

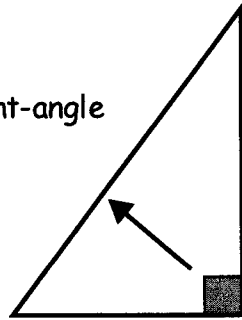
Pythagoras and Trigonometry

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PYTHAGORAS made simple

- 1) Is the triangle right-angled? If the answer is no, you cannot use Pythagoras.
- 2) Identify the "longest side". This is opposite the right angle

The longest side, opposite the right-angle



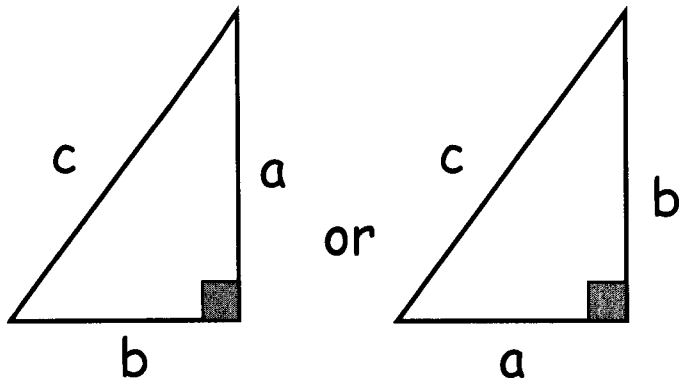
3) The rule

the longest side squared is equal to the sum of the squares of the other two sides

This is often written as $c^2 = a^2 + b^2$

c is the longest side.

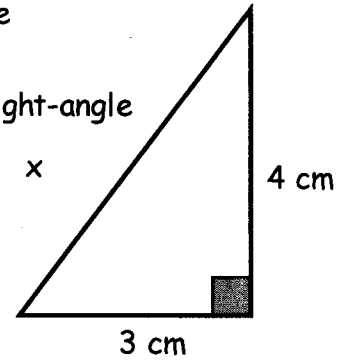
a and b are the two shorter sides. Their order does not matter



Always check your answer is sensible

4) Finding the longest side

The longest side, opposite the right-angle



From the rule $c^2 = a^2 + b^2$

$$x^2 = 3^2 + 4^2$$

$$x^2 = 9 + 16$$

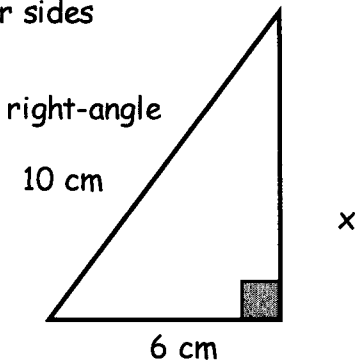
$$x^2 = 25$$

$$x = \sqrt{25} = 5 \text{ cm}$$

Check your answer is bigger than both of the shorter sides

5) Finding one of the shorter sides

The longest side, opposite the right-angle



From the rule $c^2 = a^2 + b^2$

$$10^2 = 6^2 + x^2$$

$$100 = 36 + x^2$$

$$x^2 = 100 - 36 = 64$$

$$x = \sqrt{64} = 8 \text{ cm}$$

Check your answer is smaller than longest side

Find the side x using Pythagoras. Give answers to 1 d.p.

1

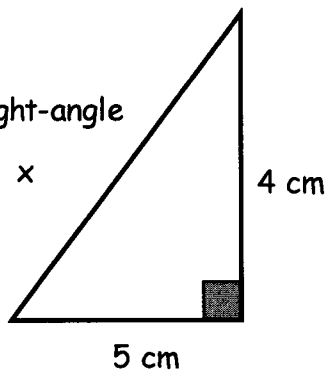
The longest side, opposite the right-angle

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

$$x^2 = 16 + 25$$

$$x^2 = 41$$

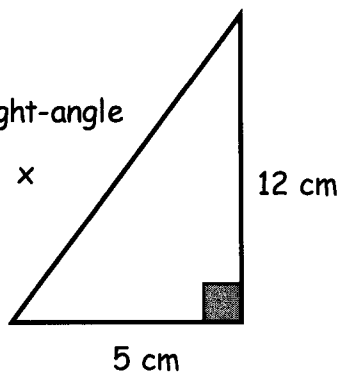
$$x = \sqrt{41} = 6.4 \text{ cm}$$



2

The longest side, opposite the right-angle

$$x = 13 \text{ cm}$$



3

The longest side, opposite the right-angle

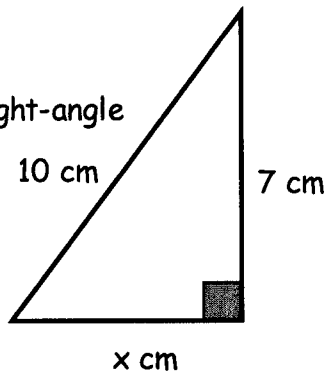
$$10^2 = x^2 + 7^2$$

$$100 = x^2 + 49$$

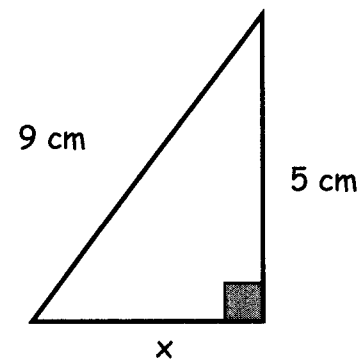
$$x^2 = 100 - 49$$

$$x^2 = 51$$

$$x = \sqrt{51} = 7.1 \text{ cm}$$

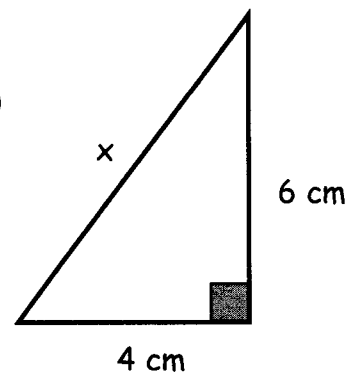


4



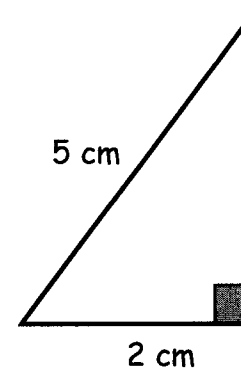
$$x = 7.5 \text{ cm}$$

5



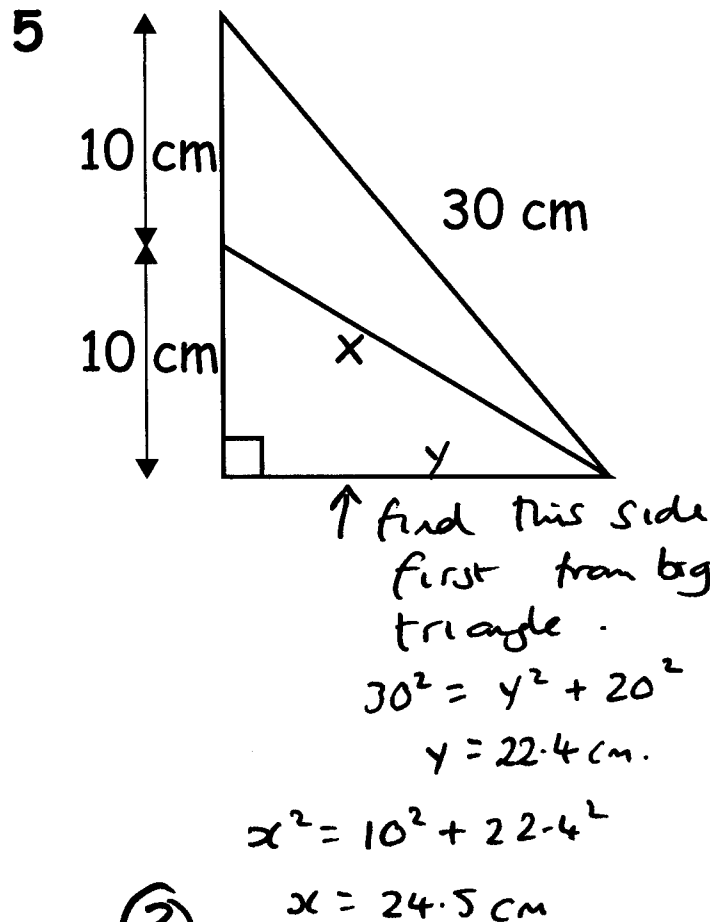
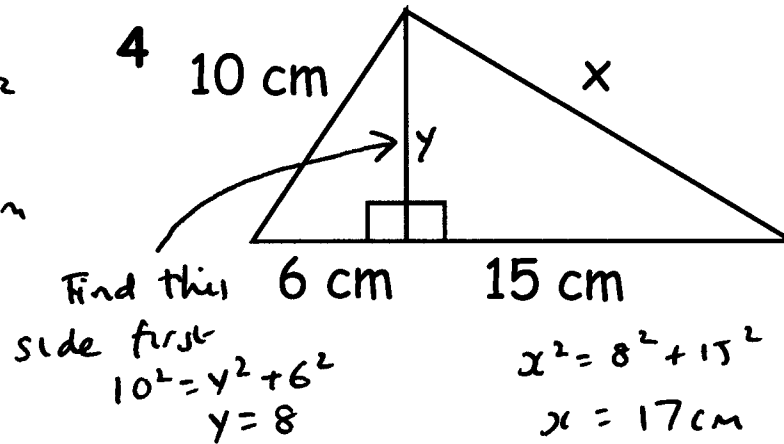
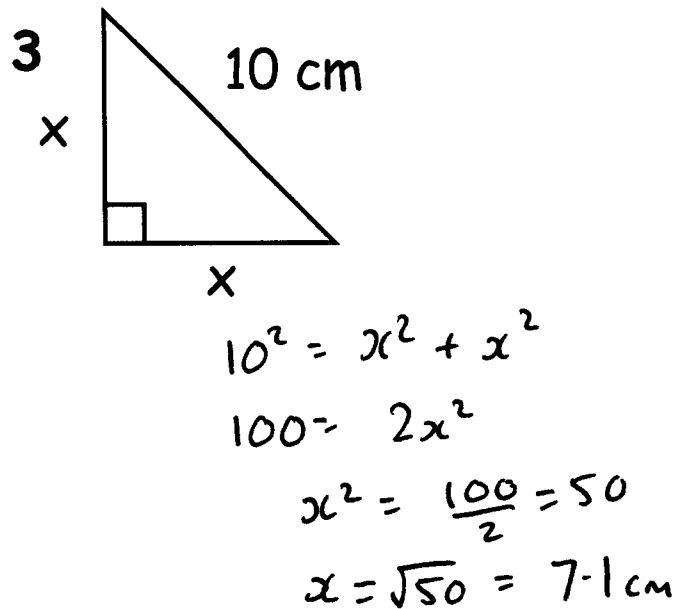
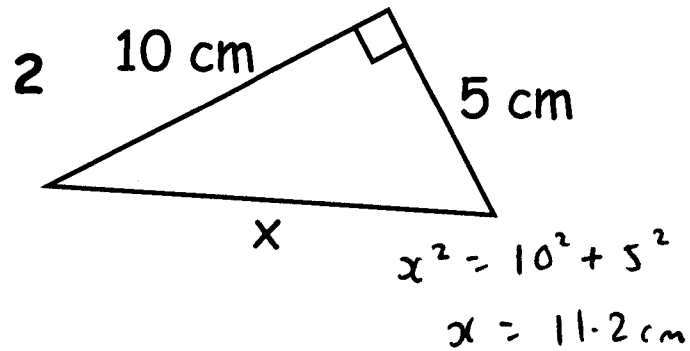
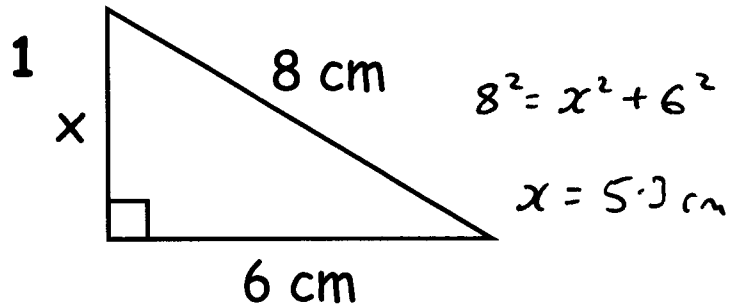
$$x = 7.2 \text{ cm}$$

