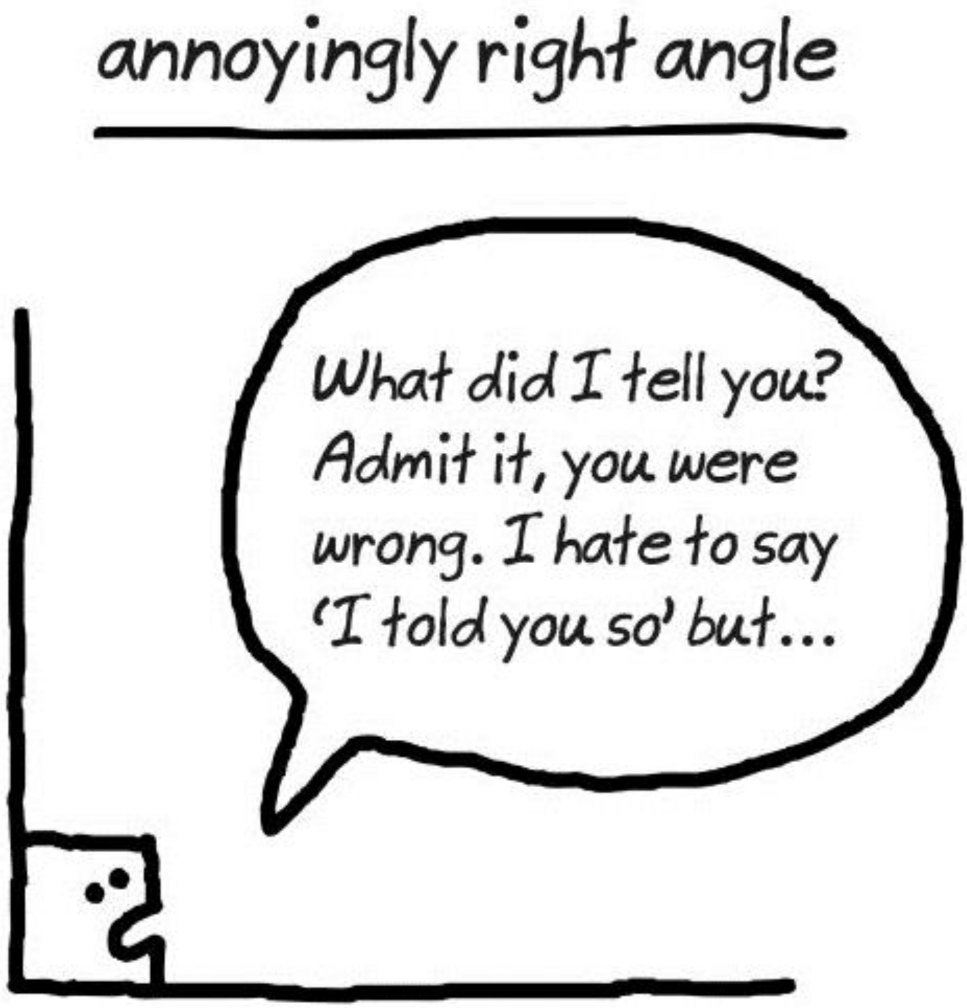

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Unit 4: Acute Angle Trigonometry

UNIT 4: ACUTE ANGLE TRIGONOMETRY – ESSENTIAL LEARNINGS

You will have at least three opportunities to demonstrate the essential learnings in this course. The first opportunity will occur during the unit with formative quizzes and homework checks. Your second opportunity will be on the unit test. Your third opportunity will be on the exam. You need to demonstrate all essential learnings to earn this credit.

Please take the opportunity to keep track of the essential learnings you've demonstrated during this unit using the checklist below.

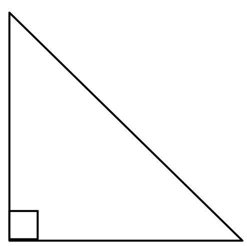
Essential Learnings: Solve Problems with Primary Trig Ratios, Sine Law, and Cosine Law	***Homework***	***Associated Lessons***
☐ Determine sides and angles in right angle triangles using primary trig ratios	*pg. 184* #1, 3, 5, 6 *pg. 194* #2, 4	Lesson 4.1
	pg. 189 – 190 #2, 4, 7, 10 *pg. 194 – 195* #1, 3, 5, 6	Lesson 4.2
☐ Solve real world problems involving the primary trig ratios	*pg. 190 – 191* #3, 4, 6, 7, 12, 17	Lesson 4.3
☐ Solve problems involving two right angle triangles in two dimensions	*pg. 200 – 201* #1 – 6, 8	Lesson 4.4
☐ Determine sides and angles in acute triangles using sine law and cosine law and solve real world problems	*pg. 207 – 208* #1ab, 2ab, 3 – 5, 8, 9, 11	Lesson 4.5
	pg. 214 – 215 #3, 4, 7, 8, 10	Lesson 4.6
☐ Describe the conditions for use of primary trig ratios, sine law, and cosine law	*worksheet*	Lesson 4.7
Unit Review:	*pg. 219 – 220* #4, 7, 10, 13 *pg. 222 – 223* #2, 4, 5, 7, 12, 14, 15 *pg. 224 – 225* #1 – 6, 8, 9, 11	

The Pythagorean Theorem and The Primary Trigonometric Ratios

A. Triangle Properties

- Recall that triangles are three-sided polygons with three angles whose sum is __________^{o}
- A right triangle has one "right" angle that measures ________^{o}
- An <u>angle</u> is named using an <u>uppercase letter</u>, and its corresponding *side* (the side opposite) is given the same *lowercase letter*. Larger angles have larger corresponding sides, which is why the hypoteneuse is the largest side on a right triangle – it is opposite the largest angle of 90^{o}!

Ex. 1: Label the corresponding sides and angles in the following right triangle, Δ *ABC*.

