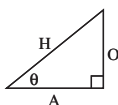


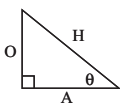
## Chapter 5

### Exercise 5A

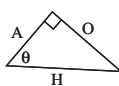
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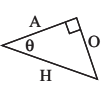
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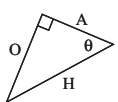
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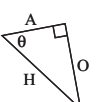
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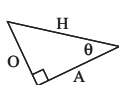
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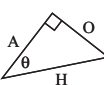
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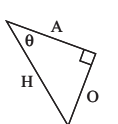
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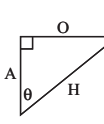
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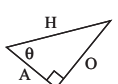
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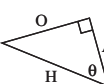
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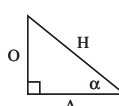
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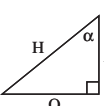
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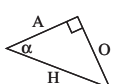
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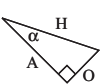
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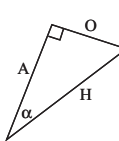
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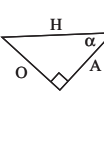
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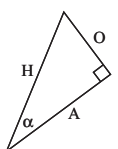
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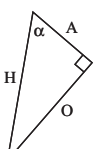
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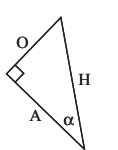
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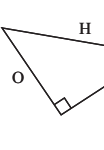
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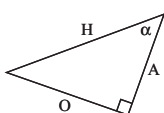
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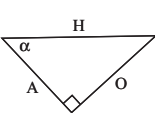
j



k



l



### Learning task 5B

2	Triangle	Length of opposite side	Length of adjacent side	Ratio: opposite side / adjacent side
	1	8.5	15.0	0.57
	2	16.5	29.0	0.57
	3	24.5	43.0	0.57
	4	32.5	57.0	0.57
	5	40.5	71.0	0.57

- 3 The ratio of the opposite side to the adjacent is approximately the same for these triangles and the average is equal to 0.57, correct to 2 decimal places.  
 $\tan 30^\circ = 0.57$

### Exercise 5C

- 1 a 1.7320      b 2.1445      c 2.7475  
 d 1.0724      e 1.2799      f 1.4826  
 g 0.4663      h 0.2679      i 0.1051  
 j 0.9004      k 0.8098      l 1.0000

- 2 The value of  $\tan 0^\circ$  to  $\tan 45^\circ$  increases from 0 to 1. The tan of angles between  $45^\circ$  and  $90^\circ$  increases from 1 to  $\infty$ .

- 3 a  $\tan 24^\circ = \frac{x}{20}$   
 $\therefore x = 20 \times \tan 24^\circ$   
 $x = 8.90 \text{ cm}$   
 b  $\tan 32^\circ = \frac{x}{46}$   
 $\therefore x = 46 \times \tan 32^\circ$   
 $x = 28.74 \text{ cm}$   
 c  $\tan 42^\circ = \frac{x}{43}$   
 $\therefore x = 43 \times \tan 42^\circ$   
 $x = 38.72 \text{ cm}$   
 d  $\tan 52^\circ = \frac{x}{33}$   
 $\therefore x = 33 \times \tan 52^\circ$   
 $x = 42.24 \text{ cm}$   
 e  $\tan 32^\circ = \frac{x}{54}$   
 $\therefore x = 54 \times \tan 32^\circ$   
 $x = 33.74 \text{ cm}$   
 f  $\tan 30^\circ = \frac{x}{94}$   
 $\therefore x = 94 \times \tan 30^\circ$   
 $x = 54.27 \text{ m}$   
 4 a  $\tan 62^\circ = \frac{76}{x}$   
 $x = 40.41 \text{ cm}$   
 b  $\tan 46^\circ = \frac{12}{x}$   
 $x = 11.59 \text{ m}$   
 c  $\tan 53^\circ = \frac{87}{x}$   
 $x = 65.56 \text{ mm}$   
 d  $\tan 42^\circ = \frac{65}{x}$   
 $x = 72.19 \text{ m}$   
 e  $\tan 53^\circ = \frac{26}{x}$   
 $x = 19.59 \text{ mm}$   
 f  $\tan 47^\circ = \frac{44}{x}$   
 $x = 41.03 \text{ m}$   
 5 a  $\tan 52^\circ = \frac{x}{67}$   
 $\therefore x = 67 \times \tan 52^\circ$   
 $x = 85.76 \text{ mm}$   
 b  $\tan 58^\circ = \frac{62}{x}$   
 $\therefore x = \frac{62}{\tan 58^\circ}$   
 $x = 38.74 \text{ m}$   
 c  $\tan 34^\circ = \frac{87}{x}$   
 $\therefore x = \frac{87}{\tan 34^\circ}$   
 $x = 128.98 \text{ cm}$   
 d  $\tan 35^\circ = \frac{x}{94}$   
 $\therefore x = 94 \times \tan 35^\circ$   
 $x = 65.82 \text{ m}$   
 e  $\tan 61^\circ = \frac{102}{x}$   
 $\therefore x = \frac{102}{\tan 61^\circ}$   
 $x = 56.54 \text{ cm}$   
 f  $\tan 21^\circ = \frac{x}{138}$   
 $\therefore x = 138 \times \tan 21^\circ$   
 $x = 52.97 \text{ m}$

### Exercise 5D

- 1 a  $60^\circ$       b  $71^\circ$       c  $57^\circ$   
 d  $80^\circ$       e  $19^\circ$       f  $37^\circ$   
 g  $44^\circ$       h  $40^\circ$       i  $45^\circ$
- 2 If the ratio of the opposite to adjacent is greater than 1, then the angle is greater than  $45^\circ$ . If the ratio is between 0 and 1, then the angle is between  $0^\circ$  and  $45^\circ$ . If the ratio is equal to 1, then the angle is equal to  $45^\circ$ .
- 3 a  $\tan \alpha = \frac{26}{41} = 0.6341$   
 $\therefore \alpha = 32.38^\circ$   
 b  $\tan \theta = \frac{44}{32} = 1.375$   
 $\therefore \theta = 53.97^\circ$   
 c  $\tan \theta = \frac{62}{78} = 0.7949$   
 $\therefore \theta = 38.48^\circ$   
 d  $\tan \alpha = \frac{87}{59} = 1.4746$   
 $\therefore \alpha = 55.86^\circ$

$$\begin{aligned} \text{e } \tan \theta &= \frac{4}{6} = 0.6667 \\ \therefore \theta &= 33.69^\circ \end{aligned}$$

$$\begin{aligned} \text{f } \tan \alpha &= \frac{56}{46} = 1.2174 \\ \therefore \alpha &= 50.60^\circ \end{aligned}$$

