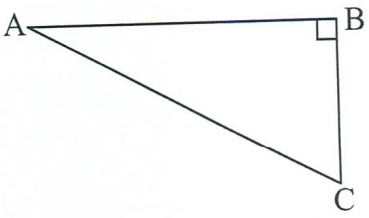
Real World Application Trig Problems

NAME _____

A# _____

Part II) Practice Problems

1. Classify each of the three angles in the figure at right as an angle of elevation, an angle of depression, or neither.

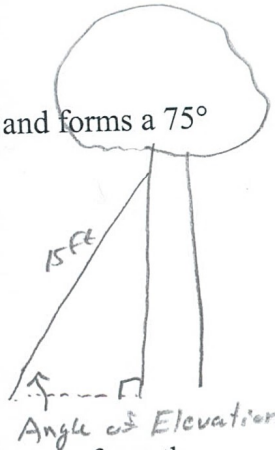


∠A = Angle of Depression

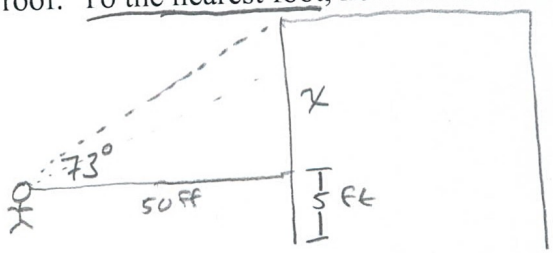
∠B & ∠C are neither

2. Multiple-Choice: A 15 foot ladder rests against a tree on level ground and forms a 75° angle of elevation. Where is the correct location of the 75° angle?

A) Between the ladder and the ground
B) Between the ladder and the tree
C) Between the tree and the ground
D) It is not possible to place a 75° angle on such a figure.



3. Tammi Jo, whose eyes are five feet off the ground, is standing 50 feet away from the base of a building, and she looks up at a 73° angle of elevation to a point on the edge of building's roof. To the nearest foot, how tall is the building?



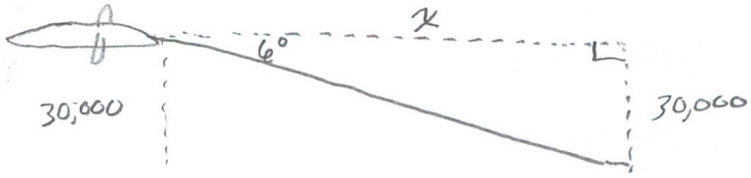
$\tan 73° = \frac{x}{50}$

$50 \cdot \tan 73° = x$

$143.164 = x$

The building is 169 ft high.

4. A pilot is traveling at a height of 30,000 feet above level ground. She looks down at an angle of depression of 6° and spots the runway. As measured along the ground, how many miles away is she from the runway? Round to the nearest tenth of a mile.



$\tan 6° = \frac{30,000}{x}$

$x \cdot \tan 6° = 30,000$

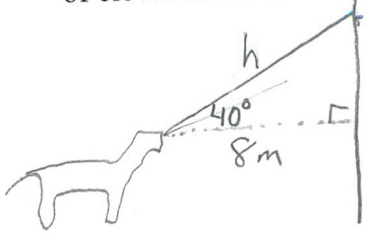
$x = \frac{30,000}{\tan 6°}$

$x = 285,430.9 ft$

$285,430.9 ft \cdot \frac{1 mile}{5280 ft}$

The airplane is 54.1 miles from the airport

5. A dog, who is 8 meters from the base of a tree, spots a squirrel in the tree at an angle of elevation of 40°. What is the direct-line distance between the dog and the squirrel?



$\cos 40° = \frac{8}{h}$

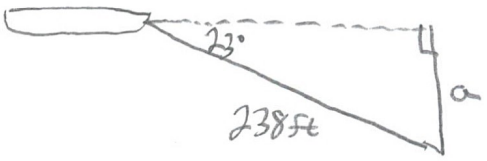
$h \cdot \cos 40° = 8$

$h = \frac{8}{\cos 40°}$

$h = 10.4$

The dog is 10.4 m from the squirrel.

