

## A Level Maths Transition Year 11 into 12

### Instructions

- 1) Complete all the transition questions – show full workings on the sheets provided.
- 2) Enter your answers into DrFrostMaths and mark your paper work.
- 3) Reattempt any questions that are incorrect.

Task	Completed? (✓)	Entered onto DFM and marked paper work? (✓)	Reattempted incorrect questions? (✓)
1 – Indices and Surds			
2 – Expanding and factorising			
3 – Solving equations			
4 – Straight line equations			
5 – Trigonometry			

### Extension ideas

#### 1) Read:

- Fermat's Last Theorem *by Simon Singh*
- Godel, Escher, Bach: An Eternal Golden Braid *by Douglas Hofstadter* (\*recommended for Further Maths students only)
- From Here to Infinity: A Guide to today's Mathematics *by Ian Stewart*
- The Equation that Couldn't be Solved *by Mario Livio*
- Mathematics: A Very Short Introduction *by Timothy Gowers*
- How to Solve It *by George Polya*
- Finding Moonshine *by Marcus du Sautoy*
- The Ultimate Mathematical Challenge *by the UKMT*

#### 2) Watch / listen:

##### Lectures

- [The University of Oxford Mathematical Institute YouTube Channel](#) contains public lectures on interesting areas of mathematics (which are accessible to school Maths students), as well as some undergraduate maths lectures (for more ambitious A Level Further Maths students).

##### Podcasts

- [The Secrets of Mathematics](#) A series of talks and lectures from Oxford Mathematicians exploring the power and beauty of their subject.
- [A brief history of Mathematics \(BBC\)](#) Professor of Mathematics Marcus du Sautoy reveals the personalities behind the calculations.
- [Women in Math: The limit does not exist](#) Stories about the contributions of women to Maths

##### Fun maths / YouTubers

- [3Blue1Brown \(Grant Sanderson\)](#) : Excellent, well-explained videos on a range of topics
- [Numberphile \(Brady Haran\)](#)

# Year 11 into 12 Task 1 - Indices & Surds

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## Question 1

Write this ratio in its simplest form

$$\sqrt{12} : \sqrt{48} : \sqrt{300}$$

..... : ..... : .....

**(3 marks)**

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## Question 2

Write  $\sqrt{75} + \sqrt{12}$  in the form  $a\sqrt{b}$  where  $a$  and  $b$  are integers.

.....

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## Question 3

Write  $\sqrt{500} - 2\sqrt{45}$  in the form  $a\sqrt{5}$  where  $a$  is an integer.

.....

**(2 marks)**

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### Question 4

Expand and simplify

$$(\sqrt{5} + 3)(\sqrt{5} - 2)(\sqrt{5} + 1)$$

.....  
(4 marks)

---

### Question 5

Rationalise the denominator of

$$\frac{8}{3 - \sqrt{5}}$$

Give your answer in the form  $a + b\sqrt{5}$  where  $a$  and  $b$  are integers.

.....  
(3 marks)

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## Question 6

Rationalise the denominator and simplify

$$\frac{2\sqrt{2} + 1}{\sqrt{2} - 3}$$

.....

---

## Question 7

Rationalise the denominator and simplify

$$\frac{5\sqrt{5} - 2}{2\sqrt{5} - 3}$$

.....

**(4 marks)**

### Question 8

Solve

$$y(\sqrt{3} - 1) = 8$$

Give your answer in the form  $a + b\sqrt{3}$  where  $a$  and  $b$  are integers.

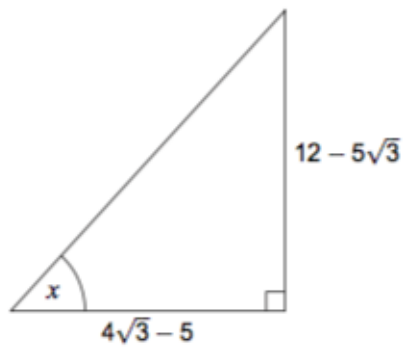
$y = \dots\dots\dots$

**(4 marks)**

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### Question 9

Find  $x$



Not drawn accurately

$x = \dots\dots\dots^\circ$

**(4 marks)**

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## Question 10

Solve

$$x^{\frac{2}{3}} = 9$$

.....

## Question 11

Solve

$$x^{-\frac{2}{3}} = 7\frac{1}{9}$$

.....

**(5 marks)**

## Question 12

$$a = 3^{2b}$$

Select the correct expression for  $\frac{1}{a}$

$3^{2b-1}$

$3^{-2b}$

$-3^{2b}$

$\left(\frac{1}{3}\right)^{-2b}$

**(1 mark)**

### Question 13

$$x^{\frac{1}{2}} = 6 \text{ and } y^{-3} = 64$$

Work out the value of  $\frac{x}{y}$

$$\frac{x}{y} = \dots\dots\dots$$

**(4 marks)**

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### Question 14

$$\sqrt[4]{x} = 2 \text{ and } y^{-2} = 25$$

$$x > 0 \text{ and } y < 0$$

Work out the value of  $\frac{x}{y}$

$$\frac{x}{y} = \dots\dots\dots$$

**(4 marks)**

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### Question 15

$$a^{11} \times b^6 \times c = a^9 \times b^{10}$$

Write  $c$  in terms of  $a$  and  $b$ .

Give your answer in its simplest form.

$$c = \dots\dots\dots$$

**(3 marks)**

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### Question 16

Write  $\sqrt{\frac{1}{m^6}}$  as a single power of  $m$ .

$$\dots\dots\dots$$

**(2 marks)**

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### Question 17

You are given that  $x = 5^m$  and  $y = 5^n$

Write  $5^{\frac{m+n}{2}}$  in terms of  $x$  and  $y$ .

$$5^{\frac{m+n}{2}} = \dots\dots\dots$$

**(2 marks)**

---

### Question 18

Solve

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

.....  
**(3 marks)**

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### Question 19

Solve

$$3m^{\frac{1}{5}} + 9 = 0$$

.....  
**(2 marks)**

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### Question 20

Work out the values of  $a$  when

$$2^{a^2} = 8^a \times 16$$

Do **not** use trial and improvement.

