

EXAM
DRILL

Some Applications of Trigonometry

SOLUTIONS

1. (d) : Let A be the kite and AC is the string.

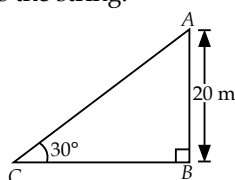
In right $\triangle ABC$, we have

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

$$\Rightarrow \frac{1}{2} = \frac{20}{AC}$$

$$\Rightarrow AC = 40 \text{ m}$$

Hence, the length of the string is 40 m.

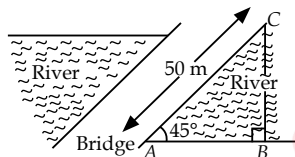


2. (c) : From figure, in right $\triangle ABC$, we have

$$\sin 45^\circ = \frac{BC}{AC}$$

$$\Rightarrow \frac{1}{\sqrt{2}} = \frac{BC}{50}$$

$$\Rightarrow BC = \frac{50}{\sqrt{2}} = 25\sqrt{2} \text{ m}$$



Hence, the width of the river is $25\sqrt{2}$ m.

3. (a) : Let $\angle ACB = \theta$

In right $\triangle ABC$,

$$\tan \theta = \frac{AB}{BC} = \frac{4}{4\sqrt{3}} \Rightarrow \tan \theta = \frac{1}{\sqrt{3}} = \tan 30^\circ \Rightarrow \theta = 30^\circ$$

Now, $\angle ACB = \angle CAD = 30^\circ$ [Alternate angles]

Hence, angle of depression from A is 30° .

4. (b) : Let AB and CD are two poles of height 14 m and 20 m respectively. AD is the wire.

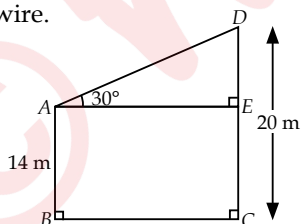
$$\text{Now, } DE = CD - CE$$

$$= 20 - 14 = 6 \text{ m}$$

In right $\triangle ADE$,

$$\tan 30^\circ = \frac{DE}{AE}$$

$$\Rightarrow \frac{1}{\sqrt{3}} = \frac{6}{AE} \Rightarrow AE = 6\sqrt{3} \text{ m}$$



Hence, distance between two poles is $6\sqrt{3}$ m.

5. Let $AC = h$ m be the height of the pole.

Length of the shadow = $BC = 5\sqrt{3}$ m

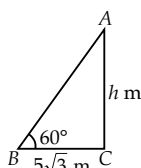
It is given that the sun's elevation is 60° .

$$\therefore \angle B = 60^\circ$$

In right $\triangle ACB$, we have

$$\frac{AC}{BC} = \tan 60^\circ \Rightarrow \frac{h}{5\sqrt{3}} = \sqrt{3} \Rightarrow h = 15$$

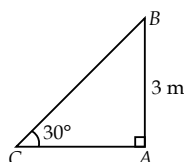
Hence, the height of the pole is 15 m.



6. Let BC be the length of ramp and AC be the horizontal path.

$AB = 3$ m and $\angle ACB = 30^\circ$

In right $\triangle ABC$,



$$\sin 30^\circ = \frac{AB}{BC} \Rightarrow \frac{1}{2} = \frac{3}{BC} \Rightarrow BC = 6 \text{ m}$$

7. $AB = 6$ m, $AD = 2.54$ m (given)

$$\therefore BD = AB - AD = 6 - 2.54 = 3.46 \text{ m}$$

Hence, in $\triangle BDC$,

$$\frac{BD}{CD} = \sin 60^\circ \Rightarrow \frac{3.46}{CD} = \frac{\sqrt{3}}{2} \Rightarrow CD = 4 \text{ m}$$

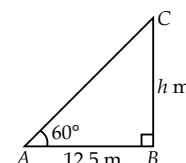
8. Let the height of the tower be h m.

In right $\triangle ABC$,

$$\tan 60^\circ = \frac{BC}{AB} = \frac{h}{12.5}$$

$$\Rightarrow \sqrt{3} = h/12.5 \Rightarrow h = 12.5\sqrt{3}$$

\therefore Height of the tower is $12.5\sqrt{3}$ m.



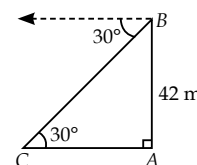
9. Let B be the position of the observer on the bridge and C be the position of boat.

