CALCULATOR NOT ALLOWED UNTIL QUESTION 67. For all questions, you must show your working out clearly.

1   (x+1) is increased by 40%
         Its value is now the same as (x+10)
         Work out the value of x.

2   (x+4) is increased by 50%
         Its value is now the same as (x+12)
         Work out the value of x.

3   (x+1) is increased by 60%
         Its value is now the same as (x+15)
         Work out the value of x.

4   The point (-8,-6) lies on a straight line with gradient $\frac{3}{4}$
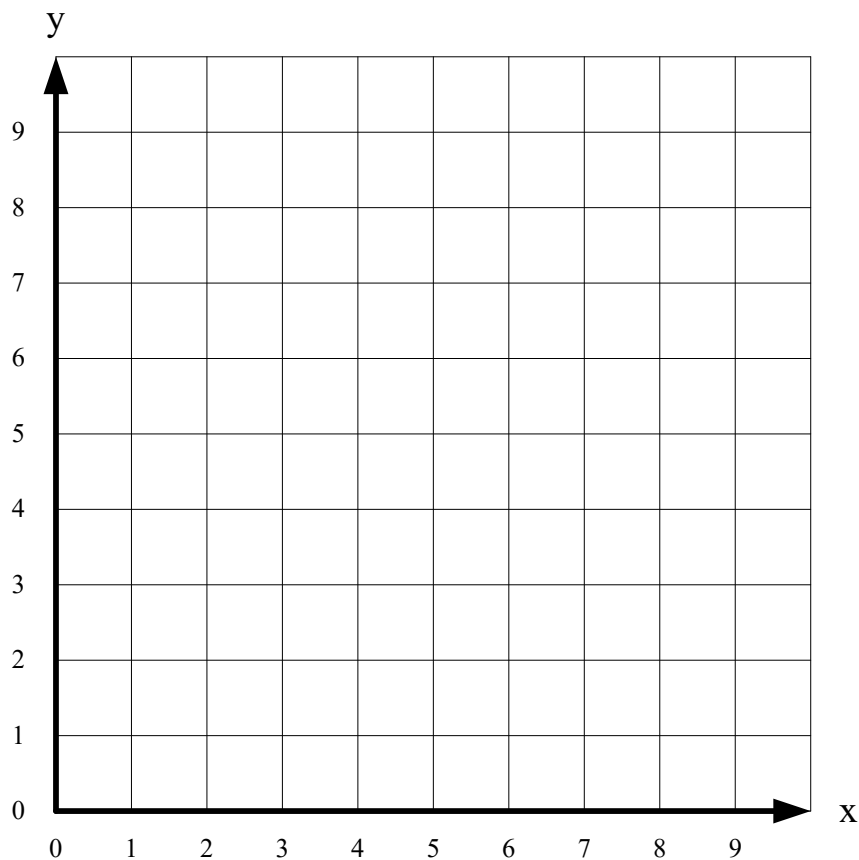   Work out the co-ordinates of where the line crosses the y axis.

5   The point (3,6) lies on a straight line with a gradient $\frac{5}{4}$
         Work out the co-ordinates of where the line crosses the x axis and the co-ordinates of the point where the line crosses the y axis.

