MATHEMATICS

N5

Unit 2

Part 1 of 2

Relationships

Exercise 1

1) Find the equation of a straight line with a gradient **2** passing through the point **(1 , 3)**

2) Find the equation of a straight line with a gradient **3** passing through the point **(3 , 5)**

3) Find the equation of a straight line with a gradient **–2** passing through the point **(1 , 2)**

4) Find the equation of a straight line with a gradient **–1** passing through the point **(–1 , 6)**

5) Find the equation of a straight line with a gradient **–3** passing through the point **(–2 , 4)**

6) Find the equation of a straight line with a gradient $\frac{1}{2}$ passing through the point **(1 , –5)**

7) Find the equation of a straight line with a gradient $\frac{1}{3}$ passing through the point **(0 , –3)**

8) Find the equation of a straight line with a gradient $-\frac{1}{2}$ passing through the point **(2 , 7)**

9) Find the equation of a straight line with a gradient $\frac{3}{2}$ passing through the point **(–1 , –5)**

10) Find the equation of a straight line with a gradient $-\frac{5}{2}$ passing through the point **(0 , –5)**

11) Find the equation of a straight line with a gradient $\frac{4}{3}$ passing through the point **(–2 , 9)**

12) Find the equation of a straight line with a gradient $-\frac{3}{2}$ passing through the point **(–1 , –3)**

Exercise 2

1) Find the equation of the line joining the points **A(2 , 5)** to **B(6 , 10)**

2) Find the equation of the line joining the points **A(–2 , 2)** to **B(6 , 4)**

3) Find the equation of the line joining the points **A(2 , 11)** to **B(–3 , 1)**

4) Find the equation of the line joining the points **A(2 , –5)** to **B(1 , 3)**

5) Find the equation of the line joining the points **A(1 , -5)** to **B(10 , 13)**

6) Find the equation of the line joining the points **A(-3 , -5)** to **B(–8 , –14)**

7) Find the equation of the line joining the points **A(6 , 5)** to **B(8 , 1)**

8) Find the equation of the line joining the points **A(–9 , 5)** to **B(5 , 12)**

9) Find the equation of the line joining the points **A(3 , –8)** to **B(10 , –16)**

10) Find the equation of the line joining the points **A(–1 , 4)** to **B(2 , 16)**

11) Find the equation of the line joining the points **A(8 , 15)** to **B(–2 , –10)**

12) Find the equation of the line joining the points **A(0 , 5)** to **B(4 , 10)**

Equations

Exercise 1

Solve the following equations

1) $3x + 1 = 2x + 3$ **2)** $5x + 3 = 2x + 12$ **3)** $4x – 1 = x + 2$

4) $6x – 2 = 2x + 6$ **5)** $7x – 8 = x – 2$ **6)** $5x – 7 = 3x – 3$

7) $11x – 20 = 6x + 5$ **8)** $4x + 2 = 17 – x$ **9)** $5x – 3 = 11 – 2x$

10) $6x + 1 = 33 – 2x$ **11)** $3x – 7 = 1 – 5x$ **12)** $4x – 1 = 5 – 2x$

13) $8x + 2 = 7 – 2x$ **14)** $6x – 7 = 2 – 4x$ **15)** $3x + 9 = 17 + 2x$

16) $6x – 8 = 4 – 3x$ **17)** $5x + 1 = 7 – 2x$ **18)** $6x – 3 = 1 – x$

19) $3x – 10 = 2x – 3$ **20)** $5x + 1 = 6 – 3x$ **21)** $11x – 20 = 10x – 15$

22) $6 + 2x = 8 – 3x$ **23)** $7 + x = 9 – 5x$ **24)** $3y – 7 = y + 1$

Exercise 2

Solve the following equations

1) $2(x – 1) = 4$ **2)** $3(x + 1) = 9$ **3)** $4(x – 2) = 8$

4) $5(x – 3) = 10$ **5)** $3(2x – 1) = 9$ **6)** $2(3x + 3) = 12$

7) $5(x + 2) = 2x + 16$ **8)** $7(x + 3) = 5x + 29$ **9)** $4(y + 1) = y + 13$

10) $5(v – 4) = 2v – 5$ **11)** $7(m – 2) = 5m – 4$ **12)** $4(n – 5) = n – 2$

13) $3(a – 2) = 9 – 2a$ **14)** $8(x + 2) = 3(x + 7)$ **15)** $4(x – 2) = 2(x + 1)$

16) $7(u – 3) = 3(u + 5)$ **17)** $9(p – 3) = 7(p – 1)$ **18)** $5(x – 3) = 2(x – 7)$

19) $8(r – 6) = 5(r – 3)$ **20)** $6(x + 2) = 2(x – 3)$

Exercise 3

Solve the following equations

1) $3(x + 2) + 2(x + 1) = 23$

2) $5(a + 2) – 2(a + 3) = 19$

3) $4(x + 3) + 3(x + 2) = 32$

4) $8(b + 3) – 4(b + 4) = 12$

5) $5(t + 2) + 3(t – 1) = 31$

6) $6(u – 2) – 2(u + 4) = 8$

7) $4(a + 1) + 3(a – 4) = 13$

8) $4(x – 2) – 3(x + 4) = 4$

9) $3x + 2(x + 1) = 3x + 12$

10) $3(x – 1) = 2x – 2$

11) $4x – 2(x + 4) = x + 1$

12) $2x – 3(x + 2) = 2x + 1$

13) $3(x + 1) + 2(x + 2) = 10$

14) $4(2x – 1) = 3(x + 1) – 2$

15) $4(x + 3) + 2(x – 1) = 4$

16) $5 + 2(x + 1) = 5(x – 1)$

Exercise 4

Solve the following equations

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

2) $x^2 + 3x = (x + 3)(x + 1)$

3) $(x + 3)(x – 1) = x^2 + 5$

4) $(x + 1)(x + 4) = (x – 7)(x + 6)$

5) $(x – 2)(x + 3) = (x – 7)(x + 7)$

6) $(x – 5)(x + 4) = (x + 7)(x – 6)$

7) $(x – 12)^2 = x^2 + 144$

8) $(x – 1)^2 = x^2 + 3$

9) $2x^2 + 3x = (2x – 1)(x + 1)$

10) $(2x – 1)(x – 3) = (2x – 3)(x – 1)$

11) $x^2 + (x + 1)^2 = (2x – 1)(x + 4)$

12) $x(2x + 6) = 2(x^2 – 5)$

13) $(x + 1)(x – 3) + (x + 1)^2 = 2x(x – 4)$

14) $(2x + 1)(x – 4) + (x – 2)^2 = 3x(x + 2)$

15) $(x + 2)^2 – (x – 3)^2 = 3x – 11$

16) $x(x – 1) = 2(x – 1)(x + 5) – (x – 4)^2$

Exercise 5 -Problems

1) In triangle ABC, angle A = x.

Angle B is three times larger than angle A.

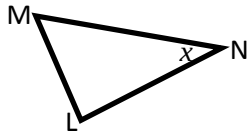
Angle C is twice the size of angle A.

a) Write down (in terms of x) the sizes of angles B and C.

b) Form an equation for x and solve it.

c) What are the sizes (in degrees) of angles B and C?

2) In triangle LMN, angle N = x.



Angle M is 40° bigger than angle N

Angle L is 10° smaller than angle N.

a) Write down (in terms of x) the sizes of angles L and M.

b) Form an equation for x and solve it.

c) What are the sizes (in degrees) of angles L and M?

3) I have x pence in my pocket.

John has 20 pence more than me.

Ian has twice as much as I have. Altogether we have 80 pence.

a) How much (in terms of x) have John and Ian?

b) Write down an equation for x and solve it.

c) How many pence have John and Ian?

4) Mary goes on holiday with £x.

Anne has three times as much as Mary

Joanne has £6 more than Mary.

Altogether they have £41.

a) Write down an equation for x and solve it.

b) How much each do Anne and Joanne have?

5) Alan is y years old. His elder brother is 6 years older than he is and his younger brother is 8 years younger than Alan.

If all their ages add up to 37 years, find the value of y.

6) Julie is z years old. Her father is 4 times older than Julie.

Her mother is 7 years younger than her father.

If their ages add up to 101 years, find the value of z.

Also find the ages of both Julie's parents.

7) 85 pence is shared between 2 boys so that one receives x pence and the other receives 17 pence more than this. Find the value of x.

8) I have a piece of string 36cm long. I use z cm of it so that the piece remaining is twice the length I have used. Find the value of z.

Exercise 6

1) p is a whole number.

a) Write down the next two whole numbers bigger than p.

b) If these 3 numbers add up to 99, find the value of p.

2) q is a whole number.

a) Write down the whole number one less than q.

b) If these 2 numbers add up to 49, find the value of q.

3) A youth club has 30 members of whom z are girls.

a) How many boys are there?

b) If the number of girls is four more than the number of boys, find the value of z.

4) Mr and Mrs Harris have five children.

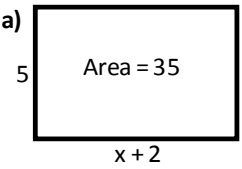
a) If there are y girls, how many boys are there?

b) Each boy is given £5 for his holiday, and each girl is given £8.

If the children are given £34 altogether, find the value of y.

5) The area of each rectangle is given in cm². If the lengths of the sides are in centimetres, find the value of x in each rectangle.

a)



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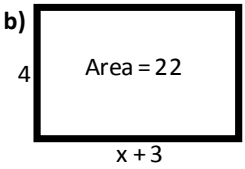

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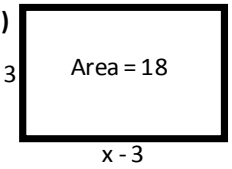
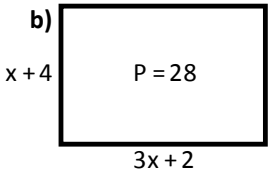


6) The perimeter of each shape is given in cm. If the lengths of the sides are also in cm, find the values of x.

b)



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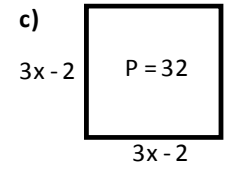

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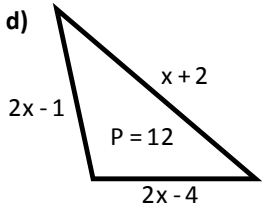

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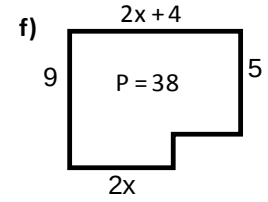

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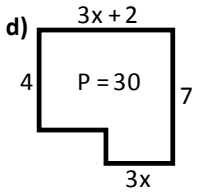

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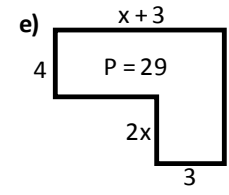
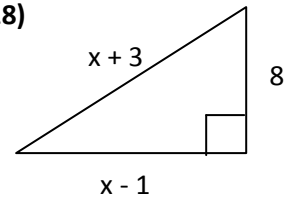


In questions 18 to 21, form an equation in x by means of Pythagoras' Theorem, and hence find the length of each side of the triangle. (All the lengths are in cm.)

