Real-World Applications – Day 5

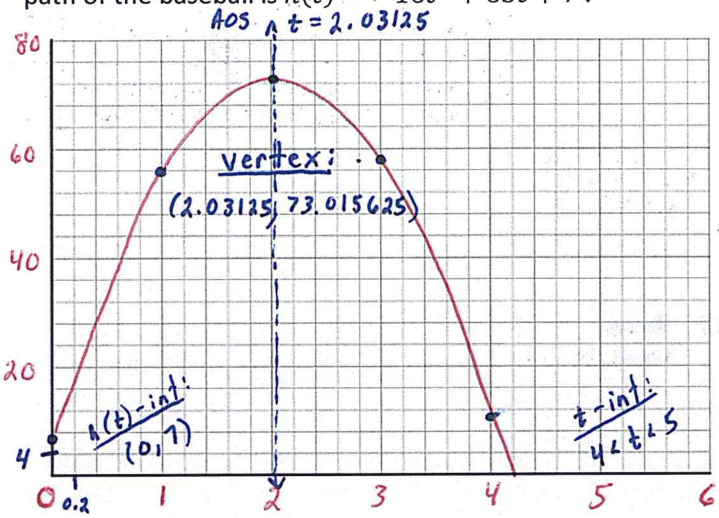
Unit 2B: Quadratic Functions - Modeling

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. Tanner throws a baseball at 65 feet per second from a height of 7 foot. The equation that shows the path of the baseball is $h(t) = -16t^2 + 65t + 7$.

Scale: $\frac{\text{y-value vertex}}{4} = \frac{73.015625}{4} = 18.25390625$ Round to 20



Scale: $\frac{\text{Bottom Table value}}{6} = \frac{5}{6} = 0.8\bar{3}$ Round to 1

AOS: $t = \frac{-b}{2a} = \frac{-65}{-32} = 2.03125$

t	$h(t) = -16t^2 + 65t + 7$	$(t, h(t))$
0	$h(0) = -16(0)^2 + 65(0) + 7$	(0, 7)
1	$h(1) = -16(1)^2 + 65(1) + 7$	(1, 56)
2	$h(2) = -16(2)^2 + 65(2) + 7$	(2, 73)
2.03125	$h(2.03125) = -16(2.03125)^2 + 65(2.03125) + 7$	(2.03125, 73.015625)
3	$h(3) = -16(3)^2 + 65(3) + 7$	(3, 58)
4	$h(4) = -16(4)^2 + 65(4) + 7$	(4, 11)
5	$h(5) = -16(5)^2 + 65(5) + 7$	(5, -68)

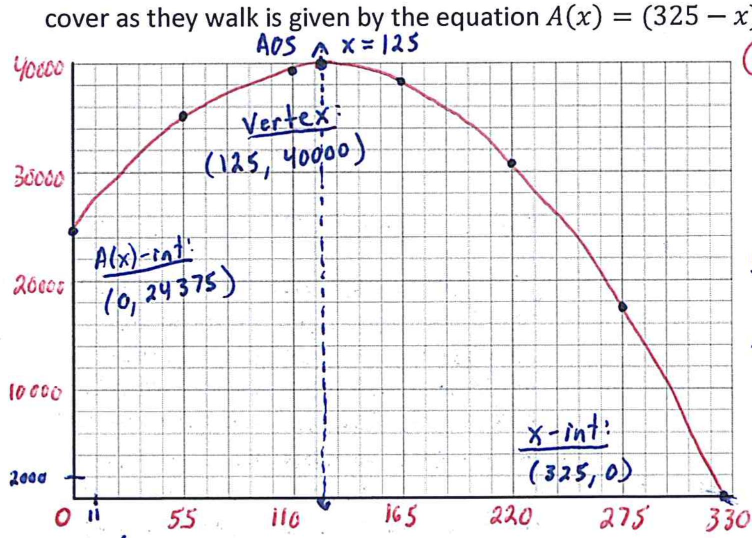
(A) $4 < t < 5$ Ball hit the ground between 4 & 5s

(B) (0, 7) Ball was released from 7 ft

(C) 73.015625 ft is how high the ball reached before falling down.

