2.0 – Naming Triangles and Pythagoras

Name:
Date:

Goal: To learn how to correctly name triangles, their sides and their angles, and to use Pythagoras.

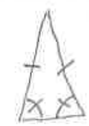
Toolkit:	**Main Ideas:**
• Labeling angles and sides of triangles • All angles in a triangle add to 180° • Pythagoras: $a^2 + b^2 = c^2$ (c is hyp!) • Labelling triangles from a target angle	Naming Triangles and Pythagorean Theorem Worksheet.

Definitions

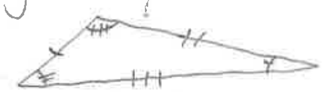
Right triangle – A triangle with a 90° angle.

Equilateral triangle – All 3 sides equal. All 3 angles 60°.

Isosceles triangle – At least 2 sides equal. At least 2 angles equal.

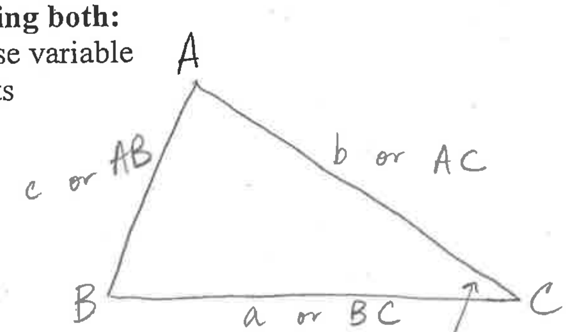


Scalene triangle – No sides equal. No angles equal.



Labelling angles and sides of triangles

Ex 1) Draw a triangle, ΔABC, and label all angles and sides.
Label sides using both:
- One lower case variable
- Two endpoints

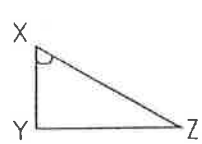


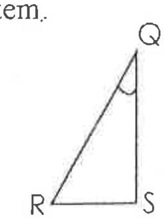
$\angle ACB$ or $\angle BCA$

Three point system of naming angles – An angle is named using the two origins of the angle, and the vertex, with the vertex ALWAYS in the middle!

eg

Ex2) Name each indicated angle using the three point system.





$\angle YXZ$
(or $\angle ZXY$)

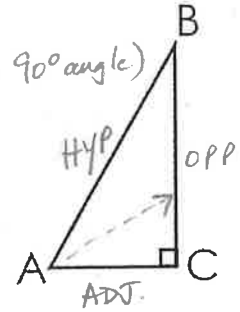
$\angle RQS$
(or $\angle SQR$)

Labelling angles from a target angle

(Only for right triangles!)

In this chapter, we will also want to label the sides of a RIGHT triangle based their position in relation to a target angle which we use as a reference point.

Ex 3) In reference to angle A, label
- the hypotenuse (HYP) (always opposite the 90° angle)
- the side opposite to A (OPP)
- the side adjacent to A (ADJ)

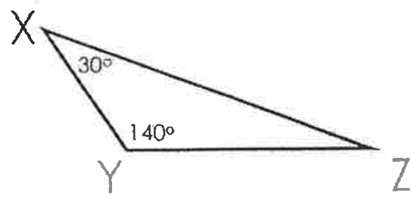


Angles in a triangle

The sum of the angles in a triangle is $\underline{180^\circ}$

Ex4) Find the missing angle(s).

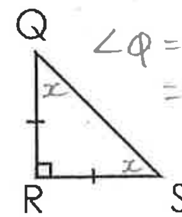
a)



$\angle Z = 180^\circ - 140^\circ - 30^\circ$

$= \boxed{10^\circ}$

b)



isosceles Δ, so

$\angle Q = \angle S = x$

$180^\circ = 90^\circ + 2x$

$2x = 90$

$x = 45^\circ$

$\angle Q = \angle S$

$= \boxed{45^\circ}$

Pythagoras

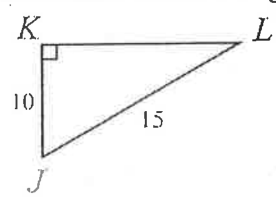
(Only for right triangles!)

Pythagoras – Remember, "c" MUST be the hypotenuse, or the side across from the right angle!

$$a^2 + b^2 = c^2$$

Ex 5) Name and find the missing side(s) (nearest tenth)

a)



$a^2 + b^2 = c^2$

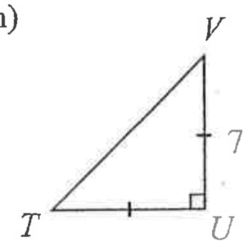
$10^2 + b^2 = 15^2$

$b^2 = 125$

$b = \sqrt{125}$

$b = 5\sqrt{5} = \boxed{11.2}$

b)



isosceles Δ, so $a = b$

$a = b = 7$

$a^2 + b^2 = c^2$

$a^2 + a^2 = c^2$

$2a^2 = c^2$

$2(7)^2 = c^2$

$c^2 = 98$

$c = 7\sqrt{2}$

$= \boxed{9.9}$

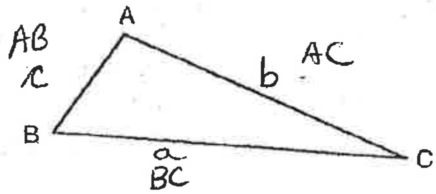
Reflection: Is it possible to have an equilateral triangle that is also a right triangle? Explain.

2.0 – Naming Triangles and Pythagoras WORKSHEET

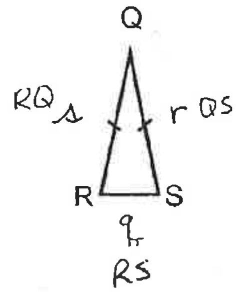
Name: Key
Date:

Labelling Triangles

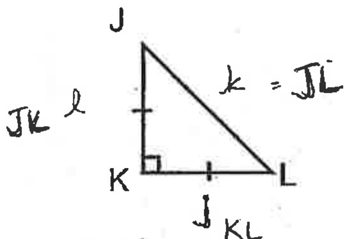
a) State: right Triangle OR not a right triangle
b) State: equilateral, isosceles, or scalene
c) Label the sides using lower case letters
d) Label the sides using their endpoints

1. 