6 The point (-5,-4) lies on a straight line with a gradient of $\frac{15}{8}$

Work out the co-ordinates of the point where the line crosses the x axis and the point where it crosses the y axis.
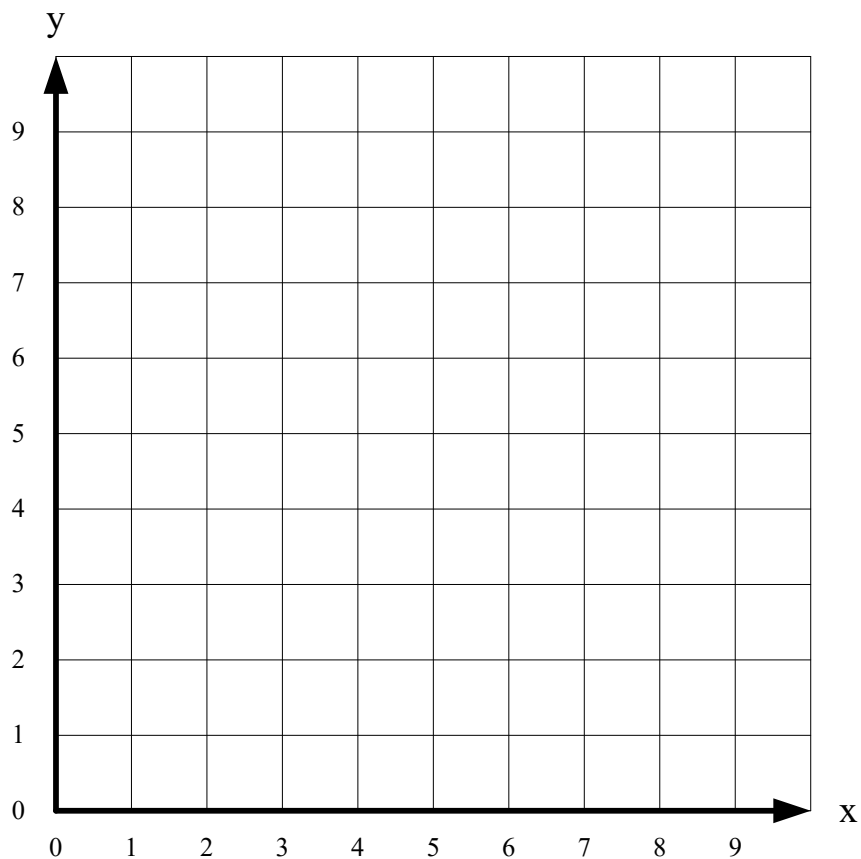
7 $f(x) = 5 - x$ $0 \leq x < 2$

       $= 5x - x^2$ $2 \leq x < 5$

       $= 4x - 19$ $5 \leq x < 7$

       $= 0$ $x \geq 7$

On the grid, draw the graph of $y = f(x)$

8    $f(x) = 5 + x$ $0 \le x < 4$

     $ = 4x - x^2 + 8$ $4 \le x < 5$

     $ = 2x - 7$ $5 \le x < 7$

     $ = 0$ $x \ge 7$

On the grid, draw the graph of $y = f(x)$

10   $k(x) = 12 - 4x$

Calculate $k^{-1}(x)$

11   $k(x) = \frac{5}{3x} - 2$

Calculate $k^{-1}(x)$

12    $k(x) = 3x + 5ax - 12$

Calculate $k^{-1}(x)$

13   Write the exact value of $tan^2 30°$ (This is like doing $(\tan 30)^2$)

14   Write down the exact value of $sin^2 30°$

15   Write down the exact value of $cos^2 30°$

16   Write down the exact value of $cos^2 45°$

17   Write down the exact value of $cos^2 60°$

18   Write down the exact value of $tan^2 45°$

19   Write down the exact value of $sin^2 45°$

20   Write down the exact value of $tan^2 60°$
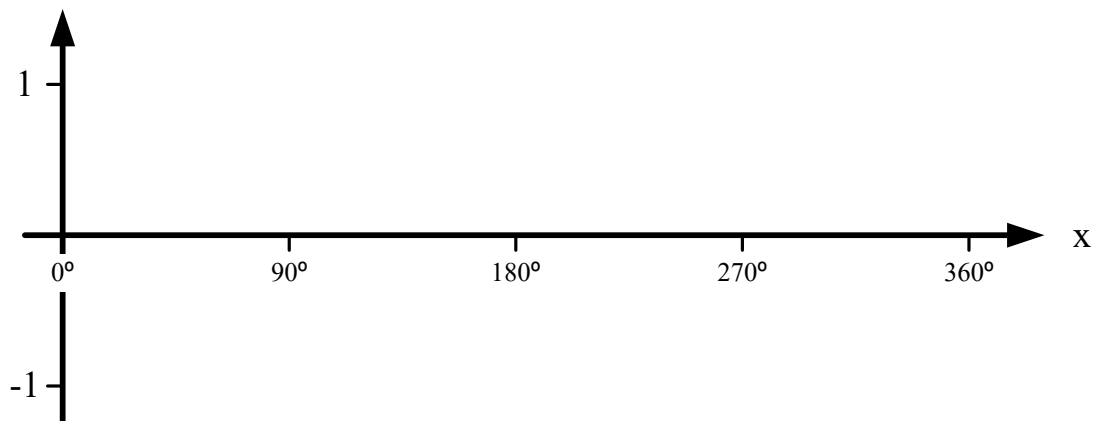
21   Write down the exact value of $sin^2 60°$