2. The school wanted to put up a tent that would shade the area where they plan on holding the PBIS picnic. The staff unpacks the tent and is in an area that is 75 foot by 325 foot, but they want to maximize the area under the tent so they bring one side in while walking the other out. The area they cover as they walk is given by the equation $A(x) = (325 - x)(75 + x)$

Scale: $\frac{\text{y-value vertex}}{4} = \frac{40000}{4} = 10{,}000$



Scale: $\frac{\text{Pos x-int}}{6} = \frac{325}{6} = 54.1\bar{6}$ Round to 55

(A) x-int: $325 - x = 0$, $+x \quad +x$, $325 = x$; $75 + x = 0$, $-75 \quad -75$, $x = -75$

(325, 0) means we removed all of the length

(-75, 0) means we have removed all of the width

AOS: $x = \frac{325 + (-75)}{2} = 125$

x	$A(x) = (325 - x)(75 + x)$	
0	$A(0) = (325 - 0)(75 + 0)$	(0, 24375)
55	$A(55) = (325 - 55)(75 + 55)$	(55, 35100)
110	$A(110) = (325 - 110)(75 + 110)$	(110, 39775)
125	$A(125) = (325 - 125)(75 + 125)$	(125, 40000)
165	$A(165) = (325 - 165)(75 + 165)$	(165, 38400)
220	$A(220) = (325 - 220)(75 + 220)$	(220, 30975)
275	$A(275) = (325 - 275)(75 + 275)$	(275, 17500)
325	$A(325) = (325 - 325)(75 + 325)$	(325, 0)

(B) (0, 24375) means we start with 24375 ft^2 under the tent before moving anything.

(C) 40000 ft^2 is the area obtainable with shifting 125 ft from the length to the width.

3. A volleyball is hit up near the batting cages in the middle school gym. A student goes up there and grabs the ball to throw it down for the game to continue. The student throws the volleyball downwards at 15 feet per second from a height of 25 feet. This is modeled by the equation

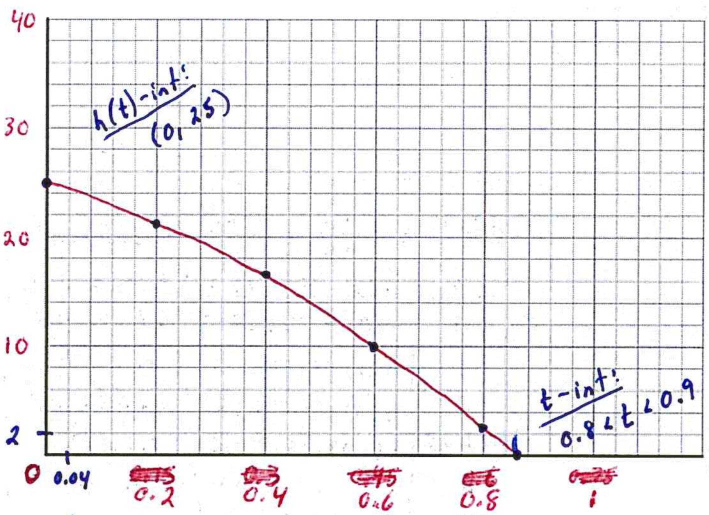
$h(t) = -16t^2 - 15t + 25$

Scale: Release height / 4

$\frac{25}{4}$

6.25

Round to 10



Scale: $\frac{\text{Bottom Table value}}{6} = \frac{0.9}{6} = 0.15$ Round to 0.2

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

t	$h(t) = -16t^2 - 15t + 25$	$(t, h(t))$
0	$h(0) = -16(0)^2 - 15(0) + 25$	(0, 25)
0.1	$h(0.1) = -16(0.1)^2 - 15(0.1) + 25$	(0.1, 23.34)
0.2	$h(0.2) = -16(0.2)^2 - 15(0.2) + 25$	(0.2, 21.36)
0.3	$h(0.3) = -16(0.3)^2 - 15(0.3) + 25$	(0.3, 19.06)
0.4	$h(0.4) = -16(0.4)^2 - 15(0.4) + 25$	(0.4, 16.44)
0.5	$h(0.5) = -16(0.5)^2 - 15(0.5) + 25$	(0.5, 13.5)
0.6	$h(0.6) = -16(0.6)^2 - 15(0.6) + 25$	(0.6, 10.24)
0.7	$h(0.7) = -16(0.7)^2 - 15(0.7) + 25$	(0.7, 6.66)
0.8	$h(0.8) = -16(0.8)^2 - 15(0.8) + 25$	(0.8, 2.76)
0.9	$h(0.9) = -16(0.9)^2 - 15(0.9) + 25$	(0.9, -1.46)

Ⓐ $0.8 < t < 0.9$ The volleyball hit the court between 0.8 and 0.9 sec.