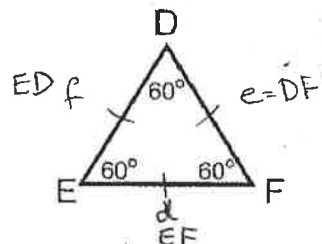
a) Not rt triangle
b) scalene

2. 

a) not rt tri
b) isosceles

3. 

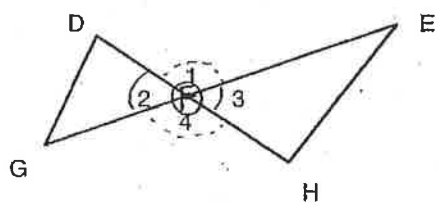
a) rt tri
b) isosceles

4. 

a) not rt tri
b) equilateral (all ∠s equal, so all sides equal)

Labelling Angles

5. If DH and EG intersect at F, name the four angles formed (using the three point system)

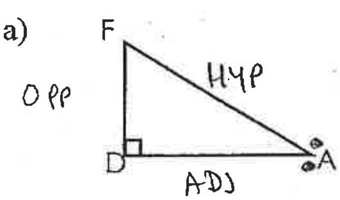


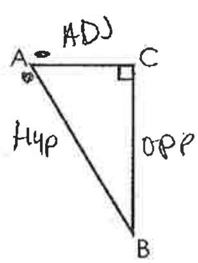
∠1 = ∠DFE ∠2 = ∠DFG

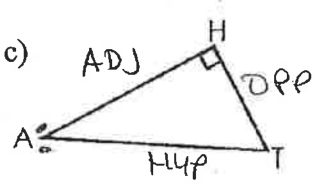
∠3 = ∠EFH ∠4 = ∠GFH

Labelling Angles from a Target Angle (for Right Triangles ONLY!!!) OPP, ADJ, HYP

6. Label the HYPotenuse, the side OPPosite to angle A and the side ADJacent to angle A (use A as the target angle).

a) 

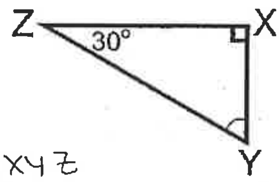
b) 

c) 

Finding Angles

7. In each triangle, find the measure of angle XYZ

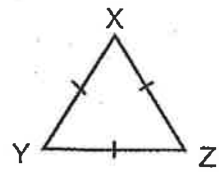
a)



$\angle XYZ$

$180° - 90° - 30° = 60°$

b)



equal sides → equal angles

$180° \div 3 = 60°$

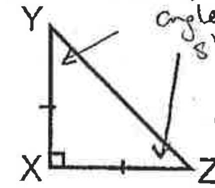
$\angle XYZ = 60°$

c)

$180° - 90° = 90°$

2 equal angles share 90°

$90° \div 2 = 45°$

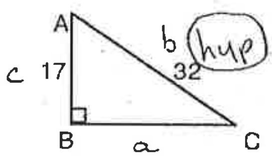


$\angle XYZ = 45°$

Pythagoras

8. **Name** and **find** the missing sides (to the nearest hundredth).

a)



$a^2 + c^2 = b^2$

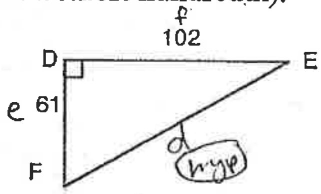
$a^2 + 17^2 = 32^2$

$a^2 = 32^2 - 17^2$

$a^2 = 735$

$a = 27.11$

b)



$e^2 + f^2 = d^2$

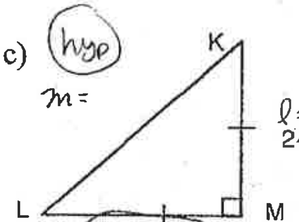
$61^2 + 102^2 = d^2$

$14125 = d^2$

$d = 118.85$

c) hyp

m =



k = 24

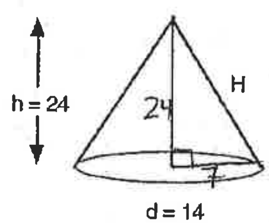
$l^2 + k^2 = m^2$

$24^2 + 24^2 = m^2$

$1152 = m^2$

$m = 33.94$

9. Find H



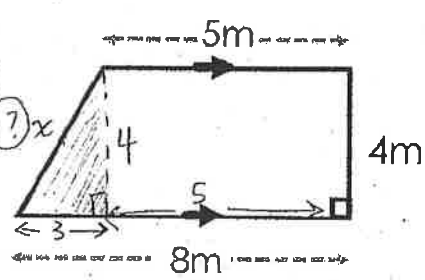
$24^2 + 7^2 = H^2$

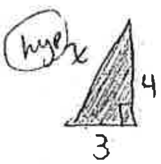
$625 = H^2$

$H = 25$

10. Find the perimeter of this trapezoid (Note: ➡ means the lines are parallel)

P = add up all sides.





$3^2 + 4^2 = x^2$

$9 + 16 = x^2$

$25 = x^2$

$x = 5$

The perimeter of the trapezoid is 22m

$P = 5 + 5 + 4 + 8 = 22m$

2.1 – Angles from the Tangent Ratio

Name:
Date:

Goal: to develop the tangent ratio and relate it to the angle of inclination of a line

Toolkit:
- Similar Triangles
- Labeling sides and angles of a triangle

Main Ideas:

p. 75-77 # 3-5, 7, 10, 11, 15-17

Terminology:

Hypotenuse: The longest side of a right triangle (and always opposite the right angle) (HYP)

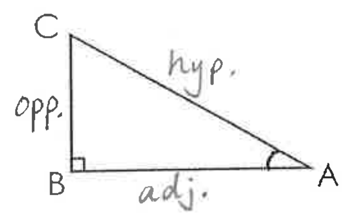
Opposite: The side that does NOT touch the angle (OPP)

Adjacent: The side that DOES touch the angle (and is not the hypotenuse) (ADJ)

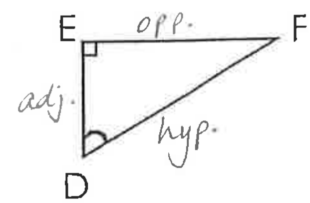
Naming Sides:

We name the sides of a right triangle (a triangle with a 90° angle) in relation to one of its acute angles (one of the angles that is NOT 90°)

Ex1)



TRY:



What is trigonometry?

The relationship between the angles and sides in a triangle.

What is the **TANGENT RATIO**?

