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VISION 5 From right triangles to trigonometric relations

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Answer key for "Vision 5" Reproducible sheets 30

Name: _____

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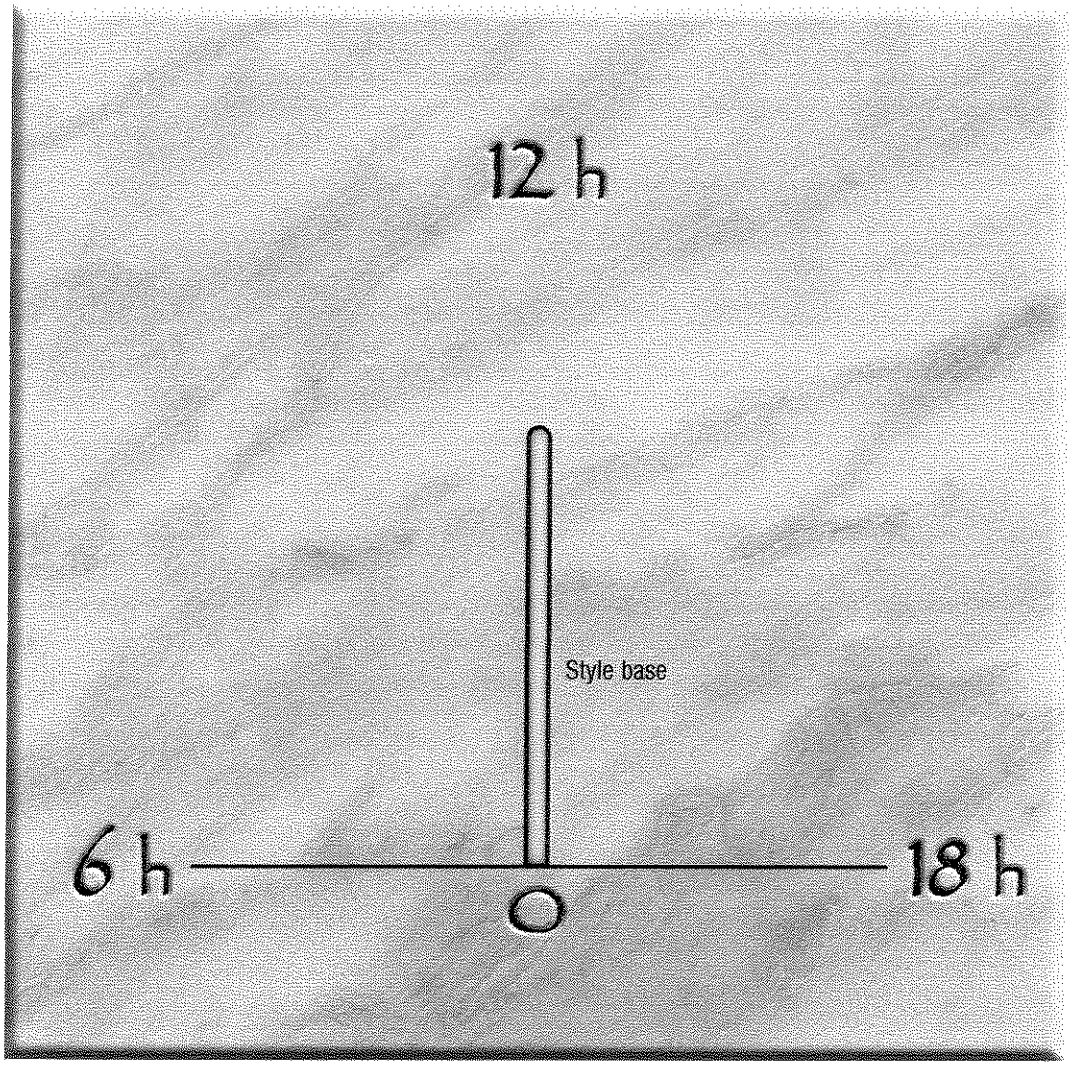
LES 10

Student Book, p. 189

LES 10 – Measuring time

After determining the angles of each hour line, create the dial plate for a sundial that could be used in the region where you live.



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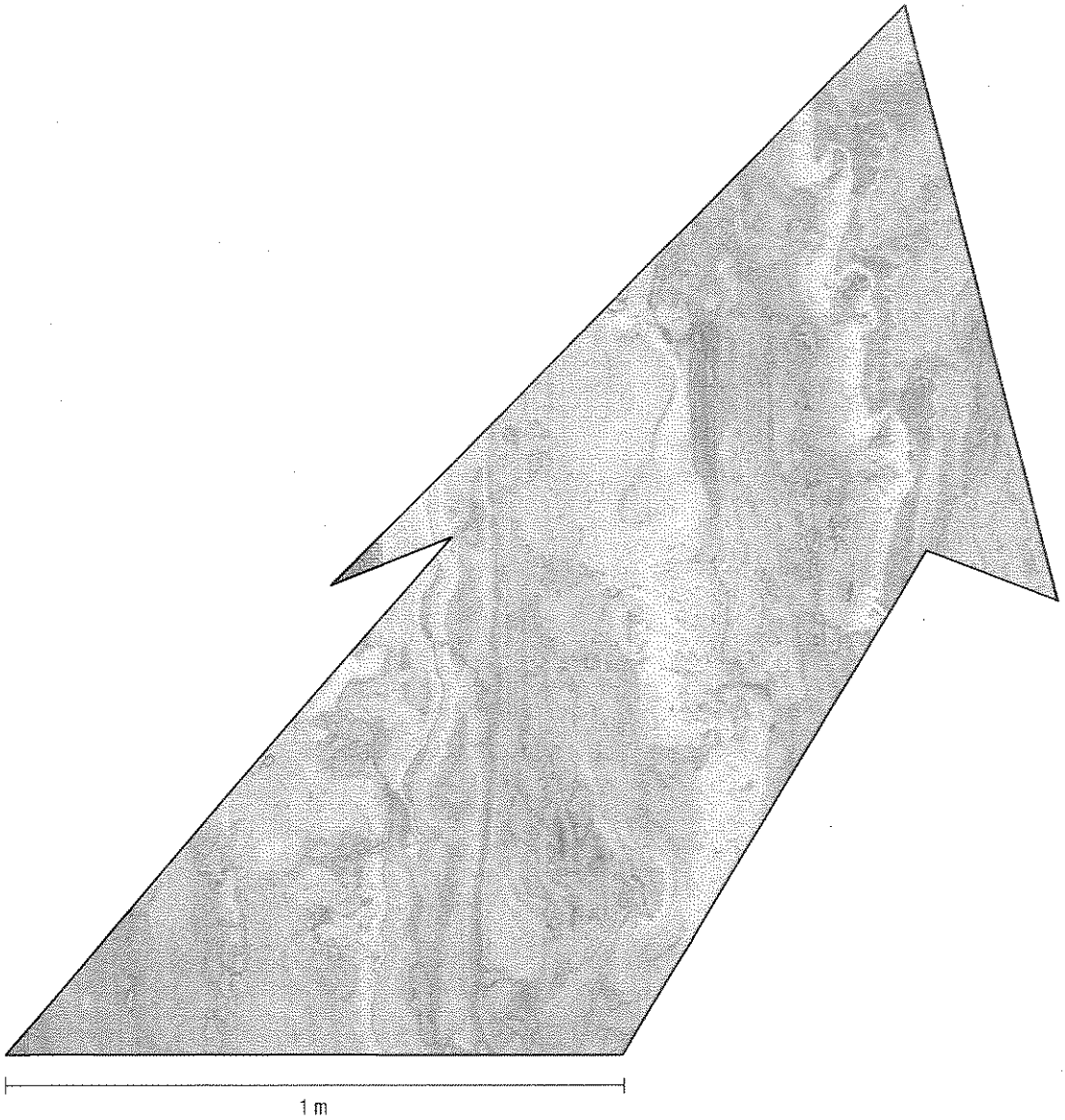
LES 11

