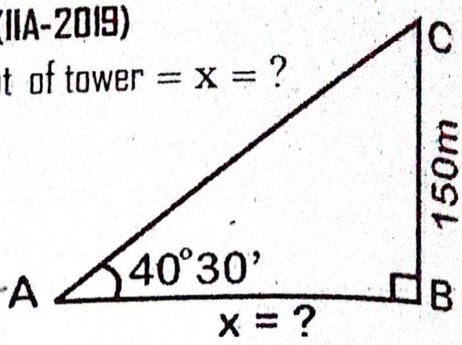
SOLUTION OF EXERCISE # 5.2

Exercise # 5.2

Q.1: How far is a man from the foot of tower 150 meters high, if the measure of the angle of elevation of its top as observed by him is $40°30'$. (IIA-2019)

Sol. Let the distance of man from the foot of tower $= x = ?$

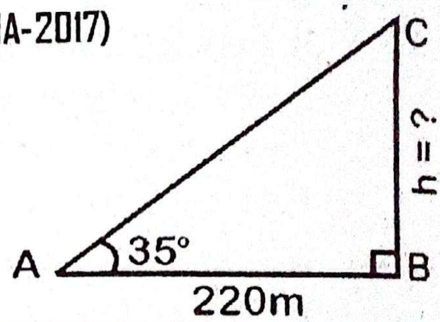


$$\tan 40°30' = \frac{150}{x}$$

$$x = \frac{150}{\tan 40°30'} = \boxed{175.63\text{m}}$$

Q.2: The Shadow of a building is 220 meters when the measure of the angle of elevation of the sun is $35°$. Find the height of the building. (IIA-2017)

Sol. Let height of building $= h = ?$



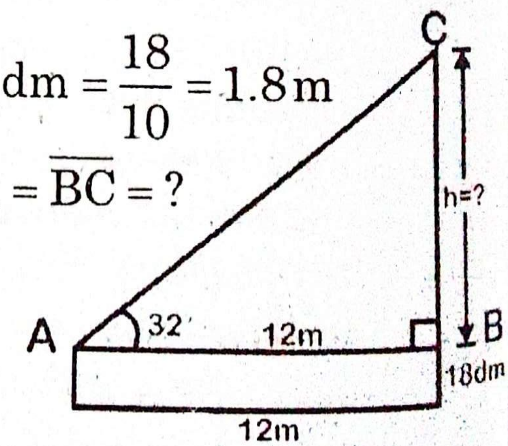
$$\tan 35° = \frac{h}{220}$$

$$h = 220 \tan 35° = \boxed{154.05\text{ m}}$$

Q.3: A man 18dm tall observes that the angle of elevation of the top of a tree at a distance of 12m from the man is $32°$. What is the height of the tree?

Sol. Let height of man $= h_1 = 18\text{dm} = \frac{18}{10} = 1.8\text{m}$

& Let height of the tree $= h = \overline{BC} = ?$



$$\tan 32° = \frac{h}{12}$$

$$h = 12 \tan 32° \Rightarrow h = 7.5\text{m}$$

Hence height of tree $= h + h_1 = 7.5 + 1.8 = \boxed{9.3\text{m}}$

Q.4: On walking 300 meters towards a tower in a horizontal line through its base, the measure of the angle of elevation of the top change from $30°$ to $60°$. Find the height of the tower.