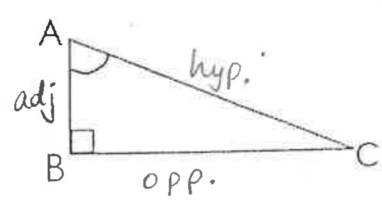
The relationship between an angle and its OPPOSITE and ADJACENT sides in a right triangle.

THE TANGENT RATIO

If $< A$ is an acute angle in a right triangle, then:

$$\text{Tan } A = \frac{\textit{length of side opposite} < A}{\textit{length of side adjacent to} < A}$$

$\tan A = \frac{opp.}{adj}$ (TOA)



You can use a scientific calculator to find an angle when you know its tangent. The $\boxed{\tan^{-1}}$ operation does this.

→ Shift Tan

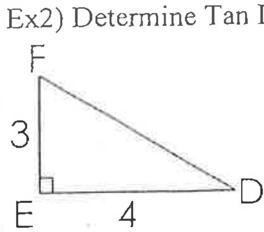
or

→ 2ndF Tan

Determining the Tangent Ratios for Angles:

* MAKE SURE CALCULATOR IS IN DEGREE MODE*

Ex2) Determine Tan D and Tan F. Then, determine <D and <F.



$\tan D = \frac{opp}{adj} = \boxed{\frac{3}{4}}$ $D = \tan^{-1}\left(\frac{3}{4}\right) = \boxed{36.9^\circ}$

$\tan F = \frac{opp}{adj} = \boxed{\frac{4}{3}}$ $F = \tan^{-1}\left(\frac{4}{3}\right) = \boxed{53.1^\circ}$

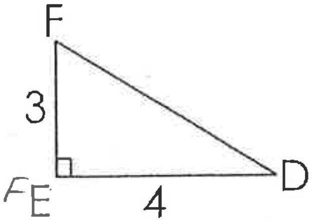
check by adding D to F.

Write Tan D again. At the moment, the Tan D ratio is written as a fraction. Ratios can also be written as decimals. Write Tan D as a decimal:

Tan D = $\frac{3}{4}$ or $\tan D = 0.75$

Trigonometric **ratios** such as tangent can be written as a fraction or a decimal.

Why is the measure of <D = 36.9° if the ratio for Tan D = ¾ ?



Look at the triangle. If the opposite is less than the adjacent side, <D will be less than 45^0. Thus, it is 36.9^0.
So, why is <F = 53.1^0 ?

Because $53.1° > 45°$, the opposite of F is greater than the adjacent of F.

Check: $\tan 45° = 1$

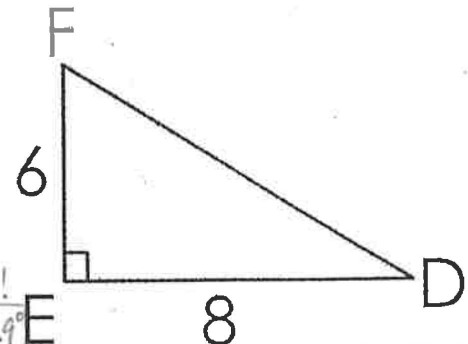
$\left(\tan 45° = \frac{1}{1}\right)$

$\left(\tan 45° = \frac{x}{x}\right)$

What would the opposite and adjacent sides have to be to have a 45^0 angle?

Opposite = adjacent

What would the other acute angle measure be in this situation? 45°

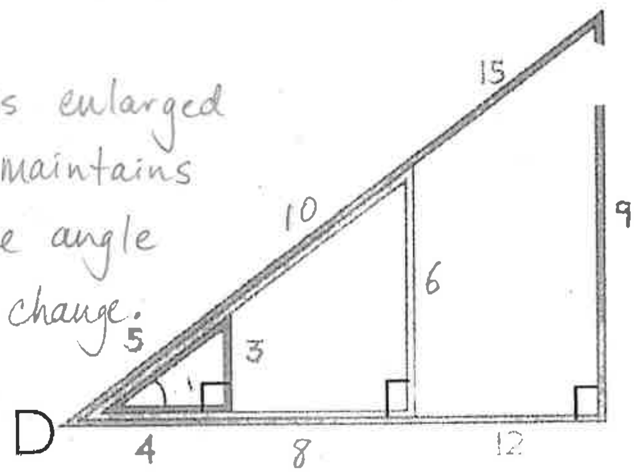


Back to Triangle DEF:
What would the measure of <D be for this triangle?

$\tan D = \frac{6}{8} \rightarrow \tan D = \frac{3}{4}$ Same! $\boxed{\angle D = 36.9°}$

No matter how big the triangle, if the ratio of opposite side to adjacent side is 0.75, then the angle will measure 36.9^0.

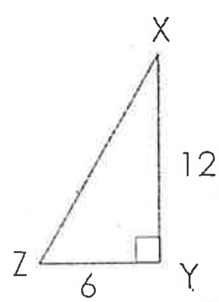
ie: If a triangle is enlarged or reduced, but maintains its proportions, the angle measures will not change.



Ex3) Determine Tan X and Tan Z

$\tan X = \frac{6}{12}$ $\tan Z = \frac{12}{6}$

$\boxed{\tan X = \frac{1}{2}}$ $\boxed{\tan Z = 2}$

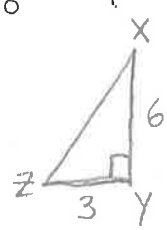


Now, determine <X and <Z:

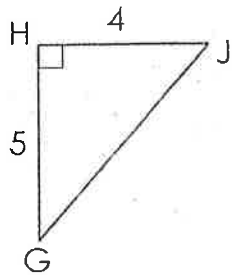
$X = \tan^{-1}\left(\frac{1}{2}\right)$ $Z = \tan^{-1}(2)$

$\boxed{X = 26.6°}$ $\boxed{Z = 63.4°}$

Sketch another right triangle with the same angle measures:



Ex4) Determine the measures of <G and <J to the nearest tenth of a degree. Start by writing the tangent ratio properly.



$\tan G = \frac{4}{5}$ $\qquad$ $\tan J = \frac{5}{4}$

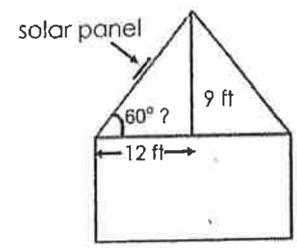
$G = \tan^{-1}\left(\frac{4}{5}\right)$ $\qquad$ $J = \tan^{-1}\left(\frac{5}{4}\right)$

$\boxed{G = 38.7^\circ}$ $\qquad$ $\boxed{J = 51.3^\circ}$

Definition:

Angle of Inclination – This is the ACUTE angle that a line makes with the horizontal

Using the Tan Ratio to Determine the Angle of Inclination:



Ex6) The latitude of Fort Smith, NWT, is approximately 60°. Determine whether this design for a solar panel is best for Fort Smith.

