MATHEMATICS

N4

Unit 2
Relationships

The Straight Line

Exercise 1

1) Given $y = x + 3$ find **y** when: **a)** $x = 2$ **b)** $x = -4$

2) Given $y = x - 4$ find **y** when: **a)** $x = 3$ **b)** $x = -1$

3) Given $y = 2x$ find **y** when: **a)** $x = 1$ **b)** $x = -2$

4) Given $y = 3x$ find **y** when: **a)** $x = 5$ **b)** $x = -6$

5) Given $y = 2x + 7$ find **y** when: **a)** $x = 3$ **b)** $x = -2$

6) Given $y = 2x - 3$ find **y** when: **a)** $x = 4$ **b)** $x = -1$

7) Given $y = 3x - 5$ find **y** when: **a)** $x = 4$ **b)** $x = -3$

8) Given $y = 3x - 2$ find **y** when: **a)** $x = 6$ **b)** $x = -2$

9) Given $y = 5x + 1$ find **y** when: **a)** $x = 1$ **b)** $x = 0$

10) Given $y = 6x - 3$ find **y** when: **a)** $x = 2$ **b)** $x = -3$

11) Given $y = \dfrac{1}{2}x$ find **y** when: **a)** $x = 10$ **b)** $x = -4$

12) Given $y = \dfrac{1}{3}x$ find **y** when: **a)** $x = 3$ **b)** $x = -9$

13) Given $y = \dfrac{1}{2}x + 2$ find **y** when: **a)** $x = 4$ **b)** $x = -6$

14) Given $y = \dfrac{1}{2}x - 3$ find **y** when: **a)** $x = 2$ **b)** $x = -4$

15) Given $y = \dfrac{1}{3}x + 1$ find **y** when: **a)** $x = 6$ **b)** $x = -3$

16) Given $y = \dfrac{2}{3}x - 2$ find **y** when: **a)** $x = 9$ **b)** $x = -6$

17) Given $y = -\dfrac{1}{2}x + 2$ find **y** when: **a)** $x = -6$ **b)** $x = 9$

Exercise 2

1) Write down the equation of the lines in these diagrams.

   a)
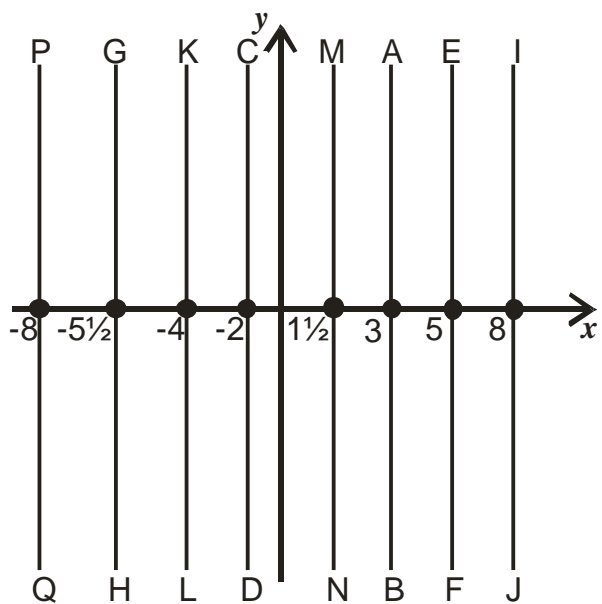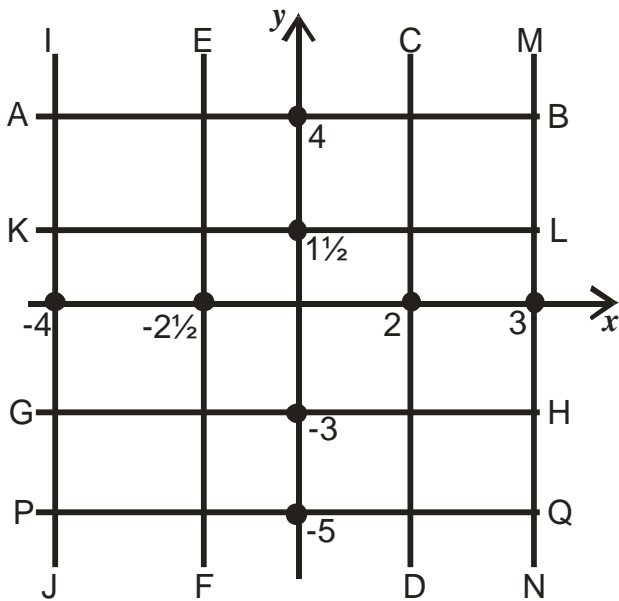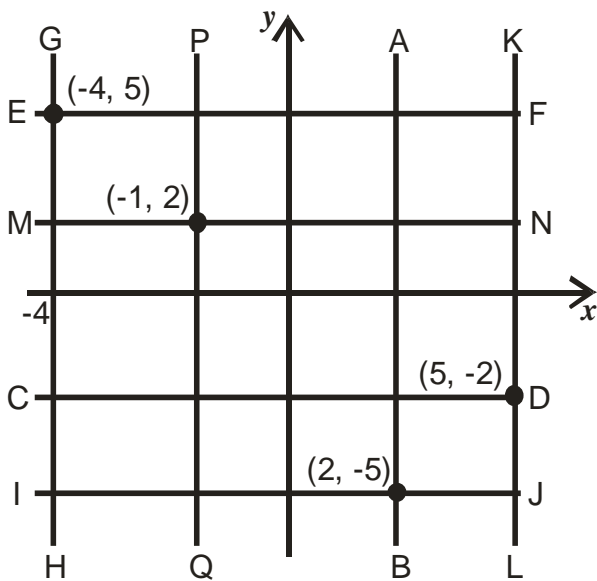

   b)
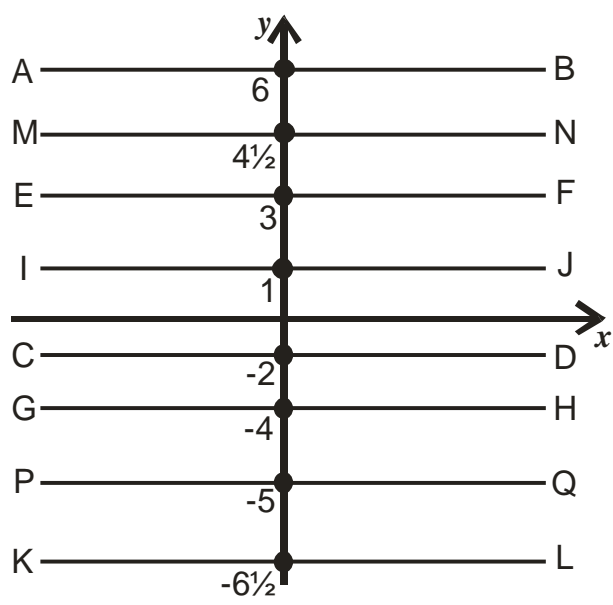
2) Write down the equation of the lines in these diagrams.

a)

b)

3) Draw x, y axes running from -8 to 8.

On this diagram draw the lines with equations

a) x = 3   **b)** y = 7   **c)** x = −4   **d)** y = −8
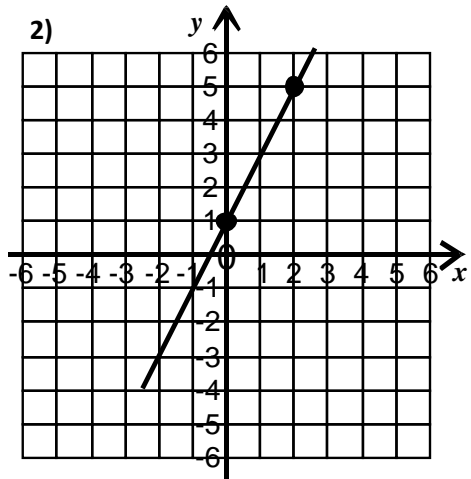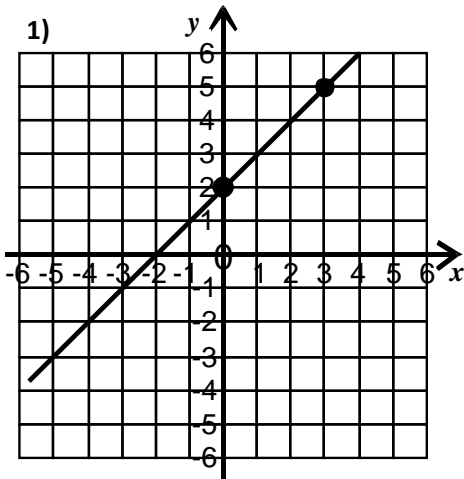
e) y = 1   **f)** x = −2   **g)** y = −2½   **h)** x = −2½

Exercise 3

Find the equation of the straight line shown in the diagram.
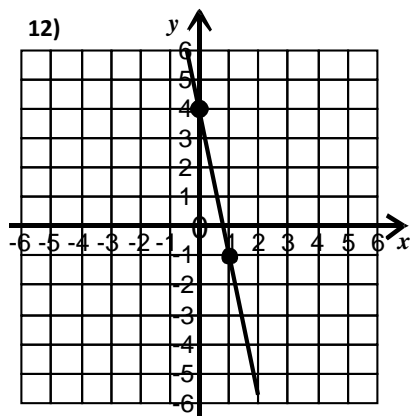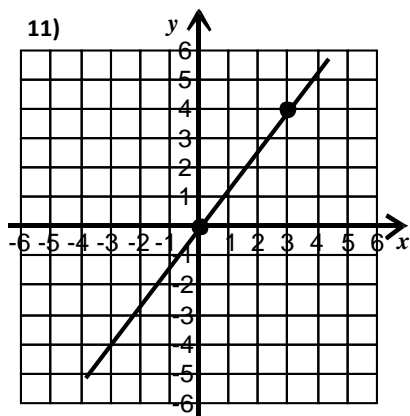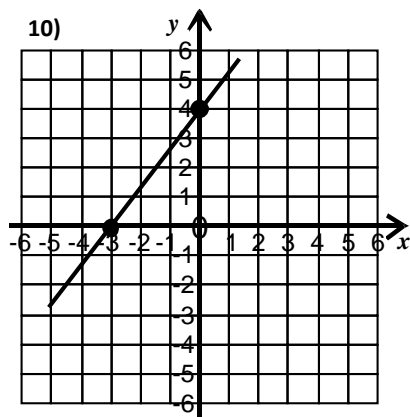
3)

4)

5)

6)

7)

8)

9)

10)

11)

12)
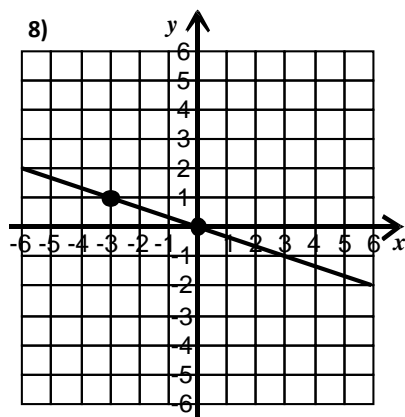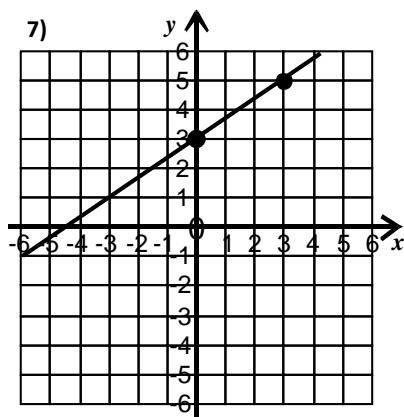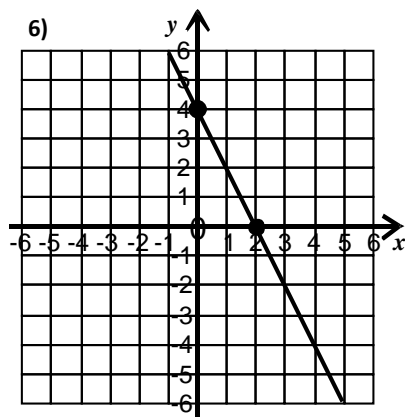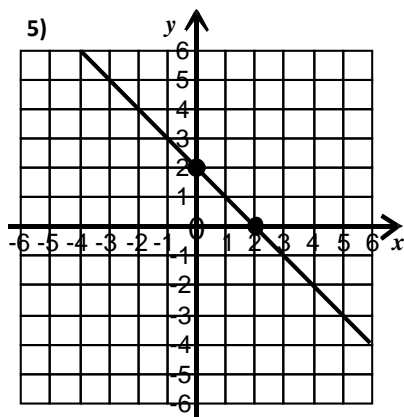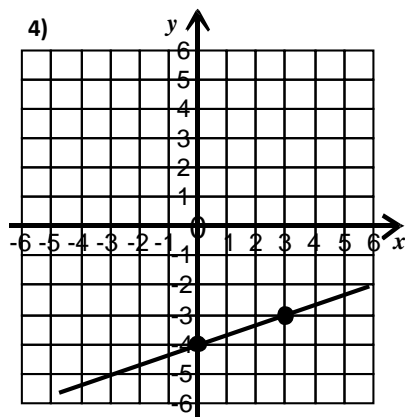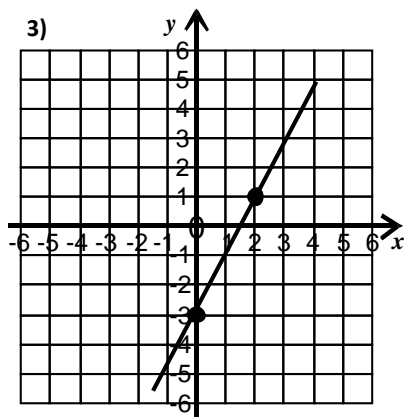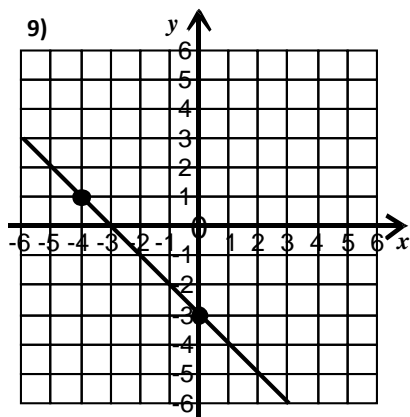
Exercise 4

Find the equation of the straight line shown in the diagram.

1)

2)

3)

4)

5)

6)

7)

Graph showing a line through points (0, -4) and (7, 1).

8)

Graph showing a line through points (0, 0) and (4, 6).

9)

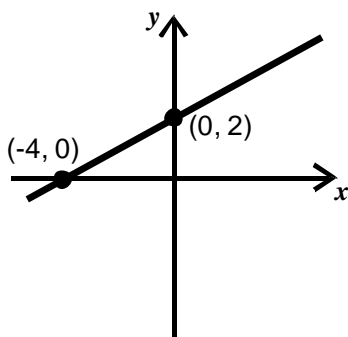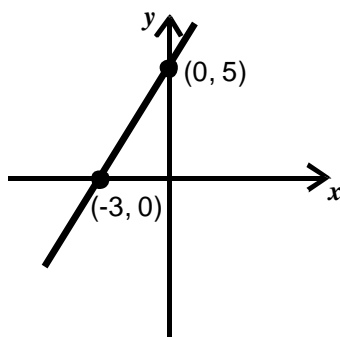

Graph showing a line through points (0, 7) and (5, 0).

10)

Graph showing a line through points (0, 0) and (3, -9).

11)

Graph showing a line through points (0, -4) and (6, 10).