Student Book, p. 190

LES 11 – Measuring pressure

Format A

View from above



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Name: _____

Group: _____ Date: _____

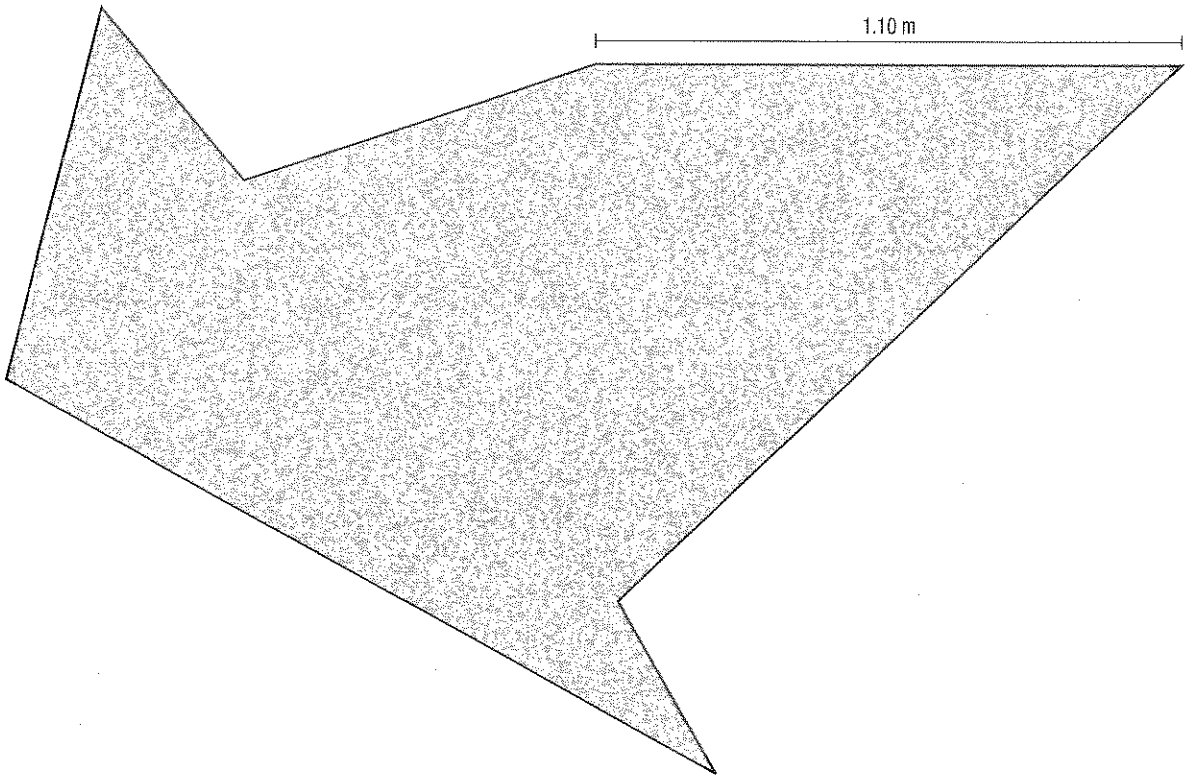
LES 11

Student Book, p. 190
(*cont'd*)

LES 11 – Measuring pressure

Format B

View from below



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SUPPORT 5.1

Trigonometric ratios

1 Match each of the statements in the column on the left with the appropriate answer from the column on the right.

1. Ratio of the length of the side adjacent to an acute angle of a right triangle to the length of its hypotenuse. _____
2. Ratio of the length of the side opposite of an acute angle of a right triangle to the length of the side adjacent to this angle. _____
3. Ratio of the length of the side opposite an acute angle of a right triangle to the length of its hypotenuse. _____

A. Acute angle
B. Obtuse angle
C. Cosine of an angle
D. Pythogorean relation
E. Sine of an angle
F. Tangent of an angle

2 a) Considering that each of the following are right triangles, find the measurement of:

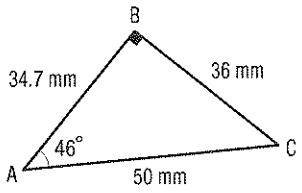
1) the side opposite angle A
2) the side adjacent to angle A
3) the hypotenuse

b) Calculate, without using your calculator's SIN, COS and TAN keys, the ratio corresponding to:

1) the sine of angle A
2) the cosine of angle A
3) the tangent of angle A

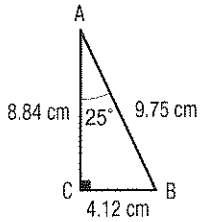
c) Check your answers in b) using your calculator's SIN, COS and TAN keys.

1.



a) 1) _____ 2) _____ 3) _____
b) 1) _____ 2) _____ 3) _____
c) 1) _____ 2) _____ 3) _____

2.



a) 1) _____ 2) _____ 3) _____
b) 1) _____ 2) _____ 3) _____
c) 1) _____ 2) _____ 3) _____

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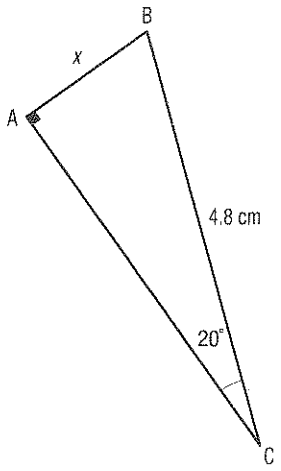
3 Consider the adjacent triangle ABC.



a) Using a calculator, find the value for the sine of 20°.

_____

b) Write the equation that can be deduced using the answer obtained in the preceding question and the information provided in the figure.

_____

c) Solve this equation.

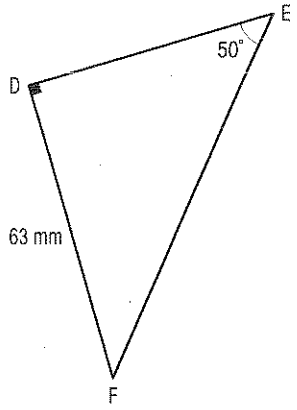
_____

d) Find m ∠ B and m $\overline{AC}$.

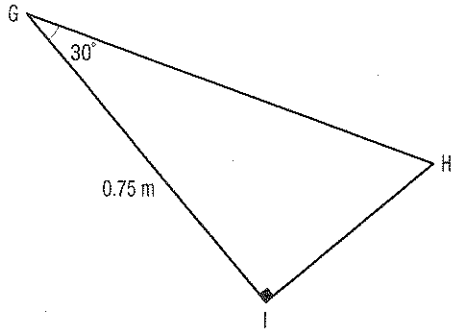
_____

e) Solve the two triangles below using an approach similar to one previously used.