22   On the axes, sketch
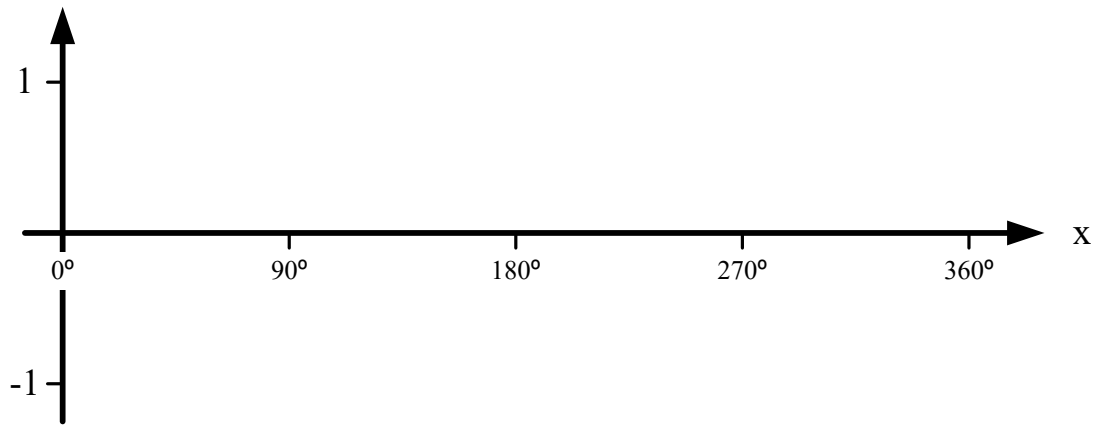
$$y = \sin x \quad for\ 0° \leq x \leq 360°$$

23   On the axes, sketch

$$y = \cos x \quad for\ 0° \leq x \leq 360°$$

24   On the axes, sketch

$$y = \tan x \quad for \ 0° \leq x \leq 360°$$

25      $(6x + a)(4x - 4) = 24x^2 - 12x + b$

Work out the values of a and b.

26      $(3x + a)(7x - 5) = 21x^2 - x + b$

Work out the values of a and b.

27      $(8x - a)(5x - 2) = 40x^2 - 19x + b$

Work out the values of a and b.

28      $(3x + 4)(9x - a) = 27x^2 + b$

Work out the values of a and b.

29      $(ax + 5)(5x + b) = 35x^2 + 46x + c$

Work out the values of a, b and c.

30      $y = 3x + 12 - x^2$

Find the value of $\frac{dy}{dx}$

31      $y = 3x^3 \left(x^2 + 5 - \frac{7}{x}\right)$

Find the value of $\frac{dy}{dx}$

32      $y = (8x^3 + 5)(7x^9 - 3x)$

Find the value of $\frac{dy}{dx}$

33      $y = 5x^4 \left(\frac{2}{x^3} + 4x^3\right)$

Find the value of $\frac{dy}{dx}$

34      $y = 8x^5 \left(\frac{4}{5x} - x + \frac{2}{3}\right)$

Find the value of $\frac{dy}{dx}$

35      $y = \frac{3x - 12 + x^5}{x^3}$

Find the value of $\frac{dy}{dx}$

36      $A = \begin{bmatrix} -2 & 3 \\ -4 & 0 \end{bmatrix}$ $B = \begin{bmatrix} 4 & 3 \\ 5 & 9 \end{bmatrix}$

Find **AB**

37 $A = \begin{bmatrix} -2 & 3 \\ -4 & 0 \end{bmatrix}$ $B = \begin{bmatrix} 4 & 3 \\ 5 & 9 \end{bmatrix}$

Find **BA**

38 $A = \begin{bmatrix} -2 & 3 \\ -4 & 0 \end{bmatrix}$ $B = \begin{bmatrix} 4 & 3 \\ 5 & 9 \end{bmatrix}$

Find **AA**

39 $A = \begin{bmatrix} -2 & 3 \\ -4 & 0 \end{bmatrix}$ $B = \begin{bmatrix} 4 & 3 \\ 5 & 9 \end{bmatrix}$

Find **BB**

40 $A = \begin{bmatrix} \frac{3}{5} & 1 \\ -5 & 2 \end{bmatrix}$ $B = \begin{bmatrix} 3 & 4 \\ 5 & -\frac{1}{2} \end{bmatrix}$
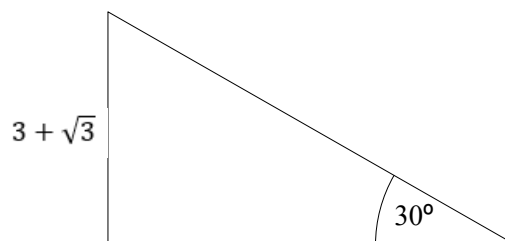
Find **AB**

