Real-World Applications – Day 4

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

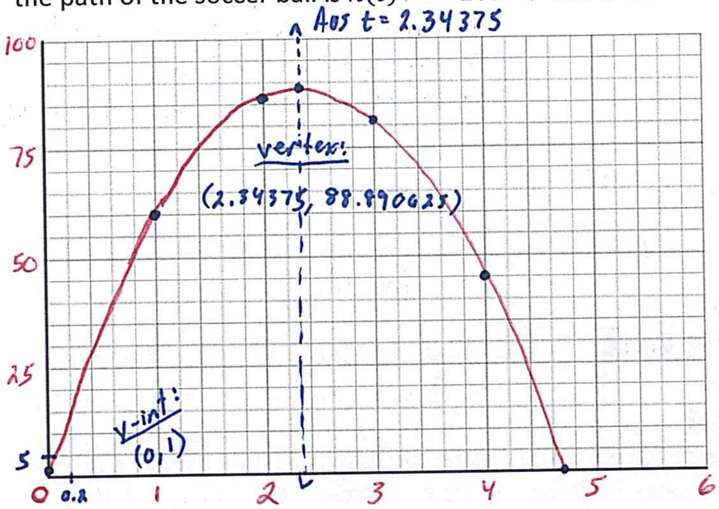
C. Identify the maxima/minima of the function and tell what it means

D. Graph and label the function

1. Andrew shoots a soccer ball at 75 feet per second from a height of 1 foot. The equation that shows the path of the soccer ball is $h(t) = -16t^2 + 75t + 1$.

AOS: $t = \frac{-b}{2a} = \frac{-75}{-32} = 2.34375$

Scale $\frac{\text{y value vertex}}{4} = \frac{88.890625}{4} = 22.22265625$ Round to 25



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

t	$h(t) = -16t^2 + 75t + 1$	
0	$h(0) = -16(0)^2 + 75(0) + 1$	(0, 1)
1	$h(1) = -16(1)^2 + 75(1) + 1$	(1, 60)
2	$h(2) = -16(2)^2 + 75(2) + 1$	(2, 87)
2.34375	$h(2.34375) = -16(2.34375)^2 + 75(2.34375) + 1$	(2.34375, 88.890625)
3	$h(3) = -16(3)^2 + 75(3) + 1$	(3, 82)
4	$h(4) = -16(4)^2 + 75(4) + 1$	(4, 45)
5	$h(5) = -16(5)^2 + 75(5) + 1$	(5, -24)

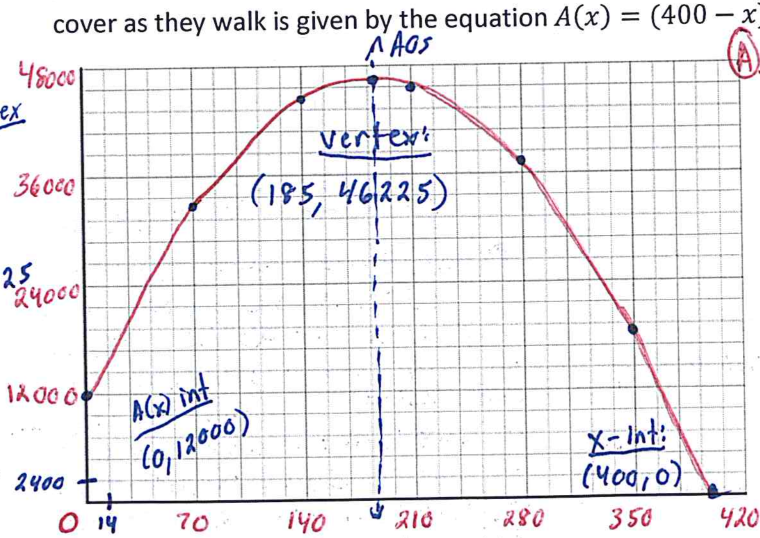
A) $4 < t < 5$ The ball hits the ground after 4 seconds, but before 5 sec.

B) (0, 1) The ball left Andrews foot from 1 ft in the air.