18)



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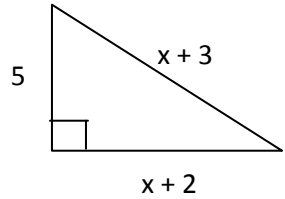

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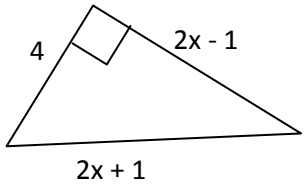

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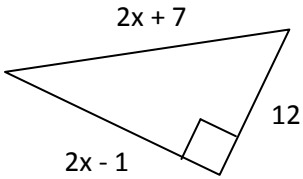

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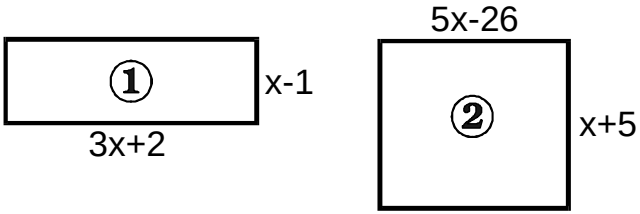


a) Rectangle ① has length 3x + 2 and breadth x – 1.

Rectangle ② has length 5x – 26 and breadth x + 5.

Lengths are in centimetres. The 2 areas are the same.

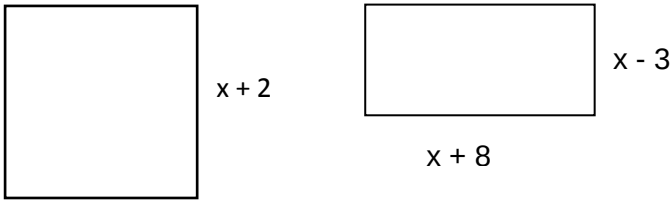
Form an equation in x and hence prove that x = 8.

b) Calculate the length of a diagonal of rectangle ②.

c) Calculate the length of the side of a square which has the same area as both rectangles.

23) The square and rectangle have the same area.

Find x and hence state the dimensions of the rectangle.



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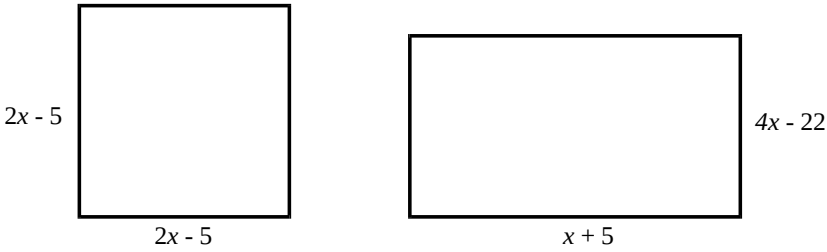


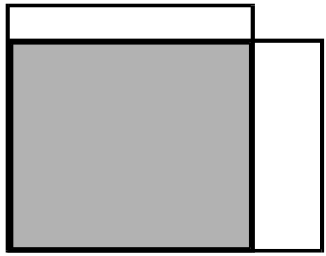
a) The areas of the square and the rectangle above are equal.

Use this information to build an equation in ***x***.

Solve the equation to find the value of ***x***

b) The square and rectangle in **a** have been drawn to overlap as shown in this diagram.

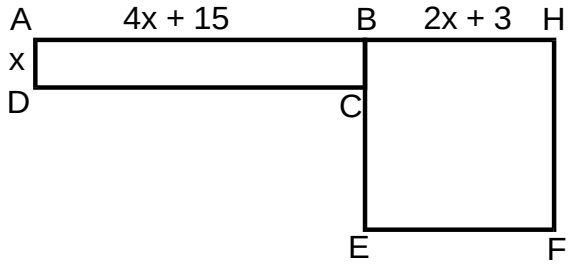
Calculate the area of the overlap (shaded in the diagram).



25) The diagram below shows a rectangle ABCD and a square BHFE.

The rectangle has length 4x + 15 and breadth x centimetres.

The square has length 2x + 3 centimetres.



The areas of the rectangle and square are the same.

a) Use this information to form an equation in x and hence prove that x = 3 centimetres.

b) A straight line is drawn from D to E. Calculate the length of DE.

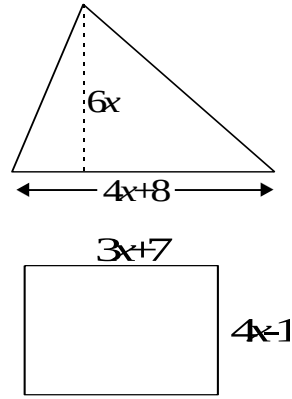
26) The lengths in this question are in centimetres.

a) Explain clearly why the area of this triangle is given by $12x^2 + 24x$ square centimetres.

b) The area of this rectangle is the same as the area of the triangle in part **a.**

Form an equation in x and hence prove that $x = 7$ **centimetres**.

c) Hence calculate the length of a diagonal of the rectangle in part **b.**



27) The hypotenuse of a right-angled triangle is (5x + 5) cm long and the lengths of the other two sides are (4x + 8) cm and (3x – 5) cm.

Form an equation and solve it. Hence write down the lengths of each of the sides.

Exercise 7

Solve these equations:

1) $\frac{x}{2}=3$ **2)** $\frac{x}{5}=2$ **3)** $\frac{x}{6}=4$

4) $\frac{x}{8}=3$ **5)** $4=\frac{a}{4}$ **6)** $7=\frac{w}{5}$

7) $6=\frac{x}{2}$ **8)** $9=\frac{y}{4}$ **9)** $\frac{2}{3}x=4$

10) $\frac{3}{4}w=6$ **11)** $\frac{2d}{5}=-8$ **12)** $\frac{5n}{6}=20$

13) $\frac{3x}{5}=-6$ **14)** $\frac{4c}{7}=-4$ **15)** $\frac{a}{8}=\frac{3}{4}$

16) $\frac{3}{5}=\frac{m}{10}$ **17)** $\frac{4a}{5}=\frac{3}{8}$ **18)** $\frac{3p}{4}=\frac{4}{7}$

19) $\frac{2}{3}b=\frac{5}{9}$ **20)** $\frac{4}{9}z=\frac{-2}{3}$ **21)** $\frac{h+1}{4}=3$

22) $\frac{y-5}{5}=2$ **23)** $\frac{a-6}{2}=3$ **24)** $\frac{z+2}{3}=-1$

25) $\frac{2x-1}{3}=5$ **26)** $\frac{3a+4}{5}=-1$ **27)** $\frac{2a+1}{2}=\frac{3}{5}$

28) $\frac{7-d}{2}=\frac{5}{2}$ **29)** $\frac{2-3h}{3}=-\frac{5}{6}$ **30)** $\frac{3+2a}{4}=-\frac{2}{3}$

31) $\frac{4x-5}{6}=\frac{3}{4}$ **32)** $\frac{5-4y}{2}=-\frac{3}{5}$ **33)** $\frac{x+2}{5}=\frac{3-x}{4}$

34) $\frac{a+1}{2}=\frac{a-1}{3}$ **35)** $\frac{2x-1}{6}=\frac{2-x}{3}$ **36)** $\frac{2x+1}{3}=\frac{5x+1}{7}$

37) $\frac{x}{2}+\frac{x}{4}=1$ **38)** $\frac{x}{2}-\frac{x}{3}=2$ **49)** $\frac{a}{5}-\frac{a}{2}=-3$

40) $\frac{x}{4}+\frac{3x}{8}=-1$ **41)** $\frac{c}{2}+\frac{2c}{3}=7$ **42)** $\frac{2x}{3}-\frac{x}{6}=-2$

43) $\frac{x+1}{2}+\frac{x-1}{3}=1$ **44)** $\frac{x+2}{3}-\frac{x+1}{4}=2$ **45)** $\frac{x+2}{2}+\frac{x-1}{5}=\frac{1}{10}$

46) $\frac{2x-3}{6}+\frac{x+2}{3}=\frac{5}{2}$ **47)** $\frac{x}{3}-\frac{3x-7}{5}=\frac{x-2}{6}$

48) $\frac{4p-1}{3}-\frac{3p-1}{2}=\frac{5-2p}{4}$ **49)** $\frac{3m-5}{4}-\frac{9-2m}{3}=0$

50) $\frac{x}{3}-\frac{2x-5}{2}=0$ **51)** $\frac{4x-5}{2}-\frac{2x-1}{6}=x$

Exercise 11 - Inequalities

Solve the following inequalities

1) $2x + 1 > 7$ **2)** $2x + 1 \geq 7$ **3)** $3x - 2 > 10$

4) $5y - 3 \leq 27$ **5)** $7y + 4 \leq 4$ **6)** $8y + 3 \geq 59$

7) $3t + 4 > 1$ **8)** $6u + 14 < 2$ **9)** $3v + 2 > -16$

10) $5q + 6 < 3q + 24$ **11)** $7r - 3 > 3r + 13$ **12)** $3s + 1 \geq 13 - s$

13) $3t - 2 \leq 13 - 2t$ **14)** $3b+5>10b-3$ **15)** $8(x - ½) < 20$

16) $6(2x - ½) \geq 15$ **17)** $3(4x + 7) < 69$ **18)** $½(6x + 8) \leq 10$

Exercise 12

Solve the following inequalities

1) $-4z > 8$ **2)** $-3f \leq 9$ **3)** $7f \geq -42$

4) $-2q < -20$ **5)** $3 - 2r < 5$ **6)** $14 - 3x > 4x$

7) $-5f > 4f - 9$ **8)** $4t < 7t + 12$ **9)** $5 - 3h \leq h - 3$

10) $-5 - f \geq 12f - 18$ **11)** $3 - 5k < 2(3 + 2k)$

12) $3(m - 2) > 5m$ **13)** $3(2n - 1) < 8n + 5$

14) $8(x - 4) \leq 5(x - 7)$ **15)** $2(x + 3) > 3(2 - x)$

Simultaneous Equations

Exercise 1

In each of the following questions, draw a set of x, y axes running from –4 to 6.

