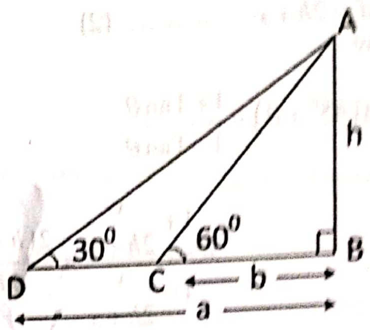
Chapter : Heights and Distances

LECTURER'S TASK

1. From the diagram :



$$\text{Tan}\,30^0 = \frac{h}{a}$$

$$\Rightarrow \frac{1}{\sqrt{3}} = \frac{h}{a}$$

$$\Rightarrow h = \frac{a}{\sqrt{3}} \quad \text{.......... (1)}$$

Again $\text{Tan}\,60^0 = \frac{h}{b}$

$$\Rightarrow \sqrt{3} = \frac{h}{b}$$

Now

$$\Rightarrow h = b\sqrt{3} \quad \text{.......... (2)}$$

New (1) x (2)

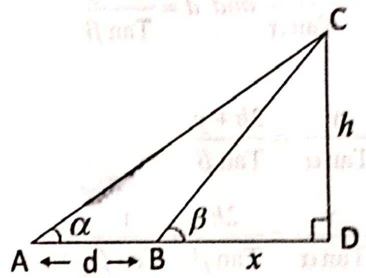
$$\Rightarrow h^2 = \frac{a}{\sqrt{3}} \times b\sqrt{3}$$

$$\Rightarrow h^2 = ab$$

$$\Rightarrow h = \sqrt{ab}$$

Ans: B

2. From the diagram



$$\text{Tan}\,\beta = \frac{h}{x}$$

$$\Rightarrow x = \frac{h}{\tan\beta}$$

$$\Rightarrow x = h\cot\beta \quad \text{.......... (i)}$$

Now, $\tan\alpha = \frac{h}{d+x}$

$$\Rightarrow d + x = h\cot\alpha$$

$$\Rightarrow x = h\cot\alpha - d \quad \text{.......... (ii)}$$

from (i) and (ii)

$$h\cot\beta = h\cot\alpha - d$$

$$\Rightarrow h\cot\alpha - h\cot\beta = d$$

$$\Rightarrow h(\cot\alpha - \cot\beta) = d$$

$$\Rightarrow h = \frac{d}{\cot\alpha - \cot\beta}$$

Ans: A

3. From diagram

$\text{Tan}\,\theta = \frac{x}{d}$ .... (1)

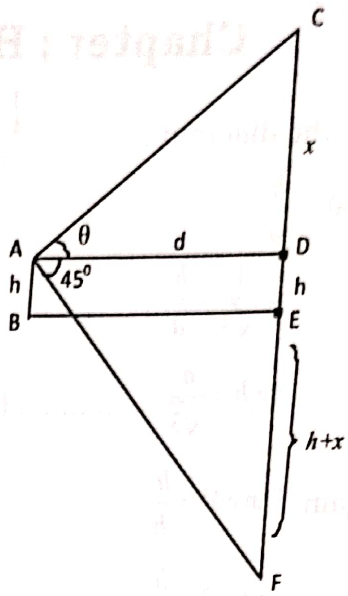
$\text{Tan}\,45^0 = \frac{2h+x}{d}$

$\Rightarrow d = 2h + x$ .... (2)

Now

$\text{Tan}\left(45^0+\theta\right) = \frac{1+\text{Tan}\,\theta}{1-\text{Tan}\,\theta}$

$= \frac{1+\frac{x}{2h+x}}{1-\frac{x}{2h+x}} = \frac{2(h+x)}{2h} = \frac{h+x}{h}$



$\therefore h+x = h\left(\text{Tan}\,45^0+\theta\right)$

$\therefore$ The hight of the cloud is $h\left(\text{Tan}\,45^0+\theta\right)$

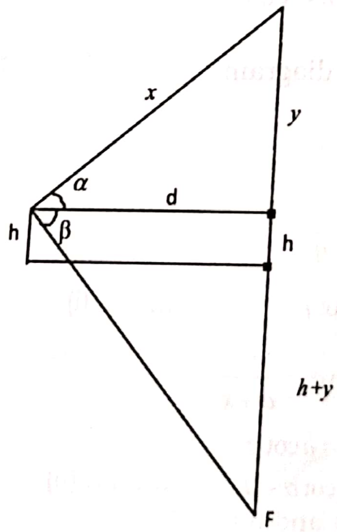
Ans: A

4. From diagram

$\text{Tan}\,\alpha = \frac{y}{d}$

$\text{Tan}\,\beta = \frac{2h+y}{d}$

$\therefore d = \frac{y}{\text{Tan}\,\alpha}$ *and* $d = \frac{2h+y}{\text{Tan}\,\beta}$



$\therefore \frac{y}{\text{Tan}\,\alpha} = \frac{2h+y}{\text{Tan}\,\beta}$

$\Rightarrow \frac{y}{\text{Tan}\,\alpha} = \frac{2h}{\text{Tan}\,\beta} + \frac{y}{\text{Tan}\,\beta}$

$\Rightarrow \frac{y}{\text{Tan}\,\alpha} - \frac{y}{\text{Tan}\,\beta} = \frac{2h}{\text{Tan}\,\beta}$