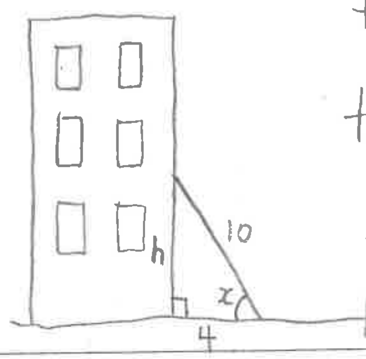
ie. Is $\tan 60^\circ = \frac{9}{12}$?

No! $\tan 60^\circ = 1.7 = \frac{17}{10}$

opposite should be 1.7 × longer than adjacent

Ex7) A 10ft ladder leans against the side of a building with its base 4ft from the wall. What is the angle of inclination of the ladder?

DRAW A DIAGRAM!



$\tan x = \frac{h}{4}$

$\tan x = \frac{9.2}{4}$

$x = \tan^{-1}\left(\frac{9.2}{4}\right)$

$\boxed{x = 66.5^\circ}$

$a^2 + b^2 = c^2$

$4^2 + h^2 = 10^2$

$h^2 = 84$

$h = 9.2$

Reflection: You have just studied the Tan ratio, which is the ratio of the opposite side to the adjacent side of a right triangle. What are the other two pairs of sides you could have in a right triangle? (think opp, adj, and hyp!)

2.2 – Sides from the Tangent Ratio

Name:
Date:

Goal: Apply the tangent ratio to calculate lengths of sides of triangles

Toolkit:
- Similar Triangles
- Labeling sides and angles of a triangle
- Tan Ratio (opposite and adjacent sides)

Main Ideas:

p.82-83 #3-11, 14.

Terminology:

Direct Measurement: When we use a measuring instrument (eg. Ruler, protractor) to determine a length or an angle.

Indirect Measurement: When we use math concepts (eg. Trig, Pythagoras) to calculate a length or an angle

We can use the Tan ratio as a tool to calculate the length of a side of a right triangle *indirectly*.

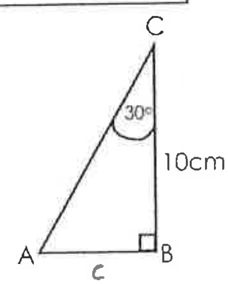
Steps:
1) Use the Tan ratio ($\frac{opposite}{adjacent}$) to write an equation
2) When we know the measure of an angle (that is NOT the 90° angle!) and the length of one of the legs (not the hypotenuse), solve the equation to determine the length of the other leg.

REMEMBER:

Calculator MUST be in DEGREE mode!

Determining the Length of a Side **Opposite** a Given Angle:

Ex1) Determine the length of AB to the nearest tenth of a centimeter.



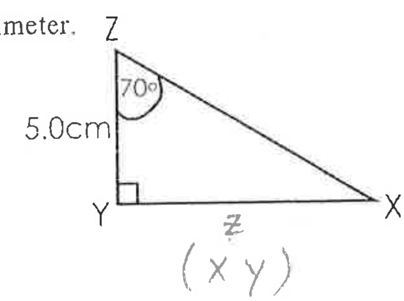
$\tan 30° = \frac{c}{10}$

$c = 10 \tan 30°$

$\boxed{c = 5.8 \text{ cm}}$

note: $\angle A = 60°$, so BC (10cm) should be greater than c (5.8 cm)

Ex2) Determine the length of XY to the nearest tenth of a centimeter.



$\tan 70° = \frac{z}{5}$

$z = 5 \tan 70°$

$\boxed{z = 13.7 \text{ cm}}$

reasonable? Yes. 70° angle should create a longer side.

Note: when solving a question where you have two equal fractions.....
"multiply the pair, divide by the spare!"

Ex 1. $\frac{3}{1} = \frac{8}{x}$

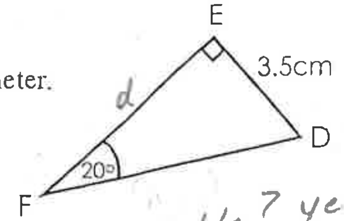
$x = (8 \times 1) \div 3$
$x = 2.67$

Ex 2. $\frac{2.4}{1} = \frac{y}{11}$

$x = (2.4 \times 11) \div 1$
$x = 26.4$

Determining the Length of a Side **Adjacent** a Given Angle:

Ex3) Determine the length of EF (d) to the nearest tenth of a centimeter.



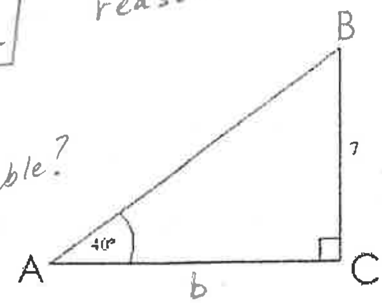
$\tan 20° = \frac{3.5}{d}$

$d \tan 20° = 3.5$

$d = \frac{3.5}{\tan 20°} \rightarrow \boxed{d = 9.6 \text{ cm}}$

reasonable? yes

Ex 4) Find side AC (b) to the nearest tenth.



$\tan 40° = \frac{7}{b}$

$b \tan 40° = 7$

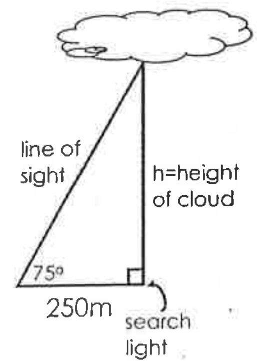
$b = \frac{7}{\tan 40°}$

$\boxed{b = 8.3}$

reasonable? YES

Using the Tan Ratio to Solve an Indirect Measurement Problem:

Ex5) A searchlight beam shines vertically on a cloud. At a horizontal distance of 250m from the searchlight, the angle between the ground and the line of sight to the cloud is 75°. Determine the height of the cloud to the nearest metre.