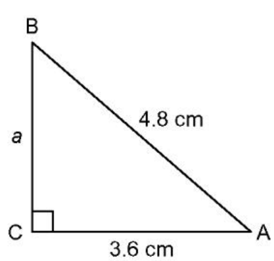


B. The Pythagorean Theorem

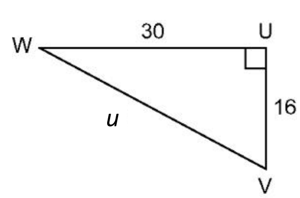
- Recall the **Pythagorean Theorem**, in the words of the Scarecrow from *The Wizard of Oz*: "The square of the hypoteneuse of a right triangle is equal to the sum of the squares of the other two sides." Translate this into a mathematical statement using sides *a, b*, and *c*, where *c* is the hypoteneuse:

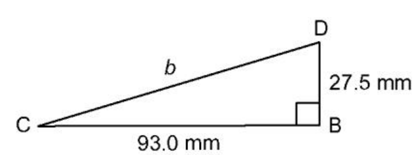
Ex. 2: Determine the measure of the unknown side in each triangle. Round answers to one decimal place.

a)

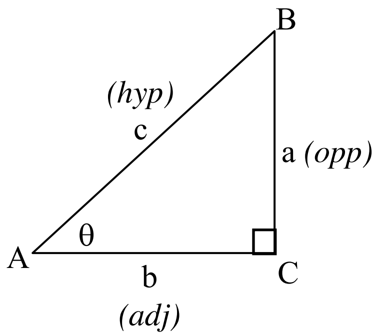


b)





C. The Primary Trigonometric Ratios for Right Triangles

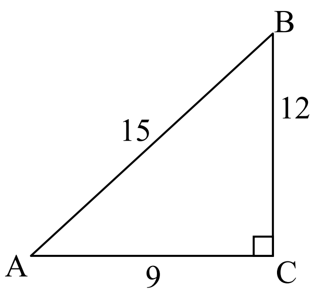


$$\sin\theta = \frac{opposite}{hypotenuse}$$

$$\cos\theta = \frac{adjacent}{hypotenuse}$$

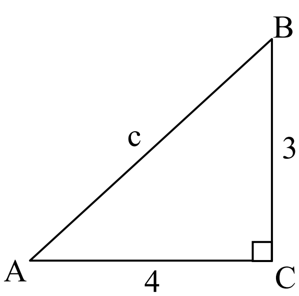
$$\tan\theta = \frac{opposite}{adjacent}$$

Ex. 3: State the three primary trigonometric ratios for $\angle A$ and find the measure of $\angle A$.



$\sin\angle A =$ $\cos\angle A =$ $\tan\angle A =$

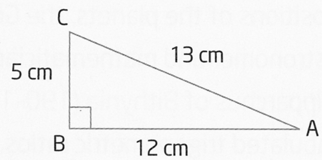
Ex. 4: Solve the following triangle. Round your answers to the nearest tenth of a unit, if necessary.



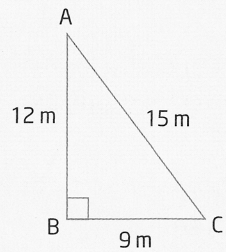
HW: p. 184 # 1, 3, 5, 6; p. 194 # 2, 4

1. Copy each right triangle. Label the hypotenuse and the opposite and the adjacent sides relative to ∠A. Then, find the sine, cosine, and tangent ratios for ∠A. Express the ratios as fractions in lowest terms.

a)



b)



3. Use your calculator to evaluate each trigonometric ratio. Round to four decimal places.

a) sin 40° **b)** cos 54° **c)** tan 82°

d) tan 46° **e)** sin 17.1° **f)** cos 76°

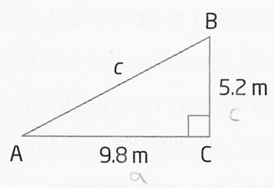
5. Determine the measure of each angle, to the nearest degree.

a) sin X = 0.7314 **b)** cos B = 0.6972 **c)** tan Y = 1.9970

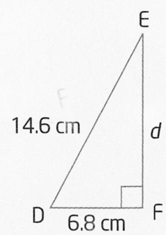
d) sin A = 0.9397 **e)** cos B = 0.9397 **f)** tan Y = 3.7321

6. Determine the measure of the unknown side in each triangle. Round answers to the nearest tenth of a unit.

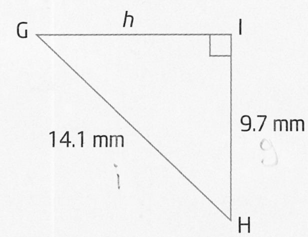
a)



b)

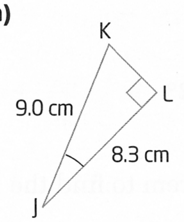


c)

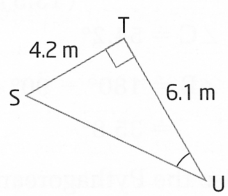


2. Find the measure of the marked angle, to the nearest degree.

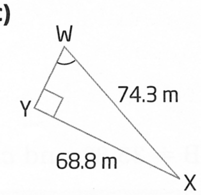
a)



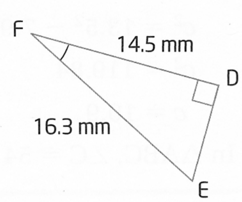
b)



c)

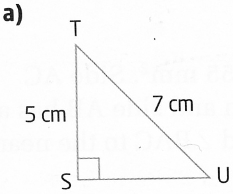


d)

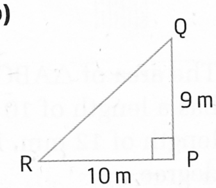


4. Solve each triangle. Round your answers to the nearest tenth of a unit.

a)



b)

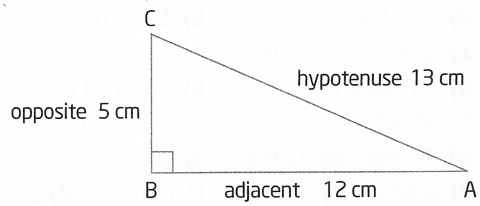


c) In △HIJ, ∠I = 90°, $i = 1.5$ m, and ∠J = 21°.

d) In △BCD, ∠C = 90°, $b = 12.0$ cm, and $d = 13.5$ cm.