## Exercise 5E

$$\begin{aligned} \text{1 a } \tan 12^\circ &= \frac{x}{107} \\ x &= 107 \tan 12^\circ \\ &= 22.74 \text{ cm} \end{aligned}$$

$$\begin{aligned} \tan 17^\circ &= \frac{22.74}{y} \\ y &= \frac{22.74}{\tan 17^\circ} \\ &= 74.38 \text{ cm} \end{aligned}$$

$$\begin{aligned} \text{c } \tan 27^\circ &= \frac{x}{0.6} \\ x &= 0.6 \tan 27^\circ \\ &= 0.31 \text{ m} \\ \tan 8^\circ &= \frac{0.31}{y} \\ y &= \frac{0.31}{\tan 8^\circ} \\ &= 2.21 \text{ m} \end{aligned}$$

$$\begin{aligned} \text{2 a } \tan 27^\circ &= \frac{4}{x} \\ x &= \frac{4}{\tan 27^\circ} \\ &= 7.85 \text{ m} \end{aligned}$$

$$\begin{aligned} \tan \theta &= \frac{4}{7.2} \\ \therefore \theta &= \tan^{-1}\left(\frac{4}{7.2}\right) \\ &= 29^\circ \end{aligned}$$

$$\begin{aligned} \text{c } \tan 70^\circ &= \frac{12}{x} \\ x &= \frac{12}{\tan 70^\circ} \\ &= 4.37 \text{ m} \\ \tan \theta &= \frac{12}{45} \\ \therefore \theta &= \tan^{-1}\left(\frac{12}{45}\right) \\ &= 15^\circ \end{aligned}$$

$$\begin{aligned} \text{3 } \tan 40^\circ &= \frac{O}{6.2} \\ O &= 6.2 \tan 40^\circ \\ &= 5.2 \text{ m} \end{aligned}$$

The ladder reaches 5.2 m up the wall.

$$\begin{aligned} \text{4 } \tan 37^\circ &= \frac{O}{375+1.7} \\ O &= 376.7 \tan 37^\circ \\ &= 283.9 \text{ m} \end{aligned}$$

The tanker is 282.6 m from the cliff.

$$\begin{aligned} \text{5 a } \tan 52^\circ &= \frac{269}{A} \\ A &= \frac{269}{\tan 52^\circ} \\ &= 210.2 \text{ m} \end{aligned}$$

The boat is 210.2 m from the cliff.

$$\begin{aligned} \text{b } \tan 7^\circ &= \frac{x}{48} \\ x &= 48 \tan 7^\circ \\ &= 5.89 \text{ m} \end{aligned}$$

$$\begin{aligned} \tan 26^\circ &= \frac{5.89}{y} \\ y &= \frac{5.89}{\tan 26^\circ} \\ &= 12.08 \text{ m} \end{aligned}$$

$$\begin{aligned} \text{d } \tan 15^\circ &= \frac{x}{1.7} \\ x &= 1.7 \tan 15^\circ \\ &= 0.46 \text{ m} \end{aligned}$$

$$\begin{aligned} \tan 4^\circ &= \frac{0.46}{y} \\ y &= \frac{0.46}{\tan 4^\circ} \\ &= 6.58 \text{ m} \end{aligned}$$

$$\begin{aligned} \text{b } \tan 38^\circ &= \frac{5}{x} \\ x &= \frac{5}{\tan 38^\circ} \\ &= 6.40 \text{ m} \end{aligned}$$

$$\begin{aligned} \tan \theta &= \frac{5}{16} \\ \therefore \theta &= \tan^{-1}\left(\frac{5}{16}\right) \\ &= 17^\circ \end{aligned}$$

$$\begin{aligned} \text{d } \tan 15^\circ &= \frac{2}{x} \\ x &= \frac{2}{\tan 15^\circ} \\ &= 7.46 \text{ m} \end{aligned}$$

$$\begin{aligned} \tan \theta &= \frac{2}{5} \\ \therefore \theta &= \tan^{-1}\left(\frac{2}{5}\right) \\ &= 22^\circ \end{aligned}$$

$$\begin{aligned} \text{b } \tan \theta &= \frac{269+50}{210.2} \\ &= \frac{319}{210.2} \\ \theta &= \tan^{-1}\left(\frac{319}{210.2}\right) \\ \theta &= 56.6^\circ \end{aligned}$$

The angle of elevation from sea level to the top of the lighthouse is  $56.6^\circ$ .

$$\begin{aligned} \text{6 } \tan \theta &= \frac{1.5}{3.8} \\ \therefore \theta &= \tan^{-1}(0.39) \\ \theta &= 21.5^\circ \end{aligned}$$

$$\begin{aligned} \text{7 } \tan \theta &= \frac{12}{17.9} \\ \therefore \theta &= \tan^{-1}\left(\frac{12}{17.9}\right) \\ &= 33.8^\circ \end{aligned}$$

$$\begin{aligned} \text{8 a } \tan 20^\circ &= \frac{O}{60} \\ O &= 60 \tan 20^\circ \\ &= 21.8 \text{ cm} \end{aligned}$$

The painting is 21.8 cm high.

$$\begin{aligned} \text{b } 21.8 \div 3 \\ &= 7.3 \end{aligned}$$

Each triangle is 7.3 cm high.

## Learning task 5F

Triangle	Length of opposite side	Length of hypotenuse	Ratio: $\frac{\text{opposite side}}{\text{hypotenuse}}$
1	8.5	17	0.50
2	16.5	33	0.50
3	24.5	49	0.50
4	32.5	65	0.50
5	40.5	81	0.50

- 3 The ratio of the opposite side to the hypotenuse is the same for these triangles and equal to 0.5.  
 $\sin 30^\circ = 0.5$

## Exercise 5G

$$\begin{aligned} \text{1 a } \sin 24^\circ &= \frac{x}{38} \\ \therefore x &= 38 \times \sin 24^\circ \\ x &= 15.46 \text{ cm} \end{aligned}$$

$$\begin{aligned} \text{c } \sin 22^\circ &= \frac{z}{120} \\ \therefore z &= 120 \times \sin 22^\circ \\ z &= 44.95 \text{ mm} \end{aligned}$$

$$\begin{aligned} \text{e } \sin 22^\circ &= \frac{x}{56} \\ \therefore x &= 56 \times \sin 22^\circ \\ x &= 20.98 \text{ m} \end{aligned}$$

$$\begin{aligned} \text{g } \sin 27^\circ &= \frac{x}{63} \\ \therefore x &= 63 \times \sin 27^\circ \\ x &= 28.60 \text{ km} \end{aligned}$$

$$\begin{aligned} \text{i } \sin 32^\circ &= \frac{x}{68} \\ \therefore x &= 68 \times \sin 32^\circ \\ x &= 36.03 \text{ m} \end{aligned}$$

$$\begin{aligned} \text{b } \sin 49^\circ &= \frac{y}{94} \\ \therefore y &= 94 \times \sin 49^\circ \\ y &= 70.94 \text{ cm} \end{aligned}$$

$$\begin{aligned} \text{d } \sin 32^\circ &= \frac{a}{16} \\ \therefore a &= 16 \times \sin 32^\circ \\ a &= 8.48 \text{ cm} \end{aligned}$$

$$\begin{aligned} \text{f } \sin 35^\circ &= \frac{y}{7} \\ \therefore y &= 7 \times \sin 35^\circ \\ y &= 4.02 \text{ cm} \end{aligned}$$

$$\begin{aligned} \text{h } \sin 42^\circ &= \frac{a}{18} \\ \therefore a &= 18 \times \sin 42^\circ \\ a &= 12.04 \text{ m} \end{aligned}$$

