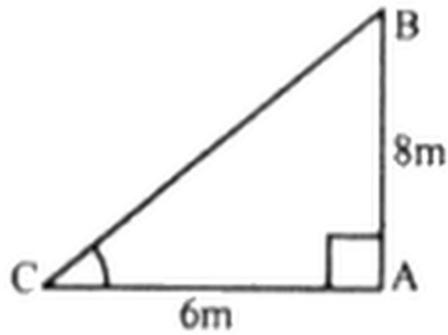


Exercise 12.3

1. A vertical pole is 8 m high and the length of its shadow is 6 m. What is the angle of elevation of the sun at that moment?



Solution

Let the angle of elevation = x

$$\tan x^\circ = \frac{|AB|}{|AC|}$$

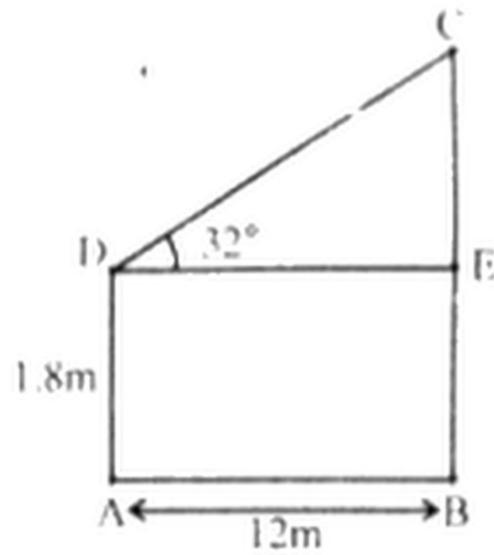
$$\tan x^\circ = \frac{8}{6} = 1.333$$

$$x = \tan^{-1}(1.33)$$

$$x = 53^\circ 7' 48''$$

Hence, the angle of elevation = $53^\circ 7' 48''$

2. A man 18 dm tall observes that the angle of elevation of the top of a tree at a distance of 12 m from the man is 32° . What is the height of the tree?



Solution

Let the height of the tree = x

height of man = 18 dm

$$= 1.8 \text{ m}$$

In fig $|AB| = |DE| = 12\text{m}$

And

$$|EC| = |BC| = |EB|$$

$$|EC| = x - |EB| = x - 1.8$$

$$\tan 32^\circ = \frac{|EC|}{|DE|}$$

$$\tan 32^\circ = \frac{x - 1.8}{12}$$

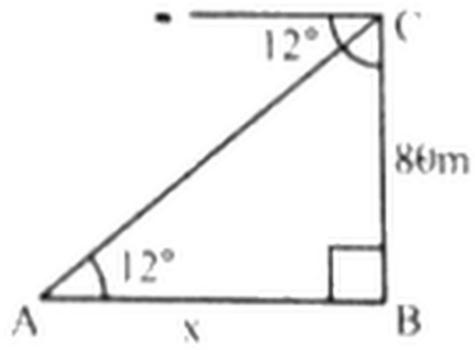
$$x - 1.8 = 12(\tan 32^\circ)$$

$$x = 1.8 + 7.498 = 9.298$$

$$x = 9.30 \text{ m}$$

hence, the height of the tree = 9.30 m

3. At the top of a cliff 80 m high, the angle of depression of a boat is 12° . How far is the boat from the cliff?



Solution

Let the distance between the boat and the cliff = x

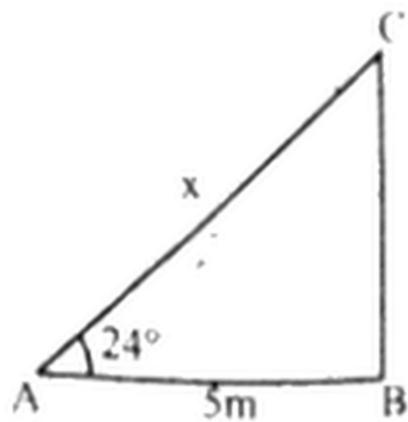
$$\tan 12^\circ = \frac{80}{x}$$

$$x = \frac{80}{\tan 12^\circ}$$

$$x = \frac{80}{0.212} = 376.37 \text{ m}$$

Hence, the distance between the boat and the cliff = 376.37 m

4. A ladder leaning against a vertical wall makes an angle of 24° with the wall. Its foot is 5 m from the wall. Find its length.



