

Steps to solve triangle

- Right triangles can be solved with the primary trig. ratios
- Non-right triangles can be solved with sine law and cosine law.

Use Sine Law if:

- 2 sides and one opposite angle to one of the given sides are known (SSA)
- 2 angles and one opposite side to one of the given angles are known (AAS)

Use Cosine Law if:

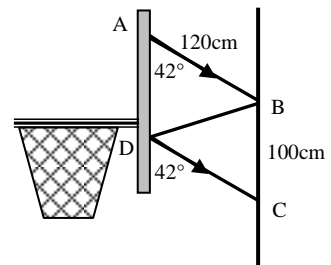
- all 3 sides are known (SSS)
- 2 sides and a contained angle are known (SAS)

* *If both the sine and cosine law can be used to solve a triangle, use the Sine Law, because it is easier !!!*

** *The side opposite to the largest angle in a triangle is the longest side and vice versa.*

Example 1

A basketball backboard is supported by parallel brackets AB and CD, each 120 cm long. The brackets make an angle of 42° with the backboard. The distance from B to C is 100 cm. Find the length of the diagonal brace DB.



Example 2: Direction and Bearing

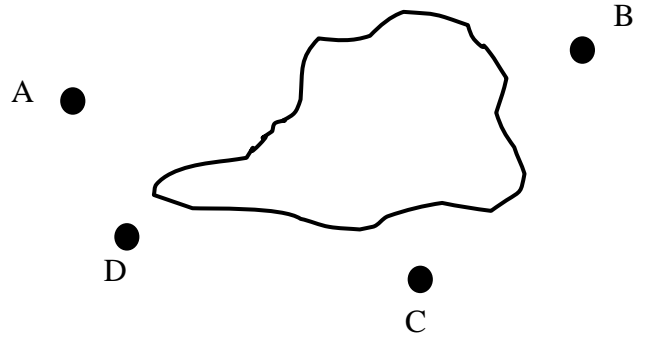
Nick is flying a triangular course from A to B to C and back to A again. A is directly north of C. The distances he must travel are $AB = 130$ km, $BC = 80$ km, and $CA = 76$ km.

- Calculate $\angle CAB$, correct to 1 decimal place.
- What bearing must he take from A to head toward B?

Example 3

A tunnel through the mountains is to be constructed to join A and B. Point C is 12.6 km from B. A cannot be seen from B or from C. Point D is 10.3 km from C and 6.7 km from A; $\angle ADC = 125^\circ$ and $\angle DCB = 142^\circ$.

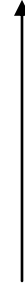
- a) Find the length of the tunnel AB.
b) Find the angle between i) AB and AD ii) AB and CB



Example 4:

The radar screen at an air traffic control tower shows a Piper Cherokee 15 km from the tower in a direction 30° east of north ($N30^\circ E$), and a Cessna Skyhawk 16 km from the tower in a direction 40° east of north ($N40^\circ E$), at their closest approach to each other. If the two aircraft are less than 2 km apart, the controller must file a report.

- From the tower, what is the angle separating the aircraft?
- Will the controller need to file a report?

**Example 5:**

Two cars A & B leave the same town. The first car A leaves at 12:30pm and drives 5° south of east at 100 km/h. The second car B leaves at 1:00pm and drives in a direction $N40^\circ W$, at a speed of 120 km/h. How far apart are the cars at 3:00pm? Determine the bearing of Car B to Car A at 3:00pm.

Exercise

1. Complete each of the following statements of the Cosine Law.

a) $b^2 =$

b) $=$ $\cos \angle A$

c) $=$ $2ab$

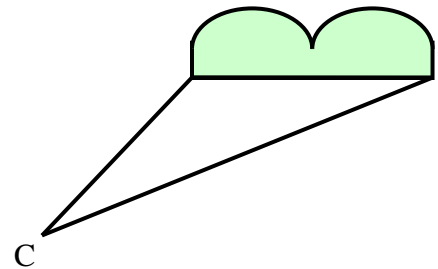
2. Write the Sine Law:

3. For each of the following triangles ABC , with the given information, determine the value of the stated unknown:

a) $a = 12$; $b = 10$; $\angle C = 78^\circ$ $\therefore c = ?$ b) $a = 10$; $c = 12$; $\angle C = 57^\circ$ $\therefore \angle B = ?$

c) $a = 10$; $\angle A = 23^\circ$; $\angle B = 80^\circ$ $\therefore c = ?$ d) $a = 19$; $b = 23$; $c = 31$ $\therefore \angle A = ?$

4. You are standing at point C which is 3.2 m from the nearest goal post and 4.3 m from the far goal post of a hockey net. If the net is 1.8 m wide, within what angle should you shoot the puck in order to hit the net?