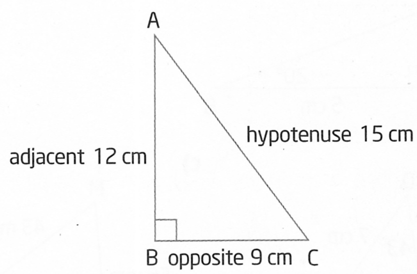
e) In △LMN, ∠M = 90°, $l = 9.6$ m, and ∠N = 34.2°.

1. a)



$\sin A = \frac{5}{13}$ $\cos A = \frac{12}{13}$ $\tan A = \frac{5}{12}$

b)



$\sin A = \frac{3}{5}$ $\cos A = \frac{4}{5}$ $\tan A = \frac{3}{4}$

3. a) 0.6428 **b)** 0.5878 **c)** 7.1154
d) 1.0355 **e)** 0.2940 **f)** 0.2419

5. a) 47° **b)** 46° **c)** 63°
d) 70° **e)** 20° **f)** 75°

6. a) 11.1 m **b)** 12.9 cm **c)** 10.2 cm

2. a) 23° **b)** 35°
c) 68° **d)** 27°

4. a) $\angle T \doteq 44.4°$, $\angle U \doteq 45.6°$, and $t \doteq 4.9$ cm
b) $\angle Q \doteq 48.0°$, $\angle R \doteq 42.0°$, and $p \doteq 13.5$ m
c) $\angle H \doteq 69°$, $h \doteq 1.4$ m, and $j \doteq 0.5$ m
d) $\angle B \doteq 41.6°$, $\angle D \doteq 48.4°$, and $c \doteq 18.1$ cm
e) $\angle L \doteq 55.8°$, $m \doteq 11.6$ m, and $n \doteq 6.5$ m

Applying The Primary Trigonometric Ratios – Extra Practice

A. Solving for a Side Length

- if the unknown variable is in the numerator of the ratio, **multiply both sides by the denominator** to isolate the variable

Ex. 1: $\tan 72° = \frac{y}{6.1}$

- if the unknown variable is in the denominator of the ratio, **set up a proportion and cross-multiply** to isolate the variable

Ex. 2: $\sin 58° = \frac{18.8}{x}$

B. Solving for an Angle

- to solve for an angle when the ratio is known, take the inverse trig operation of both sides

Ex. 3: $\cos C = \frac{7.9}{13.5}$

HW: p. 189-190 # 2, 4, 7, 10; p. 194-195 # 1, 3, 5, 6

Applying the Primary Trigonometric Ratios to Angles of Elevation and Depression

A. Angle of Elevation

- the angle between the horizontal and the line of sight *UP* to an object
- also called the **angle of inclination**

Ex. 1: Bensen is playing his rock harmonica before an adoring crowd! From a height of 1.7 m, his sightline forms an angle of elevation of 43^{o} to the nearest spotlight. If the distance directly from his eye to the spotlight is 12.3 m, how high is the spotlight above the ground?

B. Angle of Depression:

- the angle between the horizontal and the line of sight *DOWN* to an object
- also called the **angle of declination**

Ex. 2: Sarah is on horseback riding towards the stable, when her horse stops to graze. From a height of 2.6 metres, Sarah's sightline makes an angle of depression of 6^{o} to the threshold of the stable. How far are they from the stable?

HW: p. 190-191 # 3, 4, 6, 7, 12, 17

3. Draw the triangle. Then, find the lengths of all unknown sides. Round answers to the nearest tenth of a unit.

a) In $\triangle ABC$, $\angle A = 90°$, $\angle B = 40°$, and $a = 15$ cm.

b) In $\triangle PQR$, $\angle P = 90°$, $\angle R = 60°$, and $p = 10$ cm.

c) In $\triangle DEF$, $\angle F = 90°$, $\angle E = 70°$, and $e = 8.4$ cm.

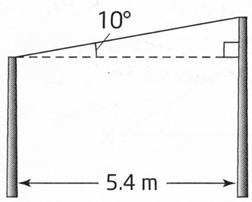
d) In $\triangle WXY$, $\angle Y = 90°$, $\angle W = 30.5°$, and $x = 3.4$ m.

4. The angle of depression from the top of a ski hill to the bottom is 24.6°. The length of the hill was measured at 168 m.

a) Draw a diagram to represent this situation. Label fully.

b) What is the drop in altitude of the ski hill, to the nearest metre?

6. A steel cable is attached to two posts that are 5.4 m apart, at an angle of inclination of 10°.



a) Which trigonometric ratio can you use to calculate the length of the cable? Explain.

b) How long is the cable, to the nearest tenth of a metre?

7. The angle of elevation from Eric to the top of a tree is 68.3°. He is standing 4.5 m from the base of the tree.

a) Which trigonometric ratio can you use to calculate the height of the tree? Explain.

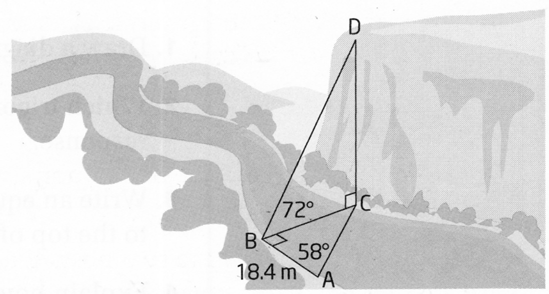
b) Ignoring Eric's height, how tall is the tree, to the nearest tenth of a metre?

12. An airplane is flying at an altitude of 2000 m. The angle of depression from the airplane to a landmark on the ground is 12°.

a) What is the airplane's horizontal distance to the landmark, to the nearest metre?

b) What is the airplane's direct distance to the landmark, to the nearest metre?

17. The diagram shows the readings that were taken in order to determine the height of a cliff on the other side of a river. What is the height of the cliff, to the nearest tenth of a metre?