$\Rightarrow y\left(\frac{\text{Tan}\,\beta - \text{Tan}\,\alpha}{\text{Tan}\,\alpha . \text{Tan}\,\beta}\right) = \frac{2h}{\text{Tan}\,\beta}$

$\Rightarrow y\left(\frac{\text{Tan}\,\beta - \text{Tan}\,\alpha}{\text{Tan}\,\alpha}\right) = 2h$

$\Rightarrow \frac{y}{\text{Tan}\,\alpha} = \frac{2h}{\text{Tan}\,\beta - \text{Tan}\,\alpha}$

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$$\Rightarrow d=\frac{2h}{\operatorname{Tan}\beta-\operatorname{Tan}\alpha} \longrightarrow (1)$$

Now $\sec\alpha=\frac{x}{d}$

$$\therefore x=d\sec\alpha$$

$$\Rightarrow x=\frac{2h\sec\alpha}{\operatorname{Tan}\beta-\operatorname{Tan}\alpha} \quad (\because \text{from } (1))$$

Hence, the distance between the cloud and the observer is $\frac{2h\sec\alpha}{\operatorname{Tan}\beta-\operatorname{Tan}\alpha}$

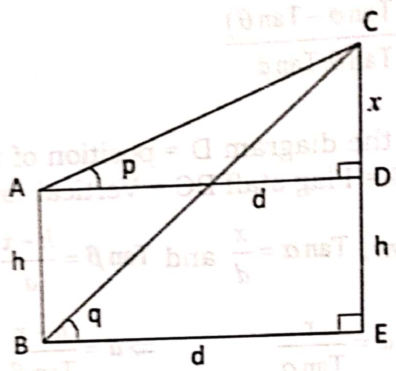
Ans: C

5. From the diagram

AB = Building

CE = Hill

A,B = Position of the observers → x



Now, $\operatorname{Tan}p=\frac{x}{d}$ and $\operatorname{Tan}q=\frac{x+h}{d}$

$$\Rightarrow d=x\cot p \qquad \Rightarrow d=(x+h)\cot q$$

$$\therefore x\cot p=(x+h)\cot q$$

$$\Rightarrow x\cot p-x\cot q=h\cot q$$

$$\Rightarrow x(\cot p-\cot q)=h\cot q$$

$$\Rightarrow x=\frac{h\cot q}{\cot p-\cot q}$$

Now, height of the hill

$$x+h=\frac{h\cot q}{\cot p-\cot q}+h$$

$$=\frac{h\cot q+h\cot p-h\cot q}{\cot p-\cot q}$$

$$=\frac{h\cot p}{\cot p-\cot q}$$

Ans: C

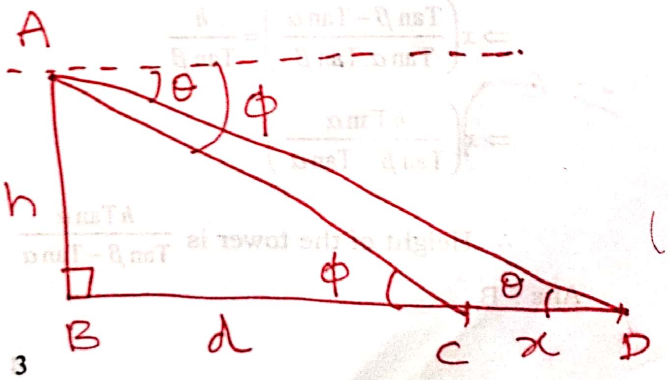
6. In the diagram

C,D = Position of the boats

A = Position of the observer

AB = Light hense house

Now, $\operatorname{Tan}\phi=\frac{h}{d}$ and $\operatorname{Tan}\theta=\frac{h}{d+x}$



$$\Rightarrow d = \frac{h}{\text{Tan}\,\phi} \qquad \Rightarrow d + x = \frac{h}{\text{Tan}\,\theta}$$

$$\therefore \frac{h}{\text{Tan}\,\phi} + x = \frac{h}{\text{Tan}\,\theta}$$

$$\Rightarrow x = \frac{h}{\text{Tan}\,\theta} - \frac{h}{\text{Tan}\,\phi}$$

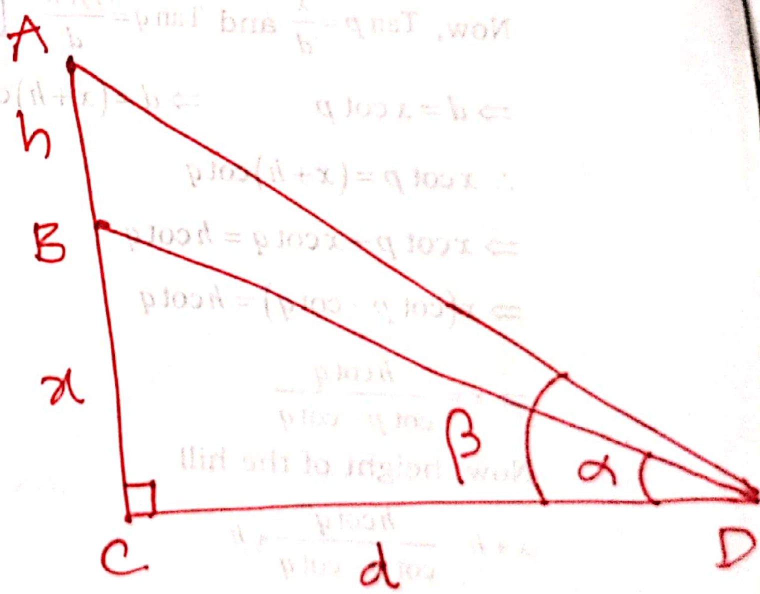
$$\therefore x = h\left(\frac{\text{Tan}\,\phi - \text{Tan}\,\theta}{\text{Tan}\,\theta.\text{Tan}\,\phi}\right)$$