12)

Graph showing a line through points (-5, 0) and (0, -8).
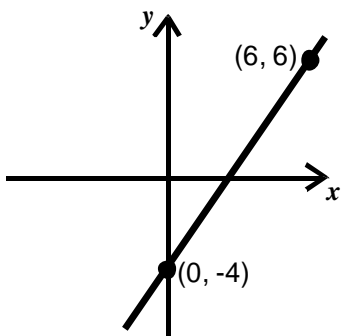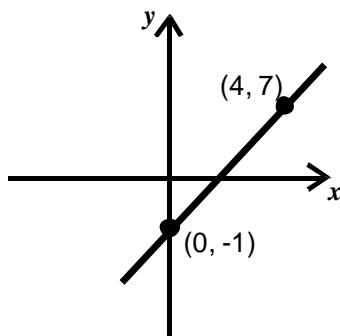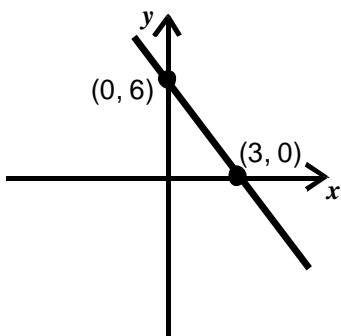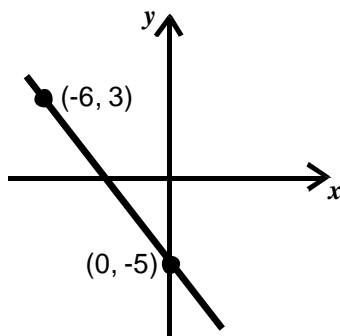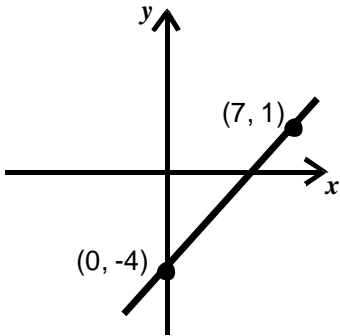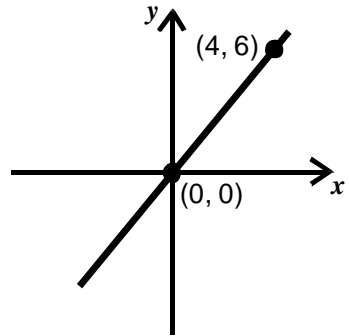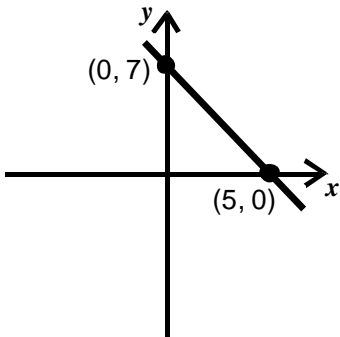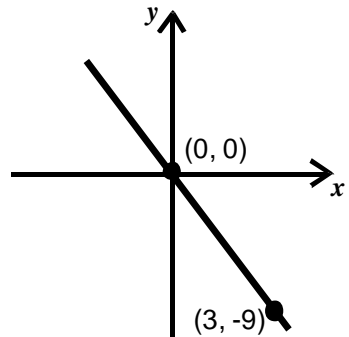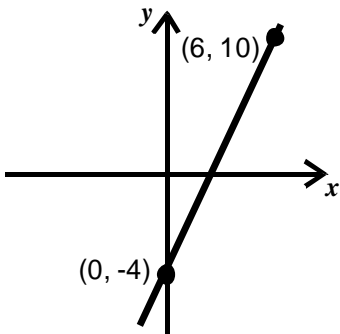
Scatter Graphs

1) The scattergraph shows the
   height and weight of six children.
   a)   What height is Fred?
   b) What weight is Eric?
   c) Which two children are the
      same height?
   d) Who is the lightest?
   e) Who is the shortest?
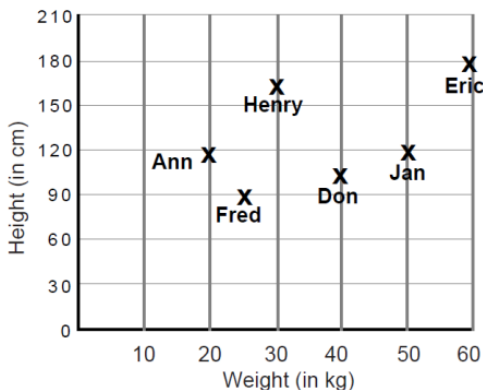
2) This graph shows a relation between
   the temperature during the day and
   the sales of ice lollies on that day.
   a) Suggest a connection between the
      temperature and the sale of ice
      lollies.
   b) Use the chart to estimate the
      number of ice lollies which might
      be sold when the temperature
      reaches 35 degrees.
   c) Estimate what the temperature was when thirteen ice lollies were sold?
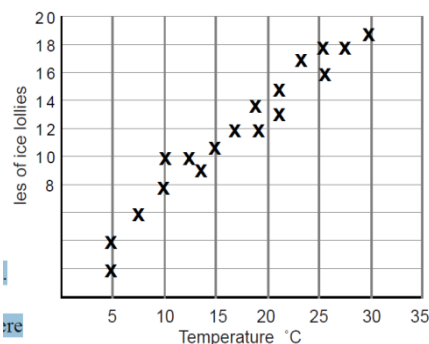
3) This scattergraph shows the prices which taxi cabs charge for fairly short
   distances.
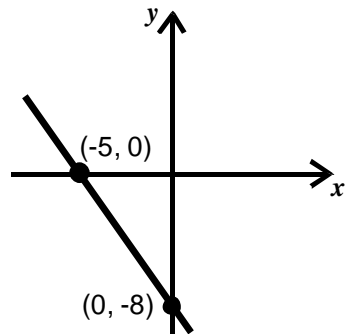   a) Suggest a connection between
      the fare and the number of
      miles travelled.
   b) Use the chart to give a
      reasonable guess at how far
      you could go in a taxi for
      £1.50.
   c) How much do you think a 6 mile
      journey would cost?
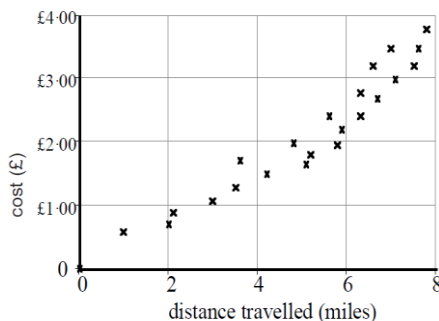
4) Here is a table of exam marks (out of 50) from a modern languages department.

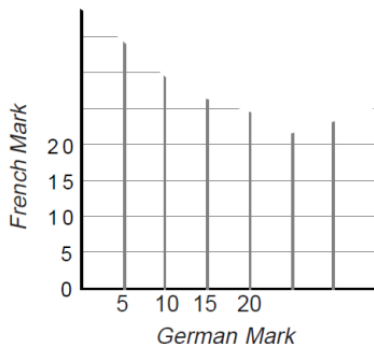| Name	Ali	Bo	Ed	Dan	Flo	Hal	Nan	Pen	Rab	Sid
German Mark	5	5	10	15	20	25	30	35	35	45
French Mark	5	10	10	20	15	30	30	40	40	45

a) Draw a diagram similar to the one shown, using the same scale for each axis.

b) Plot the information from the table to make a scatter diagram

c) Describe some connections between the French marks and the German marks.

d) Draw a line of best fit through the points.

e) Use the graph to estimate what the German mark would be if the French mark was 35.

f) One person seems to go against the trend. Who is it, and what makes you think that?

5) Brad and his pals record the number of take away meals they deliver each evening, and the time it takes them.

Time (min)	25	22	20	20	15	13	9	15	17	14
No. of meals	40	33	30	32	22	20	13	20	21	19

a) Draw up a set of axes on squared paper, with time on the horizontal axis and number of meals on the vertical axis. Using suitable scales draw a scatter diagram.

b) Estimate the time it would take Brad & Co. to deliver 28 meals.

Equations

Exercise 1

Solve the following equations

1) $x - 3 = 5$ 2) $x - 4 = 6$ 3) $x - 2 = 11$ 4) $x + 5 = 8$

5) $x + 7 = 12$ 6) $x + 15 = 21$ 7) $x - 3 = 1$ 8) $x + 4 = 5$

9) $x - 8 = 0$ 10) $x + 4 = 2$ 11) $x + 6 = 3$ 12) $x + 8 = 3$

13) $y - 7 = -5$ 14) $y - 8 = -10$ 15) $y + 10 = 20$ 16) $y + 9 = 4$

17) $y - 7 = -6$ 18) $y + 25 = 15$ 19) $4 + x = 9$ 20) $5 + x = 7$

21) $8 + x = 24$ 22) $a + 6 = -2$ 23) $a - 7 = -3$ 24) $a + 6 = 0$

25) $x - 7 = 5$ 26) $x + 11 = 20$ 27) $x + 12 = 30$ 28) $x - 6 = -2$

29) $x - 8 = 9$ 30) $x + 5 = 0$ 31) $x - 13 = -7$ 32) $x + 10 = 3$

33) $5 + x = 9$ 34) $9 + x = 17$ 35) $y - 6 = 11$ 36) $y + 8 = 3$

37) $7 = x + 2$ 38) $9 = x - 3$ 39) $15 = x + 4$ 40) $12 = x - 7$

41) $5 = x + 11$ 42) $16 = x - 7$ 43) $18 = 9 + x$ 44) $23 = 11 + x$

45) $-10 = x + 6$ 46) $7 = 6 + x$ 47) $18 = 13 + x$ 48) $-5 = 7 + x$

49) $3 = x - 2$ 50) $14 = y + 11$

Exercise 2

Solve the following equations

1) $3x = 9$ **2)** $2x = 12$ **3)** $4x = 28$ **4)** $5x = 30$

5) $7x = 56$ **6)** $4x = 36$ **7)** $9x = 81$ **8)** $9x = 90$

9) $6x = 180$ **10)** $12x = 60$ **11)** $10x = 1000$ **12)** $8x = 96$

13) $5x = 2$ **14)** $7x = 5$ **15)** $8x = 3$ **16)** $4x = 1$

17) $2x = 1$ **18)** $9x = 5$ **19)** $3x = 5$ **20)** $4x = 7$

21) $3x = 7$ **22)** $2x = 9$ **23)** $3x = 10$ **24)** $5x = 11$

25) $5x = -4$ **26)** $6x = -24$ **27)** $5x = -10$ **28)** $4x = -36$

29) $3x = -2$ **30)** $12x = -1$ **31)** $7x = -10$ **32)** $5x = 1$

33) $4x = -19$ **34)** $10x = -10$ **35)** $18x = -18$ **36)** $17x = -68$

37) $8 = 4x$ **38)** $10 = 2x$ **39)** $12 = 3y$ **40)** $72 = 9a$

41) $6 = 5a$ **42)** $15 = 2z$ **43)** $-8 = 2y$ **44)** $-7 = 2x$

45) $9 = -3m$ **46)** $15 = -5n$ **47)** $-20 = -2x$ **48)** $-40 = -4y$

49) $35 = -7a$ **50)** $-2 = -4x$

Exercise 3

Solve the following equations

1) $2x - 3 = 3$ **2)** $3x - 1 = 5$ **3)** $4x - 3 = 5$

4) $3x - 5 = 13$ **5)** $5x - 7 = 3$ **6)** $7x - 1 = 27$

7) $2x - 1 = 5$ **8)** $3x + 1 = 13$ **9)** $4x + 2 = 5$

10) $5x + 1 = 7$ **11)** $5x - 3 = 10$ **12)** $3x + 1 = 2$

13) $2y + 10 = 11$ **14)** $3y - 6 = -3$ **15)** $2y + 10 = 9$

16) $3y + 10 = 7$ **17)** $4y + 10 = 10$ **18)** $3y - 6 = -4$

19) $5a + 6 = 10$ **20)** $7a + 4 = 0$ **21)** $9a - 7 = 0$

22) $10a - 3 = 0$ **23)** $5n - 3 = 11$ **24)** $6n + 3 = -2$

25) $3x + 4 = -3$ **26)** $8x - 2 = 10$ **27)** $4t + 10 = 0$

28) $6 + 3x = 12$ **29)** $5 + 2x = 13$ **30)** $7 + 4x = 20$

31) $5 + 8x = 10$ **32)** $8 + 5x = 2$ **33)** $3 + 7x = 2$

34) $8 + 5x = 0$ **35)** $9 + 3x = 0$ **36)** $5 + 3x = -1$

37) $10 = 2x + 3$ **38)** $2 = 3x - 4$ **39)** $7 = 4x - 5$

40) $4 = 5x - 1$ **41)** $7 = 3x + 6$ **42)** $-11 = 3x - 5$

43) $6 = 3x - 4$ **44)** $-2 = 2x + 1$ **45)** $0 = 10x - 1$

46) $0 = 11x + 2$ **47)** $19 = 6x - 5$ **48)** $7 = 3x + 7$

49) $3x + 1 = 16$ **50)** $4x + 3 = 27$ **51)** $2x - 3 = 1$

52) $5x - 3 = 1$ **53)** $3x - 7 = 0$ **54)** $2x + 5 = 20$

55) $6x - 9 = 2$ **56)** $7x + 6 = 6$ **57)** $3x + 4 = 16$

58) $5x + 2 = 17$ **59)** $4y + 3 = 19$ **60)** $2y + 5 = 15$

61) $8z + 9 = 25$ **62)** $6a + 7 = 25$ **63)** $7b + 8 = 36$

64) $5c + 7 = 32$ **65)** $9m + 5 = 41$ **66)** $8n + 5 = 53$

67) $6x + 7 = 13$ **68)** $3y + 8 = 29$ **69)** $8t + 9 = 41$

70) $3z + 8 = 17$ **71)** $4a + 11 = 19$ **72)** $5b + 13 = 38$

73) $7c + 11 = 60$ **74)** $9d + 16 = 34$ **75)** $12p + 13 = 85$

76) $11q + 16 = 60$ **77)** $3x - 11 = 10$ **78)** $4x - 9 = 3$

79) $6y - 5 = 1$ **80)** $7y - 2 = 12$ **81)** $6z - 7 = 11$

82) $2t - 3 = 15$ **83)** $3a - 5 = 16$ **84)** $5b - 8 = 17$

85) $4c - 5 = 19$ **86)** $8d - 9 = 15$ **87)** $5m - 7 = 18$

88) $7n - 8 = 27$ **89)** $9p - 8 = 28$ **90)** $6q - 7 = 47$

91) $8x - 12 = 20$ **92)** $7x - 10 = 25$ **93)** $6y - 15 = 21$

94) $9y - 20 = 34$ **95)** $12z - 14 = 22$ **96)** $11t - 15 = 40$

97) $9x - 4 = 1$ **98)** $11x - 10 = 1$ **99)** $15y + 2 = 5$

100) $7y + 8 = 10$

Exercise 4

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) $5x + 7 = 4x + 11$ 6) $3x - 3 = x + 3$

7) $10x + 1 = 4x + 4$ 8) $7x - 8 = x - 2$ 9) $5x - 7 = 3x - 3$

10) $11x - 20 = 6x + 5$ 11) $4x + 2 = 17 - x$ 12) $5x - 3 = 11 - 2x$

13) $6x + 1 = 33 - 2x$ 14) $3x - 7 = 1 - 5x$ 15) $4x - 1 = 5 - 2x$

16) $8x + 2 = 7 - 2x$ 17) $6x - 7 = 2 - 4x$ 18) $3x + 9 = 17 + 2x$

19) $10x - 8 = 20 + 6x$ 20) $3x - 12 = 4 - 3x$ 21) $5x - 2 = 6 + 4x$

22) $10x + 7 = 12 - 2x$ 23) $3x + 5 = 8 - x$ 24) $7x = 8 - 2x$

25) $3x = 10 + x$ 26) $4x - 12 = 2x$ 27) $7x + 1 = 5x$

28) $2x + 1 = x - 6$ 29) $3x - 2 = 2x - 10$ 30) $5x - 4 = 2x - 10$

31) $7x - 3 = 3x + 8$ 32) $5x + 4 = 2x + 9$ 33) $6x - 2 = x + 8$

34) $8x + 1 = 3x + 2$ 35) $7x - 10 = 3x - 8$ 36) $5x - 12 = 2x - 6$

37) $4x - 23 = x - 7$ 38) $8x - 8 = 3x - 2$ 39) $11x + 7 = 6x + 7$

40) $9x + 8 = 10$ 41) $5 + 3x = x + 8$ 42) $4 + 7x = x + 5$

43) $6x - 8 = 4 - 3x$ 44) $5x + 1 = 7 - 2x$ 45) $6x - 3 = 1 - x$

46) $3x - 10 = 2x - 3$ 47) $5x + 1 = 6 - 3x$ 48) $11x - 20 = 10x - 15$

49) $6 + 2x = 8 - 3x$ **50)** $7 + x = 9 - 5x$ **51)** $3y - 7 = y + 1$

52) $8y + 9 = 7y + 8$ **53)** $7y - 5 = 2y$ **54)** $3z - 1 = 5 - 4z$

55) $8 = 13 - 4x$ **56)** $10 = 12 - 2x$ **57)** $13 = 20 - 9x$

58) $8 = 5 - 2x$ **59)** $5 + x = 7 - 8x$ **60)** $3x + 11 = 2 - 3x$

61) $6a + 2 = 2a + 10$ **62)** $9b + 3 = 6b + 18$ **63)** $12c + 9 = 7c + 14$

64) $11d + 9 = 4d + 30$ **65)** $5e + 8 = 4e + 15$ **66)** $7f + 8 = f + 20$

67) $8p - 7 = 6p + 3$ **68)** $9a - 8 = 3a + 16$ **69)** $11r - 12 = 8r + 6$

70) $20s - 3 = 11s + 6$ **71)** $15t - 2 = 14t + 5$ **72)** $5u - 12 = u + 20$

73) $5x - 9 = 2x - 3$ **74)** $7y - 10 = 5y - 2$ **75)** $9z - 14 = 6z - 5$

76) $15t - 56 = 7t - 16$ **77)** $10u - 20 = 9u - 11$**78)** $9v - 40 = v - 24$

79) $4m - 5 = 7 - 2m$ **80)** $5n - 8 = 32 - 3n$ **81)** $4s - 13 = 5 - 2s$

82) $2t - 50 = 14 - 6t$ **83)** $3u - 14 = 6 - u$ **84)** $v - 8 = 16 - 3v$

85) $3x + 1 = 11 - 2x$ **86)** $4y + 3 = 31 - 3y$ **87)** $2z + 7 = 25 - 4z$

88) $4t + 15 = 25 - 6t$ **89)** $5a + 12 = 42 - a$ **90)** $b + 6 = 30 - 3b$

Exercise 5

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) $5(3x-2) = 5$ **8)** $2(3x-5) = 8$ **9)** $10(x-2) = 8$