Now, in right $\triangle ABC$,

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

$$\Rightarrow \frac{1}{\sqrt{3}} = \frac{42}{AC} \Rightarrow AC = 42\sqrt{3} \text{ m}$$

\therefore Required distance is $42\sqrt{3}$ m.

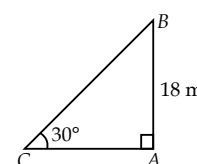


10. Let AB is the pillar of height 18 m and AC is the shadow of AB .

In right $\triangle ABC$, $\tan 30^\circ = \frac{AB}{AC}$

$$\Rightarrow \frac{1}{\sqrt{3}} = \frac{18}{AC} \Rightarrow AC = 18\sqrt{3} \text{ m}$$

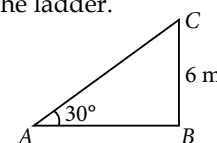
\therefore Required length of shadow is $18\sqrt{3}$ m.



11. (i) (c) : Let AC be the length of the ladder.

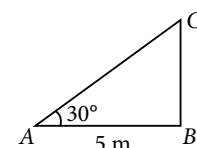
In $\triangle ABC$, $\frac{BC}{AC} = \sin 30^\circ$

$$\Rightarrow \frac{6}{AC} = \frac{1}{2} \Rightarrow AC = 12 \text{ m}$$



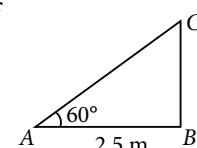
- (ii) (b) : In $\triangle ABC$, $\frac{AB}{AC} = \cos 30^\circ$

$$\Rightarrow \frac{5}{AC} = \frac{\sqrt{3}}{2} \Rightarrow AC = \frac{10}{\sqrt{3}} \text{ m}$$



- (iii) (a) : Let BC be the height of window from ground.

In $\triangle ABC$, $\frac{BC}{AB} = \tan 60^\circ$



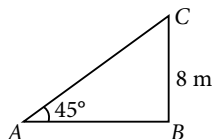
$$\Rightarrow \frac{BC}{2.5} = \sqrt{3}$$

$$\Rightarrow BC = 2.5 \times 1.73 = 4.325 \text{ m}$$

(iv) (d) : Let AB be the horizontal distance between the foot of ladder and wall.

$$\text{In } \triangle ABC, \frac{BC}{AB} = \tan 45^\circ$$

$$\Rightarrow \frac{8}{AB} = 1 \Rightarrow AB = 8 \text{ m}$$



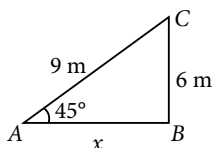
(v) (b) : Let the required distance be x .

$$\text{In } \triangle ABC, (9)^2 = x^2 + (6)^2$$

[By Pythagoras theorem]

$$\Rightarrow 81 - 36 = x^2 \Rightarrow 45 = x^2$$

$$\Rightarrow x = 3\sqrt{5} \text{ m}$$



12. (i) Total height of pole = 8 m

$$\therefore BD = AD - AB = (8 - 2) \text{ m} = 6 \text{ m}$$

$$(ii) \text{ In } \triangle BDC, \frac{BD}{BC} = \sin 60^\circ$$

$$\Rightarrow \frac{6}{BC} = \frac{\sqrt{3}}{2} \Rightarrow BC = \frac{12}{\sqrt{3}} \times \frac{\sqrt{3}}{\sqrt{3}} = 4\sqrt{3} \text{ m}$$

(iii) In $\triangle BDC$,

$$\frac{BD}{CD} = \tan 60^\circ \Rightarrow \frac{6}{CD} = \sqrt{3} \Rightarrow CD = \frac{6}{\sqrt{3}} \times \frac{\sqrt{3}}{\sqrt{3}} = 2\sqrt{3} \text{ m}$$

(iv) If $\triangle BCD$,

$$\frac{BD}{CD} = \tan \theta \Rightarrow 1 = \tan \theta \quad [\because BD = CD]$$

$$\Rightarrow \theta = 45^\circ$$

(v) In $\triangle BDC$, $\angle B + \angle D + \angle C = 180^\circ$

$$\therefore \angle B = 180^\circ - 60^\circ - 90^\circ = 30^\circ$$

13. (i) $\angle XAC = 45^\circ$ (Given)

$$\therefore \angle ACD = 45^\circ \quad [\text{Alternate interior angles}]$$

$$(ii) \angle ABD = \angle YAB = 30^\circ \quad [\text{Alternate interior angles}]$$