.....  
**(4 marks)**

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## Year 11 into 12 Task 2 - Expanding & Factorising

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### Question 1

You are given that  $x^2 + ax + b \equiv (x - 5)^2 + 7$

Work out the values of  $a$  and  $b$ .

.....  
**(3 marks)**

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### Question 2

$$2x^2 - 2bx + 7a \equiv 2(x - a)^2 + 3$$

Work out the **two** possible pairs of values of  $a$  and  $b$ .

.....  
**(6 marks)**

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### Question 3

$x^3 + ax^2 + bx + 150$  factorises to  $(x + c)^2(x + d)$

$a, b, c$  and  $d$  are positive integers and  $c \neq 1$

Work out the values of  $a, b, c$  and  $d$ .

.....  
**(6 marks)**

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### Question 4

Expand and simplify

$$xy(2x + 3y)(5x - 2y)$$

.....  
**(4 marks)**

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### Question 5

Expand and simplify fully  $(x + 2)(x + 3)(x + 4)$

.....  
**(3 marks)**

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### Question 6

Expand and simplify

$$(x - 5)(x^2 + 4x - 2)$$

.....  
**(2 marks)**

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### Question 7

Simplify fully

$$(3n + 1)^2 - (3n - 1)^2$$

### Question 8

$$3a(2x - 1) + 4(ax + 5) \equiv 60x + b$$

Work out the values of  $a$  and  $b$ .

.....

### Question 9

It can be shown that  $(x + m)(x + n) \equiv x^2 + nx + mx + mn$

$$x^2 + qx + r \equiv (x + m)(x + n)$$

Write  $q$  and  $r$  in terms of  $m$  and  $n$ .

.....

**(2 marks)**

### Question 10

Expand and simplify fully

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

.....

**(2 marks)**

### Question 11

$$5(3x - 2) - 3(x - h) \equiv 4(kx + 2)$$

Work out the values of  $h$  and  $k$ .

.....  
**(4 marks)**

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### Question 12

Simplify fully

$$\frac{3x^2 - x - 14}{9x^2 - 4} \div \frac{x + 2}{3x^2 + 2x}$$

.....  
**(5 marks)**

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### Question 13

Factorise

$$5x^2 + 4xy - 12y^2$$

.....  
**(3 marks)**

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### Question 14

Factorise fully

$$3a^4b - 2a^3b^2 - 5a^2b^3$$

.....  
(2 marks)

---

### Question 15

Factorise fully  $(w + 4)^3 - (w + 4)^2(w + 1)$

.....  
(3 marks)

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### Question 16

Factorise fully  $(x + 6)^4 + (x + 6)^3(3x + 4)$  Do **not** attempt to expand the brackets.

.....  
(3 marks)

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### Question 17

Factorise fully  $48 - 75x^2$

.....  
**(2 marks)**

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### Question 18

Factorise fully

$$(x^2 - 16) - (x - 4)(3x + 5)$$

---

### Question 19

Simplify fully

$$\frac{4x^2 + 19x - 5}{9x^2 - 16} \div \frac{x + 5}{3x - 4}$$

.....  
(5 marks)

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### Question 20

Write

$$x(y + 6) - (xy + 4)$$

in the form  $a(bx + c)$

.....  
(3 marks)

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## Year 11 into 12 Task 3 - Solving Equations

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### Question 1

Solve

$$\frac{5x - 3}{6} + \frac{2x}{3} = 13$$

.....  
(4 marks)

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### Question 2

Solve  $\sqrt{35 + 4x^2} = 6$

.....  
(3 marks)

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### Question 3

Solve

$$\frac{3}{8x} = \frac{x^2}{9}$$

.....  
**(3 marks)**

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### Question 4

Solve the equation

$$\frac{3+x}{4} = \frac{9}{5}$$

to work out the value of  $x$ .

.....  
**(4 marks)**

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## Question 5

Solve the equation

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

Give your answers to 2 decimal places.

.....  
**(6 marks)**

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## Question 6

Solve

$$\frac{y-2}{5} + \frac{2y+1}{4} = 3$$

.....  
**(4 marks)**

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### Question 7

Solve the equation

$$\frac{6}{x+3} + \frac{1}{2x+5} = 3$$

Give your answer to 2 decimal places.

.....  
**(6 marks)**

---

### Question 8

Solve

$$\frac{2x+3}{4} - \frac{3x-3}{2} = 2$$

.....  
**(4 marks)**

---

### Question 9

It can be shown that

$$\frac{4}{x} + \frac{2}{x-1} = \frac{6x-4}{x(x-1)}$$

Hence, or otherwise, solve  $\frac{4}{x} + \frac{2}{x-1} = 3$

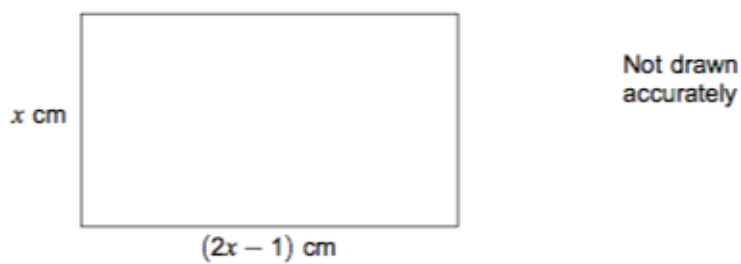
Give your solutions to 3 significant figures.

.....  
**(5 marks)**

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### Question 10

The diagram shows a rectangle with area  $9 \text{ cm}^2$



Set up and solve an equation to work out the value of  $x$ .  
Give your answer to 3 significant figures.

.....  
**(5 marks)**

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### Question 11

Solve the simultaneous equations

$$2y = 3x + 4$$

$$2x = -3y - 7$$

Do **not** use trial and improvement.

.....  
(4 marks)

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### Question 12

Solve the simultaneous equations

$$\frac{x-1}{y-2} = 3$$

$$\frac{x+6}{y-1} = 4$$

Do **not** use trial and improvement.