10) $3(4x+1) = 15$ **11)** $7(x-3) = 10-x$ **12)** $2(x+1) = x+5$

13) $5(x+2) = 2x+16$ **14)** $7(x+3) = 5x+29$ **15)** $4(y+1) = y+13$

16) $8(z-2) = 3z+9$ **17)** $6(t-3) = 2t+10$ **18)** $9(u-1) = 8u+3$

19) $5(v-4) = 2v-5$ **20)** $7(m-2) = 5m-4$ **21)** $4(n-5) = n-2$

22) $3(a-2) = 9-2a$ **23)** $8(x+2) = 3(x+7)$ **24)** $4(x-2) = 2(x+1)$

25) $9(z+1) = 5(z+5)$ **26)** $5(x-3) = 3(x+2)$ **27)** $7(u-3) = 3(u+5)$

28) $3(x+2) = 2(x-1)$ **29)** $9(p-3) = 7(p-1)$ **30)** $5(x-3) = 2(x-7)$

Exercise 6

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) $5(y+1) + 3(y+4) = 25$ **6)** $4(c+2) - 2(c+5) = 14$

7) $3(z+4) + 2(z-3) = 26$ **8)** $5(t-1) - 3(t+2) = 1$

9) $5(t + 2) + 3(t - 1) = 31$

10) $6(u - 2) - 2(u + 4) = 8$

11) $5x - 2(x - 2) = 6 - 2x$

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

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) $5 + 2(x + 1) = 5(x - 1)$

17) $3(x - 2) - 2(x + 1) = 5$

18) $6 + 3(x + 2) = 2(x + 5) + 4$

19) $5(x - 3) + 3(x + 2) = 7x$

20) $5(x + 1) = 2x + 3 + x$

21) $3(2x + 1) - 2(2x + 1) = 10$

22) $4(2x - 2) = 5x - 17$

23) $4(3x - 1) - 3(3x + 2) = 0$

24) $x + 2(x + 4) = -4$

25) $7 - (2 - 3x) = 17$

26) $3(t + 4) - 1 = 3 - (4t - 1)$

27) $5(6 + y) - 10 = 9 - (2y + 3)$

28) $3 - (2d - 5) = -(5d + 1)$

29) $4(1 - 3y) = 7 - (4y - 5)$

30) $5p - (1 - 2p) = 9 - (p - 8)$

Inequalities

Exercise 1

Solve the following inequalities

1) $2x + 1 > 7$

2) $2x + 1 \geq 7$

3) $3x - 2 > 10$

4) $y + 5 \geq 1$

5) $2y + 3 > 3$

6) $5y - 1 \geq -11$

7) $4x + 5 > 17$

8) $2x - 2 > 18$

9) $3x - 1 < 11$

10) $5y - 3 \leq 27$

11) $7y + 4 \leq 4$

12) $8y + 3 \geq 59$

13) $3t + 4 > 2$ **14)** $6u + 14 < 3$ **15)** $3v + 2 > -14$

16) $5w + 1 \leq -34$ **17)** $2x + 7 \geq 4$ **18)** $4y - 1 \leq -27$

19) $2x + 3 > 10$ **20)** $5x - 7 < 13$ **21)** $7x - 8 \geq 13$

22) $2(5x - 4) \leq 27$ **23)** $4(3x + 2) < 38$ **24)** $5(x + 2) > 25$

25) $8(x - \frac{1}{2}) < 20$ **26)** $6(2x - \frac{1}{2}) \geq 15$ **27)** $3(4x + 7) < 69$

28) $9(x + 2) > 63$ **29)** $\frac{1}{2}(6x + 8) \leq 10$ **30)** $\frac{1}{4}(8x - 12) > 1$

Exercise 2

Solve the following inequalities

1) $4x - 1 \geq x + 8$ **2)** $9x + 4 < 5x - 8$

3) $5q + 6 < 3q + 24$ **4)** $7r - 3 > 3r + 13$

5) $3s + 1 \geq 13 - s$ **6)** $3s + 1 \geq 13 - s$

7) $3t - 2 \leq 13 - 2t$ **8)** $u + 4 \geq 24 - 3u$

9) $6(2p - 1) - 5 > -23$ **10)** $5(2z - 1) + 4 \leq 29$

11) $2(x + 1) + 3 > 15$ **12)** $3(y + 5) - 4 < 29$

13) $3(x + 4) - 3 \geq 5(x - 3)$ **14)** $7(2a + 5) < 3(6a + 3) + 5a$

15) $2(4x + 7) < 4(3x + 3) - 2(x + 1)$ **16)** $5(3y + 1) \geq 7 - 4(5y - 4)$

17) $4(3x + 2) - 3(2x - 1) > 3x + 2$ **18)** $2(5x - 1) - 4(x - 3) < x + 5$

19) $5(x + 3) \geq 2(2x + 5)$ **20)** $3(2x + 1) + 2(x - 4) > 3(x - 5)$

Mathematical Models

Exercise 1

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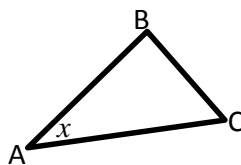
a) Write down (in terms of x) the sizes of angles B and C.

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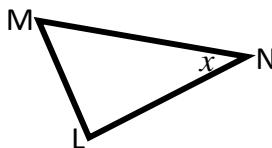
a) Write down (in terms of x) the sizes of angles L and M.

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) Three people go shopping in the city.

- Mrs White spends £x

- Mrs James spends twice as much as Mrs White

- Mrs Brown spends three times as much as Mrs White

If they spend £126 altogether, what is the value of x?

6) Three boys go on a school trip

- Douglas takes £x in pocket money

- Jim takes three times as much as Douglas

- Malcolm takes four times as much as Douglas

If altogether they have £16, find the value of x.

7) Sandra is x years old.

Helen is 3 years older than Sandra

Karen is 2 years younger than Sandra.

If all their ages added together give 43 years, find the value of x.

8) 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.

9) 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.

10) I spent x minutes doing my homework today. Yesterday I spent twice as long on homework; tomorrow I shall spend 20 minutes more than today on it. If I do 180 minutes over these 3 days, find the value of x.

11) Three boys cycle to school. Peter takes y minutes; Brian takes 15 minutes longer than Peter; Stephen takes 5 minutes less than Peter.
The total time taken for all three boys together is 46 minutes.
Find the value of y.
Find also how long Brian and Stephen take.

12) Alfred has £x and Barry has £6 more than Alfred. If they have £30 altogether, how much do they each have.

13) Mr Clegg is 3 years older than his wife and 33 years older than his son. Their ages add up to 72 years. If Mr Clegg is x years old, find the value of x and find all their ages.

14) 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.

15) 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.

16) I am thinking of a whole number n.

a) Write down the next whole number bigger than n.

b) If these 2 numbers add up to 29, find the value of n.

Exercise 2

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 boy has x marbles. If he wins 20 more, he will have three times as many as when he started. Find the value of x.

4) A class has 27 pupils of whom x are boys.

   a) How many girls are there?

   b) If the number of girls is twice the number of boys, find the value of x.

5) 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.

6) 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.

7) 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)
5 | Area = 35
x + 2

b)
4 | Area = 22
x + 3

c)
3 | Area = 18
x - 3

d)
4 | Area = 24
2x - 1

e)
4x + 2 | Area = 12
3

f)
½ | Area = 7
3x + 2
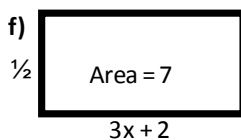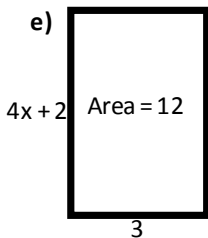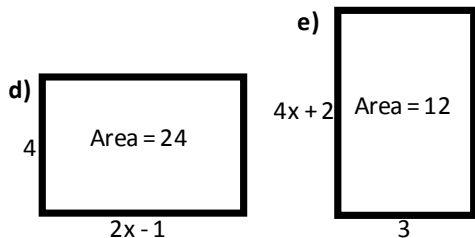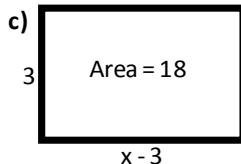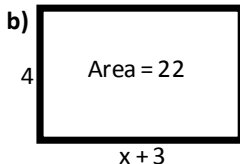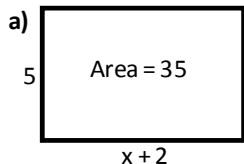
8) The perimeter of each shape is given in cm. If the lengths of the sides are also in cm, find the values of x.

a)
3 | P = 15
x + 1

b)
x + 4 | P = 28
3x + 2

c)
3x - 2 | P = 32
3x - 2

d)
2x - 1
x + 2
P = 12
2x - 4

e)
x + 8
2x
P = 21
x - 3

f)
2x + 4
9 | P = 38 | 5
2x

g)
3x + 2
4 | P = 30 | 7
3x

h)
x + 3
4 | P = 29
2x
3

i)
2x
x
P = 46 | 6
2x + 5
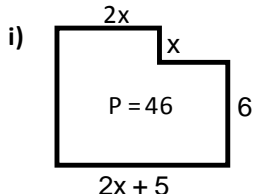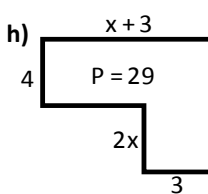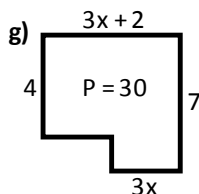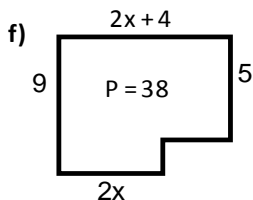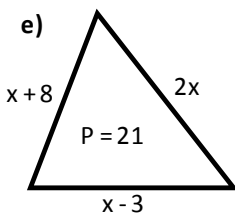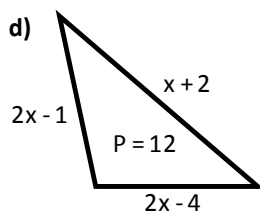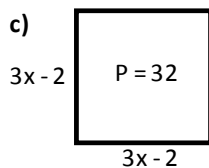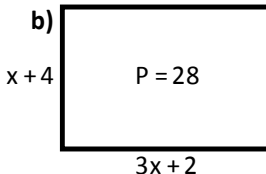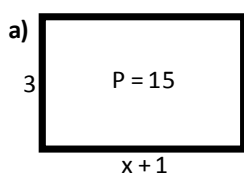
9) A square has sides of length x + 2 cm. Its perimeter is 32cm. Find the value of x.

Changing the Subject of a Formula

Exercise 1

Make x the subject of these formulas.

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

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

7) $x - 4 = c$ **8)** $x - p = q$ **9)** $2x = f$

10) $3x = a$ **11)** $ax = 4$ **12)** $cx = d$

13) $px = -q$ **14)** $dx = -f$ **15)** $kx + h = 0$

16) $2x + 3 = c$ **17)** $3x + y = 4$ **18)** $ax + b = 9$

19) $2x + 4 = b$ **20)** $4x + r = h$ **21)** $3x - k = 5$

22) $3x - c = a$ **23)** $2x - c = d$ **24)** $ax - 3 = m$

25) $ax - b = 7$ **26)** $px - q = r$

Exercise 2

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)** $\frac{x}{2} = 5$ **6)** $\frac{x}{p} = q$

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

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

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

13) $C = \pi d$ to d **14)** $S = \pi dn$ to n **15)** $PV = c$ to V

16) $A = \pi rl$ to l **17)** $v^2 = 2gh$ to h **18)** $I = PRT$ to R

19) $x = \frac{a}{y}$ to a **20)** $I = \frac{E}{R}$ to E **21)** $x = \frac{u}{a}$ to u

22) $P = \frac{RT}{V}$ to T **23)** $v = u + at$ to t **24)** $n = p + cr$ to r

25) $y = ax + b$ to x **26)** $H = S + qL$ to q

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

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

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

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

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

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

PYTHAGORAS

Exercise 1 – hypotenuse

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

1)

x 5 6

2)

x 7 6

3)

x 3 5

4)

4 6 x

5)

2 x 8

6)

8 5 x

7)

5 x 7

8)

2 1 x

9)

x 3 4

10)

9 8 x

11)

7.1 x 9.2

12)

7.4 x 12.3

13)

x 1.1 1.4

14)

1.3 x 1.5

15)

x 12 13

16)

x 8.2 6.1

17)

x 5 5

18)

x 4.7 2.9
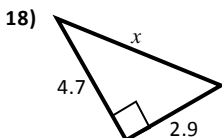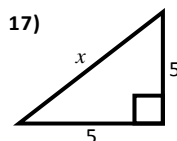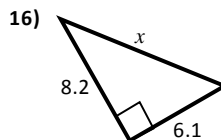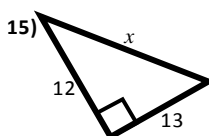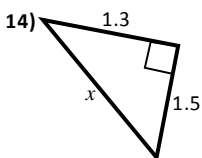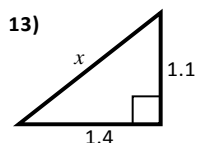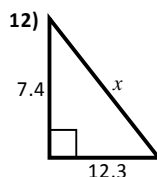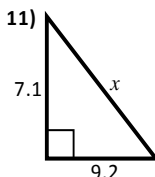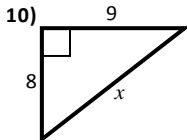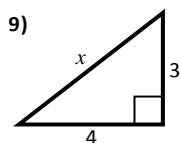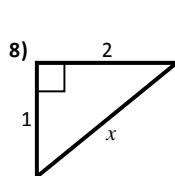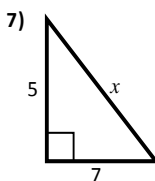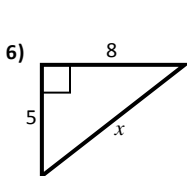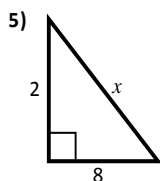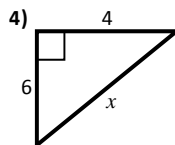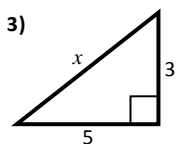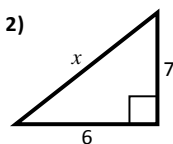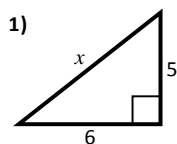
Exercise 2 – shorter side

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

1)

2)

3)

4)

5)

6)

7)

8)

9)

10)

11)

12)

13)

14)

15)

16)

17)

18)
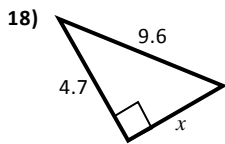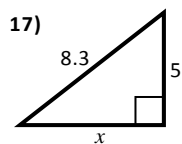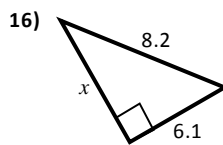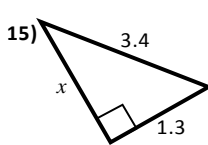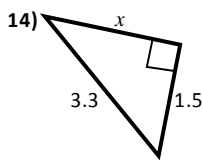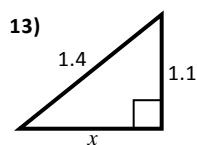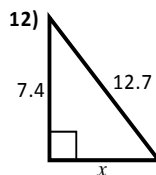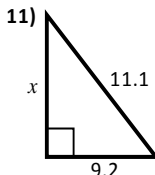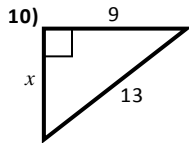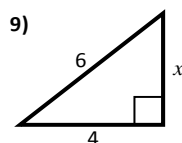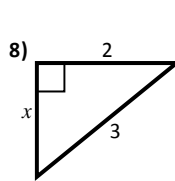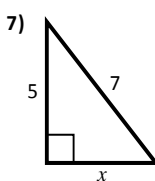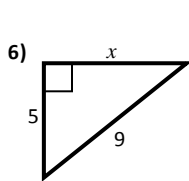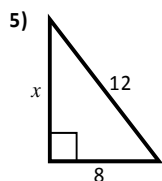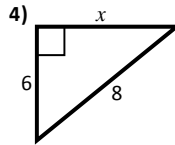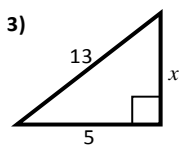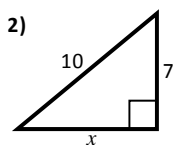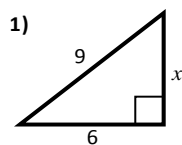
Exercise 3 – mixed

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

1)

6

x

8

2)

5

8

x

3)

x

3

6

4)

4

x

12

5)

x

10

7

6)

x

9

4

7)

8

x

4

8)

x

6

2

9)

5

7

x

10)

13

x

16

11)

13

16

x

12)

10

19

x

13)

3.3

x

6.2

14)

x

3.3

1.5

15)

8.8

4.1

x

16)

x

1.2

8.22

17)

x

7.33

5.26

18)

9.2

x

9.8

19)

12.2

16.2

x

20)

3.72

14.3

x
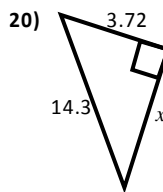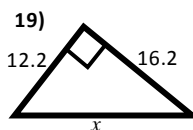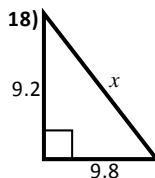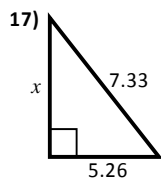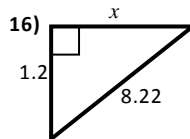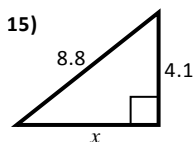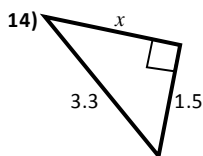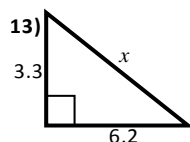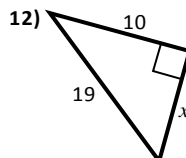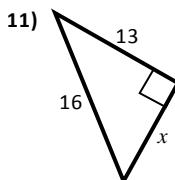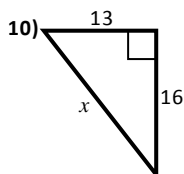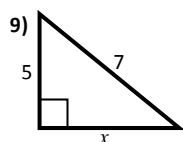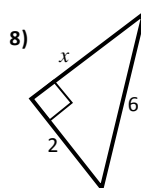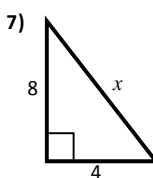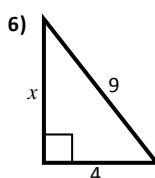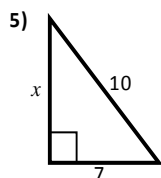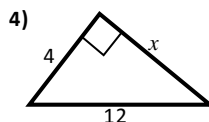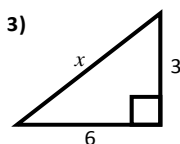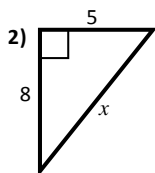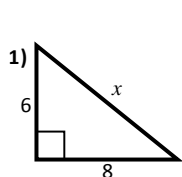
Exercise 4 – questions in context

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) A ladder 15 m long leans against a wall and reaches a window 14 m above the ground. Calculate the distance from the foot of the ladder to the wall.