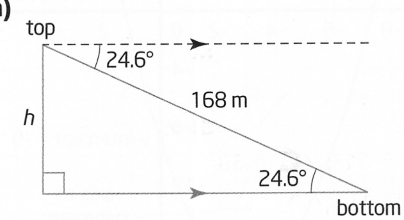
3. a) Diagrams may vary. b is 9.6 cm; c is 11.5 cm

b) Diagrams may vary. p is 8.7 cm; q is 5 cm

c) Diagrams may vary. f is 8.9 cm; d is 3.1 cm

d) Diagrams may vary. y is 3.9 cm; w is 2.0 cm

4. a)



b) 70 m

6. a) 11.1 m **b)** 12.9 cm **c)** 10.2 cm

7. a) $x = 58°$ **b)** $b = 70°$

c) $m = 45°$; $n = 65°$

12. a) 9409 m **b)** 9619 m

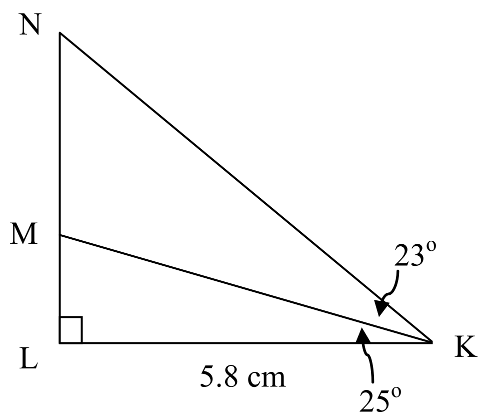
17. 90.6 m

Solving Problems Involving Two Right Triangles

Strategies for Solving Problems Involving Two Triangles

- Start by drawing a well-labelled diagram.
- In more complex problems, you may want to break the diagram into parts, separating the triangles.
- Problems involving two triangles can often be solved by finding a side length or angle in one triangle, then translating that information to the other triangle (*i.e.* the side is shared; the angle is shared or complementary or supplementary; one side makes up a portion of the other side; etc.)

Ex. 1: Find the length of side MN.

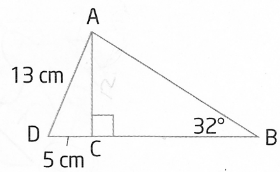


HW: p. 200-201 # 1-6, 8. (Use the examples from p. 198-199 to help you!)

For help with questions 1 and 2, refer to Example 1.

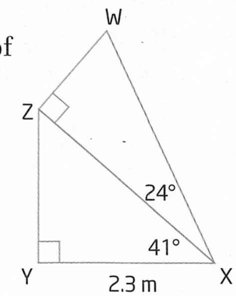
1. **a)** Outline a plan to determine the length of side BC.

   b) Carry out your plan. Round your answer to the nearest centimetre.



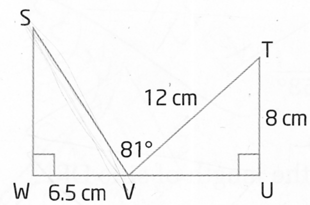
2. **a)** Outline a plan to determine the length of side WZ.

   b) Carry out your plan. Round your answer to the nearest tenth of a metre.



3. **a)** Outline a plan to determine the length of side SV.

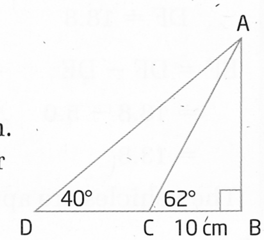
   b) Carry out your plan. Round your final answer to the nearest tenth of a centimetre.



For help with questions 4 and 5, refer to Example 3.

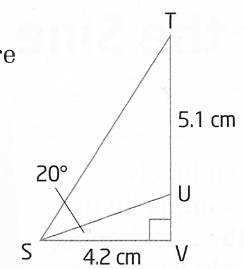
4. **a)** Outline a plan to determine the length of side DC.

   b) Carry out your plan. Round your answer to the nearest centimetre.



5. **a)** Outline a plan to determine the measure of ∠TSU.

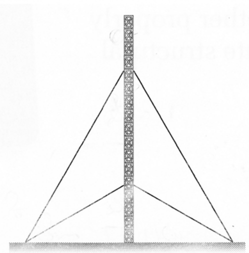
   b) Carry out your plan. Round your answer to the nearest degree.



6. A radio tower is supported by four cables, as shown. The cables are anchored to the ground on each side at points 10 m from the base of the tower. The angle of inclination of the shorter cables is 30°. The angle of inclination of the longer cables is 60°. The installers must determine the distance between the points where the pairs of cables are attached to the tower.

   a) Explain the steps to solve this problem.

   b) Carry out your plan. Round your answer to the nearest tenth of a metre.



8. A salvage vessel locates a sunken ship 168 m below the water's surface. It determines that the angle of depression to one end of the ship is 47.6° and to the other end is 65.1°. Determine the length of the ship, to the nearest metre.

1. a) First, use the Pythagorean theorem in $\triangle ADC$ to solve for the length of AC. Next, in $\triangle ABC$ use the value of AC obtained and the given angle in a tangent ratio to solve for the length of BC.

b) 19 cm

2. a) First, use the cosine ratio in $\triangle XYZ$ to solve for the length of the hypotenuse, XZ. Next, in $\triangle WXZ$, use the value of XZ obtained and the given angle in a tangent ratio to solve for the length of WZ.

b) 1.4 m

3. a) First, use an inverse sine ratio in $\triangle TUV$ to solve for the measure of $\angle TVU$. Next, use the straight angle to find the measure of $\angle WVS$. Finally, in $\triangle SVW$ use the value obtained for the angle in a cosine ratio to find the length of SV.

b) 12.0 cm

4. a) First, use the tangent ratio in $\triangle ABC$ to solve for the length of AB. Next, in $\triangle ABD$ use the value obtained in a tangent ratio to find the length of BD. Finally, subtract 10 from the length of BD to find the length of DC.

b) 12 cm

5. a) First, in $\triangle SUV$, use the tangent ratio to find the length of UV. Next, add the length obtained to the given length of TU to find the length of TV. Next, in $\triangle STV$, use an inverse tangent ratio to find the measure of $\angle TSV$. Finally, subtract the given measure for $\angle USV$ from the calculated angle for $\angle TSV$ to obtain the measure of the requested angle.

b) 38°

6. a) First, ignore the lower cables and use the tangent ratio to find the height up the tower to attach the upper cables. Next, use the triangles formed by the ground and the lower cables to find the height up the tower to attach the lower cables. Finally, subtract the lower height from the upper height to find the distance between the points where the cables are to be attached.

b) 11.5 m

8. 75 m

The Sine Law

The Sine Law is an expansion of a fundamental trig ratio into a law that can be used on any triangle (non-right triangles included)! It states that the sines of the angles of a triangle are proportional to the lengths of their opposite sides.