(iii) In $\triangle ACD$,

$$\frac{AD}{DC} = \tan 45^\circ$$

$$\Rightarrow \frac{100}{DC} = 1 \Rightarrow DC = 100 \text{ m}$$

$$(iv) \text{ In } \triangle ABD, \frac{AD}{BD} = \tan 30^\circ$$

$$\Rightarrow \frac{100}{BD} = \frac{1}{\sqrt{3}} \Rightarrow BD = 100\sqrt{3} \text{ m}$$

(v) In $\triangle ADC$,

$$\frac{AD}{AC} = \sin 45^\circ \Rightarrow \frac{100}{AC} = \frac{1}{\sqrt{2}} \Rightarrow AC = 100\sqrt{2} \text{ m}$$

14. (i) (c) : In $\triangle OPQ$, we have

$$\tan 60^\circ = \frac{PQ}{PO}$$

$$\Rightarrow \sqrt{3} = \frac{20}{PO} \Rightarrow PO = \frac{20}{\sqrt{3}} \text{ m}$$

(ii) (b) : In $\triangle ORS$, we have

$$\tan 30^\circ = \frac{RS}{OR} \Rightarrow \frac{1}{\sqrt{3}} = \frac{20}{OR} \Rightarrow OR = 20\sqrt{3} \text{ m}$$

(iii) (d) : Clearly, width of the road = PR

$$= PO + OR = \left(\frac{20}{\sqrt{3}} + 20\sqrt{3} \right) \text{ m}$$

$$= 20 \left(\frac{4}{\sqrt{3}} \right) \text{ m} = \frac{80}{\sqrt{3}} \text{ m} = 46.24 \text{ m}$$

(iv) (a) : In $\triangle OPQ$, if $\angle POQ = 45^\circ$, then

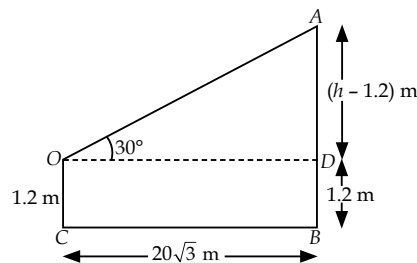
$$\tan 45^\circ = \frac{PQ}{PO} \Rightarrow 1 = \frac{20}{PO} \Rightarrow PO = 20 \text{ m}$$

(v) (b)

15. Let CO be the observer, who is 1.2 m tall.

Let AB be the tower of height h m and $CB = 20\sqrt{3}$ m.

Let O be the point of observation of the angle of elevation of the top of tower such that $\angle AOD = 30^\circ$.



Draw OD parallel to CB such that $OD = CB = 20\sqrt{3}$ m.

In right $\triangle AOD$, we have

$$\tan 30^\circ = \frac{AD}{OD} \Rightarrow \frac{1}{\sqrt{3}} = \frac{h - 1.2}{20\sqrt{3}}$$

$$\Rightarrow h - 1.2 = 20 \Rightarrow h = 21.2$$

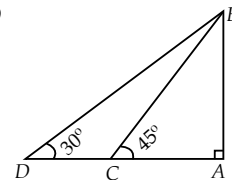
Hence, the height of the tower is 21.2 m.

16. Let AB be the tower and AC and AD are the shadows of tower AB , such that $AC + 14 = AD$

In right $\triangle ABC$,

$$\tan 45^\circ = \frac{AB}{AC}$$

$$\Rightarrow 1 = \frac{AB}{AC} \Rightarrow AB = AC \quad \dots(i)$$



In right $\triangle ABD$,

$$\begin{aligned}\tan 30^\circ &= \frac{AB}{AD} \Rightarrow \frac{1}{\sqrt{3}} = \frac{AB}{AC+14} \Rightarrow AC+14 = AB\sqrt{3} \\ \Rightarrow AB\sqrt{3} - AB &= 14 \quad [\text{From (i)}] \\ \Rightarrow AB &= \frac{14}{\sqrt{3}-1} \times \frac{\sqrt{3}+1}{\sqrt{3}+1} = 7(\sqrt{3}-1) = 5.124 \text{ m}\end{aligned}$$

17. Let AB be the lamp-post and CD be the boy after walking 5 seconds. Let $DE = x$ m be the length of his shadow such that $BD = 1.5 \times 5 = 7.5$ m.