5) 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?

41

30

9
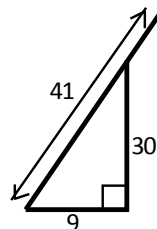
6) This diagram shows the gable end of a shed, with dimensions as shown in the diagram.
Calculate the length of the roof.

roof

3·5 m

2 m

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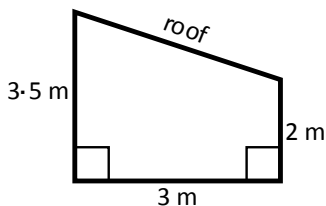
7) The tops of two masts on a ship are joined by a wire 9 m long. If the masts are 16 m and 20 m high, how far apart are they?

9

20

16
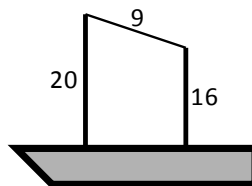
8) A barn has a sloping roof and is 14 m high at the front and 18 m high at the back. It is 12 m from front to back.
Calculate the length of the sloping roof.
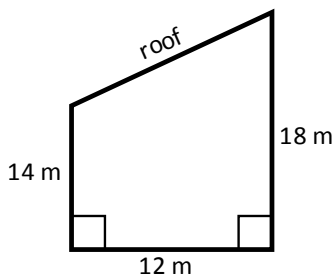
9) This is the diagram of a lawn. Kerb stones are put round the outside of the lawn. Calculate the total length of kerb stones required.
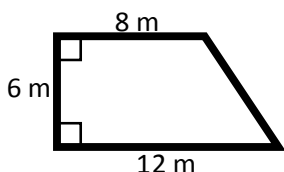
10) ABC is a lawn in the shape of an isosceles triangle. Kerb stones are put round the outside of the lawn. If the 'base' AC is 6 m, and the 'height' is 10m, calculate the total length of kerb stones required.
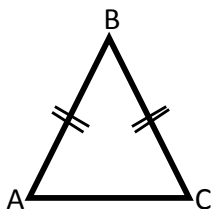
11) Calculate the perimeter of this shape.
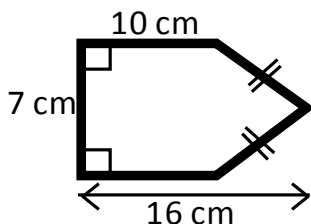
12) In a rectangular garden which measures 38 m by 21 m, a path goes diagonally from one corner to the opposite corner.
Calculate the length of the path.

Pythagoras – using co-ordinates

Exercise 1

1) Calculate the length between each pair of points on the line.
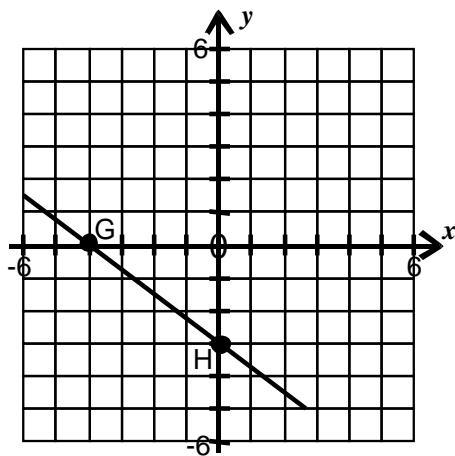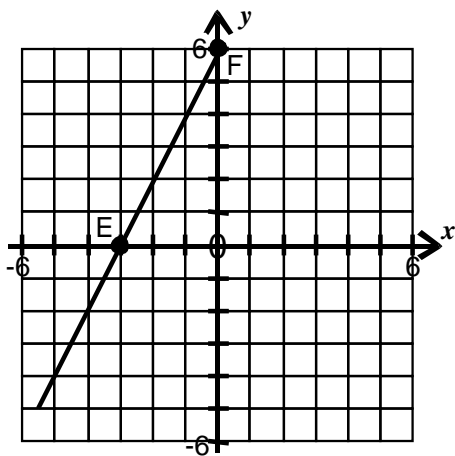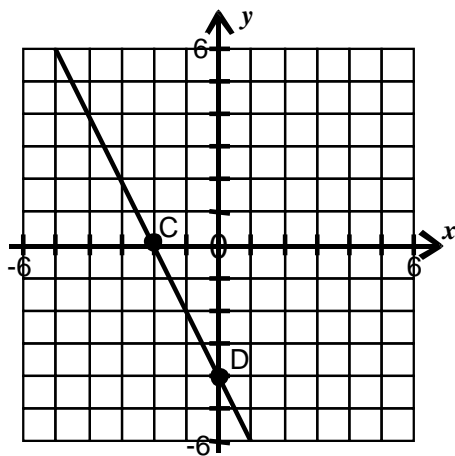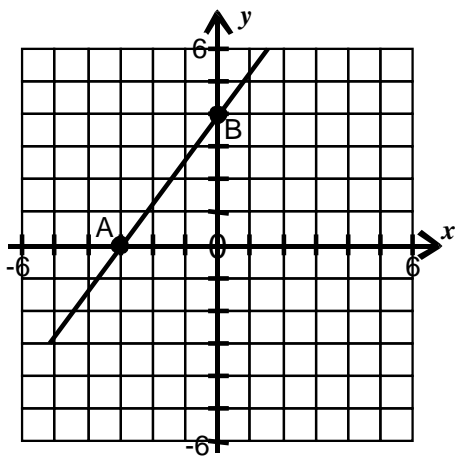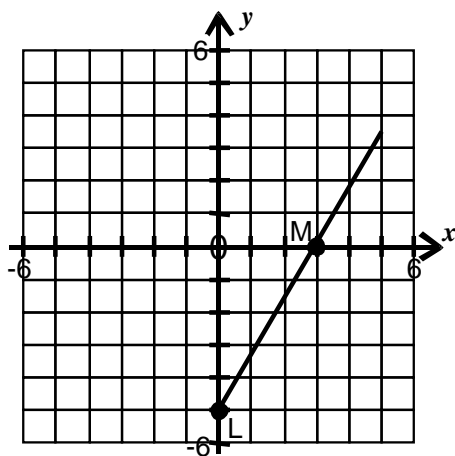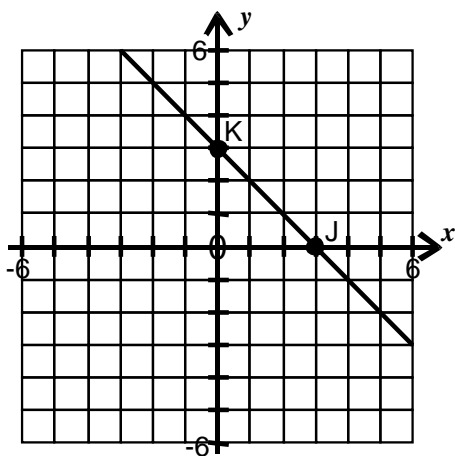
2) Calculate the length between each pair of points on the line.

(e)

(f)

3) Calculate the length between each pair of points on the line.

(1, 1)

(-2, -5)

(a)

(-1, 6)

(3, -6)

(b)

(6, 1)

(2, -3)

(c)

(1, -4)

(4, -6)

(d)

(e)

(f)
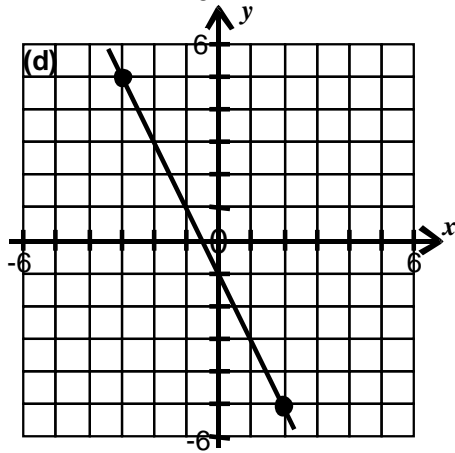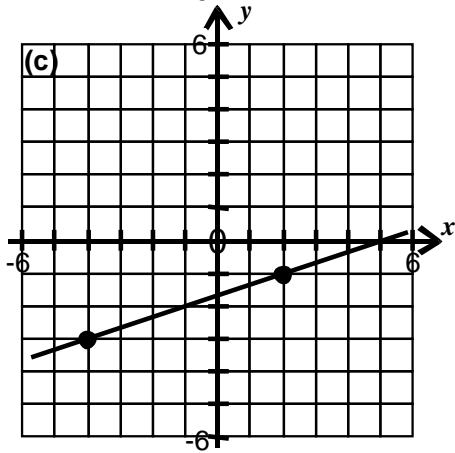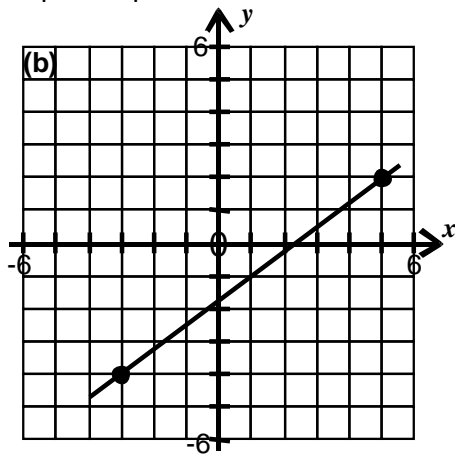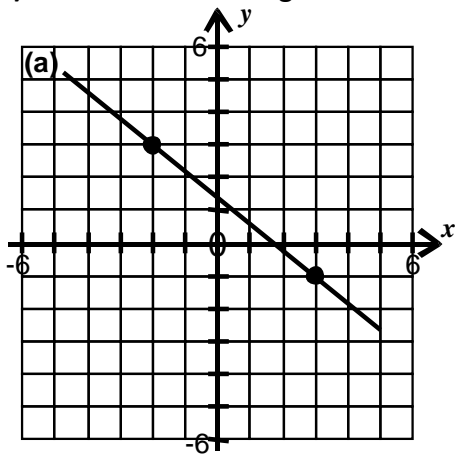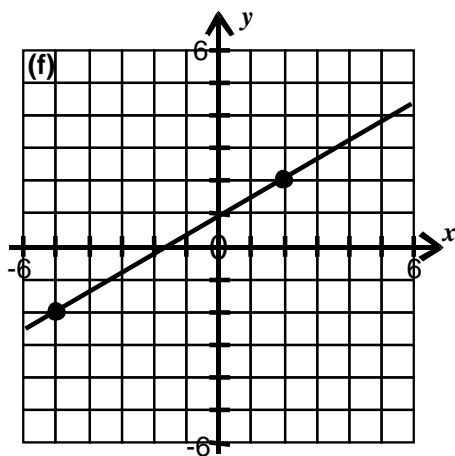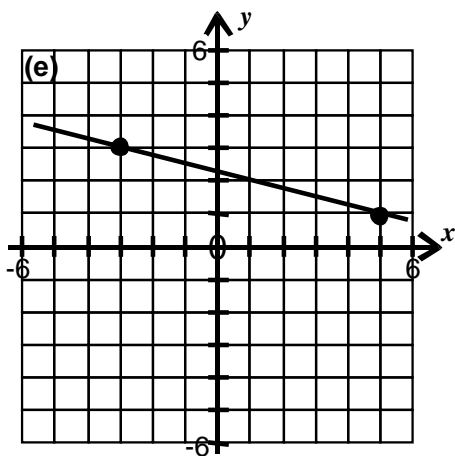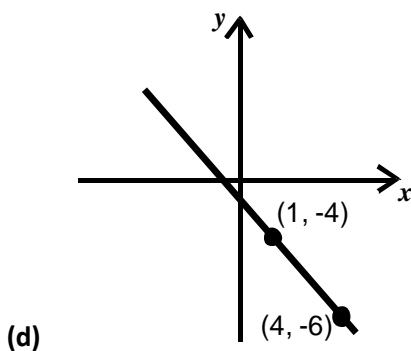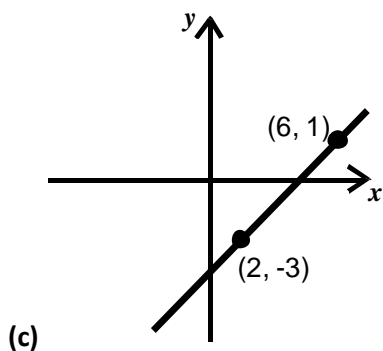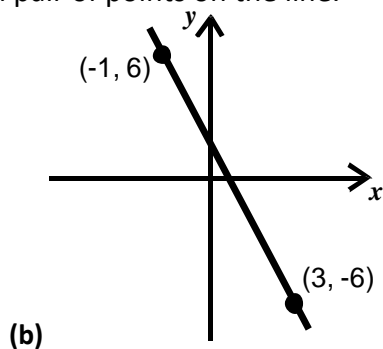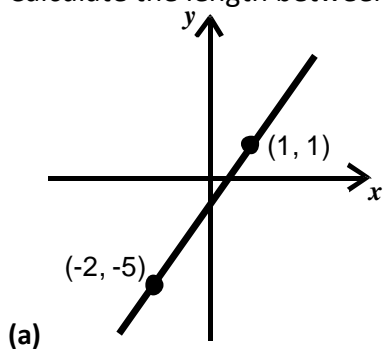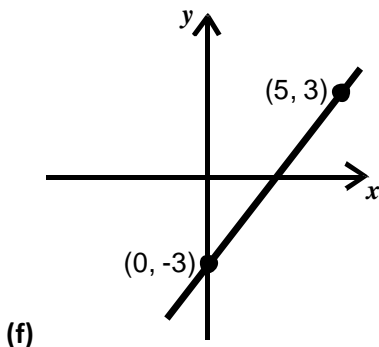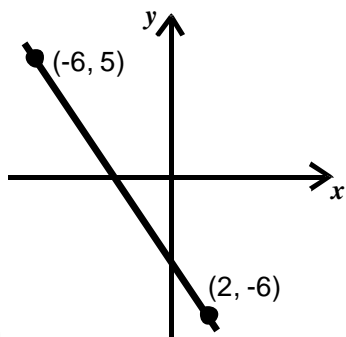
Exercise 2

Find the length of the line AB where

1) A(1 , 2) B(5 , 5)　　　**2)** A(1 , 2) B(7 , 6)　　　**3)** A(1 , 8) B(7 , 3)

4) A(−2 , 8) B(7 , 0)　　　**5)** A(1 , 4) B(5 , −2)　　　**6)** A(8 , 3) B(2 , −2)

7) A(6 , 1) B(4 , −4)　　　**8)** A(−3 , 5) B(2 , 1)　　　**9)** A(−4 , −5) B(1 , −2)

Exercise 3

1) 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.

2) If A(4 , −1), B(−3 , 3) and C(9 , 10) are the three corners of triangle ABC, find the length of all 3 sides.

