## Are there any Homework Questions you would like to see on the board?

pp. 239-241 # 2, 4 – 8, 13 **AND** 6bc, 7, 13a
READ p. 253 **AND**
Work ahead on Review: pp. 254-255 # 1 – 10, 3

# Today's Learning Goal(s):

By the end of the class, I will be able to:

a) Determine the equation of a curve using vertex form.

p. 240

**3.** A cliff diver dives from about 17 m above the water. The diver's height above the water, $h(t)$, in metres, after $t$ seconds is modelled by $h(t) = -4.9t^2 + 1.5t + 17$. Explain how to determine when the diver is 5 m above the water.

**4.** Determine when the diver in question 3 is 5 m above the water.

$h(t) = 5$

$\therefore 5 = -4.9t^2 + 1.5t + 17$

$0 = -4.9t^2 + 1.5t + 17 - 5$

$= -4.9t^2 + 1.5t + 12$

$a = -4.9 \quad b = 1.5 \quad c = 12$

$$t = \frac{-1.5 \pm \sqrt{1.5^2 - 4(-4.9)(12)}}{2(-4.9)}$$

$$= \frac{-1.5 \pm \sqrt{237.45}}{-9.8}$$

$\therefore t = \dfrac{-1.5 + \sqrt{237.45}}{-9.8}$ or $t = \dfrac{-1.5 - \sqrt{237.45}}{-9.8}$

$\doteq -1.419$ $\doteq 1.725$

inadmissible

$\therefore$ the diver is 5 m above the water at 1.73 seconds.

p. 240 **6.** The population of a town is modelled by the function $P(t) = 6t^2 + 110t + 4000$, where $P(t)$ is the population and $t$ is the time in years since 2000.

a) What will the population be in 2020?
b) When will the population be 6000?
c) Will the population ever be 0? Explain your answer.

b) $P(t)=6000$

$\therefore 6000 = 6t^2+110t+4000$

$0 = 6t^2+110t+4000-6000$

$= 6t^2+110t-2000$

$a=6 \quad b=110 \quad c=-2000$

$t = \dfrac{-110 \pm \sqrt{110^2-4(6)(-2000)}}{2(6)}$

$= \dfrac{-110 \pm \sqrt{60100}}{12}$

$t = \dfrac{-110+\sqrt{60100}}{12}$ or $t = \dfrac{-110-\sqrt{60100}}{12}$

$\doteq 11.26$ $\qquad \doteq -29.596$

$\therefore 2000 + 11.26$ $\qquad \therefore t \doteq 2000 - 29.596$

$\doteq 2011.2$ $\qquad \doteq 1970.4$

$\therefore$ the population WAS 6000 in 1970, and was again in 2011.

c) $P(t)=0$?

$0 = 6t^2+110t+4000$

$a=6 \quad b=110 \quad c=4000$

$t = \dfrac{-110 \pm \sqrt{110^2-4(6)(4000)}}{2(6)}$

$= \dfrac{-110 \pm \sqrt{-83\,900}}{12}$

$\therefore$ there are no possible solutions

it means the population will NEVER be 0.

p. 240 **7.** The profit of a shoe company is modelled by the quadratic function $P(x) = -5(x-4)^2 + 45$, where $x$ is the number of pairs of shoes produced, in thousands, and $P(x)$ is the profit, in thousands of dollars. How many thousands of pairs of shoes will the company need to sell to earn a profit?

Break-even when $P(x)=0$

$0 = -5(x-4)^2+45$

$= -5(x^2-8x+16)+45$

$= -5x^2+40x-80+45$

$= -5x^2+40x-35$

$= -5(x^2-8x+7)$

$= -5(x-1)(x-7)$

$\therefore x=1$ or $x=7$

this means the profit is 0 for sales of 1000 and 7000 pairs of shoes.

$\therefore$ the company must sell 1001 pairs of shoes to make a profit.

(and less than 6999 pairs.)

p. 241 **13.** The height of a soccer ball kicked in the air is given by the quadratic equation $h(t) = -4.9(t - 2.1)^2 + 23$, where time, $t$, is in seconds and height, $h(t)$, is in metres.