SOLUTION OF EXERCISE # 5.2

Sol. Let h = height of tower = ? & $x = |\overline{BC}|$

In right ΔBCD

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

$$\sqrt{3} = \frac{h}{x}$$

$$h = \sqrt{3}x \rightarrow (i)$$

In right ΔACD

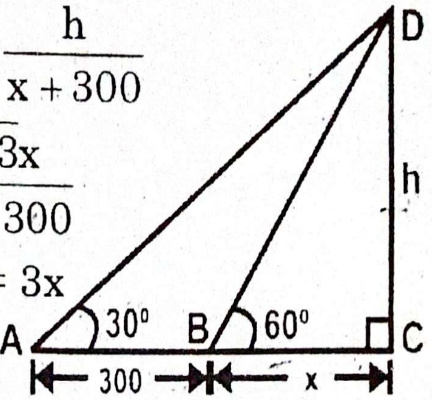
$$\tan 30^\circ = \frac{h}{x+300}$$

$$\frac{1}{\sqrt{3}} = \frac{\sqrt{3}x}{x+300}$$

$$x + 300 = 3x$$

$$2x = 300$$

$$x = 150$$



Put in eq. (i) $h = \sqrt{3}(150) = \boxed{259.81\text{m}}$

Q.5: **The measure of the angle of elevation of the top of a cliff is 25°. On walking 100 meters straight towards the cliff, the measure of the angle of elevation of the top is 48°. Find the height of the cliff.**

Sol. Let $\overline{CD}$ = h = height of the cliff = ? & $|\overline{BC}| = x$

In right ΔBCD

$$\tan 48^\circ = \frac{h}{x}$$

$$1.11 = \frac{h}{x}$$

$$x = \frac{h}{1.11} \rightarrow (i)$$

In right ΔACD

$$\tan 25^\circ = \frac{h}{100+x}$$

$$\tan 25^\circ(100+x) = h$$

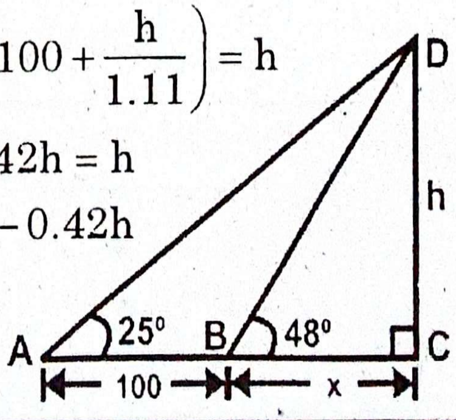
$$(0.4663)\left(100 + \frac{h}{1.11}\right) = h$$

$$46.63 + 0.42h = h$$

$$46.63 = h - 0.42h$$

$$46.63 = 0.58h$$

$$h = \frac{46.63}{0.58} = \boxed{80.40\,\text{m}}$$



Q.6: **From two points A and B. 50 meters apart and in the line with a tree, the measure of the angles of elevation of the top of the tree are 30° and 40° respectively. Find the height of the tree.**

Sol Let $\overline{CD}$ = h = height of the tree = ? & $|\overline{BC}| = x$

SOLUTION OF EXERCISE # 5.2

In right ΔACD

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

$$\frac{1}{\sqrt{3}} = \frac{h}{x}$$

$$x = \sqrt{3}h \rightarrow (i)$$

In right ΔBCD

$$\tan 40^\circ = \frac{h}{50 - x}$$

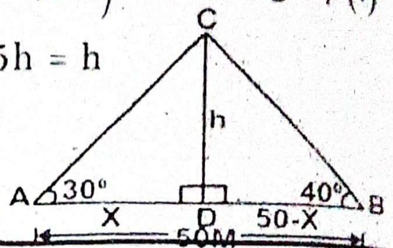
$$0.8391(50 - x) = h$$

$$0.8391\left(50 - \sqrt{3}h\right) = h \text{ using eq. (i)}$$

$$41.95 - 1.45h = h$$

$$41.95 = h + 1.45h$$

$$41.95 = 2.45h \Rightarrow h = \frac{41.95}{2.45} = \boxed{17.12m}$$



Q.7: Two men on the opposite sides of a tower observe that the measure of the angles of elevation of the tower as observed by them separately are 15° and 25° respectively. If the height of the tower is 150 meters. Find the distance between the observers.