3) If A(−2 , −4), B(−2 , 8) and C(6 , 0) are the three corners of triangle ABC, find the length of all 3 sides.

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

5) If A(−3 , 1), B(5 , −3) and C(1 , 5) are the three corners of triangle ABC, find the length of all 3 sides of triangle ABC

Enlargement and Reduction

Exercise 1 – scale factor of 2

Draw each of the following shapes TWICE as large in your jotter.
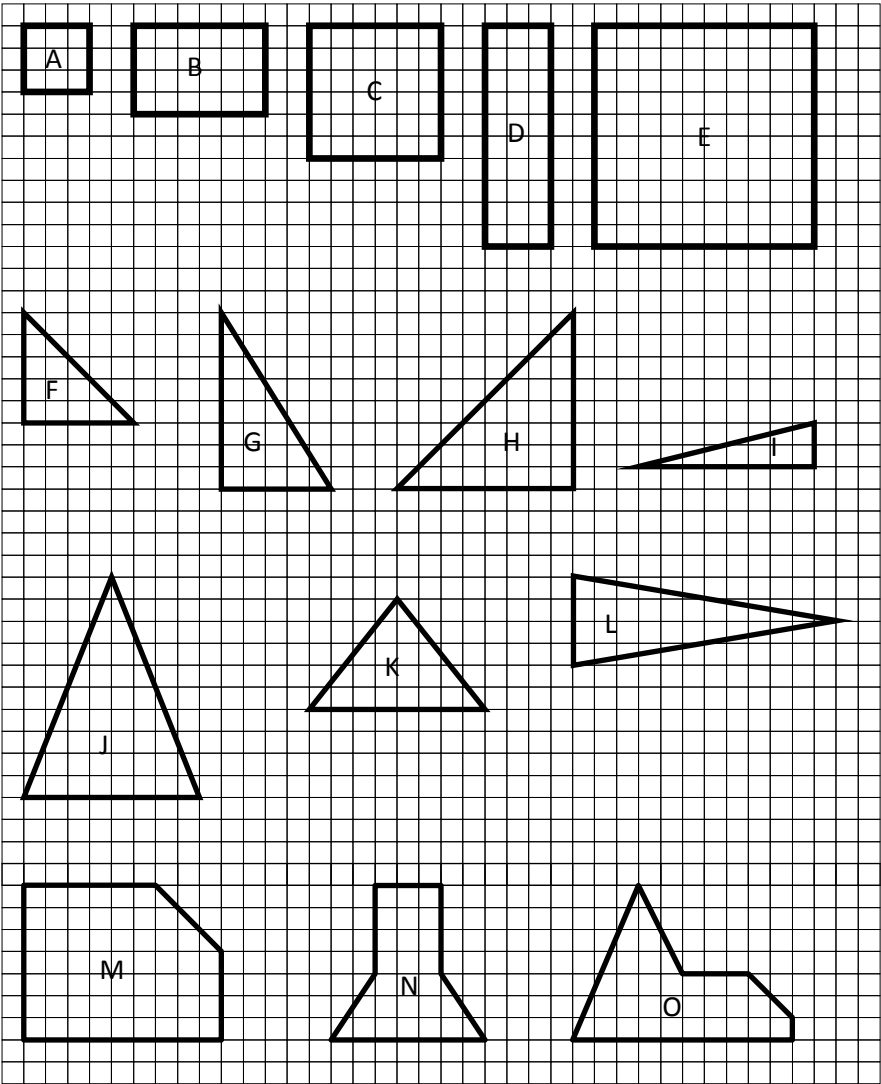
Exercise 2 – scale factor of 3

Draw each of the following shapes THREE times larger in your jotter.
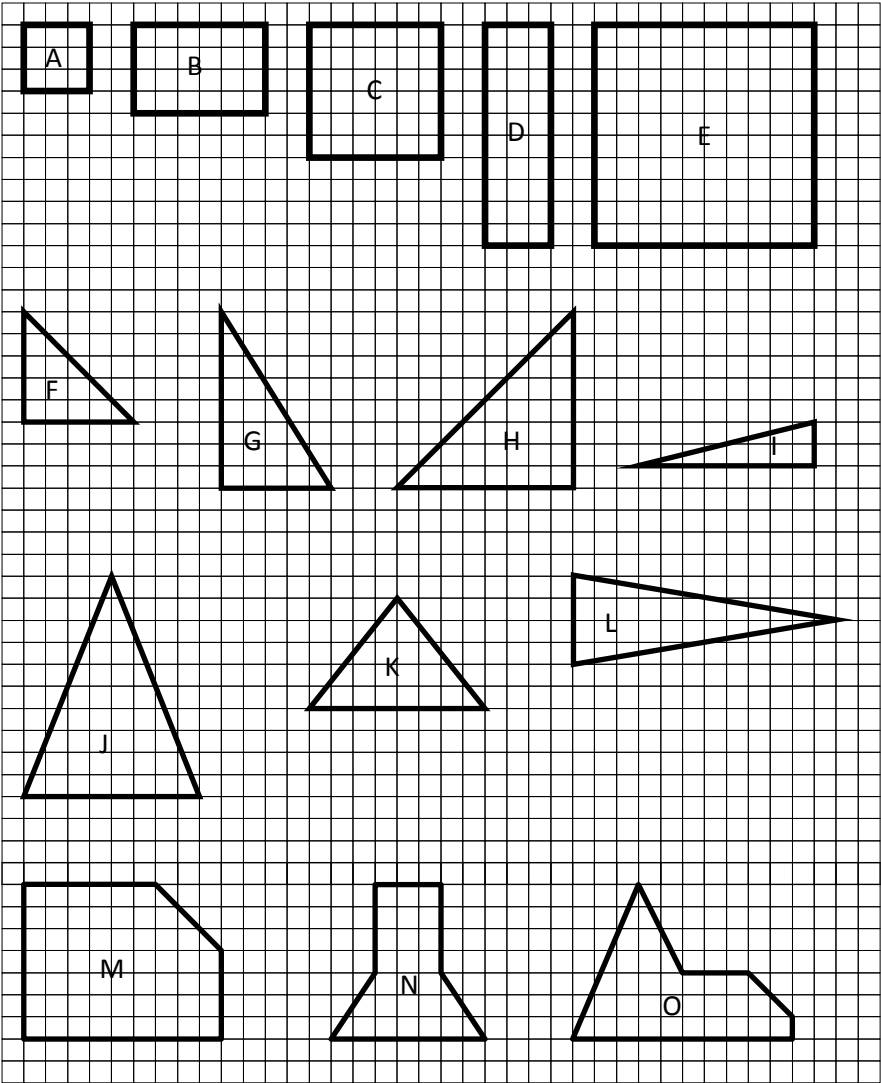
Exercise 3 – scale factor of $\frac{1}{2}$

Draw each of the following shapes HALF the size in your jotter.
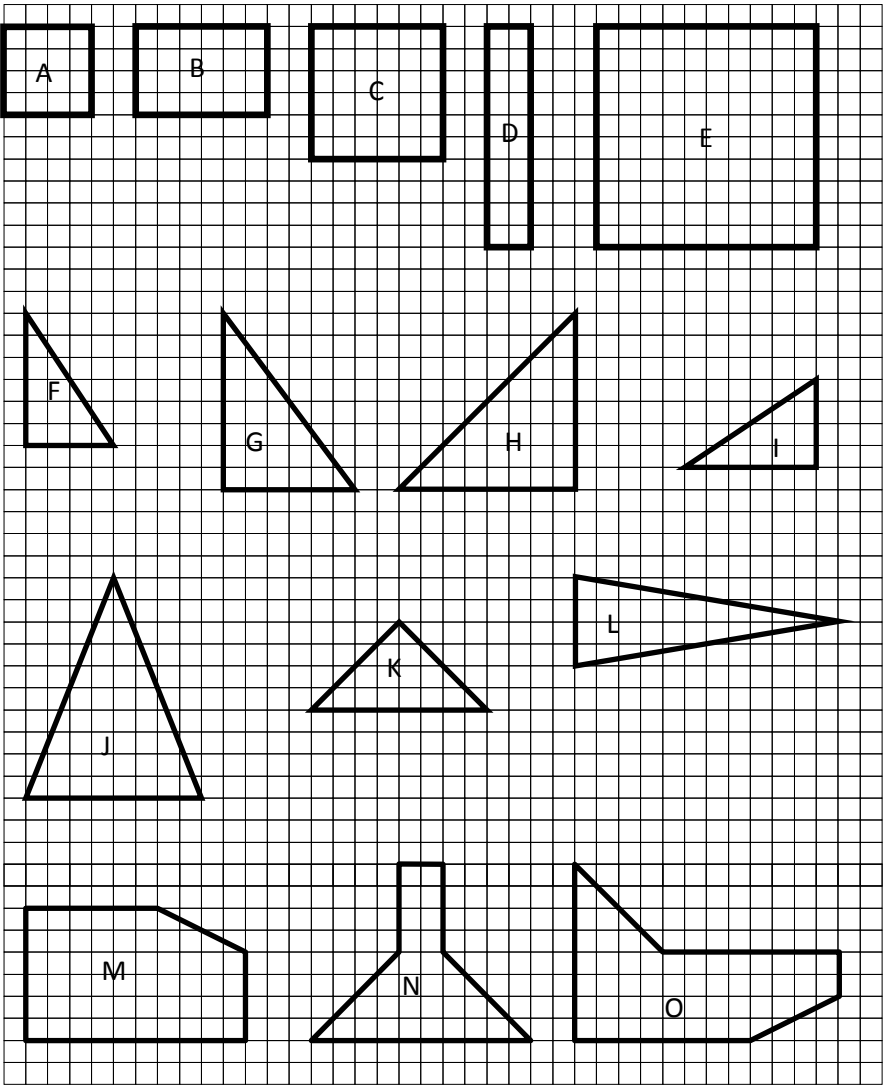
Exercise 4 – scale factor of $\frac{1}{3}$

Draw each of the following shapes a THIRD the size in your jotter.
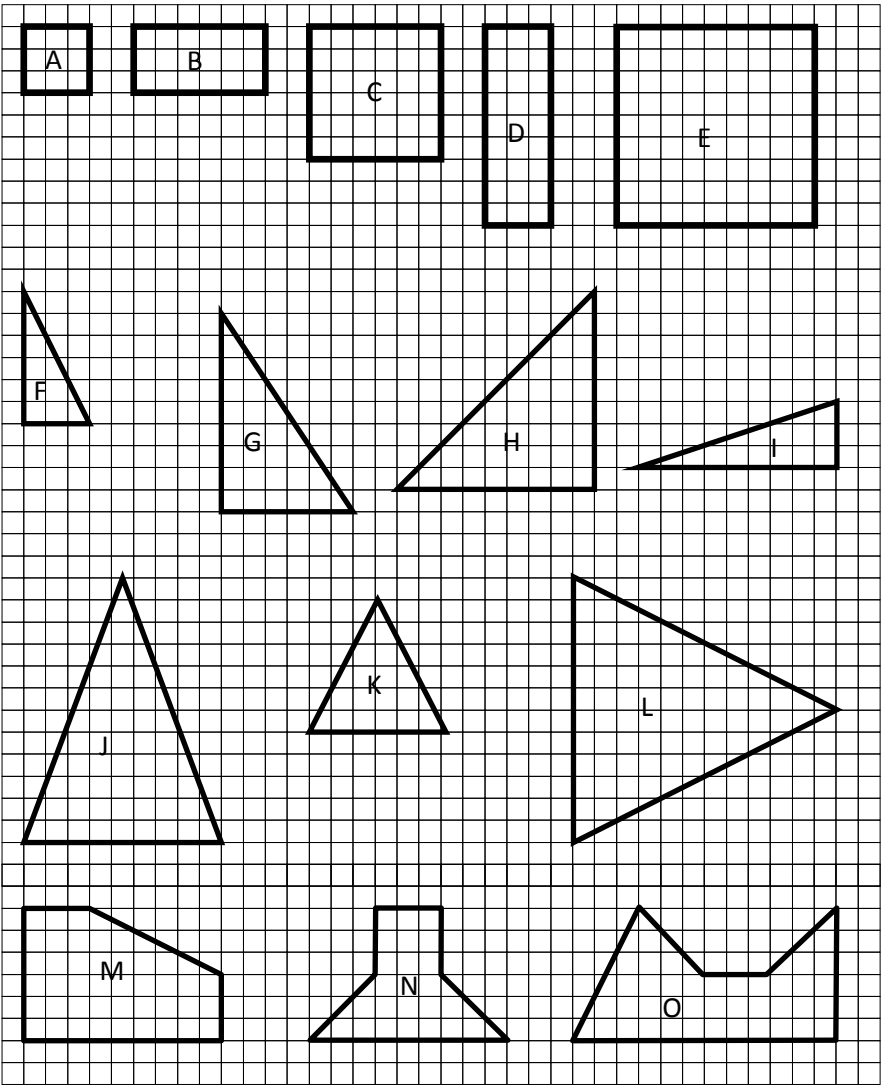
Exercise 5 – scale factor of $\frac{1}{4}$

Draw each of the following shapes a QUARTER the size in your jotter.
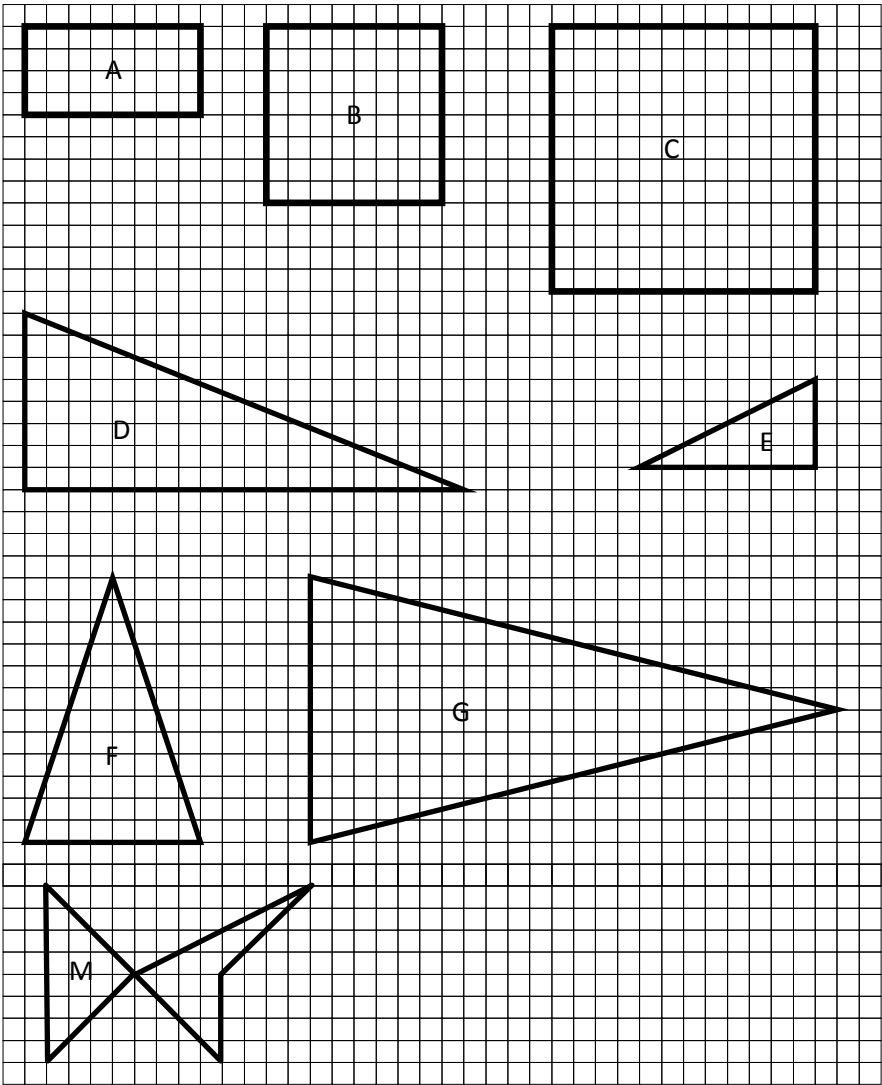
Exercise 6 – scale factor of $\frac{3}{2}$