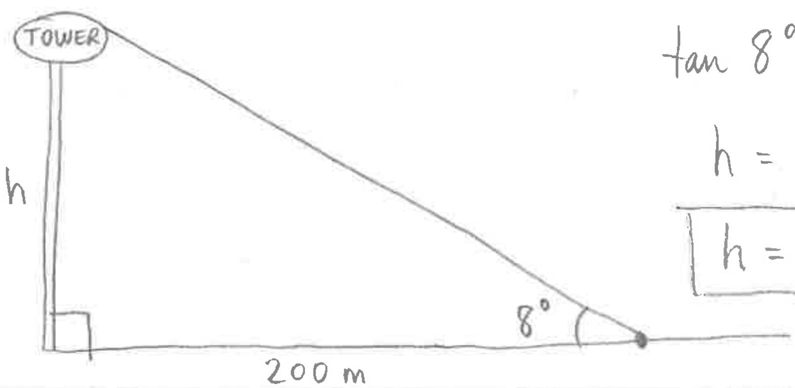
$\tan 75° = \frac{h}{250}$

$h = 250 \tan 75°$

$\boxed{h = 933 \text{ m}}$

Ex6) At a horizontal distance of 200m from the base of an observation tower, the angle between the ground and the line of sight to the top of the tower is 8°. How high is the observation tower, to the nearest metre?

Start by sketching and labeling a diagram to represent the information in the problem.......



$\tan 8° = \frac{h}{200}$

$h = 200 \tan 8°$

$\boxed{h = 28.1 \text{ m}}$

Reflection: Write, in your own words, how you can find the length of a side by using a known angle and a known side, and using the Tan Ratio.

2.4 – The Sine and Cosine Ratios

Name:
Date:

Goal: to develop and apply the sine and cosine ratios to determine angle measures

Toolkit:

- Labeling sides and angles of a triangle
- What you have learned about the Tan ratio
- Angle of elevation vs depression

(HYP) – **Hypotenuse**: The longest side of a right triangle (and always opposite the right angle)
(OPP) – **Opposite**: The side that does NOT touch the angle
(ADJ) – **Adjacent**: The side that DOES touch the angle (and is not the hypotenuse)

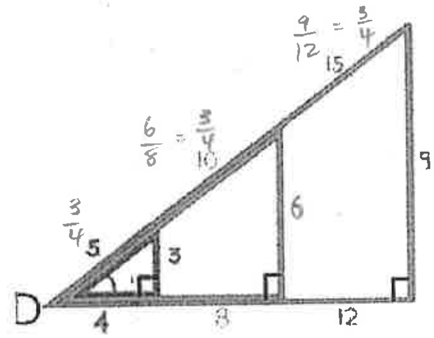
Main Ideas:

p. 95-96 # 4-8, 10, 12, 17.

Remember from yesterday that:

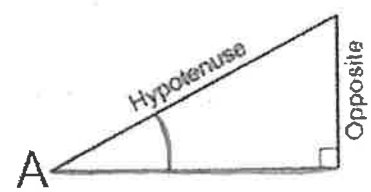
$$\text{Tan } D = \frac{\text{opposite side}}{\text{adjacent side}}$$

If the ratio of opposite to adjacent doesn't change, then angle D doesn't change. Look at angle D compared to the length of the opposite vs. the length of the adjacent sides.



You can also compare the ratio of other pairs of sides compared to the target angle. Tangent ratio is opposite side divided by adjacent side, but you can make a ratio with each of these sides and the hypotenuse, and these ratios can be related to the size of the target angle:

THE SINE RATIO



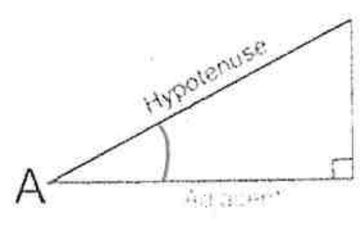
If < A is an acute angle in a right triangle, then

$$\text{Sin } A = \frac{\text{length of side opposite} <A}{\text{length of hypotenuse}}$$

What values will the sine ratio always be between? between 0 and 1.
Why? The hypotenuse is always the longest side, so the opposite will be shorter.

If the opposite side is quite small compared to the hypotenuse, will the target angle be closer to 0^0 or 90^0 ? closer to 0°

THE COSINE RATIO



If < A is an acute angle in a right triangle, then

$$\text{Cos } A = \frac{\text{length of side adjacent} <A}{\text{length of hypotenuse}}$$

What values will the cosine ratio always be between? between 0 and 1.
Why? The hypotenuse is always the longest side, so the adjacent will be shorter.

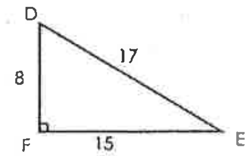
If the adjacent side is quite small compared to the hypotenuse, will the target angle be closer to 0^0 or 90^0 ?

closer to $90°$

S O H C A H T O A

Determining the Sine and Cosine of an Angle, and Determining the Measure of the Angle

Ex1) a) In triangle DEF, identify the side opposite <D, the side adjacent to <D, and the hypotenuse



opp. = 15
adj. = 8
hyp. = 17

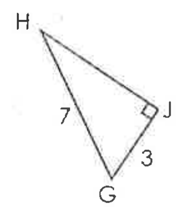
b) Determine the ratios Sin D and Cos D, and give the values as decimals (nearest hundredth)

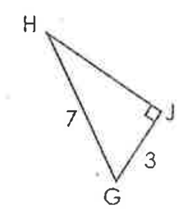
$\sin D = \frac{15}{17}$ $\cos D = \frac{8}{17}$

c) Determine angles D and E to the nearest tenth

$D = \sin^{-1}\left(\frac{15}{17}\right)$ $\boxed{\angle D = 61.9°}$ $\angle E = 180° - 90° - 61.9°$ $\boxed{\angle = 28.1°}$

Ex2) Determine the measures of <G and <H to the nearest tenth of a degree.