$\therefore$ The distance between the two boats is

$$\frac{h(\text{Tan}\,\phi - \text{Tan}\,\theta)}{\text{Tan}\,\theta.\text{Tan}\,\phi}$$

Ans: B

7. In the diagram D = position of the observer
AB = Flag staff BC = Vertical tower



Now, $\text{Tan}\,\alpha = \frac{x}{d}$ and $\text{Tan}\,\beta = \frac{h+x}{d}$

$$\Rightarrow d = \frac{x}{\text{Tan}\,\alpha} \qquad \Rightarrow d = \frac{h+x}{\text{Tan}\,\beta}$$

$$\therefore \frac{x}{\text{Tan}\,\alpha} = \frac{h+x}{\text{Tan}\,\beta}$$

$$\Rightarrow \frac{x}{\text{Tan}\,\alpha} = \frac{h}{\text{Tan}\,\beta} + \frac{x}{\text{Tan}\,\beta}$$

$$\Rightarrow \frac{x}{\text{Tan}\,\alpha} - \frac{x}{\text{Tan}\,\beta} = \frac{h}{\text{Tan}\,\beta}$$

$$x\left(\frac{1}{\text{Tan}\,\alpha} - \frac{1}{\text{Tan}\,\beta}\right) = \frac{h}{\text{Tan}\,\beta}$$

$$\Rightarrow x\left(\frac{\text{Tan}\,\beta - \text{Tan}\,\alpha}{\text{Tan}\,\alpha.\text{Tan}\,\beta}\right) = \frac{h}{\text{Tan}\,\beta}$$

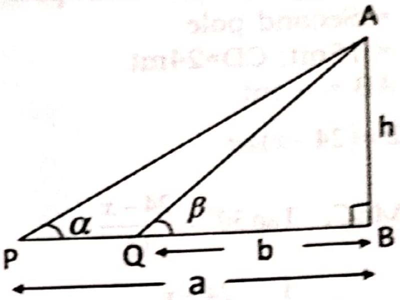
$$\Rightarrow x\left(\frac{h\,\text{Tan}\,\alpha}{\text{Tan}\,\beta - \text{Tan}\,\alpha}\right)$$

$\therefore$ Height of the tower is $\dfrac{h\,\text{Tan}\,\alpha}{\text{Tan}\,\beta - \text{Tan}\,\alpha}$

Ans : B

8. In the diagram AB = Tower

P,Q = Position of the observer



Given $\alpha+\beta=90^0$

$\Rightarrow \text{Tan}(\alpha+\beta)=\text{Tan}\,90^0$

$\Rightarrow \dfrac{\text{Tan}\,\alpha+\text{Tan}\,\beta}{(1-\text{Tan}\,\alpha.\text{Tan}\,\beta)}=$ Not defined

$\Rightarrow 1-\text{Tan}\,\alpha.\text{Tan}\,\beta=0$

$\Rightarrow \text{Tan}\,\alpha.\text{Tan}\,\beta=1$

$\Rightarrow \dfrac{h}{a}.\dfrac{h}{b}=1$

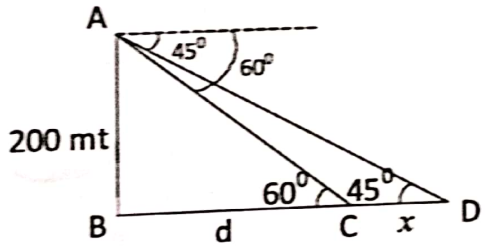
$\Rightarrow h^2=ab$

$\Rightarrow h=\sqrt{ab}$

$\therefore$ Heigth of the tower is $\sqrt{ab}$

Ans: A

9.



In the above diagram AB = Altitude of the aeroplane C,D = Opposite sides of the banks of a river

$CD=x$ = width of the river.

Now, $\quad \text{Tan}\,60^0=\dfrac{200}{d}$

$\Rightarrow \sqrt{3}=\dfrac{200}{d}$

$\Rightarrow d=\dfrac{200}{\sqrt{3}}$ and $\text{Tan}\,45^0=\dfrac{200}{d+a} \longrightarrow x$

