More Real Life Situations Modeled With Quadratic Equations

1. $h = -16t^2 + 16t + 480$

a) How long to reach max. height?
Find L.O.S.

$LOS = \frac{-b}{2a} = \frac{-16}{2(-16)} = \frac{1}{2}$ second

b) Highest point? Find vertex

$h = -16t^2 + 16t + 480$
$= -16(0.5)^2 + 16(0.5) + 480$
$= 484$ feet

c) When does he hit the water?
Find 2nd x-intercept

$\frac{0}{-16} = \frac{-16t^2}{-16} + \frac{16t}{-16} + \frac{480}{-16}$

$0 = t^2 - t - 30$

$0 = (t-6)(t+5)$

$t - 6 = 0$ $\quad$ $t - 5 = 0$

6 seconds

2. $h = -16t^2 + 128t = -16t(t-8)$

a) How long to return to ground?
Find 2nd x-intercept

$0 = -16t(t-8)$

$-16t = 0$ $\quad$ $t - 8 = 0$

$t = 0$ $\quad$ $t = 8$

8 seconds

b) When will it be at 112 ft?
Solve for t when $h = 112$

$112 = -16t^2 + 128t$
$-112 \qquad\qquad -112$

$\frac{0}{-16} = \frac{-16t^2}{-16} + \frac{128t}{-16} - \frac{112}{-16}$

$0 = t^2 - 8t + 7$

$0 = (t-7)(t-1)$

$0 = t - 7$ $\quad$ $0 = t - 1$

At 1 and 7 seconds

c) When will it reach max. height?
Find LOS

$LOS = \frac{-b}{2a} = \frac{-128}{2(-16)} = 4$

4 seconds

d) What is max height?
Substitute in LOS

$h = -16(4)^2 + 128(4)$
$= 256$ feet

3. $h = -16t^2 + 150t - 3$

When will it hit the target?

Find 2nd x-intercept

9.39 seconds

$0 = -16t^2 + 150t - 3$

$t = \frac{-150 \pm \sqrt{(150)^2 - 4(-16)(-3)}}{-16(2)}$

$t = \frac{-150 \pm \sqrt{150^2 - 192}}{-32}$

$t = 9.39$

4. $h = -16t^2 + 32t + 5$

a) Maximum height?

Find vertex

$LOS = \frac{-b}{2a} = \frac{-32}{2(-16)} = 1$

$h = -16(1)^2 + 32(1) + 5$

$= 21$ feet

b) Can you throw high enough to reach ledge 20ft above?

Yes, according to vertex

Can also use discriminant.

$20 = -16t^2 + 32t + 5$

$-20 \quad\quad -20$

$0 = -16t^2 + 32t - 15$

$b^2 - 4ac = 32^2 - 4(32)(-15)$

$= 2944$

> 0

YES

5. $h = -16t^2 + 12t = -4t(4t - 3)$

a) Max height of feet above ground?

Find vertex

$LOS = \frac{-b}{2a} = \frac{-12}{2(-16)} = 0.375$

$h = -4(0.375)(4(.375) - 3)$

$= 2.25$

2.25 feet

NO, you can't dunk!

6. a. $h = -16t^2 + 8t + 24$

$= -8(t + 1)(2t - 3)$

How long to hit the water? Find 2nd x-intercept

$0 = -8(t + 1)(2t - 3)$

$t + 1 = 0$ $\quad\quad$ $2t - 3 = 0$

$t = -1$ $\quad\quad$ $t = \frac{3}{2}$

1.5 seconds

7. $h = -16t^2 + 5t + 15$

How long to hit the ground? Find 2nd x-int

$$x = \frac{-5 \pm \sqrt{5^2 - 4(-16)(15)}}{2(-16)} = \frac{-5 \pm \sqrt{25 + 960}}{-32}$$

= 1.14 seconds

8. $h = -16t^2 + 39t$

Can the ball reach 25 ft? Use the discriminant.

$25 = -16t^2 + 39t$

$-25 \quad -25$

$0 = -16t^2 + 39t - 25$

$b^2 - 4ac = (39)^2 - 4(-16)(-25)$

$= 1521 - 1600$

$= -79$

The ball will NOT hit the ball.

9. $h = -16t^2 + 315t$

How long will it be above 1000 ft? Find x-ints

$1000 = -16t^2 + 315t$

$-1000 \quad -1000$

$0 = -16t^2 + 315t - 1000$

$$t = \frac{-315 \pm \sqrt{(315)^2 - 4(-16)(-1000)}}{2(-16)}$$

$t = 3.98$ and 19.71

$19.71 - 3.98 = 11.73$

The rocket will be out of sight for 11.73 sec.