6. A ship is on the surface of the water, and its radar detects a submarine at a distance of 238 feet, at an angle of depression of 23°. How deep underwater is the submarine?



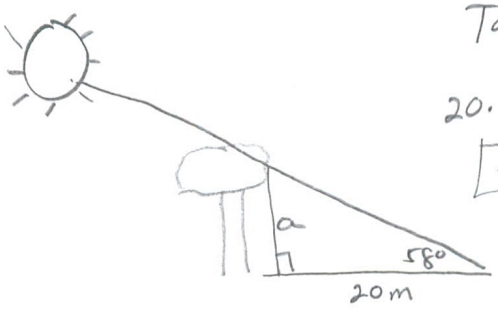
$\sin 23^\circ = \frac{a}{238}$

$238 \cdot \sin 23^\circ = a$

$93.0\text{ft} = a$

The submarine is 93.0 ft below the surface of water.

7. The sun is at an angle of elevation of 58°. A tree casts a shadow 20 meters long on the ground. How tall is the tree?



$\tan 58^\circ = \frac{a}{20}$

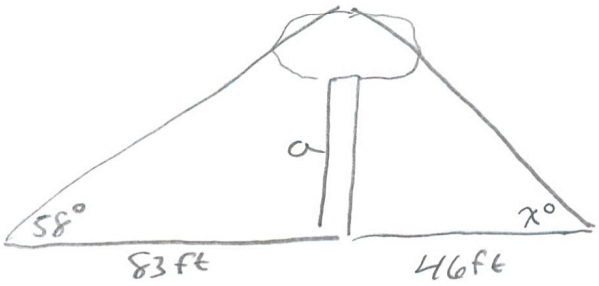
$20 \cdot \tan 58^\circ = a$

$32.0\text{m} = a$

The tree is 32.0 m tall.

8. Two observers on the ground are looking up at the top of the same tree from two different points on the horizontal ground. The first observer, who is 83 feet away from the base of the tree, looks up at an angle of elevation of 58°. The second observer is standing only 46 feet from the base of the tree. (Note: you may ignore the heights of the observers and assume their measurements are made directly from the ground.)

a) How tall is the tree, to the nearest foot?



$\tan 58^\circ = \frac{a}{83}$

$83 \cdot \tan 58^\circ = a$

$132.8\text{ft} = a$

The tree is 133 ft tall.

b) At what angle of elevation must the second observer look up to see the top of the tree?

$\tan x^\circ = \frac{132.8}{46}$

$x = \tan^{-1}\left(\frac{132.8}{46}\right)$

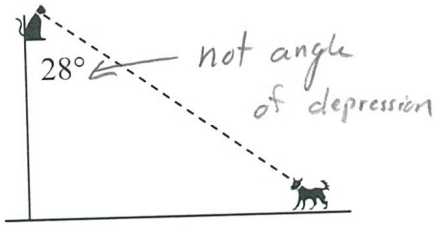
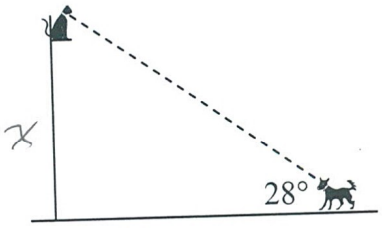
$x = 70.9^\circ$

The angle of elevation is 70.9°.

9. Error Analysis: Consider the following problem, which Stephanie and Adam are both trying to solve:

"A cat, who has climbed a tree, looks down at a dog at a 28° angle of depression. If the dog is 34 meters from the base of the tree, how high up is the cat?"

The first steps of their work are shown below. Analyze their work and determine who, if anyone, has set it up correctly.

Stephanie's work	Adam's work
 not angle of depression 34 meters $\tan 28° = \frac{34}{x}$	 34 meters $\tan 28° = \frac{x}{34}$

Adam is correct because the angle of elevation is equal to the angle of depression.