41 $A = \begin{bmatrix} \frac{2}{3} & \frac{4}{5} \\ -\frac{1}{3} & \frac{1}{4} \end{bmatrix}$ $B = \begin{bmatrix} 1 & 1 \\ 2 & 0 \end{bmatrix}$
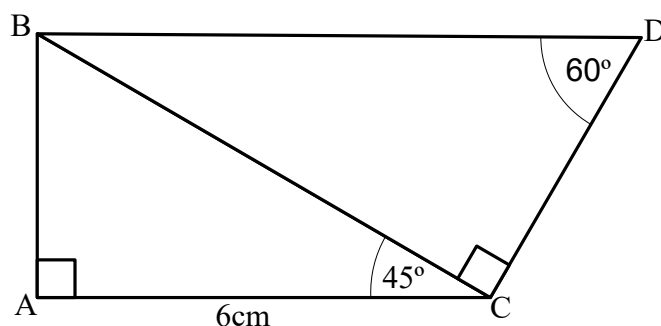
Find **AB**

42 ABC is a right-angled triangle with vertices A(-3,4), B (8,4) and C $\left(-3, 4\frac{3}{5} \right)$.

Work out the length of BC

43 Calculate the area of the right angled triangle below.

44   Look at the diagram below.

Calculate the length of CD.

 Give you answer in the form $k\sqrt{6}$ where k is an integer.

45   A quadratic sequence starts

        -3   14   39   72

Work out the expression for the nth term.

46   A different quadratic sequence has nth term $2n^2 + 10n$

Use an algebraic method to determine the number of terms in the sequence are less than 3000.

Do NOT use trial and improvement.

You must show your working.

47   A quadratic sequence starts

        6   5   2   -3   -10

Work out the expression for the nth term.

48   A quadratic sequence starts

        5   1   -7   -19

Work out the expression for the nth term.

49   A different sequence has nth term $3n^2 - 4n$

Use an algebraic method to work out how many terms in the sequence are less than 600.

Do NOT use trial and improvement
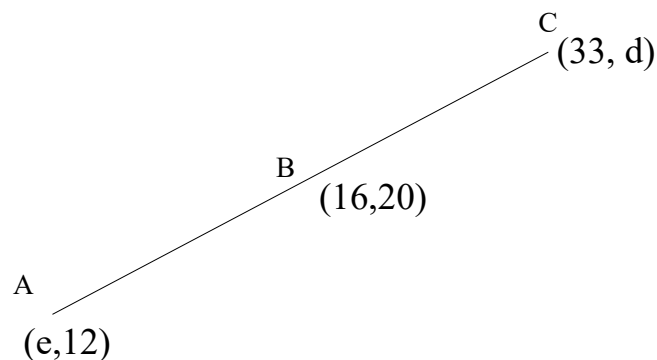
You must show your working.

50   Rationalise and simplify fully $\dfrac{\sqrt{5}}{5+\sqrt{5}}$

51   Rationalise and simplify fully $\dfrac{\sqrt{7}}{7+\sqrt{7}}$

52   Rationalise and simplify fully $\dfrac{\sqrt{13}}{13-\sqrt{13}}$

53   Expand and simplify fully $(5+3x)^5$

54   Expand and simplify fully $(2+5x)^4$

55   Expand and simplify fully $\left(9+4\sqrt{x}\right)^5$

56   The nth term in a sequence is $\dfrac{5n^2}{n^2+3}$

One term in the sequence is $\dfrac{15}{4}$

Work out the value of n.

