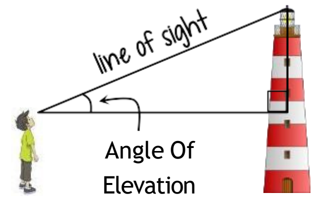
Name:

Date:

Main Ideas/Questions	Notes/Examples

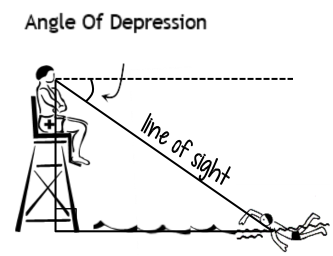
Angle of Elevation

When looking UP to an object, the **angle of elevation** is formed by an observer's line of sight and a horizontal line.



Angle of Depression

When looking DOWN to an object, the **angle of depression** is formed by an observer's line of sight and a horizontal line.



Examples

Draw and label a diagram, then find the unknown.

1. John sights the top of a 60 m lighthouse at an angle of elevation of 58°. If John is 1.55m, how far is he standing from the base of the lighthouse?

Ans: ≈36.5

2. Building A is 180 m and Building B is 220 m. If the angle of depression from the top of Building B to the top of Building A is 42°, how far apart are the buildings?

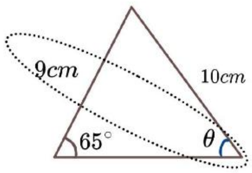
Ans: ≈44.4

SINE RULE & COSINE RULE

Main Ideas

The Sine Rule and Cosine Rule can be used for **<u>all types of triangles</u>**, including both right-angled and non-right-angled triangles.

SINE RULE



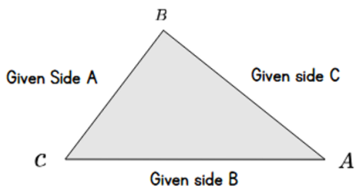
$$\frac{a}{\sin a} = \frac{b}{\sin b} = \frac{c}{\sin b} \quad or \quad \frac{\sin a}{a} = \frac{\sin b}{b} = \frac{\sin c}{c}$$

(Provided in Formula Sheet)

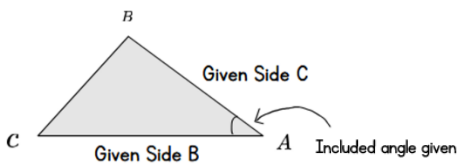
We use Sine rule when we have:

Info on one side and its opposite angle are given (1 pair)
+ info either one more side or one more angle (1/2 pair)

COSINE RULE



Or



$$a^2 = b^2 + c^2 - 2bc\cos A$$

(Provided in Formula Sheet)

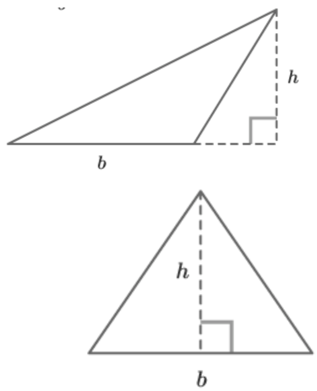
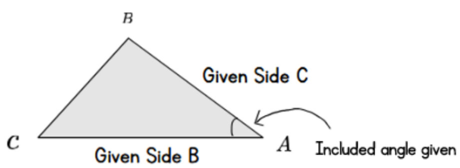
!! When finding angle A, be sure to move $b^2$and c^2 first before dividing by *-2bc.*

$$Cos\ A = \frac{b^2 + c^2 - a^2}{2bc}$$

We use Cosine rule when we have either:

1. All 3 sides are given Or
2. 2 sides and an included angle is given.

AREA OF TRIANGLE FORMULA

There are 2 ways to calculate area of Triangle.	
	❖ Area of Triangle = $\frac{1}{2}$ x b x h What happens if the height h is not given?
	❖ Area of Triangle = $\frac{1}{2}ab\sin C$ ***(Provided in Formula Sheet)*** Used when two sides and the included angle are known.

IMPORTANT! Commonly Tested Question

Exam questions may ask things like:

- Find the **shortest distance from** a line AB to a point C.
- Sally walks from A to C and reaches a point where the **angle of elevation to the top of tower P is the greatest.** Find the angle of elevation.

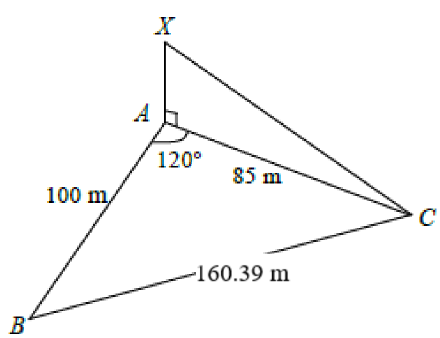
Concept: The shortest distance from a point to a line is the **perpendicular distance**.
Concept: The angle of elevation from Sally to the top of the tower is greatest when she is at the point closest to the tower, forming a perpendicular distance to the tower.

The approach is to always find the area of the triangle using $\frac{1}{2}ab\sin C$. After that, use the area found and equate it to the formula $\frac{1}{2} \times$ base $\times$ heightto solve for h.

Refer to example below.

Example : [2022 BOONLAY SEC 3 EOY P2]

The figure below shows a triangular plot of land ABC with a vertical signal tower AX.
$AB = 100$ m and $AC = 85$ m.