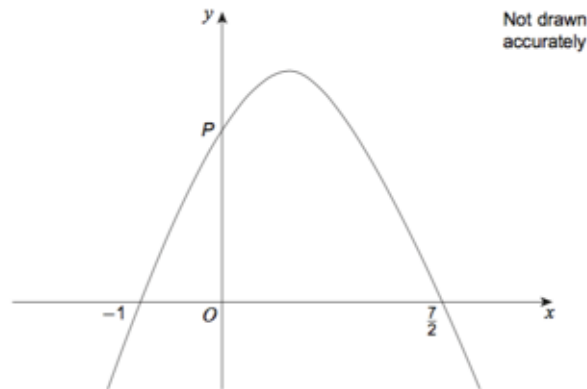
.....  
(5 marks)

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### Question 13

Here is a sketch of  $y = a + bx - 2x^2$  where  $a$  and  $b$  are constants.

The graph intersects the  $x$ -axis at  $(-1, 0)$  and  $(\frac{7}{2}, 0)$  and the  $y$ -axis at point  $P$ .



Work out the coordinates of point  $P$ .

.....  
(4 marks)

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### Question 14

Solve the simultaneous equations

$$y = 10 - xy = 2x^2 + 4$$

.....  
(5 marks)

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### Question 15

Solve the simultaneous equations

$$y - x = 2y = 2x^2 + 5x + 1$$

Give your answers correct to 1 decimal place.

.....  
**(6 marks)**

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### Question 16

Solve the simultaneous equations

$$x + y = 4$$

$$y^2 = 4x + 5$$

Do **not** use trial and improvement.

.....  
**(6 marks)**

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### Question 17

The equation of a circle is  $(x - 2)^2 + (y - 1)^2 = 16$

The equation of a line is  $y = 2x + 1$

The circle and the line intersect at two points.

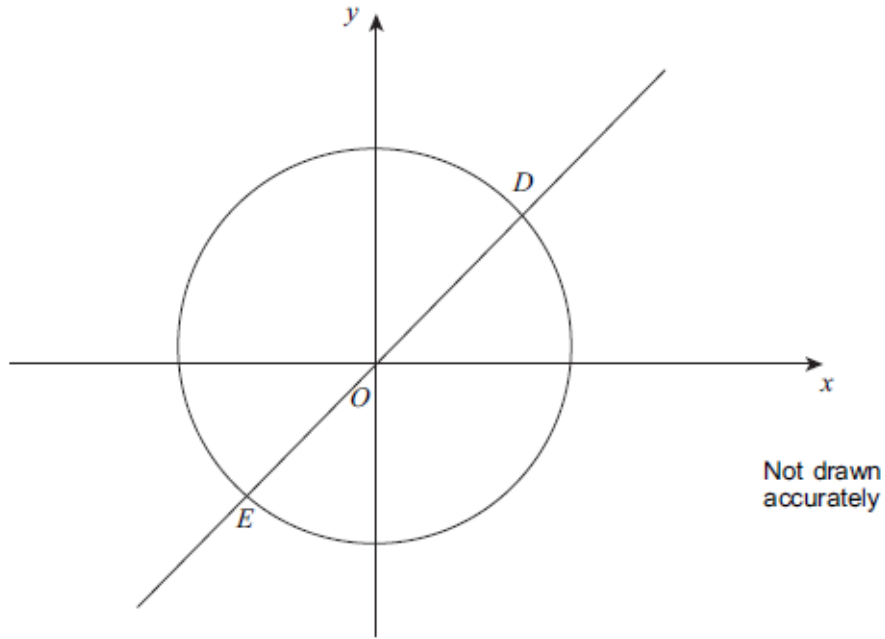
Work out the coordinates of the two points.

Do **not** use trial and improvement.

.....  
**(5 marks)**

### Question 18

The circle  $x^2 + y^2 = 20$  and the line  $y = 2x$  intersect at points D and E.



Work out the coordinates of D and E.  
Do **not** use trial and improvement.

.....  
**(5 marks)**

### Question 19

Solve the simultaneous equations

$$xy = 2 \quad \text{and} \quad y = 3x + 5$$

Do **not** use trial and improvement.

.....  
**(6 marks)**

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### Question 20

Solve the simultaneous equations  $y^2 = x + 3$  and  $y = 2x$

Do **not** use trial and improvement.

## Year 11 into 12 Task 4 - Straight Line Equations

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### Question 1

A straight line has equation  $y = 2x - 3$  The point  $P$  lies on the straight line.

The  $y$  coordinate of  $P$  is  $-4$ .

Find the  $x$  coordinate of  $P$ .

.....

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### Question 2

Determine the coordinate of the point where  $y = 2x + 6$  crosses the  $x$ -axis.

.....

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### Question 3

$P$  is the point  $(-4, 4)$

$Q$  is the point  $(1, -5)$

Find the gradient of  $PQ$ .

.....

**(2 marks)**

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### Question 4

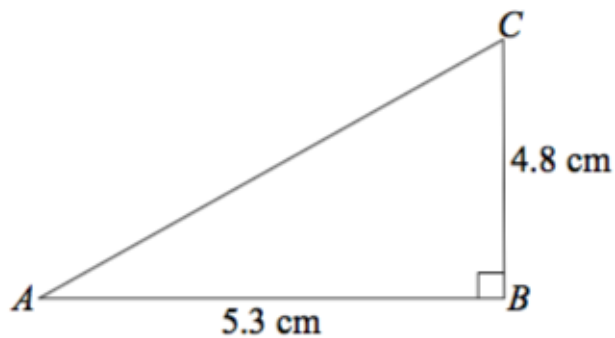


Diagram **NOT** accurately drawn

In triangle ABC, angle  $ABC = 90^\circ$ .

$AB = 5.3$  cm, correct to 2 significant figures.

$BC = 4.8$  cm, correct to 2 significant figures.

The base, AB, of the triangle is horizontal.

Calculate the lower bound for the gradient of the line AC.