57   The nth term in a sequence is $\dfrac{5n^2}{n^2+3}$

Write down the limiting value of the sequence as $n \rightarrow \infty$

58   The nth term in a sequence is $\dfrac{3n^2}{n^2+5}$

Write down the limiting value of the sequence as $n \rightarrow \infty$

59   Rearrange $de = \dfrac{7d+9}{4}$ to make d the subject

60   Rearrange $gh = \dfrac{6h+9}{12}$ to make h the subject

61   Write $8x^2 + 32x - 19$ in the form $a(x + b)^2 + c$ where a, b and c are integers.

62   Write $5x^2 - 25x + 17$ in the form $a(x + b)^2 + c$.

63   Write $12x^2 - 30x + 45$ in the form $a(x + b)^2 + c$.

64   The curve $y = 2x^3 - 3x^2 - 12x + 4$ has two stationary points.
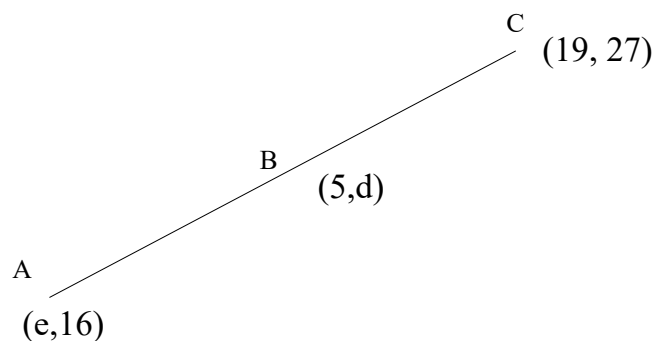
Calculate them and determine their nature.

By determine their nature, you need to differentiate twice and then determine if the derivative is positive or negative to determine whether the stationary point is a local minimum or maximum.

65   The curve $y = x^3 - 12x + 3$ has two stationary points.

Calculate them and determine their nature.

66   The curve $y = x^3 - 4x^2 + 9$ has two stationary points.

Calculate them and determine their nature.
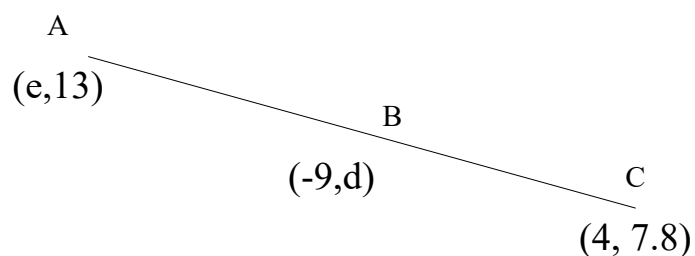
CALCULATOR ALLOWED FOR THE FOLLOWING QUESTIONS

67   Factorise fully $30k + 36k^2$

68   Factorise fully $24w + 36w^2$

69   B is the midpoint of AC.

Determine the values of d and e.

C
(33, d)

B
(16,20)

A
(e,12)

70   B is the midpoint of AC.

Determine the values of d and e.

C
(19, 27)

B
(5,d)

A
(e,16)

71   B is the midpoint of AC.

Determine the values of d and e.

A
(e,13)

B
(-9,d)

C
(4, 7.8)

72   Work out $4\begin{pmatrix} 5 & 8 \\ 1 & 0 \end{pmatrix}\begin{pmatrix} 3 & 4 \\ -3 & -2 \end{pmatrix}$

Give your answer as a single matrix.

73   Work out $3\begin{pmatrix} 2 & 4 \\ -1 & 3 \end{pmatrix}\begin{pmatrix} 4 & 2 \\ -6 & -3 \end{pmatrix}$

Give your answer as a single matrix.

74   Work out $2\begin{pmatrix} 3 & 4 \\ -5 & 6 \end{pmatrix}\begin{pmatrix} -2 & 1 \\ 0 & -5 \end{pmatrix}$

Give your answer as a single matrix.

75    $\begin{pmatrix} a & 4 \\ 1 & b \end{pmatrix}\begin{pmatrix} c & a-4 \\ b+8 & 4 \end{pmatrix} = \begin{pmatrix} 9 & 3a+4 \\ -17 & -3a \end{pmatrix}$

Work out the values of p, q and r.

76 $\begin{pmatrix} 8 & a \\ b & -1 \end{pmatrix} \begin{pmatrix} 3 & a+2 \\ b-1 & 5 \end{pmatrix} = \begin{pmatrix} -14 & 42 \\ -35 & -77 \end{pmatrix}$

Work out the values of a and b.

77 Work out all the negative integer values of x for which $5x^2 < 125$

78 Work out all the negative integer values of x for which $8x^2 < 72$

79 Work out all the negative integer values of x for which $5x^2 < 80$

80 Prove algebraically that when n is an integer

$$\frac{(6n+3)^2 - (6n-3)^2}{12} \text{ is always even.}$$

81 How many integers between 10,000 and 50,000 can be formed using only the digits

| 1 | 2 | 3 | 5 | 7 | 8 |

without repeating any single digit?