Then draw the lines in the question.

Finally solve the simultaneous equations by finding the point of intersection of the lines.

1) $x+y=5$, $y=x+1$

2) $x+y=4$, $y=x+2$

3) $x+y=2$, $y=x-2$

4) $2x+y=6$, $x+y=2$

5) $y=2x+3$, $x+2y=6$

6) $y=x-3$, $x+y=1$

7) $2x+y=4$, $y=3x-1$

8) $3x+y=6$, $x+y=0$

9) $y=x-3$, $x+y=-1$

10) $y=2x+1$, $y=\frac{1}{2}x-2$

11) $y=\frac{1}{2}x$, $x+2y=8$

12) $y=2x-3$, $x+2y=4$

13) $2x+3y=12$, $y=2x-4$

14) $y=4x+4$, $4x+y=4$

15) $y=\frac{1}{3}x+2$, $2x+y+5=0$

Exercise 2

Solve each of the following pairs of simultaneous equations.

1) $x + y = 7$, $x - y = 3$

2) $3x - y = 1$, $x + y = 3$

3) $2x - y = 2$, $x + y = 7$

4) $4x + y = 9$, $2x - y = 3$

5) $-x + 2y = 13$, $x + y = 8$

6) $x + y = 7$, $x - y = 3$

7) $x + 4y = 9$, $3x - 4y = -5$

8) $5x - 2y = 13$, $3x + 2y = 3$

9) $5x + 2y = 8$, $2x - y = 5$

10) $3x + 4y = 1$, $5x - 2y = -7$

11) $x + y = 3$, $2x - 3y = 1$

12) $x + y = 6$, $3x - 2y = 8$

13) $3x + y = 11$, $-x + 3y = 13$

14) $2x - y = 3$, $x + 4y = 24$

15) $2x + y = 10$, $-x + 2y = 5$

16) $5x + 3y = 12$, $6x - 4y = 22$

17) $7x - 2y = 11$, $12x + 5y = 2$

18) $3x + 4y = 5$, $-2x + 5y = 12$

19) $2x + 3y = 14$, $8x - 5y = 5$

20) $x - 3y = 8$, $x + 2y = -7$

21) $-3x + 2y = 5$, $4x + 3y = -1$

22) $2x + 3y = 8$, $3x + 2y = 7$

23) $2x + 3y = 11$, $3x + 7y = 19$

24) $5x + 9y = 8$, $4x + 12y = 8$

25) $\begin{aligned} 9x-4y&=-20\\ 5x-6y&=-13 \end{aligned}$

26) $\begin{aligned} 4x-7y&=15\\ 5x-2y&=12 \end{aligned}$

27) $\begin{aligned} 3x+7y&=-2\\ 4x+3y&=-9 \end{aligned}$

28) $\begin{aligned} 4x+y&=2\\ 2y+1&=2x \end{aligned}$

29) $\begin{aligned} 3x-2y&=3\\ -3y&=7-2x \end{aligned}$

30) $\begin{aligned} x&=3y+1\\ 2y+x&=6 \end{aligned}$

31) $\begin{aligned} y&=2x-3\\ 3x+2y&=8 \end{aligned}$

32) $\begin{aligned} y&=3x-1\\ x-2y&=-8 \end{aligned}$

33) $\begin{aligned} x-y&=1\\ 3x&=2y \end{aligned}$

34) $\begin{aligned} 5x-y&=9\\ y-2x&=3 \end{aligned}$

35) $\begin{aligned} 3x+4y-3&=0\\ 6y&=9x \end{aligned}$

36) $\begin{aligned} 4x+2y-11&=0\\ 3x&=y+7 \end{aligned}$

37) $\begin{aligned} 5x-4&=4y\\ y+1&=\tfrac{1}{2}x \end{aligned}$

38) $\begin{aligned} y&=\tfrac{1}{2}x-3\\ x-4y&=6 \end{aligned}$

39) $\begin{aligned} x-3y&=1\\ \frac{3x}{4}-y&=2 \end{aligned}$

40) $\begin{aligned} x-y&=1\\ \frac{2x}{5}+\frac{3y}{4}&=5 \end{aligned}$

41) $\begin{aligned} x+1&=\frac{y}{2}\\ x-\frac{1}{4}&=\frac{y}{4} \end{aligned}$

42) $\begin{aligned} \frac{x}{5}-\frac{y}{3}&=0\\ \frac{x}{4}-\frac{y}{2}&=-1 \end{aligned}$

43) $\begin{aligned} \frac{x}{3}-\frac{y}{4}&=-1\\ \frac{x}{2}+\frac{y}{5}&=10 \end{aligned}$

44) $\begin{aligned} \tfrac{1}{4}x-y&=2\tfrac{1}{2}\\ x+12y&=2 \end{aligned}$

45) $\begin{aligned} \frac{1}{2}x+\frac{2}{3}y&=\frac{1}{6}\\ \frac{1}{4}x+\frac{1}{2}y&=\frac{1}{4} \end{aligned}$

Exercise 3

1) If I add two numbers the result is 7, if I subtract them the result is 3.

Find both numbers.

2) The difference in price between a T-shirt and a pair of jeans is £16 and the cost of one T-shirt and one pair of jeans is £24.

Find the cost of each item.

3) If I buy 2 packets of sweets and a bar of chocolate the total is 49p. If one packet of sweets is 2 p dearer than one bar of chocolate, find both prices.

4) Three times a number added to two times another number gives the result 53.

The first number minus two times the second number gives the result 7.

Find both numbers.

5) Bobby buys 5 pairs of trainers and 2 pairs of jeans. This costs him £230.

The price of 2 pairs of trainers minus one pair of jeans is £20.

Find the price of each item.

6) Jean buys 2 comics and 3 books. This comes to a total of £11.

Sharon buys 3 comics and 2 books. This comes to a total of £9.

Find the cost of each item.

7) A farmer can buy 3 cows and 4 sheep for £650, or he can buy 6 cows and 4 sheep for £920. Find the cost of:

a) a cow **b)** a sheep.

8) Mrs Wilson can buy large balls of wool or small ones.

She needs 175 grams for a scarf and she buys three of the large size ball and one small one.

She needs 300 grams for a pullover so she buys five large balls and two small ones.

Find the mass of one ball of wool of each size.

9) 6 tins of dog food and 3 tins of cat food cost 255 pence. 4 tins of dog food and 1 tin of cat food cost 145 pence.

Find the cost of each tin.

10) 2 knives and 3 forks have a total cost of £1.20. 3 knives and 5 forks have a total cost of £1.90.

Find the cost of each knife and each fork.

11) The sum of the ages of a father and son is 77 years.

The difference is 27 years.

Find their ages.

12) In 10 years time, a daughter will be as old as her mother was 15 years ago.

Their ages now total 61 years.

What are their present ages?

13) A magazine costs **20p** more than a newspaper.

3 magazines and 5 newspapers cost **£5**.

Find algebraically the cost of a magazine and a newspaper.

14) A heap of 64 coins contains only 5p and 2p coins.

The total value of the heap of coins is £2.

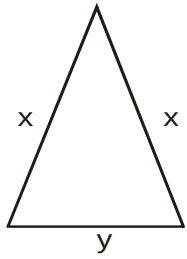
How many coins of each kind are there?

15) The perimeter of a rectangle is 27 cm.

The length is 8 cm more than the breadth.

What are the length and the breadth?

16) In this isosceles triangle, the equal sides (x) are longer than the other side (y).



a) The perimeter of the triangle is 85 cm.

Write down an equation connecting x and y.

b) The longer side is $\frac{1}{2}$ cm longer than 3 times the shorter side.

Write down a second equation connecting x and y.

c) **Hence** find the values of x and y.

17) A biology department keeps two different types of solution in its storeroom, one weak and the other strong.

a) The technician is asked to prepare **4 litres** of a new glucose solution using **x litres** of the weak solution and **y litres** of the strong solution.

Write down a simple equation in x and y from this information.

b) The weak solution contains **8 grams of glucose per litre** of water.

The strong solution contains **18 grams of glucose per litre** of water.

The new glucose solution contains **60 grams of glucose**.

Write down a second equation in x and y from this information.

c) **Hence** calculate the volume of weak solution and the volume of strong solution he must mix together to prepare the new solution.

18) In a sequence of fractions, the next term after $\frac{x}{y}$ is $\frac{x+y}{2x+y}$.

The first term is $\frac{2}{3}$.

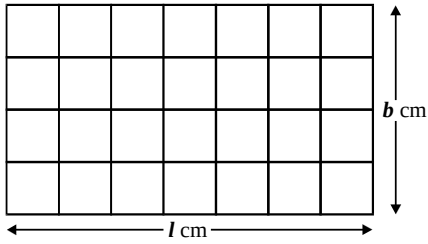
The second term therefore is $\frac{2+3}{2(2)+3}=\frac{5}{7}$.

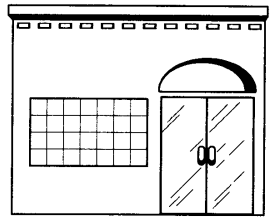
a) Write down the **fourth** term of the sequence which begins

$\frac{2}{3}, \frac{5}{7}, \frac{12}{17}, \ldots\ldots\ldots$

b) By forming and solving a system of equations, find the term which comes immediately **before** $\frac{408}{577}$.

19) A rectangular window has length, l centimetres and breadth, b centimetres.





A security grid is made to fit this window.

The grid has 5 horizontal wires and 8 vertical wires.

a) The perimeter of the window is 260 centimetres.

Use this information to write down an equation involving l and b.

b) In total, 770 centimetres of wire is used.

Write down another equation involving l and b.

c) Find the length and breadth of the window.

20) Let a be the cost of an adult ticket for a short journey, and let c be the cost of a child's ticket for the same journey.

a) The total cost of 11 adult tickets and 6 children's tickets is £27.

Write down an equation connecting a and c.

b) The cost of an adult ticket is 15 pence more than the 3 times the cost of a child's ticket.

Write down a second equation connecting a and c.

c) Hence find the cost of an adult's ticket and the cost of a child's ticket.