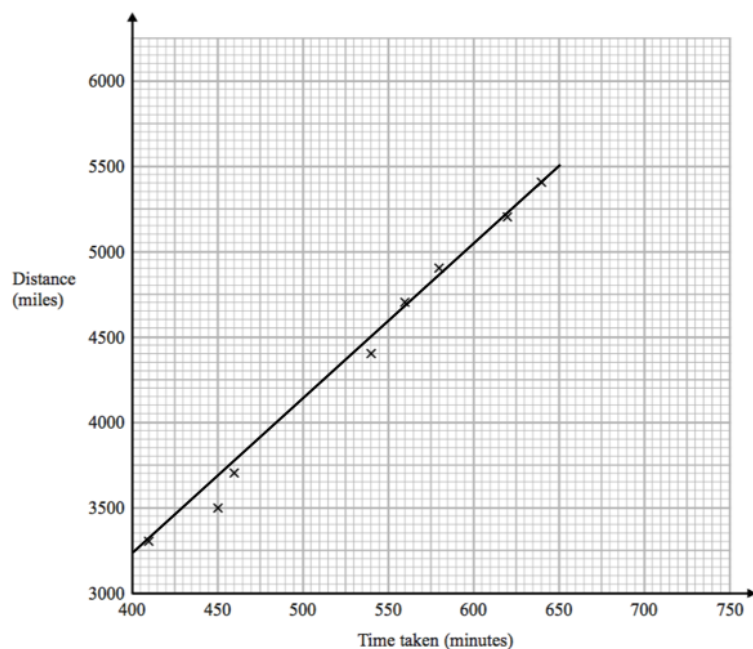
.....

### Question 5

Oliver records the distance from London to each of eight cities in the USA.

He also records the time taken to fly from London to each of these cities.

The scatter graph shows this information.



Calculate the gradient of the line of best fit.

.....

**(2 marks)**

### Question 6

The straight line **L** has equation  $3x - 2y = 15$

Find the gradient of **L**.

Gradient = .....

**(3 marks)**

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### Question 7

*A* is the point with coordinates  $(1,3)$  *B* is the point with coordinates  $(-2, -1)$

The line **L** has equation  $3y = 4 - 2x$

Is line **L** parallel to *AB*?

Yes

No

**(3 marks)**

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### Question 8

*A* is the point with coordinates  $(1,3)$ . *B* is the point with coordinates  $(4, -1)$ .

The straight line **L** goes through both *A* and *B*.

Is the line with equation  $2y = 3x - 4$  perpendicular to line *L*?

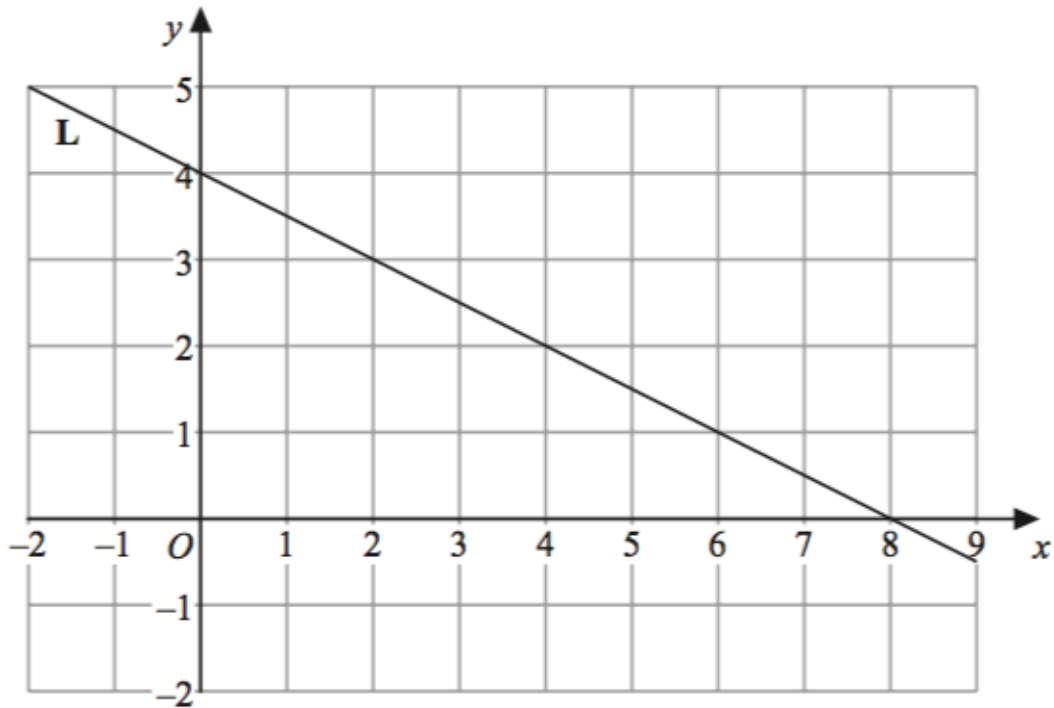
Yes

No

**(4 marks)**

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### Question 9



Find the equation of the line L.

.....

**(3 marks)**

### Question 10

The line L cuts the y-axis at (0, 5).

L also passes through the point (2, 1).

Find the equation of the line L.

.....

**(3 marks)**

### Question 11

$L_1$  and  $L_2$  are parallel lines.

The equation of  $L_1$  is  $y = 3x + 2$ .  $L_2$  passes through the point (3,4).

Find an equation for  $L_2$ .

.....  
(3 marks)

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### Question 12

The equation of a line  $L$  is  $2x - 3y = 6$

Find the equation of the line which is parallel to  $L$  and passes through the point (6, 9).

.....  
(2 marks)

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### Question 13

The straight line  $L$  passes through the points  $(-2,3)$  and  $(6,9)$ .

Find an equation of the line that is parallel to  $L$  and passes through the point  $(5, -1)$ . Give your answer in the form  $ax + by = c$  where  $a$ ,  $b$  and  $c$  are integers.