The Sine Law can be written in two forms, as the relationship represents a proportion. It is easiest to solve a proportion when **the unknown is in the numerator**, so when the unknown is an angle, use the first form, and when the unknown is a *side length*, use the *second form*.

The Sine Law

$$\frac{\sin A}{a} = \frac{\sin B}{b} = \frac{\sin C}{c}$$

or

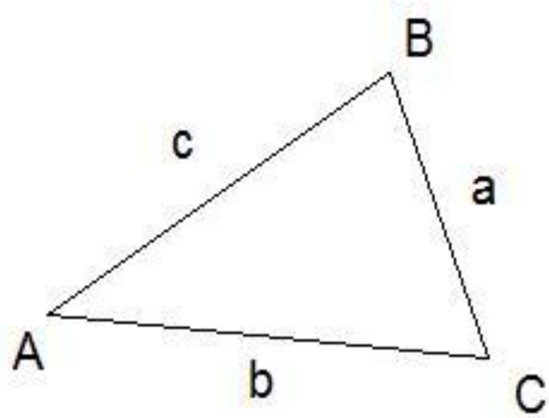
$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

When can we use the *Sine Law*?

1. When we are given **two angles and a side** for an acute triangle. (We use the angle sum of 180^o to find the third angle, and then set up a proportion to find any side we want!)

2. When we are given **two sides and an angle opposite one of them**. (We set up a proportion to find the second angle.)

*Basically, we can use the **Sine Law** when we have a* **corresponding side-angle pair plus one other piece of information** *about the triangle.*



1. Two Angles and a Side

Solve ΔPQR, where R = 68°, Q = 69°, and p = 21 cm

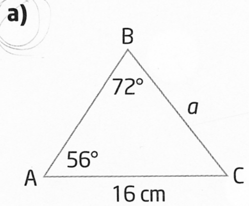
2. Two Sides and an Angle Opposite One of Them

Solve ΔABC, where B = 75°, a = 8.3 cm, and b = 10.4 cm

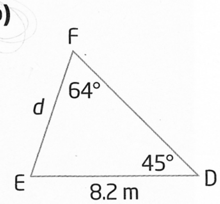
HW: p. 207-208 #1ab, 2ab, 3, 4, 5, 8, 9, 11

1. Find the length of the indicated side in each triangle, to the nearest tenth of a unit.

a)

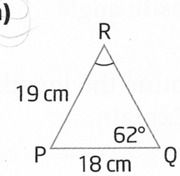


b)

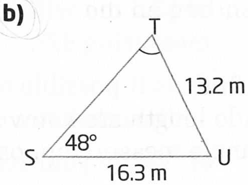


2. Find the measure of the marked angle, to the nearest tenth of a degree.

a)

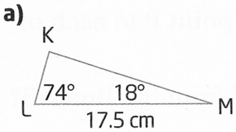


b)

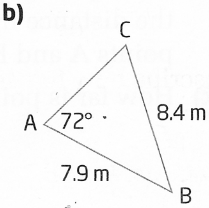


3. Solve each triangle. Round your answers to the nearest tenth of a unit, if necessary.

a)



b)

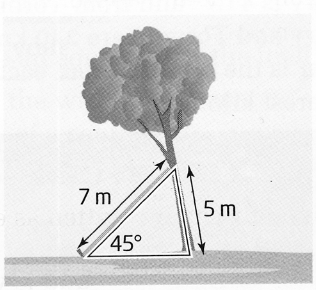


4. Sketch then solve each triangle. Round your answers to the nearest tenth of a unit, if necessary.

a) In $\triangle RST$, $\angle R = 37°$, $r = 16$ cm, and $\angle S = 64°$.

b) In $\triangle PQR$, $\angle P = 59°$, $q = 140.1$ m, and $p = 164.2$ m.

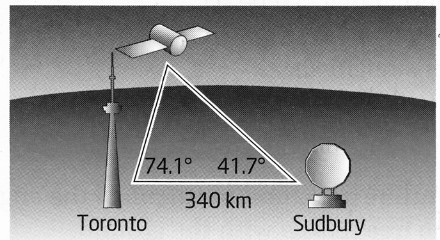
5. A 7-m long post supports a tree at a point 5 m up the trunk. The post makes an angle of 45° with the ground.



a) Outline a method to calculate the angle the tree makes with the ground.

b) Use your method to calculate the angle the tree makes with the ground, to the nearest degree.

8. As a satellite orbits around Earth, it is sighted between the cities of Sudbury and Toronto. Its angle of elevation from Sudbury is 41.7° and from Toronto is 74.1°. Sudbury and Toronto are 340 km apart. How far is the satellite from each city, to the nearest kilometre?



B

9. A communication satellite is between two receiving towers. The angle of elevation from tower A is 78.2° and from tower B is 83.6°. The towers are 2140 m apart. How far is the communication satellite from each tower, to the nearest metre?

11. Two ranger stations are 100 km apart. A fire is located between the two ranger stations at an angle of 46° from Lawrence Station and 69° from Nelson Station. Which station is closer to the fire? Justify your answer.

