Section 4: Trigonometry

This booklet belongs to:_____ Block: _____

Section	Due Date	How Did It Go?	Corrections Made and Understood
4.1			
4.2			
4.3			

Assessment Rubric

Category	L-T Score	Learning Target Procedure	Algebraic/Arithmetic Procedure	Communication	Anecdotal Example
Extending	4	Procedural context demonstrates a detailed understanding of the learning targets	Algebraic/Arithmetic process is error free, logic is clear and easy to follow	Written output is clear, easy to follow, and shows depth of understanding	"You could teach this" or "It's an answer key"
	3.5	Procedural context demonstrates a thorough understanding of the learning targets	Algebraic/Arithmetic process contains very minor errors, logic is clear and easy to follow	Written output is clear, easy to follow, and shows depth of understanding	"Almost perfect, one or two little errors"
Proficient	3	Procedural context is clear, demonstrates sound reasoning and thought of the learning targets	Algebraic/Arithmetic process contains minor errors, logic is clear and easy to follow	Written output is clear and organized, and shows depth of understanding	"Good understanding with a few errors"
Developing	2.5	Procedural context is clear, contains errors but demonstrates sound reasoning and thought of the learning targets	Algebraic/Arithmetic process contains errors, logic is clear and easy to follow	Written output is difficult to follow, but shows an understanding of the task	"You know what to do bet not clear how to do it"
Developing	2	Procedural context contains errors. Understanding of the learning targets is developing	Algebraic/Arithmetic process contains numerous errors, difficult to follow	Written output is difficult to follow but shows an understanding of the task	"You are on the right track but key concepts are missing"
Emerging	1	Procedural context is not clear, demonstrates minimal understanding of the learning targets	Algebraic/Arithmetic process contains numerous errors, difficult to follow	Written output is difficult to follow, but shows an understanding of the task	"You have achieved the bare minimum to meet the learning outcome"
Not Yet Meeting Outcomes	IE	Procedural context is not clear, demonstrates minimal understanding of the learning targets	Algebraic/Arithmetic process contains numerous errors, difficult to follow	Written output is difficult to follow or completely absent and lacks clarity	"Learning outcomes are not met at this time"

Learning Targets and Self-Evaluation

L – T	Description	Mark
$4-1$	• Understanding Trigonometric Ratios and their inverses • Using calculator effectively in making angle calculations • Solving proportions	
$4-2$	• Right angle triangle properties and trigonometric relationships • Solving angles and sides using trigonometric properties Tan/Sine/Cosine	
$4-3$	• Understanding how to draw scenarios involving trigonometric principles • Solving word problems involving angles and direction	

Comments:

Competency Evaluation

A valuable aspect to the learning process involves self-reflection and efficacy. Research has shown that authentic self-reflection helps improve performance and effort, and can have a direct impact on the growth mindset of the individual. In order to grow and be a life-long learner we need to develop the capacity to monitor, evaluate, and know what and where we need to focus on improvement. Read the following list of Core Competency Outcomes and reflect on your behaviour, attitude, effort, and actions throughout this unit.

- Rank yourself on the left of each column: 4 (Excellent), 3 (Good), 2 (Satisfactory), 1 (Needs Improvement)

		4	3	2	1
Personal Responsibility	• I **listen** during instruction and come ready to ask questions				
	• I am **on time** for class • I am **fully prepared** for the class, with all the required supplies				
	• I am **fully prepared** for Tests				
	• I **follow** instructions keep my Workbook organized and tidy • I am **on task** during work blocks • I **complete** assignments **on time**				
Self-Regulation	• I keep track of my **Learning Targets**				
	• I take **ownership** over my goals, learning, and behaviour • I can **solve problems** myself and know when to ask for help • I can **persevere** in challenging tasks • I **am actively** engaged in lessons and discussions				
	• I only **use my phone** for school tasks				
Classroom Responsibility and Communication	• I am **focused** on the discussion and lessons • I **ask questions** during the lesson and class • I give **my best effor**t and **encourage** others to work well • I am polite and communicate questions and concerns with my peers and teacher in a timely manner • I clean up after myself and leave the classroom tidy when I leave				
Collaborative Actions	• I can **work with others** to achieve a common goal • I make **contributions** to my group • I **am kind** to others, can work collaboratively and **build relationships** with my peers • I **can identify** when others need support and provide it				
Communication Skills	• I present informative **clearly**, in an organized way • I **ask and respond** to simple direct questions • I am an **active listener**, I support and encourage the speaker • I **recognize** that there are different points of view and can disagree respectfully • I do not interrupt or speak over others				
	Overall				
Goal for next Unit – refer to the above criteria. **Please selec**t (underline/highlight) **two areas** you want to focus on					

Section 4.1 – Right Angle Triangle Trigonometry

- **Trigonometry** is the study of **angles and the ratios** that relate to them
- In the following sections will be only focus on **Right Angle Triangle** Trigonometry
- With the **Pythagorean Theorem** and **3 Trigonometric Functions** we can solve triangles
- They are:

Sine **Tangent** **Cosine**

Using your Calculator

- In my opinion, Trigonometry is the only topic that **requires a calculator** in this course
- This is because calculating the value of angles, given a specific Trig Function is very hard
- Also converting from the given ratios value back to the angle is just as tough
- In fact, I don't even know how to do it by hand!