.....  
**(5 marks)**

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### Question 14

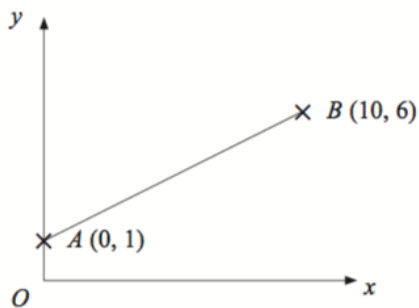


Diagram **NOT**  
accurately drawn

Find the equation of the line perpendicular to  $AB$  passing through  $B$ .

### Question 15

$ABCD$  is a square.

$P$  and  $D$  are points on the  $y$ -axis.

$A$  is a point on the  $x$ -axis.

$PAB$  is a straight line.

The equation of the line that passes through the points  $A$  and  $D$  is  $y = -2x + 6$ .

Find the length of  $PD$ .

$PD = \dots\dots\dots$

**(4 marks)**

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### Question 16

$P$  has coordinates  $(-9,7)$   $Q$  has coordinates  $(11,12)$

$M$  is the point on the line segment  $PQ$  such that  $PM:MQ = 2:3$

Line  $L$  is perpendicular to the line segment  $PQ$ .  $L$  passes through  $M$ .

Find an equation of  $L$ .

$\dots\dots\dots$

**(5 marks)**

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### Question 17

The points  $A$ ,  $B$  and  $C$  lie in order on a straight line.

The coordinates of  $A$  are  $(2,5)$ The coordinates of  $B$  are  $(4,p)$ The coordinates of  $C$  are  $(q, 17)$

Given that  $AC = 4AB$ , find the values of  $p$  and  $q$ .

.....  
**(3 marks)**

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### Question 18

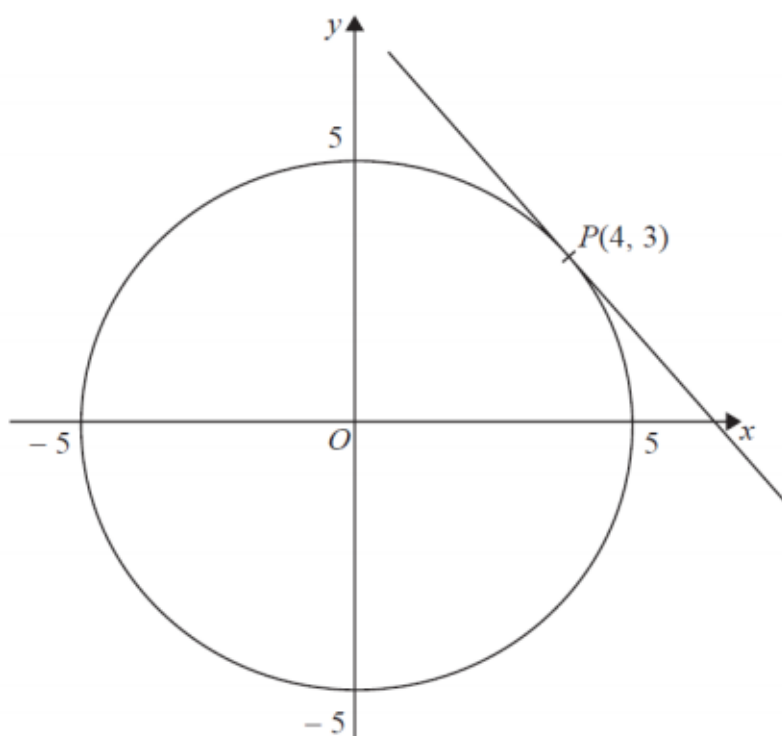
Find the coordinates of the point of intersection of the line with equation  $3x + 4y = 10$  and the line with equation  $5x - 6y = 23$

.....  
**(5 marks)**

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### Question 19

Here is a circle, centre  $O$ , and the tangent to the circle at the point  $P(4,3)$  on the circle.



Find an equation of the tangent at the point  $P$ .

.....

## Question 20

The line  $l$  is a tangent to the circle  $x^2 + y^2 = 40$  at the point  $A$ .  $A$  is the point  $(2,6)$ .

The line  $l$  crosses the  $x$ -axis at the point  $P$ .

Work out the area of triangle  $OAP$ .

.....  $units^2$

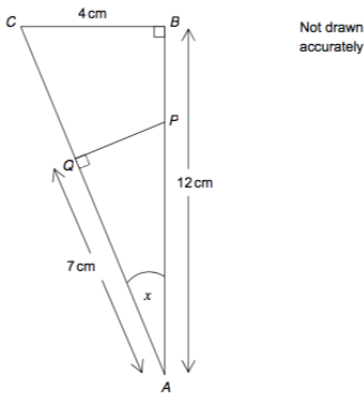
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# Year 11 into 12 Task 5 - Trigonometry

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## Question 1

The diagram shows two right-angled triangles ABC and APQ.



Using triangle ABC, write down the value of  $\tan x$ .

$$\tan x = \dots\dots\dots$$

**(1 mark)**

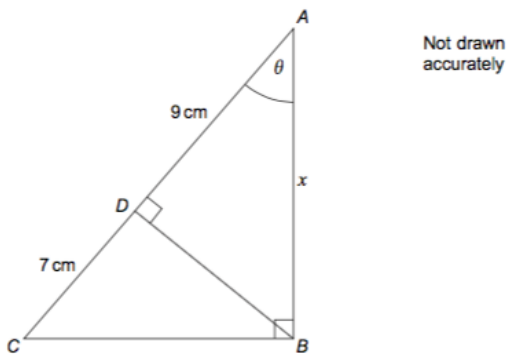
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## Question 2

ABC is a right-angled triangle.

D is a point on AC.

BD is perpendicular to AC.



It can be shown that  $\cos \theta = \frac{x}{16}$

By writing another expression for  $\cos \theta$  in terms of  $x$ , or otherwise, work out the value of  $x$ .