Draw each of the following shapes using a scale factor of $\frac{3}{2}$
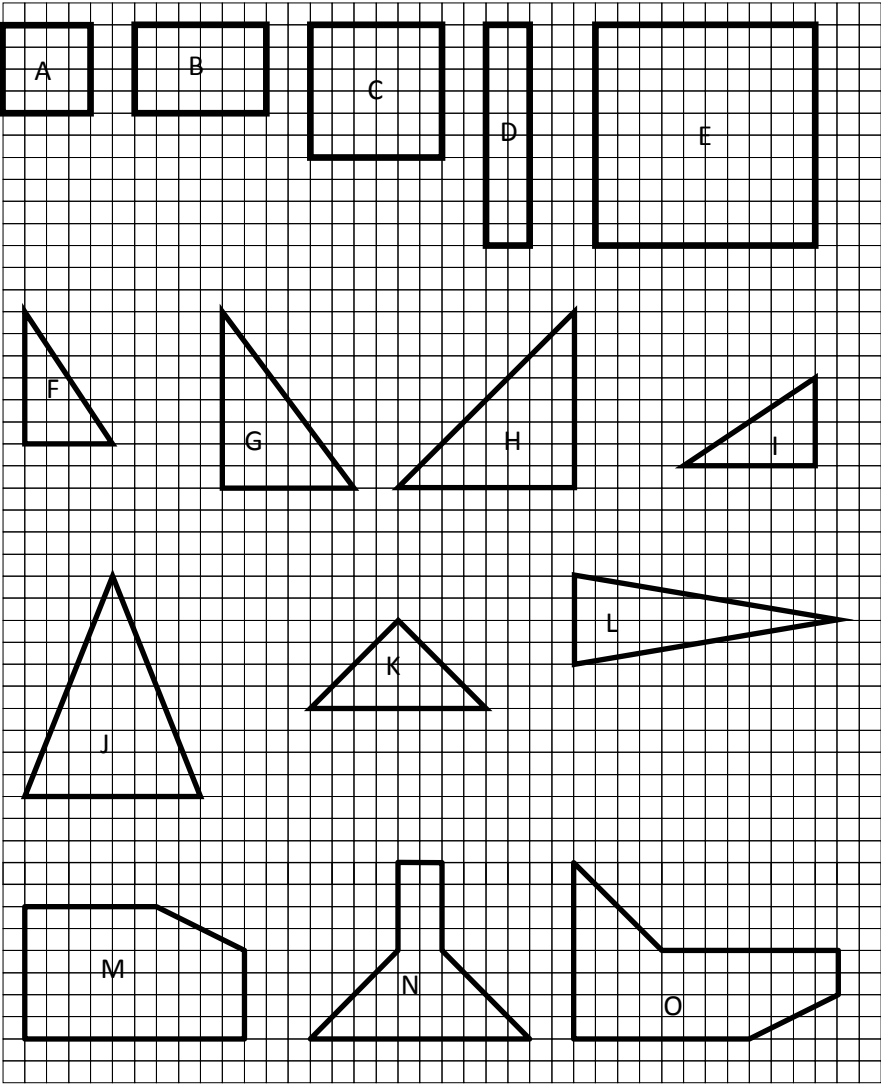
Exercise 7 – scale factor of $\frac{5}{2}$

Draw each of the following shapes using a scale factor of $\frac{5}{2}$
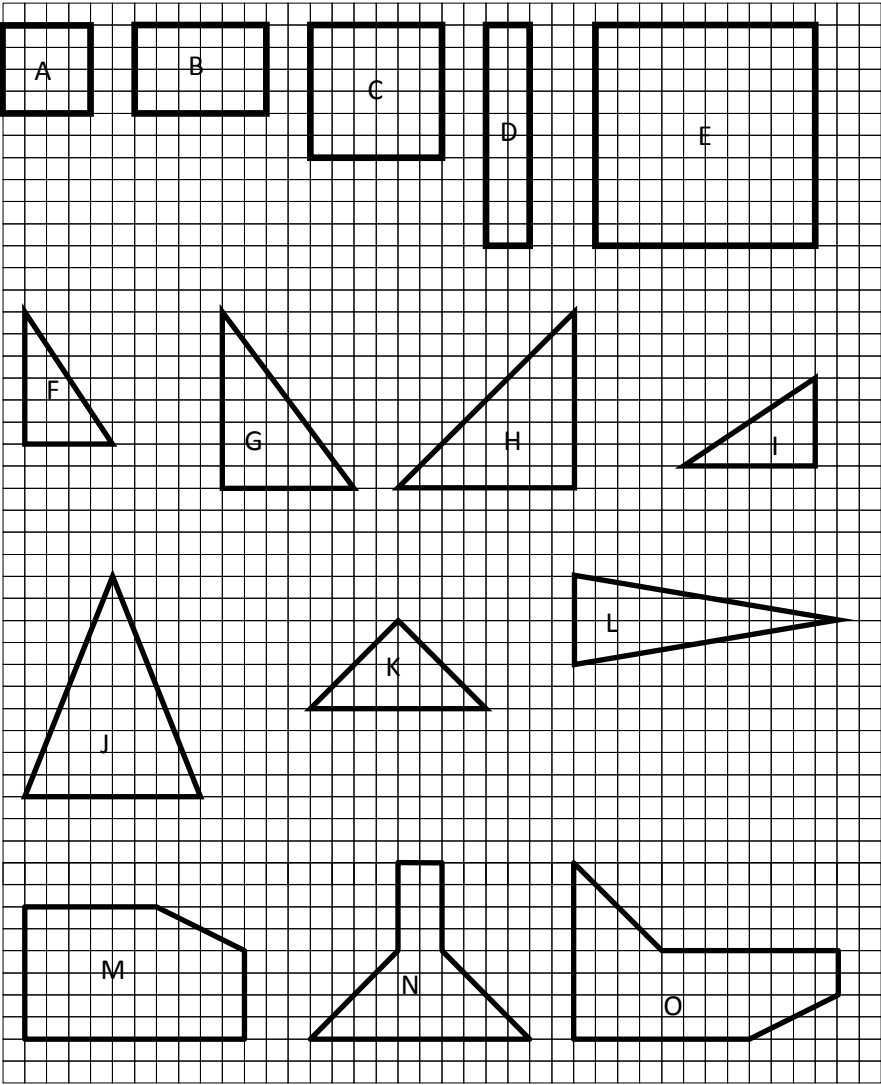
Exercise 8 – scale factor of $\frac{4}{3}$

Draw each of the following shapes using a scale factor of $\frac{4}{3}$
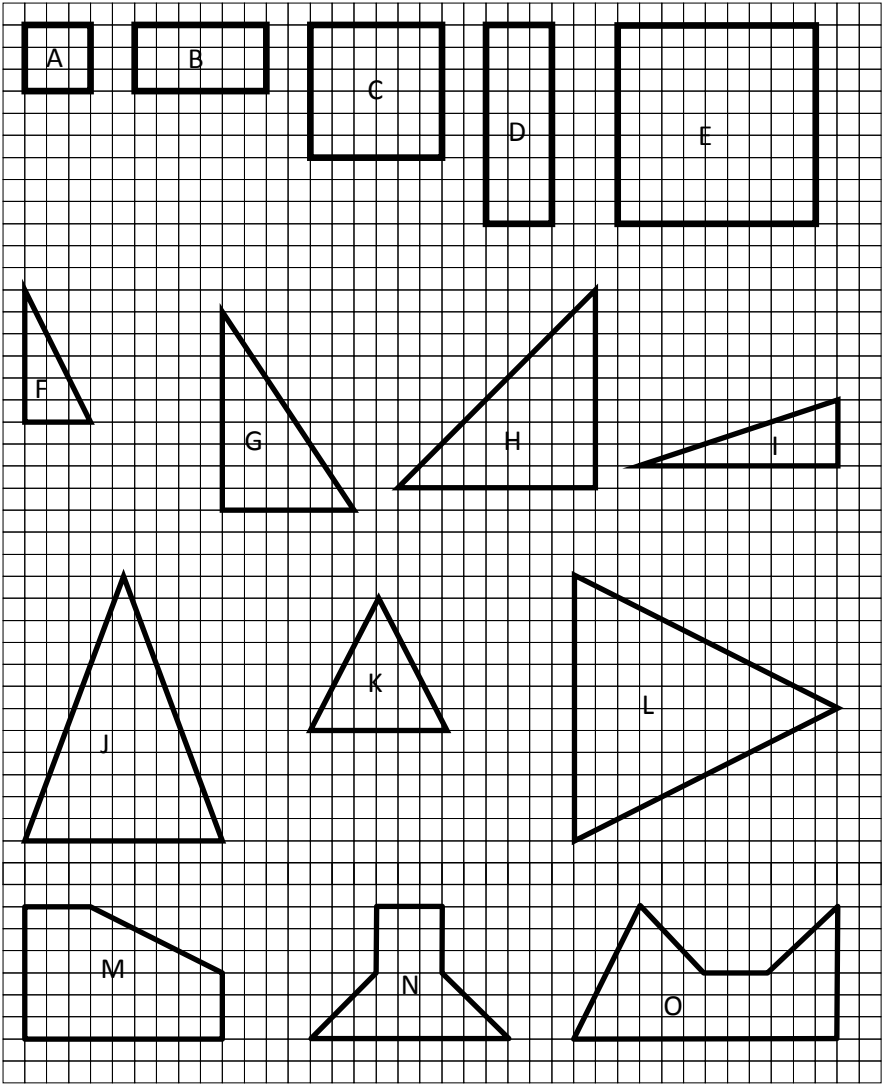
Exercise 9 – scale factor of $\frac{5}{3}$

Draw each of the following shapes using a scale factor of $\frac{5}{3}$
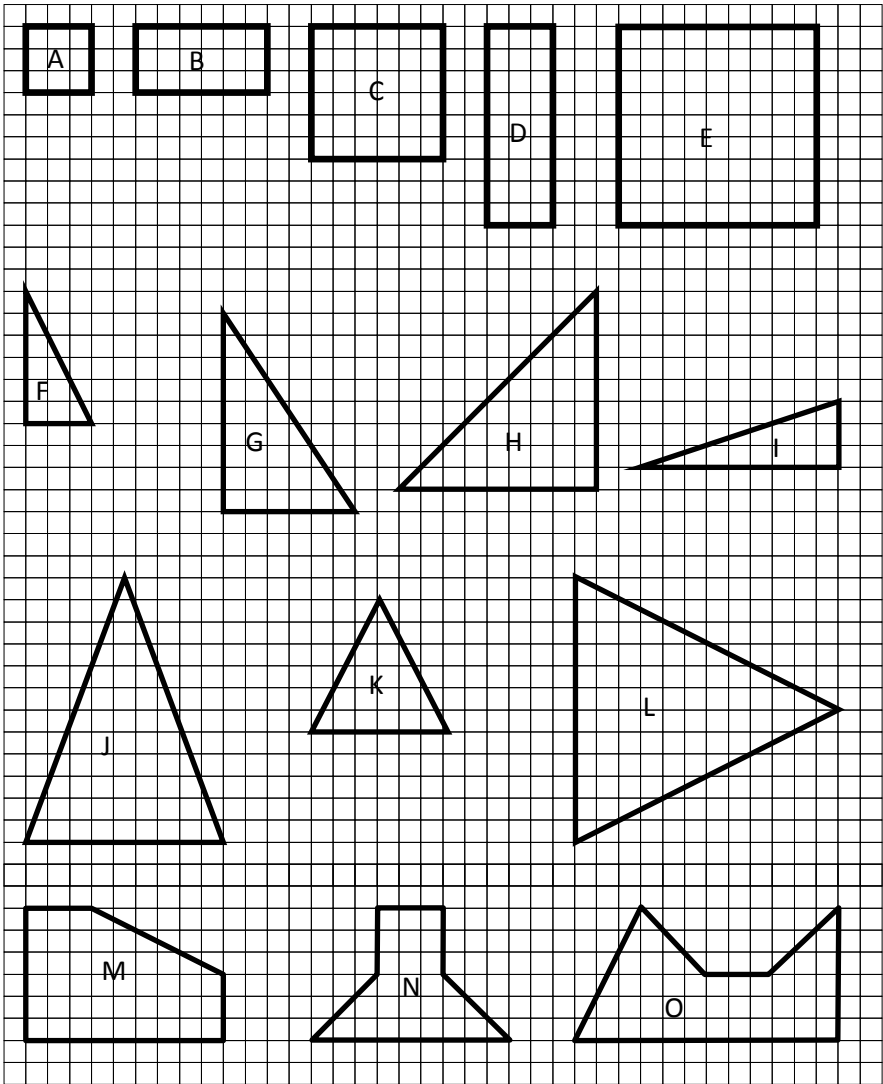
Circles and Angle Properties

Exercise 1 – Angle in a Semi-Circle

Copy each diagram and fill in the sizes of all the angles.
The line AB is a diameter.

1)
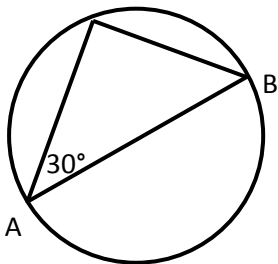
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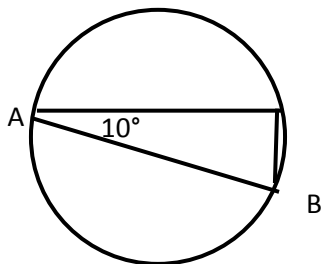
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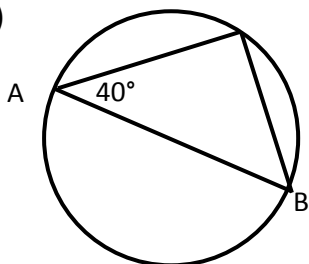
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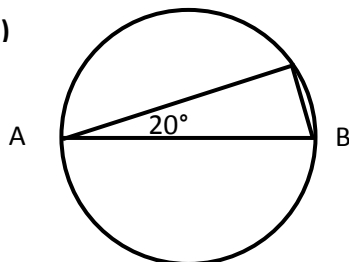
5)
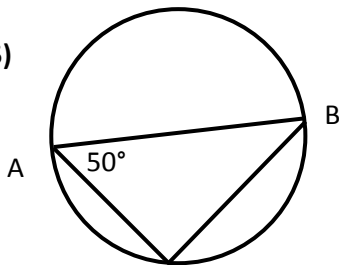
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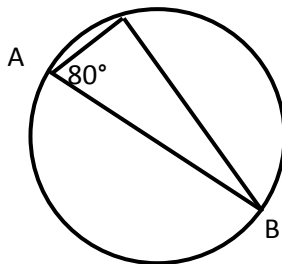
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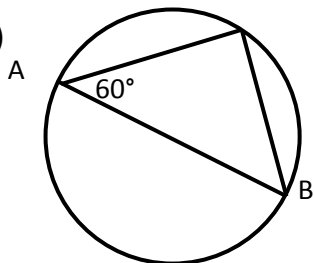
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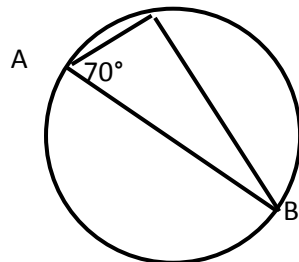
Exercise 2 – Angle in a Semi-Circle

Copy each diagram and fill in the sizes of all the angles.
The line AB is a diameter.

1)
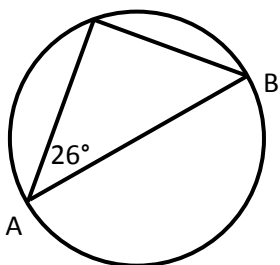
2)
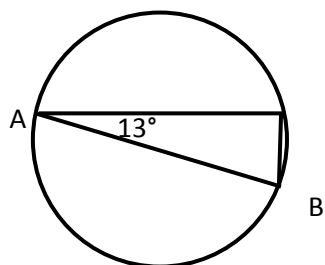
3)
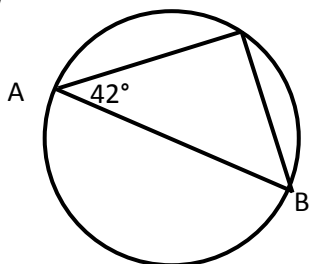
4)
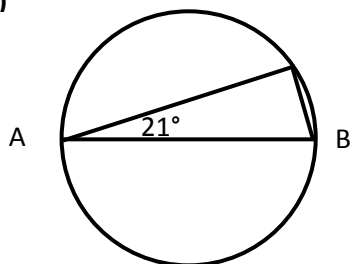
5)
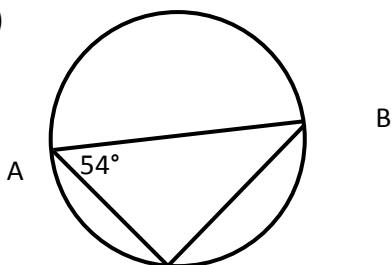
6)
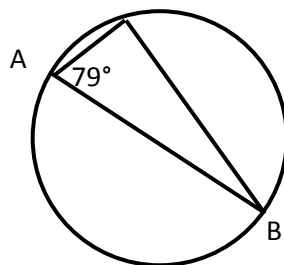
7)
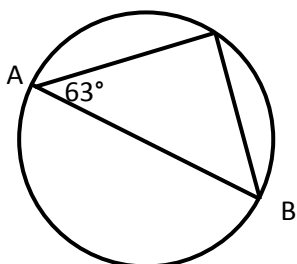
8)
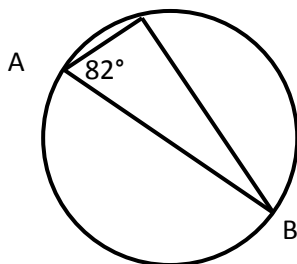
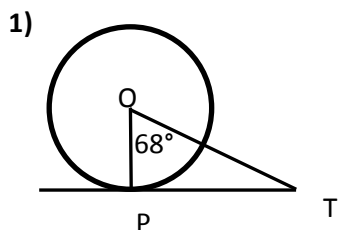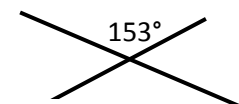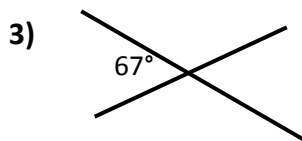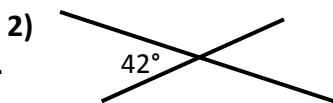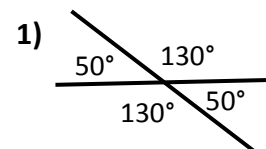# Exercise 3 – Tangent/Radius

Copy each diagram and fill in the size of all the angles.
The point O is the centre and TP is a tangent to the circle.

