

Student Name

Mathematics Stage 5 Core

TRIGONOMETRY B

Book 1 Solve right-angled triangle problems
involving angles of elevation and depression

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OVERVIEW

SYLLABUS CONTENT

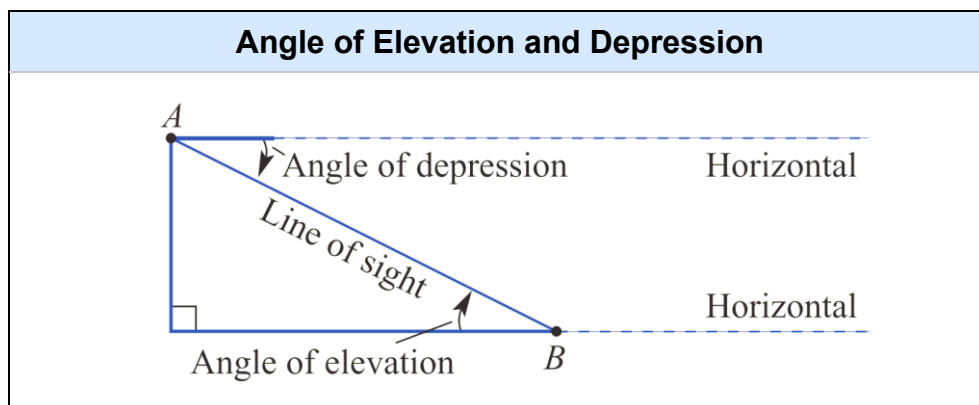
MA5-TRG-C-02 applies trigonometry to solve problems, including bearings and angles of elevation and depression

Solve right-angled triangle problems involving angles of elevation and depression

- Identify and describe angles of elevation and depression
- Solve practical problems involving angles of elevation and depression

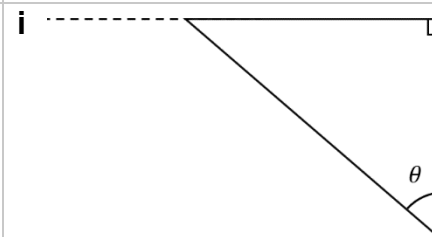
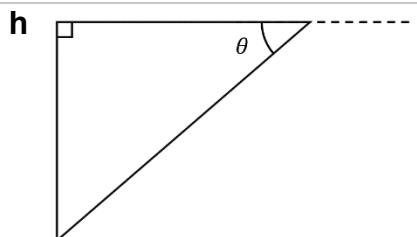
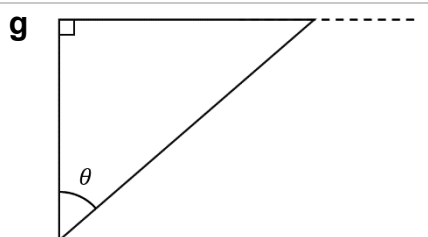
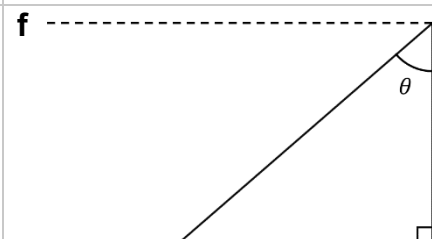
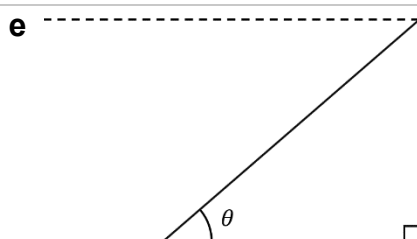
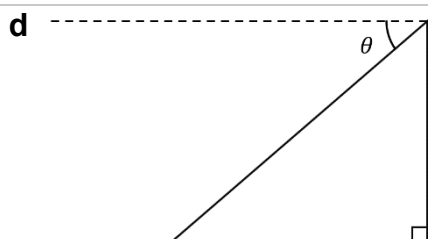
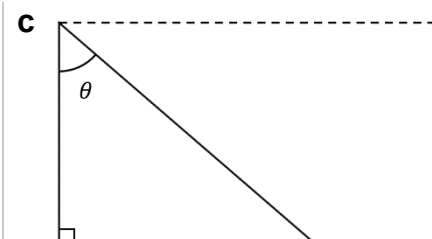
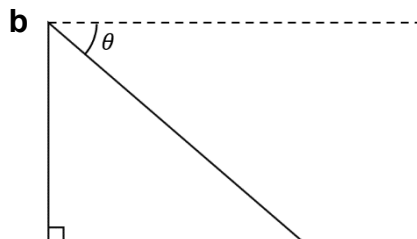
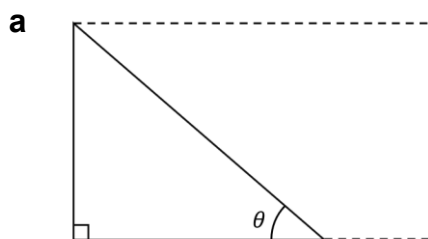
ANGLES OF ELEVATION AND DEPRESSION