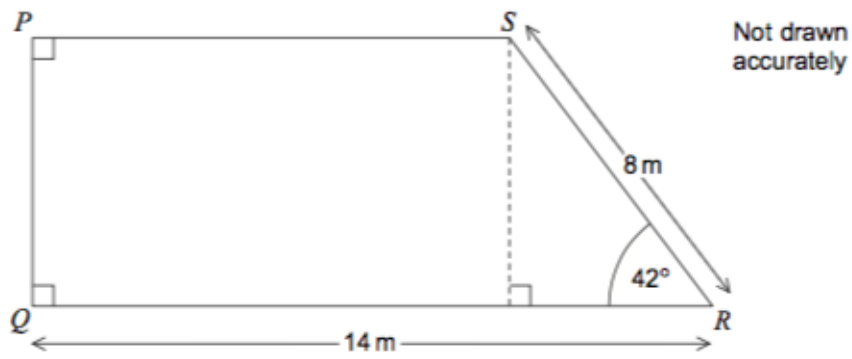
$$x = \dots\dots\dots \text{ cm}$$

**(2 marks)**

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### Question 3

PQRS is a trapezium.



Work out the perimeter of PQRS.

*Input note: give your answer correct to 1 decimal place.*

..... m

**(5 marks)**

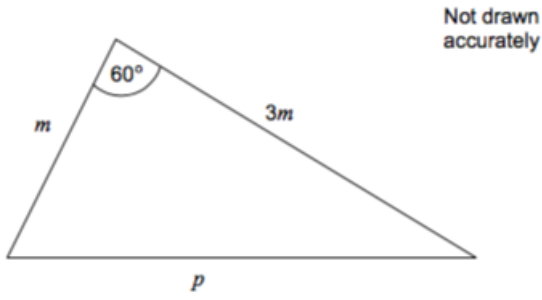
### Question 4

A triangle has sides 10.2 cm, 6.8 cm and 5.7 cm.

Work out the area of the triangle.

.....  $cm^2$

### Question 5



Use the cosine rule to express  $p$  in terms of  $m$ .

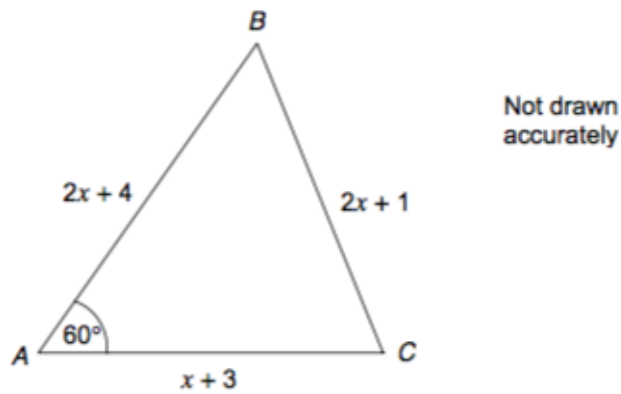
$p = \dots\dots\dots$

**(3 marks)**

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### Question 6

In triangle ABC, angle BAC =  $60^\circ$



Use the cosine rule to find the exact value of  $x$

.....

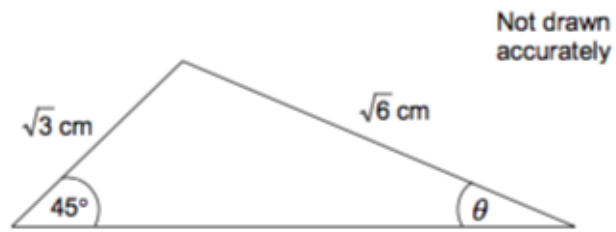
**(6 marks)**

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### Question 7

Here is a triangle.



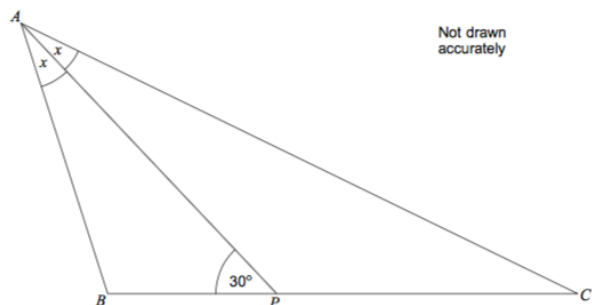
Work out the value of  $\theta$ .

$$\theta = \text{.....}^\circ$$

**(5 marks)**

### Question 8

In triangle ABC, AP bisects angle BAC.



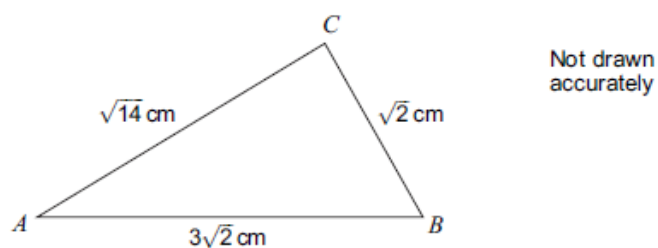
Use the sine rule in triangles ABP and ACP to prove that  $\frac{AB}{AC} = \frac{BP}{x}$  where  $x$  is a line segment.

= .....

**(5 marks)**

### Question 9

Here is triangle ABC.



It can be shown that angle  $B = 60^\circ$ .

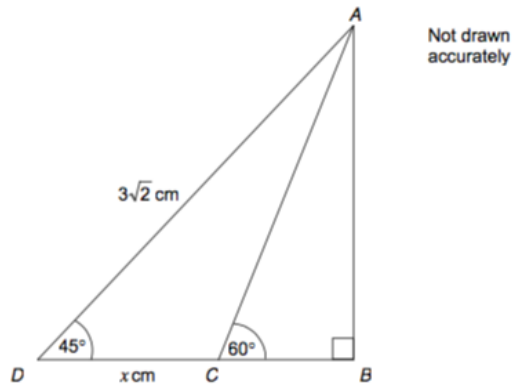
Hence work out the area of triangle ABC.

..... cm<sup>2</sup>

**(3 marks)**

### Question 10

In the diagram, DCB is a straight line.