1



2



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_____ _____

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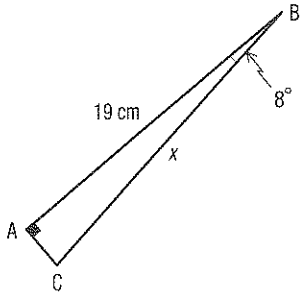
CONSOLIDATION 5.1

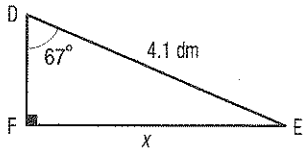
Trigonometric ratios

1 Find the measurement represented by the variable x in each of the triangles below.

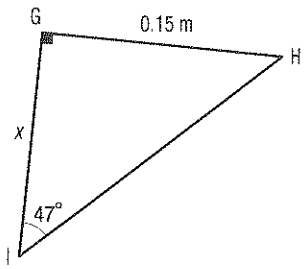
a)



b)



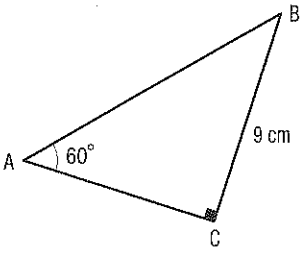
c)



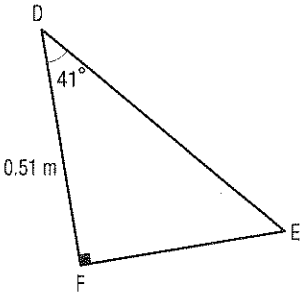
_____ _____ _____

2 Solve each of the triangles below.

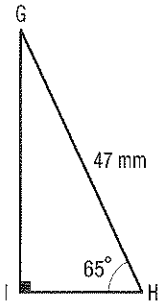
a)



b)



c)



_____ _____ _____

_____ _____ _____

_____ _____ _____

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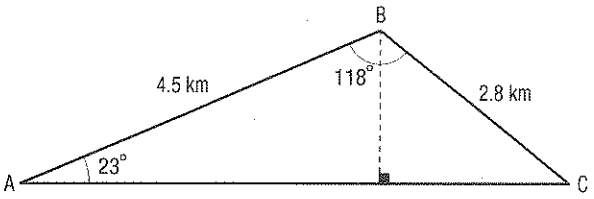
Group: _____ Date: _____

3 A person walks from point A to point C, passing through point B. The diagram below illustrates this situation. According to the information provided, what distance separates point A from point C?



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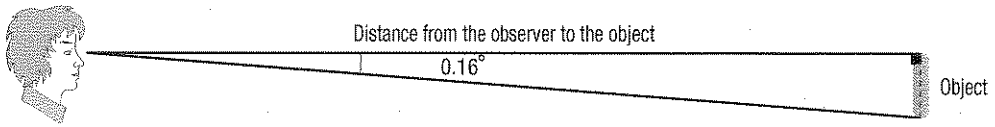
4 The human eye cannot make out objects whose size subtends an angle inferior to 0.16°. The diagram below illustrates this situation.



a) What is the size of the smallest object an individual can discern if the individual is:

1) 50 cm from the object? _____

2) 3.5 m from the object? _____

3) 50 km from the object? _____

b) In this context, what is the maximum distance an individual can be from an object in order to discern it, if it measures:

1) 1 mm? _____

2) 2 cm? _____

3) 15 m? _____

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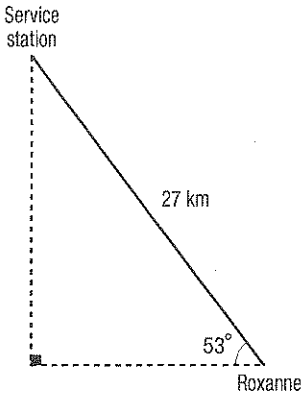
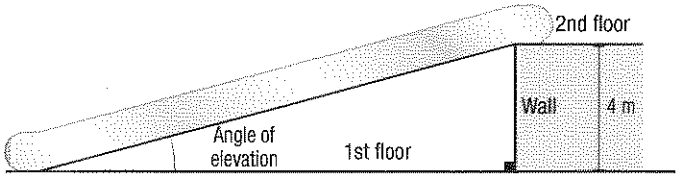
5 Roxanne's snowmobile uses 1 L of gas to travel 11 km. Roxanne has to follow the route represented by the dotted line in the adjacent diagram in order to get to the closest service station. If the snowmobile's tank holds 3.5 L of gas, will Roxanne get to the station before running out of gas? Justify your answer.



6 As shown in the adjacent illustration, a moving walkway has been installed in a shopping centre so that clients can move between the first and second floors. Safety standards require that the walkway's angle of elevation does not exceed 15°.



a) What is the shortest possible distance between the wall and the base of the walkway?

b) What can the shortest length be for the moving walkway?

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ENRICHMENT 5.1

Trigonometric ratios

1 **a)** Calculate the following using a calculator.

1) $(\sin 20°)^2 + (\cos 20°)^2$ _____

2) $(\sin 60°)^2 + (\cos 60°)^2$ _____

3) $(\sin 45°)^2 + (\cos 45°)^2$ _____

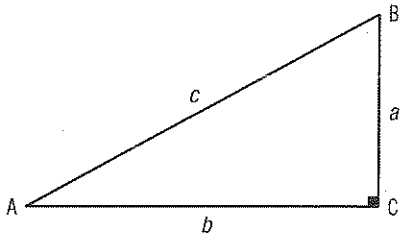
4) $(\sin 85°)^2 + (\cos 85°)^2$ _____

b) What conjecture can you formulate based on the results obtained in **a)**?

_____

_____

c) In order to demonstrate this conjecture, complete a proof while referring to triangle ABC below:



1. According to trigonometric ratios you have:

   $\sin A = \frac{a}{c}$, therefore $a = c \times \sin A$

   $\cos A = \frac{b}{c}$, therefore $b =$ _____

2. Pythagorean theorem additionally shows that:

   _____

3. By substituting the expressions obtained in Step **1** for a and b, you have:

   $(c \times \sin A)^2 +$ _____ $= c^2$

4. You will get the following if you continue to simplify the equation algebraically:

   _____ $+ c^2 \times (\cos A)^2 = c^2$

5. By removing a common factor, you get:

   $c^2 \times ($_____ $+$ _____$) = c^2$

6. In order for the equality to be true, you obtain the following:

   $(\sin A)^2 +$ _____ $=$ _____

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Group: _____ Date: _____

PRACTICE 5.2

Student Book, p. 96

Number 4

4 The table below provides some information on several right triangles ABC with a right angle located at vertex C. Complete the table.

	Length of side adjacent to angle A (cm)	Length of side opposite to angle A (cm)	Length of hypotenuse (cm)	Measurement of angle A (°)	Measurement of angle B (°)
Triangle ①	12		35		
Triangle ②		30	60		
Triangle ③	11.4	15.5			
Triangle ④	45.76			30	
Triangle ⑤			0.45		27
Triangle ⑥	34.5	46	57.5		

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SUPPORT 5.2

Finding missing measurements

1 Calculate the value of each of the following expressions.

a) $\sin^{-1} 0.95$ _____

b) arccos 0.12 _____

c) arcsin 0.5 _____

d) $\tan^{-1} 0$ _____

e) $\cos^{-1} 1$ _____

f) $\arctan\left(\frac{2.2 \text{ cm}}{1.1 \text{ cm}}\right)$ _____

2 Complete the table below.

Expression	Translation	Result
arcsin 0.5	Find the measurement of an angle which has a sin of 0.5.	30°
$\tan^{-1} 232$		
	Find the measurement of an angle for which the cosine is 0.67.	
arctan 0.5		
	In a right triangle, find the measurement of an angle so that the ratio of $\frac{\text{the length of the side adjacent to this angle}}{\text{length of the hypotenuse}}$ is 0.17.	
$\sin^{-1} 0.3$		
	In a right triangle, find the measurement of an angle so that the ratio of $\frac{\text{the length of the side opposite to this angle}}{\text{length of the side adjacent to this angle is 0.17.}}$ is 1.	