The very **first thing** you want to check:

Make sure your Calculator is in **DEGREE MODE**, you should see a little **D or DEG** on the top

Second:

There are three buttons we will be using on our calculators they are:

Tan^{-1} Tan Sin^{-1} Sin Cos^{-1} Cos

- We use $\boldsymbol{Tan}, \boldsymbol{Sin}, \boldsymbol{Cos}$ when we are **trying to get the decimal value** of a given angle
- Or their INVERSE buttons:
- We use $\boldsymbol{Tan^{-1}}, \boldsymbol{Sin^{-1}}, \boldsymbol{Cos^{-1}}$ when we are **trying to get the angle value** of a given decimal
    - You will need to hit the 2nd function button to access the INVERSE buttons

Third:

Depending on the calculator you have you will either be pressing:

- The **Trig button first** then the angle/ratio

or

- The **angle/ratio first** and then the Trig button

Solving for Values

- When **solving an angle** and getting it's **decimal expansion**, round to **4 decimal places**

Example: Solve the following: $Tan\ 60°, Sin\ 60°, Cos\ 60°$

Solution: $Tan\ 60° = 1.732$ $Sin\ 60° = 0.8660$ $Cos\ 60° = 0.5$

Example: Solve the following: $Tan\ 30°, Sin\ 30°, Cos\ 30°$

Solution: $Tan\ 30° = 0.5774$ $Sin\ 30° = 0.5$ $Cos\ 30° = 0.8660$

Example: Solve the following: $Tan\ 0°, Sin\ 0°, Cos\ 0°$

Solution: $Tan\ 0° = 0$ $Sin\ 0° = 0$ $Cos\ 0° = 1$

Example: Solve the following: $Tan\ 34°, Sin\ 57°, Cos\ 102°$

Solution: $Tan\ 34° = 0.675$ $Sin\ 57° = 0.8387$ $Cos\ 102° = -0.208$

- When **converting a decimal** expansion **to an angle**, round to **1 decimal place**

Example: Convert 0.8660 to angles of all three trigonometric functions

Solution: $Tan^{-1}(0.8660) = 40.9°$ $Sin^{-1}(0.8660) = 60.0°$ $Cos^{-1}(0.8660) = 30.0°$

Example: Convert 1.0 to angles of all three trigonometric functions

Solution: $Tan^{-1}(1.0) = 45.0°$ $Sin^{-1}(1.0) = 90.0°$ $Cos^{-1}(1.0) = 0.0°$

Example: Convert 0.7002 to angles of all three trigonometric functions

Solution: $Tan^{-1}(0.7002) = 35.0°$ $Sin^{-1}(0.7002) \approx 44.4°$ $Cos^{-1}(0.7002) \approx 45.6°$

Next we will see how we use these Trigonometric Functions to Solve for missing information

Solving Proportions

Solving trigonometry problems is just solving a proportion.

- A proportion is when we have two things equal to one another and one piece of information is unknown, ALGEBRA all over again

Example:

Solve the following proportions for a

1. $ab = c \quad \rightarrow \quad \frac{ab}{b} = \frac{c}{b} \quad \rightarrow \quad \boldsymbol{a = \frac{c}{b}}$

   Divide both sides by b

2. $abc = d \quad \rightarrow \quad \frac{abc}{bc} = \frac{d}{bc} \quad \rightarrow \quad \boldsymbol{a = \frac{d}{bc}}$

   Divide both sides by bc

3. $\frac{ab}{c} = d \quad \rightarrow \quad c * \frac{ab}{c} = d * c \quad \rightarrow \quad ab = dc \quad \rightarrow \quad \frac{ab}{b} = \frac{dc}{b} \quad \rightarrow \quad \boldsymbol{a = \frac{dc}{b}}$

   Multiply both sides by c — *Divide both sides by b*

4. $\frac{a+b}{c} - d = e \quad \rightarrow \quad \frac{a+b}{c} - d + d = e + d \quad \rightarrow \quad \frac{a+b}{c} = e + d \quad \rightarrow \quad c * \frac{a+b}{c} = (e+d)c \quad \rightarrow$

   Add d to both sides — *Multiply both sides by c*

   $a + b = (e+d)c \quad \rightarrow \quad a + b - b = (e+d)c - b \quad \rightarrow \quad \boldsymbol{a = c(e+d) - b}$

   Subtract b from both sides

Section 4.1 – Practice Problems

Solve for the following Trigonometric Ratios. (Round to 4 decimals)

1. $Sin\ 12° =$	2. $Tan\ 57° =$	3. $Cos\ 123° =$
4. $Cos\ 34° =$	5. $Sin\ 360° =$	6. $Tan\ 270° =$
7. $Sin\ 234° =$	8. $Tan\ 2° =$	9. $Cos\ 180° =$
10. $Tan\ 45° =$	11. $Sin\ 45° =$	12. $Cos\ 45° =$

Solve for the following angles. (Round to 1 decimal)

13. $Sin^{-1}(0.8660) =$	14. $Tan^{-1}(0.2354) =$	15. $Cos^{-1}(0.6775) =$
16. $Cos^{-1}(0.1111) =$	17. $Sin^{-1}(0.9999) =$	18. $Tan^{-1}(1.234) =$
19. $Sin^{-1}(0.5628) =$	20. $Tan^{-1}(0.5555) =$	21. $Cos^{-1}(0.6258) =$
22. $Tan^{-1}(1.879) =$	23. $Sin^{-1}(0.1111) =$	24. $Cos^{-1}(0.0001) =$

Solve the following proportions for the variable a.

25. $b = \frac{a}{c}$	26. $b = \frac{c}{a}$
27. $c = \frac{b}{a+d}$	28. $d = ab - ac$
29. $ab = ac + d$	30. $b = \frac{ac}{d}$

Section 4.2 – Solving Triangles

- Solving triangles involves solving for **all three angles** and **all three sides**
- A quick reminder, **all three angles** in a triangle add up to $\mathbf{180}°$
- At this level we only discuss **RIGHT ANGLE** triangles so we already know **one angle is $\mathbf{90}°$**
- So the **other two** must also **add to $\mathbf{90}°$**

Solving Triangles

- Whenever we are solving triangle **we need at least 2 pieces** of information
- Either **2 sides** or **1 side and 1 angle**
- From there we can then solve for everything else