Sol. Let $\overline{CD} = h =$ height of tower $= 150m$ & $\overline{AB} = ?$

In right ΔACD

$$\tan 15^\circ = \frac{150}{x}$$

$$x = \frac{150}{\tan 15^\circ}$$

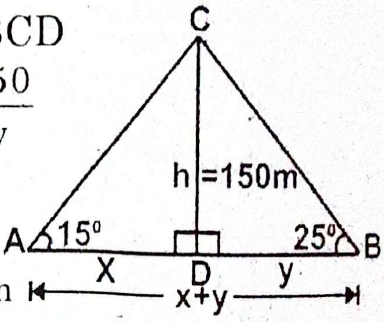
$$x = 559.81$$

In right ΔBCD

$$\tan 25^\circ = \frac{150}{y}$$

$$y = \frac{150}{\tan 25^\circ}$$

$$y = 321.68m$$



Distance $= x + y = 559.81 + 321.68 = \boxed{881.49\,m}$

Q.8: From a light house, angles of depression of two ships on opposite of the light-house are observed to be 30° and 45°. If the height of the light house be 300m. Find the distance between the ships of the line joining them passes through foot of light-house.

Sol. Let $\overline{CD} = h =$ height of light house $= 300m$ & $\overline{AB} = ?$

In right ΔACD

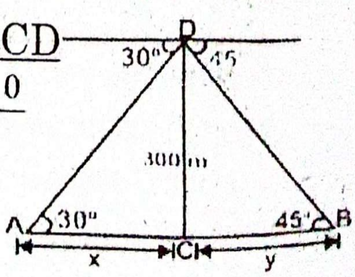
$$\tan 30^\circ = \frac{300}{x}$$

$$x = \frac{300}{\tan 30^\circ}$$

In right ΔBCD

$$\tan 45^\circ = \frac{300}{y}$$

$$y = \frac{300}{\tan 45^\circ}$$



SOLUTION OF EXERCISE # 5.2

$x = 519.62m$ | $y = 300m$

Distance between ships $= x + y = 519.62 + 300 = \boxed{819.62m}$

Q.9: The measure of angle of elevation of the top of a tower is $30°$ from a point on the ground. On retreating 100 meters, the measure of the angle of elevation is found to be $15°$. Find the height of the tower.

Sol. Let $\overline{CD} = h =$ height of the tower $= ?$

In right ΔBCD

$$\tan 30° = \frac{h}{x}$$

$$\frac{1}{\sqrt{3}} = \frac{h}{x}$$

$$x = \sqrt{3}h \rightarrow (i)$$

In right ΔACD

$$\tan 15° = \frac{h}{x+100}$$

$$\tan 15°(x+100) = h$$

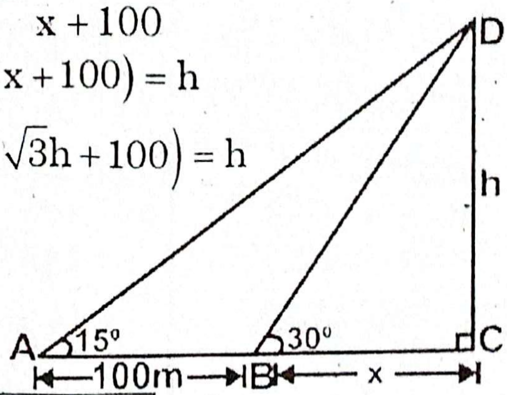
$$\tan 15°\left(\sqrt{3}h + 100\right) = h$$

$$0.46h + 26.79 = h$$

$$26.79 = h - 0.46h$$

$$26.79 = 0.54h$$

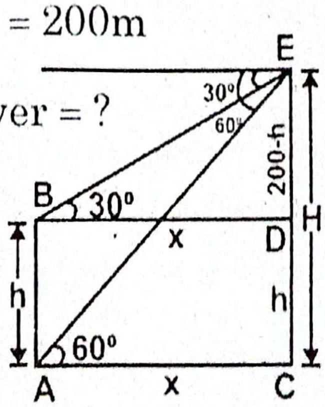
$$h = \frac{26.79}{0.54} \Rightarrow \boxed{h = 49.61m}$$



Q.10: From the top of hill 200 meters high, the angles of depression of the top and bottom of a tower are observed to be $30°$ and $60°$ respectively. Find the height of the tower.