1. a) 13.9 cm **b)** 6.5 m
c) 113.5 mm **d)** 26.5 cm

2. a) 56.8° **b)** 66.6 ° **c)** 54.9° **d)** 71.2°

3. a) $\angle K = 88°$; $l \doteq 16.8$ cm; $m \doteq 5.4$ cm
b) $\angle B \doteq 44.6°$; $\angle C \doteq 63.4°$; $b \doteq 6.2$ m

4. a) $\angle T = 79°$; $s \doteq 23.9$ cm; $t \doteq 26.1$ cm
b) $\angle Q \doteq 47.0°$; $\angle R \doteq 74.0°$; $r \doteq 184.1$ m

5. a) The measure of an angle opposite a known side in a triangle and also the measures of another angle and its opposite side are needed. Use the sine law to set up and solve an equation for the requested angle.
b) 82°

8. 363 km from Sudbury, 251 km from Toronto

9. approximately 6809 m from tower A, 6707 m from tower B

10. longer side approximately 176 m, shorter side approximately 117 m

11. Nelson Station

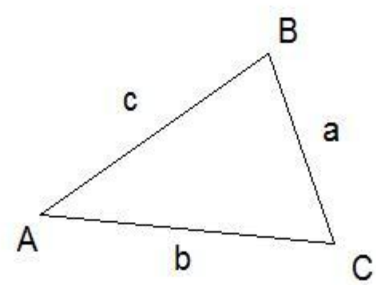
The Cosine Law

The Cosine Law is another expansion of a fundamental trig ratio into a law that can be used on any triangle (non-right triangles included)! It represents a general version of the Pythagorean Theorem, adapted to non-right triangles. It can also be rearranged to solve for the unknown angle.

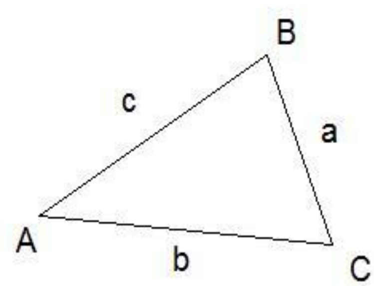
The Cosine Law	***Rearranged to Solve for the Angle***
$c^2 = a^2 + b^2 - 2ab\cos C$	$\angle C = \cos^{-1}\left(\frac{a^2 + b^2 - c^2}{2ab}\right)$

When do we use the *Cosine Law*?

1. When we are given two sides and a contained angle, and we want to find the side opposite the angle.



2. When we are given three sides, and we want to find any other angle. (When given a choice, find the largest angle first!)



1. Two Sides and a Contained Angle

Solve ΔPQR, where R = 121°, p = 32 cm, and q = 27 cm

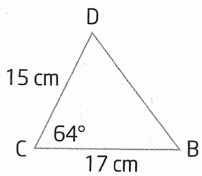
2. Three Sides

Solve ΔDEF, where d = 41 cm, e = 32 cm, and f = 21 cm

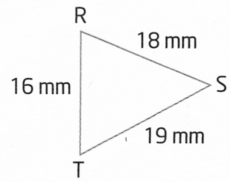
HW: p. 214-215 #3, 4, 7, 8, 10

3. Solve each triangle using the cosine law. Round your answers to the nearest tenth of a unit.

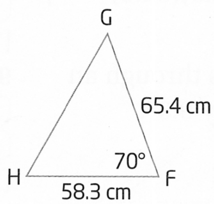
a)



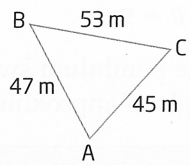
b)



c)



d)



4. Sketch then solve each triangle using the cosine law. Round your answers to the nearest tenth of a unit.

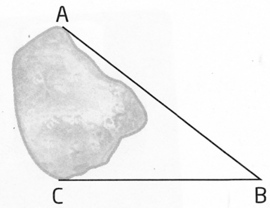
a) In $\triangle ABC$, $BC = 16$ cm, $AC = 18$ cm, and $\angle C = 70°$.

b) In $\triangle PQR$, $PQ = 25$ mm, $PR = 19$ mm, and $QR = 23$ mm.

c) In $\triangle XYZ$, $XY = 40.6$ m, $XZ = 38.9$ m, and $YZ = 12.7$ m.

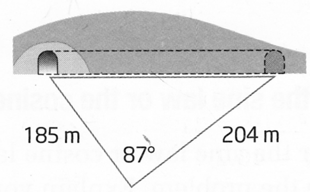
d) In $\triangle JKL$, $JK = 21.2$ cm, $JL = 24.7$ cm, and $\angle J = 46.2°$.

7. To measure the length of a pond, a surveyor places stakes at points A, B, and C and measures AB to be 23.1 m, BC to be 19.4 m, and $\angle B$ to be 38.5°.



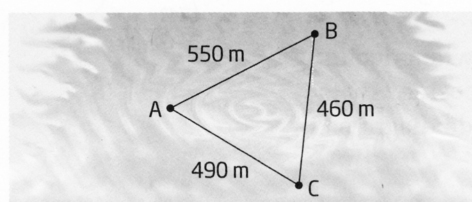
What is the length of the pond, to the nearest tenth of a metre?

8. In order to plan a tunnel through a mountain, a surveyor makes the measurements shown.



Use the surveyor's measurements to determine the length of the tunnel to the nearest metre.

10. The three markers in a triangular sailing course are shown in the diagram. The instructors would like each of the angles to be less than 70°. Will this design be appropriate? Justify your answer.



3. a) $\angle B \doteq 52.4°$; $\angle D \doteq 63.6°$; $c \doteq 17.0$ cm

b) $\angle R \doteq 67.7°$; $\angle S \doteq 51.2°$; $\angle T \doteq 61.1°$

c) $\angle G \doteq 50.3°$; $\angle H \doteq 59.7°$; $f \doteq 71.2$ m

d) $\angle A \doteq 70.3°$; $\angle B \doteq 53.1°$; $\angle C \doteq 56.6°$

4. a) $\angle A \doteq 50.3°$; $\angle B \doteq 59.7°$; $c \doteq 19.6$ cm

b) $\angle P \doteq 61.3°$; $\angle Q \doteq 46.4°$; $\angle R \doteq 72.3°$

c) $\angle X \doteq 18.2°$; $\angle Y \doteq 73.3°$; $\angle Z \doteq 88.5°$

d) $\angle K \doteq 77.0°$; $\angle L \doteq 56.8°$; $j \doteq 18.3$ cm

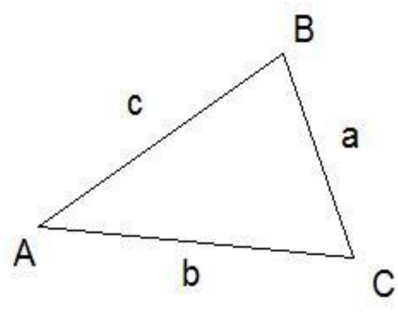
7. 7.4 m

8. 363 km from Sudbury, 251 km from Toronto

10. longer side approximately 176 m, shorter side approximately 117 m

Whose Law is it Anyway?