6

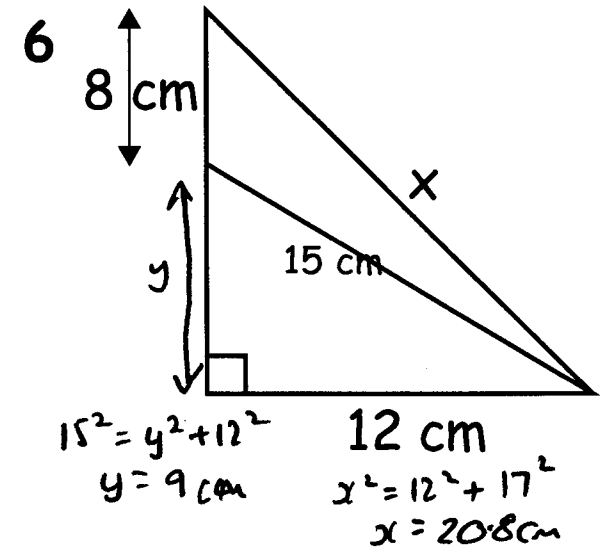


$$x = 4.6 \text{ cm}$$

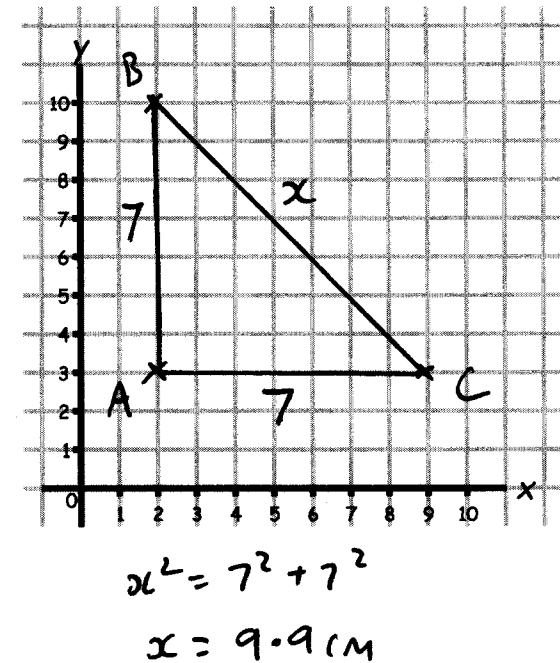
Pythagoras. Find the missing length 'x' for each question. Show your working out



③

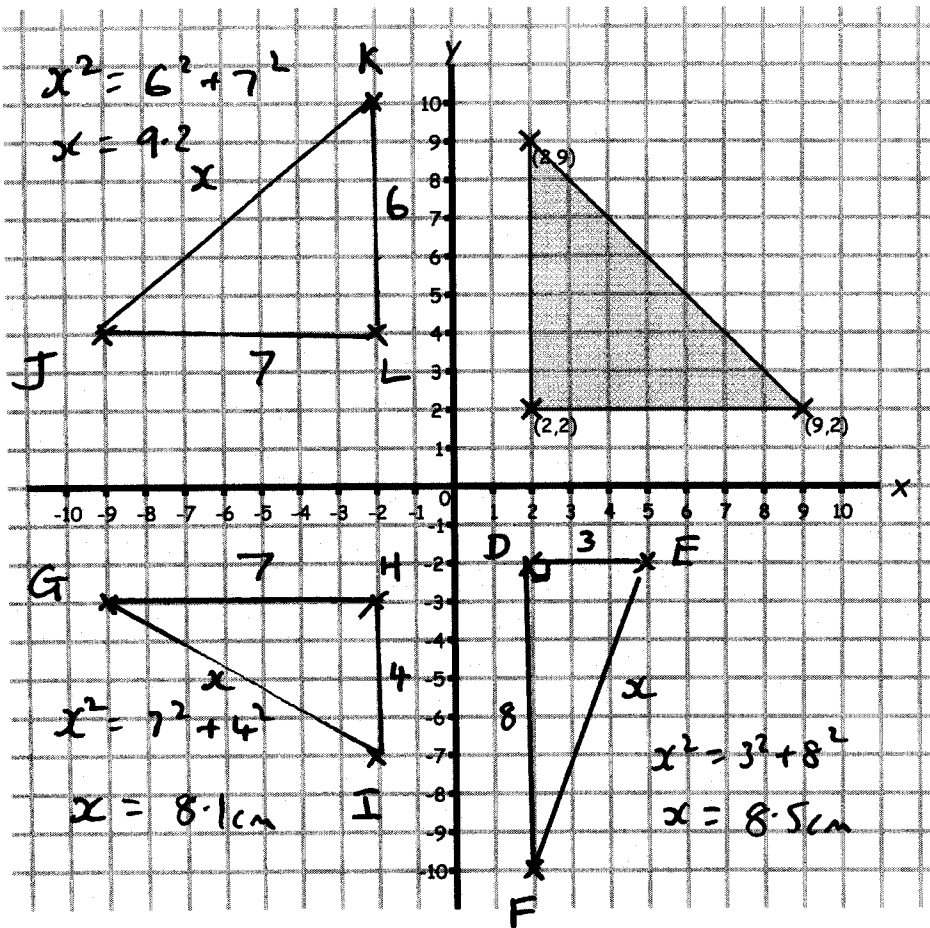


7) Plot A (2,3), B (2,10), C (9,3). length BC.



Pythagoras Questions using Coordinates

Plot the following triangles and then calculate the length of the longest side. Answers to 1 decimal place.



1) A (2,9), B(9,2) and C(2,2). Join the points to make a triangle. Find the length of AB.

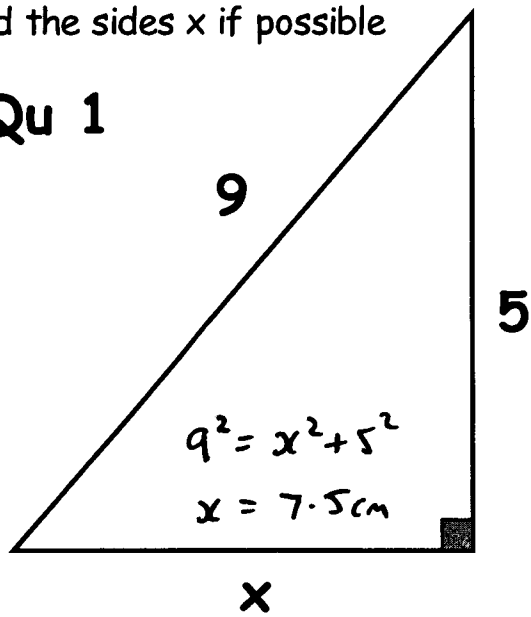
2) D (2,-2), E(5,-2) and F(2,-10). Join the points to make a triangle. Find the length of EF. 8.5 cm

3) G (-9,-3), H(-2,-3) and I(-2,-7). Join the points to make a triangle. Find the length of GI. 8.1 cm

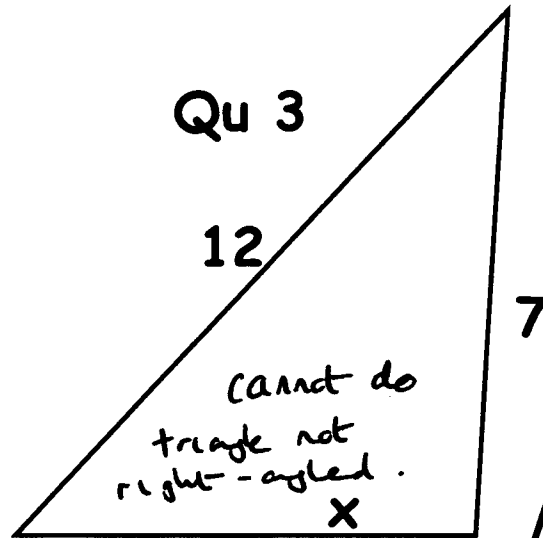
4) J (-9,4), K(-2,10) and L(-2,4). Join the points to make a triangle. Find the length of JK. 9.2 cm