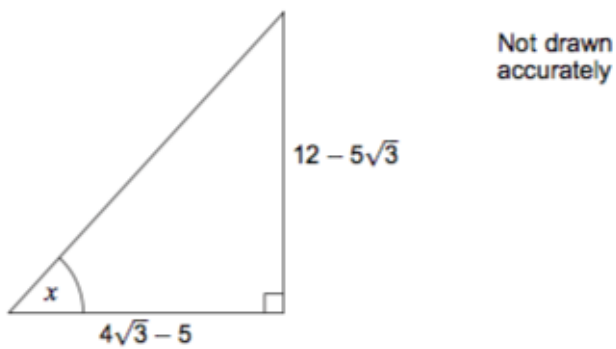


Work out the length of DC, marked  $x$  on the diagram.

Write your answer in the form  $a - \sqrt{b}$

$DC = \dots\dots\dots$

### Question 11

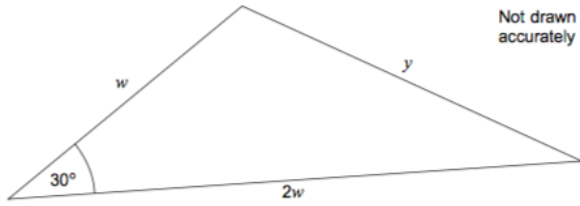


$x = \dots\dots\dots^\circ$

**(4 marks)**

### Question 12

The area of this triangle is  $18 \text{ cm}^2$ .



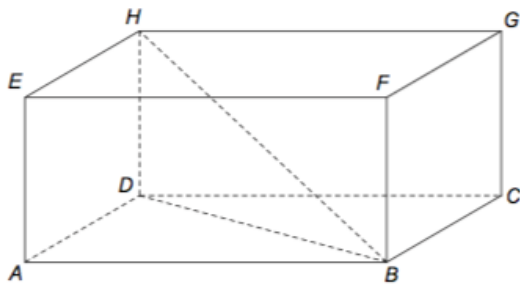
Work out  $y$ .

$y = \dots\dots\dots$

**(5 marks)**

### Question 13

ABCDEFGH is a cuboid.



$HB = 34 \text{ cm}$

$HD = 16 \text{ cm}$

$AD = 18 \text{ cm}$

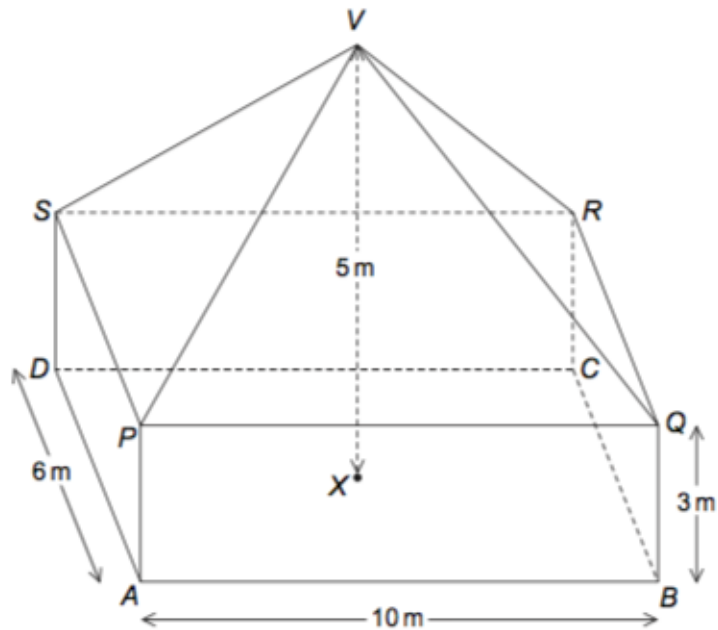
Work out the angle between  $HB$  and  $ABCD$ .

$\dots\dots\dots^\circ$

**(2 marks)**

### Question 14

The diagram shows a cuboid  $ABCDPQRS$  and a pyramid  $PQRSV$ .  
 $V$  is directly above the centre,  $X$ , of  $ABCD$ .



The total height,  $VX$ , is 5 metres.

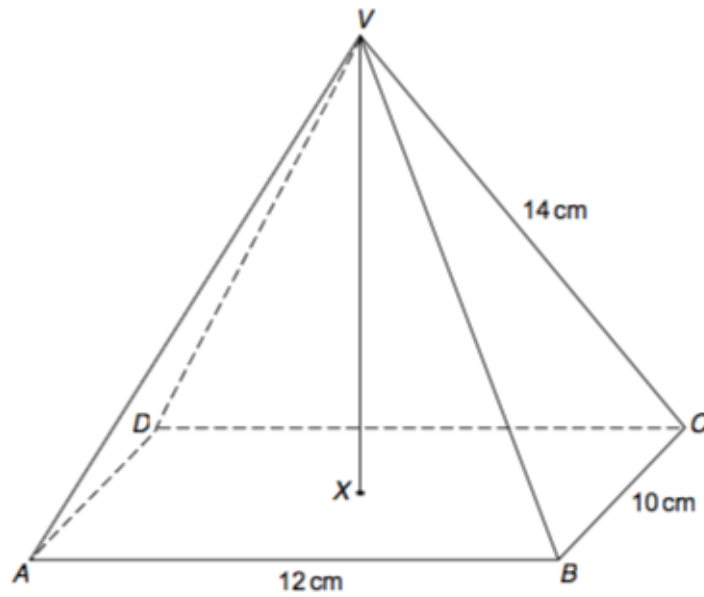
Work out the angle between the line  $VA$  and the plane  $ABCD$ .

.....  
**(4 marks)**

### Question 15

VABCD is a rectangular based pyramid.  
AB = 12 cm, BC = 10 cm and VC = 14 cm

The base ABCD is horizontal and the vertex V is directly above X, the centre of the base.



It can be shown that the height of the pyramid, VX, is equal to 11.6 cm.