$\Rightarrow d+a=200 \longrightarrow x$

$\therefore \dfrac{200}{\sqrt{3}}+x=200$

$\Rightarrow x=200-\dfrac{200}{\sqrt{3}}$

$\Rightarrow x=200\left(\dfrac{\sqrt{3}-1}{\sqrt{3}}\right)$

Ans : B

10. In the diagram AB = First pole

CD = Second pole

BD = 15mt; CD=24mt

Let AB = x mt

$\therefore CE=(24-x)mt$

In ΔAEC, $\text{Tan}\,30^0=\frac{24-x}{15}$

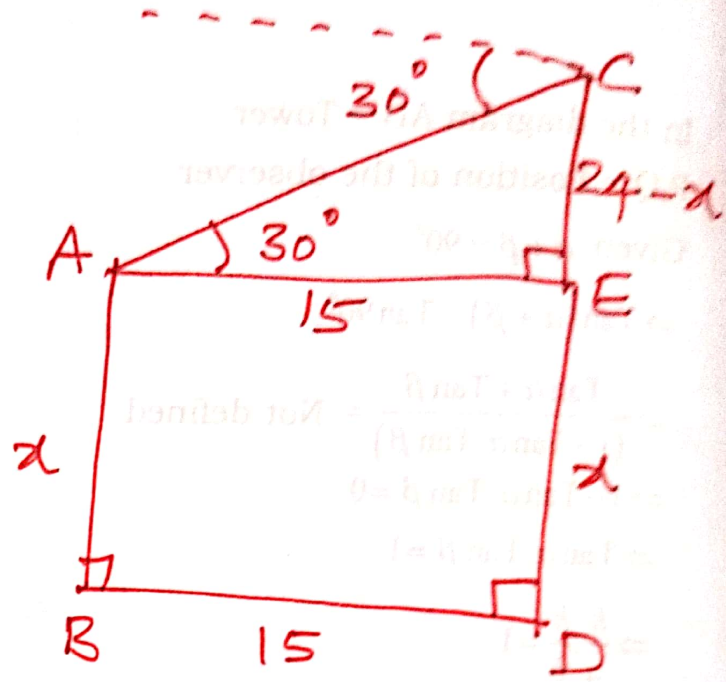
$$\Rightarrow\frac{1}{\sqrt{3}}=\frac{24-x}{15}$$

$$\Rightarrow 24-x=\frac{15}{\sqrt{3}}$$

$$\Rightarrow 24-x=8.67$$

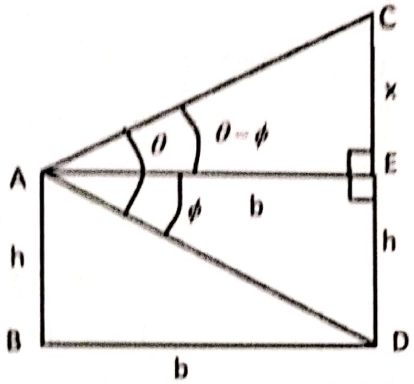
$$\Rightarrow x=24-8.66$$

$$\Rightarrow x=15.34 \text{ (opprex)}$$



Ans : C

11. In the figure AB = Window, CD = Building, BD = Road, given AB = h



Now, $\tan\phi = \frac{h}{b} \rightarrow (i)$

$$\tan(\theta-\phi) = \frac{x}{b}$$

$$\Rightarrow \frac{\tan\theta - \tan\phi}{1+\tan\theta\cdot\tan\phi} = \frac{x}{b}$$

$$\Rightarrow \frac{\frac{\sin\theta}{\cos\theta} - \frac{h}{b}}{1+\frac{\sin\theta}{\cos\theta}\cdot\frac{h}{b}} = \frac{x}{b} \quad (\because from(i))$$

$$\Rightarrow \frac{b\sin\theta - h\cos\theta}{b\cos\theta + h\sin\theta} = \frac{x}{b}$$

$$\Rightarrow x = \frac{b(b\sin\theta - h\cos\theta)}{b\cos\theta + h\sin\theta}$$

$\therefore$ Height of the building = $h+x$

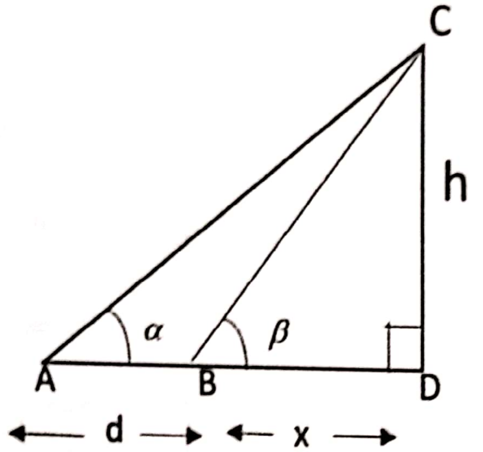
$$\therefore\ h+x = \frac{b(b\sin\theta - h\cos\theta)}{b\cos\theta + h\sin\theta} + h$$

$$= \frac{b^2\sin\theta - bh\cos\theta + bh\cos\theta + h^2\sin\theta}{b\cos\theta + h\sin\theta}$$

$$= \frac{(b^2+h^2)\sin\theta}{b\cos\theta + h\sin\theta}$$

ANS: C

12. In the figure A, B = positions of the observers, CD = Tower, AB = d



Let BD = x, CD = h

Now, $Tan\beta = \dfrac{h}{x}$ and $Tan\alpha = \dfrac{h}{d+x}$

$\Rightarrow x = h\cot\beta$ and $d + x = h\cot\alpha$

$\therefore d + h\cot\beta = h\cot\alpha$

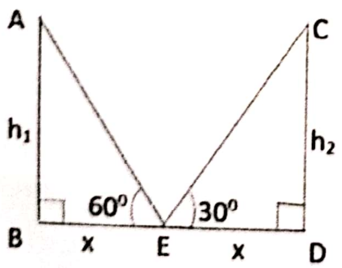
$\Rightarrow h(\cot\alpha - \cot\beta) = d$