Changing the Subject of a Formula

Exercise 1

Make x the subject of these formulas.

1) $x + 4 = 7$ **2)** $x + a = 7$ **3)** $x + 3 = b$

4) $x + a = b$ **5)** $x - 3 = 8$ **6)** $x - a = 5$

7) $x - 4 = c$ **8)** $x - p = q$ **9)** $x + h = 4h$

10) $x - c = 5c$ **11)** $x + 2a = 3a$ **12)** $x - 2a = 3a$

13) $2x = 5$ **14)** $3x = a$ **15)** $ax = 4$

16) $cx = d$ **17)** $px = -q$ **18)** $dx = -f$

19) $kx + h = 0$ **20)** $2x + 3 = 4$ **21)** $2x + 3a = 4a$

22) $ax + 5 = 9$ **23)** $2x + a = b$ **24)** $4x + r = h$

25) $3x - 4 = 1$ **26)** $3x - 4a = a$ **27)** $2x - c = d$

28) $ax - 3 = 1$ **29)** $ax - b = 7$ **30)** $px - q = r$

31) $2(x + 3) = 7$ **32)** $3(x - b) = 2b$ **33)** $4(x + c) = d$

34) $5(x - h) = k$ **35)** $a(x + b) = c$ **36)** $p(x - q) = r$

Exercise 2

Make x the subject of these formulas.

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

4) $a - 4x = 5$ **5)** $2x - a = b$ **6)** $5x + a = 3x + b$

7) $3x - a = x + b$ **8)** $(a + b)x = 3$ **9)** $a = bx + c$

10) $p(x + q) = r$ **11)** $a(x - c) = b$ **12)** $y = mx + c$

13) $y - x = 3$ **14)** $y + 2x = 3$ **15)** $5y - 2x + 10 = 0$

16) $4y + x + 5 = 0$ **17)** $2x + 3y + 4 = 0$ **18)** $ax + by = c$

Exercise 3

Make x the subject of these formulas.

1) $\frac{x}{2} = 3$ **2)** $\frac{x}{5} = a$ **3)** $\frac{x}{c} = 4$

4) $\frac{x}{a} = b$ **5)** $\frac{x}{2} = \frac{3}{4}$ **6)** $\frac{x}{a} = \frac{b}{2}$

7) $\frac{2x}{3} = 4$ **8)** $\frac{3x}{4} = h$ **9)** $\frac{ax}{5} = b$

10) $\frac{cx}{p} = q$ **11)** $\frac{x}{a} = \frac{b}{c}$ **12)** $\frac{1}{k} = \frac{x}{r}$

13) $\frac{x+a}{2} = 5$ **14)** $\frac{x+a}{b} = c$ **15)** $\frac{x-p}{3} = q$

16) $\frac{x-p}{q} = r$

Exercise 4

Make x the subject of these formulas.

1) $y = x^2$ **2)** $y = 3x^2$ **3)** $c = ax^2$

4) $y = \sqrt{x}$ **5)** $y = 5\sqrt{x}$ **6)** $y = \dfrac{\sqrt{x}}{4}$

7) $y = x^2 + c$ **8)** $y = \sqrt{x} + c$ **9)** $y = c + \dfrac{x^2}{d}$

10) $y = \dfrac{\sqrt{x}}{a} - c$ **11)** $3x^2 = y$ **12)** $y = 2x^2 + a = b$

13) $y - 7x^2 = 10$ **14)** $\sqrt{x+3} = y$ **15)** $\dfrac{\sqrt{x+2}}{3} = a$

16) $\dfrac{1}{4}\sqrt{2y - x} = z$ **17)** $y = \dfrac{x-3}{5-x}$ **18)** $\sqrt{\dfrac{x}{a-x}} = 2a$

19) $\sqrt{\dfrac{x+a}{x-a}} = 2$ **20)** $y(x-1) = 3(2-x)$

Exercise 5

Change the subject of each of the following formulae to the variable indicated.

1) $C = \pi d \ \ to\ d$ **2)** $S = \pi dn \ \ to\ n$ **3)** $PV = c \ \ to\ V$

4) $A = \pi rl \ \ to\ l$ **5)** $v^2 = 2gh \ \ to\ h$ **6)** $I = PRT \ \ to\ R$

7) $x = \frac{a}{y} \ \ to\ y$ **8)** $I = \frac{E}{R} \ \ to\ R$ **9)** $\boldsymbol{x = \frac{u}{a}} \ \ to\ u$

10) $P = \frac{RT}{V} \ \ to\ T$ **11)** $d = \frac{0.866}{N} \ \ to\ N$ **12)** $S = \frac{ts}{T} \ \ to\ t$

13) $H = \frac{PLAN}{33000} \ \ to\ L$ **14)** $v = \frac{\pi d^2 h}{4} \ \ to\ h$ **15)** $p = P - 14.7 \ \ to\ P$

16) $v = u + at \ \ to\ t$ **17)** $n = p + cr \ \ to\ r$ **18)** $y = ax + b \ \ to\ x$

19) $y = \frac{x}{5} + 17 \ \ to\ x$ **20)** $H = S + qL \ \ to\ q$

21) The perimeter of a square is $P = 4x$. Change the subject to x.

22) The area of a rectangle is $A = lb$. Change the subject to l.

23) The volume of a cuboid is $V = lbh$. Change the subject to h.

24) The speed of a train is $S = \frac{D}{T}$. Change the subject to
a) D **b)** T.

25) The current in a circuit is $I = \frac{V}{R}$. Change the subject to
a) V **b)** R.

26) The area of a triangle is $A = \frac{1}{2}bh$. Change the subject to h.

27) The area of a metal plate is $A = \frac{3}{2}ab$. Change the subject to a.

28) The equation of a straight line is $y = mx + c$. Change the subject to m.

29) The illumination of a lamp is $I = \frac{C}{d^2}$. Change the subject to C.

30) The perimeter of a rectangle is $P = 2(l + b)$.

a) Change the subject of the formula to b.

b) Calculate b when $P = 22 \; and \; l = 7$.

31) The sum of the numbers in a series cab be given by $S = \frac{1}{2}n(a + l)$.

a) Change the subject of the formula to l.

b) Calculate l when $S = 75, n = 20 \; and \; a = 5$.

Exercise 1

Solve the following equations

1) $(x+2)(x-1)=0$ **2)** $(x-4)(x-5)=0$ **3)** $(x+3)(x+2)=0$

4) $(x-4)(x+3)=0$ **5)** $x(x-7)=0$ **6)** $x(x+2)=0$

7) $(2x-1)(x-5)=0$ **8)** $(2x+3)(3x-1)=0$ **9)** $(4x-1)(3x-2)=0$

10) $x(2x+3)=0$ **11)** $(5x+2)(x-3)=0$ **12)** $(2x+5)(3x-4)=0$

Exercise 2

Solve the following quadratic equations

1) $x^2+2x=0$ **2)** $x^2-5x=0$ **3)** $2z^2-z=0$

4) $y^2+8y=0$ **5)** $5x^2-2x=0$ **6)** $3x-4x^2=0$

7) $2t^2-3t=0$ **8)** $7p^2+21p=0$ **9)** $6n-2n^2=0$

10) $21x^2-14x=0$ **11)** $7x^2+9x=0$ **12)** $18p^2+27p=0$

13) $14y^2-35y=0$ **14)** $12m-15m^2=0$ **15)** $25a-40a^2=0$

16) $20x^3-5x^2=0$ **17)** $14p^3+7p^2=0$ **18)** $5x^3-2x^2=0$

19) $12y^2-18y^3=0$ **20)** $8x^3+12x^2=0$ **21)** $6x^2-24x^3=0$

22) $x^2-9=0$ **23)** $x^2-4=0$ **24)** $x^2-25=0$

25) $4m^2-9=0$ **26)** $4z^2-1=0$ **27)** $9p^2-4=0$

28) $4m^2-49=0$ **29)** $25y^2-1=0$ **30)** $16x^2-49=0$

31) $1-y^2=0$ **32)** $9-4t^2=0$ **33)** $16-x^2=0$

34) $25x^2-81=0$ **35)** $49-4x^2=0$ **36)** $9t^2-16=0$

37) $x^2-3x+2=0$ **38)** $y^2-7y+12=0$ **39)** $z^2-6z+5=0$

40) $m^2-m-6=0$ **41)** $t^2+2t-15=0$ **42)** $p^2-5p+4=0$

43) $x^2+10x+21=0$ **44)** $a^2+4a+3=0$ **45)** $x^2-6x+9=0$

46) $22-9q-q^2=0$ **47)** $30-7x-x^2=0$ **48)** $39-10b-b^2=0$

49) $m^2+11m+18=0$ **50)** $x^2-x-42=0$ **51)** $27-6x-x^2=0$

52) $66+5z-z^2=0$ **53)** $t^2+19t+84=0$ **54)** $x^2-21x+110=0$

55) $2x^2-5x+2=0$ **56)** $2a^2+5a-3=0$ **57)** $2a^2-5a+3=0$

58) $3t^2-10t+3=0$ **59)** $3y^2-8y-3=0$ **60)** $5v^2-v-4=0$

61) $2x^2+3x-35=0$ **62)** $6x^2+x-2=0$ **63)** $3x^2-x-4=0$

64) $12-19x+4x^2=0$ **65)** $15-2y-y^2=0$ **66)** $16+24d+9d^2=0$

67) $6+5w-6w^2=0$ **68)** $2p^2+11p+5=0$ **69)** $9x^2-12x+4=0$

70) $12+7x-12x^2=0$ **71)** $10x^2-17x+3=0$ **72)** $36-13y+y^2=0$

73) $3x^2-2x-8=0$ **74)** $6-5x-6x^2=0$ **75)** $12t^2+23t+10=0$

76) $20+7x-6x^2=0$ **77)** $14a^2-13a+3=0$ **78)** $35+3d-20d^2=0$

79) $25x^2-9=0$ **80)** $7x^2-14x=0$ **81)** $x^2+6x-16=0$

82) $2x^2+5x+2=0$ **83)** $12x^2-18x^3=0$ **84)** $49-9p^2=0$

85) $14+17t-6t^2=0$ **86)** $6a^2-a=0$ **87)** $6p^2+19p-7=0$

88) $81x^2-25=0$ **89)** $21-8m-4m^2=0$ **90)** $18y^3+27y^2=0$

91) $9t^2+12t+4=0$ **92)** $100-49q^2=0$ **93)** $25x^2-50x=0$

94) $4x^2+8x+3=0$ **95)** $10+x-2x^2=0$ **96)** $9m^2-1=0$

Exercise 3

Solve the following quadratic equations

1) $8x^2 - 2 = 0$ **2)** $27x^2 - 12 = 0$ **3)** $50 - 2x^2 = 0$

4) $40 = 90y^2$ **5)** $45x^2 = 20$ **6)** $6x^2 + 10x - 4 = 0$

7) $9t^2 + 3t - 3 = 0$ **8)** $12v^2 + 28v + 8 = 0$ **9)** $40d^2 - 46d + 12 = 0$