**a)** What was the height of the ball when it was kicked?
**b)** What is the maximum height of the ball?
**c)** Is the ball still in the air after 6 s? Explain.
**d)** When is the ball at a height of 10 m?

a) let $t=0$ $\therefore h(0) = -4.9(0-2.1)^2 + 23$
$= -4.9(4.41) + 23$
$= -21.609 + 23$
$= 1.391$

$\therefore$ the ball was 1.391 m above the ground when it was kicked.

**Lesson 4.2**

p. 254 **3.** Write in vertex form by completing the square.

**a)** $f(x) = x^2 + 2x - 15$
**b)** $f(x) = -x^2 + 8x - 7$
**c)** $f(x) = 2x^2 + 20x + 16$
**d)** $f(x) = 3x^2 + 12x + 19$
**e)** $f(x) = \frac{1}{2}x^2 - 6x + 26$
**f)** $f(x) = 2x^2 + 2x + 4$

$f(x) = 3(x^2 + 4x) + 19$
$= 3(x^2 + 4x + 2^2 - 2^2) + 19$
$= 3(x+2)^2 + 3(-4) + 19$
$= 3(x+2)^2 - 12 + 19$
$= 3(x+2)^2 + 7$

MCF 3MI

## 4.6 Using Vertex Form to Create Quadratic Models (from Data)

Date: Apr. 8/19

***Recall:*** Three forms of a **quadratic relation**:

| **Vertex Form** | **Standard Form** | **Factored Form** |
|---|---|---|
| $y = a(x-h)^2 + k$ | $y = ax^2 + bx + c$ | $y = a(x-r)(x-s)$ |

Ex.1: A hose sprays a stream of water across a lawn. (p.244 I

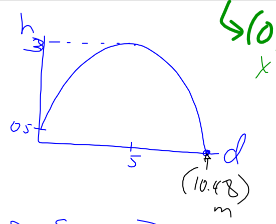
The table shows the approximate height of the stream above the lawn at various distances from the person holding the nozzle.

a) Determine an algebraic model (in vertex form) that relates the height of the water to the distance from the person.

b) State any restrictions on the domain and range of the model.

c) Use the model to predict when the water will hit the ground.

| **Distance from Nozzle (m)** | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|---|
| **Height above Lawn (m)** | 0.5 | 1.4 | 2.1 | 2.6 | 2.9 | 3.0 | 2.9 | 2.5 | 1.9 |




$(0, 0.5)$
$x \quad y$

$v(5,3)$

$y = a(x-5)^2 + 3$

$0.5 = a(0-5)^2 + 3$

$0.5 = a(-5)^2 + 3$

$0.5 - 3 = a(25)$

$-2.5 = 25a$

$\frac{-2.5}{25} = a$

$-\frac{1}{10} = a$

$\therefore h(d) = -\frac{1}{10}(d-5)^2 + 3$ is the equation in vertex form.

b) D: $\{x \in \mathbb{R}\}$ ✗ $\{d \in \mathbb{R} \mid 0 \le d \le 10.48\}$

R: $\{y \in \mathbb{R} \mid y \le 3\}$

c) $h(d) = -\frac{1}{10}(d-5)^2 + 3$

or $h(d) = -0.1(d-5)^2 + 3$

$h(d) = 0$

$0 = -0.1(d-5)^2 + 3$

$= -0.1(d^2 - 10d + 25) + 3$

$= -0.1d^2 + 1d - 2.5 + 3$

$= -0.1d^2 + d + 0.5$

$a = -0.1 \quad b = 1 \quad c = 0.5$

$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

$d = \frac{-(1) \pm \sqrt{(1)^2 - 4(-0.1)(0.5)}}{2(-0.1)}$

$= \frac{-1 \pm \sqrt{1 + 0.2}}{-0.2}$

$= \frac{-1 \pm \sqrt{1.2}}{-0.2}$

$d = \frac{-1 + \sqrt{1.2}}{-0.2}$ or $d = \frac{-1 - \sqrt{1.2}}{-0.2}$

$\doteq -0.477$ $\qquad \doteq 10.477$

$\doteq 10.48$

inadmissible
(distance must be positive)

$h(x) = -0.1(x-5)^2 + 3$

10.477 sec

$\therefore$ the water will hit the ground 10.48 m from the hose

**Today's Homework:**

pp. 250-252 #3, 4ac, 5, 8, 14