- **Line of sight** is a straight line from your eye to an object.
- Angle of **elevation**: The angle you turn to look up from the horizontal.
- Angle of **depression**: The angle you turn to look down from the horizontal.
- The **horizontal** is a line parallel to the ground.



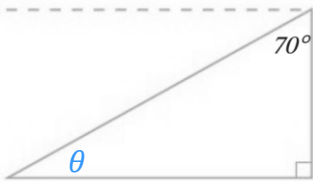
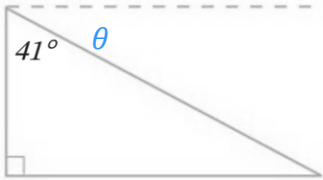
Example Identify angle of elevation or depression.

Identify whether the angle shown is an angle of elevation, depression, or neither.

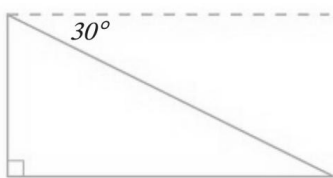


- To find angles, we can use these angle relationships:
 - Angles in a right-angle sum to 90°
 - Angle sum of a triangle is 180°
 - Alternate angles on parallel lines are equal.

Example Identify angles of elevation and depression.

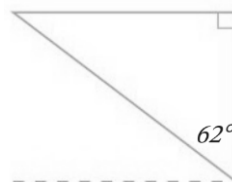
Calculate the angle of elevation.  $\theta + 70^\circ + 90^\circ = 180^\circ$ $\theta + 160^\circ = 180^\circ$ $\theta = 20^\circ$	Which angle relationship did we use here? <i>Angle sum of a is 180°</i> What would be the angle of depression? <i>The angle of depression would also be</i> Why is the angle of elevation always the same as the angle of depression? <i>..... angles on parallel lines equal.</i>
Calculate the angle of depression.  $\theta + 41^\circ = 90^\circ$ $\theta = 90^\circ - 41^\circ$ $\theta = 49^\circ$	Why is 41° NOT the angle of depression? <i>It is not the angle between the line of sight and the</i> Which angle relationship did we use here? <i>Angles in a angle are c.....</i>

a Calculate the angle of elevation.



30°

b Calculate the angle of depression.



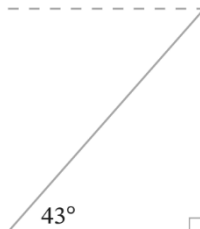
28°

c Calculate the angle of elevation.



54°

d Calculate the angle of depression.