(a) Find the shortest distance from A to BC. [2]

$$\text{Area of triangle } ABC = \frac{1}{2} \times 100 \times 85 \times sin120°$$
$$= 3680 \text{ m}^2 \text{ (3.s.f)}$$

$$Area\ of \text{ triangle } ABC = \frac{1}{2} \times 160.3901 \times height$$
$$3680.60797 = \frac{1}{2} \times 160.3901 \times height$$
Shortest distance = 45.896 cm

(b) A signal tower XA stands vertically at A. The angle of elevation of the top of the tower from C is 10°. Calculate the height of the tower. [2]

$$tan10° = \frac{height}{85}$$
Height = 14.9877 m
= 15.0 m (3.s.f)

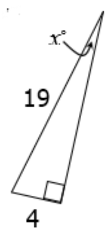
(c) Calculate the greatest angle of elevation of the top of the tower when viewed from any point along BC. [2]

$$tan\emptyset = \frac{14.9877}{45.896}$$
Greatest angle of elevation = 18.1°

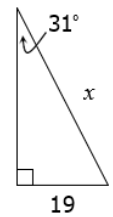
Practice on Applying Formulas (Basic)

Use Sine Rule to solve for x.

1.

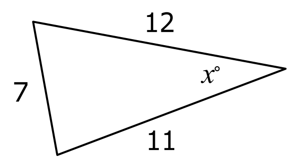


2.

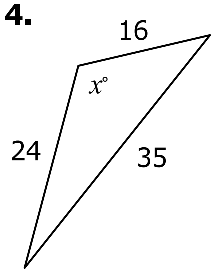


Use Cosine Rule to solve for x.

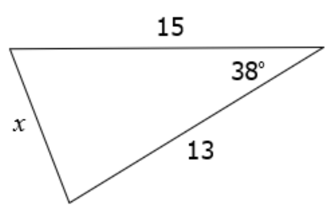
3.



4.

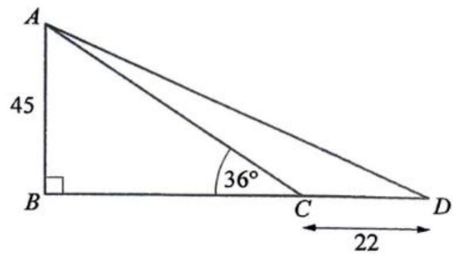


5.



Application Questions –

6. 2020 O LEVEL EMATH P1 Q18 [4 MARKS]



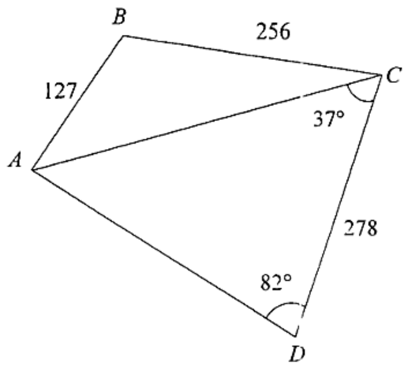
The diagram represents a tower, AB, built on horizontal ground.
The height of the tower is 45 m.
From a point C, the angle of elevation of the top of the tower is 36°.
Point D is 22 m from C and BCD is a straight line.

Calculate the angle of elevation of the top of the tower from the point D.

Answer .... [4]

Ans: 28.2° (d.p)

7. 2023 Ahmad Ibrahim Secondary 3 EOY P1 Q14 [3 MARKS]



In the diagram, $AB = 127$ km, $BC = 256$ km and $CD = 278$ km.

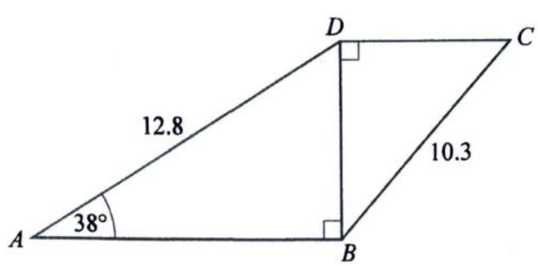
Angle $ACD = 37°$ and angle $ADC = 82°$.

Find angle ABC.

Answer Angle ABC = …… …….° [3]

Ans: 105.5° (d.p)

8. 2022 O LEVEL EMATH P1 Q22 [3 MARKS]



The diagram shows a trapezium $ABCD$.
Angle ABD = angle $BDC = 90°$.
$AD = 12.8$ cm, $BC = 10.3$ cm and angle $DAB = 38°$.

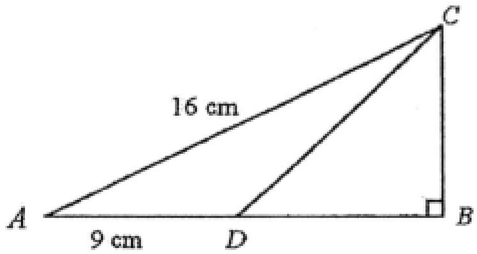
Calculate angle CBD.

Answer Angle CBD = ... [3]

Ans: 40.1° (d.p)

9. 2015 Clementi Town Secondary School Sec 4 PRELIM P1 Q20 [7 Marks]

In the diagram, ADB is a straight line, $\angle ABC = 90°$, $AC = 16$ cm, $AD = 9$ cm and area of $\Delta ADC = 36\text{ cm}^2$.



(a) Prove that $\angle CAD = 30°$.

Answer (a)

[2]

(b) Find the shortest distance between point D and the line AC.

Answer (b).............................. cm [1]

(c) Find the length of CD.

Answer (c).............................. cm [2]

(d) Find $\sin \angle ADC$.

Answer (d).............................. [2]

Ans: b)4.5cm c) 9.36cm d)0.855