



In these questions, give any answers involving angles to the nearest degree.

- 1 Eric sees an aircraft in the sky. The aircraft is at a horizontal distance of 25 km from Eric. The angle of elevation is 22° . How high is the aircraft?
- 2 A passenger in an aircraft hears the pilot say that they are flying at an altitude of 4000 m and are 10 km from the airport. If the passenger can see the airport, what is the angle of depression?
- 3 A man standing 200 m from the base of a television transmitter looks at the top of it and notices that the angle of elevation of the top is 65° . How high is the tower?
- 4 From the top of a vertical cliff, 200 m high, a boat has an angle of depression of 52° . How far from the base of the cliff is the boat?
- 5 From a boat, the angle of elevation of the foot of a lighthouse on the edge of a cliff is 34° .
 - a If the cliff is 150 m high, how far from the base of the cliff is the boat?
 - b If the lighthouse is 50 m high, what would be the angle of elevation of the top of the lighthouse from the boat?
- 6 A bird flies from the top of a 12 m tall tree, at an angle of depression of 34° , to catch a worm on the ground.
 - a How far does the bird actually fly?
 - b How far was the worm from the base of the tree?
- 7 Sunil stands about 50 m away from a building. The angle of elevation from Sunil to the top of the building is about 15° . How tall is the building?
- 8 The top of a ski run is 100 m above the finishing line. The run is 300 m long. What is the angle of depression of the ski run?

Trigonometry and bearings

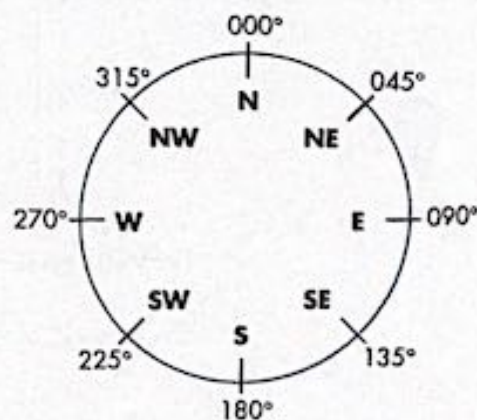
A **bearing** is the direction to one place from another. The usual way of giving a bearing is as an angle measured from north in a clockwise direction. This is how a navigational compass and a surveyor's compass measure bearings.

A bearing is always written as a three-digit number, known as a **three-figure bearing**.

The diagram shows how this works, using the main compass points as examples.

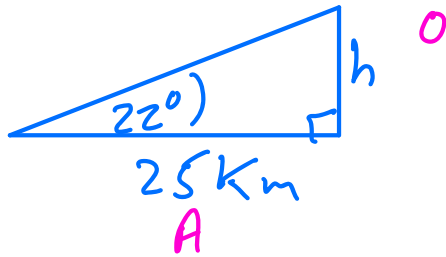
When working with bearings, follow these three rules.

- Always start from *north*.
- Always measure *clockwise*.
- Always give a bearing in degrees and as a *three-figure bearing*.



Solutions

- 1 Eric sees an aircraft in the sky. The aircraft is at a horizontal distance of 25 km from Eric. The angle of elevation is 22° . How high is the aircraft?



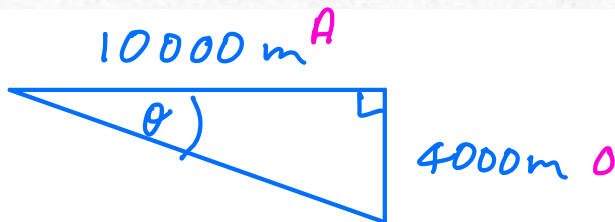
$$\tan = \frac{O}{A}$$

$$\tan 22^\circ = \frac{h}{25}$$

$$25 \tan 22^\circ = h$$

$$h = 10.1 \text{ km}$$

- 2 A passenger in an aircraft hears the pilot say that they are flying at an altitude of 4000 m and are 10 km from the airport. If the passenger can see the airport, what is the angle of depression?



$$\tan = \frac{O}{A}$$

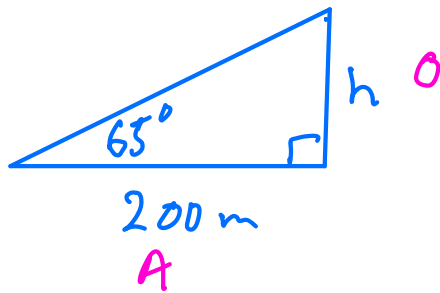
$$\tan \theta = \frac{4000}{10000}$$

$$\theta = \tan^{-1} \left(\frac{4000}{10000} \right)$$

$$\theta = 21.8^\circ$$

$$\theta = 22^\circ \text{ to nearest degree}$$

- 3 A man standing 200 m from the base of a television transmitter looks at the top of it and notices that the angle of elevation of the top is 65° . How high is the tower?



$$\tan = \frac{O}{A}$$

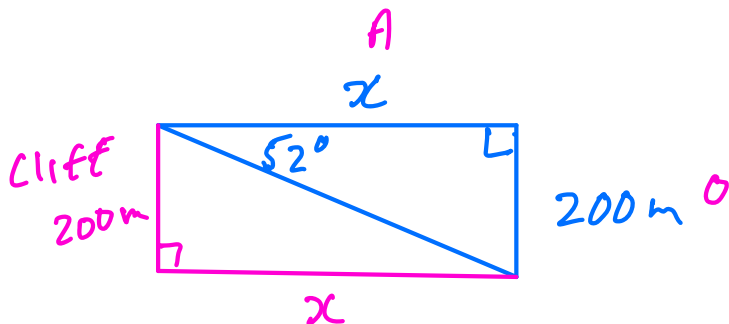
$$\tan 65^\circ = \frac{h}{200}$$

$$200 \tan 65^\circ = h$$

$$h = 428.9 \text{ m}$$

$$\underline{h = 429 \text{ m}}$$

- 4 From the top of a vertical cliff, 200 m high, a boat has an angle of depression of 52° . How far from the base of the cliff is the boat?