5. Jennifer and Eric swim from their dock along lanes that form an angle of 70° . If Jennifer swims at a speed of 30 m per minute and Eric swims at 21 m per minute, how far apart are they after 5 minutes?

6. A baseball diamond is actually a square with each side approximately 27.4 m. The pitcher's mound is 18.4 m from home plate on the diagonal of the square – *note that the pitcher's mound is NOT located at the centre of the diamond!*

a) How far from the centre of the diamond is the pitcher's mound? Is it closer to home plate or second base? *Include a diagram with your calculations.*

b) During a baseball game, a pitcher has to leave the pitching mound to run to first base to cover a play. How far does he have to run?

7. A surveyor wishes to find the height of a mountain. He selects two points A and B on level ground along the same line of sight to the mountain. He measures the distance AB to be 1503 m and the angles of elevation of the top of the mountain from the points to be 16.9° from A and 22.3° from B.

a) Calculate the distances to the top of the mountain from point A.

b) Calculate the distances to the top of the mountain from point B.

c) What is the height of the mountain?

Answers

3a) 13.93 b) 78.66° c) 24.94 d) 37.65° 4) within 22.14° 5) 150.84 m

6a) home b) 19.40 m 7a) 902.38 m b) 691.3 m c) 262.3 m

Solve the following problem. Keep the final answers to one decimal place.

- Two ships, A and B, are 60 km apart. Ship A sights a distress flare at $S6^{\circ}E$. Ship B sights the same flare at $S14^{\circ}W$. Ship A is $N48^{\circ}W$ of ship B. How far is each ship from the distress flare?
- Two ships, M and N, are 70 km apart. Ship M sights a distress flare at $S6^{\circ}E$. Ship N sights the same flare at $S14^{\circ}W$. Ship M is $N48^{\circ}W$ of ship N. How far is each ship from the distress flare?
- Two ships, A and B, are 85 km apart. Ship A sights a distress flare at $S6^{\circ}E$. Ship B sights the same flare at $S14^{\circ}W$. Ship A is $N48^{\circ}W$ of ship B. How far is each ship from the distress flare?
- A boat leaves Kingston and heads due east for 25 km. At the same time, a second boat travel in a direction $E 30^{\circ} S$ from Kingston for 15 km. How far apart are the boats at this moment?
- A boat leaves Kingston and heads due east for 26 km. At the same time, a second boat travel in a direction $E 32^{\circ} S$ from Kingston for 15 km. How far apart are the boats at this moment?
- A boat leaves Kingston and heads due east for 31 km. At the same time, a second boat travel in a direction $E 28^{\circ} S$ from Kingston for 17 km. How far apart are the boats at this moment?
- Frank and Amy are 600 m apart. A plane flies overhead between them. At the same time, they measure the angle of elevation of the plane. Frank measures the angle of elevation to be 60° . Amy measures it to be 37° . What is the altitude of the plane?
- Frank and Amy are 500 m apart. A plane flies overhead between them. At the same time, they measure the angle of elevation of the plane. Frank measures the angle of elevation to be 55° . Amy measures it to be 38° . What is the altitude of the plane?
- Frank and Amy are 550 m apart. A plane flies overhead between them. At the same time, they measure the angle of elevation of the plane. Frank measures the angle of elevation to be 63° . Amy measures it to be 32° . What is the altitude of the plane?
- A helicopter hovers 500 m above a long straight road. Ahead of the helicopter on the road are two trucks. The angle of depression of the two trucks are 60° and 20° . How far apart are the two trucks?
- A eagle flies 200 m above a long straight road. Ahead of the eagle on the road are two trucks. The angle of depression of the two trucks are 40° and 30° . How far apart are the two trucks?
- A plane flies 1500 m above a long straight road. Ahead of the plane on the road are two trucks. The angle of depression of the two trucks are 70° and 50° . How far apart are the two trucks?
- A kite floats 100 m above a long straight road. Ahead of the kite on the road are two trucks. The angle of depression of the two trucks are 25° and 10° . How far apart are the two trucks?

Answers

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| 1. 154.9 km, 117.4 km | 2. 180.7 km, 136.9 km | 3. 166.3 km, 219.4 km |
| 4. 14.2 km | 5. 15.5 km | 6. 17.9 km |
| 7. 315 m | 8. 252.5 m | 9. 260.7 m |
| 10. 1085.2 m | 11. 108.1m | 12. 712.7 m |
| 13. 352.7 m | | |