All of the rest of the information comes from **working with ratios**

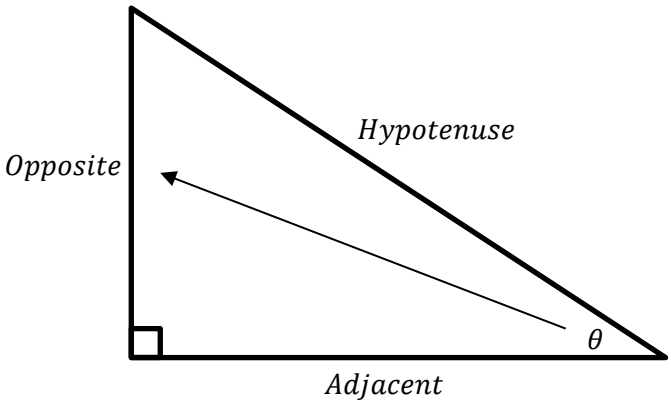
To help remember these ratios we think about these three words

SOH CAH TOA

They stand for:

$$Sine\theta = \frac{Opposite}{Hypotenuse} \qquad Cosine\theta = \frac{Adjacent}{Hypotenuse} \qquad Tangent\theta = \frac{Opposite}{Adjacent}$$

- With a right angle triangle, depending on what angle you want, the sides get named differently



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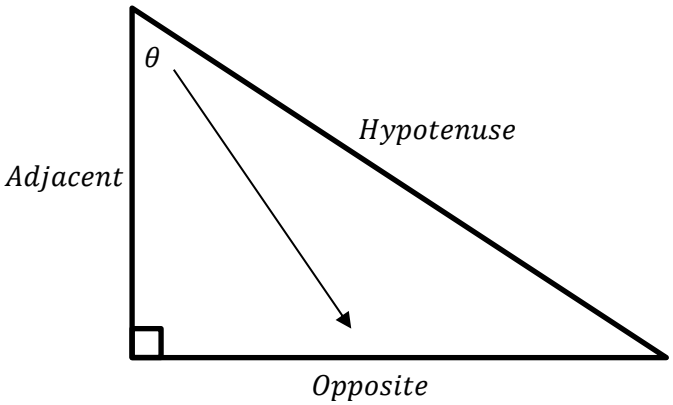
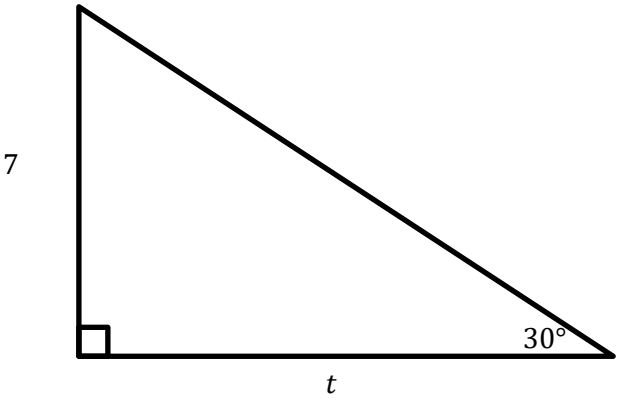


Different Solving Scenarios

An unknown Side – Using Tangent

- If you look at the triangle we have **an angle** and the **opposite side**
- We want the **adjacent side**
- So we have **two letters of TOA**, so were using $\boldsymbol{TANGENT}$



- Using the **TOA Ratio** from before:

$$Tan(\theta) = \frac{Opposite}{Adjacent} \quad \rightarrow \quad Tan(30) = \frac{7}{t}$$

- Doing some Algebra:

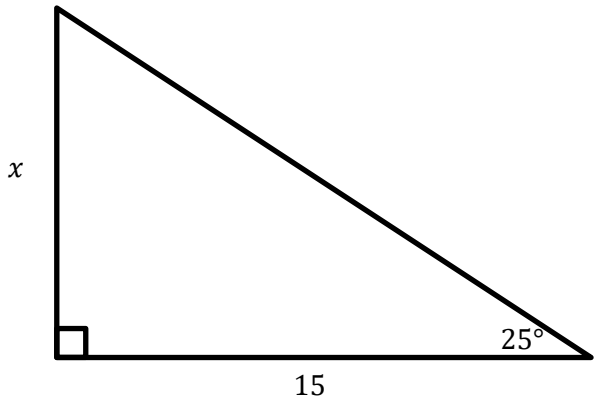
$$(t)Tan(30) = 7 \quad \rightarrow \quad t = \frac{7}{Tan(30)}$$

- Then we solve, you can simplify the $Tan(30)$ 1st

$$t = \frac{7}{0.5774} \quad \rightarrow \quad \boldsymbol{t = 12.1}$$

An unknown Side – Using Tangent

- If you look at the triangle we have **an angle** and the **adjacent side**
- We want the **opposite side**
- So we have **two letters of TOA**, so were using $\boldsymbol{TANGENT}$



- Using the **TOA Ratio** from before:

$$Tan(\theta) = \frac{Opposite}{Adjacent} \quad \rightarrow \quad Tan(25) = \frac{x}{15}$$

- Doing some Algebra:

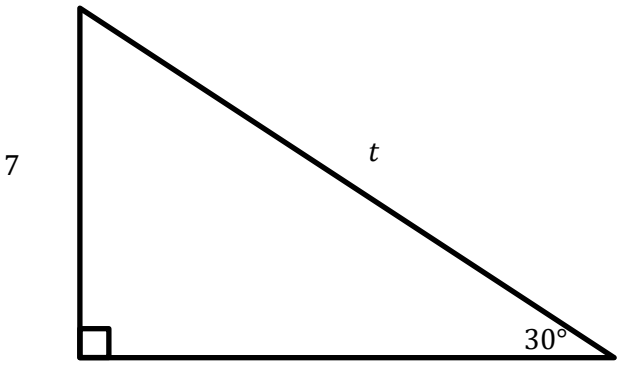
$$(15)Tan(25) = x$$

- Then we solve, you can simplify the $Tan(25)$ 1st

$$(15)(0.4663) = x \quad \rightarrow \quad \boldsymbol{x = 7.0}$$

An unknown Side – Using Sine

- If you look at the triangle we have **an angle** and the **opposite side**
- We want the **hypotenuse**
- So we have **two letters of SOH**, so were using $\boldsymbol{SINE}$