3 Find the value of x for each of the expressions below.

a) $\tan x = 20$ _____

b) $\cos x = \frac{1}{3}$ _____

c) $\sin(20° + x) = 0.5$ _____

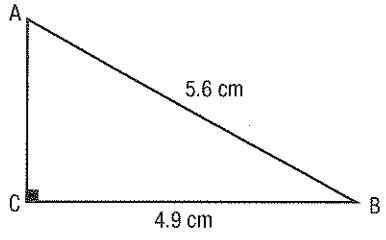
d) $\sin x = 1$ _____

e) $\tan x = \frac{3}{2}$ _____

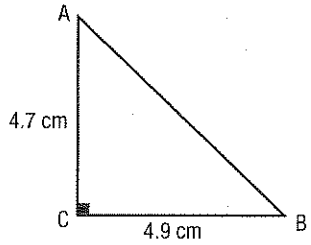
f) $\cos 2x = 0.5$ _____

4 Find the measurement of angle B for each of the triangles below.

a)



b)



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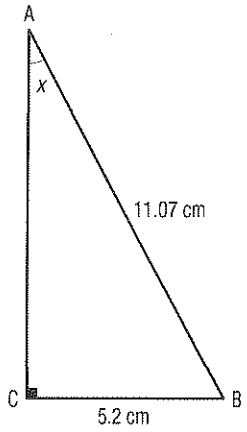
5 Indicate one of the properties specific to a right triangle containing an angle of 30°.

_____

_____

6 Consider the adjacent triangle ABC.



a) What trigonometric ratio associated with angle A relates the two measurements provided in the figure?

_____

b) What is this ratio?

_____

c) What equation can be formulated using the answers given in **a)** and **b)**?

_____

d) Solve this equation using your calculator's arcsin function.

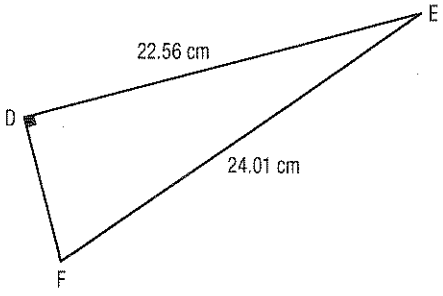
_____

e) Calculate m $\angle$ B and m $\overline{AC}$.

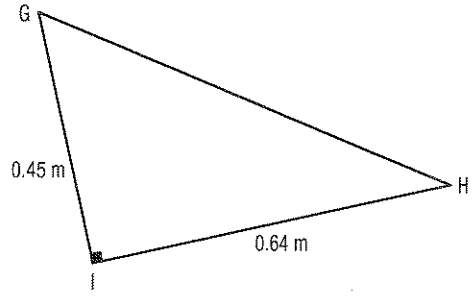
_____

f) Solve the two triangles below using an approach similar to one used above.

1



2



_____ _____

_____ _____

_____ _____

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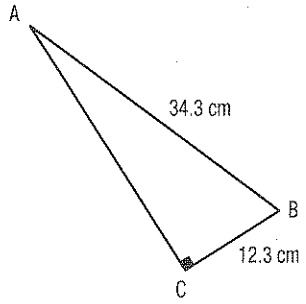
Group: _____ Date: _____

CONSOLIDATION 5.2

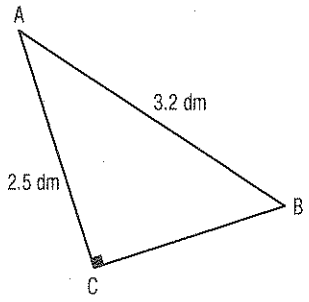
Finding missing measurements

1 Calculate the measurement of angle A for each of the triangles below.

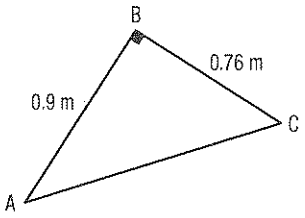
a)



b)



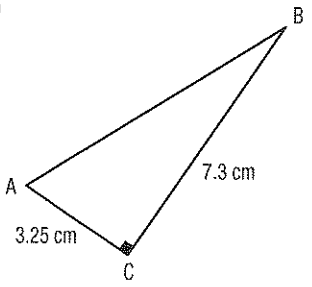
c)



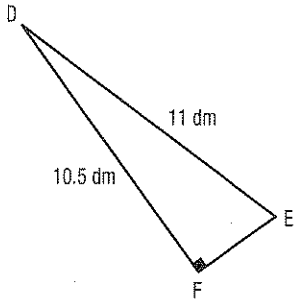
m ∠ A _____ m ∠ A _____ m ∠ A _____

2 Solve each of the triangles below.

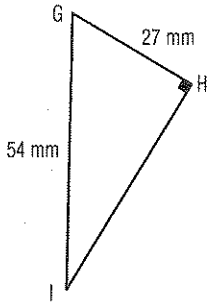
a)



b)



c)



_____ _____ _____

_____ _____ _____

_____ _____ _____

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Group: _____ Date: _____

3 Considering that Triangles A, B, C and D below are right triangles, indicate those which contain an angle measuring 30°. Explain your answers.

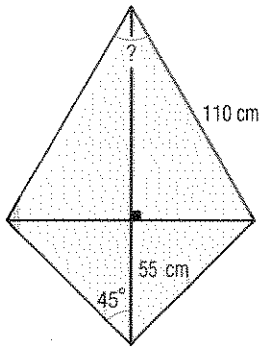
	Lengths of the three sides
Triangle A	3 cm, 5.2 cm, 6 cm
Triangle B	35.97 dm, 13.6 dm, 33.3 dm
Triangle C	115.2 mm, 103 mm, 154.53 mm
Triangle D	0.97 m, 1.12 m, 0.56 m

_____

_____

_____

4 Adele constructed the kite shown in the adjacent diagram. Calculate the following:



a) the measure of the angle at the upper end of the kite

_____

b) the kite's perimeter

_____

c) the kite's area

_____

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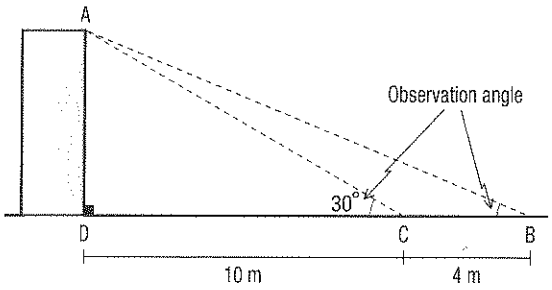
CONSOLIDATION 5.2

(cont'd)

5 An individual standing 10 m from the base of a building measures the observation angle which permits this individual to see the top of the building. The individual steps back 4 m and measures the angle for a second time. What observation angle is used to take the second measurement?



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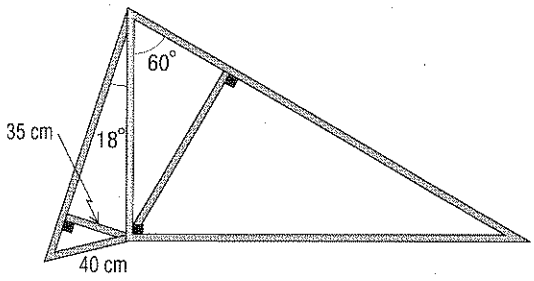
6 A roof truss is shaped as illustrated below. Using the information provided, calculate the total length of wood required to build the roof truss.