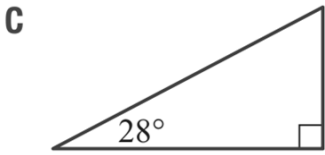
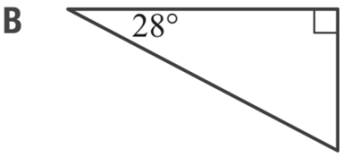
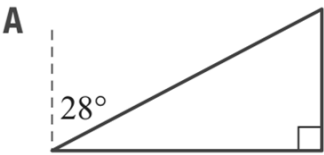


43°

Key ideas

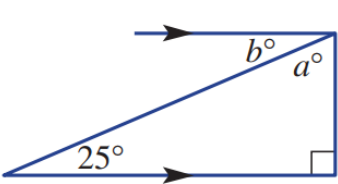
- The angle of elevation and depression are measured from the
- The angle of elevation and depression are always equal because they are angles on parallel lines.

1 A girl views a kite at an angle of elevation of 28° . Which diagram shows this?



C

2 Find the values of the pronumerals in the diagram:



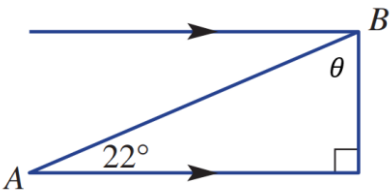
a

65°

b

25°

3 Consider the diagram.



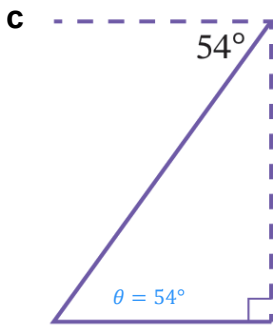
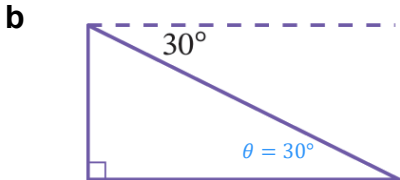
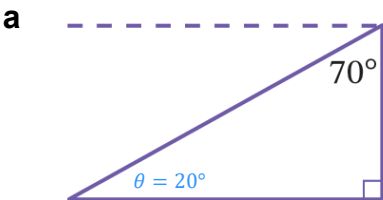
a Explain why θ is **not** the angle of depression.

θ is not between the line of sight and the horizontal.

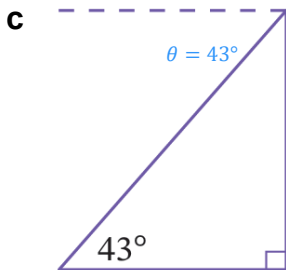
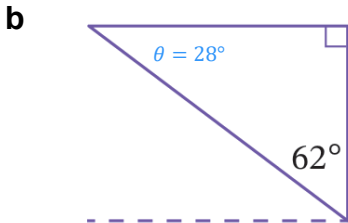
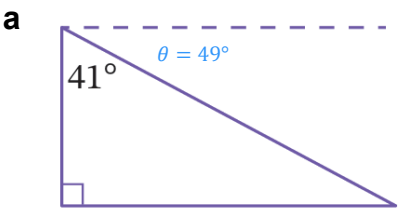
b Determine the size of the angle of depression from B to A.

22°

4 Mark the angle of elevation θ and find its size.



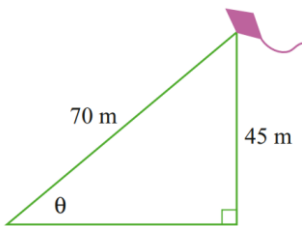
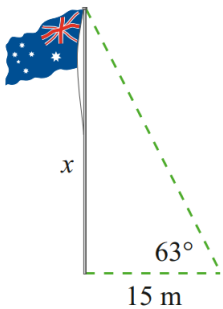
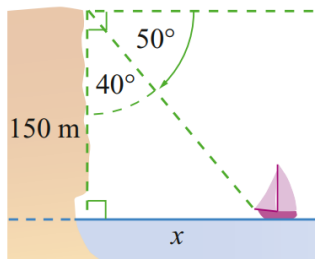
5 Mark the angle of depression θ and find its size.