Ⓑ (0, 25) The volleyball was thrown from 25 ft in the air.

Ⓒ 25 ft since the volleyball doesn't float up it will never rise above 25 ft.

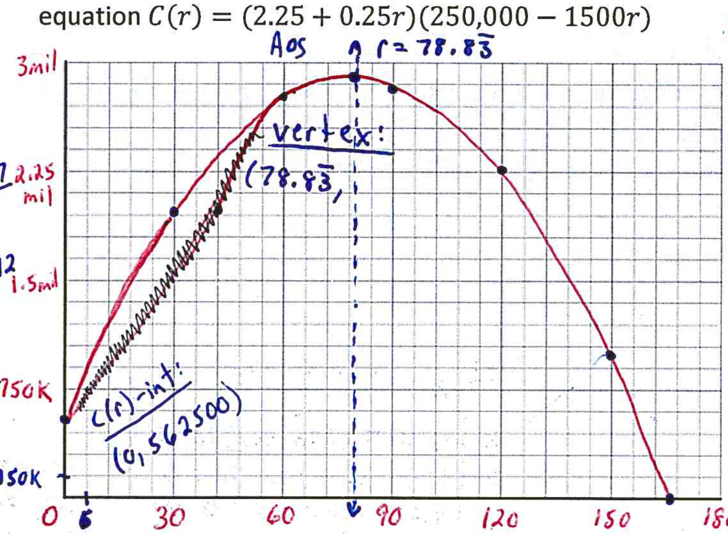
4. The Chicago Tribune sells their Sunday papers for \$2.25 per issue currently. At this rate the paper is selling about 250,000 papers per week. The paper however needs to increase the price that they are charging for the paper to accommodate for problems that have come up in their office. For every quarter they increase the price of the paper it has been projected that they will lose 1500 papers per week in sales. The maximum profit and the amount of increase you should charge is given by the equation $C(r) = (2.25 + 0.25r)(250{,}000 - 1500r)$

Scale: value vertex / 4

$\frac{2893010.417}{4}$

723252.6042

Round to 750,000



Scale: $\frac{\text{Pos x-int}}{6} = \frac{166.\overline{6}}{6} = 27.\overline{7}$ Round to 30

Ⓐ r-int: $2.25 + 0.25r = 0$; $-2.25 \quad -2.25$; $\frac{0.25r}{0.25} = \frac{-2.25}{0.25}$; $r = -9$

$250000 - 1500r = 0$; $+1500r \quad +1500r$; $\frac{250000}{1500} = \frac{1500r}{1500}$; $r = 166.\overline{6}$

(-9, 0) If we reduce the cost by 9 Quarters its free

$(166.\overline{6}, 0)$ We are no longer selling any papers if we increase the cost by \$41.67.

AOS: $r = \frac{166.\overline{6} + (-9)}{2} = 78.8\overline{3}$

r	$C(r) = (2.25 + 0.25r)(250{,}000 - 1500r)$	
0	$C(0) = (2.25 + .25(0))(250000 - 1500(0))$	(0, 562500)
30	$C(30) = (2.25 + .25(30))(250000 - 1500(30))$	(30, 1998750)
60	$C(60) = (2.25 + .25(60))(250000 - 1500(60))$	(60, 2760000)
$78.8\overline{3}$	$C(78.8\overline{3}) = (2.25 + .25(78.8\overline{3}))(250K - 1500(78.8\overline{3}))$	$(78.8\overline{3}$, 2893010.
90	$C(90) = (2.25 + .25(90))(250000 - 1500(90))$	(90, 2846250)
120	$C(120) = (2.25 + .25(120))(250000 - 1500(120))$	(120, 2257500)
150	$C(150) = (2.25 + .25(150))(250000 - 1500(150))$	(150, 993750)
$166.\overline{6}$	$C(166.\overline{6}) = (2.25 + .25(166.\overline{6}))(250K - 1500(166.\overline{6}))$	$(166.\overline{6}$, 0)

Ⓑ (0, 562500) with the current price of the paper the Tribune is making \$562,500 per week.

Ⓒ \$2,893,010.42 is the maximum projected profit by increasing the cost per paper by \$41.67 making each paper \$43.92 and losing ~~[illegible]~~ 118250 customers.