- Using the **SOH Ratio** from before:

$$Sin(\theta) = \frac{Opposite}{Hypotenuse} \quad \rightarrow \quad Sin(30) = \frac{7}{t}$$

- Doing some Algebra:

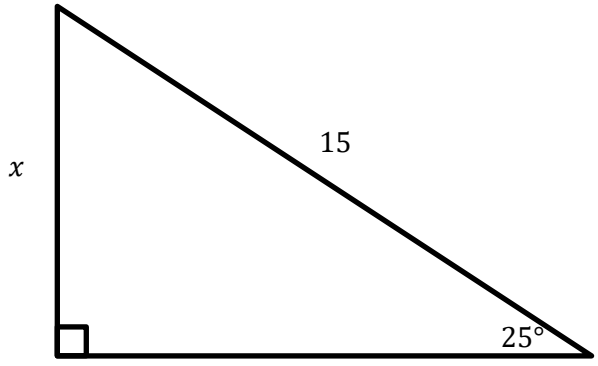
$$(t)Sin(30) = 7 \quad \rightarrow \quad t = \frac{7}{Sin(30)}$$

- Then we solve, you can simplify the $Sin(30)$ 1st

$$t = \frac{7}{0.5} \quad \rightarrow \quad \boldsymbol{t = 14}$$

An unknown Side – Using Sine

- If you look at the triangle we have **an angle** and the **hypotenuse**
- We want the **opposite side**
- So we have **two letters of SOH**, so were using $\boldsymbol{SINE}$



- Using the **SOH Ratio** from before:

$$Sin(\theta) = \frac{Opposite}{Hypotenuse} \quad \rightarrow \quad Sin(25) = \frac{x}{15}$$

- Doing some Algebra:

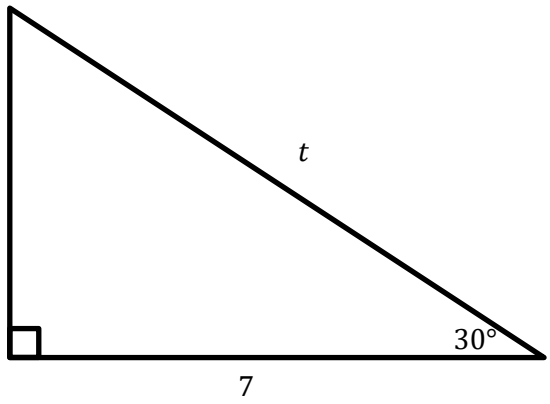
$$(15)Sin(25) = x$$

- Then we solve, you can simplify the $Sin(25)$ 1st

$$(15)(0.4226) = x \quad \rightarrow \quad \boldsymbol{x = 6.3}$$

An unknown Side – Using Cosine

- If you look at the triangle we have **an angle** and the **adjacent side**
- We want the **hypotenuse**
- So we have **two letters of CAH**, so were using $\boldsymbol{COSINE}$



- Using the **CAH Ratio** from before:

$$Cos(\theta) = \frac{Adjacent}{Hypotenuse} \quad \rightarrow \quad Cos(30) = \frac{7}{t}$$

- Doing some Algebra:

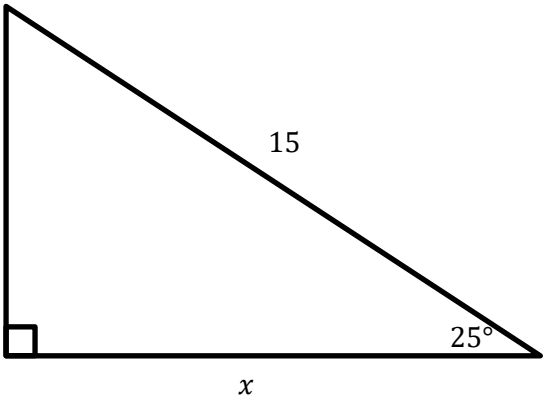
$$(t)Cos(30) = 7 \quad \rightarrow \quad t = \frac{7}{Cos(30)}$$

- Then we solve, you can simplify the $Cos(30)$ 1st

$$t = \frac{7}{0.8660} \quad \rightarrow \quad \boldsymbol{t = 8.1}$$

An unknown Side – Using Cosine

- If you look at the triangle we have **an angle** and the **hypotenuse**
- We want the **adjacent side**
- So we have **two letters of CAH**, so were using $\boldsymbol{COSINE}$



- Using the **CAH Ratio** from before:

$$Cos(\theta) = \frac{Adjacent}{Hypotenuse} \quad \rightarrow \quad Cos(25) = \frac{x}{15}$$

- Doing some Algebra:

$$(15)Cos(25) = x$$

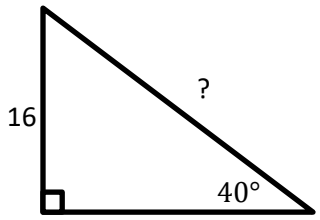
- Then we solve, you can simplify the $Cos(25)$ 1st

$$(15)(0.9063) = x \quad \rightarrow \quad \boldsymbol{x = 13.6}$$

Trigonometry of Right Angle Triangles – SOH CAH TOA

Solve for the **missing side** of the right angle triangle, round to the nearest tenth.

1.

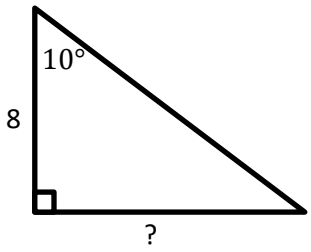


$\sin\theta = \frac{opp}{hyp}$ $\quad x = \frac{16}{\sin 40°}$

$\sin 40° = \frac{16}{x}$ $\quad x = 24.9$ ft

$x \sin 40° = 16$

2.