$$\tan = \frac{O}{A}$$

$$\tan 52^\circ = \frac{200}{x}$$

$$x \tan 52^\circ = 200$$

$$x = \frac{200}{\tan 52^\circ}$$

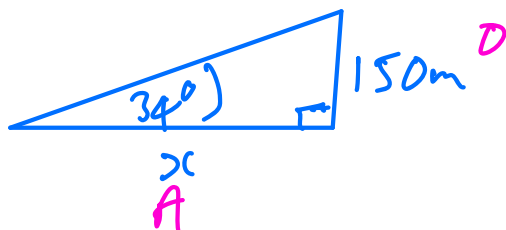
$$x = 156.3 \text{ m}$$

$$\underline{x = 156 \text{ m}}$$

5 From a boat, the angle of elevation of the foot of a lighthouse on the edge of a cliff is 34° .

- a If the cliff is 150 m high, how far from the base of the cliff is the boat?
- b If the lighthouse is 50 m high, what would be the angle of elevation of the top of the lighthouse from the boat?

a)



$$\tan = \frac{O}{A}$$

$$\tan 34^\circ = \frac{150}{x}$$

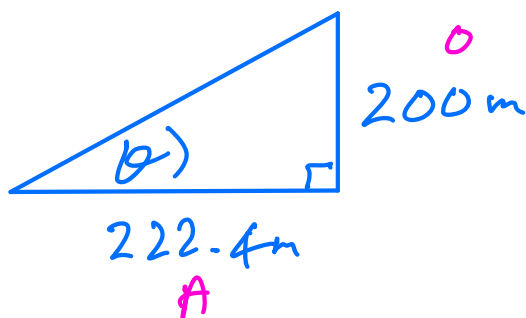
$$x \tan 34^\circ = 150$$

$$x = \frac{150}{\tan 34^\circ}$$

$$x = 222.4 \text{ m}$$

222 m from base of cliff

b)



$$\tan = \frac{O}{A}$$

$$\tan \theta = \frac{200}{222.4}$$

$$\theta = \tan^{-1} \left(\frac{200}{222.4} \right)$$

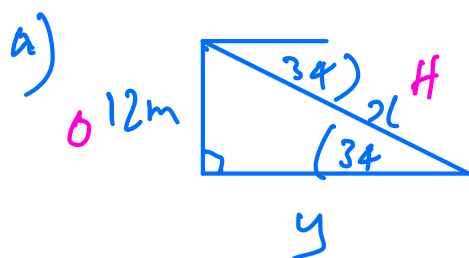
$$\theta = 41.96^\circ$$

$$\underline{\theta = 42^\circ}$$

6 A bird flies from the top of a 12 m tall tree, at an angle of depression of 34° , to catch a worm on the ground.

a How far does the bird actually fly?

b How far was the worm from the base of the tree?



$$\sin = \frac{O}{H}$$

$$\sin 34^\circ = \frac{12}{x}$$

$$x \sin 34^\circ = 12$$

$$x = \frac{12}{\sin 34^\circ}$$

$$x = 21.5 \text{ m}$$

Bird flies 21.5 m

b)

$$\tan 34^\circ = \frac{12}{y}$$

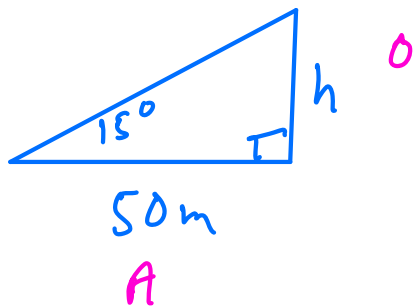
$$y \tan 34^\circ = 12$$

$$y = \frac{12}{\tan 34^\circ}$$

$$y = 17.8 \text{ m}$$

worm 17.8 m from base of tree

- 7 Sunil stands about 50 m away from a building. The angle of elevation from Sunil to the top of the building is about 15° . How tall is the building?



$$\tan = \frac{O}{A}$$

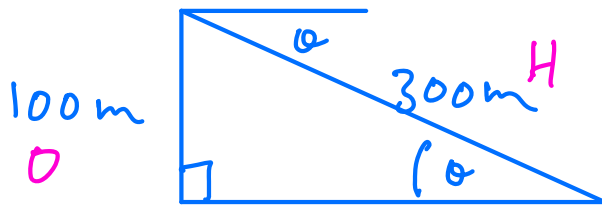
$$\tan 15^\circ = \frac{h}{50}$$

$$50 \tan 15^\circ = h$$

height

$$\underline{h = 13.4 \text{ m}}$$

- 8 The top of a ski run is 100 m above the finishing line. The run is 300 m long. What is the angle of depression of the ski run?



$$\sin = \frac{O}{H}$$

$$\sin \theta = \frac{100}{300}$$

$$\theta = \sin^{-1}\left(\frac{100}{300}\right)$$

$$\theta = 19.47^\circ$$

Angle of depression = 19° to nearest degree

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