Let $\angle AEB = \angle CED = \theta$

Now, in right $\triangle CED$,

$$\tan \theta = \frac{CD}{ED} = \frac{0.95}{x} \quad \dots(i)$$

$$[\because CD = 95 \text{ cm} = 0.95 \text{ m}]$$

In right $\triangle ABE$,

$$\begin{aligned}\tan \theta &= \frac{AB}{ED} \\ \Rightarrow \tan \theta &= \frac{3.8}{7.5+x} \quad \dots(ii)\end{aligned}$$

From (i) and (ii), we get

$$\begin{aligned}\frac{0.95}{x} &= \frac{3.8}{7.5+x} \\ \Rightarrow 7.5 \times 0.95 + 0.95x &= 3.8x \Rightarrow 7.125 + 0.95x = 3.8x \\ \Rightarrow 7.125 &= 3.8x - 0.95x \Rightarrow 7.125 = 2.85x \Rightarrow x = 2.5\end{aligned}$$

Hence, the length of his shadow after 5 seconds is 2.5 m.

18. Let A be the point on the ground which is 70 m away from the tower. Let BC be the tower of height h m and CD the flagstaff of height x m.

It is given that the angle of elevation of the top of the flagstaff from the point A is 60° and angle of elevation of the bottom of the flagstaff from the point A is 45° .

$\therefore \angle CAB = 45^\circ$ and $\angle DAB = 60^\circ$

In right $\triangle CBA$,

$$\begin{aligned}\tan 45^\circ &= \frac{BC}{AB} \Rightarrow 1 = \frac{h}{70} \\ \Rightarrow h &= 70 \quad \dots(i)\end{aligned}$$

Now, in right $\triangle DBA$,

$$\begin{aligned}\tan 60^\circ &= \frac{DB}{AB} \\ \Rightarrow \sqrt{3} &= \frac{h+x}{70} \\ \Rightarrow \sqrt{3} &= \frac{70+x}{70} \quad [\text{Using (i)}]\end{aligned}$$

$$\Rightarrow 70\sqrt{3} = 70 + x \Rightarrow x = 70\sqrt{3} - 70$$

$$\Rightarrow x = 70(\sqrt{3} - 1) \Rightarrow x = 70(0.732) \Rightarrow x = 51.24$$

Hence, the height of the flagstaff is 51.24 m and the height of the tower is 70 m.

19. Let A be the first aeroplane, vertically above another aeroplane B such that $AC = 5000$ m be the height of the first aeroplane from the ground.

Let O be a point on the ground such that $\angle AOC = 60^\circ$

and $\angle BOC = 45^\circ$.

In right $\triangle AOC$,

$$\begin{aligned}\tan 60^\circ &= \frac{AC}{OC} \\ \Rightarrow \sqrt{3} &= \frac{AC}{OC} \\ \Rightarrow OC &= \frac{5000}{\sqrt{3}} \quad [\because AC = 5000 \text{ m}] \\ \Rightarrow OC &= \frac{5000\sqrt{3}}{3} = 2883.3 \text{ m} \quad \dots(ii)\end{aligned}$$

In right $\triangle BOC$,

$$\begin{aligned}\tan 45^\circ &= \frac{BC}{OC} \Rightarrow 1 = \frac{BC}{OC} \Rightarrow BC = OC \\ \Rightarrow BC &= 2883.3 \text{ m} \quad [\text{Using (i)}] \\ \text{Thus, } AB &= AC - BC \\ &= 5000 - 2883.3 = 2116.7 \text{ m} \quad \dots(ii)\end{aligned}$$

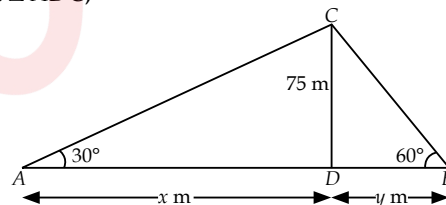
Hence, the vertical distance between the two aeroplanes is 2116.7 m.

20. Let $CD = 75$ m be the height of the building. Let A and B be the points of observations such that the angle of elevation at A is 30° and the angle of elevation at B is 60° .

$\therefore \angle CAD = 30^\circ$ and $\angle CBD = 60^\circ$

Let $AD = x$ m and $DB = y$ m.

