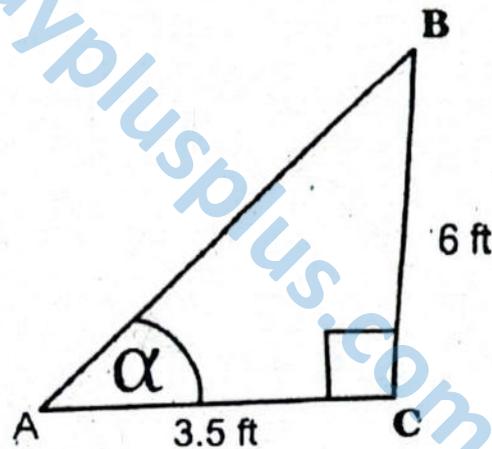**1. Find the angle of elevation of the sun if a 6 feet man casts a 3.5 feet shadow.**

Solution.

Let $\overline{AC}$ be the height of man and $\overline{BC}$ be the length of his shahdow.

then From the figure.

$$\tan(\alpha) = \frac{m\overline{BC}}{m\overline{AC}}$$

$$= \frac{6}{3.5}$$

$$\tan \alpha = \tan^{-1} 1.71429$$
$$\alpha = \tan^{-1} 1.71429$$
$$= 59.74°$$

2. A tree casts a 40 meter shadow when the angle of elevation of the sun is 25°. Find the height of the tree.

Solution:

Let $\overline{AC}$ be the tree and it height as h meter.

Shadow of the tree $m\overline{AC} = 40m.$
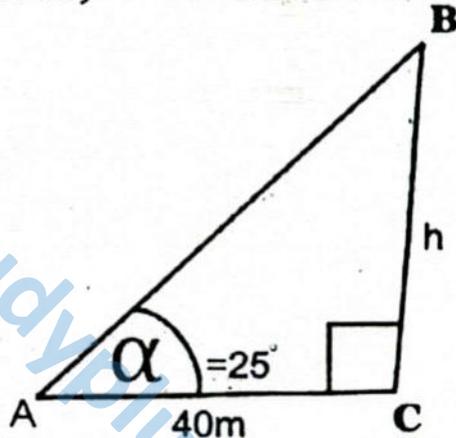
Let the height of the tree $m\overline{BC} = h = ?$

Now, from the figure.

$$tan\ \alpha = \frac{m\overline{BC}}{m\overline{AC}}$$

$$tan\ 25° = \frac{h}{40}$$

$$0.4663 = \frac{h}{40}$$

$$h = (40)(0.4663) \quad = 18.652\ m$$

3. A 20 feet long ladder is leading against a wall. The bottom of the ladder is 5 feet from the base of the wall. Find the acute (angle of elevation) the ladder makes with the ground.
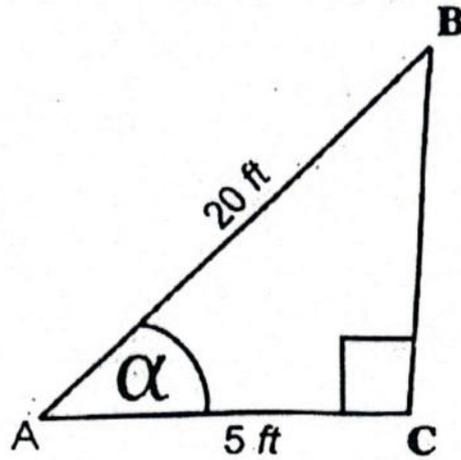
Solution.

Let BC be the height of wall, and $\overline{AB} = 20\ ft$ *be the length of ladder and distance of ladder from the base of wall* $m\overline{AC} = 5ft.$

then $\quad Cos\ \alpha = \frac{m\overline{AC}}{m\overline{AB}}$

$$= \frac{5}{20}$$

$$Cos\ \alpha = 0.25$$

$$\alpha = Cos^{-1}(0.25)$$
$$\alpha = 75.52225°$$
(Using calculator)
$$= 75.5° \ or \qquad 75°30'$$

4. **The base of a rectangle is 25 feet and the height of the rectangle is 13 feet. Find the angle that the diagonal of the rectangle makes with the base.**

Solution.