Sol. Let $\overline{CE} = H =$ height of the Hill $= 200m$

& $\overline{AB} = h =$ height of the Tower $= ?$



In right ΔACE

$$\tan 60° = \frac{200}{x}$$

$$x = \frac{200}{\tan 60°}$$

$$x = \frac{200}{\sqrt{3}} \rightarrow (i)$$

In right ΔBDE

$$\tan 30° = \frac{200-h}{x}$$

$$\frac{1}{\sqrt{3}} = \frac{200-h}{x}$$

$$x = 200\sqrt{3} - \sqrt{3}h$$

$$\sqrt{3}h = 200\sqrt{3} - x$$

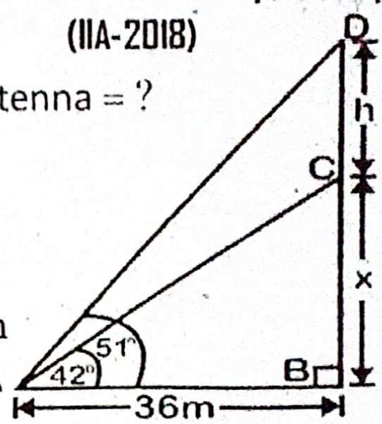
SOLUTION OF EXERCISE # 5.2

using eq.(i) $\sqrt{3}h = 200\sqrt{3} - \dfrac{200}{\sqrt{3}} = \dfrac{200\left(\sqrt{3}\right)^2 - 200}{\sqrt{3}}$

$$h = \frac{600-200}{\left(\sqrt{3}\right)^2} = \frac{400}{3} = \boxed{133.33\text{m}}$$

Q.11: **A television antenna is on the roof of a building. From a point on the ground 36m from the building, the angle of elevation of the top and the bottom of the antenna are 51° and 42° respectively. How tall is the antenna? (IIA-2018)**

Sol. Let $\overline{CD} = h =$ height of the Antenna = ?



<u>In right ΔABC</u>

$\tan 42° = \dfrac{x}{36}$

$36(\tan 42°) = x$

$x = 32.41\text{m}$

<u>In right ΔABD</u>

$\tan 51° = \dfrac{x+h}{36}$

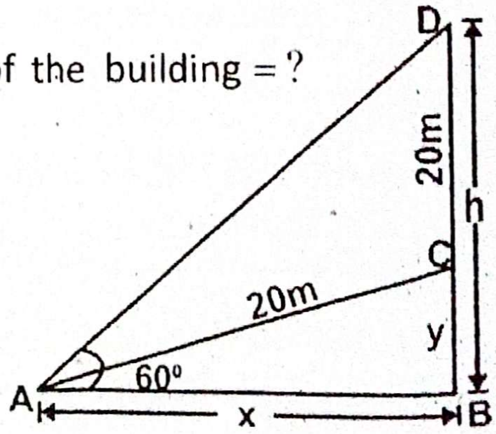
$36(\tan 51°) = x + h$

$44.45 = 32.41 + h$

$44.45 - 32.41 = h \Rightarrow \boxed{h = 12.04\text{m}}$

Q.12: **A ladder 20-meter-long reaches the distance of 20 meters, from the top of a building. At the foot of the ladder the measure of the angle of elevation of the top of the building is 60°. Find the height of the building.**

Sol. Let $\overline{BD} = h =$ height of the building = ?



In right ΔABD

$\tan 60° = \dfrac{h}{x}$

$x = \dfrac{h}{\tan 60°}$

$x = \dfrac{20+y}{\sqrt{3}} \rightarrow (i)$

In right ΔABC

SOLUTION OF EXERCISE # 5.2

By using Pythagoras Theorem : $\left(\overline{AB}\right)^2 + \left(\overline{BC}\right)^2 = \left(\overline{AC}\right)^2$

$$x^2 + y^2 = (20)^2$$

$$\left(\frac{y+20}{\sqrt{3}}\right)^2 + y^2 = 400 \qquad \text{using eq.(i)}$$

$$\frac{y^2+40y+400}{3} + y^2 = 400$$

Multipling by '3', we get

$$y^2 + 40y + 400 + 3y^2 = 1200$$

$$4y^2 + 40y - 800 = 0$$

$$4\left(y^2 + 10y - 200\right) = 0$$

$$y^2 + 10y - 200 = 0$$

$$y^2 + 20y - 10y - 200 = 0 \qquad \{\text{By factorization}\}$$

$$y(y+20) - 10(y+20) = 0$$

$$(y-10)(y+20) = 0$$

Either	OR
$y - 10 = 0$	$y + 20 = 0$
$y = 10$	$y = -20$ (Not possible)