# Fully Worked Solutions

- 2 a**  $\sin 24^\circ = \frac{x}{38}$   
 $\therefore x = 3.8 \times \sin 24^\circ$   
 $x = 1.55 \text{ cm}$
- c**  $\sin 22^\circ = \frac{a}{12.9}$   
 $\therefore a = 12.9 \times \sin 22^\circ$   
 $a = 4.83 \text{ mm}$
- e**  $\sin 35^\circ = \frac{y}{1.7}$   
 $\therefore y = 1.7 \times \sin 35^\circ$   
 $y = 0.98 \text{ cm}$
- g**  $\sin 35^\circ = \frac{a}{6.4}$   
 $\therefore a = 6.4 \times \sin 35^\circ$   
 $a = 3.67 \text{ m}$
- i**  $\sin 38^\circ = \frac{x}{5.2}$   
 $\therefore x = 5.2 \times \sin 38^\circ$   
 $x = 3.20 \text{ m}$

## Exercise 5H

- 1 a**  $\cos 44^\circ = \frac{x}{64}$   
 $\therefore x = 64 \times \cos 44^\circ$   
 $x = 46.04 \text{ cm}$
- c**  $\cos 36^\circ = \frac{z}{129}$   
 $\therefore z = 129 \times \cos 36^\circ$   
 $z = 104.36 \text{ cm}$
- e**  $\cos 19^\circ = \frac{x}{48}$   
 $\therefore x = 48 \times \cos 19^\circ$   
 $x = 45.38 \text{ cm}$
- g**  $\cos 46^\circ = \frac{a}{16}$   
 $\therefore a = 16 \times \cos 46^\circ$   
 $a = 11.11 \text{ m}$
- i**  $\cos 36^\circ = \frac{x}{102}$   
 $\therefore x = 102 \times \cos 36^\circ$   
 $x = 82.52 \text{ m}$
- 2 a**  $\cos 23^\circ = \frac{y}{9.8}$   
 $\therefore y = 9.8 \times \cos 23^\circ$   
 $y = 9.02 \text{ m}$
- c**  $\cos 48^\circ = \frac{a}{5.6}$   
 $\therefore a = 5.6 \times \cos 48^\circ$   
 $a = 3.75 \text{ cm}$
- e**  $\cos 34^\circ = \frac{x}{6.7}$   
 $\therefore x = 6.7 \times \cos 34^\circ$   
 $x = 5.55 \text{ m}$
- g**  $\cos 41^\circ = \frac{z}{7.9}$   
 $\therefore z = 7.9 \times \cos 41^\circ$   
 $z = 5.96 \text{ km}$
- i**  $\cos 52^\circ = \frac{y}{26.5}$   
 $\therefore y = 26.5 \times \cos 52^\circ$   
 $y = 16.32 \text{ mm}$
- b**  $\sin 49^\circ = \frac{y}{9.4}$   
 $\therefore y = 9.4 \times \sin 49^\circ$   
 $y = 7.09 \text{ cm}$
- d**  $\sin 32^\circ = \frac{y}{1.6}$   
 $\therefore y = 1.6 \times \sin 32^\circ$   
 $y = 0.85 \text{ cm}$
- f**  $\sin 26^\circ = \frac{x}{4.6}$   
 $\therefore x = 4.6 \times \sin 26^\circ$   
 $x = 2.02 \text{ mm}$
- h**  $\sin 54^\circ = \frac{x}{4.2}$   
 $\therefore x = 4.2 \times \sin 54^\circ$   
 $x = 3.40 \text{ mm}$
- b**  $\cos 18^\circ = \frac{y}{168}$   
 $\therefore y = 168 \times \cos 18^\circ$   
 $y = 159.78 \text{ m}$
- d**  $\cos 28^\circ = \frac{a}{28}$   
 $\therefore a = 28 \times \cos 28^\circ$   
 $a = 24.72 \text{ cm}$
- f**  $\cos 31^\circ = \frac{x}{96}$   
 $\therefore x = 96 \times \cos 31^\circ$   
 $x = 82.29 \text{ cm}$
- h**  $\cos 32^\circ = \frac{y}{9}$   
 $\therefore y = 9 \times \cos 32^\circ$   
 $y = 7.63 \text{ m}$
- b**  $\cos 37^\circ = \frac{x}{4.3}$   
 $\therefore x = 4.3 \times \cos 37^\circ$   
 $x = 3.43 \text{ m}$
- d**  $\cos 27^\circ = \frac{y}{7.6}$   
 $\therefore y = 7.6 \times \cos 27^\circ$   
 $y = 6.77 \text{ mm}$
- f**  $\cos 25^\circ = \frac{b}{9.2}$   
 $\therefore b = 9.2 \times \cos 25^\circ$   
 $b = 8.34 \text{ m}$
- h**  $\cos 33^\circ = \frac{y}{24.8}$   
 $\therefore y = 24.8 \times \cos 33^\circ$   
 $y = 20.80 \text{ mm}$

- 3** Let  $h$  be the height of the pole:

$$\cos 24^\circ = \frac{h}{48}$$

$$\therefore h = 48 \times \cos 24^\circ$$

$$h = 43.9 \text{ m}$$

The height of the pole is 43.9 m.

## Exercise 5I

- 1 a**  $\sin 67^\circ = \frac{d}{10}$   
 $\therefore d = 10 \times \sin 67^\circ$   
 $d = 9.2 \text{ m}$   
 The ladder reaches a height of 9.2 m.
- b**  $\cos 67^\circ = \frac{x}{10}$   
 $\therefore x = 10 \times \cos 67^\circ$   
 $x = 3.91 \text{ m}$   
 The distance from the foot of the ladder to the wall is 3.91 m.
- 2**  $\cos 20^\circ = \frac{d}{780}$   
 $\therefore d = 780 \times \cos 20^\circ$   
 $d = 732.96 \text{ m}$   
 The distance to the base is 733 m.
- 3** Kite A:  
 $\cos 63^\circ = \frac{a}{68}$   
 $\therefore a = 68 \times \cos 63^\circ$   
 $a = 30.87 \text{ m}$   
 The horizontal distance from kite A to Percy is 30.87 m.
- Kite B:  
 $\cos 42^\circ = \frac{b}{155}$   
 $\therefore b = 155 \times \cos 42^\circ$   
 $b = 115.19 \text{ m}$   
 The horizontal distance from kite B to Percy is 115.19 m.
- 4 a** Let the base length of the left triangular section be  $a$ :  
 $\cos 18^\circ = \frac{a}{280}$   
 $\therefore a = 280 \times \cos 18^\circ$   
 $a = 266.30 \text{ m}$   
 The base length of the left triangular section is 266.30 m.  
 Let the base length of the right triangular section be  $b$ :  
 $\cos 23^\circ = \frac{b}{320}$   
 $\therefore b = 320 \times \cos 23^\circ$   
 $b = 294.56 \text{ m}$   
 The base length of the right triangular section is 294.56 m.
- b** The maximum distance they can span is  
 $266.30 + 294.56 - 10 - 10 = 540.86 \text{ m}$ .
- 5 a** Let the bottom length of the yellow sail be  $a$ :  
 $\cos 34^\circ = \frac{a}{340}$   
 $\therefore a = 340 \times \cos 34^\circ$   
 $a = 281.87 \text{ cm}$   
 The bottom length of the yellow sail is 281.87 cm.

Let the bottom length of the blue sail be  $b$ :

$$\begin{aligned}\cos 21^\circ &= \frac{b}{530} \\ \therefore b &= 530 \times \cos 21^\circ \\ b &= 494.8 \text{ cm}\end{aligned}$$

The bottom length of the blue sail is 494.8 cm.