TRIGONOMETRY WITH ANGLES OF ELEVATION & DEPRESSION

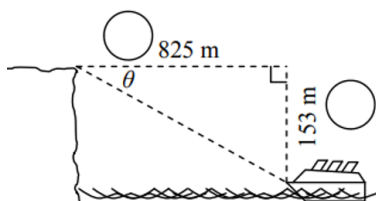
1. Draw a diagram and label the key information.
2. Solve using trigonometry to find the missing information.

Example Solve problems involving angles of elevation and depression.

Worked Example	Your Turn
A kite is flying at a height of 45 m above the ground at the end of a string of length 70 m. Find the angle of elevation from the ground to the string.  $\sin \theta = \frac{45}{70}$ $\theta = \sin^{-1}\left(\frac{45}{70}\right)$ $\theta \approx 40^\circ$	A kite is flying at a height of 35 m above the ground at the end of a string of length 60 m. Find the angle of elevation from the ground to the string, answer to the nearest minute. $35^\circ 41'$
The angle of elevation of the top of a flagpole from the ground, as observed from a point 15 m from its base, is 63°. Find the height of the flagpole.  $\tan(63^\circ) = \frac{x}{15}$ $15 \tan(63^\circ) = x$ $x \approx 29.4 \text{ m}$	The angle of elevation of the top of a flagpole from the ground, as observed 50 m from its base, is 38°. Find the height of the flagpole to 1 d.p. 39.1 m
The angle of depression from the top of a vertical cliff, 150 m above sea level, to a boat below is 50°. Find the distance of the boat from the base of the cliff to the nearest metre.  $\tan(40^\circ) = \frac{x}{150}$ $150 \tan(40^\circ) = x$ $x \approx 126 \text{ m}$	The angle of depression from the top of a vertical cliff, 135 m above sea level, to a boat below is 37°. Find the distance of the boat from the base of the cliff to the nearest metre. 179 m

1 For all of these questions, answer to the nearest whole number.

- a A ship is 825 m from a 153 m cliff. Eric is at the top of the cliff looking down. Calculate the angle of depression.

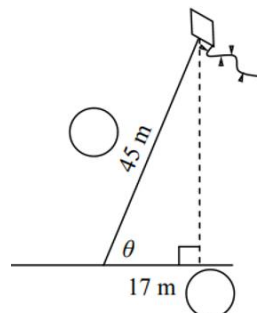


$$\boxed{} \theta = \frac{\boxed{}}{\boxed{}}$$

$$\theta = \boxed{}^{\circ}$$

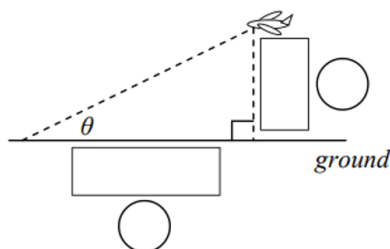
11°

- b A flying kite is attached to the ground. Its string is 45 m long. The kite is above a point 17 m away. Calculate the angle of elevation.



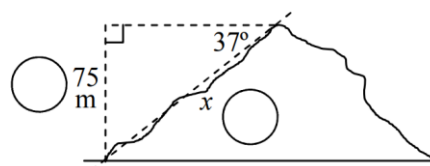
68°

- c Evie is looking up at a plane that is a ground distance of 3.7 km away and is flying at a height of 800 m. Calculate the angle of depression.



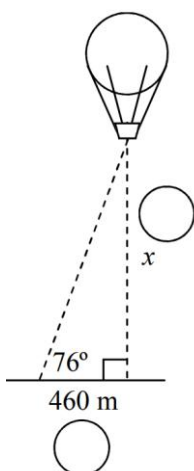
12°

- d Jill is on top of a 75 m hill. The angle of depression from the top to the base of the hill is 37°. Estimate the distance Jill travelled to climb the hill.