$\Rightarrow h = \dfrac{d}{\cot\alpha - \cot\beta}$

$\therefore$ *Height* of the tower $= \dfrac{d}{\cot\alpha - \cot\beta}$

ANS : B

13. Statement I



In the figure $Tan60^0 = \dfrac{h_1}{x}$ | $Tan30^0 = \dfrac{h_2}{x}$

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$$\Rightarrow \sqrt{3} = \frac{h_1}{x}$$

$$\Rightarrow x = \frac{h_1}{\sqrt{3}} \rightarrow (i)$$

$$\Rightarrow \frac{1}{\sqrt{3}} = \frac{h_2}{x}$$

$$\Rightarrow x = \sqrt{3}h_2 \rightarrow (ii)$$

From (i) and (ii)

$$\frac{h_1}{\sqrt{3}} = \sqrt{3}h_2$$

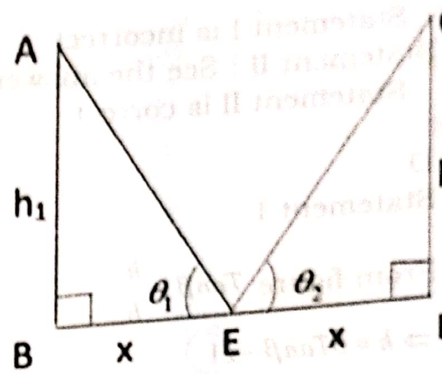
$$\Rightarrow h_1 = 3h_2$$

$$\Rightarrow h_1 : h_2 = 3:1$$

Hence, Statement I is correct

Statement II

In the figure



$$\tan\theta_1 = \frac{h_1}{x} \text{ and } \tan\theta_2 = \frac{h_2}{x}$$

$$\Rightarrow x = \frac{h_1}{\tan\theta_1} \text{ and } x = \frac{h_2}{\tan\theta_2}$$

$$\Rightarrow \frac{h_1}{\tan\theta_1} = \frac{h_2}{\tan\theta_2}$$

$$\Rightarrow \frac{h_1}{h_2} = \frac{\tan\theta_1}{\tan\theta_2}$$

$$\Rightarrow h_1 : h_2 = \tan\theta_1 : \tan\theta_2$$

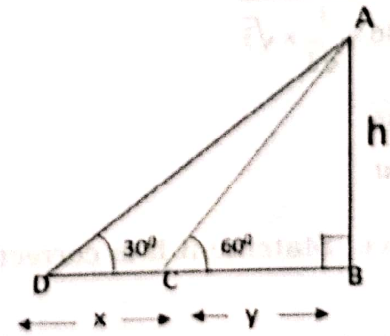
Hence, Statement II is correct.

Also, Statement II is the correct explanation of Statement I

ANS : A

14. Statement I

From the figure $Tan30^0 = \frac{h}{x+y}$



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

$$\Rightarrow x+y = \sqrt{3}h \rightarrow (1)$$

Again $Tan60^0 = \frac{h}{y}$

$\Rightarrow \sqrt{3} = \frac{h}{y}$

$\Rightarrow y = \frac{h}{\sqrt{3}} \rightarrow (2)$

Now, from 1, $x + \frac{h}{\sqrt{3}} = \sqrt{3}h$

It is not possible to find h value unless we know x value.

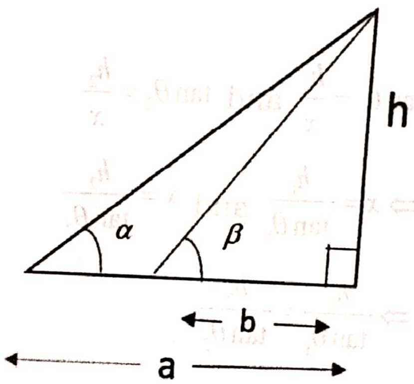
$\therefore$ Statement I is incorrect.

Statement II : See the answer given for question number 12.

$\therefore$ Statement II is correct.

ANS : D

15. Statement I



From figure $Tan\beta = \frac{h}{b}$

$\Rightarrow h = bTan\beta \rightarrow (1)$

Also, $Tan\alpha = \frac{h}{a}$

$\Rightarrow h = a\ Tan\alpha \rightarrow (2)$

Now, $(1) \times (2) \Rightarrow h^2 = abTan\alpha \cdot Tan\beta$

$\Rightarrow h = \sqrt{abTan\alpha \cdot Tan\beta}$

Statement I is incorrect.

Statement II : Given $a = 9mt$, $b = 4mt$

$\alpha = 30^0$, $\beta = 60^0$

Now, $h = \sqrt{ab\ \text{Tan}\alpha \cdot \text{Tan}\beta}$

$= \sqrt{9 \times 4 \times Tan30^0 \cdot Tan60^0}$

$= \sqrt{36 \times \frac{1}{\sqrt{3}} \times \sqrt{3}}$

$= \sqrt{36}$

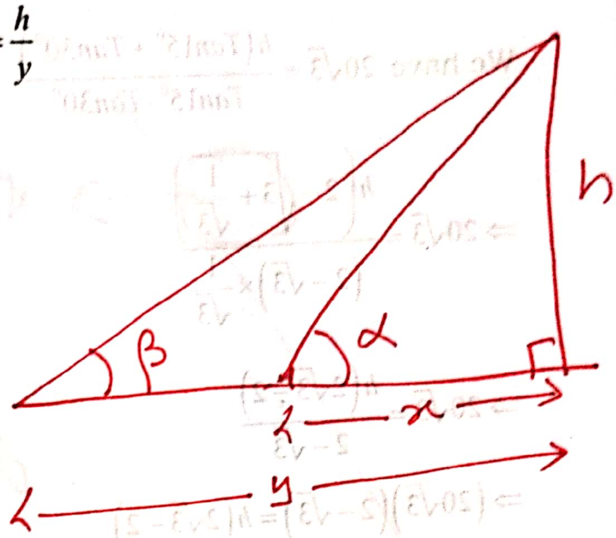
$= 6mt$

Hence, Statement II is correct.