Find the sides x if possible

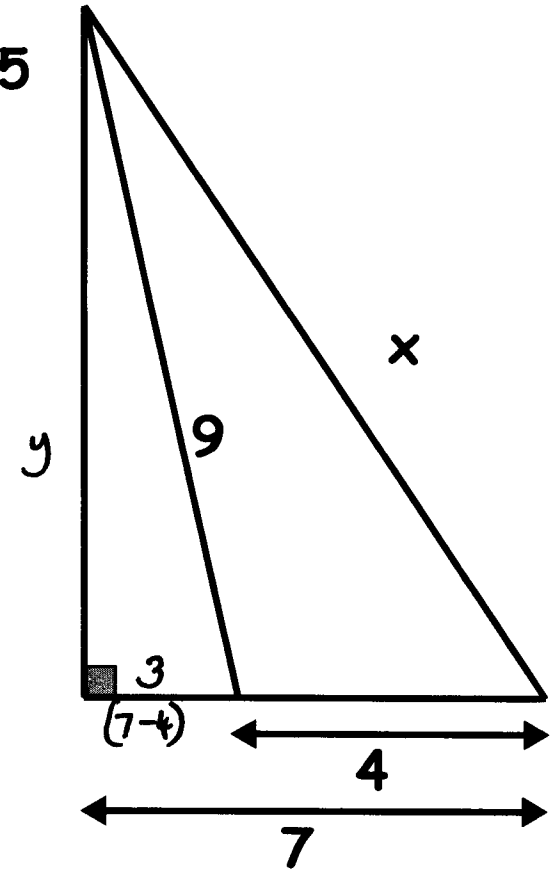
Qu 1



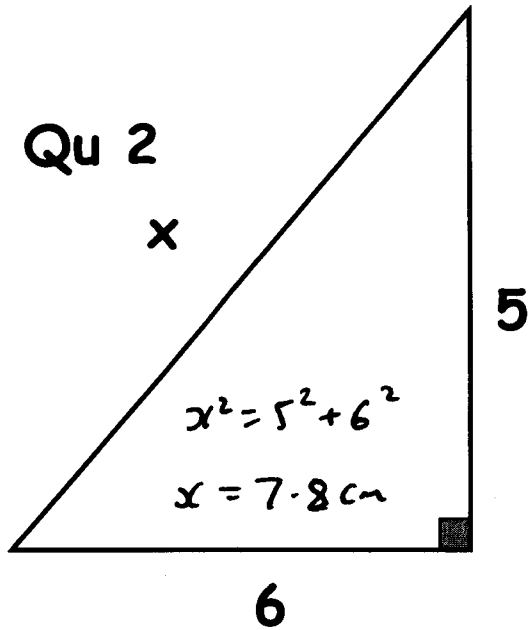
Qu 3



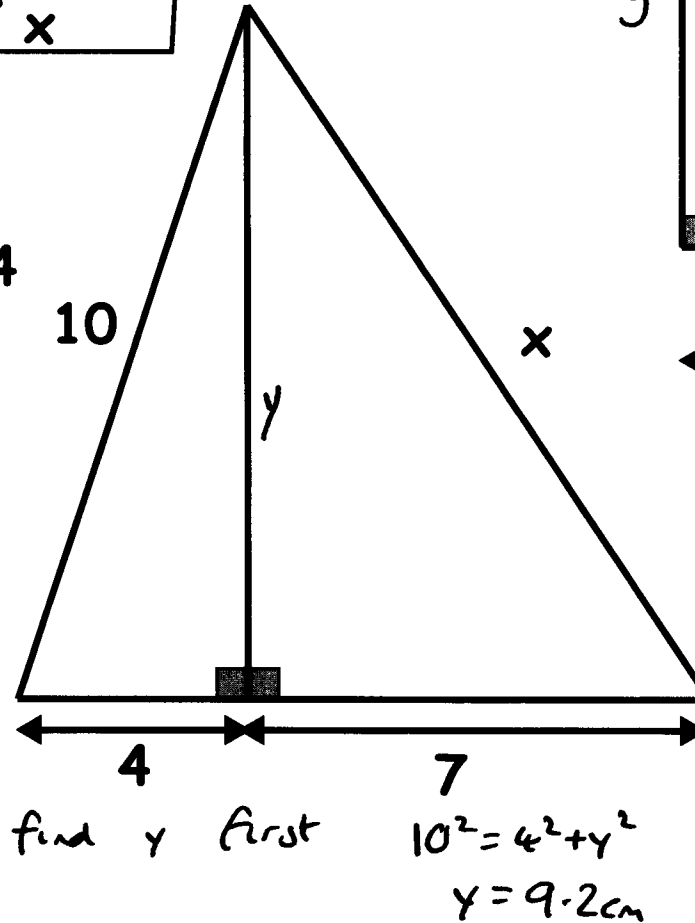
Qu 5



Qu 2



Qu 4



$9^2 = y^2 + 3^2$
 $y = 8.5 \text{ cm}$
 $x^2 = 8.5^2 + 7^2$
 $x = 11 \text{ cm}$

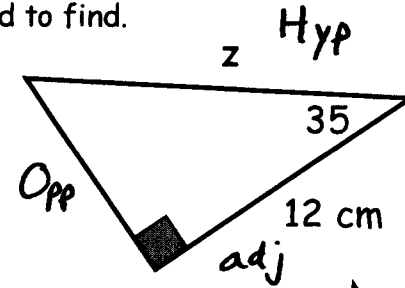
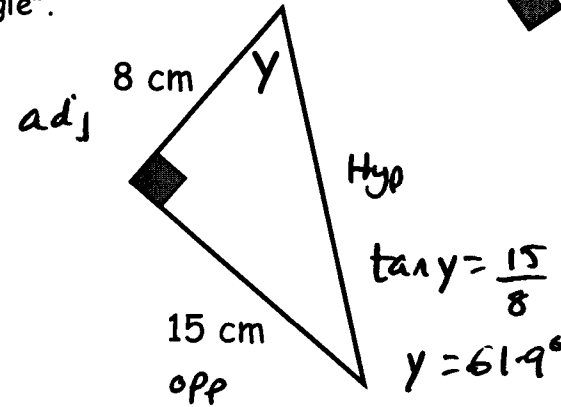
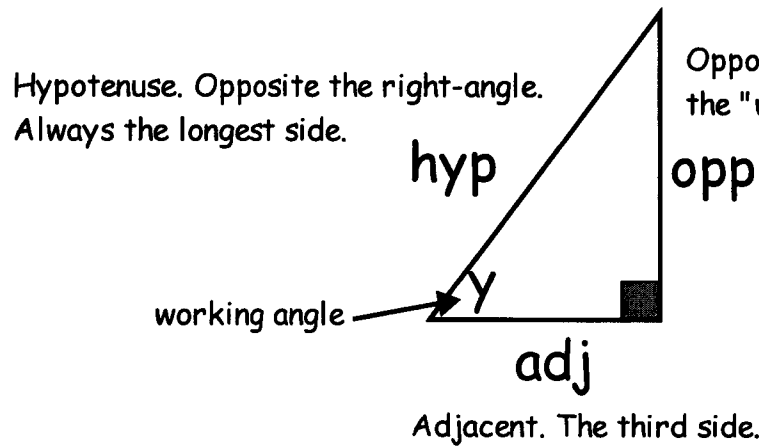
$x^2 = 9.2^2 + 7^2$
 $x = 11.5 \text{ cm}$

5

Trigonometry made simple

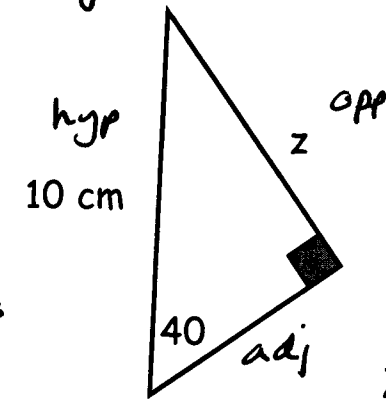
Always check your answer is sensible

- 1) Is the triangle right-angled? If the answer is no you cannot use Trigonometry.
- 2) Identify the "working angle". This may be an angle you are given, or one that you are asked to find.
- 3) Label the sides in order hyp, opp, adj.



$$\cos 35 = \frac{12}{z}$$

$$z = \frac{12}{\cos 35} = 14.6 \text{ cm}$$

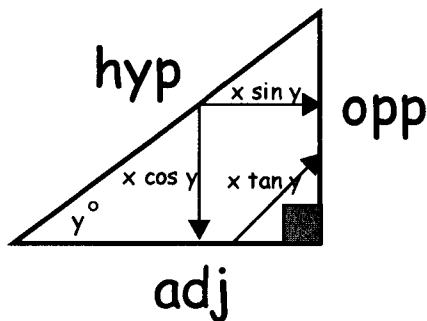


$$\sin 40 = \frac{z}{10}$$

$$z = 10 \times \sin 40$$

$$z = 6.4 \text{ cm}$$

- 4) Choose the correct ratio you need to solve the problem.

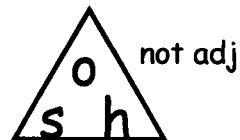


sin

$$\text{opp} = \text{hyp} \times \sin y$$

$$\text{hyp} = \text{opp} \div \sin y$$

$$\sin y = \text{opp} \div \text{hyp}$$



cos

$$\text{adj} = \text{hyp} \times \cos y$$

$$\text{hyp} = \text{adj} \div \cos y$$

$$\cos y = \text{adj} \div \text{hyp}$$

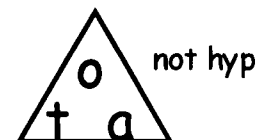


tan

$$\text{opp} = \text{adj} \times \tan y$$

$$\text{adj} = \text{opp} \div \tan y$$

$$\tan y = \text{opp} \div \text{adj}$$



Note : if you are calculating an angle, remember to press SHIFT, before SIN, COS or TAN.

Trigonometry - Finding a missing angle

1) Is the triangle right-angled?