1. Write the **Sine Law** and the **Cosine Law** for ∆ABC:



2. Describe the conditions that guide when it is appropriate to use the Sine Law, the Cosine Law, the Sum of Interior Angles, the Primary Trig Ratios (SOH CAH TOA), and the Pythagorean Theorem.

3. Decide whether the unknown in each defending triangle can be determined using the **Sine Law**, **Cosine Law**, **SOHCAHTOA**, **Sum of Interior Angles**, **Pythagorean Theorem** or **Insufficient Evidence**. Complete the chart to discover the general conditions that guide the use of each.

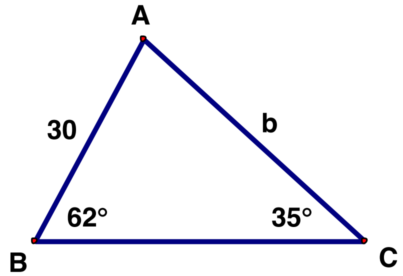
Name of Δ	Find	Given	Given	Given	State the law required and the formula, using the correct letters.
ΔABC	b				
ΔPQR	p				
ΔDEF	∠F				
ΔTUV	u				
ΔXYZ	y				
ΔGHJ	h				
ΔNSW	∠N				
ΔKLM	∠K				

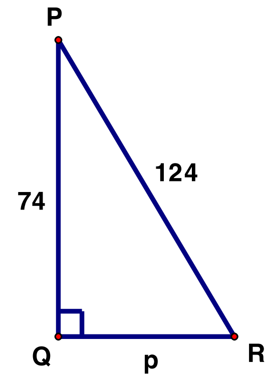
HW: WORKSHEET – "Whose Law is it Anyway?"

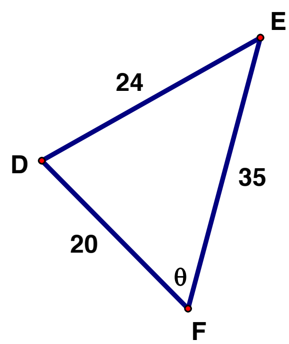
 Name: ________________________

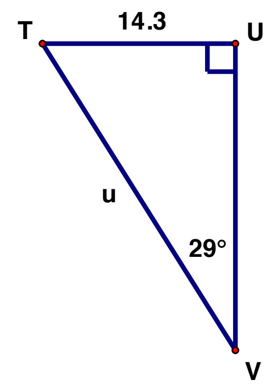
WORKSHEET – “Whose Law is it Anyway?”

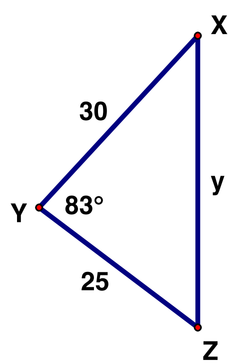
Solve the following triangles. Round angles to the nearest degree and sides to the nearest tenth of a unit.

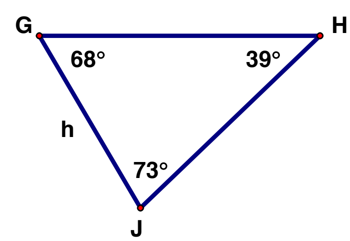


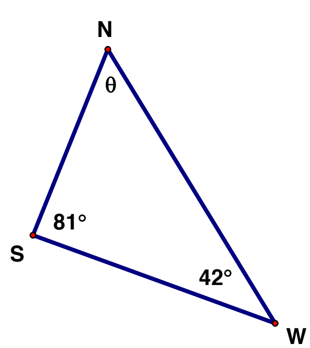


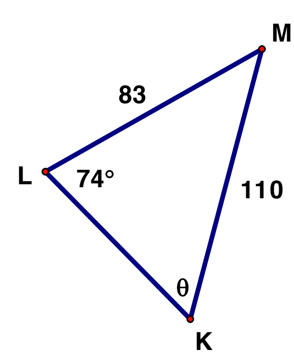










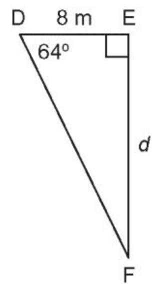


Review for Unit 4 Test

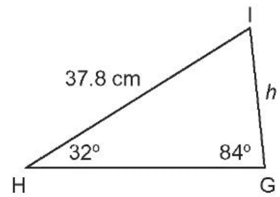
Representative Questions for Review:

1) Find the indicated side lengths in the following triangles, rounded to the nearest tenth:

a)

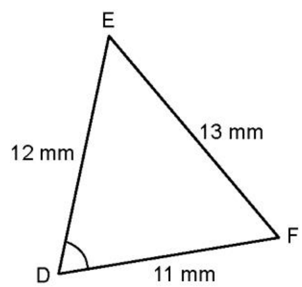


b)

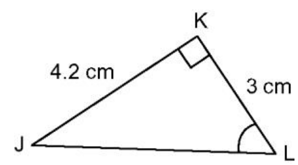


2) Find the indicated angles in the following triangles, rounded to the nearest degree:

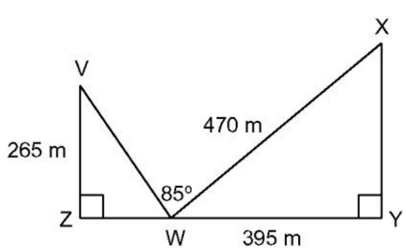
a)



b)



3) Determine the length of side VW, rounding your answer to the nearest metre.