The length of the boom is:

$$281.87 + 494.8 = 776.67 \text{ cm}$$

$$\begin{aligned}\mathbf{b} \quad \sin 34^\circ &= \frac{h}{340} \\ \therefore h &= 340 \times \sin 34^\circ \\ h &= 190.13\end{aligned}$$

The yellow sail is 190.13 cm high.

$$\begin{aligned}\sin 21^\circ &= \frac{h}{530} \\ \therefore h &= 530 \times \sin 21^\circ \\ h &= 189.94\end{aligned}$$

The blue sail is 189.94 cm high.

- 6 a** Let the height of block  $A$  be  $a$ :

$$\begin{aligned}\sin 42^\circ &= \frac{a}{20} \\ \therefore a &= 20 \times \sin 42^\circ \\ a &= 13.38 \text{ cm}\end{aligned}$$

The height of block  $A$  is 13.38 cm.

- b** Let the height of block  $B$  be  $b$ :

$$\begin{aligned}\sin 35^\circ &= \frac{b}{32} \\ \therefore b &= 32 \times \sin 35^\circ \\ b &= 18.35 \text{ cm}\end{aligned}$$

The height of block  $B$  is 18.35 cm.

- c** Height of block  $C = 18.35 - 13.38 = 4.97 \text{ cm}$

- d** Let the base length of block  $B$  be  $c$ :

$$\begin{aligned}\cos 35^\circ &= \frac{c}{32} \\ \therefore c &= 32 \times \cos 35^\circ \\ c &= 26.21 \text{ cm}\end{aligned}$$

The base length of block  $B$  is 26.21 cm.

- e** Let the base of block  $C$  be  $d$ :

$$\begin{aligned}\therefore \text{base of block } A &= d \\ \therefore \cos 42^\circ &= \frac{d}{20} \\ d &= 20 \times \cos 42^\circ \\ d &= 14.86 \text{ cm}\end{aligned}$$

The base of block  $C$  is 14.86 cm.

## Exercise 5J

$$\begin{aligned}\mathbf{1 a} \quad \sin 42^\circ &= \frac{34}{x} \\ \therefore x &= \frac{34}{\sin 42^\circ} \\ x &= 50.81 \text{ cm}\end{aligned}$$

$$\begin{aligned}\mathbf{c} \quad \sin 52^\circ &= \frac{67}{x} \\ \therefore x &= \frac{67}{\sin 52^\circ} \\ x &= 85.02 \text{ cm}\end{aligned}$$

$$\begin{aligned}\mathbf{e} \quad \sin 49^\circ &= \frac{46}{x} \\ \therefore x &= \frac{46}{\sin 49^\circ} \\ x &= 60.95 \text{ m}\end{aligned}$$

$$\begin{aligned}\mathbf{b} \quad \sin 39^\circ &= \frac{20}{x} \\ \therefore x &= \frac{20}{\sin 39^\circ} \\ x &= 31.78 \text{ m}\end{aligned}$$

$$\begin{aligned}\mathbf{d} \quad \sin 63^\circ &= \frac{14}{x} \\ \therefore x &= \frac{14}{\sin 63^\circ} \\ x &= 15.71 \text{ cm}\end{aligned}$$

$$\begin{aligned}\mathbf{f} \quad \sin 38^\circ &= \frac{82}{x} \\ \therefore x &= \frac{82}{\sin 38^\circ} \\ x &= 133.19 \text{ mm}\end{aligned}$$

$$\begin{aligned}\mathbf{2 a} \quad \cos 16^\circ &= \frac{24}{x} \\ \therefore x &= \frac{24}{\cos 16^\circ} \\ x &= 24.97 \text{ cm}\end{aligned}$$

$$\begin{aligned}\mathbf{c} \quad \cos 34^\circ &= \frac{98}{x} \\ \therefore x &= \frac{98}{\cos 34^\circ} \\ x &= 118.21 \text{ cm}\end{aligned}$$

$$\begin{aligned}\mathbf{e} \quad \cos 22^\circ &= \frac{12}{x} \\ \therefore x &= \frac{12}{\cos 22^\circ} \\ x &= 12.94 \text{ m}\end{aligned}$$

$$\begin{aligned}\mathbf{g} \quad \cos 49^\circ &= \frac{28}{x} \\ \therefore x &= \frac{28}{\cos 49^\circ} \\ x &= 42.68 \text{ mm}\end{aligned}$$

$$\begin{aligned}\mathbf{i} \quad \cos 38^\circ &= \frac{84}{x} \\ \therefore x &= \frac{84}{\cos 38^\circ} \\ x &= 106.60 \text{ m}\end{aligned}$$

$$\begin{aligned}\mathbf{3 a} \quad \sin 64^\circ &= \frac{88}{x} \\ \therefore x &= \frac{88}{\sin 64^\circ} \\ x &= 97.91 \text{ cm}\end{aligned}$$

$$\begin{aligned}\mathbf{c} \quad \cos 29^\circ &= \frac{22}{x} \\ \therefore x &= \frac{22}{\cos 29^\circ} \\ x &= 25.15 \text{ cm}\end{aligned}$$

$$\begin{aligned}\mathbf{e} \quad \sin 25^\circ &= \frac{76}{x} \\ \therefore x &= \frac{76}{\sin 25^\circ} \\ x &= 179.83 \text{ cm}\end{aligned}$$

$$\begin{aligned}\mathbf{g} \quad \cos 68^\circ &= \frac{52}{x} \\ \therefore x &= \frac{52}{\cos 68^\circ} \\ x &= 138.81 \text{ cm}\end{aligned}$$

- 4** Support A:

$$\begin{aligned}\sin 48^\circ &= \frac{19}{x} \\ \therefore x &= \frac{19}{\sin 48^\circ} \\ x &= 25.57 \text{ m}\end{aligned}$$

Support A is 25.57 m long.

Support B:

$$\begin{aligned}\cos 36^\circ &= \frac{4.8}{x} \\ \therefore x &= \frac{4.8}{\cos 36^\circ} \\ x &= 5.93 \text{ m}\end{aligned}$$

Support B is 5.93 m long.

$$\begin{aligned}\mathbf{b} \quad \cos 26^\circ &= \frac{18}{x} \\ \therefore x &= \frac{18}{\cos 26^\circ} \\ x &= 20.03 \text{ m}\end{aligned}$$

$$\begin{aligned}\mathbf{d} \quad \cos 42^\circ &= \frac{82}{x} \\ \therefore x &= \frac{82}{\cos 42^\circ} \\ x &= 110.34 \text{ m}\end{aligned}$$

$$\begin{aligned}\mathbf{f} \quad \cos 33^\circ &= \frac{52}{x} \\ \therefore x &= \frac{52}{\cos 33^\circ} \\ x &= 62.00 \text{ cm}\end{aligned}$$

$$\begin{aligned}\mathbf{h} \quad \cos 26^\circ &= \frac{56}{x} \\ \therefore x &= \frac{56}{\cos 26^\circ} \\ x &= 62.31 \text{ km}\end{aligned}$$

$$\begin{aligned}\mathbf{b} \quad \cos 53^\circ &= \frac{46}{x} \\ \therefore x &= \frac{46}{\cos 53^\circ} \\ x &= 76.44 \text{ m}\end{aligned}$$

$$\begin{aligned}\mathbf{d} \quad \cos 62^\circ &= \frac{34}{x} \\ \therefore x &= \frac{34}{\cos 62^\circ} \\ x &= 72.42 \text{ cm}\end{aligned}$$

$$\begin{aligned}\mathbf{f} \quad \cos 61^\circ &= \frac{29}{x} \\ \therefore x &= \frac{29}{\cos 61^\circ} \\ x &= 59.82 \text{ m}\end{aligned}$$

$$\begin{aligned}\mathbf{h} \quad \sin 36^\circ &= \frac{82}{x} \\ \therefore x &= \frac{82}{\sin 36^\circ} \\ x &= 139.51 \text{ cm}\end{aligned}$$

# Fully Worked Solutions

Support C:

$$\begin{aligned}\cos 24^\circ &= \frac{6.2}{x} \\ \therefore x &= \frac{6.2}{\cos 24^\circ} \\ x &= 6.79 \text{ m}\end{aligned}$$

Support C is 6.79 m long.