ANS : D

16. Statement I

From figure $Tan\alpha = \frac{h}{x}$ and $Tan\beta = \frac{h}{y}$



Also, $\alpha + \beta = 90^0$

$\Rightarrow Tan(\alpha + \beta) = Tan90^0$

$\Rightarrow \frac{Tan\alpha + Tan\beta}{1 - Tan\alpha \cdot Tan\beta} = Not$ defined

$\Rightarrow 1 - Tan\alpha \cdot Tan\beta = 0$

$\Rightarrow Tan\alpha \cdot Tan\beta = 1$

$\Rightarrow \frac{h}{x} \cdot \frac{h}{y} = 1$

$\Rightarrow h^2 = xy$

$\Rightarrow h = \sqrt{xy}$

Hence, Statement I is correct.

Statement II

Given $x = a^2 + b^2$, $y = 2ab$

We have, $h = \sqrt{xy}$

$h = \sqrt{(a^2 + b^2)2ab} \neq a + b$

Statement II is incorrect.

ANS: C

17. We have $d = \frac{h(Tan\alpha + Tan\beta)}{Tan\alpha \cdot Tan\beta}$

Given $h = 10mts$, $\alpha = 45^0$, $\beta = 30^0$

$\therefore d = \frac{10(Tan45^0 + Tan30^0)}{Tan45^0 \cdot Tan30^0}$

$= \frac{10\left(1 + \frac{1}{\sqrt{3}}\right)}{1 + \frac{1}{\sqrt{3}}} = 10(\sqrt{3} + 1)mt$

ANS: A

18. Given $d = 20\sqrt{3}, \alpha = 15^0, \beta = 30^0$

We have $20\sqrt{3} = \dfrac{h(Tan15^0 + Tan30^0)}{Tan15^0 \cdot Tan30^0}$

$$\Rightarrow 20\sqrt{3} = \frac{h\left(2-\sqrt{3}+\frac{1}{\sqrt{3}}\right)}{\left(2-\sqrt{3}\right)\times\frac{1}{\sqrt{3}}}$$ $\rightarrow \sqrt{3}+\frac{1}{\sqrt{3}}$

$$\Rightarrow 20\sqrt{3} = \frac{h\left(2\sqrt{3}-2\right)}{2-\sqrt{3}}$$

delete

$$\Rightarrow \left(20\sqrt{3}\right)\left(2-\sqrt{3}\right) = h\left(2\sqrt{3}-2\right)$$

$$= \frac{10\left(1+\frac{1}{\sqrt{3}}\right)}{1+\frac{1}{\sqrt{3}}} = 10\left(\sqrt{3}+1\right)mt$$

ANS: A

8. Given $d = 20\sqrt{3}, \alpha = 15^0, \beta = 30^0$

We have $20\sqrt{3} = \dfrac{h(Tan15^0 + Tan30^0)}{Tan15^0 \cdot Tan30^0}$

$$\Rightarrow 20\sqrt{3} = \frac{h\left(2-\sqrt{3}+\frac{1}{\sqrt{3}}\right)}{\left(2-\sqrt{3}\right)\times\frac{1}{\sqrt{3}}}$$ $\sqrt{3}+\frac{1}{\sqrt{3}}$

$$\Rightarrow 20\sqrt{3} = \frac{h\left(2\sqrt{3}-2\right)}{2-\sqrt{3}}$$

$$\Rightarrow \left(20\sqrt{3}\right)\left(2-\sqrt{3}\right) = h\left(2\sqrt{3}-2\right)$$

$$\Rightarrow 10\sqrt{3}\left(2-\sqrt{3}\right) = h\left(\sqrt{3}-1\right)$$

$$\Rightarrow h = \frac{10\sqrt{3}\left(2-\sqrt{3}\right)}{\sqrt{3}-1}$$

ANS: B

19. Given $\alpha = 45^0$, $d = 30\sqrt{2}mt$, $h = 2mt$ then $\tan\beta$

We have $30\sqrt{2} = \dfrac{2(Tan45^0 + Tan\beta)}{Tan45^0 \cdot Tan\beta}$

$$\Rightarrow 30\sqrt{2} = \frac{2(1+Tan\beta)}{Tan\beta}$$

$$\Rightarrow 30\sqrt{2}\ Tan\beta = 2 + 2Tan\beta$$

$$\Rightarrow (30\sqrt{3} - 2)Tan\beta = 2$$

$\sqrt{2}$

$$\Rightarrow Tan\beta = \frac{2}{30\sqrt{2}-2}$$

$$\Rightarrow Tan\beta = \frac{1}{15\sqrt{2}-1}$$

ANS: B

20. We have $H = \dfrac{h(Tan\beta + Tan\alpha)}{Tan\alpha - Tan\alpha}$

β

Given $\alpha = 30^0$, $\beta = 60^0$

$$\therefore H = \frac{h(Tan60^0 + Tan30^0)}{Tan60^0 - Tan30^0}$$

$$\Rightarrow H = \frac{h\left(\sqrt{3}+\frac{1}{\sqrt{3}}\right)}{\left(\sqrt{3}-\frac{1}{\sqrt{3}}\right)}$$

