Welcome Back MYP Math 9!

Reflect on last night's exercises.

	Assignment Effort Grade (Circle One)	Comments (What was interesting or challenging?)
Monday Date: 11/20 Topic: 13D Solving for angles	0 1 2	Write!!Reflect!
Tuesday Date: _____ Topic: _____	0 1 2	
Wednesday Date: _____ Topic: _____	0 1 2	
Thursday Date: _____ Topic: _____	0 1 2	NO SCHOOL
Friday Date: _____ Topic: _____	0 1 2	NO SCHOOL

Class Plan:

1. Warm-up
2. Trigonometry Applications
3. Practice

E PROBLEM SOLVING WITH TRIGONOMETRY

The trigonometric ratios can be used to solve a wide variety of problems involving right angled triangles. When solving these problems it is important to follow the steps below:

Steps to solve:

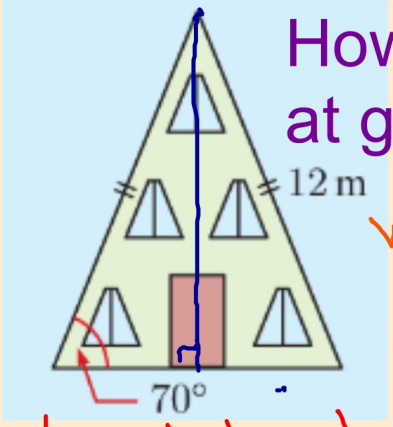
- Draw a **diagram** to illustrate the situation.
- Mark on the diagram the **unknown** angle or side that needs to be calculated. We often use x for a length and θ for an angle.
- Locate a **right angled triangle** in your diagram.
- Write an **equation** connecting an angle and two sides of the triangle using an appropriate trigonometric ratio.
- **Solve** the equation to find the unknown.
- **Write** your answer in sentence form.

We can use right angled triangle trigonometry to solve problems involving:

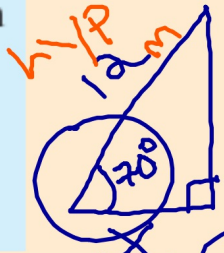
- isosceles triangles
- rectangles
- rhombuses
- kites

Warm-up:

An A-frame house has the shape of an isosceles triangle with base angles of 70°. The oblique walls of the building are 12 m long.



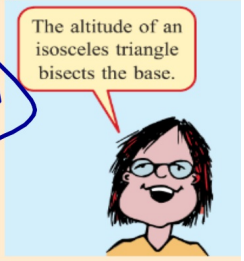
How wide is the building at ground level?



$\cos 70 = \frac{x}{12}$

$12 \cdot \cos 70^\circ = x$

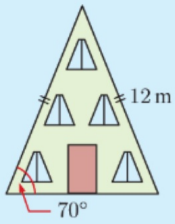
$x \approx 4.1\text{m}$



$w \approx 8.2\text{m}$

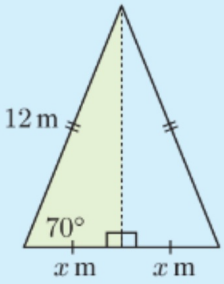
Textbook Solution

Example 5 — Self Tutor



An A-frame house has the shape of an isosceles triangle with base angles of $70°$. The oblique walls of the building are 12 m long.

How wide is the building at ground level?



Suppose the building is $2x$ m wide at ground level.

$$\cos 70° = \frac{x}{12} \qquad \left\{\cos\theta = \frac{\text{ADJ}}{\text{HYP}}\right\}$$

$\therefore \quad 12 \times \cos 70° = x$

$\therefore \quad x \approx 4.1042$

$\therefore \quad 2x \approx 8.21$

At ground level, the building is about 8.21 m wide.

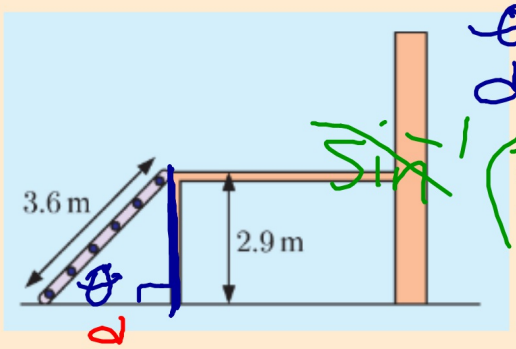
Example:

A staircase 3.6 m in length is needed to access a platform 2.9 m above ground level.