C) 88.890625 ft is how high the ball will get before falling back 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 30 foot by 400 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 $A(x) = (400 - x)(30 + x)$

Scale: $\frac{\text{y value vertex}}{4} = \frac{46225}{4} = 11556.25$ Round to 12000



Scale: $\frac{\text{Pos x-int}}{6} = \frac{400}{6} = 66.\overline{6}$ Round up to 70

A) x-int: $400 - x = 0$; $+x \quad +x$; $400 = x$; (400, 0)

$30 + x = 0$; $-30 \quad -30$; $x = -30$; (−30, 0)

AOS: $x = \frac{400 + (-30)}{2} = \frac{370}{2} = 185$

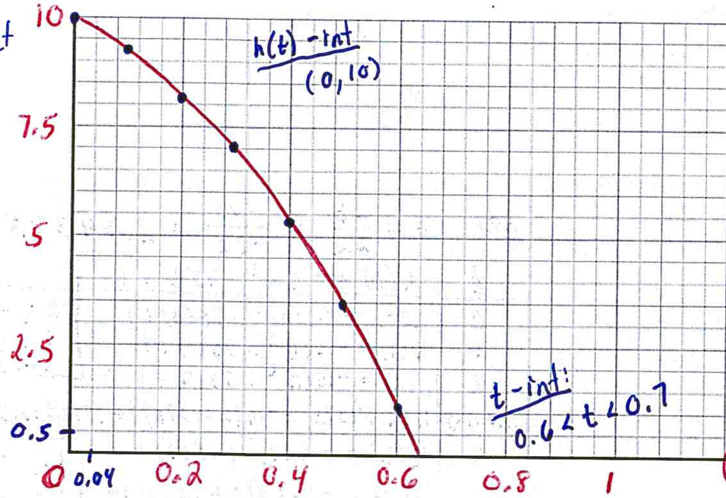
x	$A(x) = (400 - x)(30 + x)$	$(x, A(x))$
0	$A(0) = (400-0)(30+0)$	(0, 12000)
70	$A(70) = (400-70)(30+70)$	(70, 33000)
140	$A(140) = (400-140)(30+140)$	(140, 44200)
185	$A(185) = (400-185)(30+185)$	(185, 46225)
210	$A(210) = (400-210)(30+210)$	(210, 45600)
280	$A(280) = (400-280)(30+280)$	(280, 37200)
350	$A(350) = (400-350)(30+350)$	(350, 19000)
400	$A(400) = (400-400)(30+400)$	(400, 0)

B) (0, 12000) Not moving any we have 12000 ft² under the tent.

C) 46225 ft² obtainable area with a shift of 185

3. A mechanic is changing the oil in a vehicle from down in a pit. The mechanic realizes that he has forgotten the oil filter up in the garage and asks his assistant to toss him down one for this vehicle. The assistant tosses the filter down at 5 feet per second from a height of 10 feet above the pit floor. This is modeled by the equation $h(t) = -16t^2 - 5t + 10$

Scale: $\frac{\text{release height}}{4} = \frac{10}{4} = 2.5$



Scale: $\frac{\text{Bottom table value}}{6} = \frac{0.7}{6} = 0.11\overline{6}$

Round to 0.2

AOS: $t = \frac{-b}{2a} = \frac{5}{-32} = -0.15625$

t	$h(t) = -16t^2 - 5t + 10$	$(t, h(t))$
0	$h(0) = -16(0)^2 - 5(0) + 10$	(0, 10)
0.1	$h(0.1) = -16(0.1)^2 - 5(0.1) + 10$	(0.1, 9.34)
0.2	$h(0.2) = -16(0.2)^2 - 5(0.2) + 10$	(0.2, 8.36)
0.3	$h(0.3) = -16(0.3)^2 - 5(0.3) + 10$	(0.3, 7.06)
0.4	$h(0.4) = -16(0.4)^2 - 5(0.4) + 10$	(0.4, 5.44)
0.5	$h(0.5) = -16(0.5)^2 - 5(0.5) + 10$	(0.5, 3.5)
0.6	$h(0.6) = -16(0.6)^2 - 5(0.6) + 10$	(0.6, 1.24)
0.7	$h(0.7) = -16(0.7)^2 - 5(0.7) + 10$	(0.7, -1.34)

A) $0.6 < t < 0.7$ The filter hit the ground between 0.6 sec and 0.7 sec.

