$

(A) (17.39130435, 0) or $(\frac{400}{23}, 0)$ 17.39130435 increases of 25¢ would end all sales.

(B) (0, 500) Current sales with no increase in cost.

(C) \$720.72 maximum profit with increase of \$1.55¢ per paper. Cost now \$2.80 per paper.