$\cos G = \frac{3}{7}$ $\sin H = \frac{3}{7}$

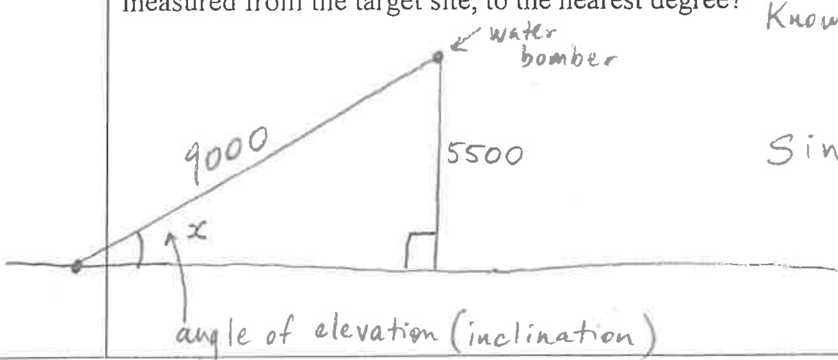
$G = \cos^{-1}\left(\frac{3}{7}\right)$ $H = \sin^{-1}\left(\frac{3}{7}\right)$

$\boxed{G = 64.6°}$ $\boxed{H = 25.4°}$

Using Sine or Cosine to Solve a Problem

Ex3) A water bomber is flying at an altitude of 5500 ft. The plane's radar shows that it is 9000 ft from the target site in a forest fire. What is the angle of elevation of the plane measured from the target site, to the nearest degree?

Know: opp. & hyp. (sin)



$\sin x = \frac{5500}{9000}$

$x = \sin^{-1}\left(\frac{5500}{9000}\right)$

$\boxed{x = 37.7°}$

Reflection: What will you do to remember the calculator steps when finding an ANGLE (whether it's a sin, cos, or tan problem)?

2.5 – Missing Sides from Sine and Cosine

Name:
Date:

Goal: to use the sine and cosine ratios to determine lengths indirectly.

Toolkit:

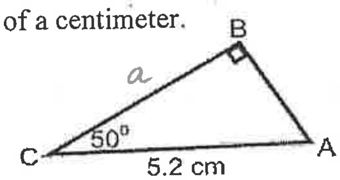
- What you have learned about the Tan ratio
- Angle of elevation vs depression
- SOHCAHTOA

Main Ideas:

p. 101 – 102
3-11, 12a.

Using the sine or cosine ratio to determine the length of a leg

Ex1) Determine the length of side a to the nearest tenth of a centimeter.



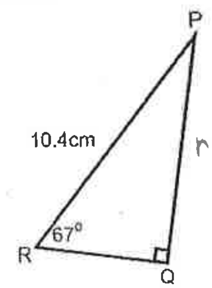
$\angle C = 50°$ → know hypotenuse, need adjacent
cos

$\cos 50° = \frac{a}{5.2}$

$a = 5.2 \cos 50°$

$\boxed{a = 3.3 \text{ cm}}$

Ex2) Determine the length of side r to the nearest tenth of a centimeter.



$\angle R = 67°$ → know hypotenuse, need opposite
sin

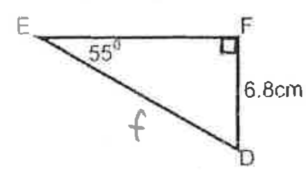
$\sin 67° = \frac{r}{10.4}$

$r = 10.4 \sin 67°$

$\boxed{r = 9.6 \text{ cm}}$

Using the sine or cosine ratio to determine the length of the hypotenuse

Ex3) Determine the length of side f to the nearest tenth of a centimeter.



$\angle E = 55°$ → know opposite, need hypotenuse
sin

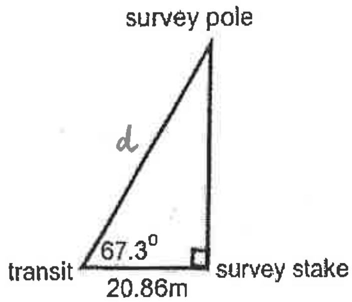
$\sin 55° = \frac{6.8}{f}$

$f \sin 55° = 6.8$

$f = \frac{6.8}{\sin 55°} = \boxed{8.3 \text{ cm}}$

Solving an Indirect Measurement Problem

Ex4) A surveyor made the measurements shown in the diagram. How could the surveyor determine the distance from the transit to the survey pole to the nearest hundredth of a metre?



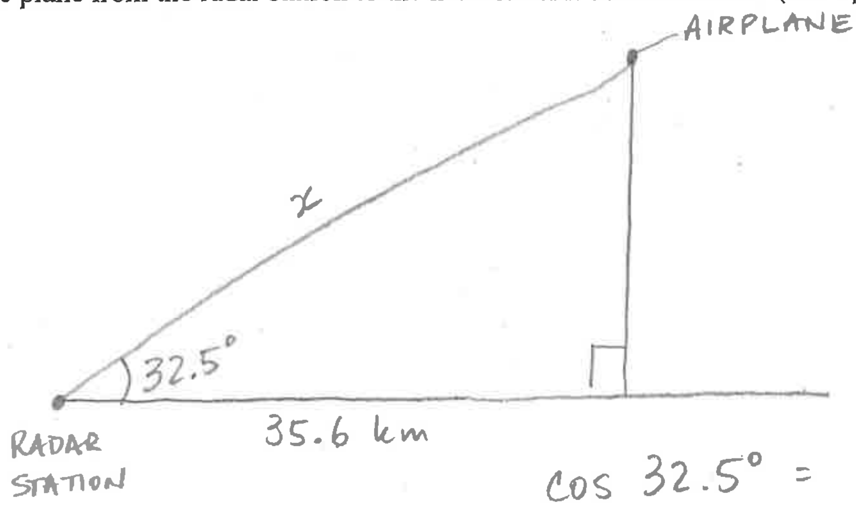
$$\cos 67.3^\circ = \frac{20.86}{d}$$

$$d \cos 67.3^\circ = 20.86$$

$$d = \frac{20.86}{\cos 67.3^\circ}$$

$$\boxed{d = 54.05\text{ m}}$$

Ex5) From a radar station, the angle of elevation of an approaching airplane is 32.5°. The horizontal distance between the plane and the radar station is 35.6km. How far is the plane from the radar station to the nearest tenth of a kilometer? (Draw a picture!)



$$\cos 32.5^\circ = \frac{35.6}{x}$$

$$x \cos 32.5^\circ = 35.6$$

$$x = \frac{35.6}{\cos 32.5^\circ} = \boxed{42.2\text{ km}}$$

Reflection: Explain when you might use the sine or cosine ratio instead of the tangent ratio to determine the length of a side in a right triangle.

2.6 – Solving Triangles

Name:
Date:

Goal: Use a trigonometric ratio to solve a problem involving a right triangle

Toolkit:

- $S\frac{O}{H}C\frac{A}{H}T\frac{O}{A}$ (SOHCAHTOA!)
- The sum of the angles in any triangle is 180°
- Pythagoras → $a^2 + b^2 = c^2$

Main Ideas:

p. 111 #3-6.