10 a) Starting height = 49 ft

b) $h = 0$ when the anchor hits the water

c) When will the anchor hit the water? Find 2nd x-int

$0 = -16t^2 + 49$

$-49 \quad -49$

$\frac{-49}{-16} = \frac{-16t^2}{-16}$

$\sqrt{3.0625} = \sqrt{t^2}$

1.75 sec

d) $-52 = -16t^2 + 49$

$-49 \quad -49$

$\frac{-101}{-16} = \frac{-16t^2}{-16}$

$\sqrt{6.3125} = \sqrt{t^2}$

$\pm 2.51 = t$

2.51 sec

11. $h = -16t^2 + 35t$

When will it reach 80 ft? Find x-ints when $h = 80$

$80 = -16t^2 + 35t$

$-80 \qquad -80$

$0 = -16t^2 + 35t - 80$

It will NEVER reach 80 ft.

$$t = \frac{-35 \pm \sqrt{35^2 - 4(-16)(-80)}}{2(-16)}$$

$$t = \frac{-35 \pm \sqrt{-3495}}{-32}$$

indicates NO solution

12. a) $h = -16t^2 + 116t + 101$

b) $$t = \frac{-116 \pm \sqrt{(116)^2 - 4(-16)(101)}}{2(-16)}$$

$t = -0.79$ and 8.04

8.04 seconds

13. $h = -4.9t^2 + 27t + 2.4$

a) $h = -4.9(1)^2 + 27(1) + 2.4$

$= 24.5$

24.5 feet

b) How long above 30 m? Find x-ints when $h = 30$.

$30 = -4.9t^2 + 27t + 2.4$

$-30 \qquad -30$

$0 = -4.9t^2 + 27t - 27.6$

$$t = \frac{-27 \pm \sqrt{27^2 - 4(-4.9)(-27.6)}}{2(-4.9)}$$

$t = 1.36$ and 4.15

$4.15 - 1.36 = 2.79$

It will be above 30 feet for 2.79 sec.

c) Max height, find vertex.

LOS: $\frac{-b}{2a} = \frac{-27}{2(-4.9)} = 2.76$

$h = -4.9(2.76)^2 + 27(2.76) + 2.4$

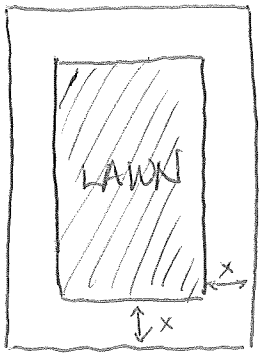
$= 39.59$

Max height = 39.59 meters

d) When will it hit the ground? Get 2nd x-int from part b.

4.15 sec

14.



Measurements of total area: $(2x+4)$ and $(2x+8)$

$(2x+4)(2x+8) = 165$

$4x^2 + 24x + 32 = 165$

$-165 \quad -165$

$4x^2 + 24x - 133 = 0$

$x = \frac{-24 \pm \sqrt{24^2 - 4(4)(-133)}}{2(4)}$

$x = -9.5$ and 3.5 — only one that makes sense

Width of flower bed 3.5 m

15. For every \$.1 increase in ticket price 20 fewer people attend. We know if the tickets cost \$11, 400 people will attend.

Let's make a table for revenue vs. ticket price

price(\$)	# of people	revenue
11	400	4400
12	380	4560
13	360	4680
14	340	4760
15	320	4800
16	300	4800
17	280	4760

maximum revenue between 15 & 16

\$15.50 tickets will get max revenue

We can write an equation: (if we want...)

2nd difference from the table is -40, so $a = -20$

$LOS = \frac{-b}{2a} \Rightarrow 15.5 = \frac{-b}{2(-20)}$

$b = 620$

Revenue $= -20x^2 + 620x + C$

Find C:

$4400 = -20(11)^2 + 620(11) + C$

$4400 = -2420 + 6820 + C$

$4400 = 4400 + C$

$0 = C$

Equation: $y = -20x^2 + 620x = (-20x)(x - 31)$

16. $h = -16t^2 + 20t - 4$

a) 4 feet

b) How long before the ball hits the ground? Find 2nd x-int.

$0 = -16t^2 + 20t - 4$

$0 = -4(4t^2 - 5t + 1)$

$0 = -4(4t^2 - 4t - t + 1)$

$0 = -4(4t-1)(t-1)$

$0 = 4t - 1$ or $0 = t - 1$

$\frac{1}{4} = t$ or $1 = t$

1 second

17. $d = 0.05v^2 + 2.2v$

$200 = 0.05v^2 + 2.2v$

$-200 \quad -200$

$0 = 0.05v^2 + 2.2v - 200$

$$v = \frac{-2.2 \pm \sqrt{(2.2)^2 - 4(0.05)(-200)}}{2(0.05)}$$

$v = -88.96$ and 44.96

44.96 miles/hr

18. $h = -16t^2 + 20t + 4$

To find how many chances, calculate the discriminant when $h = 13$

$13 = -16t^2 + 20t + 4$

$-13 \quad -13$

$0 = -16t^2 + 20t - 9$

$b^2 - 4ac = 20^2 - 4(-16)(-9)$

$= 400 - 576 = -176$

Zero chances

You can also find the vertex $\quad -\frac{b}{2a} = \frac{-20}{2(-16)} = 0.625$

$h = -16(0.625)^2 + 20(0.625) + 4$

$h = 10.25$ ft

2.75 feet too low!