3) Draw and label the arrow you need

Hyp to Opp is SIN

Hyp to Adj is COS

Adj to Opp is TAN

5) Press SHIFT COS = TAN

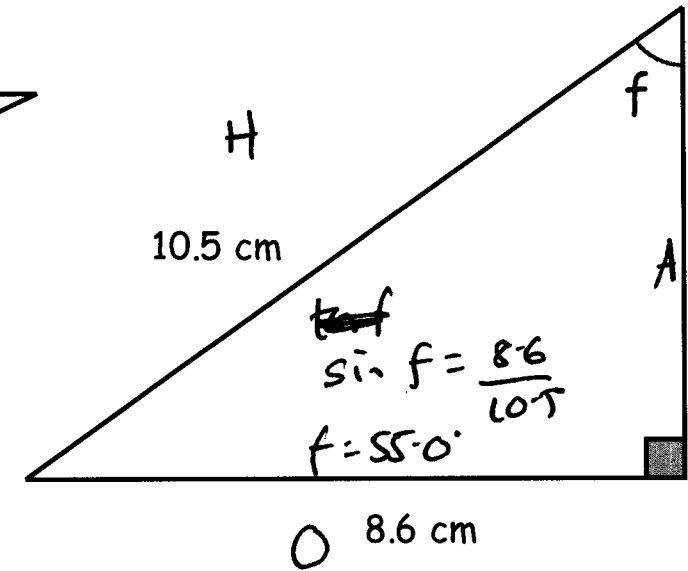
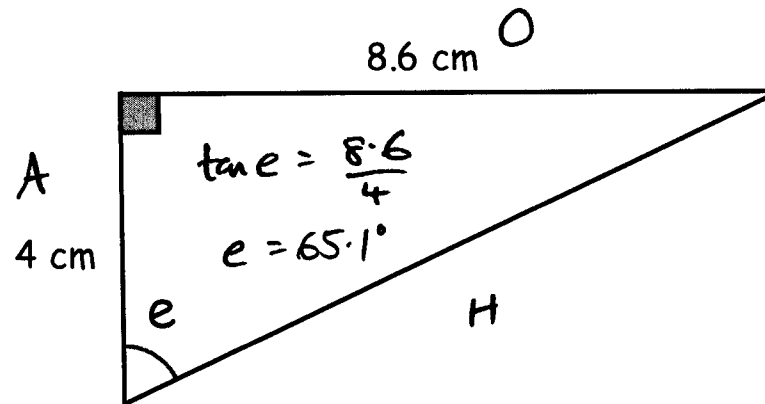
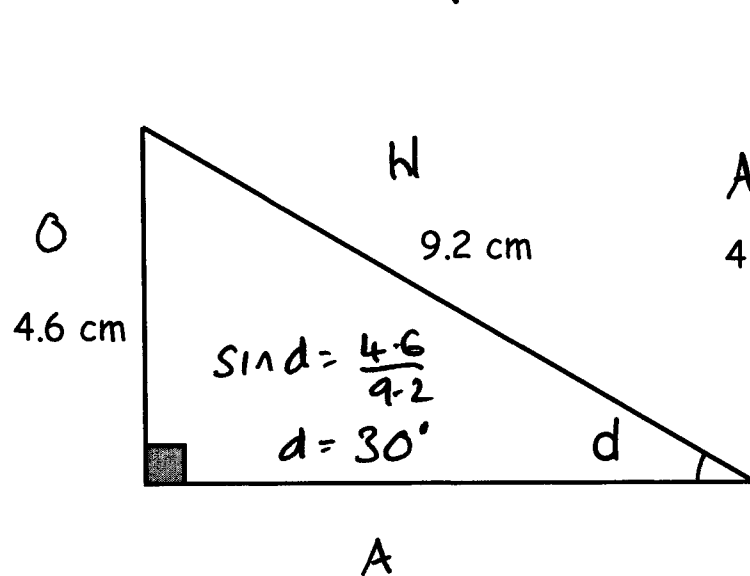
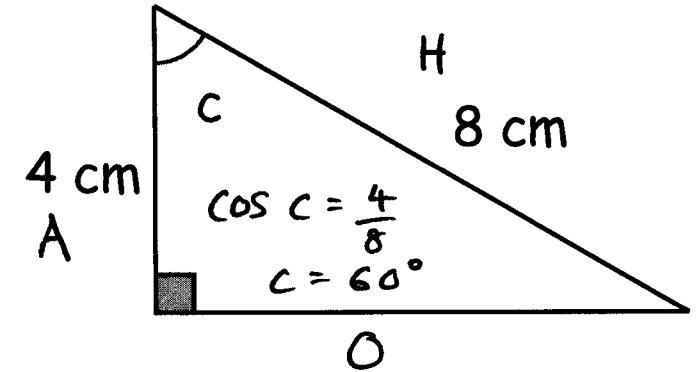
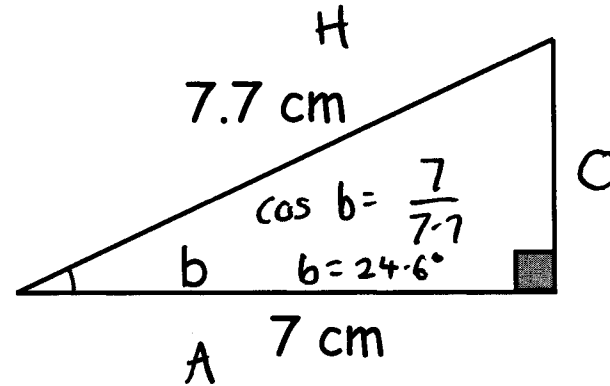
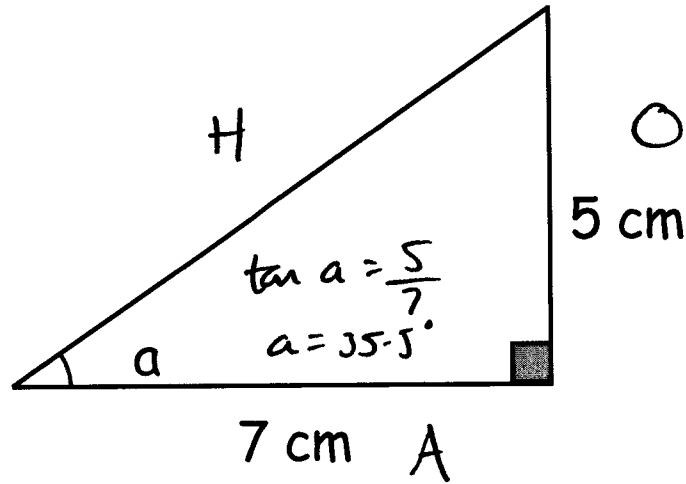
2) Label the sides.

4) Calculate the multiplier. For SIN it is Opp ÷ Hyp

For COS it is Adj ÷ Hyp

For TAN it is Opp ÷ Adj

To get the angle. Round to 1 d.p.

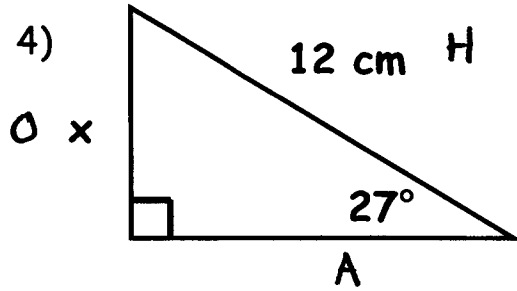


1) Work out the value of $\sin 30^\circ$ 0.5

2) Work out the value of $\cos 30^\circ$, answer to 3 d.p. 0.866

3) $\tan(x) = 0.839$. What is th of angle x ? 40°

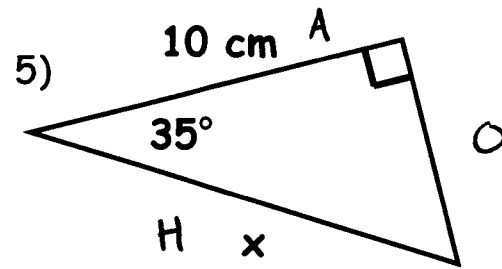
Find the value of 'x' in each of these triangles. To 1 d.p.