Let $ABCD$ be the rectangle in which $m\overline{AC} = 25\ ft$, $m\overline{BC} = 13\ ft$ and α be the angle that diagonal $\overline{AC}$ makes with $\overline{BC}$.
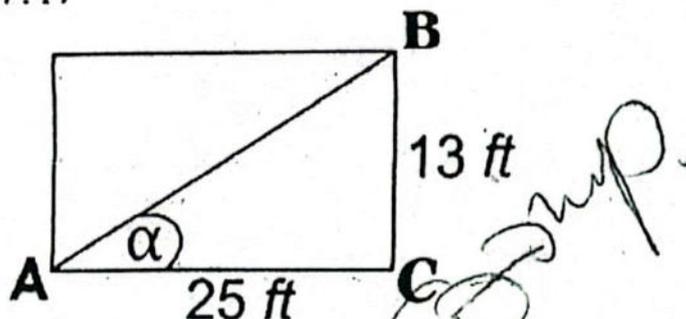
$$\tan\alpha = \frac{m\overline{BC}}{m\overline{AC}}$$

$$= \frac{13}{25}$$

$$\tan\alpha = 0.52$$
$$\alpha = \tan^{-1}(0.52)$$
$$\alpha = 27.47°$$

5. **A rocket is launched and climbs at a constant angle of 80°. Find the altitude of the rocket after it travels 5000 meter.**
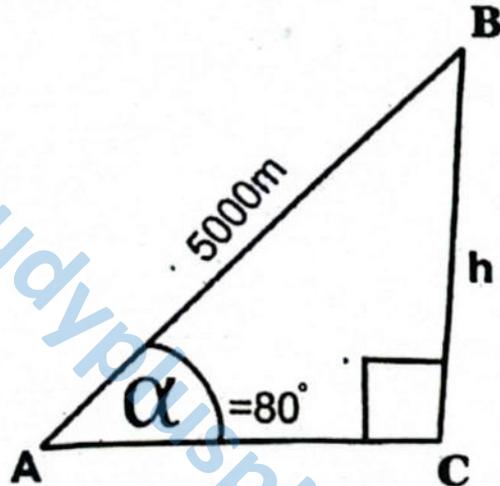
Solution:

Let $\overline{AB} = 5000\,m$ be the distance covered by the rocket Let $\overline{BC} = h = $ altitude =? then.

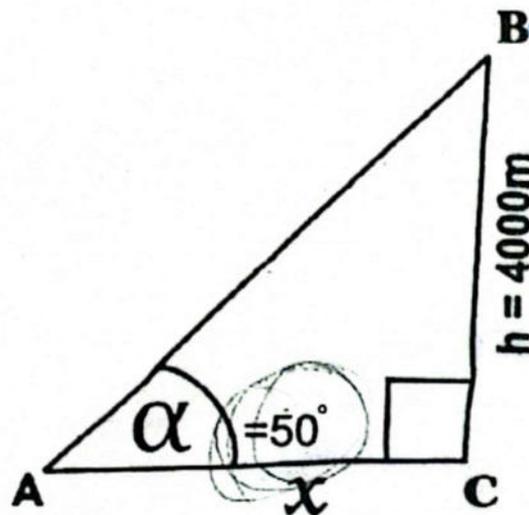$$\sin \alpha = \frac{m\overline{BC}}{m\overline{AB}}$$

$$\sin 80° = \frac{h}{5000}$$

$$0.9848 = \frac{h}{5000}$$

$$h = (0.9848)(5000)$$
$$= 4924.04\,m$$

6. An aeroplane pilot flying at an altitude of 4000m wishes to make an approach to an airport at an angle of 50° with the horizontal. How far from the airport will the plane be when the pilot begins to descend?

Solution.

Let $m\overline{BC} = h = 4000\,m$

Let $m\overline{AC}$ = distance of plane from airport = x =?

$$\tan \alpha = \frac{m\overline{BC}}{m\overline{AC}}$$
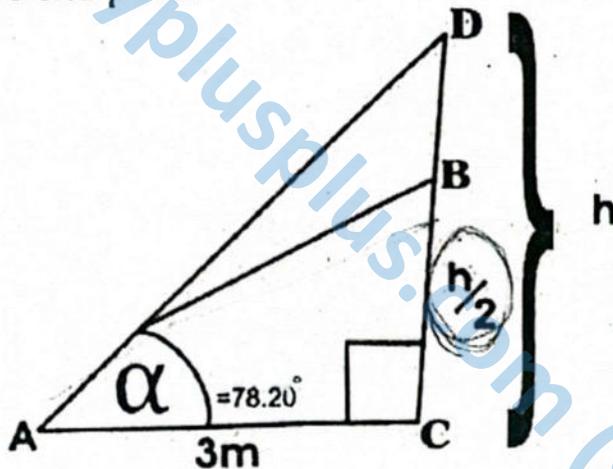
$$\tan 50° = \frac{4000}{x}$$

$$1.1918 = \frac{4000}{x}$$

$$x = \frac{4000}{1.1918}$$

$$= 3356.4\ m$$

7. **A guy wire (supporting wire) runs from the middle of a utility pole to the ground. The wire makes an angle of 78.2° with the ground and touch the ground 3 meters from the base of the pole .Find the height of the pole.**

Solution.