1)

2)

3)

4)

5)

6)

7)

8)
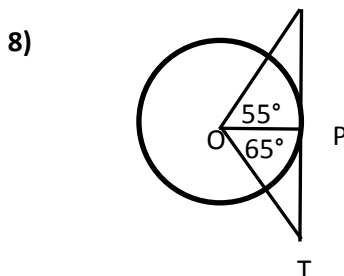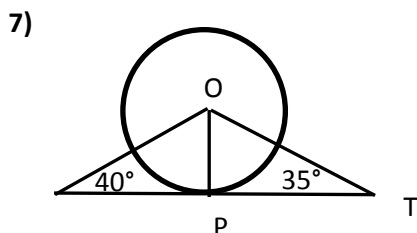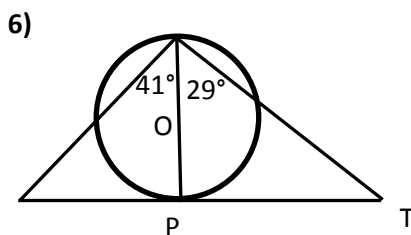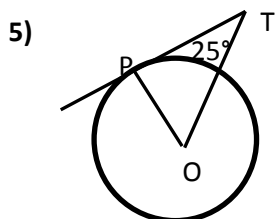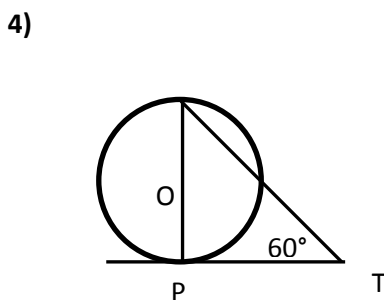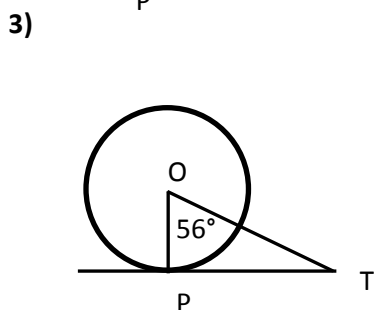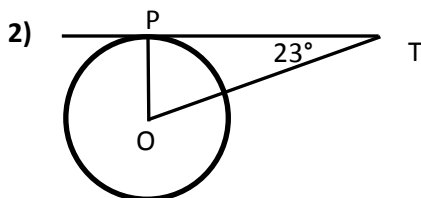
Exercise 4 – Opposite Angles

Copy the following diagrams into your jotter and fill in the sizes of all the angles.
The first one has been done for you.

1) 50° 130° 130° 50°

2) 42°

3) 67°

4) 153°

5) 161°

6) 77°
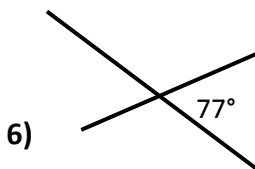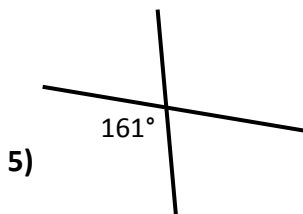
Exercise 5 – Corresponding Angles

Copy the following diagrams into your jotter and fill in the sizes of all the angles.
The first one has been done for you.

1) 100° 80° 100°

2) 113°

3) 121°

4) 134°

5) 71°

6) 67°

7) 42°

8) 148°

9)

10) 65°

11) 52°

12) 114°
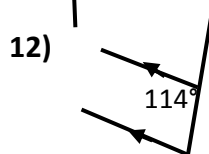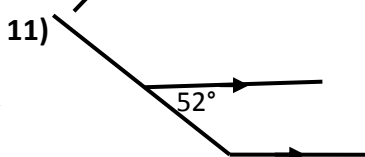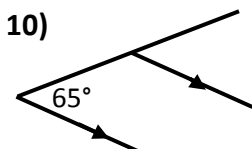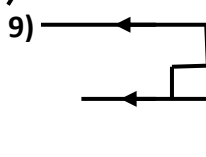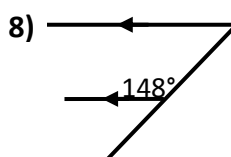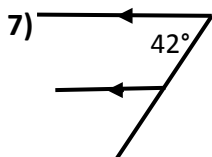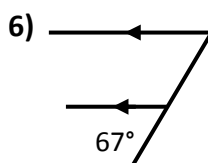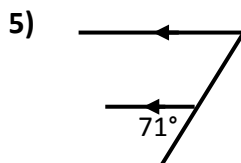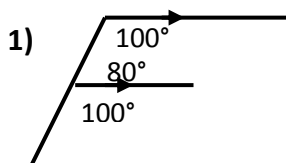
Exercise 6 – Alternate Angles

Copy the following diagrams into your jotter and fill in the sizes of all the angles. The first one has been done for you:-

1) 50° 50°

2) 65°

3) 70°

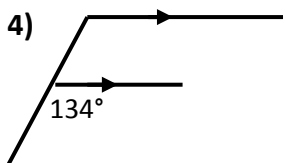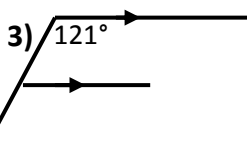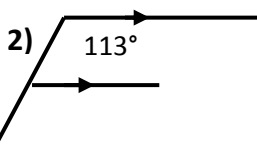**4)** 110°

5) 45°

6)

7) 150°

8) 161°
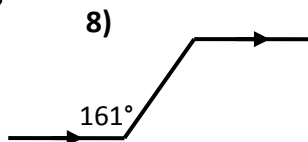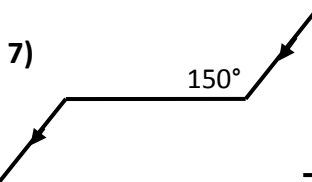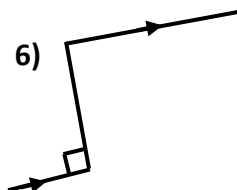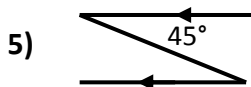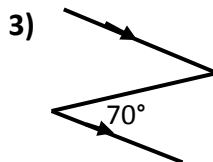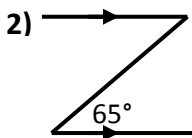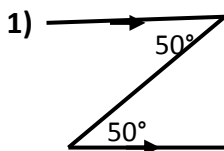
Exercise 7 – Angles in Shapes

Copy the following diagrams into your jotter and fill in the sizes of all the angles:-

1)

50°
60°

2)

50°

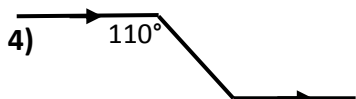**3)**

85°

4)

5)

6)

72°

7)

72°
54°

8)

56°

9)

70°
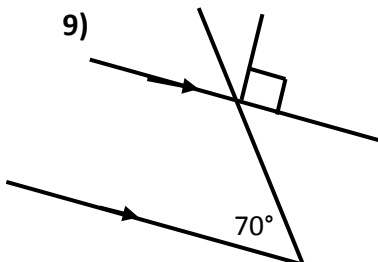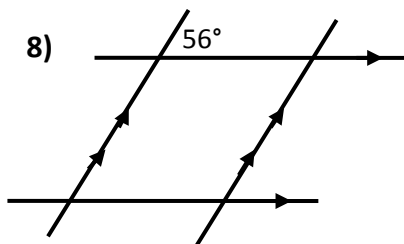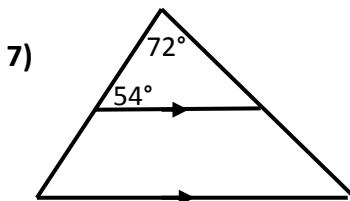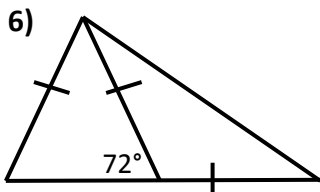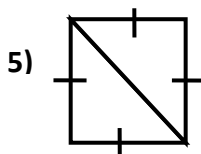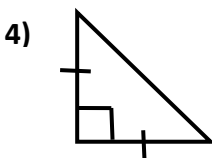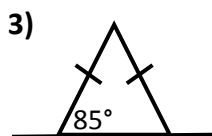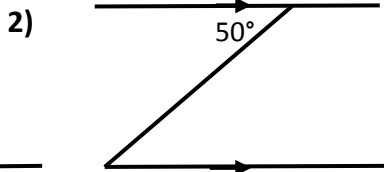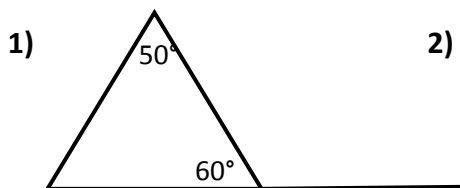
Trigonometry

Exercise 1

1) Copy each of the triangles below into your jotter.

   On each triangle mark **H** for the hypotenuse and by looking at the 'marked' angle write **O** on the opposite side and **A** on the adjacent side.
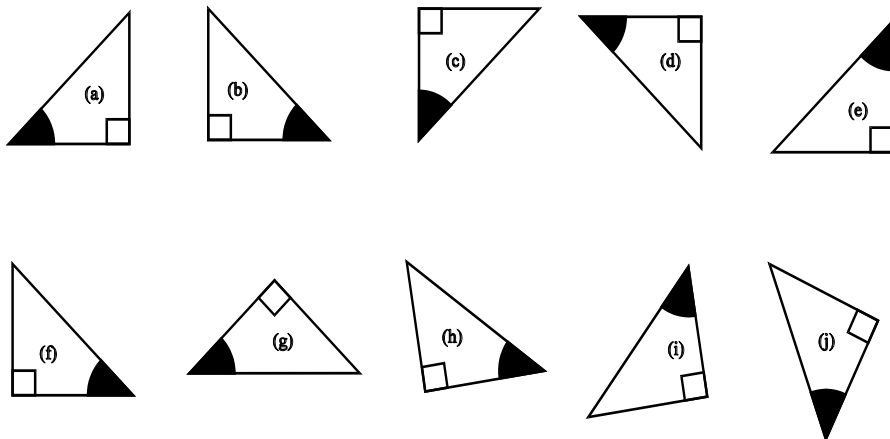
2) For the following angles find correct to 3 decimal places:

   a) sin 20° **b)** sin 61° **c)** sin 9°   **d)** sin 64° **e)** sin 27°

   f) cos 54° **g)** cos 5°   **h)** cos 84° **i)** cos 7°   **j)** cos 29°

   k) tan 43° **l)** tan 36° **m)** tan 59° **n)** tan 48° **o)** tan 71°

   p) sin 34° **q)** tan 89° **r)** cos 25° **s)** tan 18° **t)** sin 37°

   u) tan 24° **v)** cos 84° **w)** sin 35° **x)** tan 58° **y)** cos 47°

3) Find the size of angle x (correct to 1 decimal place) for

a) $\tan x = 1 \cdot 505$ **b)** $\tan x = 0 \cdot 789$ **c)** $\tan x = 0 \cdot 231$ **d)** $\tan x = 79 \cdot 456$

e) $\tan x = 10 \cdot 271$ **f)** $\tan x = 2 \cdot 512$ **g)** $\tan x = 0 \cdot 120$ **h)** $\tan x = 34 \cdot 512$

i) $\tan x = 1 \cdot 276$ **j)** $\tan x = 6 \cdot 014$

4) Find the size of angle x (correct to 1 decimal place) for

a) $\cos x = 0 \cdot 124$ **b)** $\cos x = 0 \cdot 927$ **c)** $\cos x = 0 \cdot 013$ **d)** $\cos x = 0 \cdot 523$

e) $\cos x = 0 \cdot 453$ **f)** $\cos x = 0 \cdot 758$ **g)** $\cos x = 0 \cdot 213$ **h)** $\cos x = 0 \cdot 398$

i) $\cos x = 0 \cdot 812$ **j)** $\cos x = 0 \cdot 090$

5) Find the size of angle x (correct to 1 decimal place) for

a) $\sin x = 0 \cdot 841$ **b)** $\sin x = 0 \cdot 724$ **c)** $\sin x = 0 \cdot 132$ **d)** $\sin x = 0 \cdot 523$

e) $\sin x = 0 \cdot 423$ **f)** $\sin x = 0 \cdot 390$ **g)** $\sin x = 0 \cdot 568$ **h)** $\sin x = 0 \cdot 235$

i) $\sin x = 0 \cdot 398$ **j)** $\sin x = 0 \cdot 612$

Exercise 2

1) Find the length of the side marked **x. (TANGENT)**

2) Find the length of the side marked **x**. **(SINE)**

(a)

12 cm

x

20°

(b)

29 cm

x

34°

(c)

x

52° 31 cm

(d)

78°

55 cm

x

(e)

41 cm

12°

x

(f)

60 cm

x

41°

(g)

x

84°

92 cm

(h)

18 m

x

63°

(i)

7.5 m 72°

x

(j)

x

63 m

23°
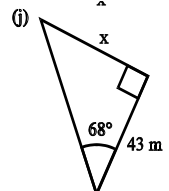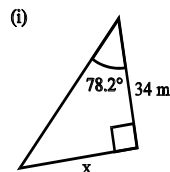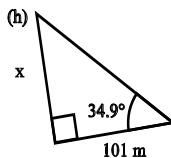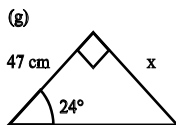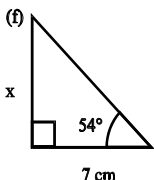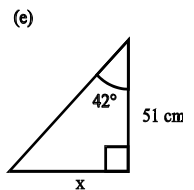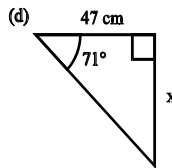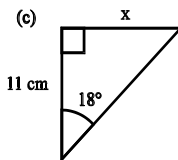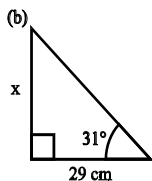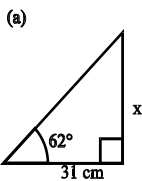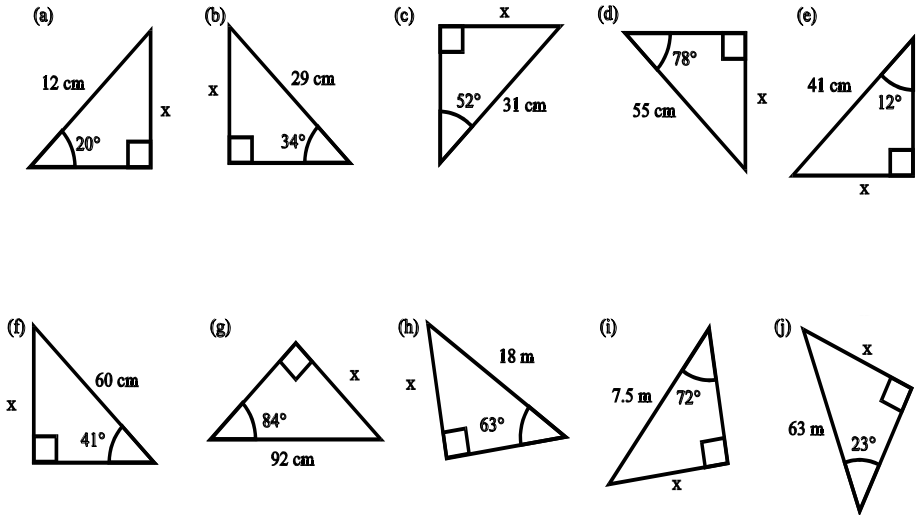
3) Find the length of the side marked **x**. **(COSINE)**

(a)

12 cm

20°

x

(b)

24 cm

34°

x

(c)

x

52° 34 cm

(d)

x

78°

8 cm

(e)

45 cm

12°

x

(f)

52 cm

41°

x

(g)

x

84°

61 cm

(h)

25 m

63°

x

(i)

32 m 72°

x

(j)