Find, using trigonometry:

a the angle the staircase makes with the ground

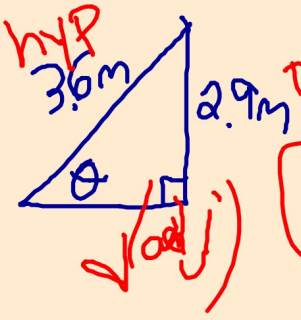
b the distance from the foot of the staircase to the post supporting the platform.



$\sin\theta = \frac{2.9}{3.6}$

$\theta = \sin^{-1}\left(\frac{2.9}{3.6}\right)$

$\theta \approx 54°$



$d \approx 2.3\text{m}$

Example:

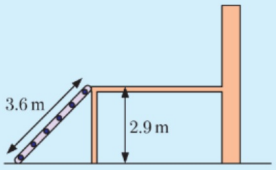
Example 6 — Self Tutor

A staircase 3.6 m in length is needed to access a platform 2.9 m above ground level.

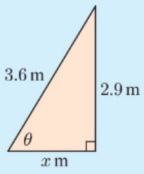
Find, using trigonometry:

a the angle the staircase makes with the ground

b the distance from the foot of the staircase to the post supporting the platform.



a



$$\sin\theta = \frac{\text{OPP}}{\text{HYP}} = \frac{2.9}{3.6}$$

$$\therefore\ \theta = \sin^{-1}\left(\frac{2.9}{3.6}\right)$$

$$\therefore\ \theta \approx 53.7^\circ$$

The staircase makes an angle of about 53.7° with the ground.

b

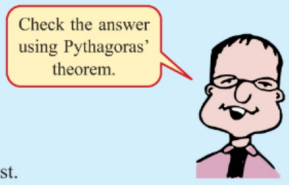
$$\cos\theta = \frac{\text{ADJ}}{\text{HYP}}$$

$$\therefore\ \cos 53.7^\circ = \frac{x}{3.6}$$

$$\therefore\ 3.6 \times \cos 53.7^\circ = x$$

$$\therefore\ x \approx 2.13$$

The foot of the staircase is about 2.13 m from the post.



Exercises....

Textbook:13E Page 262 (1 - 13)

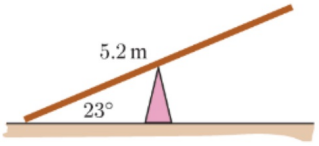
1) I am new to problem solving with trigonometry.
(#1 - #8)

2) I will use geometry knowledge to problem solve with trigonometry.
(#1 - #10)

3) I have *confidently* used geometry to problem solve with trigonometry in previous math classes.
(#5 - #13)

EXERCISE 13E

1 A see-saw has length 5.2 m. When one end is resting on the ground, it makes an angle of 23° with the ground. How far is the other end above ground level?

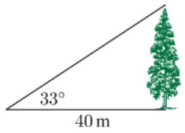


$\sin 23 = \frac{x}{5.2}$

$5.2 \times \sin(23) = x$

$2.03\text{ m} = x$

2



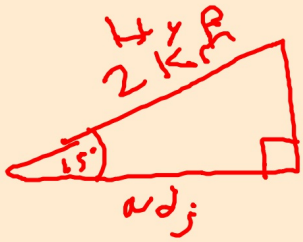
The shadow of a tree is 40 m long. The angle from the end of the shadow to the top of the tree is 33°. Find the height of the tree.

$$\frac{x}{40} = \tan 33$$

$$x = 40 \cdot \tan 33$$

$$x \simeq 26$$

3 A driver travels 2 km up a long steady incline angled 15° to the horizontal. How far has the driver moved horizontally?



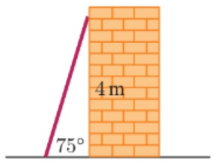
$2 \cdot \cos 15 = x$

$x \approx 1.93 \text{ km}$

$\frac{\cos 15}{1} = \frac{x}{2}$

-Earl V.