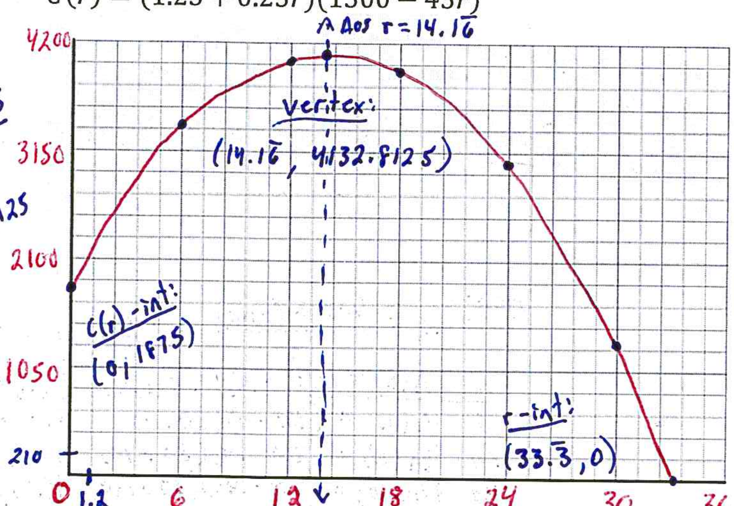
B) (0, 10) The filter was release 10 ft in the air.

C) 10 ft since the filter was thrown down it would never be higher than the release height.

4. The Hoopeston Chronicle sells their papers for $1.25 per issue currently. At this rate the paper is selling about 1500 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 45 papers per week in sales. The maximum profit and the amount of increase you should charge is given by the equation $C(r) = (1.25 + 0.25r)(1500 - 45r)$

Scale: $\frac{\text{y value vertex}}{4} = \frac{4132.8125}{4} = 1033.203125$

Round to 1050



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

A) r-int: $1.25 + 0.25r = 0$

$-1.25 \quad -1.25$

$\frac{0.25r}{0.25} = \frac{-1.25}{0.25}$

$r = -5$

$(-5, 0)$

$1500 - 45r = 0$

$+45r \quad +45r$

$\frac{1500}{45} = \frac{45r}{45}$

$r = 33.\overline{3}$

$(33.\overline{3}, 0)$

AOS $r = \frac{33.\overline{3} + (-5)}{2} = 14.1\overline{6}$

r	$C(r) = (1.25 + 0.25r)(1500 - 45r)$	$(r, C(r))$
0	$C(0) = (1.25 + 0.25(0))(1500 - 45(0))$	(0, 1875)
6	$C(6) = (1.25 + 0.25(6))(1500 - 45(6))$	(6, 3382.5)
12	$C(12) = (1.25 + 0.25(12))(1500 - 45(12))$	(12, 4080)
$14.1\overline{6}$	$C(14.1\overline{6}) = (1.25 + .25(14.1\overline{6}))(1500 - 45(14.1\overline{6}))$	(14.16, 4132.812)
18	$C(18) = (1.25 + 0.25(18))(1500 - 45(18))$	(18, 3967.5)
24	$C(24) = (1.25 + 0.25(24))(1500 - 45(24))$	(24, 3045)
30	$C(30) = (1.25 + 0.25(30))(1500 - 45(30))$	(30, 1312.5)
$33.\overline{3}$	$C(33.\overline{3}) = (1.25 + 0.25(33.\overline{3}))(1500 - 45(33.\overline{3}))$	(33.3, 0)

B) (0, 1875) Prior to raising the price the paper is making $1875.

C) $4132.81 is how much they can make by increasing the cost by $3.54 making the paper $4.79 and losing 637.5 customers.