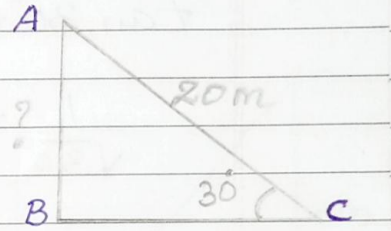
Applications of trigonometry.

class-X

Exercise 9.1

1. A circus artist is climbing a 20m long rope, which is tightly stretched and tied from the top of a vertical pole to the ground. Find the height of the pole, if the angle made by the rope with the ground level is 30°.

Given : AC = 20m
$\angle ACB = 30°$



To find : AB.

WKT

$\sin\theta = \frac{Opp}{Hyp.}$

AB → OPP. Side
AC → Hypoten.

$\sin 30° = \frac{AB}{AC}$

$AB = AC \times \sin 30°$

$= 20 \times \frac{1}{2}$

$= 10m$

$\therefore$ Height of the pole = 10m.

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② A tree breaks due to storm and broken part bends so that the top of the tree touches

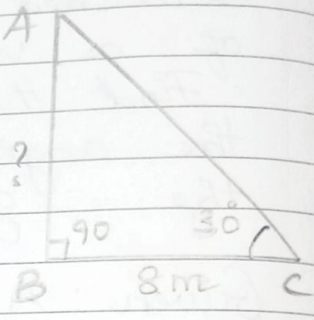
the ground making an angle 30° with it. This distance between the foot of the tree to the point where the top touches the ground is 8m. Find the height of the tree.

Soln:

Given

$\angle ACB = 30^\circ$

$BC = 8$



To find: $AB + AC$.

$$\tan 30^\circ = \frac{AB}{BC}$$

$$\frac{1}{\sqrt{3}} = \frac{AB}{8}$$

$$AB = \frac{8}{\sqrt{3}}$$

$$\sin 30^\circ = \frac{AB}{AC}$$

$$\frac{1}{2} = \frac{AB}{AC}$$

$$AC = 2 \times AB = 2 \times \frac{8}{\sqrt{3}} = \frac{16}{\sqrt{3}}$$

Height of the tree $= AB + AC$

$$= \frac{8}{\sqrt{3}} + \frac{16}{\sqrt{3}} = \frac{24}{\sqrt{3}}$$

$$= \frac{24}{\sqrt{3}} \times \frac{\sqrt{3}}{\sqrt{3}} = \frac{24\sqrt{3}}{3}$$

$$= 8\sqrt{3}$$

③ A contractor plans to install slides for the children to play in a park. For the children below the age of 5 years, she prefers to have a slide whose top is at a height of 1.5 m, and is inclined at an angle of 30° to the ground whereas for elder children, she wants to have a steep slide at a height of 3m and inclined at an angle of 60° to the ground. What should be the length of the slide in each case?

Soln:-

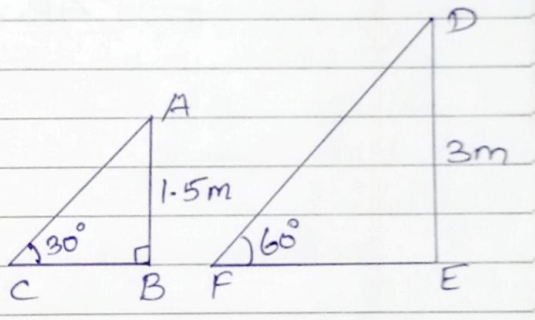
Given

$\angle ACB = 30°$

$AB = 1.5m$

$\angle DFE = 60°$

$DE = 3m$



To find : AC, DF

In $\triangle ABC$, $\sin 30° = \frac{AB}{AC}$

$\frac{1}{2} = \frac{1.5}{AC}$

$\Rightarrow AC = 2 \times 1.5 = 3m.$

In $\triangle DEF$, $\sin 60° = \frac{DE}{DF}$

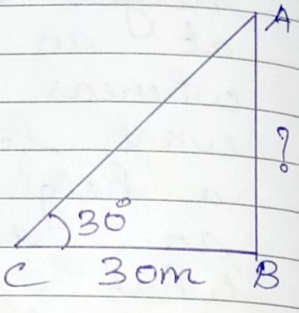
$\frac{\sqrt{3}}{2} = \frac{3}{DF}$

$DF = \frac{6}{\sqrt{3}} = \frac{6}{\sqrt{3}} \times \frac{\sqrt{3}}{\sqrt{3}} = 2\sqrt{3}\ m$

$DF = 2\sqrt{3}\ m$

④ The angle of elevation of the top of a tower from a point on the ground which is 30m away from the foot of the tower is 30°. Find the height of the tower.