Solution

Let the length of ladder = x m

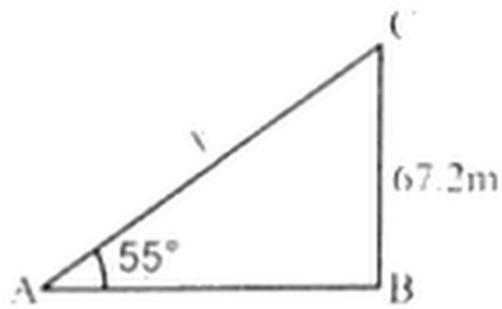
$$\cos 24^\circ = \frac{5}{x}$$

$$x = \frac{5}{\cos 24^\circ} = \frac{5}{0.9135}$$

$$x = 5.47 \text{ m}$$

Hence, the length of ladder = 5.47 m

5. A kite flying at a height of 67.2 m is attached to a fully stretched string inclined at an angle of 55° to the horizontal. Find the length of the string.



Solution

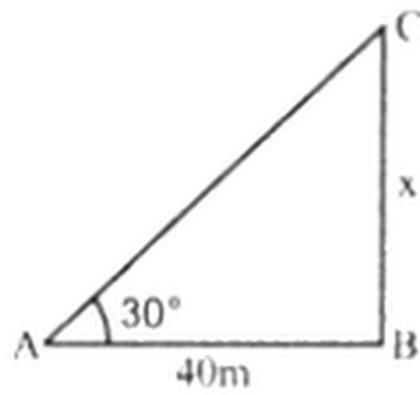
Let the length of the string = x

$$\sin 55^\circ = \frac{67.2}{x}$$

$$x = \frac{67.2}{\sin 55^\circ} = \frac{67.2}{0.819} = 82.03 \text{ m}$$

Hence, the length of the string = 82.03 m

6. When the angle between the ground and the sun is 30° , flag pole casts a shadow of 40 m long. Find the height of the top of the flag.

**Solution**

Let the length of the flag = x

$$\tan 30^\circ = \frac{x}{40}$$

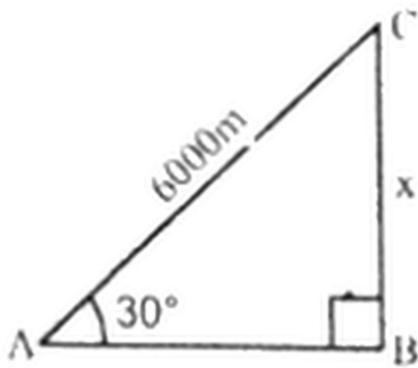
$$x = 40 \times \tan 30^\circ$$

$$= 40 \times 0.577$$

$$x = 23.09 \text{ m}$$

Hence, the height of the top of the flag = 23.09 m

7. A plane flying directly above a post 6000 m away from an anti-aircraft gun observes the gun at an angle of depression of 27° . Find the height of the plane.

**Solution**

Let the length of the plane = x m

$$\sin 27^\circ = \frac{x}{6000}$$

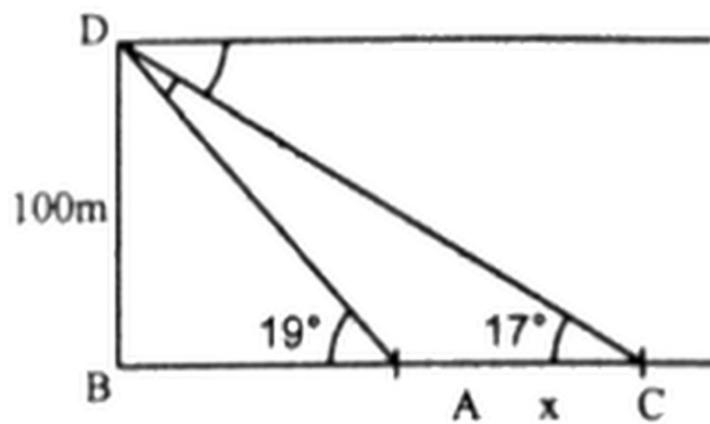
$$x = 6000 \times \sin 27^\circ$$

$$= 6000 \times 0.45399$$

$$x = 2723.94 \text{ m}$$

Hence, the height of the plane = 2723.94 m

8. A man on the top of a 100 m high light-house is in line with two ships on the same side of it, whose angles of depression from the man are 17° and 19° respectively. Find the distance between the ships.