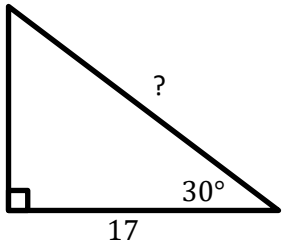


$\tan\theta = \frac{opp}{adj}$ $\quad x = 1.4$ m

$\tan 10° = \frac{x}{8}$

$x = 8 \tan 10°$

3.

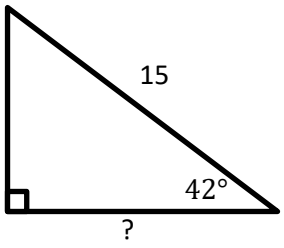


$\cos\theta = \frac{adj}{hyp}$ $\quad x = \frac{17}{\cos 30°}$

$\cos 30° = \frac{17}{x}$ $\quad x = 19.6$ km

$x \cos 30° = 17$

4.

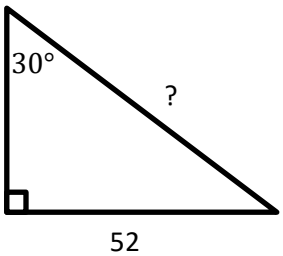


$\cos\theta = \frac{adj}{hyp}$ $\quad x = 11.1$ cm

$\cos 42° = \frac{x}{15}$

$x = 15 \cos 42°$

5.



$\sin\theta = \frac{opp}{adj}$ $\quad x = \frac{52}{\sin 30°}$

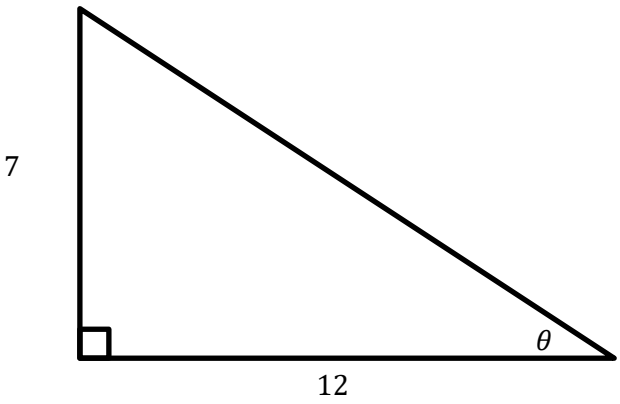
$\sin 30° = \frac{52}{x}$ $\quad x = 104$ mi

$x \sin 30° = 52$

Triangles not to scale, trust the math

An unknown Angle – Using Tangent

- If you look at the triangle we have **the opposite and adjacent sides**
- We want the **angle**
- So we have **two letters of TOA**, so were using $\boldsymbol{TANGENT}$



- Using the **TOA Ratio** from before:

$$Tan(\theta) = \frac{Opposite}{Adjacent} \quad \rightarrow \quad Tan(\theta) = \frac{7}{12}$$

- Then we can simplify the $\frac{7}{12}$ 1st

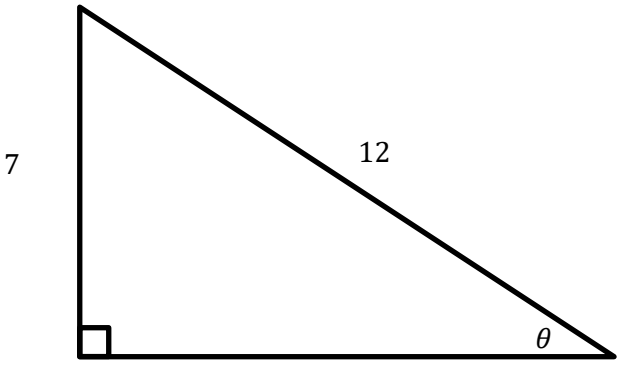
$$Tan(\theta) = 0.5833$$

- Then we use the inverse Tangent button

$$\theta = Tan^{-1}(0.5833) \quad \rightarrow \quad \mathbf{30.3°}$$

An unknown Angle – Using Sine

- If you look at the triangle we have **the opposite side and hypotenuse**
- We want the **angle**
- So we have **two letters of SOH**, so were using $\boldsymbol{SINE}$



- Using the **SOH Ratio** from before:

$$Sin(\theta) = \frac{Opposite}{Hypotenuse} \quad \rightarrow \quad Sin(\theta) = \frac{7}{12}$$

- Then we can simplify the $\frac{7}{12}$ 1st

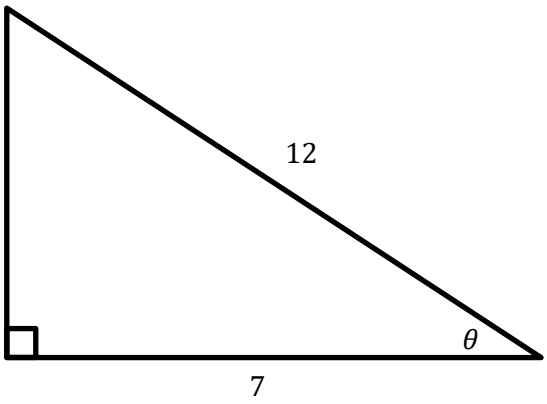
$$Sin(\theta) = 0.5833$$

- Then we use the inverse Sine button

$$\theta = Sin^{-1}(0.5833) \quad \rightarrow \quad \mathbf{35.7°}$$

An unknown Angle – Using Cosine

- If you look at the triangle we have **the adjacent side and hypotenuse**
- We want the **angle**
- So we have **two letters of CAH**, so were using $COSINE$



- Using the **CAH Ratio** from before:

$$Cos(\theta) = \frac{Adjacent}{Hypotenuse} \quad \rightarrow \quad Cos(\theta) = \frac{7}{12}$$

- Then we can simplify the $\frac{7}{12}$ 1st

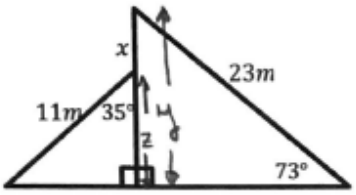
$$Cos(\theta) = 0.5833$$

- Then we use the inverse Sine button

$$\theta = Cos^{-1}(0.5833) \quad \rightarrow \quad \mathbf{54.3°}$$

Advanced Trigonometry of Right Angle Triangles

Solve for the desired side of the figure below (x), round to the nearest tenth.