$$\Rightarrow H = \frac{h(4)}{2}$$

$$\Rightarrow H = 2h$$

$$\Rightarrow h : H = 1 : 2$$

ANS: A

21. We have

$$H = \frac{h(Tan\beta + Tan\alpha)}{Tan\beta - Tan\alpha}$$

$$\Rightarrow h = \frac{H(Tan\beta - Tan\alpha)}{Tan\beta + Tan\alpha}$$

$$\Rightarrow h = \frac{H(Tan\beta - Tan\alpha)}{Tan\beta + Tan\alpha}$$

$$\Rightarrow h = \frac{H\left(\frac{1}{\cot\beta} - \frac{1}{\cot\alpha}\right)}{\left(\frac{1}{\cot\beta} + \frac{1}{\cot\alpha}\right)}$$

$$\Rightarrow h = \frac{H(\cot\alpha - \cot\beta)}{(\cot\alpha + \cot\beta)}$$

ANS : A

22. Given $\alpha = 0^0$

Now $H = \frac{h(Tan\beta + Tan\alpha)}{(Tan\beta - Tan\alpha)}$

$$\Rightarrow H = \frac{h(Tan\beta + Tan0^0)}{(Tan\beta - Tan0^0)}$$

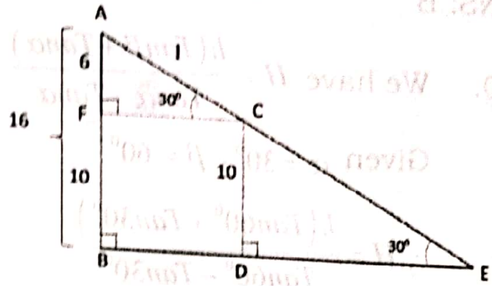
$$\Rightarrow H = h$$

Now, $h^2 + H^2 = 2h^2$ or $2H^2$

∴ The possible answer is 2.

ANS: B

23.



In the above figure

AB and CD are ten poles.

the

∴ AB = 16 mt, CD = 10 mt

∴ AF = 6 mt

AC = Length of the wire.

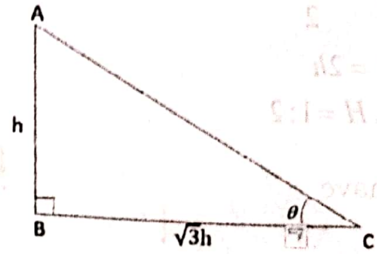
Now in $\triangle AFC, \sin 30^0 = \frac{6}{l}$

$$\Rightarrow \frac{1}{2} = \frac{6}{l}$$

$$\Rightarrow l = 12cm$$

24.

a) AB = Tower, BC = Shadow



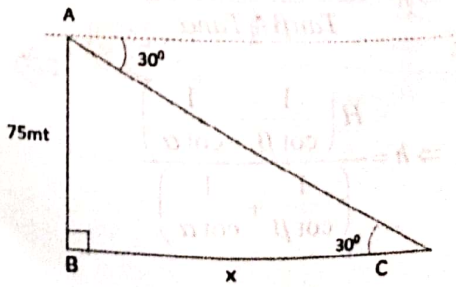
Now $Tan\theta = \frac{h}{\sqrt{3}h}$

$$\Rightarrow Tan\theta = \frac{1}{\sqrt{3}}$$

$$\Rightarrow \theta = 30^0$$

b) A= Position of the observer

C = Position of the car



Now $Tan30^0 = \frac{75}{x}$

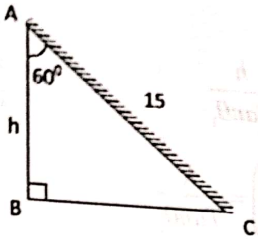
$$\Rightarrow \frac{1}{\sqrt{3}} = \frac{75}{x}$$

$\Rightarrow x = 75\sqrt{3}$

c) $\cos 60^0 = \dfrac{h}{15}$

$\Rightarrow \dfrac{1}{2} = \dfrac{h}{15}$

$\Rightarrow h = \dfrac{15}{2} mt$

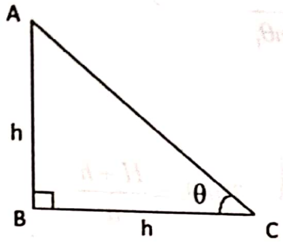


d) Here AB = Pole, BC = Shadow of the pole
Given AB = BC

$\therefore Tan\theta = \dfrac{AB}{BC}$

$\Rightarrow Tan\theta = 1$

$\Rightarrow \theta = 45^0$

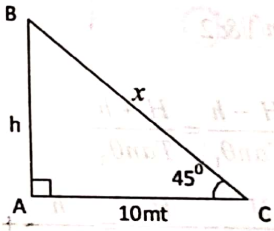


ANS: $a \to q, b \to t, c \to r, d \to s$

25. a) From figure, $Tan45^0 = \dfrac{h}{10}$ $\qquad \sin 45^0 = \dfrac{h}{x}$

$\Rightarrow 1 = \dfrac{h}{10}$ $\qquad \Rightarrow \dfrac{1}{\sqrt{2}} = \dfrac{10}{x}$