Let $\overline{AC}$ be the pole.

Let $m\overline{DC} = h$ =?

Let $m\overline{BC} = h/2$

Let $m\overline{AC}$ = distance from the base of the pole = $3m$

$$\tan \alpha = \frac{m\overline{BC}}{m\overline{AC}}$$

$$\tan 78.2° = \frac{h/2}{3}$$

$$4.7867 = \frac{h}{6}$$
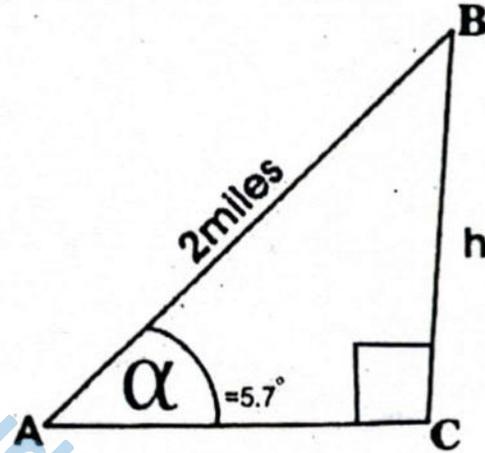
$$h = 4.7867 \times 6$$

$$x = 14.3601$$

$$h = 28.72\ m$$

8. A road is inclined at an angle $5.7°$. Suppose that we drive 2 miles up this road starting from sea level. How high above sea level are we ?

Solution.

Let $\overline{AB} = 2\ miles$

Height above sea level $= h\ mile$

$$\sin \alpha = \frac{m\overline{BC}}{m\overline{AB}}$$

$$\sin 5.7° = \frac{h}{2}$$

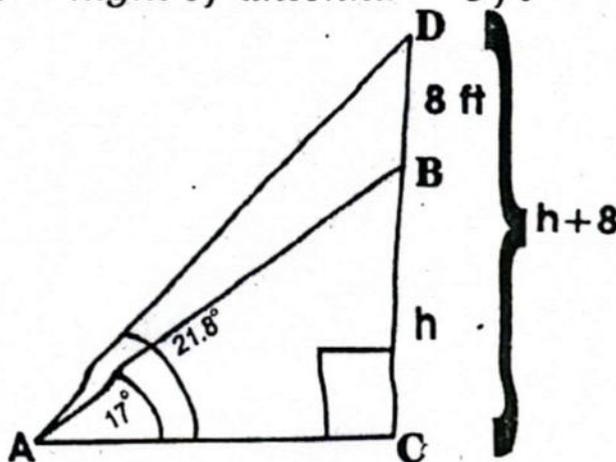$$\frac{h}{2} = 0.0992$$

$$h = 2 \times (0.0992) = 0.199\ miles$$

9. A television antenna of 8 feet height is located on the top of house. From a point on the ground the angle of elevation to the top of the house is $17°$ and the angle of elevation to the top of antenna is $21.8°$. Find the height of the house.

Solution:

Let $m\overline{BC} = h =?$

$m\overline{DC} = h + 8$

Let $m\overline{BD} = $ hight of antenna $= 8\ ft$

In $\triangle ABC$

$$\frac{m\overline{BC}}{m\overline{AC}} = \tan 17°$$

$$\frac{h}{m\overline{AC}} = 0.3057$$

$$m\overline{AC} = \frac{h}{0.3057} \text{--------- (i)}$$

In $\triangle ADC$

$$\frac{m\overline{CD}}{m\overline{AC}} = \tan 21.8°$$

$$\frac{h+8}{m\overline{AC}} = 0.4$$

$$m\overline{AC} = \frac{h+8}{0.4} \text{--------- (ii)}$$

By compairing (i) and (ii) we get

$$\frac{h+8}{0.4} = \frac{h}{0.3057}$$

$$0.3057(h + 8) = 0.4h$$
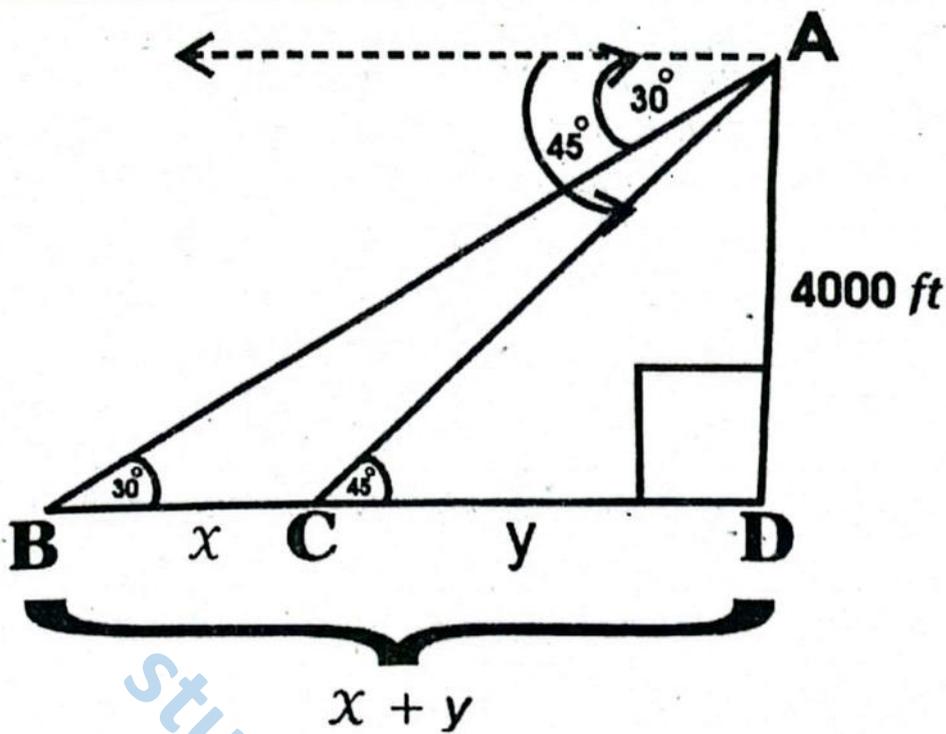
$$0.3057h + 2.4456 = 0.4h$$
$$0.4h - 0.3057h = 2.4456$$
$$0.0943h = 2.4456$$
$$h = \frac{2.4456}{0.0943}$$
$$= 25.94 \ feet$$

10. From an observation point, the angles of depression of two boats in line with this point are found to $30°$ and $45°$. Find the distance between the two boats if the point of observation is 4000 feet high.

Solution:

(ii) Let A is point of observation.
From figure

Let $m\overline{BC}$ $= x$
$m\overline{AD}$ $= 4000$ ft.

In $\triangle ACD$,

$\tan 45° = \dfrac{4000}{y}$

$1 = \dfrac{4000}{y}$

$y = 4000$ ft ....(i)

