8.4 Solve Problems using Trigonometry

A Applications

Example 1. A telephone pole makes an angle of 82° with the level ground. The angle of elevation of the Sun is 76°. Find the length of the telephone pole if its shadow is 3.5 m. (Assume that the tilt of the pole is away from the Sun and in the same plane as the pole and the Sun.)

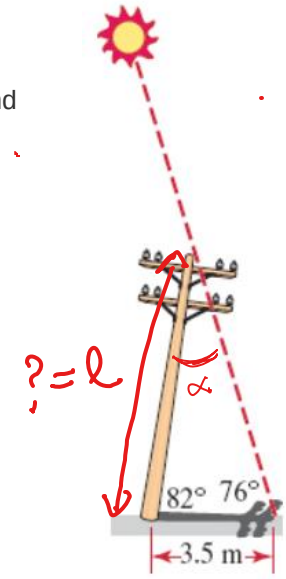
Let l be the length of the pole.

① $\alpha = 180° - 82° - 76° \Rightarrow \alpha = 22°$

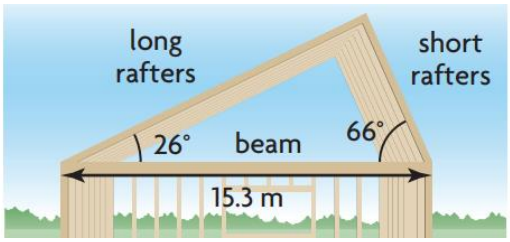
② $\frac{l}{\sin 76°} = \frac{3.5}{\sin 22°} \Rightarrow l = \frac{3.5 \sin 76°}{\sin 22°}$

$l \approx 9.07$

$\therefore$ The length of pole is about 9.07 m



Example 2. The roof of a new house must be built to exact specifications so that solar panels can be installed. The long rafters at the front of the house must be inclined at an angle of $26°$ to the horizontal beam. The short rafters at the back of the house must be inclined at an angle of $66°$. The house is $15.3\ m$ wide. Determine the length of the long rafters.



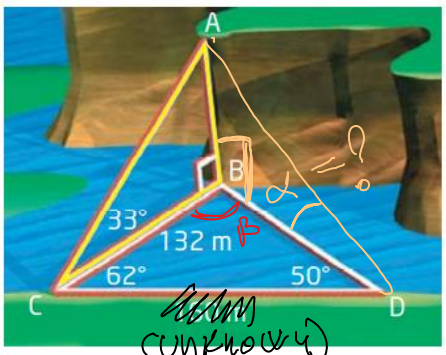
Example 3. Use the information provided on the diagram to find the angle of elevation of the cliff from the point D.

① Use $\triangle ABC$ and find AB

$\tan 33° = \frac{AB}{132} \Rightarrow AB = 132 \tan 33°$

(tangent ratio) $\angle ABC = 90°$

$AB \approx 85.72$ m



② Use $\triangle BDC$ and find BD by using the sine law

$\frac{BD}{\sin 62°} = \frac{132}{\sin 50°} \Rightarrow BD = \frac{132 \sin 62°}{\sin 50°}$

$BD \approx 152.14$ m

③ Use $\triangle ABD$ ($\angle ABD = 90°$) and tangent ratio to find α

$\tan \alpha = \frac{AB}{BD} = \frac{85.72}{152.14} \Rightarrow$

$\therefore$ The angle of elevation is 29.40

$\tan\alpha = \frac{\cancel{132}\ \tan 33^\circ \cdot \sin 50^\circ}{\cancel{132}\ \sin 62^\circ} \Rightarrow \rightarrow 29.4$