$\cos\theta = \frac{adj}{hyp}$

$\cos 35° = \frac{z}{11}$

$z = 11 \cos 35°$

$z = 9.011\ m$

$\sin\theta = \frac{opp}{hyp}$

$\sin 73° = \frac{y}{23}$

$y = 23 \sin 73°$

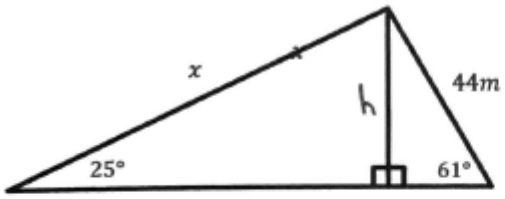
$y = 21.995\ m$

$x = y - z$

$= 21.995 - 9.011$

$= 12.984 = 13.0\ m$

Solve for the desired side of the figure below (x), round to the nearest tenth.



$\sin 61° = \frac{h}{44}$

$h = 44 \sin 61°$

$= 38.483\ m$

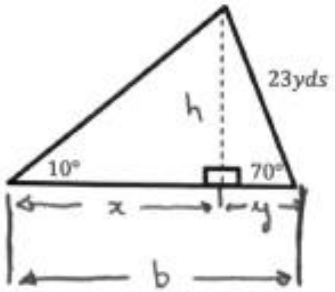
$\sin 25° = \frac{38.483}{x}$

$x = \frac{38.483}{\sin 25°}$

$x = 91.1\ m$

Find the area of the following triangles, round answers to the nearest tenth.

$$A = \frac{1}{2} b \cdot h$$



$\sin 70° = \frac{h}{23}$ $\quad$ $\cos 70° = \frac{y}{23}$

$h = 23 \sin 70°$ $\quad$ $y = 23 \cos 70°$

$h = 21.613$ yds $\quad$ $y = 7.866$ yds

$\tan 10° = \frac{21.613}{x}$ $\quad$ $b = x + y$

$= 122.573 + 7.866$

$x = \frac{21.613}{\tan 10°}$ $\quad$ $= 130.439$

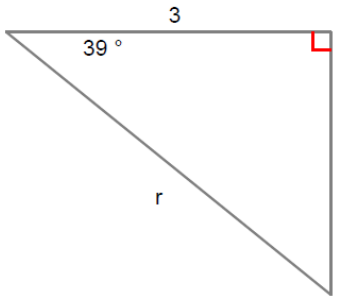
$x = 122.573$ yds $\quad$ $A = \frac{1}{2} b h$

$= \frac{1}{2}(130.439)(21.613)$

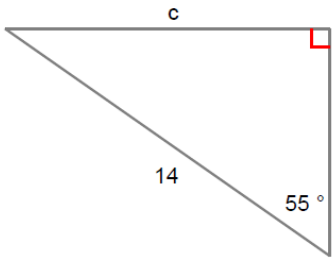
Section 4.2 – Practice Problems

Use your Trigonometric Ratios to solve for the desired side.

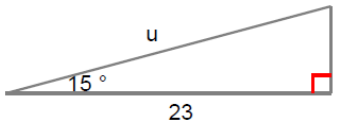
1. r = _____



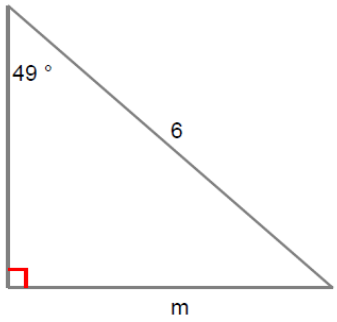
2. c = _____



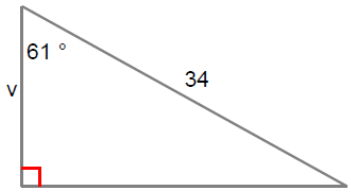
3. u = _____



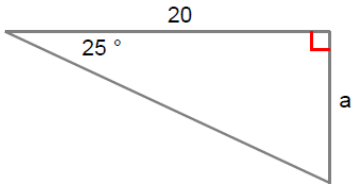
4. m = _____



5. v = _____

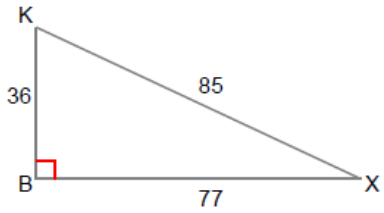


6. a = _____

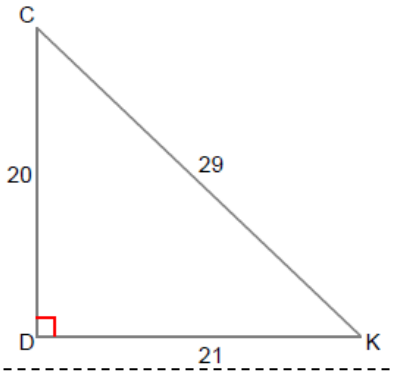


Find the measure of the indicated angle, to the nearest tenth of a degree.

