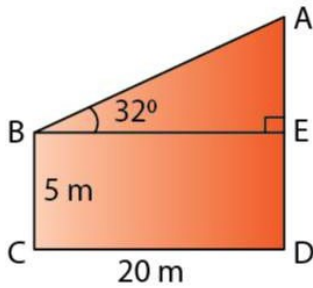


Exercise 22(C)

Find AD. (i)



Solution:

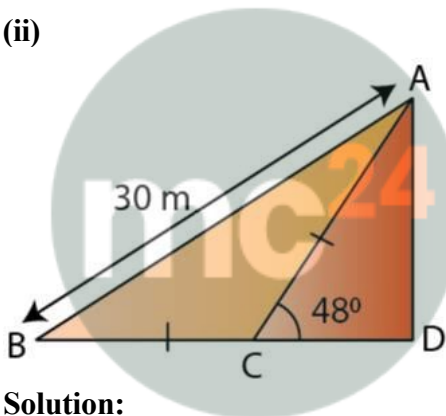
In $\triangle AEB$,

$$AE/BE = \tan 32^\circ$$

$$AE = 20 \times 0.6249 = 12.50 \text{ m}$$

$$AD = AE + ED = 12.50 + 5 = 17.50 \text{ m}$$

(ii)



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Solution:

In $\triangle ABC$,

$$\angle ACD = \angle ABC + \angle BAC$$

$$\text{and } \angle ABC = \angle BAC \quad [\text{Since, } AC = BC]$$

$$\angle ABC = \angle BAC = 48^\circ / 2 = 24^\circ$$

Now,

$$AD/AB = \sin 24^\circ$$

$$AD = 30 \times 0.4067 = 12.20 \text{ m}$$

1. In the following diagram, AB is a floor-board; PQRS is a cubical box with each edge = 1 m and $\angle B = 60^\circ$. Calculate the length of the board AB.

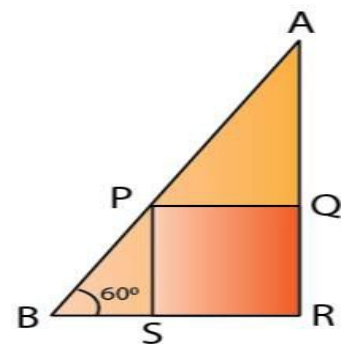
Solution:

In $\triangle PSB$,

$$PS/PB = \sin 60^\circ$$

$$PB = 2/\sqrt{3} = 1.155 \text{ m}$$

In $\triangle APQ$,



$$\angle APQ = 60^\circ$$

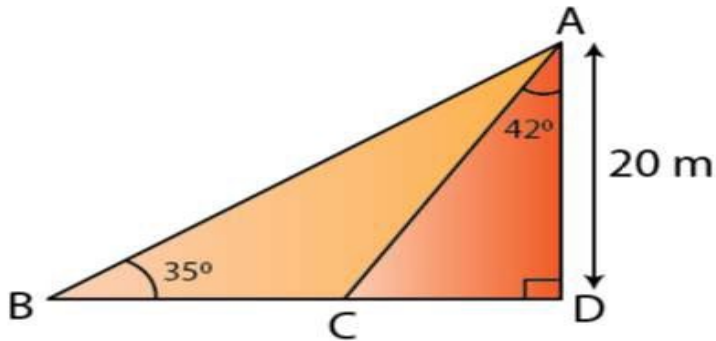
$$PQ/AP = \cos 60^\circ$$

$$AP = 1 / (1/2) = 2 \text{ m}$$

Thus,

$$AB = AP + PB = 2 + 1.155 = 3.155 \text{ m}$$

2. Calculate BC.



Solution:

In $\triangle ADC$,

$$CD/AD = \tan 42^\circ$$

$$CD = 20 \times 0.9004 = 18.008 \text{ m}$$

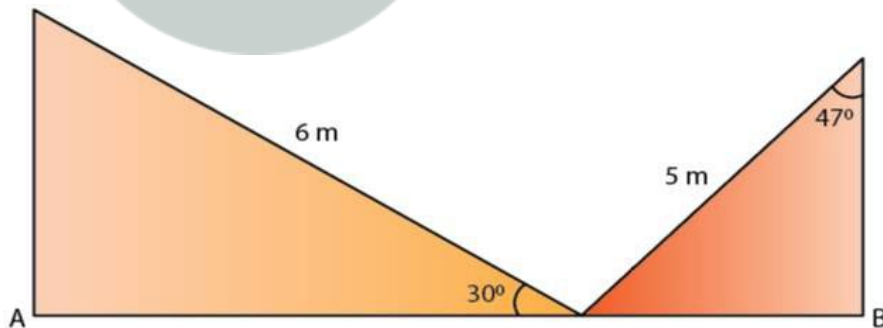
In $\triangle ADB$,

$$AD/BD = \tan 35^\circ$$

$$BD = AD / \tan 35^\circ = 20 / 0.7002 = 28.563 \text{ m}$$

$$\text{Thus, } BC = BD - CD = 10.55 \text{ m}$$

3. Calculate AB.



Solution:

In $\triangle AMO$,

$$\cos 30^\circ = AO/MO$$

$$\sqrt{3}/2 = AO/6$$

$$AO = 5.20 \text{ m}$$

In $\triangle BNO$,

$$\sin 47^\circ = OB/NO$$

$$0.73 = OB/5$$

$$OB = 3.65 \text{ m}$$

$$\text{So, } AB = OA + OB$$

$$AB = 5.20 + 3.65$$

$$AB = 8.85 \text{ m}$$

4. The radius of a circle is given as 15 cm and chord AB subtends an angle of 131° at the centre C of the circle. Using trigonometry, calculate:

(i) the length of AB;

(ii) the distance of AB from the centre C.

Solution:

Given, $CA = CB = 15 \text{ cm}$ and $\angle ACB = 131^\circ$

Construct a perpendicular CP from centre C to the chord AB.

Then, CP bisects $\angle ACB$ as well as chord AB.

So, $\angle ACP = 65.5^\circ$

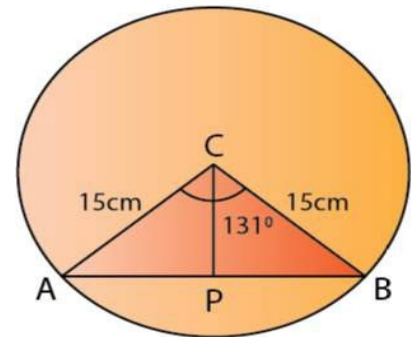
In $\triangle ACP$,

$$\frac{AP}{AC} = \sin (65.5^\circ)$$

$$AP = 15 \times 0.91 = 13.65 \text{ cm}$$

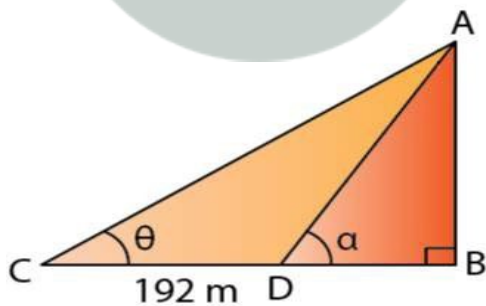
$$(i) AB = 2 AP = 2 \times 13.65 = 27.30 \text{ cm}$$

$$(ii) CP = AP \cos (65.5^\circ) = 15 \times 0.415 = 6.22 \text{ cm}$$



5. At a point on level ground, the angle of elevation of a vertical tower is found to be such that its tangent is $5/12$. On walking 192 meters towards the tower, the tangent of the angle is found to be $3/4$. Find the height of the tower.

Solution:



Let's assume AB to be the vertical tower and C and D be the two points such that $CD = 192 \text{ m}$.

And let $\angle ACB = \theta$ and $\angle ADB = \alpha$

Given,

$$\tan \theta = 5/12$$

$$AB/BC = 5/12$$

$$AB = 5/12 BC \dots\dots (i)$$

$$\text{Also, } \tan \alpha = 3/4$$

$$AB/BD = 3/4$$

$$(5/12 \times BC)/ BD = 3/4$$

$$(192 + BD)/ BD = 3/4 \times 12/5$$

BD = 240 m
 BC = (192 + 240) = 432 m
 By (i), AB = $\frac{5}{12} \times 432 = 180$ m
 Therefore, the height of the tower is 180 m.

6. A vertical tower stands on a horizontal plane and is surmounted by a vertical flagstaff of height h meter. At a point on the plane, the angle of elevation of the bottom of the flagstaff is α and at the top of the flagstaff is β . Prove that the height of the tower is $h \tan \alpha / (\tan \beta - \tan \alpha)$.

Solution:

Let AB be the tower of height x metre, surmounted by a vertical flagstaff AD. Let C be a point on the plane such that $\angle ACB = \alpha$, $\angle DCB = \beta$ and AD = h .