Soln:



In $\triangle ABC$,

$$\tan 30^\circ = \frac{AB}{BC}$$

$$\frac{1}{\sqrt{3}} = \frac{AB}{30}$$

$$\Rightarrow AB = \frac{30}{\sqrt{3}}$$

$$= \frac{30}{\sqrt{3}} \times \frac{\sqrt{3}}{\sqrt{3}}$$

$$= \frac{30\sqrt{3}}{3}$$

$$= 10\sqrt{3} \text{ m}$$

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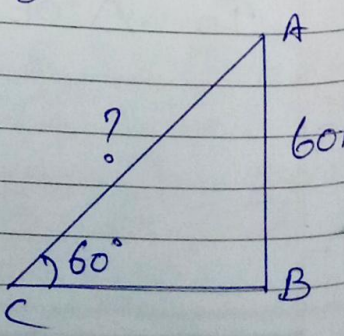
⑤ A kite is flying at a height of 60m above the ground. The string is attached to the kite is temporarily tied to a point on the ground. The inclination of the string with the ground is 60°. Find the length of the string.

Soln:

Given $AB = 60m$

$\angle ACB = 60^\circ$

To find: AC.



$$\sin 60^\circ = \frac{AB}{AC}$$

$$\frac{\sqrt{3}}{2} = \frac{60}{AC}$$

$$\Rightarrow AC = \frac{120}{\sqrt{3}}$$

$$= \frac{120}{\sqrt{3}} \times \frac{\sqrt{3}}{\sqrt{3}}$$

$$= \frac{120\sqrt{3}}{3}$$

$$= 40\sqrt{3} \text{ m.}$$

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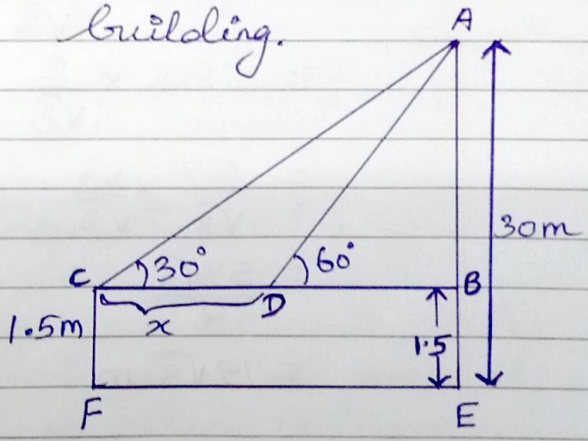
(6) A 1.5m tall boy is standing at some distance from a 30m tall building. The angle of elevation from his eyes to the top of the building increases from 30° to 60° as he walks towards the building. Find the distance he walked towards the building.

Soln:



Given: AE = 30m

BE = 1.5m

(Since BE = CF)

$\angle ACB = 30^\circ$

$\angle ADB = 60^\circ$

To find: CD

$$AB = AE - BE$$

$$= 30 - 1.5$$

$$= 28.5$$

In $\triangle ABC$, $\tan 30° = \frac{AB}{CB}$

$$\frac{1}{\sqrt{3}} = \frac{28.5}{CB}$$

$$\Rightarrow CB = 28.5\sqrt{3}.$$

In $\triangle ABD$, $\tan 60° = \frac{AB}{DB}$

$$\sqrt{3} = \frac{28.5}{DB}$$

$$\Rightarrow DB = \frac{28.5}{\sqrt{3}}$$

$$CD = CB - DB$$

$$= 28.5\sqrt{3} - \frac{28.5}{\sqrt{3}}$$

$$= 28.5\left(\sqrt{3} - \frac{1}{\sqrt{3}}\right)$$

$$= 28.5\left(\frac{3-1}{\sqrt{3}}\right)$$

$$= 28.5 \times \frac{2}{\sqrt{3}}$$

$$= \frac{57}{\sqrt{3}} \times \frac{\sqrt{3}}{\sqrt{3}}$$

$$= \frac{57\sqrt{3}}{3}$$

$$= 19\sqrt{3} \text{ m.}$$

∴ Distance moved by the boy towards the building is $19\sqrt{3}$ m.