

1. a) $f(x) = x^2 - 8x + 15 \quad a=1$

$$\begin{aligned} 0 &= x^2 - 8x + 15 \\ 0 &= (x-3)(x-5) \\ \therefore x &= 3, x = 5 \end{aligned}$$

Answer:

$$f(x) = (x-3)(x-5)$$

b) $f(x) = -0.5x^2 + 3x + 20 \quad a = -0.5$

$$\begin{aligned} mxn &= -10 \\ m+n &= 3 \\ &5, -2 \end{aligned}$$

$$\begin{aligned} 0 &= -0.5x^2 + 3x + 20 \\ 0 &= -0.5x^2 - 2x + 5x + 20 \\ 0 &= -0.5x(x+4) + 5(x+4) \\ 0 &= (x+4)(-0.5x + 5) \end{aligned}$$

$$\begin{aligned} x+4 &= 0 & \text{or} & -0.5x + 5 = 0 \\ x &= -4 & & -0.5x = -5 \\ & & & x = 10 \end{aligned}$$

Answer:

$$f(x) = -0.5(x+4)(x-10)$$

c) $f(x) = -x^2 + 10x - 25 \quad a = -1$

$$0 = -x^2 + 10x - 25$$

$$\begin{aligned} x &= \frac{-10 \pm \sqrt{100 - 4(-1)(-25)}}{2(-1)} \\ x &= \frac{-10 \pm \sqrt{100 - 100}}{-2} \end{aligned}$$

$$\begin{aligned} x &= \frac{-10 \pm \sqrt{0}}{-2} \\ x &= \frac{-10}{-2} = 5 \end{aligned}$$

Answer: $f(x) = -1(x-5)(x-5)$
or $f(x) = -1(x-5)^2$

2 a) $f(x) = 3x^2 - 9x - 54$

$$f(x) = 3(x^2 - 3x) - 54$$

$$f(x) = 3(x^2 - 3x + 9/4 - 9/4) - 54$$

$$f(x) = 3((x-3/2)^2 - 9/4) - 54$$

$$f(x) = 3(x-3/2)^2 - \frac{27}{4} - \frac{216}{4}$$

$$\therefore f(x) = 3(x-3/2)^2 - \frac{243}{4}$$

$$-3 \div 2 = -\frac{3}{2}$$

$$\left(-\frac{3}{2}\right)^2 = \frac{9}{4}$$

2 b) $f(x) = x^2 - 16$ already in standard form
 $a=1$
 $b=0$
 $c=-16$

c) $f(x) = -2x^2 - 32x - 128$ $a=-2$
 $b = \frac{-(-32)}{2(-2)} = \frac{32}{-4} = -8$

$$\begin{aligned} c &= f(-8) = -2(-8)^2 - 32(-8) - 128 \\ &= -2(64) + 256 - 128 \\ &= -128 + 256 - 128 \\ &= 0 \end{aligned}$$

Answer:
 $f(x) = -2(x+8)^2$

3. a) $V(1, 2)$ $P(-1, 10)$

$$\begin{aligned} f(x) &= a(x-1)^2 + 2 \\ 10 &= a(-1-1)^2 + 2 \\ 10 &= a(-2)^2 + 2 \\ 10 &= 4a + 2 \\ 8 &= 4a \\ 2 &= a \end{aligned} \quad \therefore f(x) = 2(x-1)^2 + 2$$

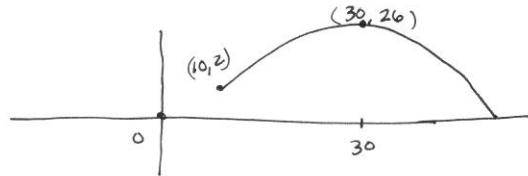
b) $x_1 = (-6, 0)$ $x_2 = (2, 0)$ $P(-4, -6)$

$$\begin{aligned} f(x) &= a(x+6)(x-2) \\ -6 &= a(-4+6)(-4-2) \\ -6 &= a(2)(-6) \\ -6 &= -12a \\ 1/2 &= a \end{aligned} \quad \therefore f(x) = 1/2(x+6)(x-2)$$

c) $P(1, 10)$ $Q(5, 10)$ $V(h, -2)$ $h = \frac{1+5}{2} = \frac{6}{2} = 3$

$$\begin{aligned} f(x) &= a(x-3)^2 - 2 \\ 10 &= a(5-3)^2 - 2 \\ 10 &= a(2)^2 - 2 \\ 10 &= 4a - 2 \\ 12 &= 4a \\ 3 &= a \end{aligned} \quad \therefore f(x) = 3(x-3)^2 - 2$$

4.



a) $v(30, 26) \quad P(10, 2)$

$$\begin{aligned}
 f(x) &= a(x-30)^2 + 26 \\
 2 &= a(10-30)^2 + 26 \\
 2 &= a(-20)^2 + 26 \\
 2 &= 400a + 26 \\
 -24 &= 400a \\
 -0.06 &= \frac{-24}{400} = a
 \end{aligned}
 \quad \therefore f(x) = -\frac{3}{50}(x-30)^2 + 26$$

b) let $y = 1.2$

$$\begin{aligned}
 1.2 &= -0.06(x-30)^2 + 26 \\
 -24.8 &= -0.06(x-30)^2 \\
 \pm \sqrt{413.3} &= (x-30) \\
 \pm 20.331 &= x-30
 \end{aligned}$$

$$50.331 = x \quad \text{or} \quad x = 9.67$$

Answer: Approximately
50.33 m from
the centre of the
field

c) ① let $x = 60$

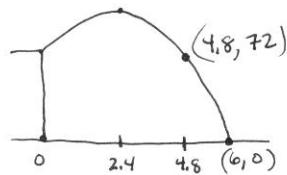
$$\begin{aligned}
 f(50) &= -0.06(60-30)^2 + 26 \\
 f(50) &= -0.06(30)^2 + 26 \\
 &= -54 + 26 \\
 &= -28 \quad \text{impossible}
 \end{aligned}$$