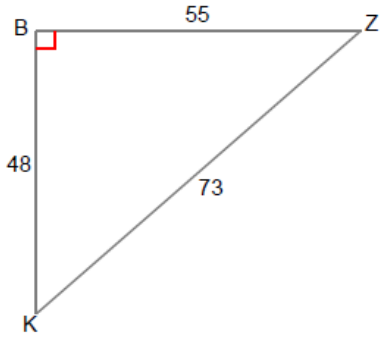
7. m∠K = _____ °



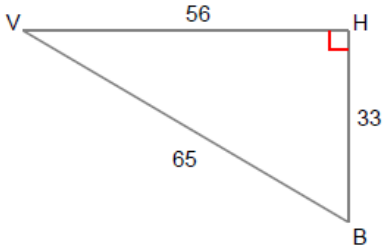
8. m∠K = _____ °



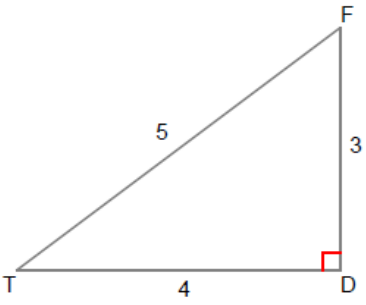
9. m∠K = _____ °



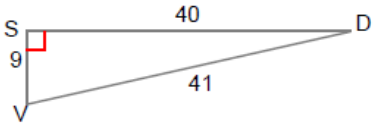
10. m∠V = _____ °



11. m∠F = _____ °

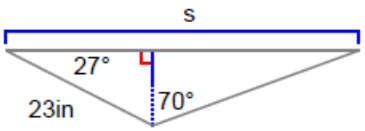


12. m∠D = _____ °

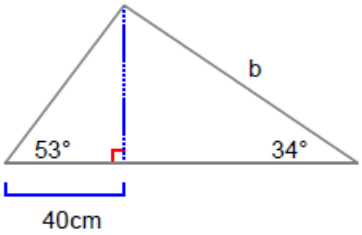


Find the length of the side denoted by a variable. Round answers to the nearest tenth.

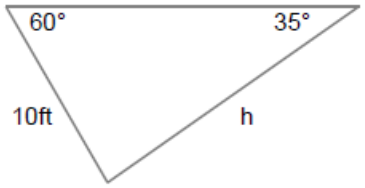
13. s = _____ in



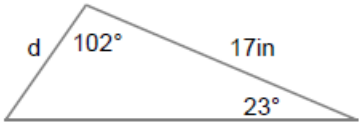
14. b = _____ cm



15. h = _____ ft

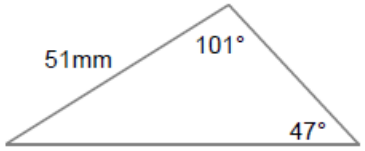


16. d = _____ in

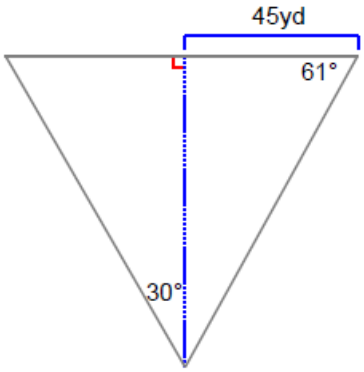


Find the area of the triangle. Round answers to the nearest tenth.

17. Area = _____ mm^2



18. Area = _____ yd^2

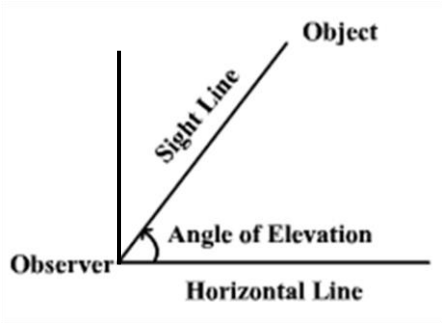


Section 4.3 – Applications of Trigonometric Concepts

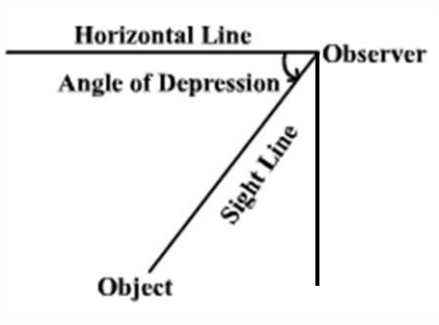
- As we move into more complex problems and word problems we need some terminology
- Trigonometry is used to calculate heights and distances that are difficult or impossible to measure by ordinary methods, these concepts will help

Terminology

Angle of Elevation

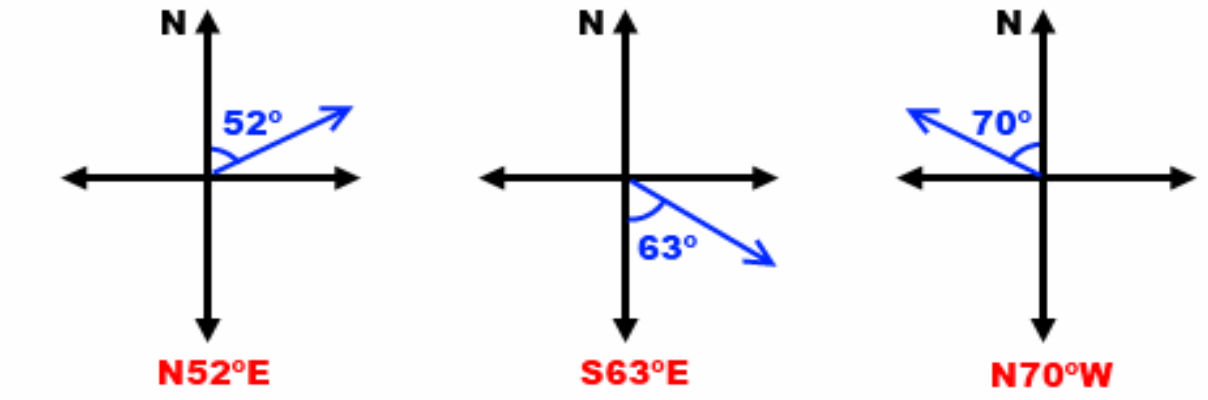


Angle of Depression



- Trigonometry was used primarily for **Navigation** in the past
- Bearings represent **direction of travel** and have to be read a certain way
- Bearings measure the **movement East and West** from a **fixed North-South line**