82 How many integers between 40,000 and 100,000 can be formed using only the digits

| 3 | 4 | 4 | 5 | 5 | 7 |

without repeating any single digit except where more than one appears in the list above?

83 A curve has the equation $y = 2x^3 - 6x^2$

At two points, the rate of change of y with respect to x is 3

Work out the equation in terms of x to represent this information.

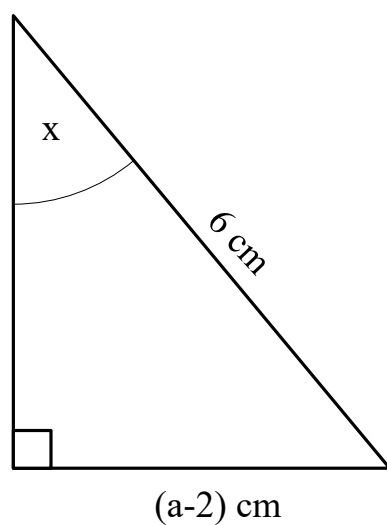Give your answer in the form $ax^2 + bx + c = 0$ where a, b and c are integers.

Hence find the two possible values of x giving your solutions to 3 significant figures.

84   A curve has the equation $y = x^3 - 8x^2$

At two points, the rate of change of y with respect to x is 2

Work out the equation in terms of x to represent this information.

Give your answer in the form $ax^2 + bx + c = 0$ where a, b and c are integers.

Hence find the two possible values of x giving your solutions to 3 significant figures.

85   Write the value of the following:

i $5 \times 2^0 =$

ii $12 \times 2^0 =$

iii $3 \times 2^0 =$

iv $7 \times 2^0 =$

v $9 \times 2^0 =$

86   The first three terms of a linear sequence are

45        $45 + 3k$ $45 + 6k$

where k is constant.

a]   Work out an expression in terms of k for the fourth and fifth terms. Give your
             answers in their simplest form.

b]   The 250th term in the sequence is 5274.

             Work out the value of k.

87   The first three terms of a linear sequence are

             $10{,}000$ $10{,}000 - 6k$ $10{,}000 - 12k$

a]   Work out an expression in terms of k for the fourth and fifth terms. Give your
             answers in their simplest form.

b]   The 100th term in the sequence is 8218.

             Work out the value of k.

88   Below is a right angled triangle.

x

6 cm

(a-2) cm

Given that a>4, use trigonometry to find the range in values of x.

89   Work out the gradient of the curve $y = \frac{8x^3 + 2x - 3}{4x}$
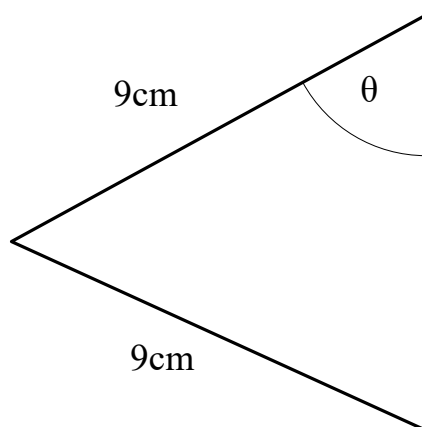
at the point where x=-2

90   Work out the gradient of the curve $y = \frac{20x^3 - 15x + 7}{4x^2}$

at the point where x=-5

91   Here is an isosceles triangle.

All the angles are acute.