$$\sin 27 = \frac{x}{12}$$

$$x = 12 \times \sin 27$$

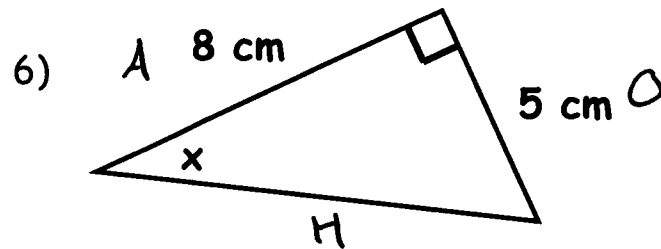
$$x = 5.4$$



$$\cos 35 = \frac{10}{x}$$

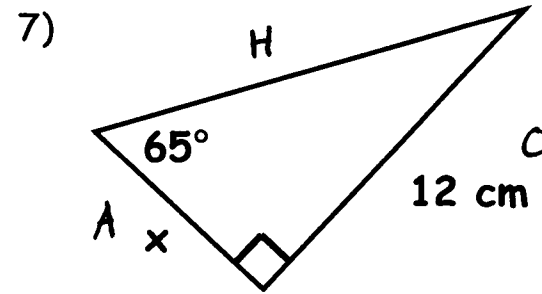
$$x = \frac{10}{\cos 35}$$

$$x = 12.2\text{ cm}$$



$$\tan x = \frac{5}{8}$$

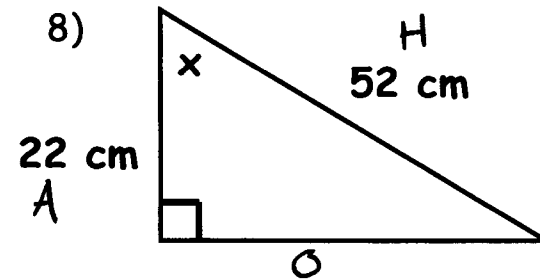
$$x = 32.0^\circ$$



$$\tan 65 = \frac{12}{x}$$

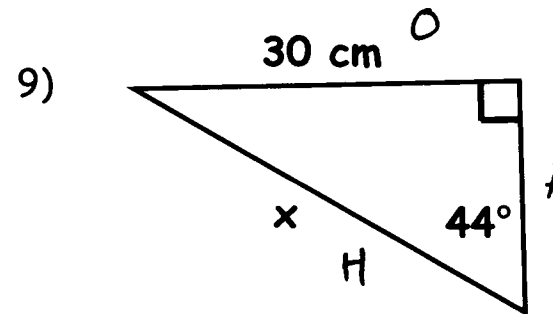
$$x = \frac{12}{\tan 65}$$

$$x = 5.6\text{ cm}$$



$$\cos x = \frac{22}{52}$$

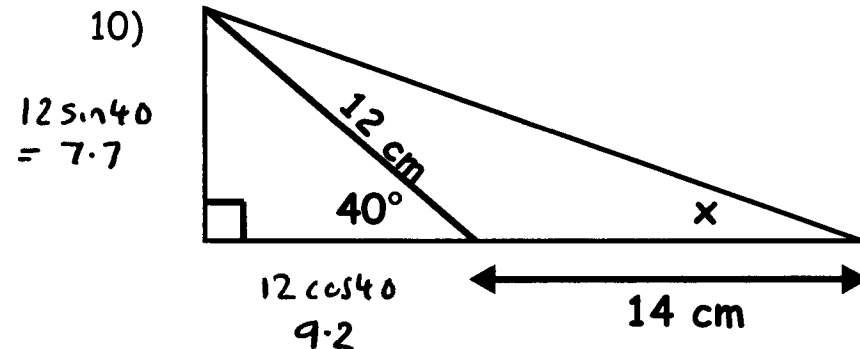
$$x = 65.0^\circ$$



$$\sin 44 = \frac{30}{x}$$

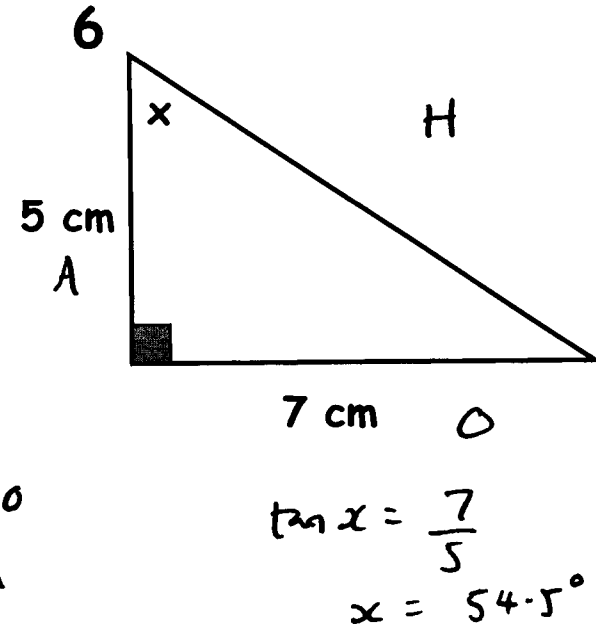
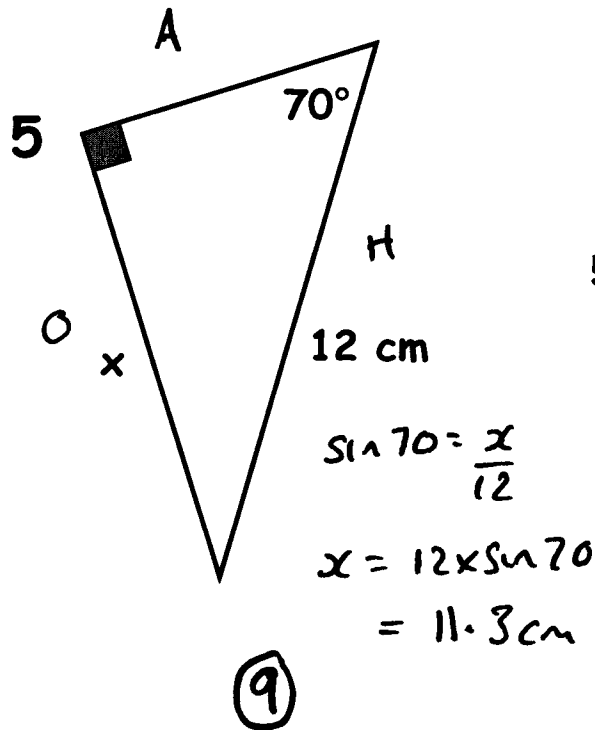
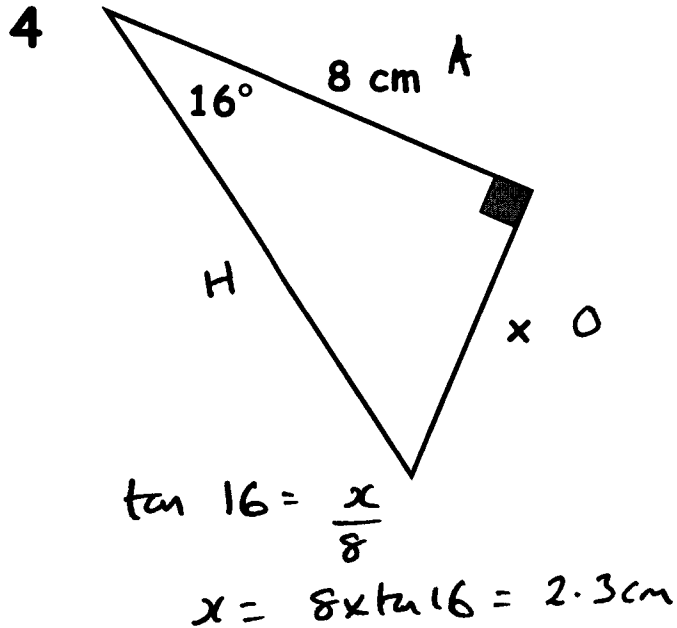
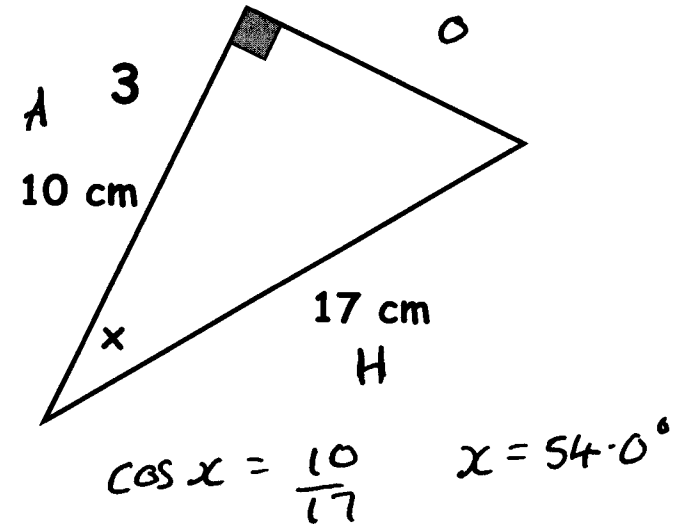
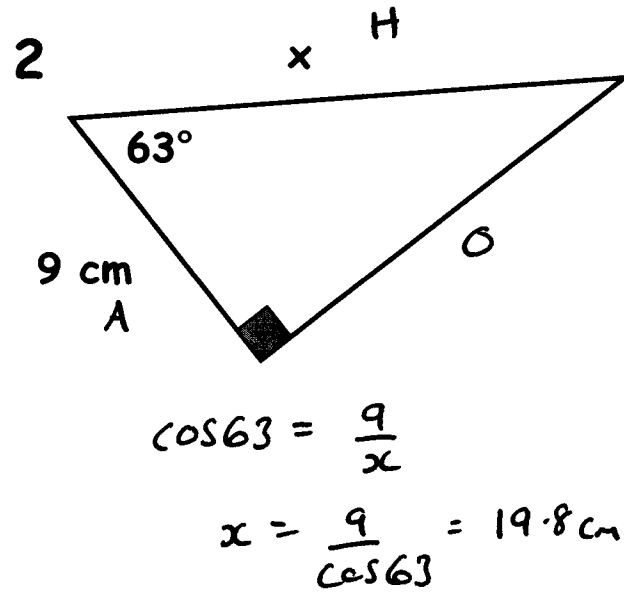
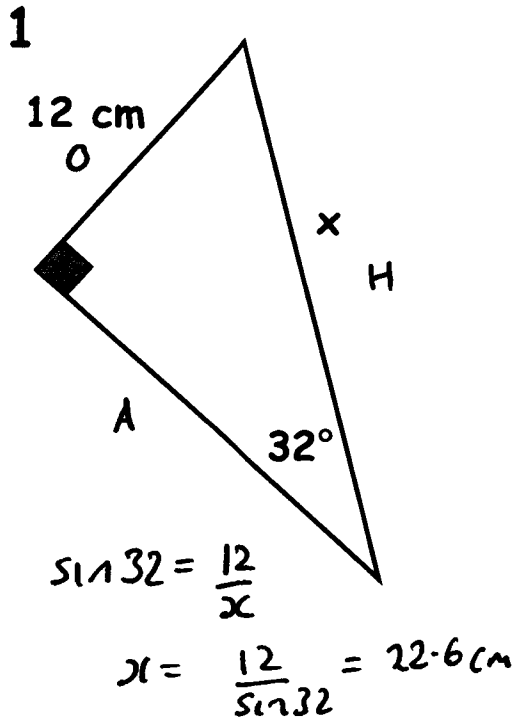
$$x = \frac{30}{\sin 44}$$

