Real-World Applications – Creating Equations Day 1

Unit 2B: Quadratic Functions - Modeling

For each of the following:

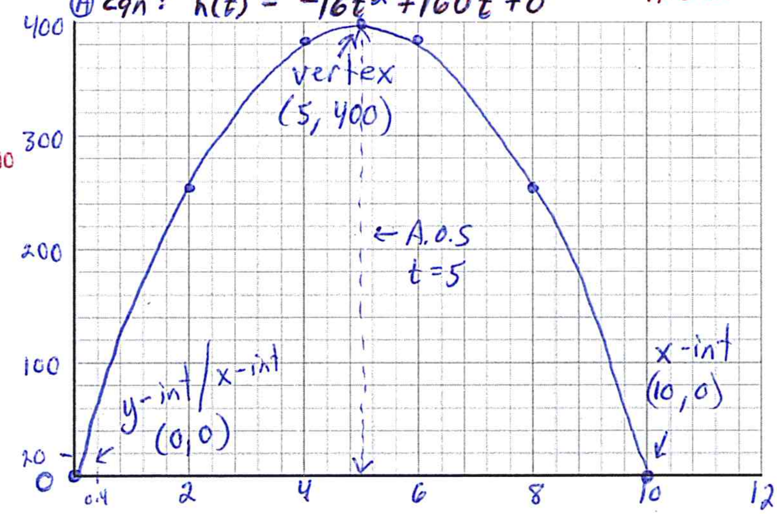
A. Write the equation that models the given context
B. Identify the x-intercept(s) and tell what they mean
C. Identify the y-intercept and tell what it means
D. Identify the maxima/minima of the function and tell what it means
E. Graph the function

1. Ryan hits a golf ball off a tee that has the ball sitting on the ground. He hits the ball with an initial velocity of 160 feet per second.

(A) Eqn: $h(t) = -16t^2 + 160t + 0$

A.O.S. $t = \frac{-b}{2a} = \frac{-160}{2(-16)} = \frac{-160}{-32} = 5$

Scale: $\frac{400}{4} = 100$



Scale: $\frac{10}{6} = 1.\overline{6}$ Round to 2

t	$h(t) = -16t^2 + 160t$	$(t, h(t))$
0	$h(0) = -16(0)^2 + 160(0)$	(0, 0)
2	$h(2) = -16(2)^2 + 160(2)$	(2, 256)
4	$h(4) = -16(4)^2 + 160(4)$	(4, 384)
5	$h(5) = -16(5)^2 + 160(5)$	(5, 400)
6	$h(6) = -16(6)^2 + 160(6)$	(6, 384)
8	$h(8) = -16(8)^2 + 160(8)$	(8, 256)
10	$h(10) = -16(10)^2 + 160(10)$	(10, 0)

(B) (0, 0) & (10, 0) Ball was on the ground when hit and 10 seconds after.

(C) (0, 0) Ball started on the ground.

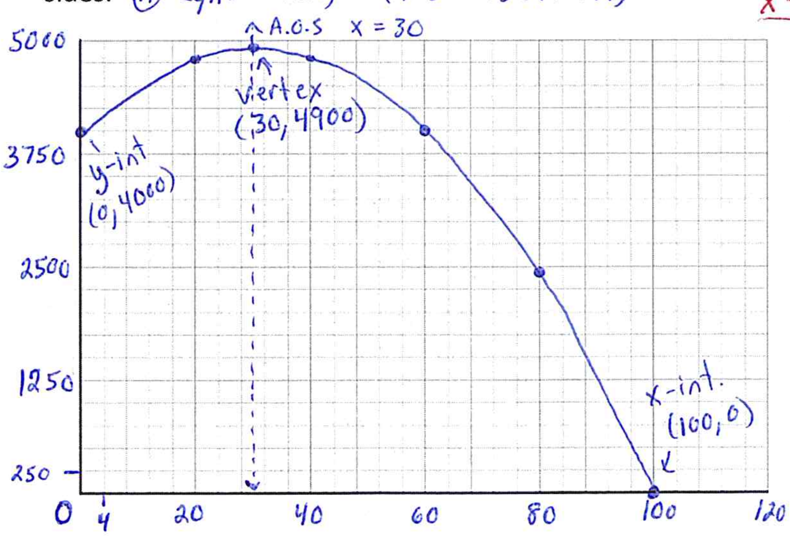
(D) 400 Highest the ball will go up.