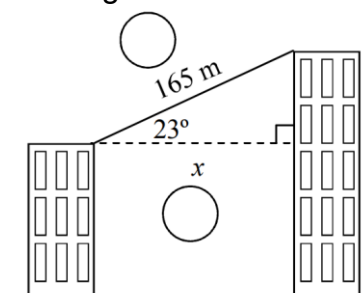
125 m

- e Ted is looking up at a hot air balloon. The angle of elevation is 76° and the balloon is above a point 460 m away. Calculate the altitude of the balloon.



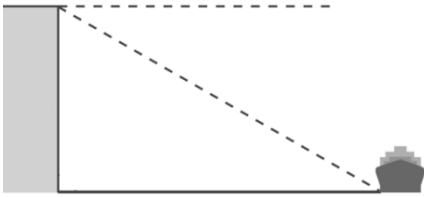
1845 m

- f Bec is set to walk a 165 m long tight-rope suspended between two buildings. The angle of elevation from the lower building is 23°. Find the distance between the two buildings.



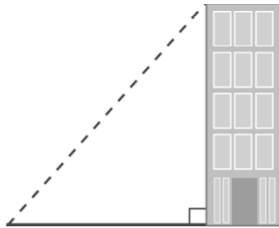
152 m

- 2 The angle of depression of a boat at sea from the top of a vertical cliff 36 m high is 10° . Calculate the distance of the boat from the base of the cliff to the nearest metre.



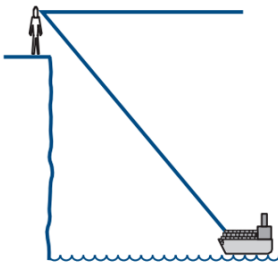
204 m

- 3 The angle of elevation of the top of a building from a point 30 m from its base is 55° . Calculate the height of the building to 1 d.p.



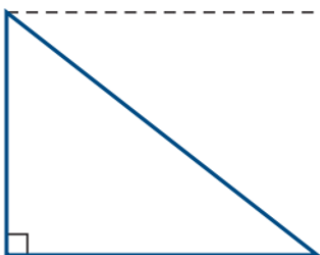
42.8 m

- 4 When Sarah looked from the top of a cliff 50 m high, she noticed a boat at an angle of depression of 25° . How far was the boat from the base of the cliff? Answer to two decimal places.



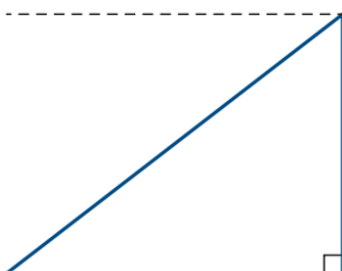
107.23 metres

- 5 An iron ore seam slopes down 120 m at an angle of depression from the horizontal of 38° . The mine engineer wishes to sink a vertical shaft. What is the depth of the required vertical shaft? Answer to the nearest metre.



74 m

- 6 A tourist viewing Sydney Harbour from a building 130 m above sea level observes a ferry 800 m from the base of the building. Find the angle of depression. Answer to the nearest degree.

 9°

- 7 The angle of elevation of the top of a castle wall from a point on the ground 25 m from the base of the castle wall is 32° . Find the height of the castle wall to the nearest metre.

16 m

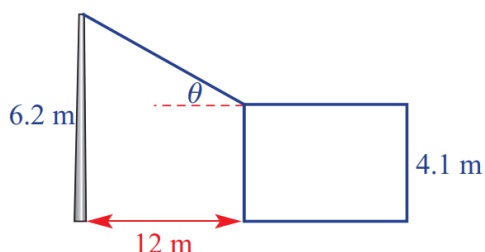
- 8 From a point on the ground, Emma measures the angle of elevation of an 80 m tower to be 27° . Find how far Emma is from the base of the tower, correct to the nearest metre.