$$x = 43.2\text{ cm}$$

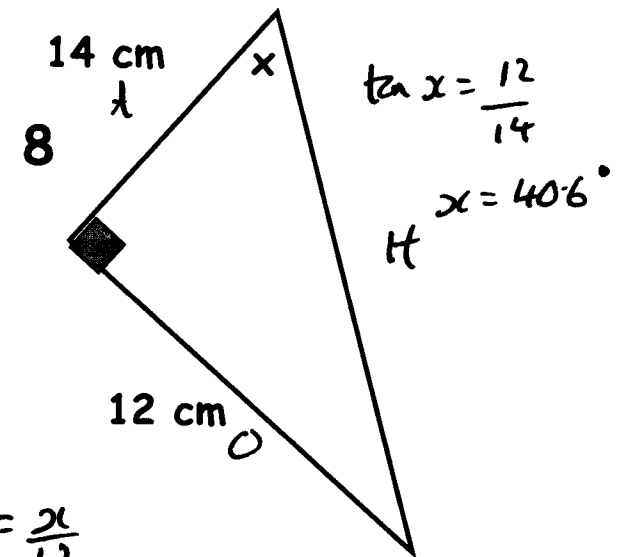
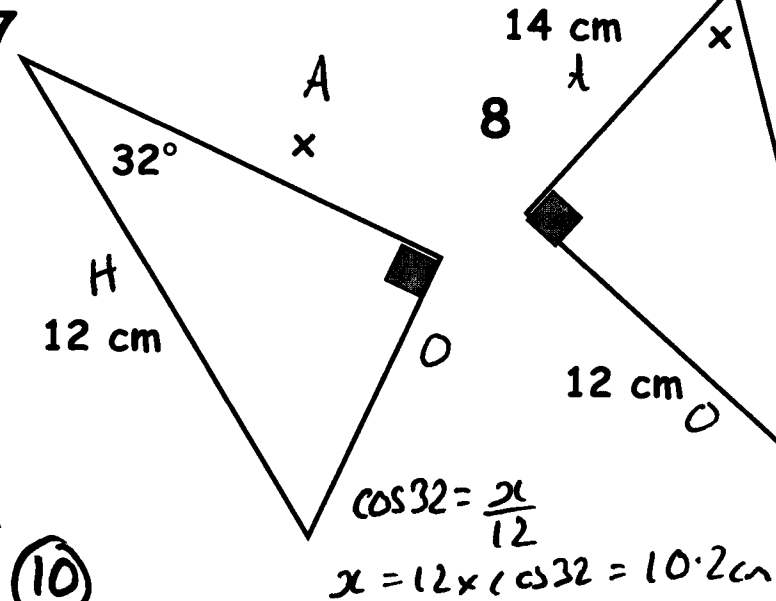
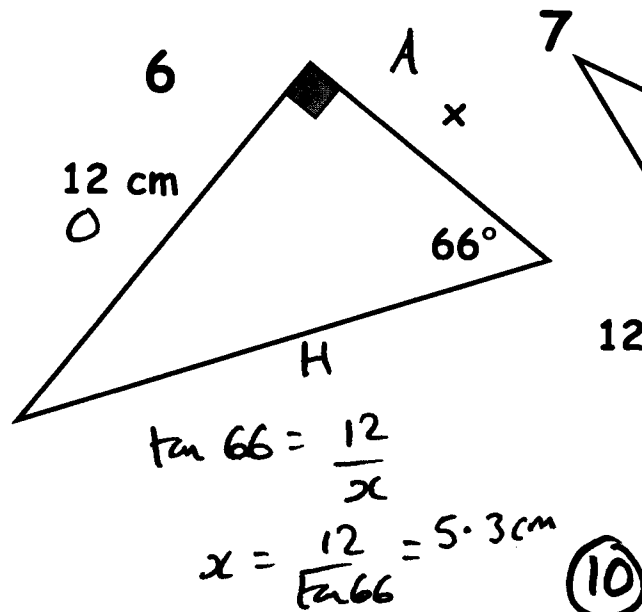
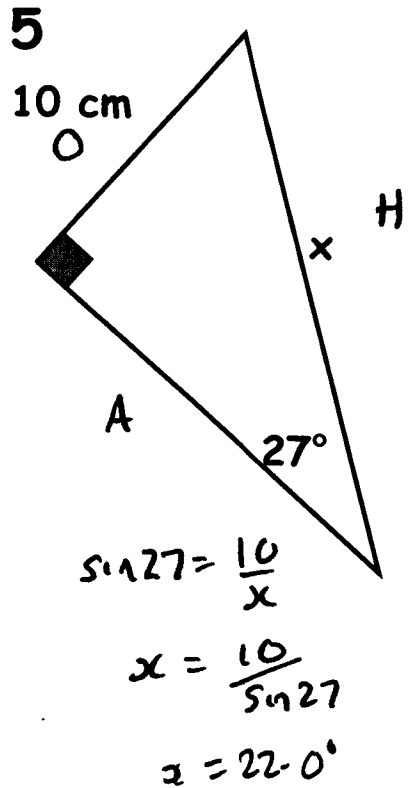
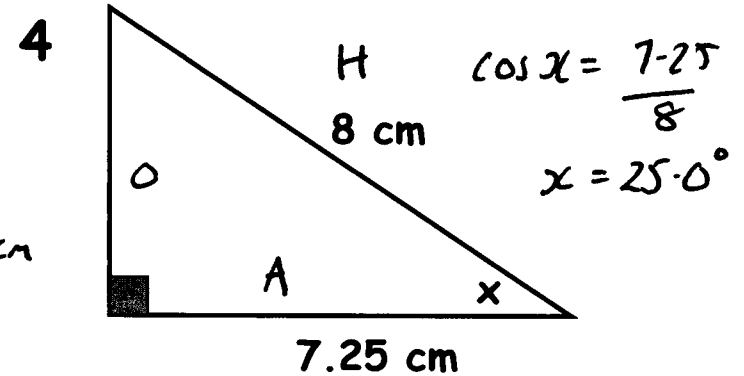
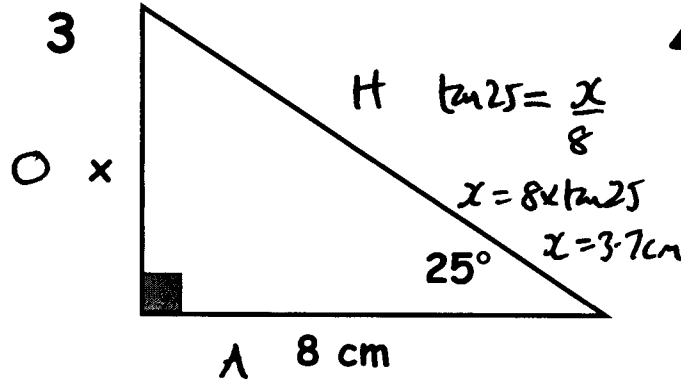
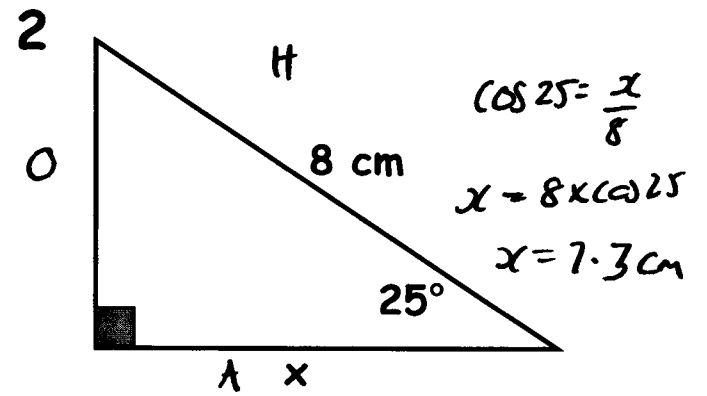
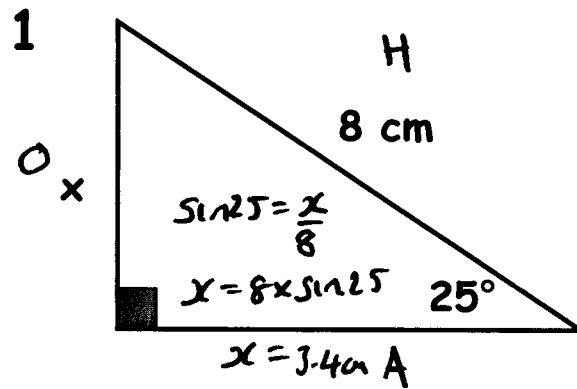


$$12 \sin 40 = 7.7$$

$$\tan x = \frac{7.7}{9.2 + 14} = \frac{7.7}{23.2} \quad x = 18.4^\circ$$



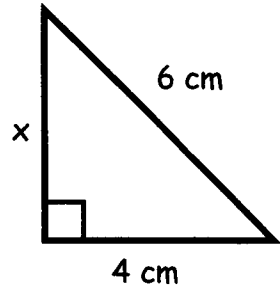
angle	sin	cos	tan
8°	0.139	0.990	0.141
25°	0.423	0.906	0.466
42°	0.669	0.743	0.900
45	0.707	0.707	1
65	0.906	0.423	2.145
85°	0.996	0.087	11.430



10

Triangles - find the value of x for each triangle.

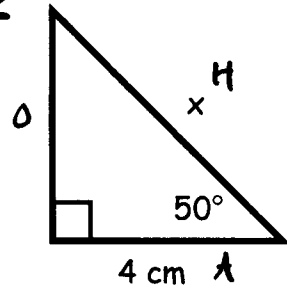
1 Pythagoras (P)



$$6^2 = x^2 + 4^2$$

$$x = 4.5 \text{ cm}$$

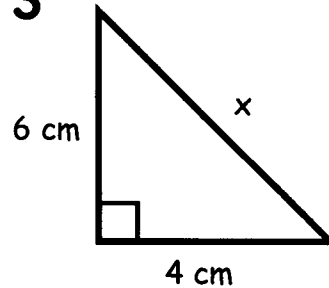
2 Trig (T)



$$\cos 50 = \frac{4}{x}$$

$$x = \frac{4}{\cos 50} = 6.2 \text{ cm}$$

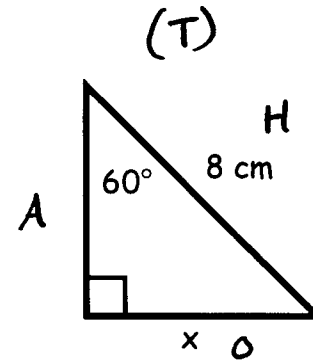
3 (P)



$$x^2 = 6^2 + 4^2$$

$$x = 7.2 \text{ cm}$$

4

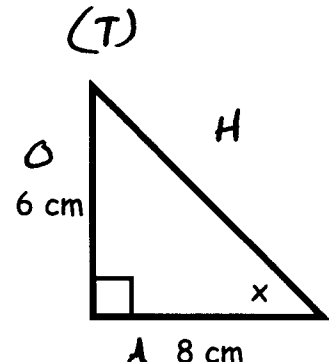


$$\sin 60 = \frac{x}{8}$$

$$x = 8 \sin 60$$

$$x = 6.9 \text{ cm}$$

5

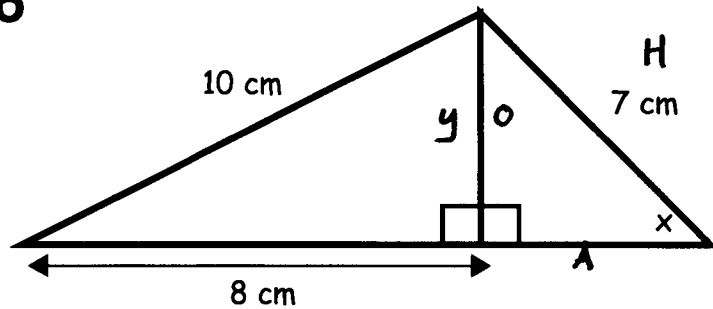


$$\tan x = \frac{6}{8}$$

$$x = 36.9^\circ$$

6

(P and T)