10. Complete problem 9: How high up in the tree is the cat?

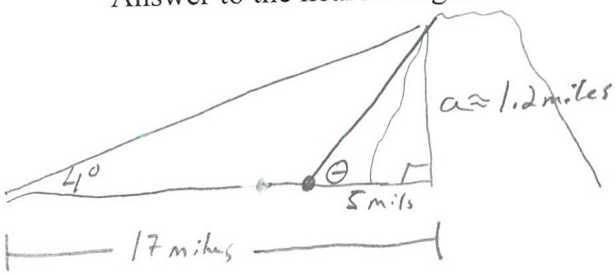
$x = 34 \cdot \tan 28°$

$x = 18.1\text{m}$

The cat is 18.1m above the ground.

Part III) Challenge Problems

11. A person starts out 17 miles from the base of a tall mountain, and looks up at a 4° angle of elevation to the top of the mountain. When they move 12 miles closer to the base of the mountain, what will be their angle of elevation when they look to the top? Answer to the nearest degree.



$\tan 4° = \frac{a}{17}$

$17 \cdot \tan 4° = a$

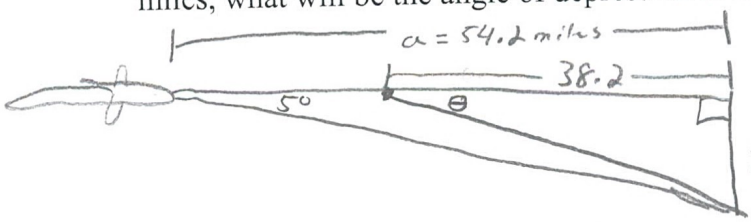
$1.2 \text{ miles} = a$

$\tan \theta = \frac{1.2}{5}$

$\theta = \tan^{-1}\left(\frac{1.2}{5}\right)$

$\theta \approx 13°$

12. A pilot maintains an altitude of 25,000 feet over level ground. The pilot observes a crater on the ground at an angle of depression of 5°. If the plane continues for 16 more miles, what will be the angle of depression to the crater? Answer to the nearest degree.



$\tan 5° = \frac{25000}{a}$ $a = 285,751$ ft

$a \tan 5° = 25000$ $a = 54.2$ miles

$a = \frac{25000}{\tan 5°}$

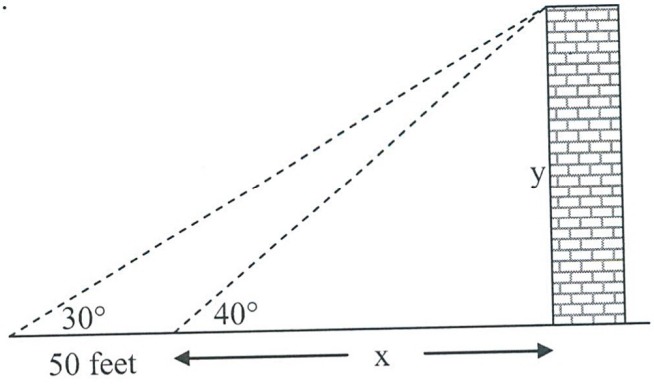
$\tan\theta = \frac{4.7}{38.2}$

$\theta = \tan^{-1}\left(\frac{4.7}{38.2}\right)$

$\theta \approx 7°$

The angle of depression is about 7°

13. An observer on the ground looks up to the top of a building at an angle of elevation of 30°. After moving 50 feet closer, the angle of elevation is now 40°. Consider the diagram below:



a) Set up an equation representing the situation from the first vantage point. Your equation will incorporate the 30° angle, x, y, and the 50 feet.

$\tan 30° = \frac{y}{50+x}$ → $y = \tan 30°(50+x)$

$x \cdot \tan 40° = \tan 30°(50+x)$

b) Set up an equation representing the situation from the second vantage point. Your equation will incorporate the 40°, x, and y.

$\tan 40° = \frac{y}{x}$ $y = x \cdot \tan 40°$

$0.839x = 0.577(50+x)$

$0.839x = 28.85 + 0.577x$

$0.262x = 28.85$

$x = 110.1$

c) You now have two equations in two variables. Solve them simultaneously to determine the value of x, the distance from the second vantage point to the base of the building.

x is about 110.1 ft from the building

d) Solve for y, the height of the building.

$\tan 40° = \frac{y}{110.1}$

$92.4 = y$

The height of the building is about 92.4 ft.