10) $12x^2 + 26x - 10 = 0$ **11)** $x^2 + 5x = -4$ **12)** $p^2 - 2p = 8$

13) $x^2 - 7x = -6$ **14)** $x^2 + x = 12$ **15)** $x^2 = x$

16) $x^2 = 4$ **17)** $x^2 = 12x - 36$ **18)** $x^2 + 15 = -8x$

19) $3x^2 + 3 = 10x$ **20)** $x^2 + 4 = 4x$ **21)** $1 + 6x^2 = 5x$

22) $4y^2 + 1 = 5y$ **23)** $k(k+4) = 32$ **24)** $x(x-5) = 24$

25) $4x(x+1) = 15$ **26)** $12x - 4 = 9x^2$ **27)** $(x+2)(x+3) = 6$

28) $(x+1)^2 = 1$ **29)** $(2x-3)^2 = 4$ **30)** $(x-3)(2x+3) = 5$

31) $4x^2 + 10x = 14$ **32)** $2n^2 = 20n + 48$ **33)** $24y^2 = 28y + 12$

34) $2p(p+4) = 64$ **35)** $t(t-5) = 24$ **36)** $8x(x+1) = 30$

37) $(2a-3)^2 = 1$ **38)** $(3b-1)^2 = 4$ **39)** $x^2 + (x-1)^2 = 1$

40) $(3x-2)(x+1) = 1 + x$ **41)** $(v+1)(v-1) = 5(v+1)$

42) $(x+2)(x+3) = x+3$ **43)** $2(x-3) = (2x+3)(3-x)$

44) $(x+1)^2 + 6(x+1) + 8 = 0$ **45)** $(2x-5)^2 + (2x-5) = 12$

46) $3 + 7(x-3) = 6(x-3)^2$ **47)** $x(x-5) - 8(x-3) = 2$

48) $x(x+29) - 9(x-2) = 4x + 3$ **49)** $x(x+7) + 3(x+4) = 3x + 2$

50) $x(x-10) - 8(x-4) = 0$ **51)** $2(x-5) + x(x+4) = 2(2x-1)$

Exercise 4

Solve the following quadratic equations correct to 1 decimal place where necessary.

1) $x^2+5x+3=0$	**2)** $x^2-3x+1=0$	**3)** $x^2+7x-5=0$
4) $x^2+4x+1=0$	**5)** $x^2+6x+4=0$	**6)** $x^2+7x+5=0$
7) $x^2+2x-1=0$	**8)** $x^2-6x+3=0$	**9)** $x^2-4x-7=0$
10) $x^2+8x-10=0$	**11)** $x^2-12x+5=0$	**12)** $x^2+20x+15=0$
13) $2x^2+x-4=0$	**14)** $2x^2-3x-4=0$	**15)** $2x^2+12x+9=0$
16) $4x^2-12x+3=0$	**17)** $3x^2-12x+11=0$	**18)** $5y^2+3y-4=0$
19) $5x^2-12x-8=0$	**20)** $10t^2-7t-1=0$	**21)** $15x^2+2x-4=0$
22) $3x^2-18x+10=0$	**23)** $5x^2+12x-5=0$	**24)** $10x^2+12x-9=0$
25) $x^2-10x-15=0$	**26)** $x^2-9x-3=0$	**27)** $6y^2-7y+2=0$
28) $2+5x-4x^2=0$	**29)** $4+2x-3x^2=0$	**30)** $3x^2+8x+2=0$
31) $x^2=-4x-5$	**32)** $y^2+6y=1$	**33)** $4+7t=4t^2$
34) $5x^2+1=-7x$	**35)** $6z^2=4z+3$	**36)** $6m^2+5m=3$
37) $7g^2=3g-4$	**38)** $15y^2=4y+12$	**39)** $9x^2+4x=6$
40) $5+6d+7d^2=0$	**41)** $4x+3=5x^2$	**42)** $8x^2+3x=4$
43) $4n^2+2=7n$	**44)** $11d^2+3=24d$	**45)** $3k^2=4k-6$
46) $14v^2=13v-2$	**47)** $7w^2+5w=2$	**48)** $3x^2+4x=7$
49) $7p^2+2p-3=0$	**50)** $7+7y-3y^2=0$	**51)** $7+5y=-4y^2$
52) $20g^2=11-15g$	**53)** $13+5p^2=6p$	**54)** $4x^2=3-7x$

Exercise 5

1) Two whole numbers **differ by 4** and their **product is 45**.
Let the numbers be **n** and **n + 4**.
Form a quadratic equation in **n** and hence obtain the two numbers.

2) Two whole numbers **differ by 6** and their **product is 55**.
What are the two numbers?

3) Two whole numbers **differ by 7** and their **product is 78**.
What are the two numbers?

4) Two whole numbers **differ by 5** and their **product is 84**.
What are the two numbers?

5) The **sum** of two whole numbers is **17** and their **product is 72**.

a) If **n** is one of the numbers, express the other **in terms of n**.

b) Form a **quadratic equation** in **n** and solve it. Hence **state** the numbers.

6) The **sum** of two whole numbers is **13** and their **product is 40**.

a) If **n** is one of the numbers, express the other **in terms of n**.

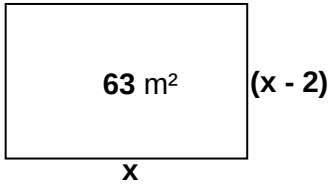
b) Form a **quadratic equation** in **n** and solve it. Hence **state** the numbers.

7) The **sum** of two whole numbers is **18** and their **product is 72**.

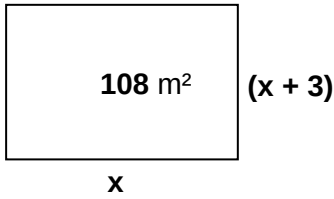
a) If **n** is one of the numbers, express the other **in terms of n**.

b) Form a **quadratic equation** in **n** and solve it. Hence **state** the numbers.

8) The diagram shows a rectangular floor of **area 63 m²**. The breadth of the floor is **2 m** less than the length.
Use this information to find the **length** and the **breadth** of the floor.



9) The diagram shows a rectangular floor of area **108 m²**. The breadth of the floor is **3 m greater** than the length.
Use this information to find the **length** and the **breadth** of the floor.

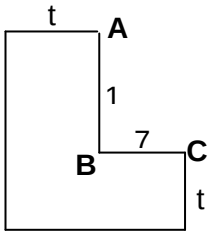


10) The area of a rectangular badge is **21 cm²**.
The length is **4 cm more** than the breadth.
Find the **length** and **breadth** of the badge.

11) The area of a rectangular badge is **99 cm²**.
The breadth is **2 cm less** than the length.
Find the **length** and **breadth** of the badge.

12) The area of a rectangular piece of drawing paper is **300 cm²**.
The length is **5 cm more** than the breadth.
Find the **length** and **breadth** of the paper.

13) The diagram shows an L-shaped piece of metal of uniform width t cm with AB =10 cm and BC=7 cm.
Show that the area A cm² of the metal is given by the formula $A = t^2 + 17t$. Find t when A = 60.



14) The **area** of a rectangular pane of glass is **96 cm²**, and its **perimeter** is**40 cm**.

a) Let **x cm** be the **length** of the pane.
Write down the **breadth** of the pane in terms of **x**.

b) Form an **equation in x** and solve it.
Hence **state** the **dimensions** of the pane.

15) The **area** of a rectangular pane of glass is **1500 cm²**, and its **perimeter** is **160 cm**.

a) Let **x cm** be the **length** of the pane.
Write down the **breadth** of the pane in terms of **x**.

b) Form an **equation in x** and solve it.
Hence **state** the **dimensions** of the pane.

16) A stone is thrown vertically upwards at a **speed** of **24 m/s**.
Its height **h metres** after **t seconds** is given approximately by the formula **$h = 24t - 5t^2$.**
Use this formula to find when the stone is **27 m high**, and explain this double answer.

17) The **perimeter** of a rectangular plot of ground is **42 m** and its **area** is **80 m^2.**
Find the **length** and **breadth** of the plot.

18) The **height** of a **triangle** is **5 cm more** than the base.
If the **area** of the triangle is **75 cm^2**, find its **height**.

19) The sum **S** of the first **n natural** numbers is given by the formula **$S = \frac{1}{2} n (n + 1)$**.
How many consecutive natural numbers, starting at 1, must be **added** together to give **210**?

20) The sum **S** of the first **n even** numbers, starting at 0, is given by the formula **$S = n (n - 1)$**.
How many consecutive even numbers, starting at 0, **add** up to **156**?

Drawing quadratic functions from a table

Exercise 1

Complete the Quadratic Functions worksheet.

Exercise 2

For each graph on your Quadratic Functions worksheet state the:

a) roots of the function

b) coordinates and nature of the turning point

c) equation of the axis of symmetry

d) coordinates of the y-intercept.