find y first

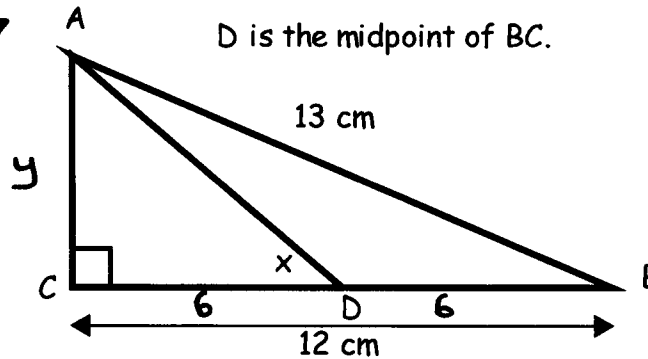
$$10^2 = y^2 + 8^2$$

$$y = 6$$

$$\sin x = \frac{6}{7}$$

$$x = 59.0^\circ$$

7



find y first

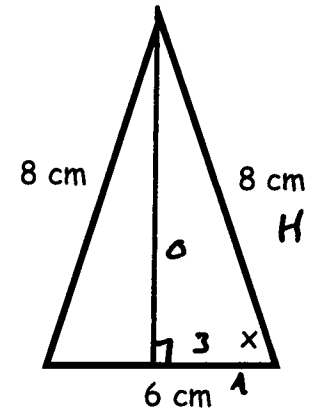
$$13^2 = y^2 + 12^2$$

$$y = 5$$

$$\tan x = \frac{5}{6}$$

$$x = 39.8^\circ$$

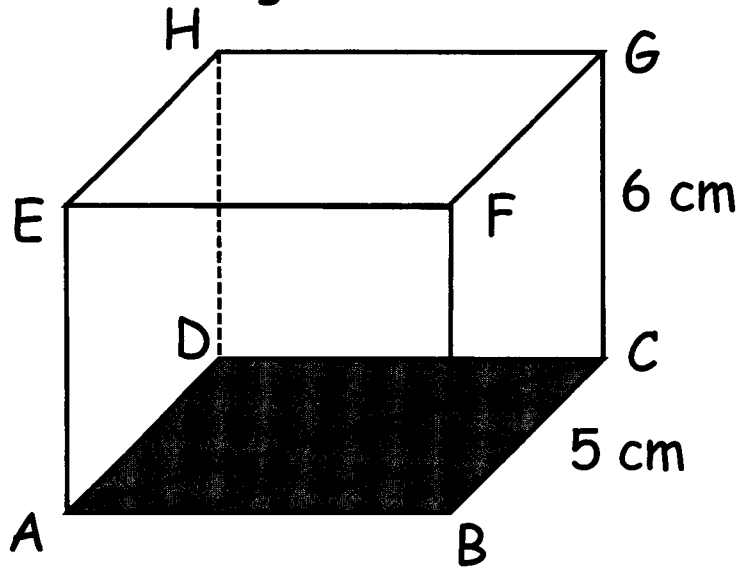
8



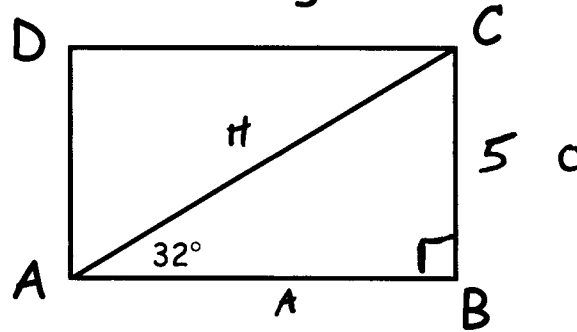
Because the triangle is isosceles, the triangle can be split exactly in half. Forming a right-angled and halving the 6 cm side.

$$\cos x = \frac{3}{8} \quad x = 68.0^\circ$$

1) Find the angle GAC in this cuboid



Find length AC

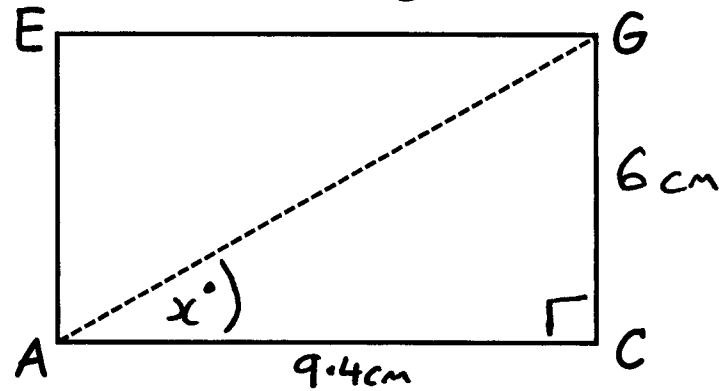
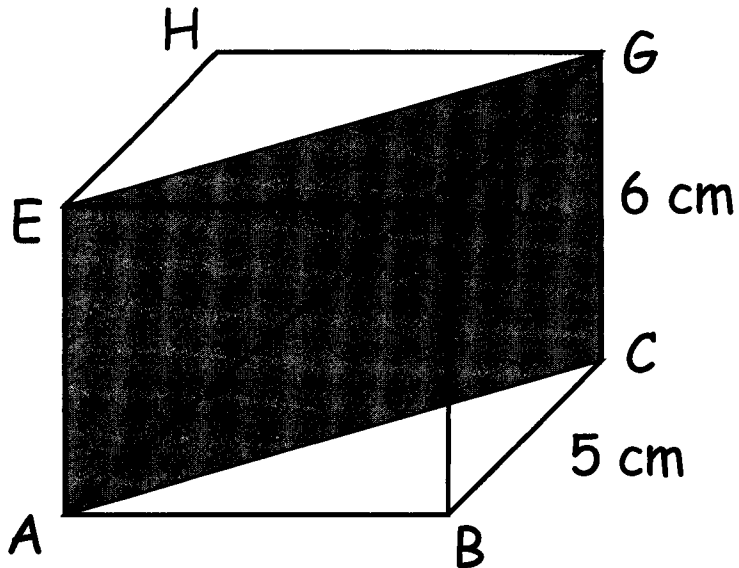


$$\sin 32^\circ = \frac{5}{AC}$$

$$AC = \frac{5}{\sin 32^\circ}$$

$$= 9.4 \text{ cm.}$$

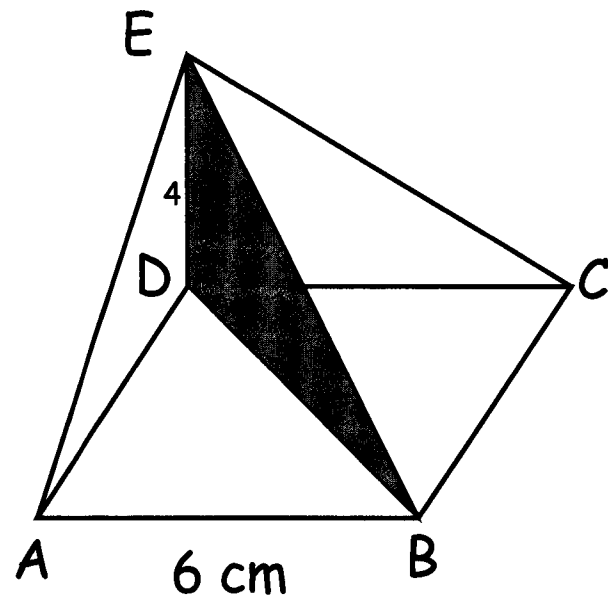
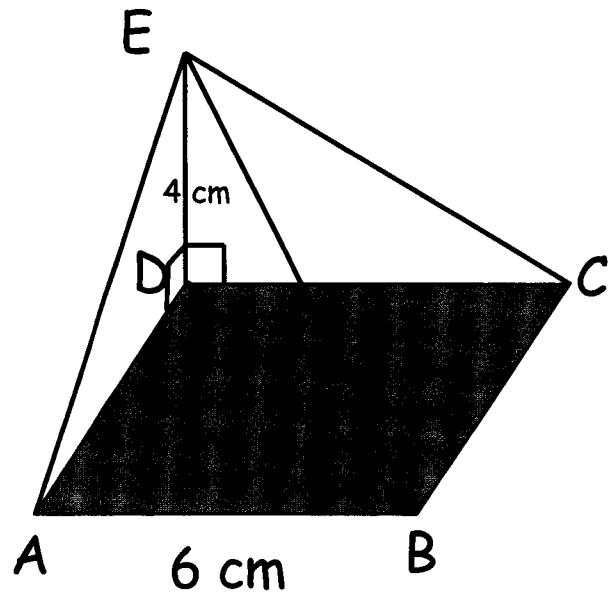
Find angle GAC



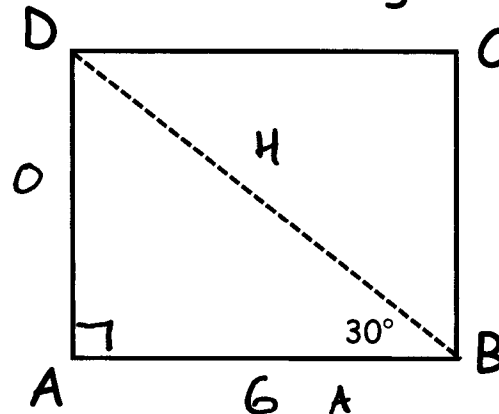
$$\tan x = \frac{6}{9.4}$$

$$x = 32.6^\circ$$

2) Find angle EBD in this shape.