2. A group of children are given a bag full of Mega Blocks and asked to construct a figure that will hold the most stuff in it. The children create a figure that is rectangular and is 100 blocks by 40 blocks. When checking with the teacher they were told could make something that will hold more. Since the children used all the blocks whatever they took from the larger side was what they could place on the shorter sides. (A) Eqn: $A(x) = (100 - x)(40 + x)$

x-intercepts: $100 - x = 0$, $+x \quad +x$, $100 = x$; $40 + x = 0$, $-40 \quad -40$, $x = -40$

Scale: $\frac{4900}{4} = 1225$

Keep or round to 1250 or 1500



A.O.S. $x = \frac{100 + (-40)}{2} = 30$

x	$A(x) = (100 - x)(40 + x)$	$(x, A(x))$
0	$A(0) = (100 - 0)(40 + 0)$	(0, 4000)
20	$A(20) = (100 - 20)(40 + 20)$	(20, 4800)
30	$A(30) = (100 - 30)(40 + 30)$	(30, 4900)
40	$A(40) = (100 - 40)(40 + 40)$	(40, 4800)
60	$A(60) = (100 - 60)(40 + 60)$	(60, 4000)
80	$A(80) = (100 - 80)(40 + 80)$	(80, 2400)
100	$A(100) = (100 - 100)(40 + 100)$	(100, 0)

Scale: $\frac{100}{6} = 16.\overline{6}$ Round to 17 or 20

(B) (100, 0) Moved the whole length to the width so now no enclosed area.

(C) (0, 4000) Original area 4000 units^2

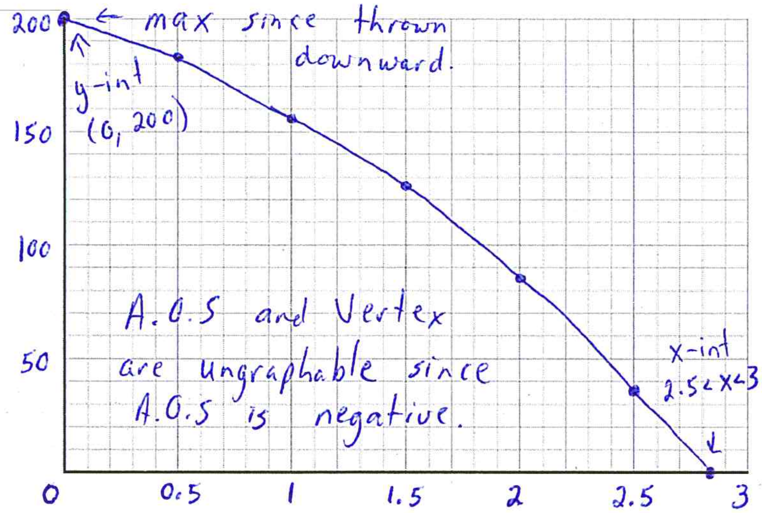
(D) 4900 Max area obtainable by shifting 30 blocks.