Exercise 3

For each function draw a sketch of its graph by working out the:

a) roots of the function

b) coordinates and nature of the turning point

c) equation of the axis of symmetry

d) coordinates of the y-intercept

1) $y=(x-2)(x-4)$ **2)** $y=(x+3)(x+5)$ **3)** $y=x(x-4)$

4) $y=x(x+6)$ **5)** $y=(x+1)(x-5)$ **6)** $y=(x+6)(x-2)$

7) $y=x^2$ **8)** $y=x^2-4$ **9)** $y=x^2-16$

10) $y=x^2-4x$ **11)** $y=x^2+2x$ **12)** $y=-x^2$

13) $y=9-x^2$ **14)** $y=6x-x^2$ **15)** $y=x^2-8x+15$

16) $y=x^2+6x+8$ **17)** $y=x^2+2x-3$ **18)** $y=x^2-2x-24$

19) $y=12-4x-x^2$ **20)** $y=x^2+4x+3$ **21)** $y=5-4x-x^2$

22) $y=4x^2-8x-5$ **23)** $y=4x^2+8x-21$ **24)** $y=x^2+x$

Exercise 4

For each function:

a) write it in the form $y=(x+a)^2+b$

b) state the coordinates and nature of the turning point

c) find the equation of the axis of symmetry

d) find the coordinates of the y-intercept

e) sketch the graph, indicating clearly **b), c) and d).**

1) $y=x^2+4x+9$ **2)** $y=x^2-6x+2$ **3)** $y=x^2+8x-3$

4) $y = x^2 + 3x + 4$ **5)** $y = x^2 - 5x - 1$ **6)** $y = x^2 + x + 1$

7) $y = 3 + 4x - x^2$ **8)** $y = 2 - 6x - x^2$ **9)** $y = -1 + 3x - x^2$

10) $y = x^2 + 10x + 3$ **11)** $y = x^2 - x - 5$ **12)** $y = 2 + 2x - x^2$

13) $y = x^2 + 4x + 4$ **14)** $y = x^2 - 5x - 3$ **15)** $y = -3 + 6x - x^2$

16) $y = x^2 + 3x - 4$ **17)** $y = x^2 - 8x - 1$ **18)** $y = 2 + 3x - x^2$

Exercise 5

For each of the following equations find:

a) the discriminant

b) the nature of the roots

1) $x^2 + 3x + 1 = 0$ **2)** $x^2 + 2x + 5 = 0$ **3)** $x^2 + 4x + 4 = 0$

4) $x^2 + 2x - 3 = 0$ **5)** $x^2 + 5x - 2 = 0$ **6)** $x^2 + 2x - 1 = 0$

7) $x^2 - 3x + 2 = 0$ **8)** $x^2 - x + 5 = 0$ **9)** $x^2 - 6x + 1 = 0$

10) $2x^2 + 3x + 3 = 0$ **11)** $2x^2 + 6x - 1 = 0$ **12)** $3x^2 - 2x + 5 = 0$

13) $x^2 + 6x + 9 = 0$ **14)** $4x^2 - 2x - 3 = 0$ **15)** $6x^2 - 8x + 1 = 0$

16) $3 - 2x - x^2 = 0$ **17)** $4 + 6x - x^2 = 0$ **18)** $-5 - 2x - x^2 = 0$

19) $6x^2 + 5x + 2 = 0$ **20)** $3x^2 - 9x + 2 = 0$ **21)** $1 - -3x - x^2 = 0$

22) $4x^2 - 12x + 9 = 0$ **23)** $5x^2 - 2x + 3 = 0$ **24)** $6 - x - x^2 = 0$

Exercise 6

For each of the following equations find:

a) the discriminant **b)** the nature of the roots

1) $x^2 = 3 - 6x$ **2)** $4x = x^2 - 3$ **3)** $10x = -25 - x^2$

4) $x^2+7=2x$ **5)** $x^2-4=6x$ **6)** $3x^2=6x+2$

7) $4=3x-2x^2$ **8)** $x^2+16=8x$ **9)** $2x=9x^2-3$

10) $4x^2+2x=3-4x$ **11)** $2x^2-3x+2=x^2+2x$

12) $2x^2-3x=7-x^2$ **13)** $5x^2-9=6x+x^2-3$

14) $x(x-1)=2x+5$ **15)** $x(3-x)=2(3x-1)$

Exercise 7

Find the value(s) of p which give the equation one real root ($p\neq 0$)

1) $x^2+6x+p=0$ **2)** $x^2-2x+p=0$ **3)** $x^2+px+25=0$

4) $x^2+px+36=0$ **5)** $x^2+px+p=0$ **6)** $x^2+2px+p=0$

7) $x^2+2px+49=0$ **8)** $x^2+2px+64=0$ **9)** $px^2+12x+9=0$

10) $3px^2+6px+1=0$ **11)** $4px^2-4x+1=0$ **12)** $4px^2-8px+1=0$

Exercise 8

Find the values of p which give the equation two real roots

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

4) $px^2+6x-2=0$ **5)** $px^2-2x+4=0$ **6)** $2x^2+8x+p=0$

7) $3x^2-12x+p=0$ **8)** $px^2+4x-2=0$ **9)** $x^2+5x+p=0$

Exercise 9

Find the values of p which give the equation no real roots

1) $x^2 - 2x + p = 0$ **2)** $x^2 + 4x + p = 0$ **3)** $2x^2 + 3x + p = 0$

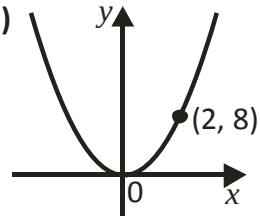
4) $px^2 - 4x + 2 = 0$ **5)** $px^2 - 8x + 1 = 0$ **6)** $3px^2 - 9x + 1 = 0$

7) $px^2 + 4x - 4 = 0$ **8)** $px^2 - 6x - 3 = 0$ **9)** $2px^2 - 2x + 4 = 0$

Exercise 10

Each diagram shows a parabola with equation $y = kx^2$. What is the value of k ?

1)



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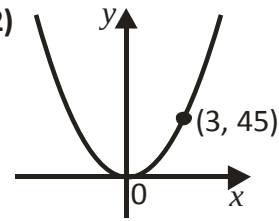

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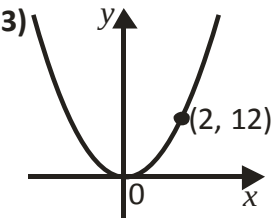

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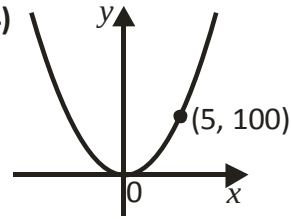

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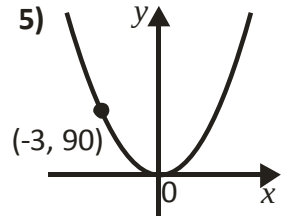

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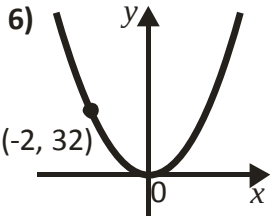

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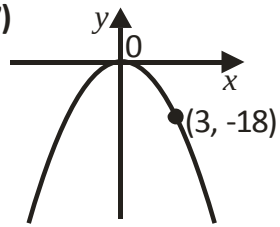

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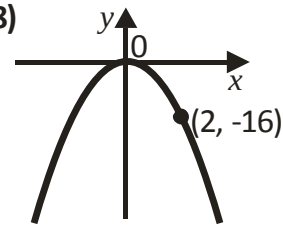

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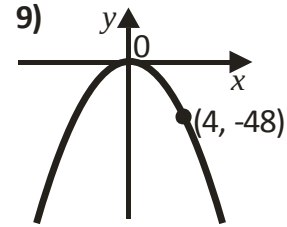

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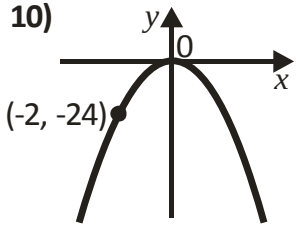

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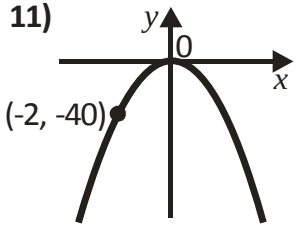

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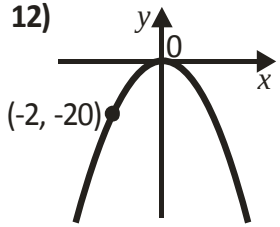
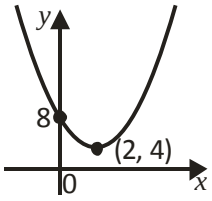


Exercise 11

The equation of the quadratic functions shown below is of the form $y = (x+a)^2 + b$, where a and b are integers.

Write down the values of a and b.

1)



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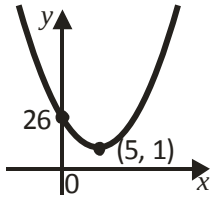

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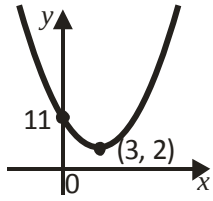

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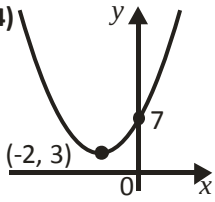

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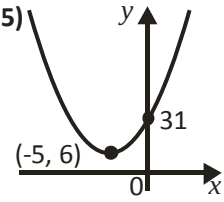

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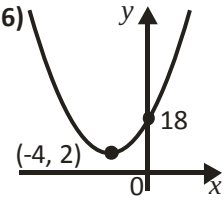

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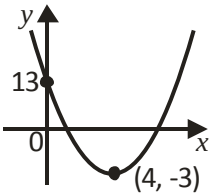

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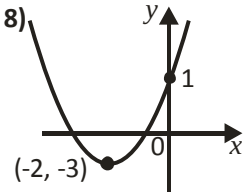

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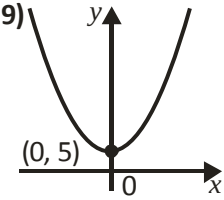

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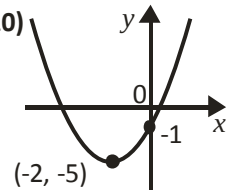

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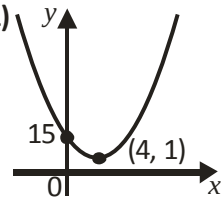

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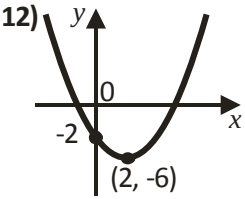

Exercise 12

Find the coordinates of **A** and **B** from the information shown in each diagram.