157 m

- 9 From a ship, a person is spotted floating in the sea at a horizontal distance of 200 m from the ship. If the viewing position on the ship is 20 m above sea level, find the angle of depression from the ship to person in the sea. Give your answer to the nearest degree.

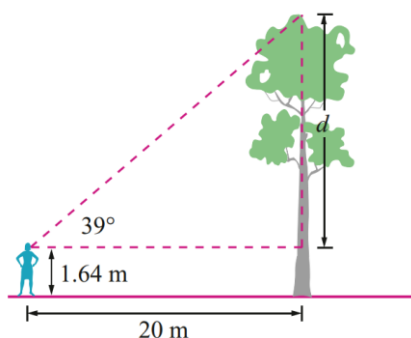
6°

- 10 A power line is stretched from a pole to the top of a house. The house is 4.1 m high and the power pole is 6.2 m tall. The horizontal distance between the house and the power pole is 12 m. Find the angle of elevation of the top of the power pole from the top of the house to the nearest degree.



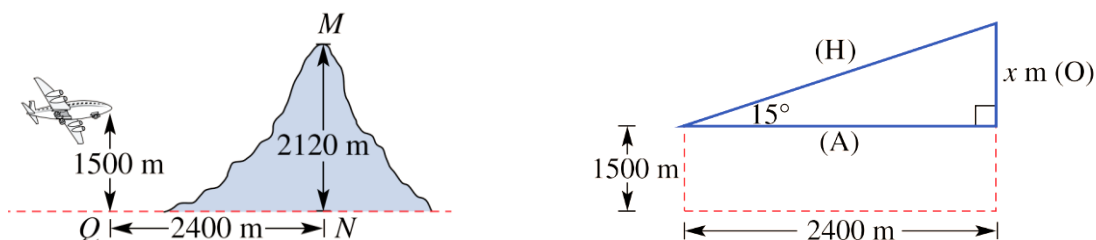
10°

- 11 From a point 20 m from the base of a tree, Sophia measures the angle of elevation of the top of the tree to be 39° . Her eye level is 1.64 m above the ground. Calculate the height of the tree in metres correct to two decimal places.



17.8 m

- 12** An aeroplane flying at an altitude of 1500 m starts to climb at an angle of 15° to the horizontal when the pilot sees a mountain peak 2120 m high, 2400 m away from him horizontally.



643.078 ...

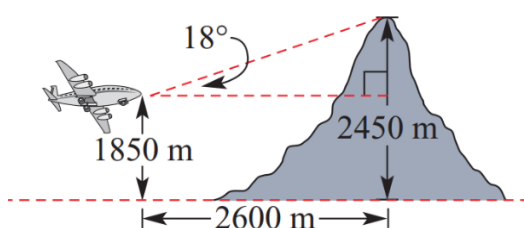
This represents how much the plane climbs if it travelled 2400 m at an angle of elevation of 15°

- a** Calculate the value of x . What does this represent?

- b** Will the aeroplane clear the mountain?

Yes, since the plane needs to climb $2120 - 1500 = 620$ m

- 13** A plane flying at 1850 m starts to climb at an angle of 18° to the horizontal when the pilot sees a mountain peak 2450 m high, 2600 m away from him in a horizontal direction. Will the pilot clear the mountain?



yes by 244.8 m

- 14** A submarine initially at sea level dives at an angle of 11° to the horizontal. At a horizontal distance of 1200 m there is an uncharted reef at a depth of 240 m. Will the submarine pass over the reef?

Yes, by 7 m

- 15** A plane has run out of fuel and is gliding at an angle of depression of $10^\circ 20'$. If it is at a height of 800 m and the airport is 4.7 km away, will it be able to reach the airport?

No, the plane can only glide 4387.6 m before crashing.