3. A farmer's employee went to the top of a grain bin to pull something off that got caught during the last storm we had. The top of the grain bin is 200 foot high and they threw the object downward at 25 feet per second. (A) Eqn: $h(t) = -16t^2 - 25t + 200$

A.O.S. $t = \frac{-b}{2a} = \frac{-(-25)}{2(-16)} = \frac{25}{-32} = -0.78125$

t	$h(t) = -16t^2 - 25t + 200$	$(t, h(t))$
0	$h(0) = -16(0)^2 - 25(0) + 200$	$(0, 200)$
.5	$h(.5) = -16(.5)^2 - 25(.5) + 200$	$(.5, 183.5)$
1	$h(1) = -16(1)^2 - 25(1) + 200$	$(1, 159)$
1.5	$h(1.5) = -16(1.5)^2 - 25(1.5) + 200$	$(1.5, 126.5)$
2	$h(2) = -16(2)^2 - 25(2) + 200$	$(2, 86)$
2.5	$h(2.5) = -16(2.5)^2 - 25(2.5) + 200$	$(2.5, 37.5)$
3	$h(3) = -16(3)^2 - 25(3) + 200$	$(3, -19)$

Scale $\frac{200}{4} = 50$



Scale: $\frac{3}{6} = 0.5$

(B) $2.5 < x < 3$ $(2.8395719, 0)$ Took the object 2.8 sec to hit the ground.

(C) $(0, 200)$ Height object was thrown from.

(D) 200 since thrown down max height is the release height.

4. The FFA is selling boxes of fruit again this year and last year they were selling the large sample boxes for \$40 each. The FFA wants to maximize their profit from the large boxes and predict that if they increase their prices by increments of \$1 they will lose 5 customers on top of their previous 500 customers. (A) Eqn: $C(r) = (40 + r)(500 - 5r)$

r-intercepts:

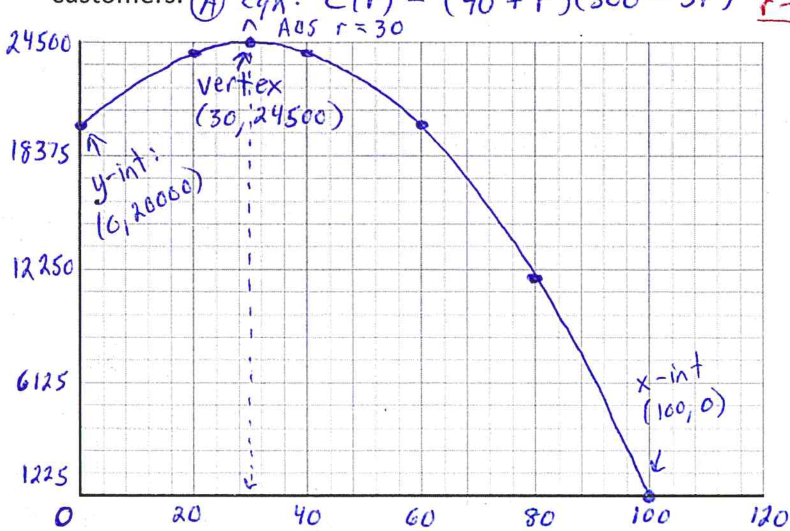
$40 + r = 0$
$-40 \quad -40$
$r = -40$

$500 - 5r = 0$
$+5r \quad +5r$
$\frac{500}{5} = \frac{5r}{5}$
$100 = r$

A.O.S. $r = \frac{100 + (-40)}{2} = 30$

r	$C(r) = (40+r)(500-5r)$	$(r, C(r))$
0	$C(0) = (40+0)(500-5(0))$	$(0, 20000)$
20	$C(20) = (40+20)(500-5(20))$	$(20, 24000)$
30	$C(30) = (40+30)(500-5(30))$	$(30, 24500)$
40	$C(40) = (40+40)(500-5(40))$	$(40, 24000)$
60	$C(60) = (40+60)(500-5(60))$	$(60, 20000)$
80	$C(80) = (40+80)(500-5(80))$	$(80, 12000)$
100	$C(100) = (40+100)(500-5(100))$	$(100, 0)$

Scale $\frac{24500}{4} = 6125$



Scale: $\frac{100}{6} = 16.\overline{6}$ round to 17 or 20

(B) $(100, 0)$ Raising the cost to \$140 per box means the FFA will no longer have any customers.

(C) $(0, 20000)$ without adjusting the cost, sales are \$20,000.

(D) \$24,500 max sales possible by selling each box for \$70, but lossing 150 customers.