4



A ladder makes an angle of 75° with the ground, and rests 4 m up a wall.
Find the length of the ladder.

$\therefore \quad x \cdot \sin(75°) = \frac{4}{x} \cdot x$

hyp x

4m opp

$75°$

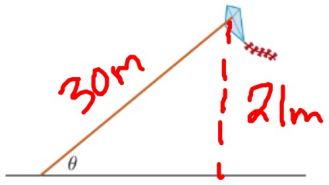
$x \cdot \sin(75) = 4$

$\frac{x \cdot \sin(75)}{\sin(75)} = \frac{4}{\sin(75)}$

$x = \frac{4}{\sin(75)}$

$x \approx 4.14\text{m}$

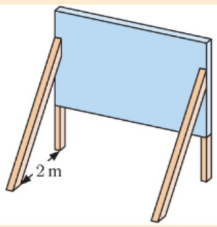
5 A kite is attached to a 30 m long string. The other end of the string is secured to the ground. If the kite is flying 21 m above ground level, find the angle θ that the string makes with the ground.



$\sin^{-1}(\sin\theta) = \sin^{-1}\left(\frac{21}{30}\right)$

$\theta = 44°$

6

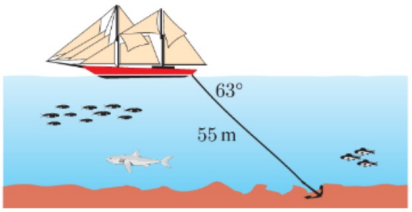


A billboard for advertising by a highway is supported by two 5 m long beams. Find the angle that the beams make with the ground.

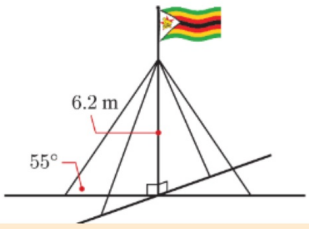
$\cos^{-1}(\cos\theta) = (2/5)\cos^{-1}$

$\theta \approx 66.4°$

7 A boat has an anchor rope of length 55 m. The boat drifts with the ocean current so that the rope makes an angle of 63° with the surface of the water. Find the depth of the water at the point where the anchor lies on the bottom.



8 A flagpole is supported by four metal braces. Each brace makes an angle of 55° with the ground and meets the pole 6.2 m above ground level. Find the total length of the metal braces.

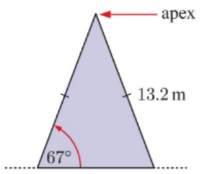


$\sin(55) = \frac{6.2}{x}$

$\frac{\sin(55) \cdot x}{\sin(55)} = \frac{6.2}{\sin(55)}$

7.57m or total of 30.28 m

9



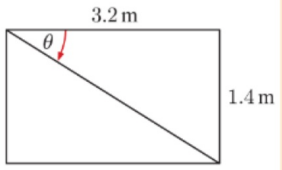
An A-frame house has the shape of an isosceles triangle with base angles 67°. The walls are 13.2 m long. Find:

a the width of the building at ground level

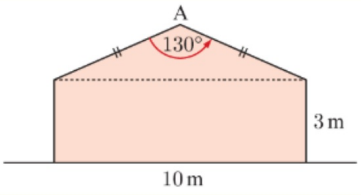
b the height of the apex above the ground.

10 An isosceles triangle has sides 7 cm, 7 cm, and 8 cm in length. Find the measure of the base angles.

11 The metal frame of a rectangular gate has height 1.4 m and length 3.2 m. A diagonal strut is welded in place to support the frame. Find the measure of the angle θ between this diagonal strut and the top of the frame.



12

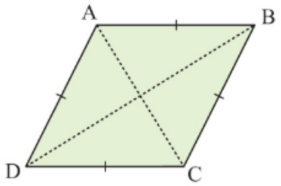


The diagram shows the end wall of a garage. Find:

a the height of the apex A above ground level

b the area of this wall.

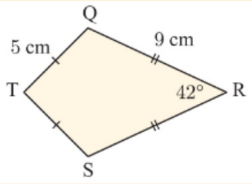
13 In the rhombus ABCD alongside, $AC = 4.8$ m and $BD = 6.6$ m. Find the measure of $B\widehat{D}C$.



