$\qquad$

## ANGLES OF ELEVATION \& DEPRESSION



## APPLICATION PROBLEMS

Steps to solving problems using trigonometric ratios

1) $\qquad$ what needs to be calculated ( $\qquad$ or $\qquad$
2) $\qquad$ the problem with a $\qquad$ triangle (draw a picture)
3) Label the relevant sides associated with the $\qquad$
4) $\qquad$ an equation using the $\qquad$ ratios
5) Substitute $\qquad$ values
6) Solve for the unknown measure, and write statement.

Example 1: While walking to school you pass a barn with a silo. Looking up to the top of the silo you estimate the angle of elevation to be about $14^{\circ}$. You continue walking and find that you were 40 m from the silo. Using this information and our knowledge of trigonometric ratios, calculate the height of the silo. ( 10 m )


$$
\tan 14=\frac{h}{40}
$$

$$
h=40 \cdot \tan 14
$$

$$
h \doteqdot 10 \mathrm{~m}
$$

$\therefore$ The silo is 10 m toll
$\qquad$

Example 2: A helicopter sights a campfire at an angle of $40^{\circ}$ from the horizontal. The helicopter is hovering 400 m above the ground. What is the horizontal distance between the helicopter and the campfire? ( 476.7 m )


Example 3: A sailboat that is 2 km due East of a lighthouse sends a signal to the lighthouse that it is in distress. The lighthouse quickly signals the coast guard that is due South of the lighthouse and 7 km Southwest of the sailboat. What heading from due north should the coast guard take in order to intercept the troubled sailboat? $\left(16.6^{\circ}\right)$


Example 4: Safety by-laws state that for a ladder to be stable, the angle the base of the ladder makes with the ground should be between $70^{\circ}$ and $80^{\circ}$. A safety inspector at a construction site notices a painter on a 10 m ladder that is leaning against a wall. The base of the ladder is 1.5 m away from the wall. Does the inspector have cause to be concerned? Explain. (81.4 ${ }^{\circ}$ )


$$
\begin{aligned}
& \cos \alpha=\frac{1.5}{10} \\
& \cos ^{-1}\left(\frac{1.5}{10}\right)=\alpha \\
& \alpha=81.4
\end{aligned}
$$

$\therefore$ Yes, the inspector has caus to be concerned because the angle is greater than $80^{\circ}$.
$\qquad$

## Primary Trigonometry Ratio Application Practice

$$
\begin{aligned}
& \text { 1) A } 5-\mathrm{m} \text { ladder is resting against a wall. The base of the ladder is } 2 \mathrm{~m} \text { along the ground from the } \\
& \text { base of the wall. What angle does the base of the ladder make with the ground? Express your } \\
& \text { answer to the nearest tenth of a degree. } \\
& \therefore \text { The angle between the loader } \\
& \cos ^{-1}\left(\frac{2}{5}\right)=\theta \\
& \theta \doteqdot 66.4^{\circ} \\
& \text { A } 2 \mathrm{~m} \\
& \text { 2) An 80-m tower is supported by a guy wire attached to the top of the tower. If the wire forms an } \\
& \text { angle of elevation of } 79^{\circ} \text {, how long is it? Express your answer to the nearest tenth of a metre. } \\
& \sin 79{ }^{\circ} \underset{x}{x} \\
& x=\frac{80}{\sin 79^{\circ}} \\
& x=81.5^{\circ} \\
& \therefore \text { The guy wire is } 81.5 \mathrm{~m} \text { long. }
\end{aligned}
$$

3) The highest point along a cliff is 80 m above the lakeshore. A surveyor stands on the top of the cliff, looking through a 1.5 m tall transit instrument. He spots a boat out on the lake, at an angle of depression of $38^{\circ}$. How far, to the nearest tenth of a metre, is it from the boat to the base of the cliff?


$$
\begin{aligned}
& \tan 38^{\circ}=\frac{81.5}{x} \\
& x=\frac{81.5}{\tan 38} \\
& x=104.3 \mathrm{~m} \\
& \therefore \text { The boat is } 10.3 \mathrm{~m} \text { away. }
\end{aligned}
$$

4) Michael stands 10.0 m from the base of a building. He measures the angle of elevation to the top of the building to be $65^{\circ}$. Michael's measurement was made from 1.5 m above the ground. Determine the height of the building to the nearest metre.

$\qquad$
5) Two buildings are 60 m apart. The angle of depression from the top of the taller building to the top of the shorter building is $15^{\circ}$. The height of the shorter building is 30.4 m . What is the height of taller building? Express your answer to the nearest tenth of a metre.

$\Rightarrow$


$$
\begin{aligned}
& \tan 15=\frac{x}{60} \\
& x=60 \tan 15 \\
& x=16.1 \mathrm{~m} \\
& \text { height }=16.1+30.4 \\
&=46.5
\end{aligned}
$$

$$
\text { : The height of the taler bail. is } 46.5 \mathrm{~m}
$$

6) From the top of a 150 m high cliff, the angles of depression of two boats on the water are $20^{\circ}$
and $25^{\circ}$. How far apart are the boats?
150

$5+2 y$ tan $25=\frac{150}{9}$
$\operatorname{stc}^{2} \tan 20=\frac{150}{b}$

$a+x=b$

$$
x=b-a
$$

$$
Q=\frac{150}{\tan 25}
$$

$$
x=412.1-321.7
$$

$\underbrace{A}_{b}$

$$
\dot{a}=321.7 \mathrm{~m}
$$

$b=\frac{150}{\tan 20}$

$$
b=412.1 \mathrm{~m}
$$

$$
x=90.4 n
$$

r. The distance between the boats is 90.4 m .
7) Two buildings are 20 m apart. The angle from the top of the shorter building to the top of the taller building is $20^{\circ}$. The angle from the top of the shorter building to the base of the taller building is $45^{\circ}$. What is the height of the taller building?

8) The CN Tower is 553.33 m high. Lina looks up at the top of the tower at a $15^{\circ}$ angle of elevation. She calculates the distance, $d$, from the base of the tower as follows:


Explain why Lina's solution is incorrect.
Write a correct solution
She set her ratio wrong.

