d) $3 = 6p^2 - 7p$
$6p^2 - 7p - 3 = 0$
$(3p + 1)(2p - 3) = 0$
$3p + 1 = 0$ or $2p - 3 = 0$
$3p = -1$ $2p = 3$
$p = -\frac{1}{3}$ $p = \frac{3}{2}$
The roots are $-\frac{1}{3}$ and $\frac{3}{2}$.

e) $3x^2 + 9x = 30$
$3x^2 + 9x - 30 = 0$
$3(x^2 + 3x - 10) = 0$
$3(x - 2)(x + 5) = 0$
$x - 2 = 0$ or $x + 5 = 0$
$x = 2$ $x = -5$
The roots are 2 and –5.

f) $2z^2 = 3 - 5z$
$2z^2 + 5z - 3 = 0$
$(2z - 1)(z + 3) = 0$
$2z - 1 = 0$ or $z + 3 = 0$
$2z = 1$ $z = -3$
$z = \frac{1}{2}$
The roots are $\frac{1}{2}$ and –3.

Section 4.2 Page 230 Question 11

a) Substitute the dimensions and given area into $A = \ell w$:
$54 = (x + 10)(2x - 3)$
$54 = 2x^2 + 17x - 30$
$0 = 2x^2 + 17x - 84$

b) Solve the equation from part a) to find the value of x.
$0 = 2x^2 + 17x - 84$
$0 = (2x - 7)(x + 12)$
$2x - 7 = 0$ or $x + 12 = 0$
$2x = 7$ $x = -12$
$x = \frac{7}{2}$
Since x represents a distance, it cannot be negative. So, reject the root –12.
The value of x is $\frac{7}{2}$, or 3.5 cm.

Section 4.2 Page 230 Question 12

a) To find the time it takes the osprey to reach a height of 20 m, solve the equation $20 = 5t^2 - 30t + 45$.

$20 = 5t^2 - 30t + 45$
$0 = 5t^2 - 30t + 25$
$0 = 5(t^2 - 6t + 5)$
$0 = 5(t - 1)(t - 5)$

$t - 1 = 0$ or $t - 5 = 0$
$t = 1$ $t = 5$

It takes the osprey 1 s to reach a height of 20 m above the water on its dive towards the salmon. It again is at this height at 5 s, flying away with its catch.

b) Example: Assume no winds and that the mass of the fish does not affect the speed at which the osprey flies after catching the fish.

Section 4.2 Page 231 Question 13

a) To find the time it takes the flare to return to the water, solve the equation $0 = 150t - 5t^2$.

b) $0 = 150t - 5t^2$
$0 = 5t(30 - t)$

$5t = 0$ or $30 - t = 0$
$t = 0$ $t = 30$

It takes 30 s for the flare to return to the water.

Section 4.2 Page 231 Question 14

Let the two consecutive even integers be x and $x + 2$. For a product of $8x + 16$,

$8x + 16 = x(x + 2)$
$8x + 16 = x^2 + 2x$
$0 = x^2 - 6x - 16$
$0 = (x - 8)(x + 2)$

$x - 8 = 0$ or $x + 2 = 0$
$x = 8$ $x = -2$

The two consecutive even integers are 8 and 10 or –2 and 0.

Section 4.2 Page 231 Question 15

Let x represent the side length of the square.
Then, the new dimensions are $(x + 10)$ and $(x + 12)$ and the new area is $3x^2$.
To determine the side length of the square, solve the equation $3x^2 = (x + 10)(x + 12)$.

$$3x^2 = (x + 10)(x + 12)$$
$$3x^2 = x^2 + 22x + 120$$
$$0 = 2x^2 - 22x - 120$$
$$0 = 2(x^2 - 11x - 60)$$
$$0 = 2(x + 4)(x - 15)$$

$x + 4 = 0$ or $x - 15 = 0$
$x = -4$ $x = 15$

Since x represents a side length, it cannot be negative. So, reject the root –4.
The side length is 15 cm.

Section 4.2 Page 231 Question 16

To find how long the ball was in the air before it is caught, solve the equation
$3 = 3 + 48t - 16t^2$.

$$0 = 48t - 16t^2$$
$$0 = 16t(3 - t)$$

$16t = 0$ or $3 - t = 0$
$t = 0$ $t = 3$

The ball was in the air for 3 s before it was caught.