Now in $\triangle ABD$

$\tan 30° = \dfrac{4000}{y+x}$

$0.5776 = \dfrac{4000}{4000+x}$ using (i) $y = 4000ft$

$(4000 + x)0.5776 = 4000$
$4000 \times 0.5776 + 0.5776x = 4000$
$2310.4 + 0.5776x = 4000$
$0.5776x = 4000 - 2310.4$
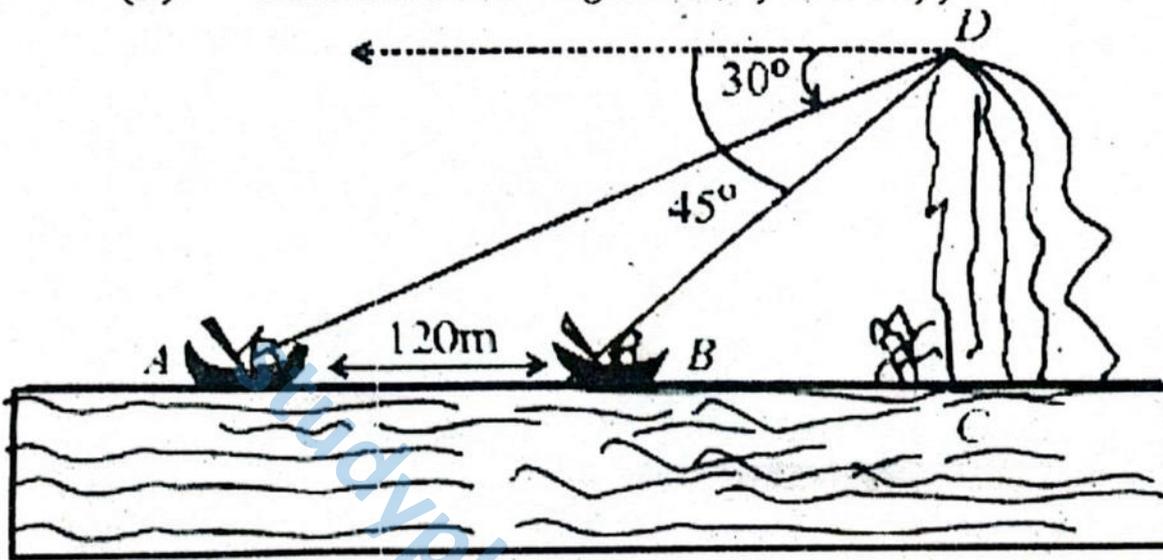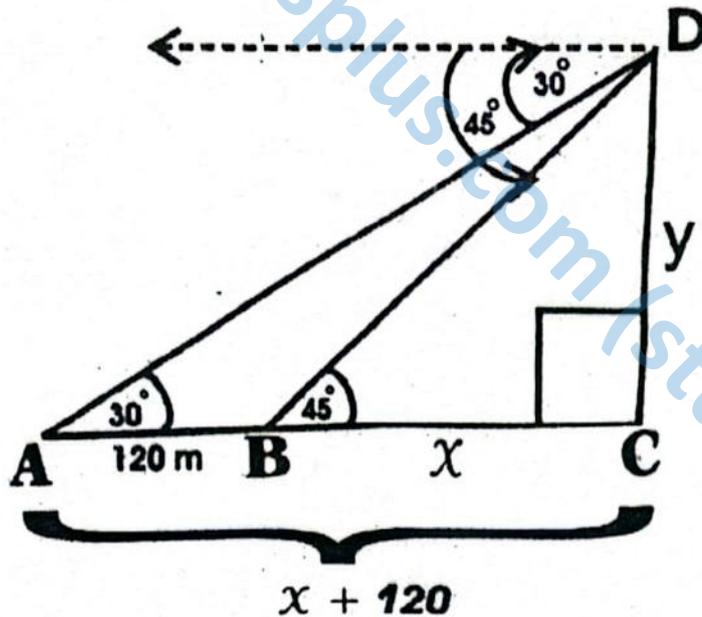$= 1689.6$

Distance between boats $x = \dfrac{1689.6}{0.5776}$

$= 2928.2$ feet

11. Two ships, which are in line with the base of a vertical cliff, are 120 meters apart. The angles of depression from the top of the cliff to the ships are 30° and 45°C, as show in the diagram.

(a). Calculate the distancer BC

(b) Calculate the height CD, of the cliff.

Solution:

$$x + 120$$

Let $m\overline{BC} = x$

$m\overline{CD} = y$

Now in ΔDCB

$$\frac{y}{x} = \tan 45°$$

$$\frac{y}{x} = 1$$

$$y = x \ldots\ldots\ldots\ldots (i)$$

Also in ΔDAC

$$\frac{y}{x+120} = \tan 30^\circ$$

$$\frac{y}{x+120} = 0.5772$$

$$\frac{x}{x+120} = 0.5772 \ (put \ y = x \ using \ i)$$

$$x = (x + 120)(0.5772)$$

$$x = 0.5772x + 69.264$$
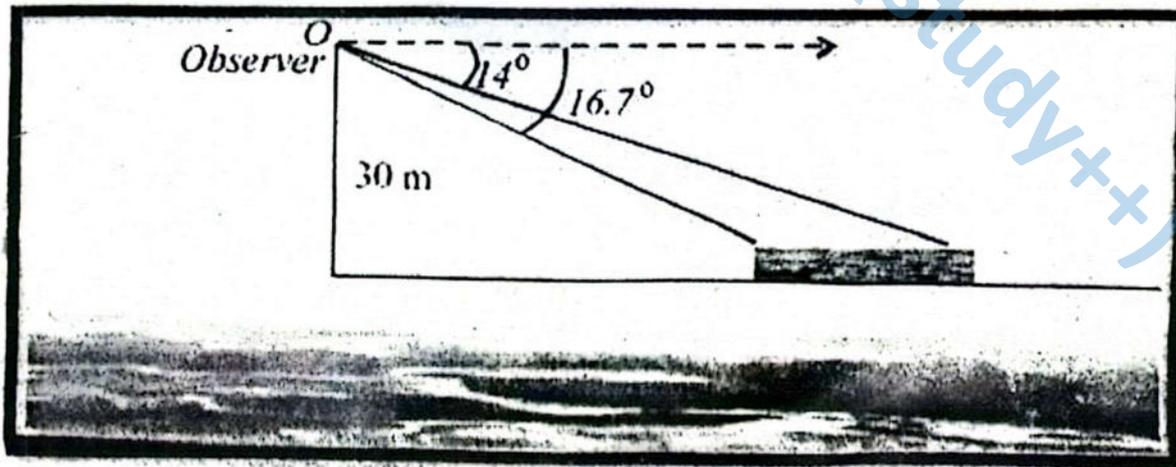
$$x - 0.5772\,x = 69.264$$

$$0.4228\,x = 69.264$$

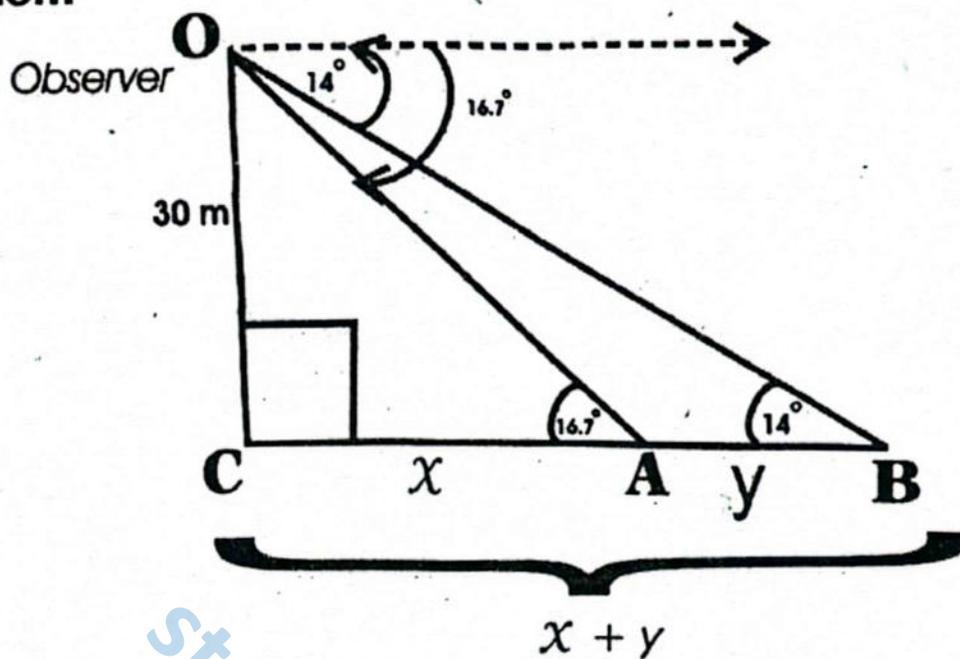$$x = \frac{69.264}{0.4228}$$

$$x = 163.9 \ m \ or \ 164 \ m$$

Also $m\overline{CD} = y = 164 \ m \quad (\because x = y)$

Therefore $m\overline{BC} = m\overline{CD} = 164 \ m.$

12. **Suppose that we are standing on a bridge 30 feet above a river watching a long (piece of wood) floating toward we .If the angle with the horizontal to the front of the log is 16.7° and angle with the horizontal to the back of the log is 14°, how long is the log ?**

Solution:

Let,

Length of log $= m\overline{AB} = y$

$m\overline{CA} = x$

In $\triangle CAO$

$$\frac{30}{x} = \tan 16.7°$$

$$\frac{30}{x} = 0.30$$

$$x = \frac{30}{0.30}$$

$$x = 100 \, m \quad\text{................(i)}$$

In $\triangle CBO$

$$\frac{30}{x+y} = \tan 14°$$

$$\frac{30}{x+y} = 0.2943$$

$$x + y = \frac{30}{0.2493}$$

$$x + y = 120.33$$

$$100 + y = 120.33 \quad \text{(Using i, } \because x = 100)$$

$$y = 120.33 - 100$$

$$y = 20.33$$

$$y = 20.33 \, m$$

Therefore length of the log $= y = 20.33 \, m$