Find length BD

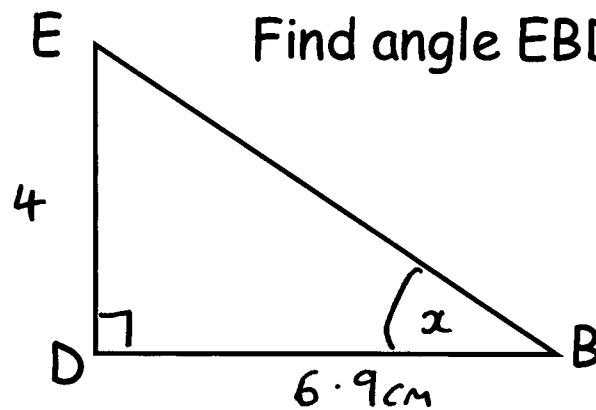


$$\cos 30 = \frac{6}{BD}$$

$$BD = \frac{6}{\cos 30}$$

$$BD = 6.9 \text{ cm.}$$

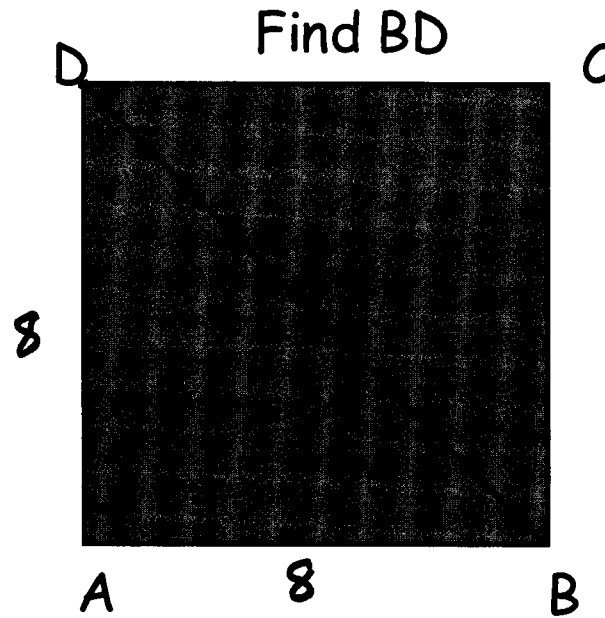
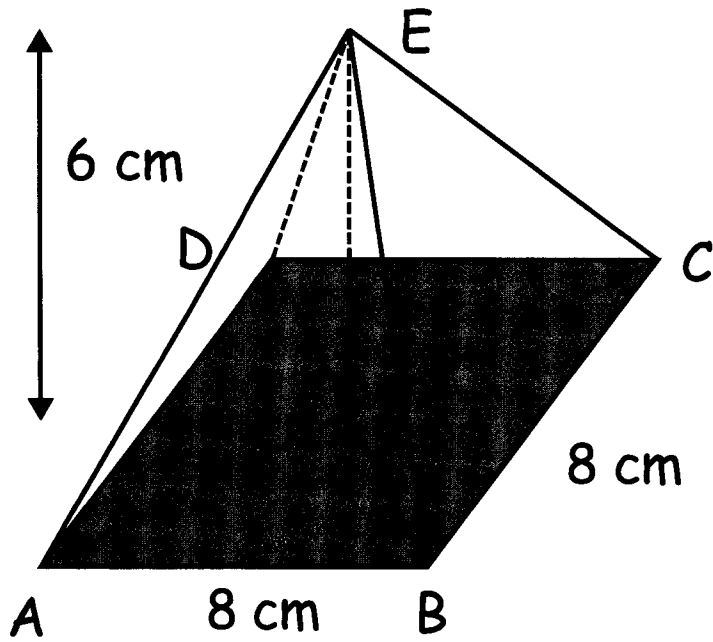
Find angle EBD



$$\tan x = \frac{4}{6.9}$$

$$x = 30.1^\circ$$

3) Find length BE in this square based pyramid



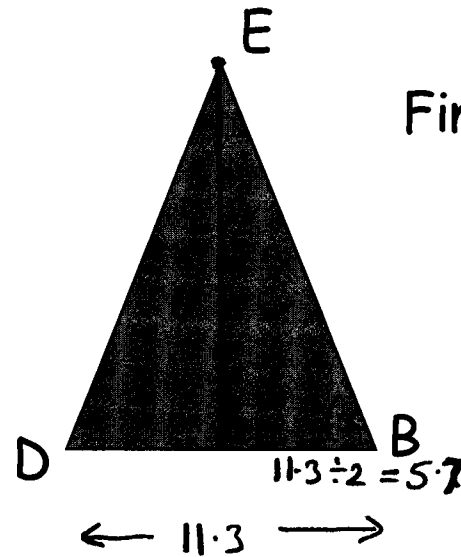
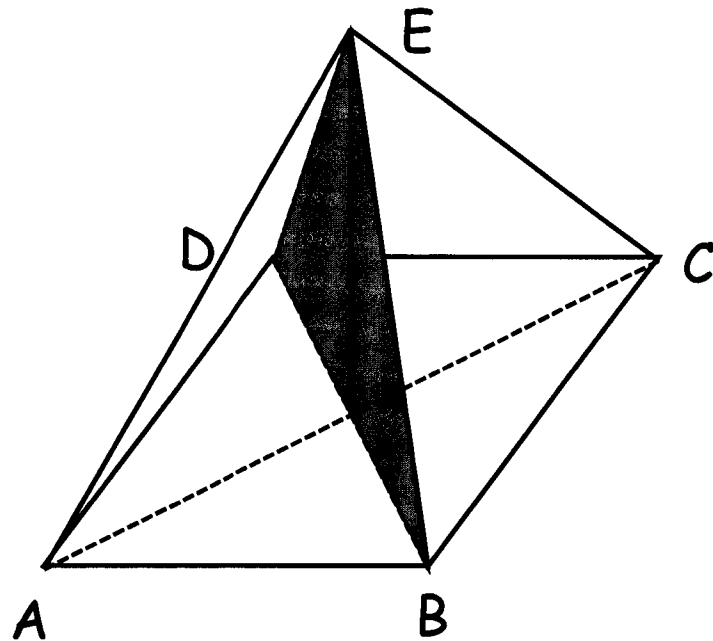
$$BD^2 = 8^2 + 8^2$$

$$= 64 + 64$$

$$= 128$$

$$BD = \sqrt{128}$$

$$= 11.3$$



Find BE

$$BE^2 = 6^2 + 5.7^2$$

$$BE = 8.3 \text{ cm}$$

Find angle DBE

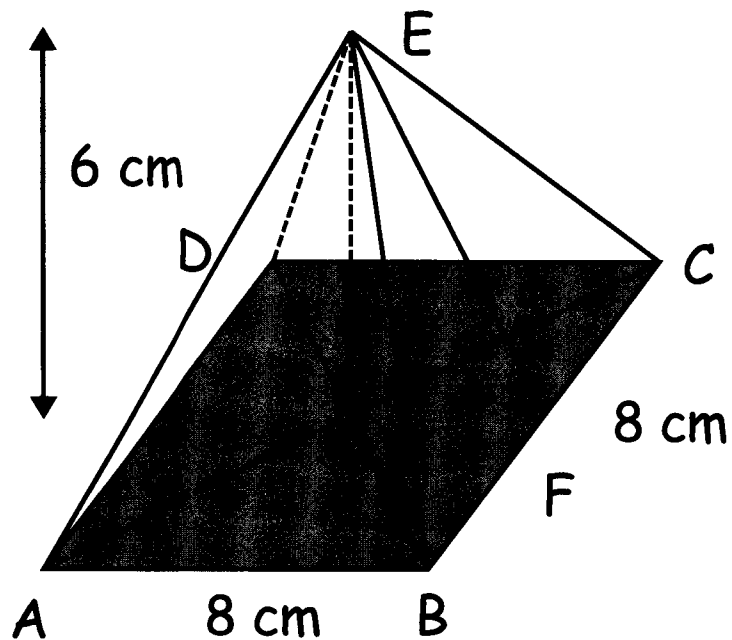
$$\tan x = \frac{6}{5.7}$$

$$x = 46.5^\circ$$

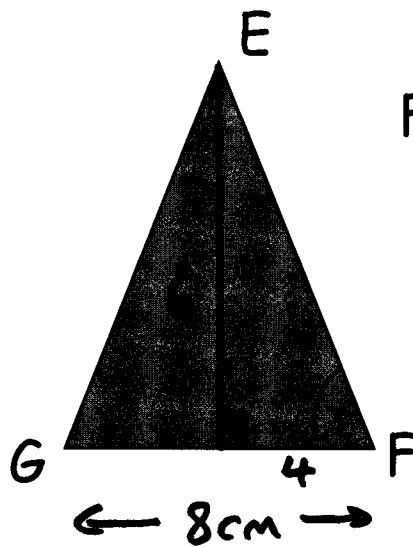
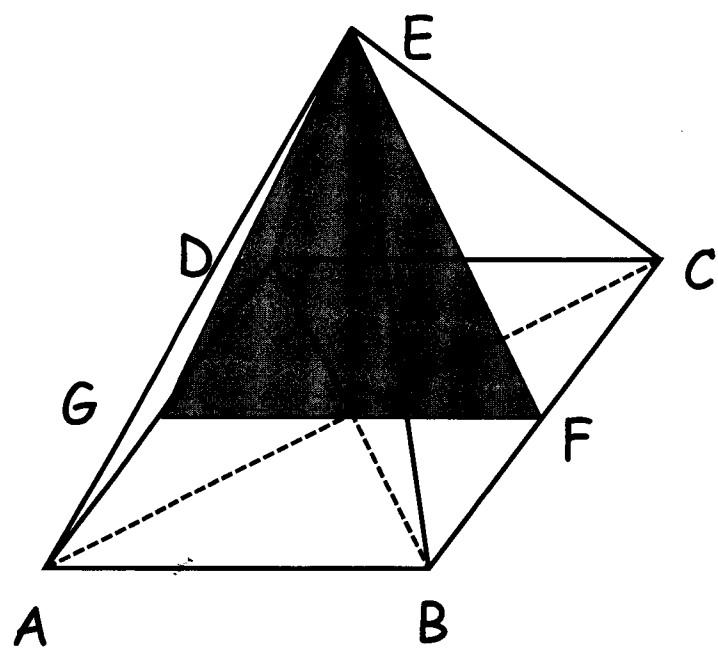
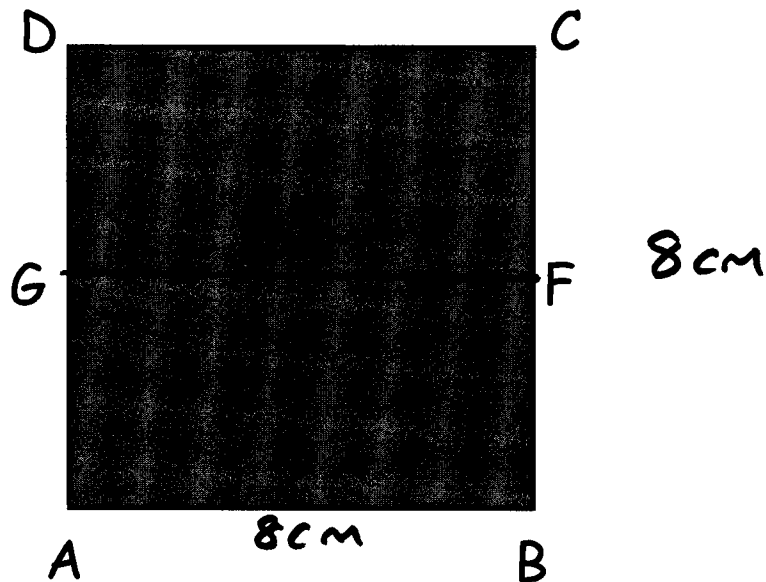
$$DBE = 46.5^\circ$$

(14)

4) Find length EF in this square based pyramid. F is the midpoint of the side BC.



Find FG. G is the midpoint of AD.



Find EF

$$EF^2 = 4^2 + 6^2$$

$$EF = 7.2 \text{ cm}$$

Find angle EFG

$$\tan x = \frac{6}{4}$$

$$x = 56.3^\circ$$

$$EFG = 56.3^\circ$$

(15)