Example: This time duration seems too long considering the ball went up to a maximum height of 39 ft. However, the initial velocity was 48 ft/s and the ball would be slowing down under the effects of gravity so 3 s may be realistic.

Section 4.2 Page 231 Question 17

a) To find the width of each strip, solve the equation $35 = (9 - 2x)(7 - 2x)$.

$$35 = (9 - 2x)(7 - 2x)$$
$$35 = 63 - 32x + 4x^2$$
$$0 = 4x^2 - 32x + 28$$
$$0 = 4(x^2 - 8x + 7)$$
$$0 = 4(x - 7)(x - 1)$$

$x - 7 = 0$ or $x - 1 = 0$
$x = 7$ $x = 1$

Since $x = 7$ would result in negative dimensions, reject this root.
The width of each strip is 1 cm.

b) The dimensions of the new rectangle are 7 cm by 5 cm.

Section 4.2 Page 232 Question 18

a) Check if $x = 5$ is a root of $x^2 - 5x - 36 = 0$.

Left Side	Right Side
$x^2 - 5x - 36$	0

$= 5^2 - 5(5) - 36$
$= 25 - 25 - 36$
$= -36$

Left Side ≠ Right Side

Since $x = 5$ is not a root, $x - 5$ is not a factor of $x^2 - 5x - 36$.

b) Check if $x = -3$ is a root of $x^2 - 2x - 15 = 0$.

Left Side	Right Side
$x^2 - 2x - 15$	0

$= (-3)^2 - 2(-3) - 15$
$= 9 + 6 - 15$
$= 0$

Left Side = Right Side

Since $x = -3$ is a root, $x + 3$ is a factor of $x^2 - 2x - 15$.

c) Check if $x = -\frac{1}{4}$ is a root of $6x^2 + 11x + 4 = 0$.

Left Side	Right Side
$6x^2 + 11x + 4$	0

$= 6\left(-\frac{1}{4}\right)^2 + 11\left(-\frac{1}{4}\right) + 4$
$= \frac{6}{16} - \frac{11}{4} + 4$
$= \frac{13}{8}$

Left Side ≠ Right Side

Since $x = -\frac{1}{4}$ is not a root, $4x + 1$ is not a factor of $6x^2 + 11x + 4$.

d) Check if $x = \frac{1}{2}$ is a root of $4x^2 + 4x - 3 = 0$.

Left Side	Right Side
$4x^2 + 4x - 3$	0

$= 4\left(\frac{1}{2}\right)^2 + 4\left(\frac{1}{2}\right) - 3$
$= 1 + 2 - 3$

$= 0$

Left Side = Right Side

Since $x = \frac{1}{2}$ is a root, $2x - 1$ is a factor of $4x^2 + 4x - 3$.

Section 4.2 Page 232 Question 19

a) $x(2x - 3) - 2(3 + 2x) = -4(x + 1)$

$$2x^2 - 3x - 6 - 4x = -4x - 4$$
$$2x^2 - 3x - 2 = 0$$
$$(2x + 1)(x - 2) = 0$$

$2x + 1 = 0$ or $x - 2 = 0$

$2x = -1$ $\quad$ $x = 2$

$x = -\frac{1}{2}$

The roots are $-\frac{1}{2}$ and 2.

b) $3(x - 2)(x + 1) - 4 = 2(x - 1)^2$

$$3(x^2 - x - 2) - 4 = 2(x^2 - 2x + 1)$$
$$3x^2 - 3x - 6 - 4 = 2x^2 - 4x + 2$$
$$x^2 + x - 12 = 0$$
$$(x + 4)(x - 3) = 0$$

$x + 4 = 0$ or $x - 3 = 0$

$x = -4$ $\quad$ $x = 3$

The roots are –4 and 3.

Section 4.2 Page 232 Question 20

Use the Pythagorean Theorem.

$$x^2 + (x - 1)^2 = 29^2$$
$$x^2 + x^2 - 2x + 1 = 841$$
$$2x^2 - 2x - 840 = 0$$
$$2(x^2 - x - 420) = 0$$
$$2(x - 21)(x + 20) = 0$$

$x - 21 = 0$ or $x + 20 = 0$

$x = 21$ $\quad$ $x = -21$

Since x represents a leg of a right triangle, it cannot be negative. So, reject the root –21.
The lengths of the legs are 21 cm and 20 cm.