9cm

θ

9cm

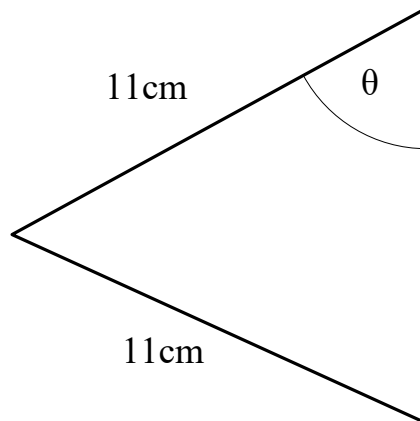The area of the triangle is 32.4 cm²

Work out the size of θ
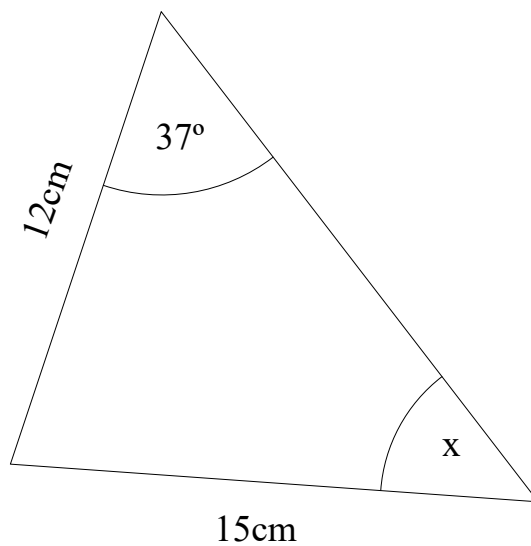
92   Here is an isosceles triangle.

All the angles are acute.

11cm

θ

11cm

The area of the triangle is 48.4 cm^2

Work out the size of angle θ.

93   Here is a scalene triangle.

12cm

37º

x

15cm

The area of the triangle is 51.62187927 cm^2

Work out the size of angle x

94   Solve these simultaneous equations algebraically showing your working.

$5x + 6y - 8z = 18$

$8x - 4y = -80.1 - 14z$

$5y - 24z = 4(x + 1) - 1.5$

95   Solve these simultaneous equations algebraically showing your working.

$6x + 2y - 5z = -51$

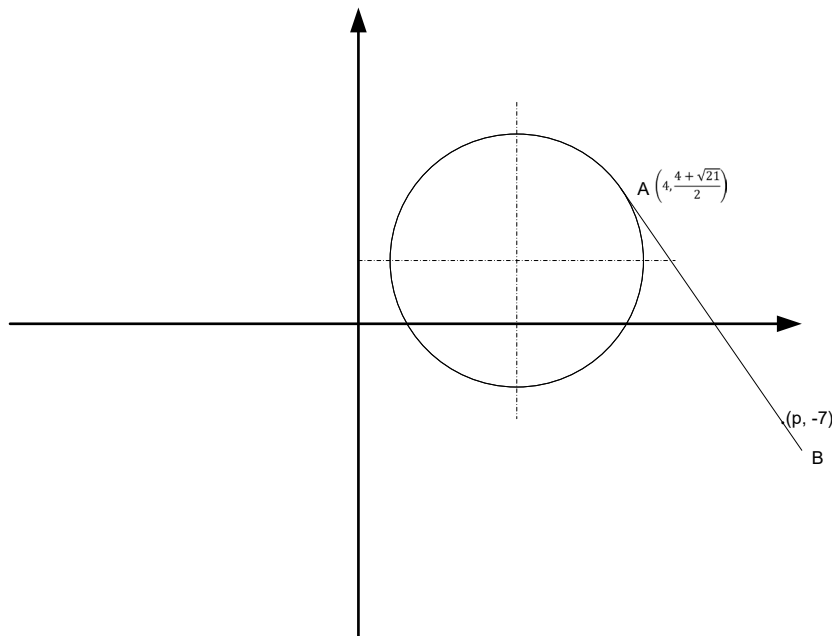$100 - (3x + 2y) = 7z + 40.6$

$10(3x - 4y + 11z) = 624$

96   A circle has the equation $(x - 3)^2 + (y - 2)^2 = 6.25$.

Point A is a point on the circle with co-ordinates $\left(4, \frac{4+\sqrt{21}}{2}\right)$.

AB is a tangent to the circle.

(p,-7) is a point on the tangent.

Find the value of p.

97	Points A(1,1) and B(5,7) are the ends of the diameter of a circle.

Find the equation of the circle.

98	By completing the square, show that the equation $x^2 + y^2 + 4x - 6y - 3 = 0$ is the equation of a circle.

99	Expand $\left(4x^2 + \frac{1}{5}\right)^5$

100	Factorise fully $12x^3 - x^2 - 9x - 2$ using the factor theorem.

101	Divide $12x^5 + 6x^4 + 6x^3 + 13x^2 - 14x - 7$ by $2x + 1$

102	Solve by using powers of three or otherwise

$$(27^x)^x = \frac{1}{3^{2x}}$$

103	Solve

$$(32^{2x})^x = \frac{1}{8^{4x}}$$

104	Solve

$$(49^x)^x = \frac{1}{343^x}$$

105	Solve

$$(64^{3x})^{2x} = \frac{1}{16^{4x}}$$