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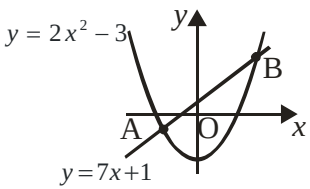

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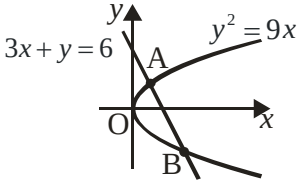

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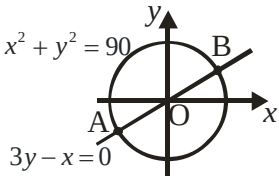

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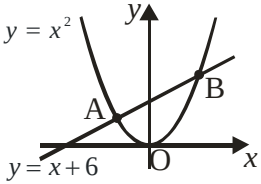

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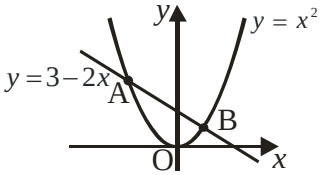

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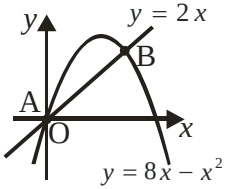

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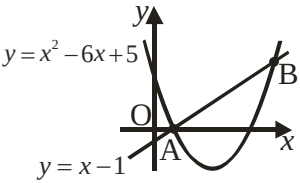

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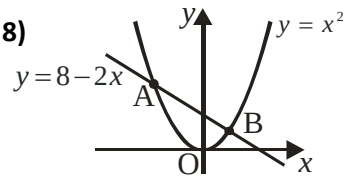

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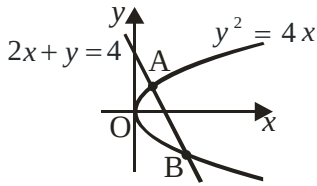

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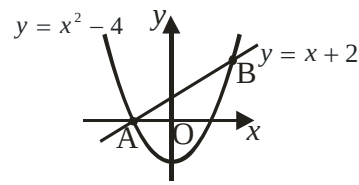

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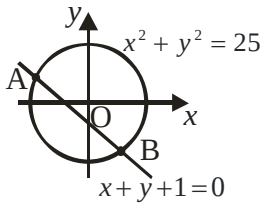
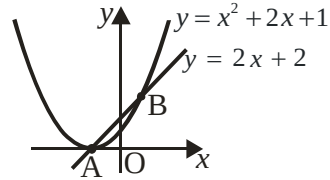


12)



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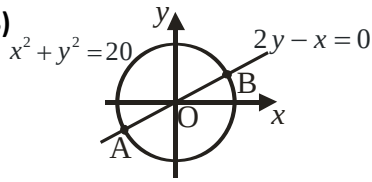

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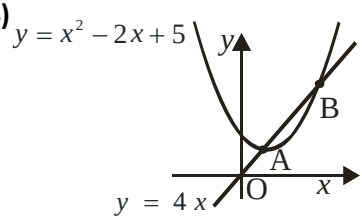


Exercise 13

1) A **circle has equation $x^2 + y^2 + 7x - 8y + 12 = 0$**.
Find the **co-ordinates** of the points where the circle **cuts**

a) the x-axis **b)** the y-axis

2) A **circle has equation $x^2 + y^2 - 2x + 5y - 24 = 0$**.
Find the **co-ordinates** of the points where the circle **cuts**

a) the **x-axis** **b)** the **y-axis**

3) **Diagram 1** below shows part of the **parabola $y = 6x - x^2$.**

a) Given the point **(3 , k)** lies on the parabola, find **k.**

b) If **MP = 8** find **OM.**

c) Find the **co-ordinates** of **C**.

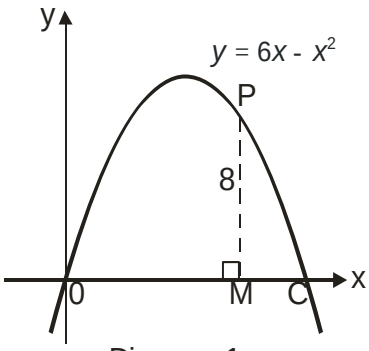


Diagram 1

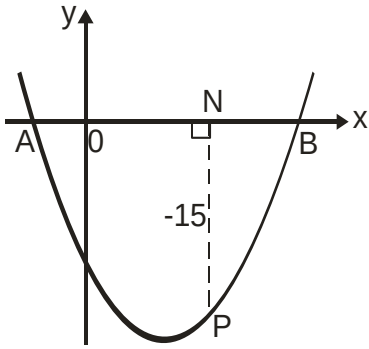


Diagram 2

4) **Diagram 3** below shows the cross-section of a cutting whose sloping sides **AD** and **BC** make an angle of 45° with the ground whose natural surface **DC** is **horizontal**.

a) Show the **area** of the cross-section **is x(48 – x) m².**

b) Find **x** for which this area is **320 m².**

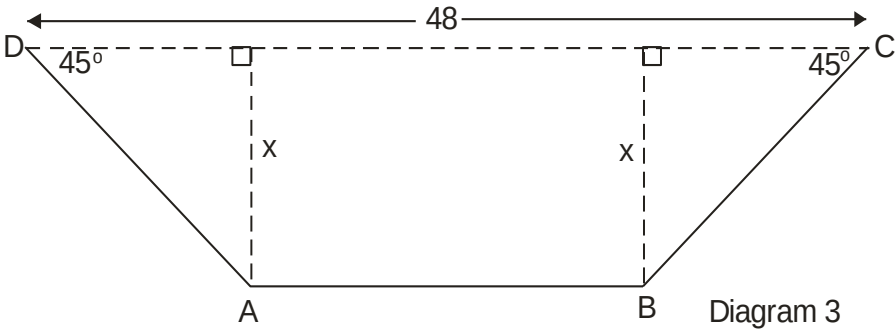


Diagram 3

5) **Diagram 4** below shows the graphs of **$y = 2x - 5$** and **$y = 8(x^2 - 1)$.**

a) Show that at the points of intersection, **$8x^2 - 2x - 3 = 0$.**

b) Hence find the **co-ordinates** of the points of intersection **A and B.**

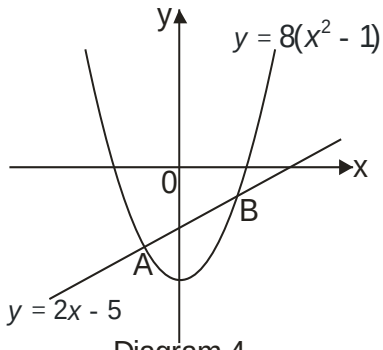


Diagram 4

6) **Diagram 5** below shows the line **$y = 5 - 2x$** and the parabola **$y = \frac{1}{2}(15 - x^2)$.**
Find the **x co-ordinates** of the points of intersection **P and Q**, and hence **state** the **co-ordinates** of these points.

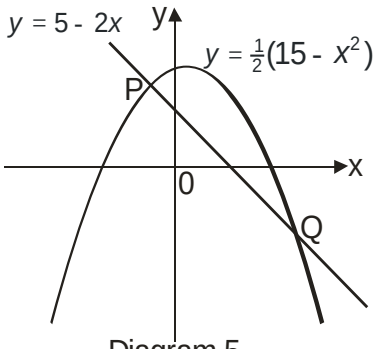


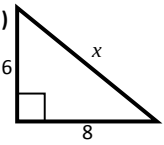
Diagram 5

Pythagoras

Exercise 1

Calculate the length of x, giving your answer where necessary to 2 decimal places (all sizes in centimetres).

1)



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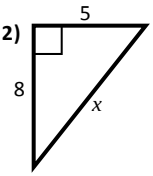

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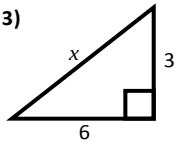

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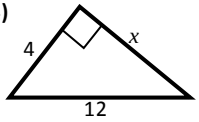
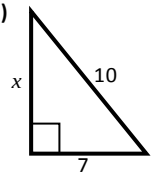


5)



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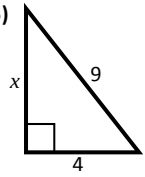

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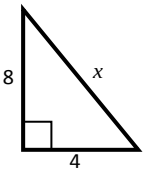

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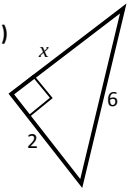

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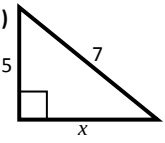

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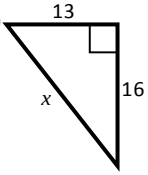

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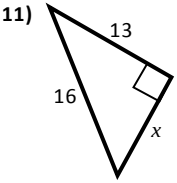

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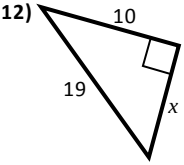

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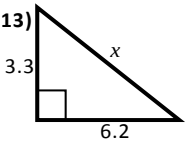

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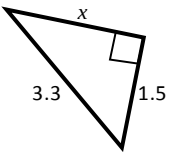

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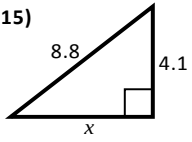

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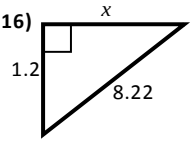

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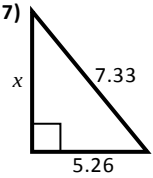

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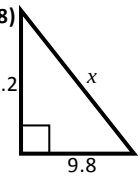

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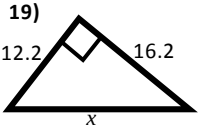

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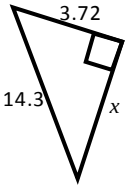


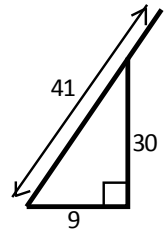
Exercise 2

1) A ladder of length 12 feet is leaning against a wall. It reaches to a height of 10 feet. How far is the foot of the ladder from the wall?

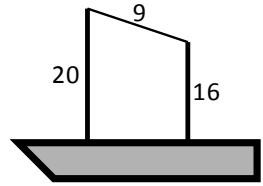
2) The foot of a ladder is 5 feet from a wall. The ladder is 14 feet long. How far up the wall does the ladder reach?

3) The foot of a ladder is 2 m from a wall. It reaches up to a height of 7 m. How long is the ladder?

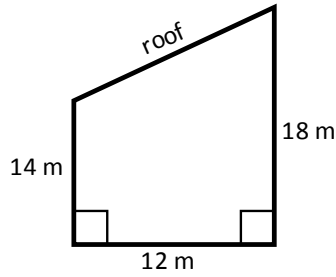
4) If a ladder 41 feet long is placed with its foot 9 feet from the bottom of a wall 30 feet high, how much of the ladder extends beyond the top of the wall?



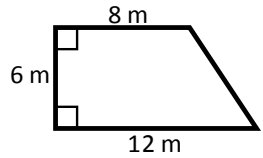
5) The tops of two masts on a ship are joined by a wire 9 m long. If the masts are 16 m and 20 m high, how far apart are they?