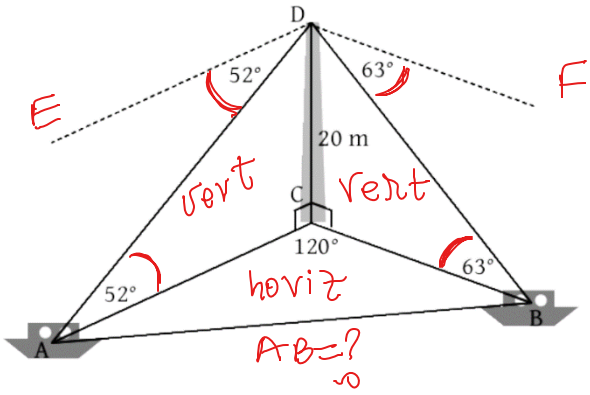
29.398

$29.398 \neq 29.39$

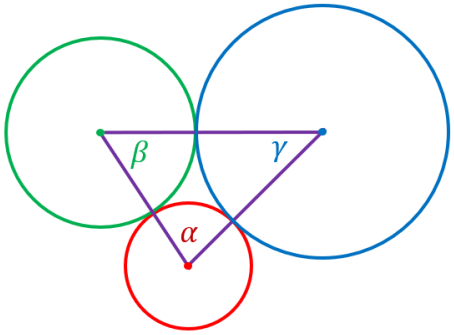
≈ 29.40

Example 4. Find the distance AB between the ships knowing the angles of elevation from each ship to the top of the lighthouse (see the diagram).

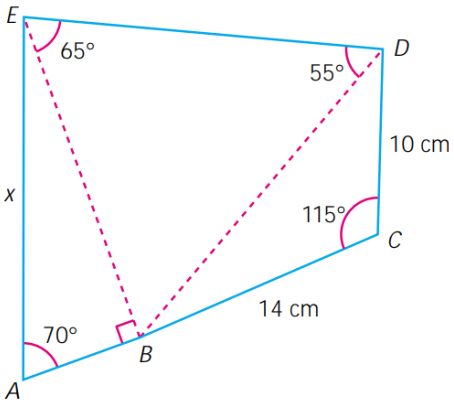
(1) $\triangle ACD \Rightarrow \tan$



Example 5. Three circles of radius 2, 3, and 4 are tangent to each other. A triangle is formed by joining their centres. Find the angles of this triangle (see the diagram).



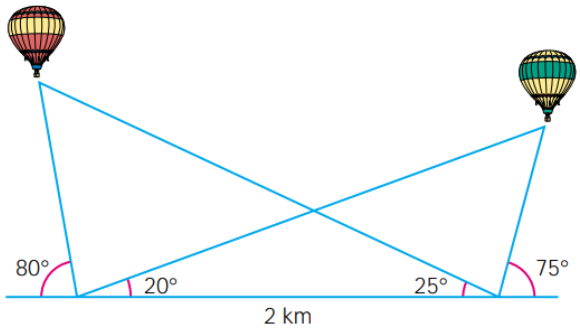
Example 6. Use the diagram below and find x .



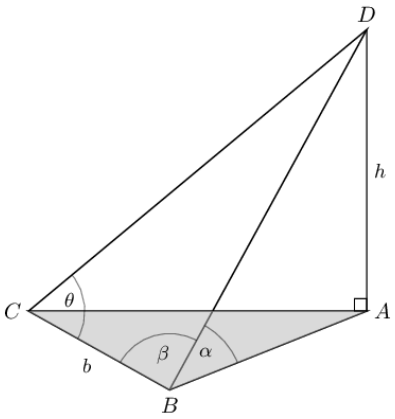
Example 7. Two hot air balloons are moored directly over a level road. The diagram shows the angle of elevation of the balloons from two observers 2 km apart.

(a) To the nearest tenth of a kilometre, how far apart are the balloons?

(b) Which balloon is higher, and by how many metres?



Example 8. D is the top of a building of height h. The base of the building is at A and ΔABC lies on the ground (a horizontal plane). Write h in terms of $b = CB$, $\alpha = \angle ABD$, $\beta = \angle CBD$, and $\theta = \angle BCD$.



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