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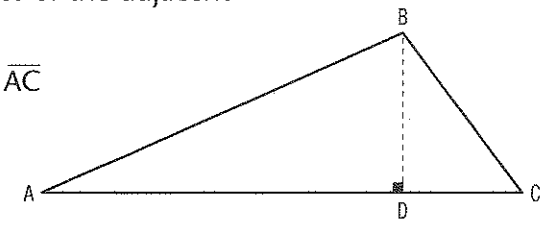
ENRICHMENT 5.2

Finding missing measurements

1 Find the measurements for the interior angles of the adjacent triangle ABC if:

a) m $\overline{CD} = \frac{1}{4} \times$ m $\overline{AC}$ and m $\overline{BD} = \frac{1}{3} \times$ m $\overline{AC}$



b) m $\overline{BD} = \frac{1}{2} \times$ m $\overline{AB}$ and m $\overline{BC} = \frac{3}{5} \times$ m $\overline{AB}$

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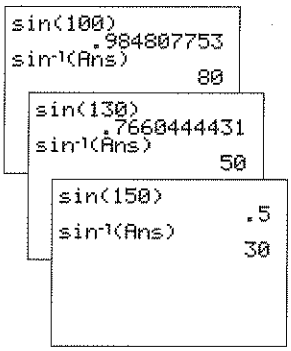
SUPPORT 5.3

Calculating the area of any triangle

1 The calculator screens shown in the adjacent illustration display several calculations involving the sine of an angle.

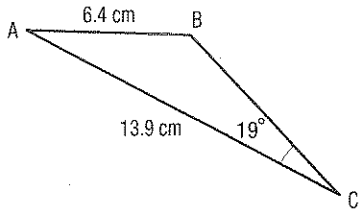


a) What property of supplementary angles is demonstrated by these screens?

_____

_____

b) The adjacent triangle ABC has an obtuse angle B. Using the sine law, write an equation which allows you to find m ∠ B, then solve the equation.



_____

c) Does the answer found in **b)** seem valid? Justify your answer.

_____

d) Modify your answer using the property stated in **a)**.

_____

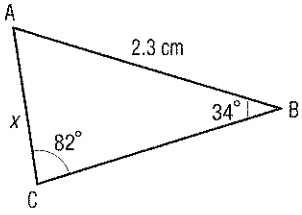
e) What must you consider when looking for the measurement of a missing angle using the sine law?

_____

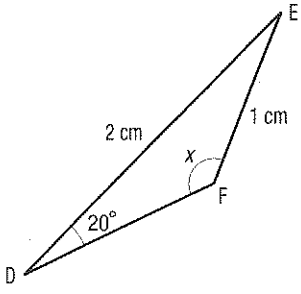
_____

2 Find the measurement represented by the variable *x* for each of the triangles below.

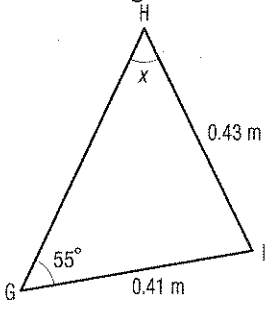
a)



b)



c)



_____ _____ _____

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SUPPORT 5.3

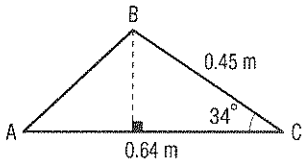
(cont'd)

3 Consider the triangles shown below.

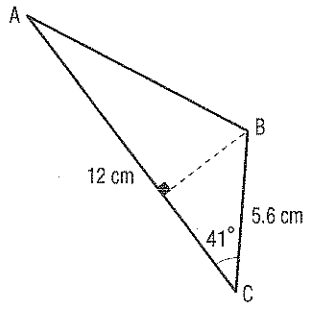
a) Calculate:

1) the length of the altitude originating in angle B
2) the area of triangle ABC using the formula $A = \frac{\text{base} \times \text{height}}{2}$

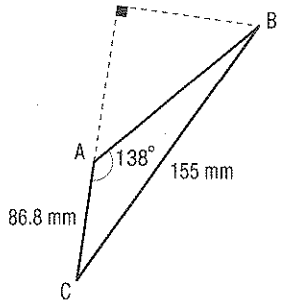
A



B



C



1) _____ 1) _____ 1) _____

2) _____ 2) _____ 2) _____

b) Write the formula which allows you to perform this procedure in a single step.

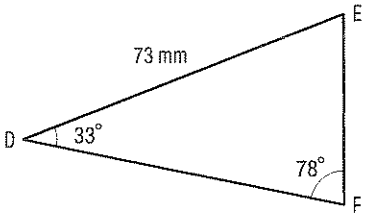
_____

4 **a)** Solve the adjacent triangle DEF.

_____

_____

_____



b) Calculate the triangle's half-perimeter.

_____

c) Calculate the triangle's area using Hero's formula.

_____

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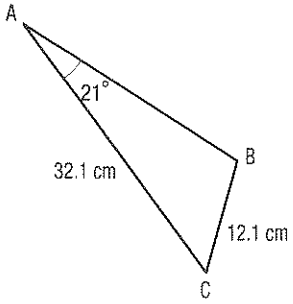
CONSOLIDATION 5.3

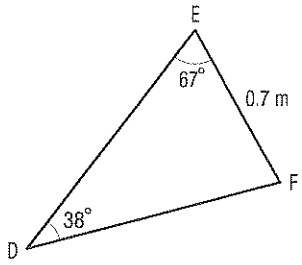
Calculating the area of any triangle

1 Solve each of the triangles below.

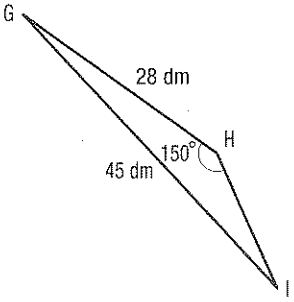
a)



b)



c)



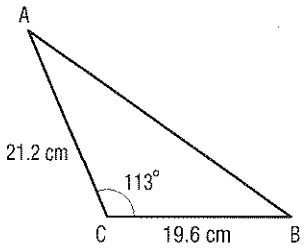
_____ _____ _____

_____ _____ _____

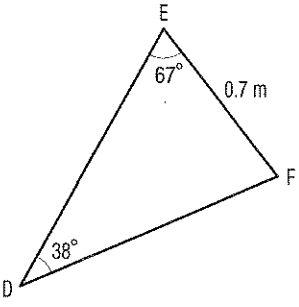
_____ _____ _____

2 Calculate the area of each of the triangles below.

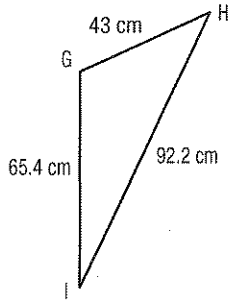
a)



b)



c)



_____ _____ _____

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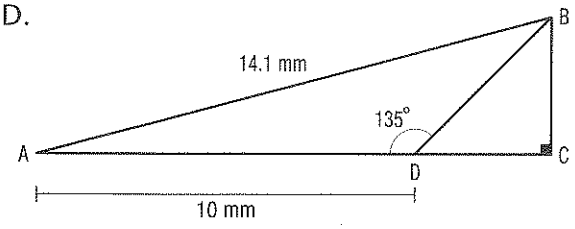
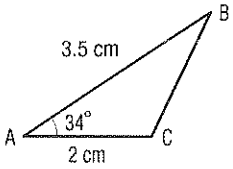
CONSOLIDATION 5.3

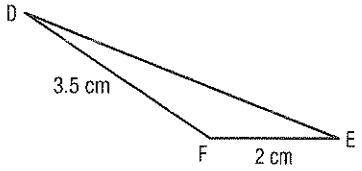
(cont'd)

3 Calculate the area of the right triangle BCD.



4 Consider the two triangles below.



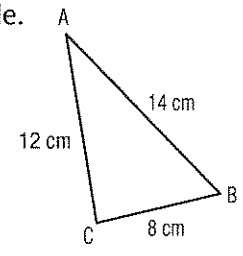


a) What is the area of triangle ABC?

b) Considering that triangles ABC and DEF have the same area, find the measurement of angle F.

c) Explain how you were able to find this measurement.