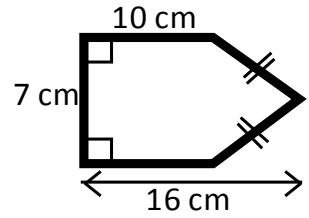
6) A barn has a sloping roof and is 14 m high at the front and 18 m high at the back. It is 12 m from front to back.
Calculate the length of the sloping roof.



7) This is the diagram of a lawn. Kerb stones are put round the outside of the lawn. Calculate the total length of kerb stones required.

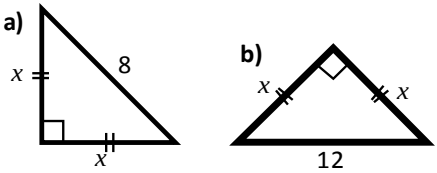


8) Calculate the perimeter of this shape.



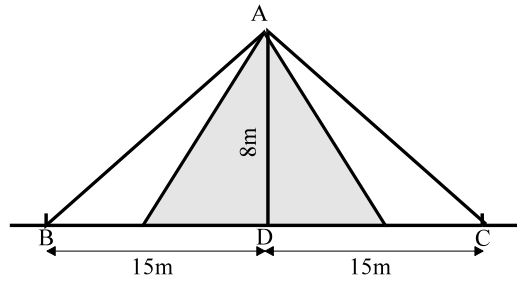
9) In a rectangular garden which measures 38 m by 21 m, a path goes diagonally from one corner to the opposite corner.
Calculate the length of the path.

10) Calculate the length of the shorter side in each of the following right-angled isosceles triangles.



11) ABCD is a rectangular plot 35m by 12m. AC is a diagonal path.
Find how much further it is to go from A to C by way of B than to go directly from A to C.

12) AB and AC are tent rope attached to the central pole at a height of 8 m from the ground. The ropes are pegged at B and C at distances of 15 m from the pole. What lengths of ropes are required?



Exercise 3

1) Find the length of the line AB where

a) A(1 , 2) B(5 , 5) **b)** A(1 , 2) B(7 , 6) **c)** A(-2 , 8) B(7 , 0)

d) A(1 , 4) B(5 , -2) **e)** A(-3 , 5) B(2 , 1) **f)** A(-4 , -5) B(1 , -2)

2) If A(3 , 1), B(7 , 6) and C(10 , -3) are the three corners of triangle ABC, find the length of all 3 sides.

3) If A(1 , 0), B(-5 , 6) and C(3 , 6) are the three corners of triangle ABC, find:

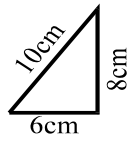
a) the length of all 3 sides of triangle ABC

b) the area of triangle ABC

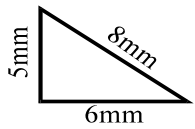
c) the shortest distance from A to the line BC.

Exercise 4

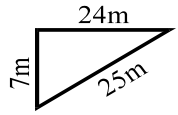
1) Use the Converse of Pythagoras to determine which of the following triangles are right-angled.



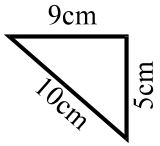
(a)



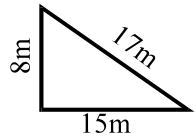
(b)



(c)



(e)



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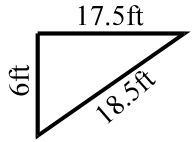
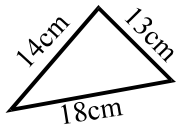
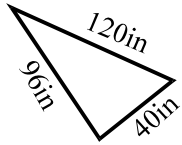


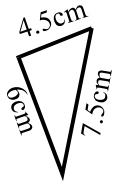
(g)



(i)



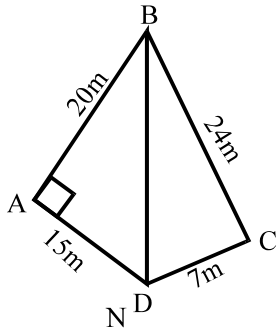
(j)



(k)

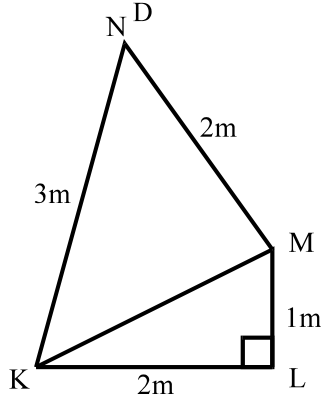
2) Quadrilateral ABCD is divided into 2 triangles as shown in the diagram. The dimensions are also shown in the diagram.

Triangle ABD is right-angled at A. Prove that triangle BCD is right-angled at C.



3) Use the information apparent in this diagram to prove that triangle KMN is right-angled at M.

[NOTE: Leave your one intermediate calculation in square root form]



4) In each of the following parts, find by calculation which angle in triangle ABC is the right-angle.

a) A(-1 , 4) B(2 , 1) C(8 , 7)

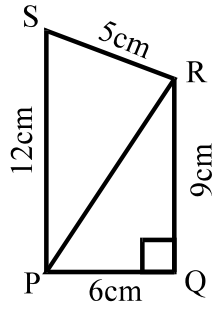
b) A(0 , -2) B(10 , 3) C(-2 , 2)

c) A(-4 , -1) B(6 , 9) C(2 , -3)

d) A(1 , 4) B(-2 , 1) C(4 , -5)

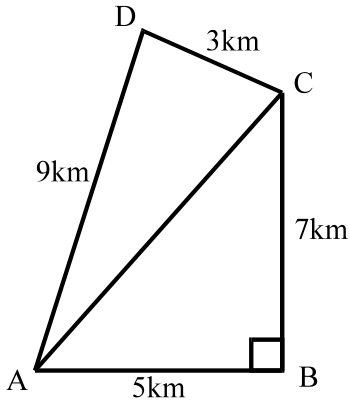
5) In this diagram angle PQR is 90°.

Is angle PRS acute or 90° or obtuse?



6) In this diagram angle ABC is 90°.

Is angle ACD acute or 90° or obtuse?



7) In each of the following parts, name the largest angle in triangle PQR and by calculation state whether it is acute, right or obtuse.

a) P(-2 , 2) Q(2 , 5) R(5 , -1)

b) P(-2 , 4) Q(1 , 7) R(4 , -2)

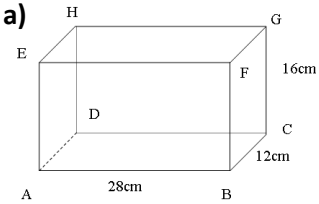
c) P(-3 , -2) Q(0 , 6) R(5 , -1)

d) P(-2 , 4) Q(0 , -3) R(6 , 7)

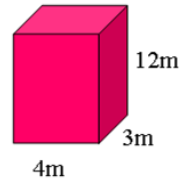
Exercise 5 – Pythagoras in 3D

1) Find the length of a space diagonal in each cuboid

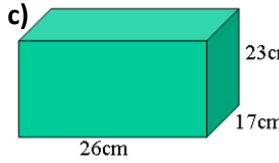
a)



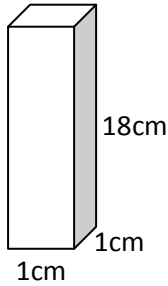
b)



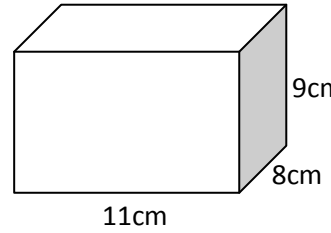
c)



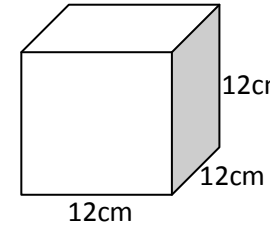
d)



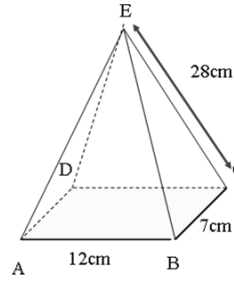
e)



f)

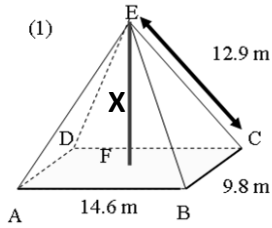


2) Find the height of this pyramid

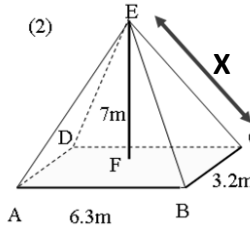


3) Find x in each diagram

(1)

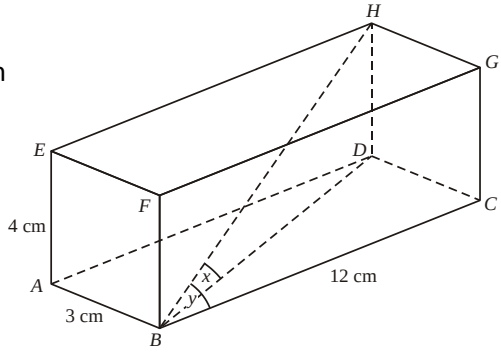


(2)

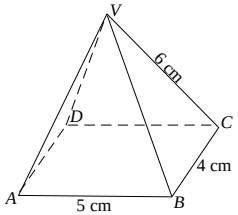


4) The diagram shows a cuboid.
AB = 3 cm, *AE* = 4 cm, *BC* = 12 cm

Find the length of *BH*.

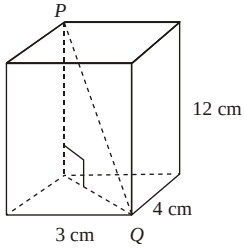


5)



Calculate the height of the pyramid.

6)



Work out the length of PQ

7)

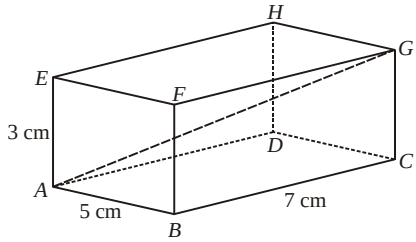


Diagram **NOT** accurately drawn

The diagram represents a Cuboid *ABCDEFGH*.

AB = 5 cm. *BC* = 7 cm. *AE* = 3 cm.

Calculate the length of *AG*. Give your answer correct to 3 sig figs.