② let $y = 0$

$$\begin{aligned}
 0 &= -0.06(x-30)^2 + 26 \\
 -26 &= -0.06(x-30)^2 \\
 \pm \sqrt{433.3} &= (x-30) \\
 \pm 20.82 &= x-30 \\
 x = 50.82 &\quad \text{or} \quad 9.18 \\
 \therefore \text{The ball hits the ground } &\sim 51 \text{ m from the centre of the field.}
 \end{aligned}$$

Answer: No a player standing 50 m from the quarterback would not be able to catch the ball.

5.



- a) 72 m 2.4 is halfway between 0 and 4.8; therefore the points would be symmetrical, so the y value at 0 has to be 72 also.

b) zero 1 : 6 $h = 2.4$ $6 - 2.4 = 3.6$

\therefore zero 2 : $2.4 - 3.6 = -1.2$

$$f(x) = a(x-6)(x+1.2) \quad P(4.8, 72)$$

$$72 = a(4.8-6)(4.8+1.2)$$

$$72 = a(-1.2)(6)$$

$$72 = -7.2a$$

$$-10 = a$$

$$f(x) = -10(x-6)(x+1.2) \quad h = 2.4$$

$$\begin{aligned} k &= f(2.4) = -10(2.4-6)(2.4+1.2) \\ &= -10(-3.6)(3.6) \\ &= 129.6 \end{aligned}$$

\therefore The maximum height was 129.6 m

6.

$$P(x) = -1.4x^2 + 67.2x - 352.8$$

a) $h = \frac{-b}{2a} = \frac{-67.2}{2(-1.4)} = \frac{-67.2}{-2.8} = 24$

Answer: 24 homes

b) let $y = 0$

$$0 = -1.4x^2 + 67.2x - 352.8$$

$$x = \frac{-67.2 \pm \sqrt{(67.2)^2 - 4(-1.4)(-352.8)}}{2(-1.4)}$$



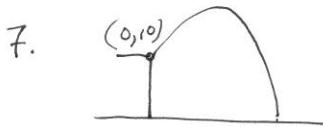
$$x = \frac{-67.2 \pm \sqrt{2540.16}}{-2.8}$$

$$x = \frac{-67.2 \pm 50.4}{-2.8}$$

$$x = \frac{-67.2 + 50.4}{-2.8} = 6$$

$$x = \frac{-67.2 - 50.4}{-2.8} = 42$$

Answer: Between 6 and 42 homes.



a) let $y = 0$ $[0 = -0.1x^2 + 1.5x + 10] \times -10$

$$0 = x^2 - 15x - 100$$

$$0 = (x-20)(x+5)$$

$$0 = x-20 \quad \text{or} \quad 0 = x+5$$

$$20 = x \quad -5 = x$$

\therefore It touches the ground 20m from the building

b) $h = \frac{-b}{2a} = \frac{-1.5}{2(-0.1)} = \frac{-1.5}{-0.2} = 7.5$

\therefore It reaches its maximum height 7.5m from the building

8. $A(t) = -t^2 + 50t - 525$

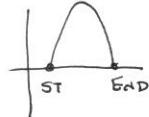
let $y = 0$

$$0 = -t^2 + 50t - 525$$

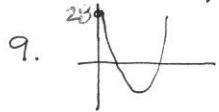
$$0 = t^2 - 50t + 525$$

$$0 = (t-35)(t-15)$$

$$t = 35 \quad t = 15$$



Duration of flight: $35 - 15 = 20$ minutes



a) 28 m

b) ① $h = \frac{b}{2a} = 10$ $k = f(10) = 0.3(10^2) - 6(10) + 28$
 $= 30 - 60 + 28$
 $= -2 \text{ m}$

Since the maximum depth is 2 m, the pelican can reach the fish at 0.5 m

② let $y = -0.5$
 $-0.5 = 0.3t^2 - 6t + 28$
 $0 = 0.3t^2 - 6t + 28.5$

9 b)

$$t = \frac{6 \pm \sqrt{(-6)^2 - 4(0.3)(285)}}{2(0.3)}$$

$$t = \frac{6 \pm \sqrt{1.8}}{0.6}$$

$$t = \frac{6 + \sqrt{1.8}}{0.6} = 12.24 \quad \text{or} \quad t = \frac{6 - \sqrt{1.8}}{0.6} = 7.76$$

The pelican should reach the bird on the way down; otherwise the disturbance would let the fish get away, so it reaches the fish around 7.76 seconds.

9 c) let $y = 0$

$$0 = 0.3t^2 - 6t + 28$$

$$t = \frac{6 \pm \sqrt{(6)^2 - 4(0.3)(28)}}{0.6}$$

$$t = \frac{6 \pm \sqrt{2.4}}{0.6}$$

$$t = \frac{6 + \sqrt{2.4}}{0.6} = 12.58 \quad t = \frac{6 - \sqrt{2.4}}{0.6} = 7.42$$

The bird resurfaces at approximately 12.58 s