5 Calculate the measures of the interior angles in the adjacent triangle.



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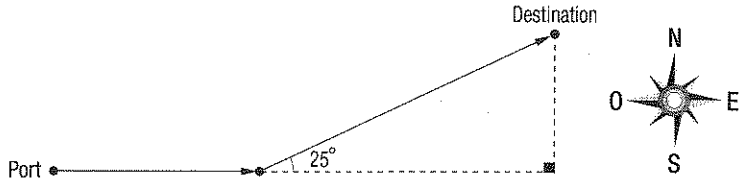
6 The Bermuda triangle is an area bordered by Florida, the Island of Puerto Rico and the Bermudian archipelago. Many individuals believe that a number of planes and boats have disappeared in this area since the 19th century. The distance between Florida and the Island of Puerto Rico is 1870 km. It is 1560 km between Puerto Rico and Bermuda while the distance between Bermuda and Florida is 1670 km. What is the area of the Bermuda triangle?

7 A ship leaves its home port, travels 45 km to the east, then changes course by 25°. It then travels a distance of 72 km in order to reach its destination. The diagram below illustrates this situation.



a) How far is it from the port to the ship's final destination?

b) A second ship leaves the same port for the same destination. What angle, in relation to the east-west axis, should it follow such that its trajectory is a straight line?

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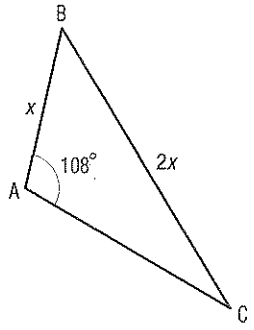
ENRICHMENT 5.3

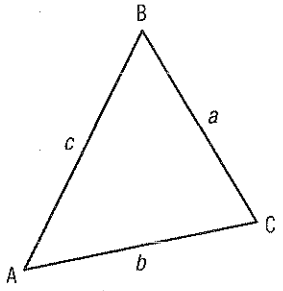
Calculating the area of any triangle

1 Calculate the measures of the interior angles of the adjacent triangle ABC.



2 The three following expressions allow you to calculate the area of the adjacent triangle ABC. Basing yourself on these expressions, demonstrate the sine law.

$A = \frac{ab \times \sin C}{2}$; $A = \frac{bc \times \sin A}{2}$; $A = \frac{ac \times \sin B}{2}$



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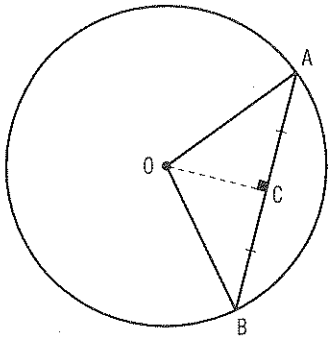
Student Book, p. 115

Number 2

2 Presuming that the adjacent circle has a radius of 1 dm, complete the following table without using a calculator.



Measure of angle AOB subtended at the centre (°)	Length of chord AB (dm)	Measure of angle AOC subtended at the centre (°)	Sine of angle AOC $\left(\frac{\text{m } \overline{AC}}{\text{m } \overline{AO}}\right)$
0	0.00	0	0
10	0.174	5	0.087
20	0.347	10	0.1735
30	0.518	15	

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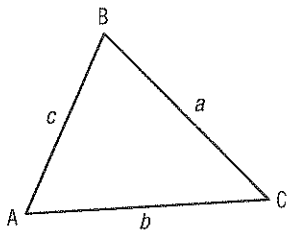
SNAPSHOT 5

1 **WHAT A FAMILY!** Students have been invited to complete the table below in order to summarize information about the type of triangles ABC (scalene, right, isosceles or equilateral) to which each of the triangles belongs. Help the students complete the table.



	Triangle ①	Triangle ②	Triangle ③	Triangle ④	Triangle ⑤	Triangle ⑥
m ∠ A (°)	26					65.72
m ∠ B (°)		60		35		
m ∠ C (°)			18.06			
a (cm)	11			13.1	25.7	4.8
b (cm)		13		8	71.08	
c (cm)	19.8		17.02			
sin A			0.31		0.34	
sin B						
sin C		1				0.84
Type						

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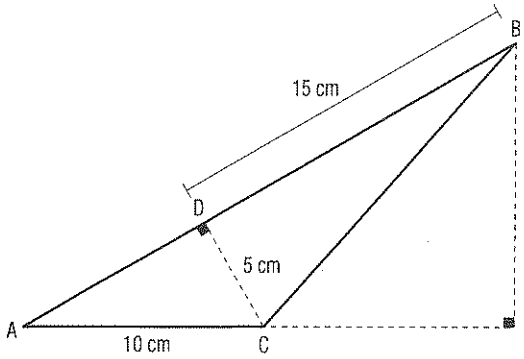
2 **HEIGHT** A woodworker wants to make the adjacent figure from a piece of wood. In order to select a piece of wood with the right dimensions, he has to determine the height relative to side AC of triangle ABC. Complete the diagram by calculating this height.



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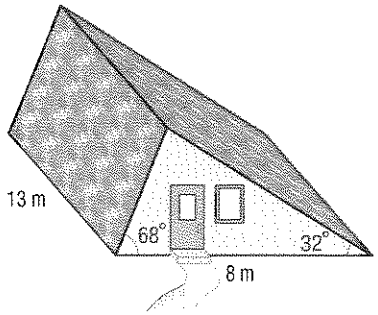
3 **THE CHALET** Maxime's chalet needs some renovations. He needs to change the roof's asphalt shingling. The chalet is in the shape of a right prism having a right triangular base. A pack of shingles costs \$24.95 and covers 3 m^2, and labour costs \$12.50/m^2. He also needs to install a heat pump, and must choose one from among the following three models.



Heat pump	Model A (\$300)	Model B (\$500)	Model C (\$650)
Installation cost	\$1,300	\$1,500	\$2,100
Suitable for a dwelling having the following volume:	150 m^3	250 m^3	350 m^3

Calculate the minimum cost of the work.

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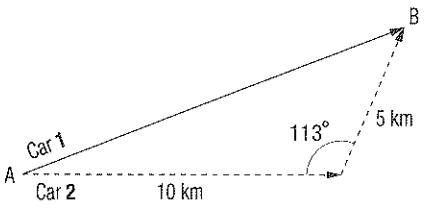
4 **GETTING THERE FIRST** Two cars leave at the same time to get from point A to point B. The first car travels at a speed of 80 km/h, while the second car travels at 110 km/h and follows the route represented by the dotted lines in the adjacent diagram. Which car will be the first to arrive at point B? Justify your answer.



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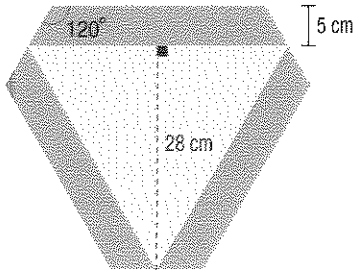
SNAPSHOT 5

(cont'd)

5 **TRACTORS** In areas where farm vehicles must travel on roads, a sign, as illustrated in the adjacent diagram, is placed on these slow moving vehicles. The sign is in the shape of an equilateral triangle having three congruent isosceles trapezoids at each of its sides. Using the information provided in the diagram, calculate the sign's surface area.