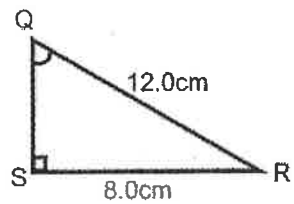
p. 127 #4.

Which Trig Ratio should be used?

Find the missing angle or side using trig...

Ex1) To determine the measure of the indicated angle or side, which trig ratio would you use? Why? Then find the indicated angle or side, to the nearest tenth of a degree.

a)

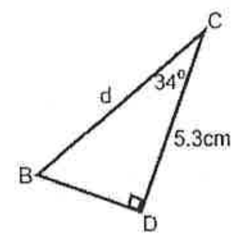


$\sin Q = \frac{8.0}{12.0}$

$Q = \sin^{-1}\left(\frac{8}{12}\right)$

$\boxed{Q = 41.8°}$

b)

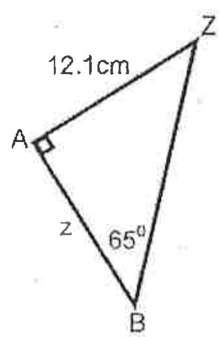


$\cos 34° = \frac{5.3}{d}$

$d \cos 34° = 5.3$

$d = \frac{5.3}{\cos 34°} = \boxed{6.4 \text{ cm}}$

c)



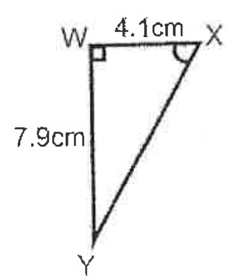
$\tan 65° = \frac{12.1}{z}$

$z \tan 65° = 12.1$

$z = \frac{12.1}{\tan 65°}$

$\boxed{z = 5.6 \text{ cm}}$

d)



$\tan X = \frac{7.9}{4.1}$

$X = \tan^{-1}\left(\frac{7.9}{4.1}\right)$

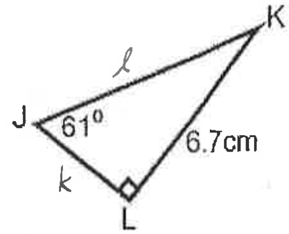
$\boxed{X = 62.6°}$

How do you *SOLVE* a triangle?

Solving a triangle means to determine the measures of all the angles and the lengths of all the sides in a triangle. We will need to use:

- $S\frac{O}{H}C\frac{A}{H}T\frac{O}{A}$
- The sum of the angles in any triangle is 180°
- Pythagoras → $a^2 + b^2 = c^2$

Ex2) Solve ΔJKL. Give measures to the nearest tenth.



$\angle K = 180° - 90° - 61°$

$\boxed{\angle K = 29°}$

side l: $\sin 61° = \frac{6.7}{l}$

$l \sin 61° = 6.7$

$l = \frac{6.7}{\sin 61°}$

$\boxed{l = 7.7\text{cm}}$

side k: trig. or Pythag.

$\tan 61° = \frac{6.7}{k}$

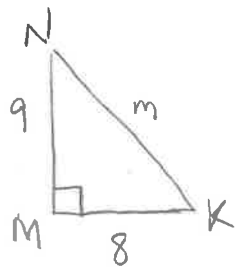
$k \tan 61° = 6.7$

$k = \frac{6.7}{\tan 61°} = \boxed{3.7\text{ cm}}$

How do you solve a triangle without the picture of the triangle?

Ex3) In right triangle ΔKMN, $< M = 90°, KM = 8cm, and\ MN = 9cm.$ Solve this triangle. Give measures to the nearest tenth.

(Draw and label the triangle, then solve!)



$\angle K$: $\tan K = \frac{9}{8}$

$K = \tan^{-1}\left(\frac{9}{8}\right)$

$\boxed{K = 48.4°}$

$\angle N = 180° - 90° - 48.4° = \boxed{41.6°}$

m: trig. or Pythag.

$\sin K = \frac{9}{m}$

$\sin 48.4° = \frac{9}{m}$

$m \sin 48.4° = 9$

$m = \frac{9}{\sin 48.4°}$

$\boxed{m = 12.0\text{ cm}}$

Reflection: What is the advantage of determining the unknown angle before the unknown sides?

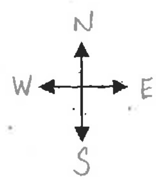
2.7A – Applications, One Triangle

Name:
Date:

Goal: to apply trigonometry to solve problems with one right triangle

Toolkit:

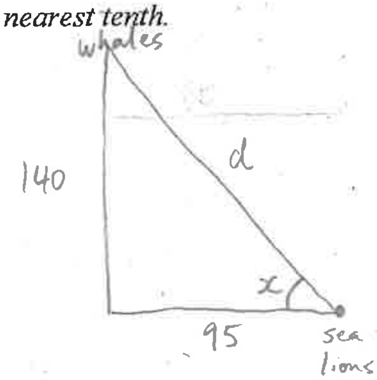
- $S\frac{O}{H}C\frac{A}{H}T\frac{O}{A}$ (SOHCAHTOA!)
- The sum of the angles in any triangle is 180°
- Pythagoras → $a^2 + b^2 = c^2$
- Perimeter
- Equilateral, isosceles, scalene
- Compass



Main Ideas:

p. 111 – 112
7 – 13, 15

Ex1) A whale-watching boat is stopped near a rock to look at some sea lions. Then it goes 95m due west to head towards a possible whale sighting. The captain points out a pod of whales, which the radar shows are 140m north of the boat. How far are the whales from the sea lions, and what is the angle at the rock (between the boat's path and the whales' direct line to the sea lions)? *Answer to the nearest tenth.*



Find d and x

$a^2 + b^2 = c^2$

$95^2 + 140^2 = d^2$

$d^2 = 28625$

$\boxed{d = 169.2 \text{ m}}$

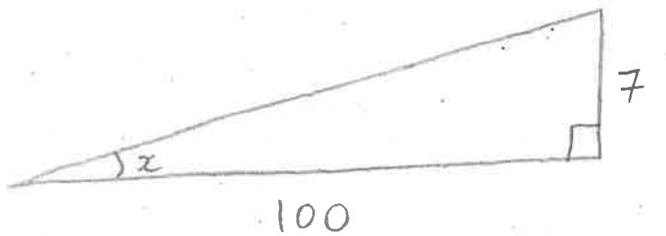
$\tan x = \frac{140}{95}$

$x = \tan^{-1}\left(\frac{140}{95}\right)$

$\boxed{x = 55.8^\circ}$

Ex2) As Sam is driving, she sees a sign telling her that the road has a 7% grade (i.e., a rise of 7 meters for a horizontal change of 100m).

a) What is the angle of inclination of the road? (nearest degree)
b) If she travels 500m along the road, how much has she risen vertically? (nearest meter)



a) $\tan x = \frac{7}{100}$

$x = \tan^{-1}\left(\frac{7}{100}\right)$

$\boxed{x = 4^\circ}$

b)

$\sin 4^\circ = \frac{h}{500}$

$h = 500 \sin 4^\circ$

$\boxed{h = 35\text{m}}$

Reflection: What are two things YOU can do (there are lots!) to help make sure you can solve an application question like the ones in this section?