Support D:

$$\begin{aligned}\sin 52^\circ &= \frac{22}{x} \\ \therefore x &= \frac{22}{\sin 52^\circ} \\ x &= 27.92 \text{ m}\end{aligned}$$

Support D is 27.92 m long.

## Exercise 5K

**1 a**  $\sin \theta = \frac{34}{48}$   
 $\therefore \theta = 45.10^\circ$

**c**  $\sin \theta = \frac{53}{85}$   
 $\therefore \theta = 38.57^\circ$

**e**  $\sin \theta = \frac{28}{32}$   
 $\therefore \theta = 61.04^\circ$

**g**  $\sin \theta = \frac{45}{55}$   
 $\therefore \theta = 54.90^\circ$

**i**  $\sin \theta = \frac{34}{45}$   
 $\therefore \theta = 49.07^\circ$

**2 a**  $\cos \theta = \frac{30}{48}$   
 $\therefore \theta = 51.32^\circ$

**c**  $\cos \theta = \frac{49}{65}$   
 $\therefore \theta = 41.08^\circ$

**e**  $\cos \theta = \frac{32}{46}$   
 $\therefore \theta = 45.92^\circ$

**g**  $\cos \theta = \frac{48}{56}$   
 $\therefore \theta = 31.00^\circ$

**i**  $\cos \theta = \frac{88}{99}$   
 $\therefore \theta = 27.27^\circ$

**3 a**  $\sin \theta = \frac{88}{94}$   
 $\therefore \theta = 69.42^\circ$

**c**  $\sin \theta = \frac{42}{66}$   
 $\therefore \theta = 39.52^\circ$

**e**  $\sin \theta = \frac{37}{46}$   
 $\therefore \theta = 53.55^\circ$

**g**  $\cos \theta = \frac{86}{108}$   
 $\therefore \theta = 37.22^\circ$

**i**  $\sin \theta = \frac{67}{85}$   
 $\therefore \theta = 52.02^\circ$

**b**  $\sin \theta = \frac{12}{34}$   
 $\therefore \theta = 20.67^\circ$

**d**  $\sin \theta = \frac{18}{22}$   
 $\therefore \theta = 54.90^\circ$

**f**  $\sin \theta = \frac{30}{45}$   
 $\therefore \theta = 41.81^\circ$

**h**  $\sin \theta = \frac{38}{42}$   
 $\therefore \theta = 64.79^\circ$

**b**  $\cos \theta = \frac{15}{24}$   
 $\therefore \theta = 51.32^\circ$

**d**  $\cos \theta = \frac{22}{38}$   
 $\therefore \theta = 54.62^\circ$

**f**  $\cos \theta = \frac{40}{65}$   
 $\therefore \theta = 52.02^\circ$

**h**  $\cos \theta = \frac{32}{48}$   
 $\therefore \theta = 48.19^\circ$

**b**  $\cos \theta = \frac{46}{52}$   
 $\therefore \theta = 27.80^\circ$

**d**  $\cos \theta = \frac{44}{53}$   
 $\therefore \theta = 33.88^\circ$

**f**  $\sin \theta = \frac{44}{64}$   
 $\therefore \theta = 43.43^\circ$

**h**  $\cos \theta = \frac{82}{94}$   
 $\therefore \theta = 29.27^\circ$

**j**  $\cos \theta = \frac{28}{49}$   
 $\therefore \theta = 55.15^\circ$

**k**  $\cos \theta = \frac{64}{490}$   
 $\therefore \theta = 82.50^\circ$

**l**  $\sin \theta = \frac{67}{83}$   
 $\therefore \theta = 53.83^\circ$

**4**  $\sin \theta = \frac{4.8}{15.6}$   
 $\therefore \theta = 17.92^\circ$

The escalator makes an angle of  $17.92^\circ$  with the horizontal.

**5 a**  $\cos \theta = \frac{1.2}{4.8} = 0.25$   
 $\therefore \theta = 75.52^\circ$

Ladder A makes an angle of  $75.52^\circ$  with the ground.

$\cos \theta = \frac{2.5}{4.8}$   
 $\therefore \theta = 58.61^\circ$

Ladder B makes an angle of  $58.61^\circ$  with the ground.

$\sin \theta = \frac{3.6}{4.8}$   
 $\therefore \theta = 48.59^\circ$

Ladder C makes an angle of  $48.59^\circ$  with the ground.

**b**  $\sin \theta = \frac{1.2}{4.8}$   
 $\therefore \theta = 14.48^\circ$

Ladder A makes an angle of  $14.48^\circ$  with the wall.

$\sin \theta = \frac{2.5}{4.8}$   
 $\therefore \theta = 31.39^\circ$

Ladder B makes an angle of  $31.39^\circ$  with the wall.

$\cos \theta = \frac{3.6}{4.8}$   
 $\therefore \theta = 41.41^\circ$

Ladder C makes an angle of  $41.41^\circ$  with the wall.

**6**  $\cos \theta = \frac{2.8}{5.1}$   
 $\therefore \theta = 56.70^\circ$

The angle  $\theta$  equals  $57^\circ$ .

$\cos \alpha = \frac{1.6}{2.2}$   
 $\therefore \alpha = 43.34^\circ$

The angle  $\alpha$  equals  $43^\circ$ .

**7** Let  $h$  = height of the pole where the wires attach:  
 $h = 6.8 - 1.5 = 5.3$  m

Let  $\theta_1$  be the angle the first wire makes with the ground:

$\sin \theta_1 = \frac{5.3}{8.2}$   
 $\therefore \theta_1 = 40.27^\circ$

The angle the first wire makes with the ground is  $40.27^\circ$ .

Let  $\theta_2$  be the angle the second wire makes with the ground:

$\sin \theta_2 = \frac{5.3}{6}$   
 $\therefore \theta_2 = 62.05^\circ$

The angle the second wire makes with the ground is  $62.05^\circ$ .