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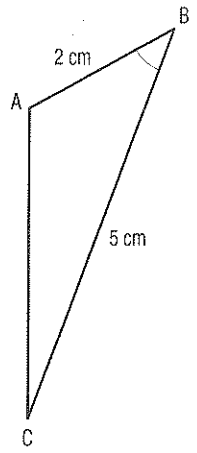
Group: _____ Date: _____

SNAPSHOT 5

(cont'd)

6 **PROVE IT!** The lengths of sides AB and BC of the adjacent triangle are fixed while the measurement of angle B can be adjusted. Jacqueline makes the following conjecture related to this situation: the greater the angle at B, the greater the area of triangle ABC.

Using mathematical reasoning, confirm or refute this conjecture.



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Support 5.1 — Page 4

1. 1 C, 2 F, 3 E

2. 1 a) 1) 36 mm 2) 34.7 mm 3) 50 mm
   b) 1) $\sin 46° = \frac{36}{50}$ 2) $\cos 46° = \frac{34.7}{50}$ 3) $\tan 46° = \frac{36}{34.7}$
   c) 1) $\sin 46° \approx 0.72$ 2) $\cos 46° \approx 0.69$ 3) $\tan 46° \approx 1.04$
   2 a) 1) 4.12 cm 2) 8.84 cm 3) 9.75 cm
   b) 1) $\sin 25° = \frac{4.12}{9.75}$ 2) $\cos 25° = \frac{8.84}{9.75}$ 3) $\tan 25° = \frac{4.12}{8.84}$
   c) 1) $\sin 25° \approx 0.42$ 2) $\cos 25° \approx 0.91$ 3) $\tan 25° \approx 0.47$

Support 5.1 (*cont'd*) — Page 5

3. a) $\sin 20° \approx 0.34$ b) $\frac{x}{4.8} \approx 0.34$
   c) $x \approx 1.64$ cm
   d) m $\angle$ B = 70° m $\overline{AC} \approx 4.51$ cm
   e) 1 m $\angle$ F = 40° m $\overline{EF} \approx 82.24$ mm m $\overline{DE} \approx 52.86$ mm
   2 m $\angle$ H = 60° m $\overline{HI} \approx 0.43$ m m $\overline{GH} \approx 0.87$ m

Consolidation 5.1 — Page 6

1. a) $x \approx 19.19$ cm b) $x \approx 3.77$ dm
   c) $x \approx 0.14$ m

2. a) m $\angle$ B = 30° m $\overline{AB} \approx 10.39$ cm m $\overline{AC} \approx 5.2$ cm
   b) m $\angle$ E = 49° m $\overline{DE} \approx 0.68$ m m $\overline{EF} \approx 0.44$ m
   c) m $\angle$ G = 25° m $\overline{GI} \approx 42.6$ mm m $\overline{HI} \approx 19.86$ mm

Consolidation 5.1 (*cont'd*) — Page 7

3. ≈ 6.32 km

4. a) 1) ≈ 0.14 cm 2) ≈ 0.01 m 3) ≈ 0.14 km
   b) 1) ≈ 358.1 mm 2) ≈ 716.2 cm 3) ≈ 5371.47 m

Consolidation 5.1 (*cont'd*) — Page 8

5. Yes, because the gas in the tank allows her to travel 38.5 km whereas she has 37.81 km to travel.

6. a) At about 14.93 m from the wall.
   b) ≈ 15.45 m

Enrichment 5.1 — Page 9

1. a) 1) $(\sin 20°)^2 + (\cos 20°)^2 = 1$
   2) $(\sin 60°)^2 + (\cos 60°)^2 = 1$
   3) $(\sin 45°)^2 + (\cos 45°)^2 = 1$
   4) $(\sin 85°)^2 + (\cos 85°)^2 = 1$
   b) The sum of the squares of the sine and the cosine of an angle equal 1.
   c) 1. $b = c \times \cos A$
   2. $c^2 = a^2 + b^2$
   3. $(c \times \sin A)^2 + (c \times \cos A)^2 = c^2$
   4. $c^2 \times (\sin A)^2 + c^2 \times (\cos A)^2 = c^2$
   5. $c^2 \times ((\sin A)^2 + (\cos A)^2) = c^2$
   6. $(\sin A)^2 + (\cos A)^2 = 1$

Practice 5.2 — Page 10

4.

	Length of side adjacent to angle A (cm)	Length of side opposite to angle A (cm)	Length of hypotenuse (cm)	Measurement of angle A (°)	Measurement of angle B (°)
Triangle 1	12	≈ 32.88	35	≈ 69.95	≈ 20.05
Triangle 2	≈ 51.96	30	60	30	60
Triangle 3	11.4	15.5	≈ 19.24	≈ 53.67	≈ 36.33
Triangle 4	45.76	≈ 26.42	≈ 52.84	30	60
Triangle 5	≈ 0.20	≈ 0.40	0.45	63	27
Triangle 6	34.5	46	57.5	≈ 53.13	≈ 36.87

Support 5.2 — Page 11

1. a) $\approx 71.81°$ b) $\approx 83.11°$
   c) 30° d) 0°
   e) 0° f) $\approx 63.43°$

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2.

Expression	Translation	Results
arcsin 0.5	Find the measurement of an angle which has a sin of 0.5.	30°
$\tan^{-1}$ 232	**Find the measurement of an angle which has a tangent of 232.**	≈ 89.75°
$\cos^{-1}$ 0.67	Find the measurement of an angle for which the cosine is 0.67.	≈ 47.93°
arctan 0.5	**Find the measurement of an angle which has a tangent of 0.5.**	≈ 26.57°
$\cos^{-1}$ 0.17	In a right triangle, find the measurement of an angle so that the ratio of $\frac{\text{the length of the side adjacent to this angle}}{\text{length of the hypotenuse}}$ is 0.17.	≈ 80.21°
$\sin^{-1}$ 0.3	**Find the measurement of an angle which has a sine of 0.3.**	≈ 17.46°
$\tan^{-1}$ 1	In a right triangle, find the measurement of an angle so that the ratio of $\frac{\text{the length of the side opposite to this angle}}{\text{length of the side adjacent to this angle}}$ is 1.	45°

3. a) $x \approx 87.14°$ b) $x \approx 70.53°$
   c) $x = 10°$ d) $x = 90°$
   e) $x \approx 56.31°$ f) $x = 30°$
4. a) m ∠ B ≈ 28.96° b) m ∠ B ≈ 43.81°

Support 5.2 (*cont'd*) — Page 12

5. In a right triangle, the length of the side opposite a 30° angle is half the length of the hypotenuse.
6. a) sin x b) $\frac{5.2}{11.07}$
   c) $\sin x = \frac{5.2}{11.07}$ d) $x \approx 28.02°$
   e) m ∠ B ≈ 61.98° m $\overline{AC}$ ≈ 9.77 cm
   f) (1) m ∠ F ≈ 69.99° m ∠ E ≈ 20.01°
   m $\overline{DF}$ ≈ 8.22 cm
   (2) m ∠ G ≈ 54.89° m ∠ H ≈ 35.11°
   m $\overline{GH}$ ≈ 0.78 m