In right $\triangle ADC$,



$$\tan 30^\circ = \frac{CD}{AD} \Rightarrow \frac{1}{\sqrt{3}} = \frac{75}{x} \Rightarrow x = 75\sqrt{3} \text{ m} \quad \dots(i)$$

In right $\triangle BDC$,

$$\tan 60^\circ = \frac{CD}{DB} \Rightarrow \sqrt{3} = \frac{75}{y} \Rightarrow y = \frac{75}{\sqrt{3}} \text{ m} \quad \dots(ii)$$

The distance between two men is AB , i.e.,

$$\begin{aligned}AB &= AD + DB = x + y \\ \Rightarrow AB &= \left(75\sqrt{3} + \frac{75}{\sqrt{3}} \right) \quad [\text{Using (i) and (ii)}] \\ \Rightarrow AB &= \left(\frac{225 + 75}{\sqrt{3}} \right) = \frac{300}{\sqrt{3}}\end{aligned}$$

$$100\sqrt{3} = 100 \times 1.73 \Rightarrow AB = 173 \text{ m}$$

Hence, the distance between the two men is 173 m.

21. Let CE be the 8 m

tall building and AD

be the multistoried

building of height x m.

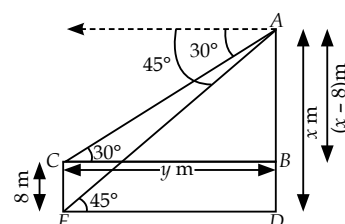
Let $BC = DE = y$ m, be

the distance between the two buildings.

Then, $AB = AD - BD$

$$= AD - CE = (x - 8) \text{ m}$$

$\therefore \angle BCA = 30^\circ$ and $\angle DEA = 45^\circ$



In right $\triangle ABC$,

$$\tan 30^\circ = \frac{AB}{BC} \Rightarrow \frac{1}{\sqrt{3}} = \frac{x-8}{y}$$

$$\Rightarrow y = \sqrt{3}(x-8) \quad \dots(i)$$

In right $\triangle ADE$,

$$\tan 45^\circ = \frac{AD}{DE} \Rightarrow 1 = \frac{x}{y}$$

$$\Rightarrow y = x \quad \dots(ii)$$

From (i) and (ii), we get

$$\sqrt{3}(x-8) = x \Rightarrow \sqrt{3}x - 8\sqrt{3} = x \Rightarrow \sqrt{3}x - x = 8\sqrt{3}$$

$$\Rightarrow x = \frac{8\sqrt{3}}{\sqrt{3}-1} = \frac{8\sqrt{3}(\sqrt{3}+1)}{(\sqrt{3}-1)(\sqrt{3}+1)} = \frac{8(3+\sqrt{3})}{3-1}$$

$$\Rightarrow x = 4(3 + \sqrt{3}) \quad \dots(iii)$$

From (ii) and (iii), we get

$$y = 4(3 + \sqrt{3})$$

So, the height of the multistoried building is $4(3 + \sqrt{3})$ m and the distance between the two buildings is also $4(3 + \sqrt{3})$ m.

22. Let AB be the vertical tower of height h m and $YX = 40$ m. Let $YD = XA = y$ m, where X is a point on the ground.

Then, $BD = AB - AD$

$$\Rightarrow BD = (h - 40) \text{ m}$$

In right $\triangle BDY$, we have

$$\tan 45^\circ = \frac{BD}{YD}$$

$$\Rightarrow 1 = \frac{h-40}{y}$$

$$\Rightarrow y = (h-40) \quad \dots(i)$$

In right $\triangle BAX$, we have

$$\tan 60^\circ = \frac{AB}{XA}$$

$$\Rightarrow \sqrt{3} = \frac{h}{y} \Rightarrow y = \frac{h}{\sqrt{3}} \quad \dots(ii)$$