$\Rightarrow h = 10mt$ $\qquad \Rightarrow x = 10\sqrt{2}mt$



The length of the entire tree = AB + BC

= h + x

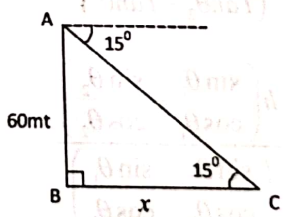
$= 10 + 10\sqrt{2}$

$= 10\left(\sqrt{2}+1\right)mt$

b) From figure $Tan15^0 = \dfrac{60}{x}$

$\Rightarrow \dfrac{\sqrt{3}-1}{\sqrt{3}+1} = \dfrac{60}{x}$

$\Rightarrow x = 60\left(\dfrac{\sqrt{3}+1}{\sqrt{3}-1}\right)$



c) Hence, AB = Building, CD = Hill A, B = Positions of the observer

Now, $Tan\theta_1 = \dfrac{H-h}{d}$ $\qquad Tan\theta_2 = \dfrac{H}{d}$

$\Rightarrow d = \dfrac{H-h}{Tan\theta_1} \to 1$ $\qquad d = \dfrac{H}{Tan\theta_2} \to 2$

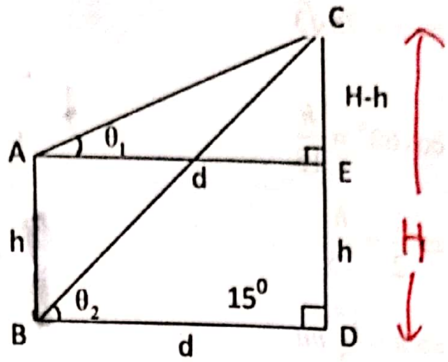
from 1 & 2

$$\frac{H-h}{Tan\theta_1}=\frac{H}{Tan\theta_2}$$

$$\Rightarrow \frac{H}{Tan\theta_1}-\frac{H}{Tan\theta_2}=\frac{h}{Tan\theta_1}$$

$$\Rightarrow H\left(\frac{Tan\theta_2-Tan\theta_1}{Tan\theta_1 - Tan\theta_2}\right)=\frac{h}{Tan\theta_1}$$

$$\Rightarrow H=\frac{h.Tan\theta_2}{Tan\theta_2-Tan\theta_1}$$



d) From the figure

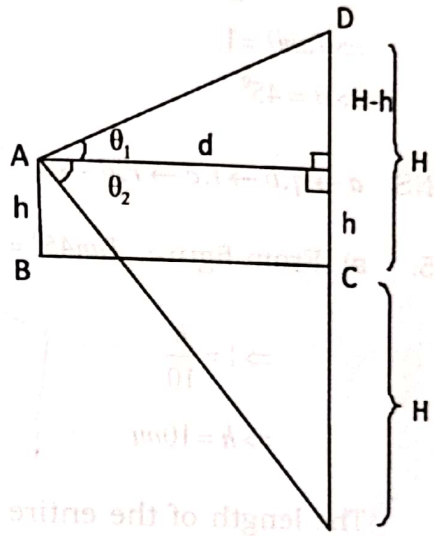
$$Tan\theta_1=\frac{H-h}{d}$$

$$\Rightarrow d=\frac{H-h}{Tan\theta_1}\rightarrow 1$$

$$Tan\theta_2=\frac{H+h}{d}$$

$$\Rightarrow d=\frac{H+h}{Tan\theta_2}\rightarrow 2$$

from 1 & 2



$$\therefore \frac{H-h}{Tan\theta_1}=\frac{H+h}{Tan\theta_2}$$

$$\Rightarrow \frac{H}{Tan\theta 1}-\frac{H}{Tan\theta_2}=\frac{h}{Tan\theta_2}+\frac{h}{Tan\theta_1}$$

$$\Rightarrow H\left(Tan\theta_2-Tan\theta_1\right)=h\left(Tan\theta_1+Tan\theta_2\right)$$

$$\Rightarrow H=\frac{h\left(Tan\theta_1+Tan\theta_2\right)}{\left(Tan\theta_2-Tan\theta_1\right)}$$

$$\Rightarrow H=\frac{h\left(\frac{\sin\theta_1}{\cos\theta_1}+\frac{\sin\theta_2}{\cos\theta_2}\right)}{\left(\frac{\sin\theta_2}{\cos\theta_2}-\frac{\sin\theta_1}{\cos\theta_1}\right)}$$

$$\Rightarrow H=h\left(\frac{\sin\theta_1\cdot\cos\theta_2+\cos\theta_1\cdot\sin\theta_2}{\sin\theta_2\cdot\cos\theta_2-\cos\theta_2\cdot\sin\theta_1}\right)$$

$$\Rightarrow H=\frac{h\sin\left(\theta_1+\theta_2\right)}{\sin\left(\theta_2-\theta 1\right)}$$

ANS: $a\rightarrow t, b\rightarrow q, c\rightarrow r, d\rightarrow s$