Consolidation 5.2 — Page 13

1. a) m ∠ A ≈ **21.01°** b) m ∠ A ≈ **38.62°**
   c) m ∠ A ≈ **40.18°**
2. a) m ∠ B ≈ 24° m ∠ A ≈ 66°
   m $\overline{AB}$ ≈ 7.99 cm
   b) m ∠ D ≈ 17.34° m ∠ E ≈ 72.66°
   m $\overline{EF}$ ≈ 3.28 dm
   c) m ∠ I = 30° m ∠ G = 60°
   m $\overline{HI}$ ≈ 46.77 mm

Consolidation 5.2 (*cont'd*) — Page 14

3. Right triangles (A) and (D) contain a 30° angle because they each have a side which is half the length of the longest side.
4. a) 60°
   b) ≈ 375.56 cm
   c) $A \approx 8264.45$ cm²

Consolidation 5.2 (*cont'd*) — Page 15

5. ≈ 22.41°
6. ≈ 836.14 cm

Enrichment 5.2 — Page 16

1. a) m ∠ A ≈ 23.96° m ∠ B ≈ 102.91°
   m ∠ C ≈ 53.13°
   b) m ∠ A = 30° m ∠ B ≈ 93.56°
   m ∠ C ≈ 56.44°

Support 5.3 — Page 17

1. a) The sine of an angle and that of its supplement are equal.
   b) $\frac{6.4}{\sin 19°} = \frac{13.9}{\sin B}$ m ∠ B ≈ 45°
   c) No, because triangle ABC is obtuse at B.
   d) m ∠ B ≈ 135°
   e) You need to make sure that you make the necessary adjustments when dealing with obtuse angles.
2. a) $x \approx 1.3$ cm
   b) $x \approx 136.84°$
   c) $x \approx 51.36°$

Support 5.3 (*cont'd*) — Page 18

3. (A) a) 1) $h \approx 0.25$ m 2) $A \approx 0.08$ m²
   (B) a) 1) $h \approx 3.67$ cm 2) $A \approx 22.04$ cm²
   (C) a) 1) $h \approx 53$ mm 2) $A \approx 2300.04$ mm²
   b) $A = \frac{a \times b \times \sin C}{2}$
4. a) m ∠ E = 69°
   m $\overline{DF}$ ≈ 69.67 mm
   m $\overline{EF}$ ≈ 40.65 mm
   b) ≈ 91.66 mm
   c) $A \approx 1385.12$ mm²

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Consolidation 5.3 — Page 19

1. a) $m \angle B \approx 108.06°$ $m \angle C \approx 50.94°$
   $m \overline{AB} \approx 26.22$ cm
   b) $m \angle F = 75°$ $m \overline{DF} \approx 1.05$ m
   $m \overline{DE} \approx 1.1$ m
   c) $m \angle I \approx 18.13°$ $m \angle G \approx 11.87°$
   $m \overline{HI} \approx 18.52$ dm
2. a) $A \approx 191.24$ cm^2 b) $A \approx 0.35$ m^2
   c) $A \approx 1274.63$ cm^2

Consolidation 5.3 (*cont'd*) — Page 20

3. $A \approx 6.57$ mm^2
4. a) $A \approx 1.96$ cm^2 b) $m \angle F = 146°$
   c) *Several answers possible. Example(s):*
   The trigonometric formula
   $A = \frac{d \times e \times \sin F}{2}$
   $1.96 \text{ cm}^2 \approx \frac{2 \text{ cm} \times 3.5 \text{ cm} \times \sin F}{2}$
   $m \angle F = 146°$
5. $m \angle A \approx 34.77°$ $m \angle B \approx 58.81°$
   $m \angle C \approx 86.42°$

Consolidation 5.3 (*cont'd*) — Page 21

6. The surface area of the Bermuda triangle is approximately 1 229 089.42 km^2.
7. a) The distance is approximately 114.38 km
   b) The angle in relation to the east-west axis is about 15.43°.

Enrichment 5.3 — Page 22

1. $m \angle B \approx 43.61°$ $m \angle C \approx 28.39°$
2. *Several answers possible. Example(s):*

$$\frac{bc \times \sin A}{2} \times 2 = \frac{ac \times \sin B}{2} \times 2 \qquad \frac{bc \times \sin A}{2} \times 2 = \frac{ab \times \sin C}{2} \times 2$$

$$\frac{bc \times \sin A}{c} = \frac{ac \times \sin B}{c} \qquad \frac{bc \times \sin A}{b} = \frac{ab \times \sin C}{b}$$

$$\frac{b \times \sin A}{ab} = \frac{a \times \sin B}{ab} \qquad \frac{c \times \sin A}{ac} = \frac{a \times \sin C}{ac}$$

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

By transivity and the fundamental properties of proportions:

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

Chronicle of the past — Page 23

2.

Measure of angle AOB subtended at the centre (°)	Length of chord AB (dm)	Measure of angle AOC subtended at the centre (°)	Sine of angle AOC $\left(\frac{m\overline{AC}}{m\overline{AO}}\right)$
0	0.00	0	0
10	0.174	5	0.087
20	0.347	10	0.1735
30	0.518	15	0.259
40	0.684	20	0.342
50	0.845	25	0.4225
60	1	30	0.5
70	1.147	35	0.5735
80	1.286	40	0.643
90	1.414	45	0.707
100	1.532	50	0.766
110	1.638	55	0.819
120	1.732	60	0.866
130	1.813	65	0.9065
140	1.879	70	0.9395
150	1.932	75	0.966
160	1.97	80	0.985
170	1.992	85	0.996
180	2	90	1

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Snapshot 5

Page 24

1.

	Triangle ①	Triangle ②	Triangle ③	Triangle ④	Triangle ⑤	Triangle ⑥
m∠ A (°)	26	30	≈ 18.06	≈ 69.92	≈ 19.88	65.72
m∠ B (°)	≈ 101.9	60	≈ 143.88	35	≈ 70.11	≈ 57.14
m∠ C (°)	≈ 52.1	90	18.06	≈ 75.08	≈ 90.01	≈ 57.14
a (cm)	11	≈ 7.51	≈ 17.02	13.1	25.7	4.8
b (cm)	≈ 24.55	13	≈ 32.36	8	71.08	≈ 4.42
c (cm)	19.8	≈ 15.01	17.02	≈ 13.48	≈ 75.58	≈ 4.42
sin A	≈ 0.44	0.5	0.31	≈ 0.94	0.34	≈ 0.91
sin B	≈ 0.98	≈ 0.87	≈ 0.59	≈ 0.57	≈ 0.94	≈ 0.84
sin C	≈ 0.79	1	≈ 0.31	≈ 0.97	≈ 1	0.84
Type	Scalene	Right and scalene	Isosceles	Scalene	Right and scalene	Isosceles

Snapshot 5 (*cont'd*)

Page 25

2. The length is approximately 11.83 cm.

Snapshot 5 (*cont'd*)

Page 26

3. The minimum cost of the work is approximately $5,220.86 ($1,297.40 for the shingling, $1,923.46 for labour and $2,000 for the heat pump.

Snapshot 5 (*cont'd*)

Page 27

4. Car **2** finishes first because it travels the distance in approximately 8.18 min whereas Car **1** travels the same distance in approximately 9.61 min.

Snapshot 5 (*cont'd*)

Page 28

5. The sign's surface area is approximately 894.32 cm^2.

Snapshot 5 (*cont'd*)

Page 29

6. Using the formula $A = \frac{a \times c \times \sin B}{2}$,
you will get $A = \frac{5 \times 2 \times \sin B}{2} = 5 \sin B$.
When an angle is obtuse (greater than 90°), the value of the angle's sine decreases. As a result, when the value of B increases (over 90°), the value of 5 sin B decreases which refutes Jacqueline's conjecture.

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