Solution

Let the distance between 100 m the ships = xm

In ΔABD

$$\tan 19^\circ = \frac{100}{AB}$$

$$AB = \frac{100}{\tan 19^\circ} = \frac{100}{0.3443} = 290.42\text{m}$$

In ΔACD

$$\tan 17^\circ = \frac{100}{BC}$$

$$BC = \frac{100}{\tan 17^\circ}$$

$$\frac{100}{0.3057} = 327.085\text{ m}$$

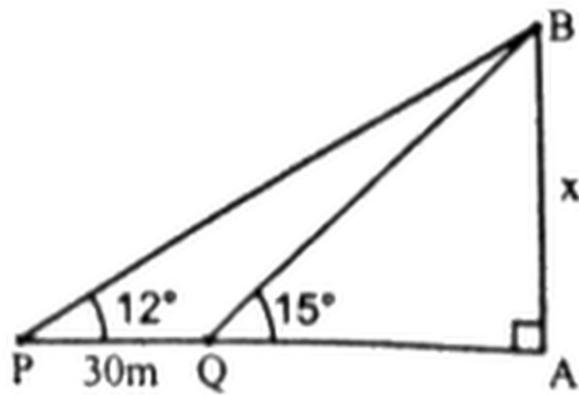
The distance between the ships

$$x = 327.085 - 290.42$$

$$x = 36.665 \text{ m}$$

Hence, the distance between the ships = 36.665 m

9. P and Q are two points in line with a tree. If the distance between P and Q be 30 m and the angles of elevation of the top of the tree at P and Q be 12° and 15° respectively, find the height of the tree.



Solution

Let the height of the tree = x m

In ΔABQ

$$\tan 15^\circ = \frac{x}{AQ}$$

$$AQ = \frac{x}{\tan 15^\circ}$$

In ΔPAB

$$\tan 12^\circ = \frac{x}{PQ + QA}$$

$$\tan 12^\circ = \frac{x}{30 + QA}$$

put the value of AQ

$$\tan 12^\circ = \frac{x}{30 + \left(\frac{x}{\tan 15^\circ}\right)}$$

$$\tan 12^\circ \left[30 + \frac{x}{\tan 15} \right] = x$$

$$0.2125 [30 + 3.732x] = x$$

$$6.375 + 0.79306x = x$$

$$x - 0.79306x = 6.375$$

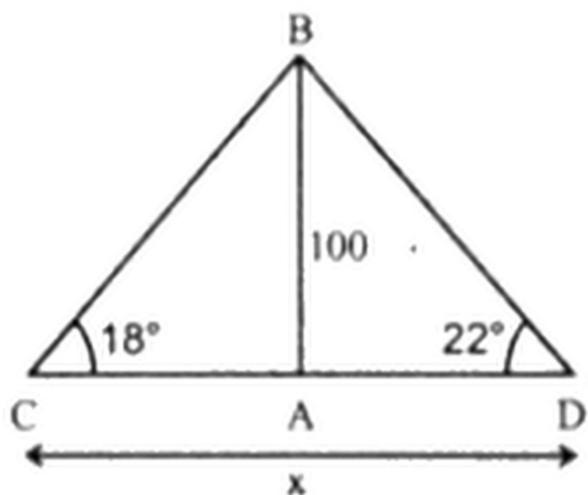
$$0.20694x = 6.375$$

$$x = \frac{6.375}{0.20694}$$

$$x = 30.81 \text{ m}$$

Hence, the height of tree = 30.81 m

10. Two men are on the opposite sides of a 100 m high tower. If the measures of the angles of elevation of the top of the tower are 18° and 22° respectively, find the distance between them.