2.7B – Applications, Two Triangles

Name:
Date:

Goal: to apply trigonometry to solve problems with two right triangles

Toolkit:

- $S\frac{O}{H}C\frac{A}{H}T\frac{O}{A}$ (SOHCAHTOA!)
- The sum of the angles in any triangle is 180°
- Pythagoras → $a^2 + b^2 = c^2$
- A PLAN: you'll need to come up with a PLAN to use more than one triangle to help you answer the question before you jump in.
- Try re-drawing the pieces.

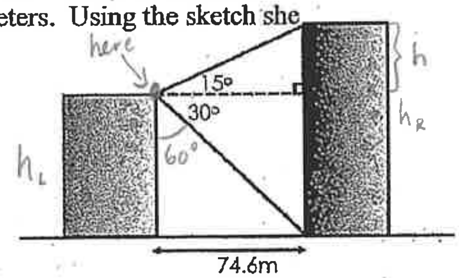
Main Ideas:

p. 118 – 120 # 3abc, 4, 5ac, 6, 8, 9, 11, 14, 16

Ch. 2 Review p. 124–126 # 1, 3, 5–8, 11, 12, 15–17, 18, 22, 23

2-D

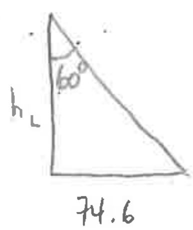
Ex1) From the top of one building, a surveyor measures the angle of elevation to the top of another (taller!) building, and the angle of depression to the base of the other building. The distance between the buildings is 74.6 meters. Using the sketch she made, find the height of the buildings (nearest tenth).

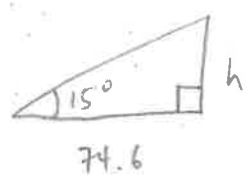


$h_L = h$ (left)

$h_R = h$ (right)

$h_R = h_L + h$





$\tan 60° = \frac{74.6}{h_L}$

$h_L \tan 60° = 74.6$

$h_L = \frac{74.6}{\tan 60°}$

$\boxed{h_L = 43.1 \text{ m}}$

$\tan 15° = \frac{h}{74.6}$

$h = 74.6 \tan 15°$

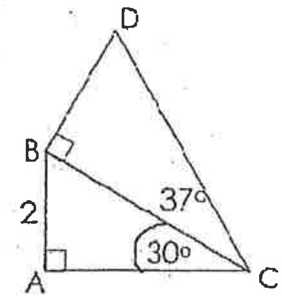
$h = 20.0 \text{ m}$

$h_R = 43.1 + 20.0$

$\boxed{= 63.1 \text{ m}}$

Ex2) For each questions, write out a PLAN to find the missing side CD.

a) Find the length CD. What's the PLAN?



(1) Find BC
(2) Find CD

(1) $\sin 30° = \frac{2}{BC}$

$BC = \frac{2}{\sin 30°}$

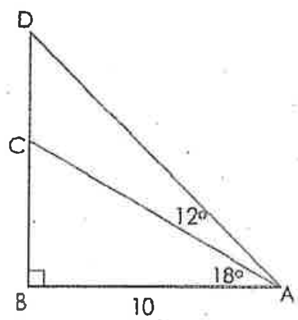
$BC = 4$

(2) $\cos 37° = \frac{4}{CD}$

$CD = \frac{4}{\cos 37°}$

$\boxed{CD = 5.0}$

b) Find the length CD. What's the PLAN?



(1) Find BD
(2) Find BC
(3) CD = BD − BC

(1) $\tan 30° = \frac{BD}{10}$

$BD = 10 \tan 30°$

$BD = 5.8$

(2) $\tan 18° = \frac{BC}{10}$

$BC = 10 \tan 18°$

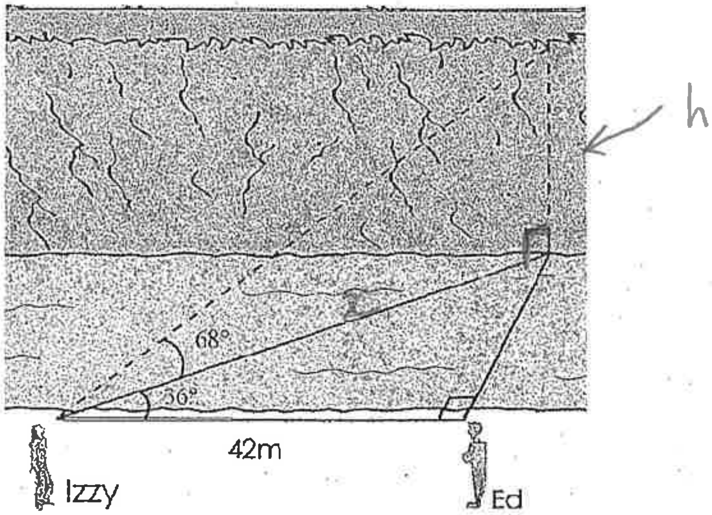
$BC = 3.2$

$CD = 5.8 - 3.2$

$\boxed{= 2.6}$

3-D
Hard to picture: try looking for right angles!

Ex3) Izzy and Ed positioned themselves 42 m apart on one side of a stream. Izzy recorded angles, as shown below. Find the height of the cliff on the other side of the stream (nearest tenth).



$\cos 36° = \frac{42}{x}$

$x = \frac{42}{\cos 36°}$

$x = 51.9m$

$\tan 68° = \frac{h}{51.9}$

$h = 51.9 \tan 68°$

$\boxed{h = 128.5 m}$

Reflection: What do you have to think about when you draw a diagram with triangles in three dimensions?