Textbook review questions:

p. 219-220 # 4, 7, *10, 13

p. 222-223 # 2, 4, 5, 7, 12, 14, *15

p. 224-225 # 1-6, 8, 9, 11

4. A steel plate is to have three holes drilled in it. The centres of two of the holes are to be 10 cm apart. The third hole is to be 16 cm from each of the other two.

   a) Draw a diagram to model this situation.

   b) What are the angle measures formed by these three holes?

7. In $\triangle JKL$, $\angle L = 40°$, $\angle K = 72°$, and $k = 24$ cm. Determine the perimeter of the triangle to the nearest centimetre.

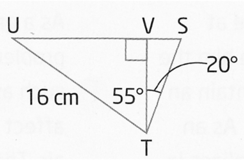
10. A regular octagon has a perimeter of 48 cm. What is the length of each diagonal?

13. A 15-m tall tree is leaning to one side. At a point 3 m from the top of the tree, it is supported by an 11.5-m long pole. The pole is anchored to the ground 5 m from the base of the tree. At what angle is the tree leaning, relative to the vertical?

2. The angle of elevation to the sun is 65°. A building casts a shadow that is 16 m long. What is the height of the building, to the nearest metre?

4. A laser light, placed 16 m from the base of a wall, shines at a point on the wall that is 7 m up from the ground. At what angle of inclination should the light be set? Round to the nearest tenth of a degree.

5. Determine the length of side TS, to the nearest centimetre.



7. A communication tower is fixed to the top of a building. From a point 10 m from the base of the building, the angle of elevation to the top of the building is 60°, and to the top of the tower is 68°. What is the height of the communication tower, to the nearest tenth of a metre?

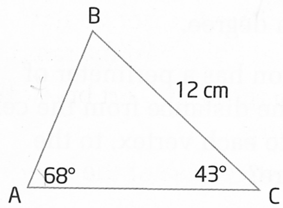
12. An airplane is 50 km from a tracking station. A second airplane is 70 km away. The angle formed by the airplanes at the tracking station is 47°. What is the distance between the airplanes, to the nearest kilometre?

14. A triangular piece of wood is to be cut with side lengths of 5 cm, 6 cm, and 7 cm. What angle measurements does the carpenter need to draw? Round answers to the nearest tenth of a degree.

15. A regular pentagon has a perimeter of 35 cm. What is the distance from the centre of the pentagon to each vertex, to the nearest centimetre?

For questions 1 to 4, select the best answer.

1. Which trigonometric tool can be used to find the length of side AB?



A tangent ratio

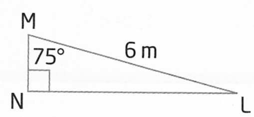
B sine law

C cosine law

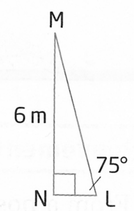
D cosine ratio

2. A 6-m ladder is leaning against a wall so that the ladder's angle of inclination is 75°. Which diagram models this situation?

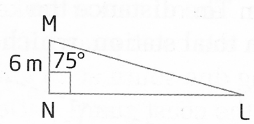
A



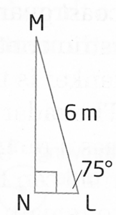
B



C



D



3. The result when evaluating

$\cos^{-1}\left(\dfrac{6^2 + 7^2 - 5^2}{2(6)(7)}\right)$ is

A 45.6°

B 44.4°

C 135.6°

D error

4. Which statement is true?

A The angles of elevation and depression are measured from the vertical.

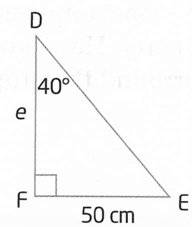
B The sum of the angles of elevation and depression always equals 90°.

C The angle of elevation from point D to the top of a building plus the angle of depression from point D to the base of the building equals 90°.

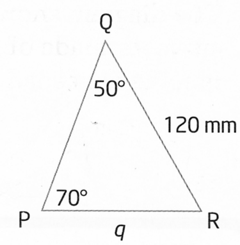
D The angle of elevation from point A to point B equals the angle of depression from point B to point A.

5. Find the length of the indicated side, to the nearest tenth of a unit.

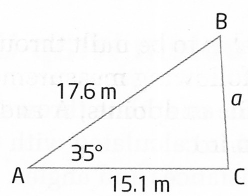
a)



b)

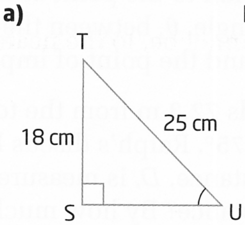


c)

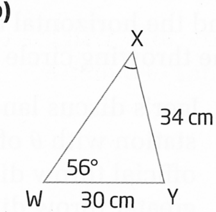


6. Find the measure of the marked angle, to the nearest degree.

a)



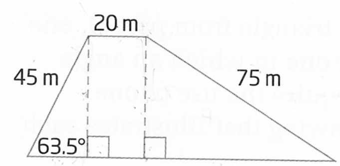
b)



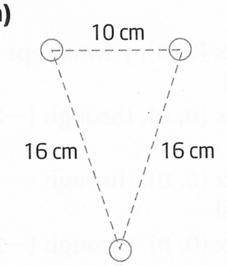
8. A ship is sailing toward a 50-m tall lighthouse. The angle of elevation from the ship to the top of the tower is 20°. How far is the ship from the lighthouse, to the nearest metre?

9. A wheelchair ramp is to have an angle of inclination of 5°. The ramp needs to rise 1.2 m. Determine the horizontal length and the surface length of the ramp, to the nearest tenth of a metre.

11. The diagram shows the measurements a surveyor made of a property. How much fencing is needed to surround the property?



4. a)



b) approximately 36.4°

7. 64 cm

10. 15.7 cm

13. 17.8° from plumb

2. 34 m

4. 23.6°

5. 9.8 cm

7. 7.4 m

12. 51 km

14. 44.4°, 78.5°, 57.1°

15. 6 cm

1. B

2. D

3. B

4. D

5. a) 59.6 cm **b)** 97.8 mm **c)** 10.1 m

6. a) 46° **b)** 47°

7. 54°

8. 137 m

9. surface length ≐ 13.8 m;
horizontal length ≐ 13.7 m

10. 37°

11. 243.35 m