24 m

23°

x
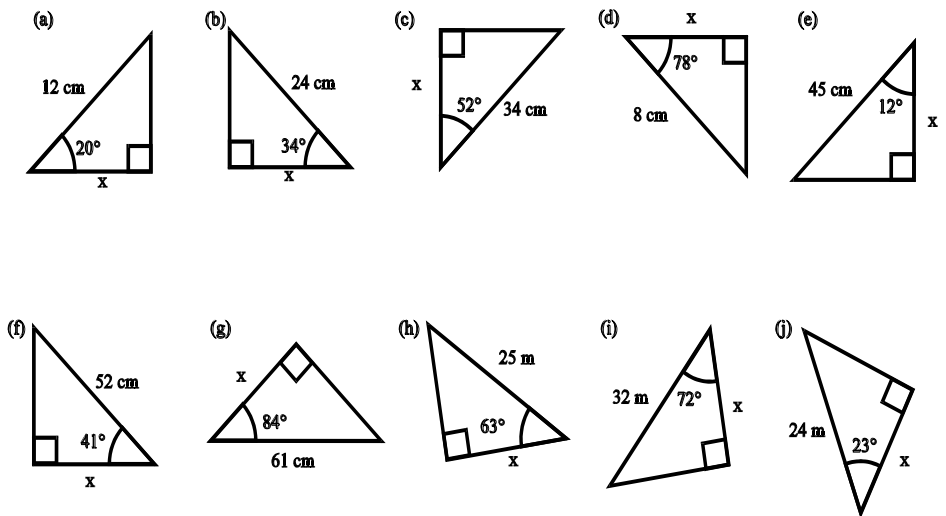
Exercise 3

Find the length of the side marked **x**. **(MIXED)**

(a)
23°
9 cm
x

(b)
14 cm
34°
x

(c)
x
49°
42 cm

(d)
52°
23 cm
x

(e)
39°
41 cm
x

(f)
71 cm
64°
x

(g)
x
84°
27 cm

(h)
9 m
17°
x

(i)
18 m
56°
x

(j)
x
92.8 m
29°

(k)
28.4 cm
44°
x

(l)
8.7 cm
51°
x

(m)
x
41.7 cm
46°

(n)
30.4 cm
21°
x

(o)
51 cm
13°
x

(p)
12 cm
x
69°

(q)
73 cm
17°
x

(r)
21.6 m
73°
x

(s)
18 m
81°
x

(t)
x
11°
11 m
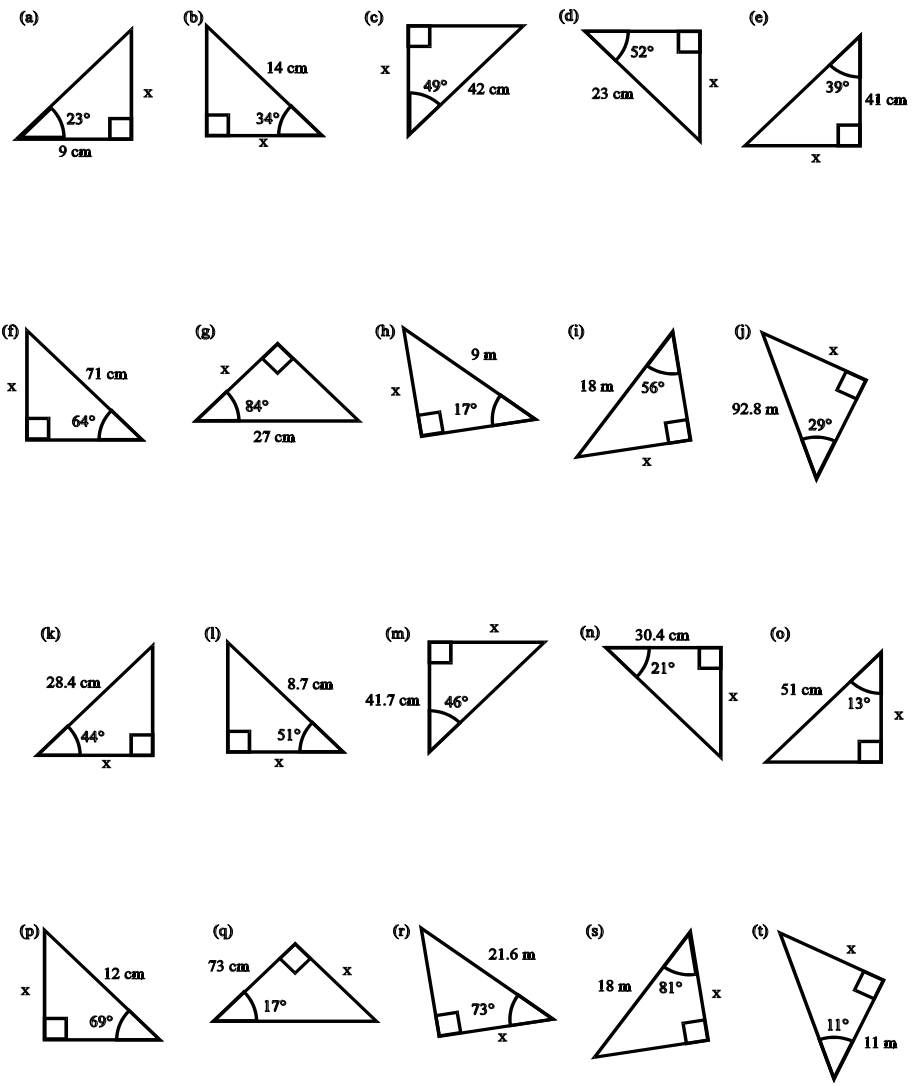
Exercise 4

Find the size of the angle marked **x** in each triangle

(a)

8 cm
10 cm
x

(b)

14 cm
8 cm
11 cm
x

(c)

39 cm
50 cm
x

(d)

29 cm
x
36 cm

(e)

25 cm
x
17 cm

(f)

64 cm
36 cm
x

(g)

21 cm
89 cm
x

(h)

57 m
34 m
x

(i)

25 m
x
17 m

(j)

43 m
29 m
x

(k)

89 cm
54 cm
x

(l)

56 cm
19 cm
x

(m)

7 cm
4 cm
x

(n)

43 cm
78 cm
x

(o)

x
12 cm
59 cm

(p)

21 cm
15 cm
x

(q)

73 cm
47 cm
x

(r)

21.6 m
13 m
x

(s)

x
18 m
8.8 m

(t)

15.5 m
11 m
x

(u)

18 cm
15 cm
x

(v)

15 cm
7 cm
x

(w)

45 cm
65 cm
x

(x)

2.9 cm
x
3.6 cm

(y)

23 cm
x
15 cm
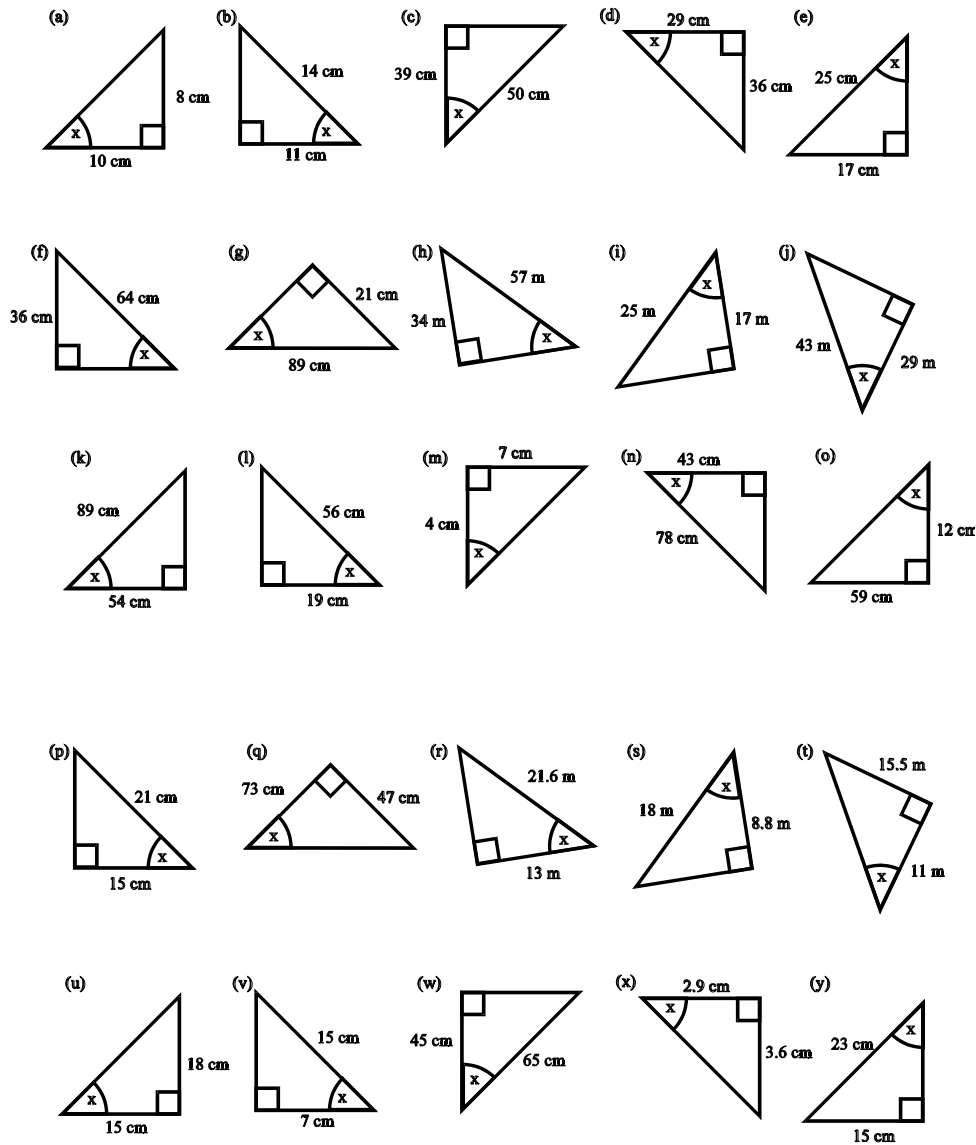
Exercise 5

Find the size of **x** in each triangle.

(a) 35°, 41 cm, x

(b) 24 cm, 32 cm, x

(c) 32°, 28 cm, x

(d) 14 cm, x, 9 cm

(e) 21 cm, 40°, x

(f) 43 cm, 11 cm, x

(g) x, 27°, 91 cm

(h) 82 m, 35 m, x

(i) 43°, 75 m, x

(j) 39 m, 17 m, x

(k) 78 cm, 53°, x

(l) 54 cm, 87 cm, x

(m) x, 22°, 39cm

(n) x, 109 cm, 56 cm

(o) x, 11 cm, 29 cm

(p) x, 41 cm, 63°

(q) 12 cm, x, 48 cm

(r) x, 44°, 19 m

(s) 71 m, x, 15 m

(t) 83 m, 75°, x

(u) 21 cm, x, 17 cm

(v) 17 cm, 21°, x

(w) x, 51 cm, 33°

(x) 5.8 cm, x, 7.3 cm

(y) 65°, 75 cm, x
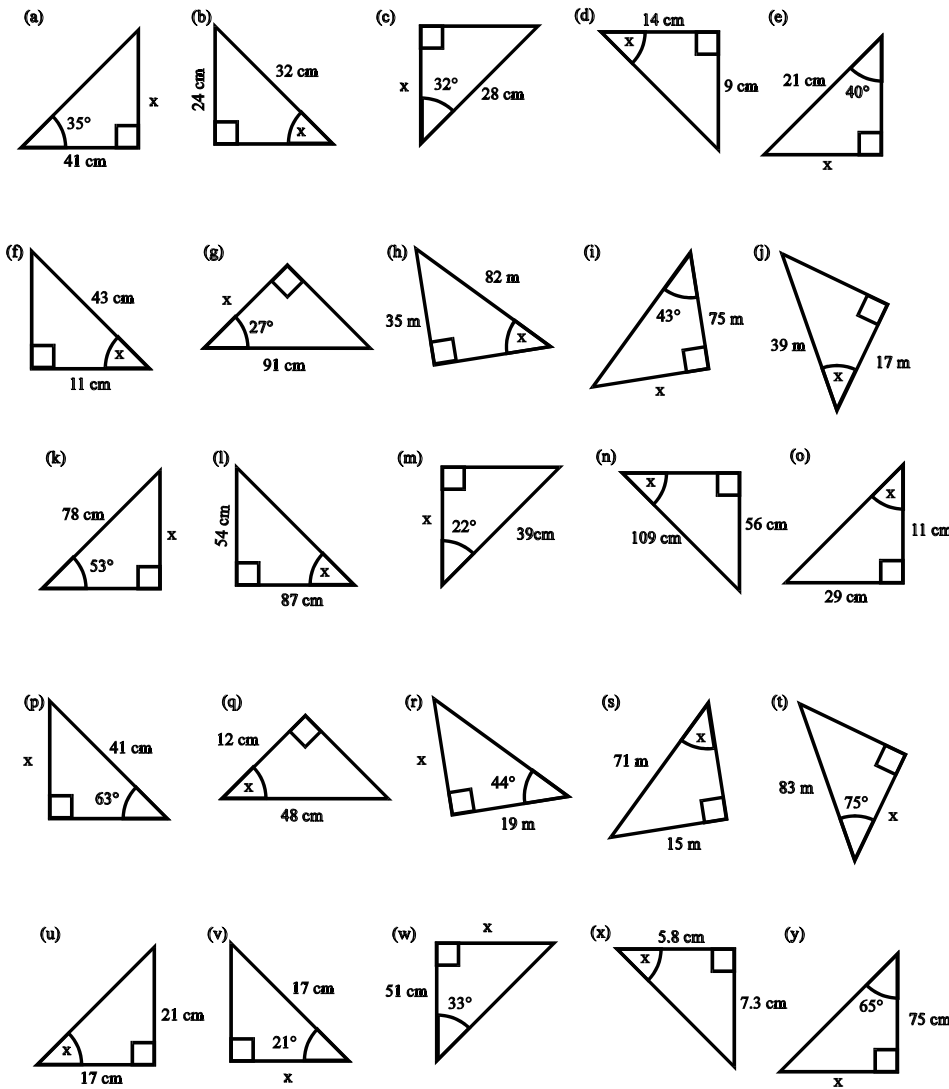
Exercise 6

1) A ramp is fitted at a school to allow disabled access to the second floor of the building
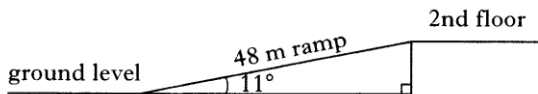
The ramp is 48 m long and is at an angle of 11° to the horizontal.

What is the height of the second floor above the ground?

2) The diagram shows a shop's ramp for customers who are wheelchair users.

It connects the pavement to the level of the shopping mall.

The ramp is 14 metres long and slopes at an angle of 9°, as shown.

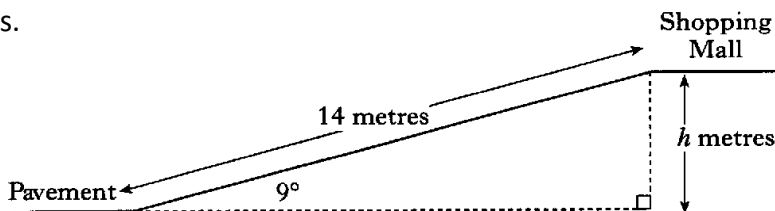Calculate the difference in height, h metres, between the pavement and the shopping mall.
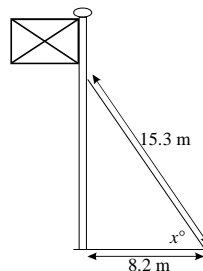Give your answer correct to the nearest metre.

3) The diagram shows a flagpole which is supported by a wire which is fixed to the ground 8·2 metres from the base of the flagpole.

The wire is 15·3 metres long.

a) Calculate the angle marked $x°$ between the wire and the ground.

b) For safety reasons the angle should be less than 60°.

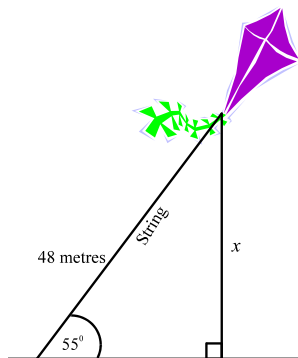Can the angle of the wire be considered safe?

4) Sam is flying a kite.

The string is 48 metres long.
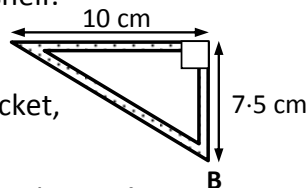
How high is the kite above the ground?

(marked x in the diagram)

48 metres

String

x

55°

5) A triangular bracket is designed to support a shelf.

10 cm

7·5 cm

B

Its length is 10 cm and its height is 7·5 cm.

  a) Calculate the angle at the base of the bracket, angle B.

  b) For safety reasons the angle should be less than 55°.

   Can the angle of the wire be considered safe?

6) A ramp has been constructed at a bowling club. It is 3·5metres long and rises through 0·3metres.

Calculate the angle, x, that the ramp makes with the horizontal.

VICTORIA BOWLING CLUB

0·3m

3·5m

$x°$
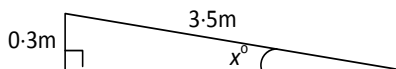
7) A boy flying a kite lets out 200 m of string which makes an angle of 72° with the horizontal. What is the height of the kite?

8) A ladder is 15 m long. The top rests against the wall of a house, and the foot rests on level ground 2 m from the wall.

Calculate the angle between the ladder and the ground.

9) A ladder 12 m long is set against the wall of a house and makes an angle of 75° with the ground.

a) How far up the wall will the ladder reach?

b) How far is the foot of the ladder from the wall?

10) A telegraph pole standing on horizontal ground is 9 m high, and is supported by a wire 10 m long fixed to the top of the pole and to the ground. Calculate:

a) the angle between the wire and the ground.

b) the distance of the point on the ground from the foot of the pole.