**8 a** Let  $\theta_1, \theta_2, \theta_3$  and  $\theta_4$  be the angles the lines  $AC, AD, AE$  and  $AF$  make with the base:

$AC: \cos \theta_1 = \frac{150}{165}$   
 $\therefore \theta_1 = 24.62^\circ$

$AC$  makes an angle of  $24.62^\circ$  with the base.

$$AD: \cos \theta_2 = \frac{150}{190}$$

$$\therefore \theta_2 = 37.86^\circ$$

$AD$  makes an angle of  $37.86^\circ$  with the base.

$$AE: \cos \theta_3 = \frac{150}{220}$$

$$\therefore \theta_3 = 47.01^\circ$$

$AE$  makes an angle of  $47.01^\circ$  with the base.

$$AF: \cos \theta_4 = \frac{150}{240}$$

$$\therefore \theta_4 = 51.32^\circ$$

$AF$  makes an angle of  $51.32^\circ$  with the base.

- b** Let  $\theta_1$ ,  $\theta_2$ ,  $\theta_3$  and  $\theta_4$  be the angles the lines  $AC$ ,  $AD$ ,  $AE$  and  $AF$  make with the edge:

$$AC: \sin \theta_1 = \frac{150}{165}$$

$$\therefore \theta_1 = 65.38^\circ$$

$AC$  makes an angle of  $65.38^\circ$  with the edge.

$$AD: \sin \theta_2 = \frac{150}{190}$$

$$\therefore \theta_2 = 52.14^\circ$$

$AD$  makes an angle of  $52.14^\circ$  with the edge.

$$AE: \sin \theta_3 = \frac{150}{220}$$

$$\therefore \theta_3 = 42.99^\circ$$

$AE$  makes an angle of  $42.99^\circ$  with the edge.

$$AF: \sin \theta_4 = \frac{150}{240}$$

$$\therefore \theta_4 = 38.68^\circ$$

$AF$  makes an angle of  $38.68^\circ$  with the edge.

**9 a**  $\sin \angle BAF = \frac{4}{5}$

$$\therefore \angle BAF = 53.13^\circ$$

**b**  $\cos \angle ABF = \frac{4}{5}$

$$\therefore \angle ABF = 36.87^\circ$$

**c**  $\sin \angle FEB = \frac{4}{6}$

$$\therefore \angle FEB = 41.81^\circ$$

**d**  $\cos \angle EBF = \frac{4}{6}$

$$\therefore \angle EBF = 48.19^\circ$$

**e**  $\sin \angle BED = \frac{5}{6}$

$$\therefore \angle BED = 56.44^\circ$$

**f**  $\cos \angle DBE = \frac{5}{6}$

$$\therefore \angle DBE = 33.56^\circ$$

**g**  $\cos \angle DBC = \frac{5}{10}$

$$\therefore \angle DBC = 60^\circ$$

**h**  $\sin \angle DCB = \frac{5}{10}$

$$\therefore \angle DCB = 30^\circ$$

## Puzzles

- 1 The square root of course
- 2 They don't believe in dogs
- 3 Dog diskettes
- 4 The high pot in use

## Applications and Activities

### Shooting for goal

**a**

$x$	$\theta$
5 m	$= \tan^{-1}\left(\frac{26.83}{5}\right) - \tan^{-1}\left(\frac{23.17}{5}\right)$ $= 1.6^\circ$
10 m	$= \tan^{-1}\left(\frac{26.83}{10}\right) - \tan^{-1}\left(\frac{23.17}{10}\right)$ $= 2.9^\circ$
15 m	$= \tan^{-1}\left(\frac{26.83}{15}\right) - \tan^{-1}\left(\frac{23.17}{15}\right)$ $= 3.7^\circ$
20 m	$= \tan^{-1}\left(\frac{26.83}{20}\right) - \tan^{-1}\left(\frac{23.17}{20}\right)$ $= 4.1^\circ$
25 m	$= \tan^{-1}\left(\frac{26.83}{25}\right) - \tan^{-1}\left(\frac{23.17}{25}\right)$ $= 4.2^\circ$
30 m	$= \tan^{-1}\left(\frac{26.83}{30}\right) - \tan^{-1}\left(\frac{23.17}{30}\right)$ $= 4.1^\circ$

The largest goal angle is  $4.2^\circ$  when  $x = 24.9$  m.

**b**

$x$	$\theta$
15 m	$= \tan^{-1}\left(\frac{35.66}{15}\right) - \tan^{-1}\left(\frac{28.34}{15}\right)$ $= 5.1^\circ$
20 m	$= \tan^{-1}\left(\frac{35.66}{20}\right) - \tan^{-1}\left(\frac{28.34}{20}\right)$ $= 5.9^\circ$
25 m	$= \tan^{-1}\left(\frac{35.66}{25}\right) - \tan^{-1}\left(\frac{28.34}{25}\right)$ $= 6.4^\circ$
30 m	$= \tan^{-1}\left(\frac{35.66}{30}\right) - \tan^{-1}\left(\frac{28.34}{30}\right)$ $= 6.6^\circ$
35 m	$= \tan^{-1}\left(\frac{35.66}{35}\right) - \tan^{-1}\left(\frac{28.34}{35}\right)$ $= 6.5^\circ$
40 m	$= \tan^{-1}\left(\frac{35.66}{40}\right) - \tan^{-1}\left(\frac{28.34}{40}\right)$ $= 6.4^\circ$

The largest angle is  $6.6^\circ$  when  $x = 31.8$  m.

### Measuring the tangent of an angle

Triangle	Angle	Height	Tangent of the angle
1	$45^\circ$	1.0 cm	1.00
2	$50^\circ$	1.2 cm	1.19
3	$55^\circ$	1.4 cm	1.43
4	$60^\circ$	1.7 cm	1.73
5	$65^\circ$	2.1 cm	2.14
6	$70^\circ$	2.7 cm	2.75
7	$75^\circ$	3.7 cm	3.73
8	$80^\circ$	5.7 cm	5.67
9	$85^\circ$	11.4 cm	11.43
10	$90^\circ$	Can't do	Not possible

# Fully Worked Solutions

## Enrichment and Extension

1 a  $\cos 25^\circ = \frac{12}{d(AE)}$   
 $\therefore d(AE) = \frac{12}{\cos 25^\circ}$   
 $d(AE) = 13.24 \text{ cm}$

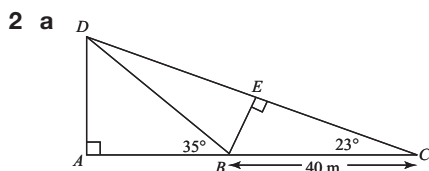
b  $\tan 25^\circ = \frac{d(BE)}{12}$   
 $\therefore d(BE) = 12 \times \tan 25^\circ$   
 $d(BE) = 5.60 \text{ cm}$

c  $\tan 57^\circ = \frac{d(ED)}{5.60}$   
 $\therefore d(ED) = 5.60 \times \tan 57^\circ$   
 $d(ED) = 8.62 \text{ cm}$

d  $\cos 57^\circ = \frac{5.60}{d(BD)}$   
 $\therefore d(BD) = \frac{5.60}{\cos 57^\circ}$   
 $d(BD) = 10.27 \text{ cm}$

e  $\sin 68^\circ = \frac{d(BC)}{10.27}$   
 $\therefore d(BC) = 10.27 \times \sin 68^\circ$   
 $d(BC) = 9.53 \text{ cm}$

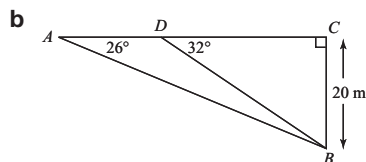
f  $\cos 68^\circ = \frac{d(CD)}{10.27}$   
 $\therefore d(CD) = 10.27 \times \cos 68^\circ$   
 $d(CD) = 3.85 \text{ cm}$