In $\triangle ABC$,

$$AB/BC = \tan \alpha$$

$$BC = x / \tan \alpha \dots\dots (i)$$

In $\triangle DBC$,

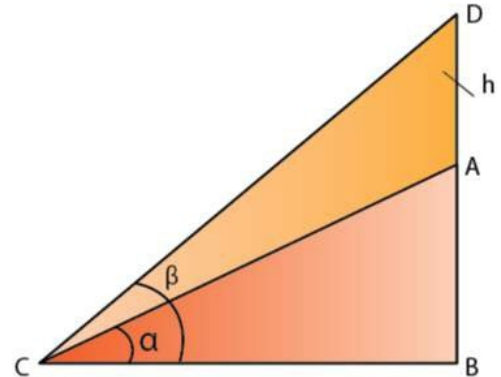
$$BD/BC = \tan \beta$$

$$BD = (x/\tan \alpha) \times \tan \beta \dots\dots [\text{From (i)}]$$

$$(h + x) \tan \alpha = x \tan \beta$$

$$x \tan \beta - x \tan \alpha = h \tan \alpha$$

Therefore, height of the tower is $h \tan \alpha / (\tan \beta - \tan \alpha)$



7. With reference to the given figure, a man stands on the ground at point A, which is on the same horizontal plane as B, the foot of the vertical pole BC. The height of the pole is 10 m. The man's eye is 2 m above the ground. He observes the angle of elevation of C, the top of the pole, as x° , where $\tan x^\circ = 2/5$. Calculate:

(i) the distance AB in metres;

(ii) angle of elevation of the top of the pole when he is standing 15 metres from the pole. Give your answer to the nearest degree.

Solution:

Let take AD to be the height of the man, AD = 2 m.

$$\text{So, CE} = (10 - 2) = 8 \text{ m}$$

(i) In $\triangle CED$,

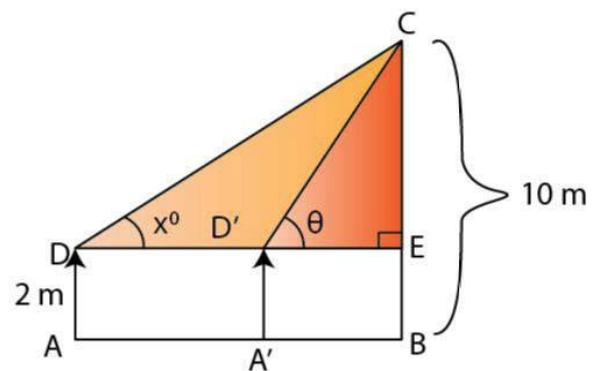
$$CE/DE = \tan x = 2/5$$

$$8/DE = 2/5$$

$$\Rightarrow DE = 20 \text{ m}$$

And, as AB = DE we get

$$AB = 20 \text{ m}$$



(ii) Let A'D' be the new position of the man and θ be the angle of elevation of the top of the tower.

$$\text{So, D'E} = 15 \text{ m}$$

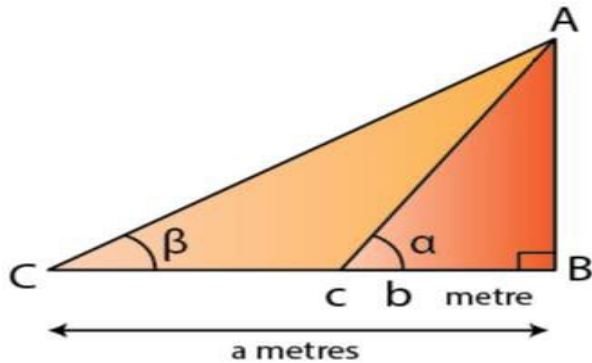
In $\triangle CED$,

$$\tan \theta = CE/ D'E = 8/15 = 0.533$$

$$\theta = 28^\circ$$

8. The angles of elevation of the top of a tower from two points on the ground at distances a and b meters from the base of the tower and in the same line are complementary. Prove that the height of the tower is \sqrt{ab} meter.

Solution:



Let's assume AB to be the tower of height h meters.

And, let C and D be two points on the level ground such that $BC = b$ meters, $BD = a$ meters, $\angle ACB = \alpha$, $\angle ADB = \beta$.

Given, $\alpha + \beta = 90^\circ$

In $\triangle ABC$,

$$AB/BC = \tan \alpha$$

$$h/b = \tan \alpha \dots (i)$$

In $\triangle ABD$,

$$AB/BD = \tan \beta$$

$$h/a = \tan (90^\circ - \alpha) = \cot \alpha \dots (ii)$$

Now, multiplying (i) by (ii), we get

$$(h/a) \times (h/b) = 1$$

$$h^2 = ab$$

$$\text{So, } h = \sqrt{ab} \text{ meter}$$

Therefore, height of the tower is \sqrt{ab} meter.

9. From a window A, 10 m above the ground the angle of elevation of the top C of a tower is x° , where $\tan x^\circ = 5/2$ and the angle of depression of the foot D of the tower is y° , where $\tan y^\circ = 1/4$. Calculate the height CD of the tower in metres.

Solution:

We have, $AB = DE = 10$ m

So, in $\triangle ABC$

$$DE/AE = \tan y = 1/4$$

$$AE = 4 DE = 4 \times 10 = 40 \text{ m}$$

In $\triangle ABC$,

$$CE/AE = \tan x = 5/2$$

$$CE = 40 \times 5/2 = 100 \text{ m}$$

$$\text{So, } CD = DE + EC = 10 + 100 = 110 \text{ m}$$

Therefore, the height of the tower CD is 110 m.