Hence height of building $= h = y + 20 = 10 + 20 = \boxed{30m}$

Q.13: 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 40m from the bank, he finds the measure the angle of elevation of the tree as 30°. Find the height of the tree and the width of the canal.

Sol. Let $\overline{CD} = h = \text{height of Tree} = ?$

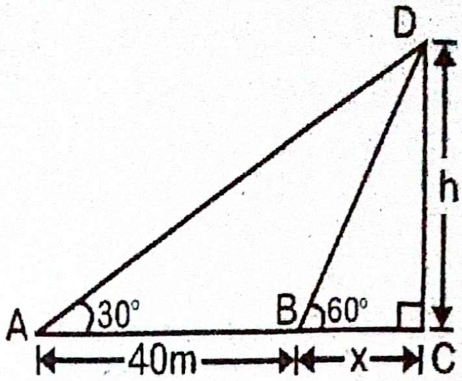
& $\overline{BC} = x = \text{Width of canal} = ?$

In right ΔBCD $\qquad \tan 60^\circ = \dfrac{h}{x}$

$$\sqrt{3}x = h \Rightarrow h = \sqrt{3}x \rightarrow \text{(i)}$$

SOLUTION OF EXERCISE # 5.2

In right ΔACD



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

$$\frac{1}{\sqrt{3}} = \frac{h}{40+x}$$

$$40 + x = \sqrt{3}h$$

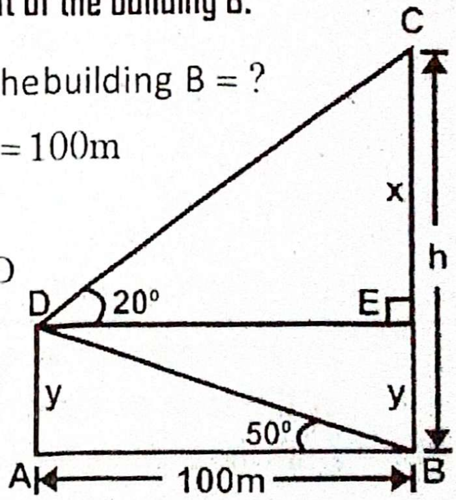
$$40 + x = \sqrt{3}\left(\sqrt{3}x\right) \quad \text{using eq.(i)}$$

$$40 + x = 3x$$

$$2x = 40 \quad \Rightarrow \quad \boxed{x = 20m}$$

Put $x = 20$ in eq.(i) $h = \sqrt{3}(20) = \boxed{34.64m}$

Q.14: Two building A and B are 100m apart. The angle of elevation from the top of the building A to 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.



Sol. Let $\overline{BC} = h = \text{height of the building B} = ?$

$\overline{AB} = \text{Distance between building A \& B} = 100m$

$\overline{AB} = \overline{DE} = 100m$

In right ΔDEC

$$\tan 20^\circ = \frac{\overline{EC}}{\overline{DE}}$$

$$\tan 20^\circ = \frac{x}{100}$$

$$100(\tan 20^\circ) = x$$

$$\boxed{x = 36.40\,m}$$

In right ΔABD

$$\tan 50^\circ = \frac{\overline{AD}}{\overline{AB}}$$

$$\tan 50^\circ = \frac{y}{100}$$

$$100(\tan 50^\circ) = y$$

$$\boxed{y = 119.20\,m}$$

$$h = x + y = 36.40 + 119.20 = \boxed{115.50m}$$