HOTS Questions on Class 10 Maths Chapter 9 'Some Applications of Trigonometry' with Answers

Question 1: The angle of elevation of the top of a tower from a point on the ground is 30°. On walking 30 m towards the tower, the angle of elevation becomes 60°. Find the height of the tower and the original distance from the tower.

Solution:

$\tan 60° = h/d \Rightarrow h = d\sqrt{3}$ ... (1)

From A (angle 30°), AQ = d + 30:

$\tan 30° = h/(d+30)$

$\Rightarrow h = (d+30)/\sqrt{3}$ ... (2)

Equate (1) and (2):

$d\sqrt{3} = (d+30)/\sqrt{3}$

$3d = d + 30$

$2d = 30$

$d = 15$ m

Substitute into (1):

$h = 15\sqrt{3}$ m

Original distance AQ = d + 30 = 15 + 30 = 45 m

Height = $15\sqrt{3}$ m ≈ 25.98 m and Original distance = 45 m

Question 2: A flagstaff of height 5 m stands on top of a tower. From a point on the ground, the angle of elevation of the top of the flagstaff is 60° and the angle of elevation of the top of the tower is 45°. Find the height of the tower.

Solution:

Angle of elevation to top of tower (B) = 45°:

$\tan 45° = h/d$

$\Rightarrow 1 = h/d$

$\Rightarrow d = h$ ... (1)

Angle of elevation to top of flagstaff (C) = 60°:

$\tan 60° = (h+5)/d$

$\Rightarrow \sqrt{3} = (h+5)/d$ ... (2)

Substitute d = h into (2):

$\sqrt{3} = (h+5)/h$

$\sqrt{3}\,h = h + 5$
$h(\sqrt{3} - 1) = 5$
$h = 5/(\sqrt{3} - 1)$
Rationalise:
$h = 5(\sqrt{3} + 1)/((\sqrt{3} - 1)(\sqrt{3} + 1)) = 5(\sqrt{3} + 1)/(3 - 1) = 5(\sqrt{3} + 1)/2$ m
Height of tower $= 5(\sqrt{3} + 1)/2$ m ≈ 6.83 m

Question 3: From the top of a cliff 80 m high, the angles of depression of two boats on the same side are 45° and 30°. Find the distance between the two boats.
Solution:
For the nearer boat C (angle of elevation = 45°):
$\tan 45° = 80/BC$
$\Rightarrow 1 = 80/BC$
$\Rightarrow BC = 80$ m
For the farther boat D (angle of elevation = 30°):
$\tan 30° = 80/BD$
$\Rightarrow 1/\sqrt{3} = 80/BD$
$\Rightarrow BD = 80\sqrt{3}$ m
Distance between the two boats:
$CD = BD - BC = 80\sqrt{3} - 80 = 80(\sqrt{3} - 1)$ m
Distance between boats $= 80(\sqrt{3} - 1)$ m ≈ 58.56 m

Question 4: From the top of a building 60 m high, the angles of elevation and depression of the top and foot of another building on the opposite side of the road are 60° and 45° respectively. Find the height of the other building and the width of the road.
Solution:
Angle of depression to D (from A) = 45°.
In $\triangle ABD$, right-angled at B:
$\tan 45° = AB/BD = 60/d$
$1 = 60/d$
$\Rightarrow d = 60$ m
Angle of elevation to C (from A) = 60°.
In $\triangle ACE$, where $CE = H - 60$ and $AE = d = 60$:
$\tan 60° = CE/AE = (H-60)/60$

$\sqrt{3} = (H-60)/60$
$H - 60 = 60\sqrt{3}$
$H = 60 + 60\sqrt{3} = 60(1 + \sqrt{3})$ m
Width of road = 60 m and height of other building = $60(1 + \sqrt{3})$ m ≈ 163.9 m

Question 5: Two buildings are on opposite sides of a road. From the top of the first building of height 10 m, the angle of elevation of the top of the second building is 60°. From the same top, the angle of depression of the foot of the second building is 30°. Find the height of the second building and the width of the road.
Solution:
Angle of depression to D = 30°. In △ABD:
$\tan 30° = AB/BD = 10/d$
$1/\sqrt{3} = 10/d \Longrightarrow d = 10\sqrt{3}$ m
Angle of elevation to C = 60°. In △ACE, AE = d = $10\sqrt{3}$:
$\tan 60° = CE/AE = (H-10)/10\sqrt{3}$
$\sqrt{3} = (H-10)/10\sqrt{3}$
$H - 10 = 10\sqrt{3} \times \sqrt{3} = 30$ H = 40 m
Height of second building = 40 m and Width of road = $10\sqrt{3}$ m ≈ 17.3 m

Question 6: A vertical pole of height 6 m casts a shadow 4 m long on the ground. At the same time, a tower casts a shadow 28 m long. Find the height of the tower.
Solution:
Since both shadows are cast at the same time, the sun's angle of elevation θ is identical for both.
For the pole:
$\tan \theta = 6/4 = 3/2$
For the tower (height H, shadow 28 m):
$\tan \theta = H/28$
Since $\tan \theta$ is the same:
$H/28 = 3/2$ H = $28 \times 3/2 = 42$ m
Height of the tower = 42 m

Question 7: As observed from the top of a lighthouse, 75 m high above sea level, the angles of depression of two ships on opposite sides of the lighthouse are 30° and 45°. Find the distance between the two ships.

Solution:

For Ship C (angle of elevation from C = 30°):

$\tan 30° = 75/BC$

$\Rightarrow BC = 75\sqrt{3}$ m

For Ship D (angle of elevation from D = 45°):

$\tan 45° = 75/BD$

$\Rightarrow BD = 75$ m

Distance between ships:

$CD = BC + BD = 75\sqrt{3} + 75 = 75(\sqrt{3} + 1)$ m

Distance between the two ships = $75(\sqrt{3} + 1)$ m ≈ 204.9 m