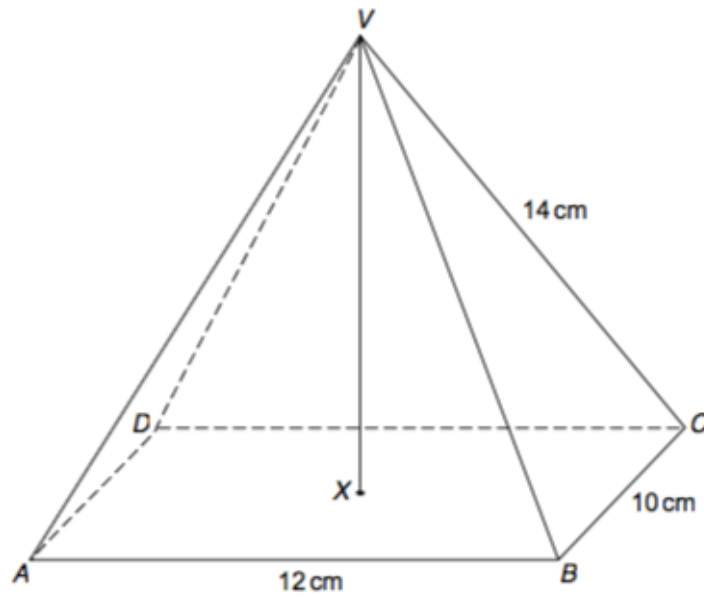
Calculate the angle between VC and the plane ABCD.

.....<sup>o</sup>

### Question 16

VABCD is a rectangular based pyramid.  
AB = 12 cm, BC = 10 cm and VC = 14 cm

The base ABCD is horizontal and the vertex V is directly above X, the centre of the base.



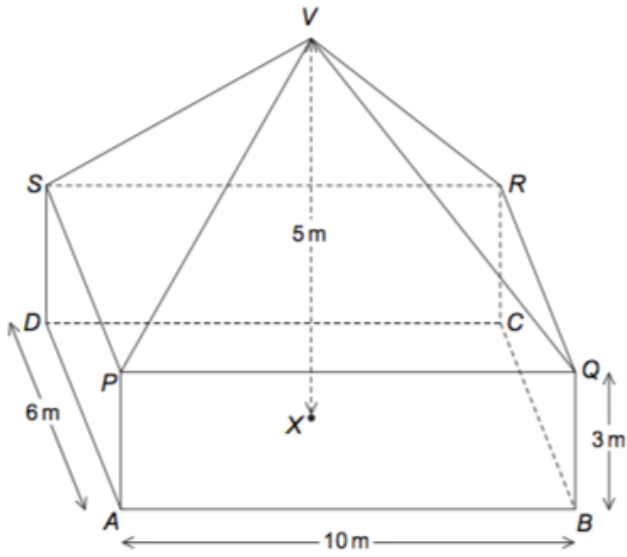
It can be shown that the height of the pyramid, VX, is equal to 11.6 cm.

Calculate the angle between the planes VBC and ABCD.

.....<sup>o</sup>

### Question 17

The diagram shows a cuboid ABCDPQRS and a pyramid PQRSV. V is directly above the centre, X, of ABCD.



The total height, VX, is 5 metres.

Work out the angle between the planes VQR and PQRS.

.....°  
**(2 marks)**



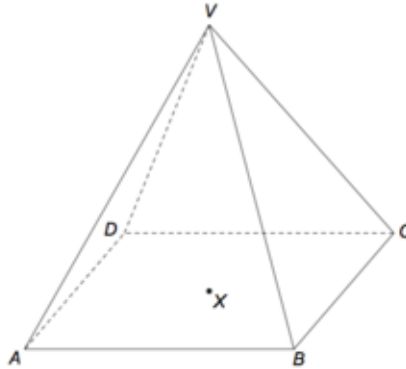
### Question 18

Pyramid VABCD has a horizontal rectangular base.

X is the centre of the base.

V is vertically above X.

$$VB = VC = 17 \text{ cm} \quad AB = 22 \text{ cm} \quad BC = 16 \text{ cm}$$



Work out the angle between the planes VBC and ABCD.

.....<sup>o</sup>  
**(4 marks)**

### Question 19

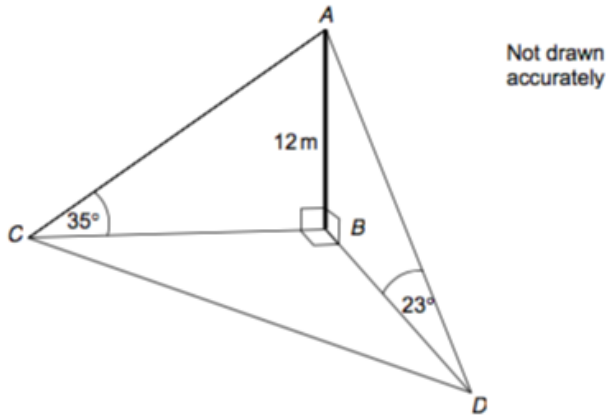
The diagram shows a vertical mast, AB, 12 metres high.  
Points B, C and D are on a horizontal plane.

Point C is due West of B.

The angle of elevation of A from C is  $35^\circ$ .

Point D is due South of B.

The angle of elevation of A from D is  $23^\circ$ .



Calculate the bearing of D from C.

Give your answer to the nearest degree.

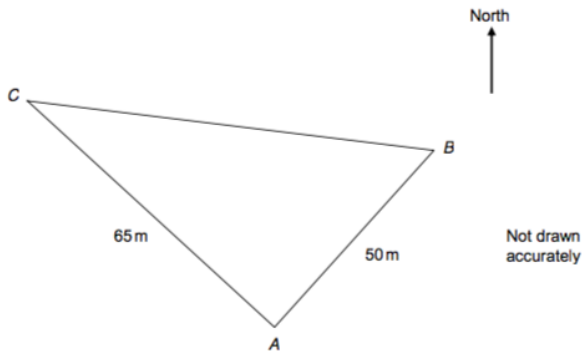
.....°

**(3 marks)**

## Question 20

B is 50 metres from A on a bearing of  $040^\circ$ .

C is 65 metres from A on a bearing of  $325^\circ$ .



Angle CAB is equal to  $75^\circ$

Work out the distance BC.

..... m

**(3 marks)**