Solution

Let the distance between two men = xm

In ΔABC

$$\tan 18^\circ = \frac{AB}{AC} = \frac{100}{AC}$$

$$AC = \frac{100}{\tan 18^\circ}$$

In ΔABD

$$\tan 22^\circ = \frac{AB}{AD}$$

$$AD = \frac{AB}{\tan 22} = \frac{100}{\tan 22} = \frac{100}{0.404}$$

$$= 247.508 \text{ m}$$

The distance between men

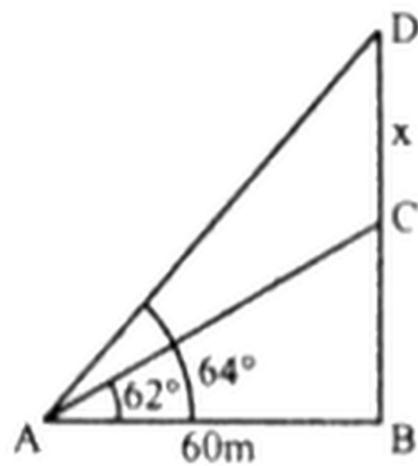
$$X = AC + AD$$

$$= 307.763 + 247.508$$

$$x = 555.271 \text{ m}$$

Hence, the distance between two men = 555.271 m

11. A man standing 60 m away from a tower notices that the angles of elevation of the top and the bottom of a flag staff on the top of the tower are 64° and 62° respectively. Find the length of the flag stall.



Solution

Let the length of the flag = x m

In ΔABC

$$\tan 62^\circ = \frac{BC}{60}$$

$$BC = 60 \tan 62^\circ = 11208435 \text{ m}$$

In ΔABD

$$\tan 64^\circ = \frac{BD}{60}$$

$$BD = 60 \times \tan 64$$

$$= 60 \times 2.0503 = 123.018 \text{ m}$$

The length of flag = $x = BD - BC$

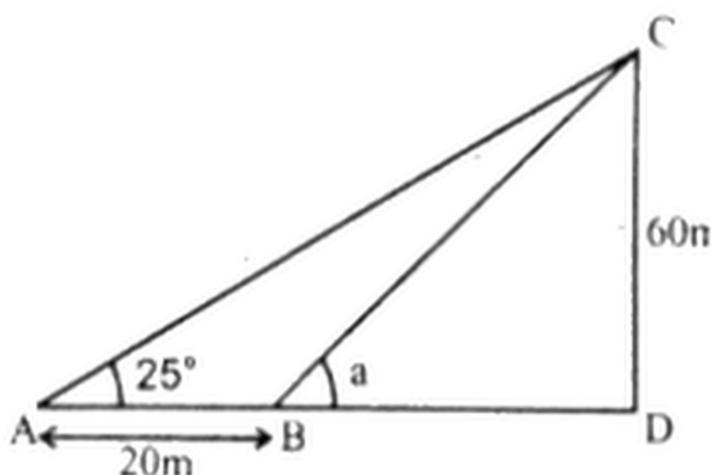
$$= 123.018 - 112.0843$$

$$= 10.175 \text{ m}$$

Hence, the length of the flag staff = 10.175 m

12. The angle of elevation of the top of a 60 m high tower from a point A, on the same level as the foot of the tower, is 25° . Find the angle of elevation of the top of the tower from a point B, 20 m nearer to A from the

from a point B, 20 m nearer foot of the tower.



Solution

Let the angle of elevation = x°

In ΔACD

$$\tan 25^\circ = \frac{60}{AD}$$

$$\overline{AD} = \frac{60}{\tan 25^\circ} = \frac{60}{0.466} = 128.67\text{m}$$

$$20 + BD = 128.67$$

$$BD = 128.67 - 20 =$$

$$108.67 \text{ m}$$

In $\triangle BCD$

$$\tan x = \frac{DC}{BD} = \frac{60}{108.67}$$

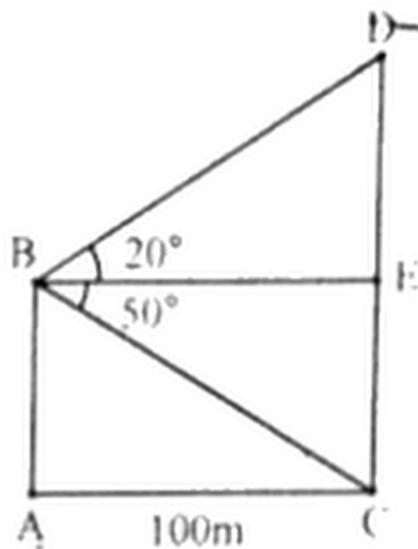
$$\tan x = 0.552$$

$$x = \tan^{-1} (0.552)$$

$$= 28^{\circ}54'15''$$

Hence, the angle of elevation = $28^{\circ}54'15''$

13. Two buildings A and B are 100 m apart. The angle of elevation from the top of the building B is 20° . The angle of elevation from the base of the building B to the top of the building A is 50° . Find the height of the building B.