Bearings

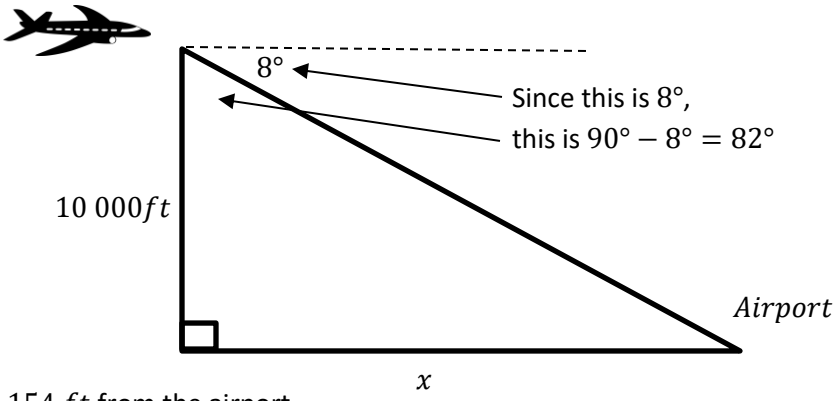


$(52° \; east \; of \; north)$ $(63° \; east \; of \; south)$ $(70° \; west \; of \; north)$

- With the following **tools and the information** from the previous sections, we should now be able to **tackle any questions** involving **triangles formed** with a **RIGHT ANGLE**

Example: A pilot has to approach Vancouver airport at an $8°$ angle of descent. IF the plane is travelling at an altitude of $10\ 000 ft$, what is the horizontal distance that the airplane should be at to begin its descent?

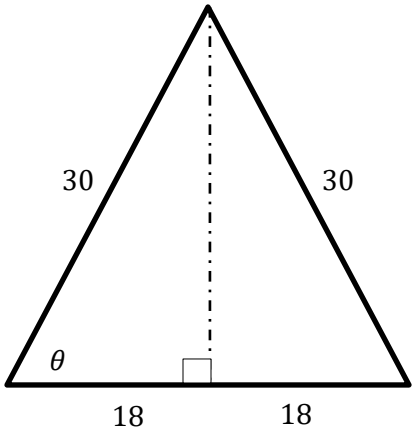
Solution:



- $Tan\ 82° = \frac{x}{10\ 000}$
- $10\ 000(Tan\ 82°) = x$
- $x = 71\ 154\ ft$
- The pilot should start descending $71\ 154\ ft$ from the airport.

Example: The **equal sides** of an **isosceles** triangle are $30cm$, and the third side is $36cm$. Determine the measure of the **interior angles** of the training.

Solution:



- $Cos\ \theta = \frac{18}{30}$
- $\theta = Cos^{-1}\left(\frac{18}{30}\right)$
- $\theta = 53.1°$
- The three angles are: $53.1°, 53.1°, and\ 73.8°$

Section 4.3 – Practice Problems

For the following questions, include a drawing of the concept being discussed. (Round to the tenth if necessary)

1. The area of a right triangle is 50. One of the angles is 45^{o} . Find the lengths of the legs and the hypotenuse of the triangle.

2. From the top of a 200 meters high building, the angle of depression to the bottom of a second building is 20 degrees. From the bottom of the building, the angle of elevation to the top of the second building is 10 degrees. Calculate the height of the second building.

3. Karla is riding vertically in a hot air balloon, directly over a point P on the ground. Karla spots a parked car on the ground at an angle of depression of 30^{o} . The balloon rises 50 metres. Now the angle of depression to the car is 35 degrees. How far is the car from point P?

4. After an hour of flying, a jet has covered 300*km*, but winds have blown it off course. The instruments on the plane show that it is 48*km* West of the planned flight path. By how many degrees if the plane off course?

5. Two boats take-off from the same spot. One travels due North for 320*km*, and the other due East for 450*km*. If the boat travelling East wanted to turn to travel to where the other boat stopped, what angle North of East should it turn?

6. Butch, who is 1.6*m* tall and works for the forestry department is tasked to measure the approximate height of some trees. The angle of inclination from his head to the tip of the tree is 48^{o} , and he is 7.2*m* from the tree. How tall is the tree?

Answer Key

Section 4.1

1. 0.2079
2. 1.5399
3. -0.5446
4. 0.8290
5. 0
6. $No\ Solution$
7. -0.8090
8. 0.0349
9. -1
10. 1
11. 0.7071
12. 0.7071
13. $60°$
14. $13.2°$
15. $47.4°$
16. $83.6°$
17. $89.2°$
18. $51.0°$
19. $34.2°$
20. $29.1°$
21. $51.3°$
22. $62.0°$
23. $6.4°$
24. $90.0°$
25. $a = bc$
26. $a = \frac{c}{b}$
27. $a = \frac{b-cd}{c}$
28. $a = \frac{d}{(b-c)}$
29. $a = \frac{d}{(b-c)}$
30. $a = \frac{bd}{c}$

Section 4.2

1. 3.86
2. 11.47
3. 23.81
4. 4.53
5. 16.48
6. 9.33
7. $64.9°$
8. $43.6°$
9. $48.9°$
10. $30.5°$
11. $53.1°$
12. $12.7°$
13. $49.1in$
14. $94.9cm$
15. $15.1ft$
16. $8.1in$
17. $924.8mm^2$
18. $3729.9yd^2$

Section 4.3

1. $H = 10, L = 10$
2. $96.9m$
3. $235m$
4. $9.2°$
5. $35.4°$
6. $9.6m$