$\sin 23^\circ = \frac{d(BE)}{40}$   
 $\therefore d(BE) = 40 \times \sin 23^\circ$   
 $d(BE) = 15.63 \text{ m}$   
 $\angle CBE = 90^\circ - 23^\circ = 67^\circ$   
 $\angle DBE = 180^\circ - 35^\circ - 67^\circ = 78^\circ$

$\cos 78^\circ = \frac{15.63}{d(BD)}$   
 $\therefore d(BD) = \frac{15.63}{\cos 78^\circ}$   
 $d(BD) = 75.17 \text{ m}$

$\sin 35^\circ = \frac{d(AD)}{75.17}$   
 $\therefore d(AD) = 75.17 \times \sin 35^\circ$   
 $d(AD) = 43 \text{ m}$

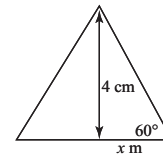


$\tan 26^\circ = \frac{20}{d(AC)}$   
 $\therefore d(AC) = \frac{20}{\tan 26^\circ} = 41.01 \text{ m}$

$\tan 32^\circ = \frac{29}{d(CD)}$   
 $\therefore d(CD) = \frac{29}{\tan 32^\circ} = 32.01 \text{ m}$   
 $\therefore d(AD) = d(AC) - d(CD)$   
 $= 9 \text{ m}$

3  $\tan 60^\circ = \frac{4}{x}$   
 $\therefore x = \frac{4}{\tan 60^\circ}$   
 $x = 2.31 \text{ m}$

The side lengths are equal to  $2 \times x = 4.62 \text{ cm}$ .



4 a The angle ( $\alpha$ ) the vertical strut makes with the ground can be calculated.

$\cos \alpha = \frac{2}{8}$   
 $\therefore \alpha = \cos^{-1}(0.25)$   
 $\alpha = 75.52^\circ$

i  $h = 2 \times \tan 75.52^\circ$   
 $h = 7.75 \text{ m}$

ii  $\tan \theta = \frac{7.75}{14}$   
 $\theta = \tan^{-1}\left(\frac{7.75}{14}\right)$   
 $\theta = 28.97^\circ$

b The angle ( $\alpha$ ) the vertical strut makes with the ground can be calculated.

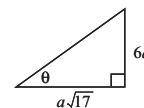
$\cos \alpha = \frac{2}{14}$   
 $\therefore \alpha = \cos^{-1}(0.14)$   
 $\alpha = 81.79^\circ$

i  $h = 2 \times \tan 81.79^\circ$   
 $h = 13.86 \text{ m}$

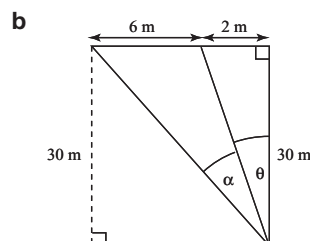
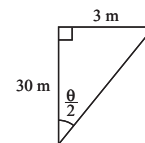
ii  $\tan \theta = \frac{13.86}{22}$   
 $\theta = 32.21^\circ$

5  $x = \sqrt{(4a)^2 + a^2}$   
 $= \sqrt{16a^2 + a^2}$   
 $= \sqrt{17a^2}$   
 $x = a\sqrt{17}$

$\tan \theta = \frac{6a}{a\sqrt{17}}$   
 $= \frac{6}{\sqrt{17}}$   
 $\theta = \tan^{-1} \frac{6}{\sqrt{17}}$   
 $\therefore \theta = 55.5^\circ$

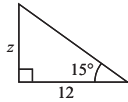


6 a  $\tan \frac{\theta}{2} = \frac{3}{30}$   
 $\therefore \frac{\theta}{2} = \tan^{-1}(0.1)$   
 $\frac{\theta}{2} = 5.7^\circ$   
 $\theta = 11.42^\circ$

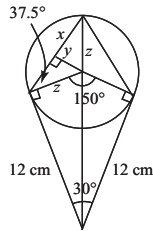


$\theta = \tan^{-1} \frac{2}{30} = 3.81^\circ$   
 $\theta + \alpha = \tan^{-1} \frac{8}{30}$   
 $= 14.93^\circ$   
 $\alpha = 14.93^\circ - 3.81^\circ$   
 $\therefore \alpha = 11.12^\circ$

**7 a**  $\tan 15^\circ = \frac{z}{12}$   
 $\therefore z = \tan 15^\circ \times 12$   
 $z = \text{radius of circle}$   
 $\text{Area} = \pi r^2$   
 $= \pi \times (\tan 15^\circ \times 12)^2$   
 $= 32.48 \text{ cm}^2$



**b**  $\sin 37.5^\circ = \frac{y}{3.2}$   
 $\therefore y = 3.2 \sin 37.5^\circ$   
 $y = 1.95 \text{ cm}$   
 $\cos 37.5^\circ = \frac{x}{3.2}$   
 $\therefore x = 3.2 \cos 37.5^\circ$   
 $x = 2.5 \text{ cm}$



$\text{Area of } \Delta = \frac{1}{2}(b \times h)$   
 $= \frac{1}{2}(1.95 \times 2.5)$   
 $= 2.4 \text{ cm}^2$

$\text{Area of shaded section} = 2.4 \times 4 = 9.6 \text{ cm}^2.$

**8** Let the height of the cliff be  $x$  and the height of the lighthouse be  $l$ :

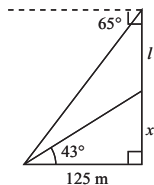
$\tan 43^\circ = \frac{x}{125}$   
 $\therefore x = 125 \times \tan 43^\circ$   
 $x = 116.56 \text{ m}$

$\tan 25^\circ = \frac{125}{x+l}$   
 $\therefore x+l = \frac{125}{\tan 25^\circ}$

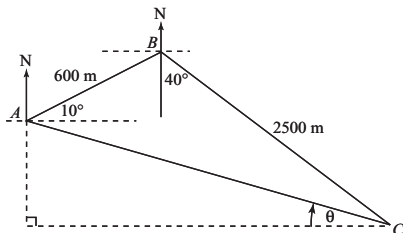
$x+l = 268.06 \text{ m}$

$268.06 - 116.56 = 151.50$

The height of the lighthouse is 151.50 m.



**9**



Total distance east:  
 $600 \cos 10^\circ + 2500 \sin 40^\circ$   
 $= 590.88 + 1606.97$   
 $= 2197.85 \text{ m}$

Total distance south from A:  
 $2500 \cos 40^\circ - 600 \sin 10^\circ$   
 $= 1915.11 - 104.19$   
 $= 1810.92 \text{ m}$

Distance AC:

$\sqrt{2197.85^2 + 1810.92^2}$   
 $= 2847.80$

Total distance of A from C is 2847.80 m.