Solution

Let the height of building B = x m

In $\triangle BED$

$$\tan 20^{\circ} = \frac{DE}{BE}$$

$$DE = BE \tan 20^{\circ}$$

$$= 100 \times \tan 20^{\circ}$$

$$DE = 100 \times 0.3639 = 36.397 \text{ m}$$

In ΔABC

$$\tan 50^\circ = \frac{AB}{AC}$$

$$AB = AC \tan 50^\circ$$

$$= 100 \times 1.1917 = 119.157 \text{ m}$$

$$AB = EC = 119.175 \text{ m}$$

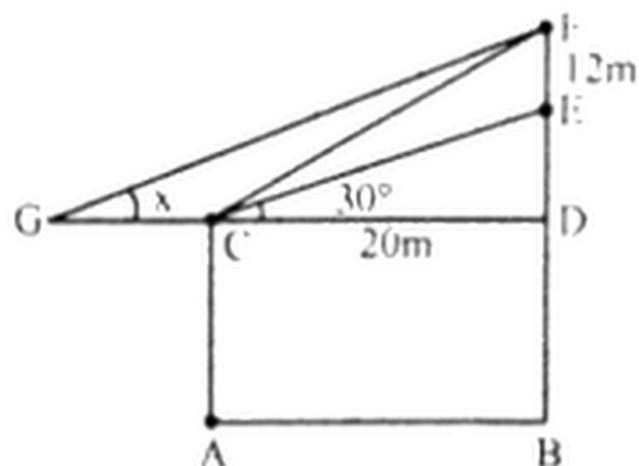
$$\text{Height of building B} = x = EC + ED$$

$$= 199.175 + 36.397$$

$$= 155.572 \text{ m}$$

Hence, the height of building 'B' = 155.572 m

14. A window washer is working in a hotel building. An observer at a distance of 20 m from the building finds the angle of elevation of the worker to be of 30° . The worker climbs up 12 m and the observer move 4 m farther away from the building. Find the new angle of elevation of the worker.



Solution

Let the new angle of elevation = x m

In ΔDCE

$$\tan 30^\circ = \frac{DE}{CD} = \frac{DE}{20}$$

$$DE = 20 \times \tan 30^\circ$$

$$= 20 \times 0.577 = 11.547 \text{ m}$$

In ΔGDF

$$FD = FE + ED$$

$$= 12 + 11.547 = 23.547 \text{ m}$$

$$\text{In } DG = DC + CG = 20 + 4 = 24 \text{ m}$$

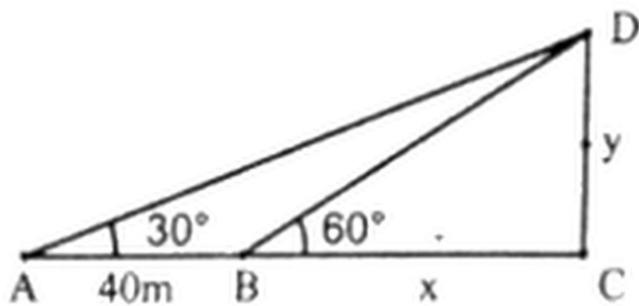
$$\tan (\angle G) = \frac{DE}{CD} = \frac{23.547}{24} = (0.9811)$$

$$\angle G = \tan^{-1} (0.9811) = 44.45^\circ$$

$$x = \angle G = 44^\circ 27'$$

hence, the new angle of elevation = $44^\circ 27'$

15. A man standing on the bank of a canal observes that the measure of the angle of elevation of a tree is 60° . On retreating 40 meters from the bank, he finds the measure of the angle of elevation of the tree as 30° . Find the height of the tree and the width of the canal.



Solution

Let the width of canal = x m

and

the height of tree = y

In $\triangle BCD$

$$\tan 60^\circ = \frac{y}{x}$$

$$y = 1.732x$$

In $\triangle ACD$

$$\tan 30^\circ = \frac{y}{x+40}$$

$$0.577 = \frac{y}{x+40}$$

$$(x+40)(0.577) = 1.732x$$

$$0.544x + 23.094 = 1.732x$$

$$1.732x - 0.577x = 23.094$$

$$1.155x = 23.094$$

$$x = \frac{23.094}{1.155}$$

$$x = 19.99 \cong 20 \text{ m}$$

and

$$y = 1.732 \times 20 = 34.64 \text{ m}$$

Hence, the width of canal = 20 m

And the height of tree = 34.6 m