16 2019 HSC Standard 2 Band 5

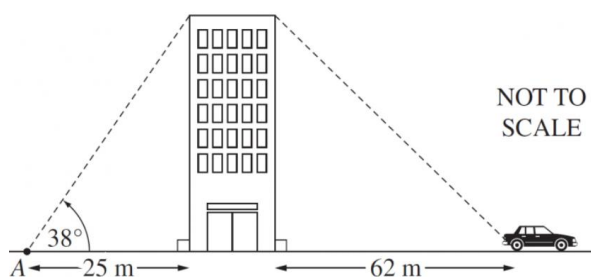
An owl is 7 metres above ground level, in a tree. The owl sees a mouse on the ground at an angle of depression of 32° .

How far must the owl fly in a straight line to catch the mouse, assuming the mouse does not move? Answer to 1 d.p.

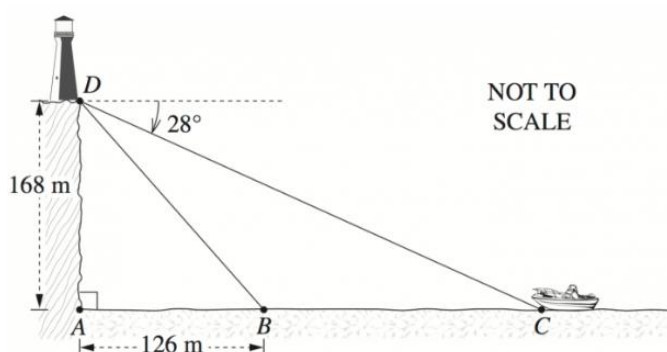
13.2 m

17 2009 HSC Standard 2 Band 5

Calculate the angle of depression from the top of the building to the car.
Answer to the nearest minute.


 $17^\circ 28'$

18 2010 HSC Standard 2 Band 5

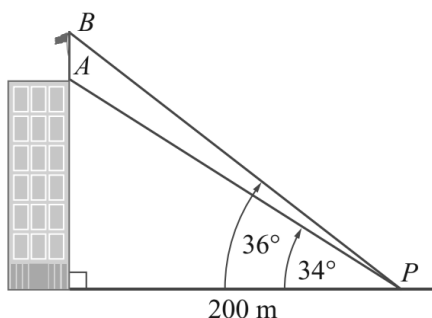


- a** Calculate the angle of depression from D to B to the nearest degree.
- b** Find the distance from C to B , to the nearest metre.

 53°

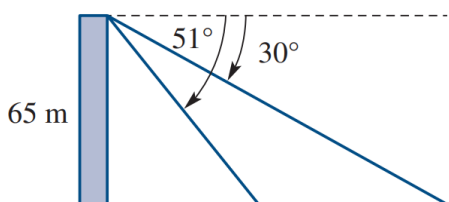
190 m

- 19** From a point P, 200 m from the base of a building, the angles of elevation of the bottom and top of a flagpole on top of the building are 34° and 36° respectively. Calculate the height, AB, of the flagpole.



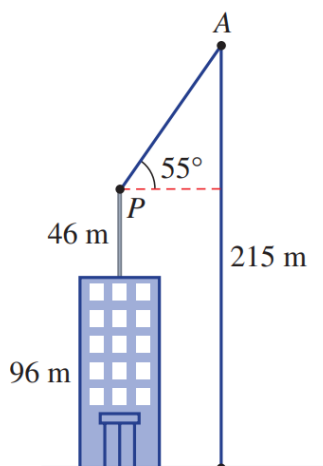
10.4 m

- 20** Jack is on the top of a 65 m high cliff. He observes a man swimming out to sea at an angle of depression of 51° . Jack also sees a boat out to sea at an angle of depression of 30° . Find, to the nearest metre, the distance between the man and the boat.



60 m

- 21** The pivot point (P) of the main supporting arm (AP) of a construction crane is 46 metres above the top of a 96-metre tall office building. When the supporting arm is at an angle of 55° to the horizontal, the length of cable dropping from the point A to the ground is 215 metres. Find the length of the main supporting arm (AP), to the nearest centimetre.



89.12 m