From (i) and (ii), we get

$$h-40 = \frac{h}{\sqrt{3}} \Rightarrow h - \frac{h}{\sqrt{3}} = 40$$

$$\Rightarrow \sqrt{3}h - h = 40\sqrt{3} \Rightarrow h(\sqrt{3}-1) = 40\sqrt{3}$$

$$\Rightarrow h = \frac{40\sqrt{3}}{\sqrt{3}-1} = \frac{40\sqrt{3} \times (\sqrt{3}+1)}{(\sqrt{3}-1) \times (\sqrt{3}+1)} = \frac{40(3+\sqrt{3})}{3-1}$$

$$\Rightarrow h = 20(3 + \sqrt{3}) \quad \dots(iii)$$

In right $\triangle BAX$, we have

$$\cos 60^\circ = \frac{AX}{XB} \Rightarrow \frac{1}{2} = \frac{y}{XB}$$

$$\Rightarrow XB = 2y \Rightarrow XB = 2(h-40) \quad [\text{Using (i)}]$$

$$\Rightarrow XB = 2[20(3 + \sqrt{3}) - 40] \quad [\text{Using (iii)}]$$

$$\Rightarrow XB = 2[60 + 20\sqrt{3} - 40] = 2[20 + 20\sqrt{3}]$$

$$\Rightarrow XB = 40(1 + \sqrt{3}) \text{ m}$$

Hence, the height of the tower AB is $20(3 + \sqrt{3})$ m and

the distance XB is $40(1 + \sqrt{3})$ m.

23. Let AB be the tower of height h m and let the angle of elevation of its top at C be α i.e., $\angle ACB = \alpha$. Let D be a point at a distance of 192 metres from C such that $\angle ADB = \beta$ and $AD = x$ m.

It is given that

$$\tan \alpha = \frac{5}{12} \text{ and } \tan \beta = \frac{3}{4}$$

In right $\triangle CAB$, we have

$$\tan \alpha = \frac{AB}{AC}$$

$$\Rightarrow \frac{5}{12} = \frac{h}{x+192} \quad \dots(i)$$

In right $\triangle DAB$, we have

$$\tan \beta = \frac{AB}{AD} \Rightarrow \tan \beta = \frac{h}{x} \Rightarrow \frac{3}{4} = \frac{h}{x} \Rightarrow x = \frac{4h}{3} \quad \dots(ii)$$

$$\Rightarrow \frac{5}{12} = \frac{h}{192 + 4h/3} \quad [\text{From (i) and (ii)}]$$

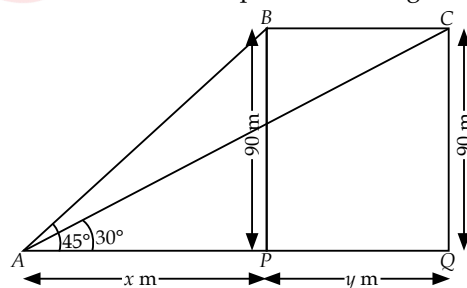
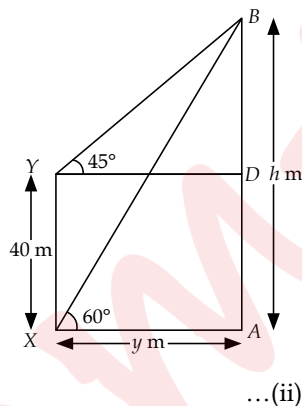
$$\Rightarrow 5\left(192 + \frac{4h}{3}\right) = 12h \Rightarrow 5(576 + 4h) = 36h$$

$$\Rightarrow 2880 + 20h = 36h \Rightarrow 16h = 2880$$

$$\Rightarrow h = \frac{2880}{16} = 180$$

Hence, the height of the tower is 180 m.

24. Let B and C (after 3 seconds) be the two positions of the bird as observed from a point A on the ground.



Given, $\angle BAP = 45^\circ$ and $\angle CAQ = 30^\circ$ and $BP = CQ = 90$ m
Let $AP = x$ m and $PQ = y$ m.

In right $\triangle APB$, we have

$$\tan 45^\circ = \frac{BP}{AP} \Rightarrow 1 = \frac{90}{x}$$

$$\Rightarrow x = 90 \quad \dots(i)$$

In right $\triangle AQC$, we have

$$\tan 30^\circ = \frac{CQ}{AQ} \Rightarrow \frac{1}{\sqrt{3}} = \frac{90}{x+y}$$

$$\Rightarrow x+y = 90\sqrt{3} \Rightarrow 90+y = 90\sqrt{3} \quad [\text{Using (i)}]$$

$$\Rightarrow y = 90(\sqrt{3} - 1) = 65.7$$

Distance covered by the bird in 3 seconds = 65.7 m

$$\text{Distance covered by the bird in 1 second} = \frac{65.7}{3} \text{ m} = 21.9 \text{ m}$$

Hence, the speed of the bird is 21.9 m/sec.