Bearing of A from C:

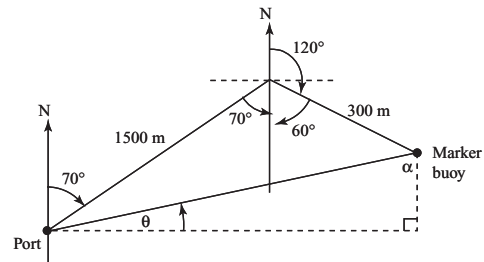
$\tan \theta = \frac{1810.92}{2197.85}$

$\therefore \theta = 39.49^\circ$

$\therefore \text{Bearing: } 270^\circ + 39.49^\circ$   
 $= 309.49^\circ$

Bearing of A from C is  $309.49^\circ$ T

**10**



**a** Total distance east from port to marker buoy:

$1500 \sin 70^\circ + 300 \sin 60^\circ$   
 $= 1409.54 + 259.81$   
 $= 1669.35 \text{ m}$

Total distance north from port to marker buoy:

$1500 \cos 70^\circ - 300 \cos 60^\circ$   
 $= 513.03 - 150$   
 $= 363.03 \text{ m}$

Distance between port and buoy:

$\sqrt{1669.35^2 + 363.03^2} = 1708.37 \text{ m}$

**b i**  $\tan \theta = \frac{363.03}{1669.35}$

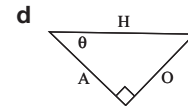
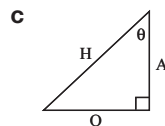
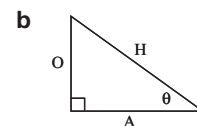
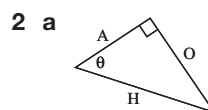
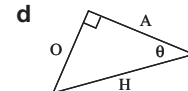
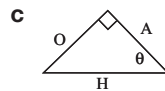
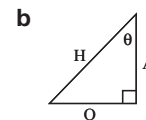
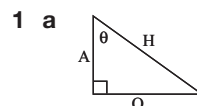
$\therefore \theta = 12.3^\circ$

Bearing:  $12.3^\circ$ T

**ii**  $\alpha = 90 - 12.3^\circ = 77.7^\circ$

Bearing:  $180^\circ + 77.7^\circ = 257.7^\circ$ T

## Revision Questions



**3 a**  $\tan 28^\circ = \frac{x}{28}$   
 $\therefore x = 28 \times \tan 28^\circ$   
 $x = 14.89 \text{ m}$

**b**  $\tan 61^\circ = \frac{57}{x}$   
 $\therefore x = \frac{57}{\tan 61^\circ}$   
 $x = 31.60 \text{ km}$

**c**  $\tan 27^\circ = \frac{45}{x}$   
 $\therefore x = \frac{45}{\tan 27^\circ}$   
 $x = 88.32 \text{ m}$

**d**  $\tan \theta = \frac{8}{9.07}$   
 $\therefore \theta = \tan^{-1}\left(\frac{8}{9.07}\right)$   
 $\theta = 41.41^\circ$

**e**  $\tan \theta = \frac{78}{96}$   
 $\therefore \theta = \tan^{-1}\left(\frac{78}{96}\right)$   
 $\theta = 39.09^\circ$

**f**  $\tan \theta = \frac{43}{61}$   
 $\therefore \theta = \tan^{-1}(0.70)$   
 $\theta = 35.18^\circ$



# Fully Worked Solutions

$$4 \quad \tan 32^\circ = \frac{x}{12}$$

$$\therefore x = 12 \times \tan 32^\circ$$

$$x = 7.50 \text{ m}$$

$$\tan 22^\circ = \frac{7.5}{y}$$

$$\therefore y = \frac{7.5}{\tan 22^\circ}$$

$$y = 18.56 \text{ m}$$

$$5 \text{ a} \quad \sin 24^\circ = \frac{x}{56}$$

$$\therefore x = 56 \times \sin 24^\circ$$

$$x = 22.78 \text{ cm}$$

$$\text{c} \quad \sin 22^\circ = \frac{z}{134}$$

$$\therefore z = 134 \times \sin 22^\circ$$

$$z = 50.20 \text{ mm}$$

$$6 \text{ a} \quad \cos 27^\circ = \frac{y}{5}$$

$$\therefore y = 5 \times \cos 27^\circ$$

$$y = 4.46 \text{ m}$$

$$\text{c} \quad \cos 18^\circ = \frac{z}{7.2}$$

$$\therefore z = 7.2 \times \cos 18^\circ$$

$$z = 6.85 \text{ km}$$

$$7 \quad \sin 18^\circ = \frac{h}{180}$$

$$\therefore h = 180 \times \sin 18^\circ$$

$$h = 55.62 \text{ m}$$

The vertical drop is 55.62 m.

$$\text{b} \quad \sin 49^\circ = \frac{y}{502}$$

$$\therefore y = 502 \times \sin 49^\circ$$

$$y = 378.86 \text{ m}$$

$$\text{d} \quad \sin 32^\circ = \frac{a}{16}$$

$$\therefore a = 16 \times \sin 32^\circ$$

$$a = 8.48 \text{ km}$$

$$\text{b} \quad \cos 32^\circ = \frac{x}{32}$$

$$\therefore x = 32 \times \cos 32^\circ$$

$$x = 27.14 \text{ cm}$$

$$\text{d} \quad \cos 51^\circ = \frac{a}{34}$$

$$\therefore a = 34 \times \cos 51^\circ$$

$$a = 21.40 \text{ m}$$

$$8 \text{ a} \quad \cos 49^\circ = \frac{78}{y}$$

$$\therefore y = \frac{78}{\cos 49^\circ}$$

$$y = 118.89 \text{ cm}$$

$$\text{c} \quad \sin 29^\circ = \frac{46}{a}$$

$$\therefore a = \frac{46}{\sin 29^\circ}$$

$$a = 94.88 \text{ m}$$

$$9 \quad \sin 25^\circ = \frac{12}{x}$$

$$\therefore x = \frac{12}{\sin 25^\circ}$$

$$x = 28.39 \text{ m}$$

$$10 \text{ a} \quad \cos \theta = \frac{67}{91}$$

$$\therefore \theta = \cos^{-1}\left(\frac{67}{91}\right)$$

$$\theta = 42.6^\circ$$

$$\text{c} \quad \sin \theta = \frac{14}{18}$$

$$\therefore \theta = \sin^{-1}\left(\frac{14}{18}\right)$$

$$\theta = 51.1^\circ$$

$$11 \quad \cos \theta = \frac{2.4}{3.8}$$

$$\therefore \theta = \cos^{-1}\left(\frac{2.4}{3.8}\right)$$

$$\theta = 50.83^\circ$$

The angle the ladder makes with the ground is  $50.83^\circ$ .

$$\text{b} \quad \sin 57^\circ = \frac{91}{x}$$

$$\therefore x = \frac{91}{\sin 57^\circ}$$

$$x = 108.51 \text{ m}$$

$$\text{d} \quad \cos 39^\circ = \frac{67}{z}$$

$$\therefore z = \frac{67}{\cos 39^\circ}$$

$$z = 86.21 \text{ mm}$$

$$\sin 45^\circ = \frac{12}{y}$$

$$\therefore y = \frac{12}{\sin 45^\circ}$$

$$y = 16.97 \text{ m}$$

$$\text{b} \quad \cos \theta = \frac{52}{73}$$

$$\therefore \theta = \cos^{-1}\left(\frac{52}{73}\right)$$

$$\theta = 44.6^\circ$$

$$\text{d} \quad \sin \theta = \frac{75}{98}$$

$$\therefore \theta = \sin^{-1}\left(\frac{75}{98}\right)$$

$$\theta = 49.9^\circ$$