15

An aeroplane takes off at an angle of 18°. Its average speed in the first 20 seconds of flight is 240 km/h. What is the altitude of the plane at the end of this time?

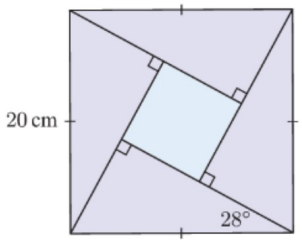
16 For the kite QRST illustrated, find the measure of $\widehat{QTS}$.



17 A rectangle is 16 cm long and 10 cm wide. Find the acute angle at which the diagonals of the rectangle intersect.

18 A square tiling pattern is created from four identical triangular tiles and a smaller central square tile, as shown. Find:

- **a** the perimeter of each triangular tile
- **b** the area of each triangular tile
- **c** the side length of the central square tile
- **d** the percentage of the pattern which is occupied by the central square tile.

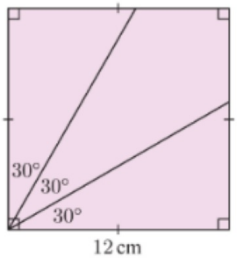


19 Julie, Tina, and Brenton have baked a 12 cm by 12 cm square cake. They are trying to work out how to share the cake equally between them.

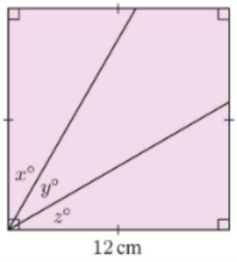
a Brenton suggests cutting the cake at 30° angles from one corner.

i Find the area of each slice.

ii Would each person receive the same amount of cake in this case?



b Find the angles $x°$, $y°$, and $z°$ which should be cut to make three slices of equal size.



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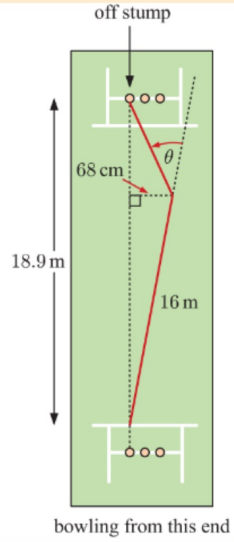
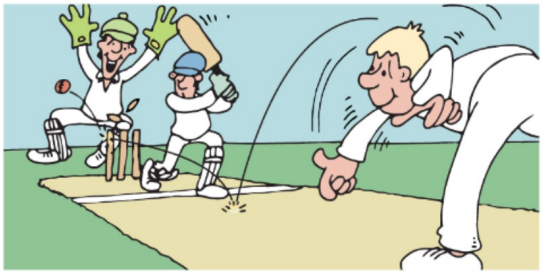


During a cricket match in England, a leg spin bowler delivers the ball from a point 18.9 m from the stumps, and level with the off stump.

The ball travels 16 m before it bounces, and lands 68 cm to the side as shown.

Find the angle θ through which the ball spins in order to hit the off stump.



EXERCISE 13E

1 ≈ 2.03 m **2** ≈ 26.0 m **3** ≈ 1.93 km **4** ≈ 4.14 m

5 $\approx 44.4°$ **6** $\approx 66.4°$ **7** ≈ 49.0 m **8** ≈ 30.3 m

9 **a** ≈ 10.3 m **b** ≈ 12.2 m **10** $\approx 55.2°$

11 $\approx 23.6°$ **12** **a** ≈ 5.33 m **b** ≈ 41.7 m^2 **13** $\approx 36.0°$

14 **a** **i** ≈ 7.98 m **ii** ≈ 12.6 m **b** $\theta \approx 21.1°$

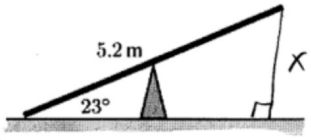
15 ≈ 412 m **16** $\approx 80.3°$ **17** $\approx 64.0°$

18 **a** ≈ 47.0 cm **b** ≈ 82.9 cm^2 **c** ≈ 8.27 cm
d $\approx 17.1\%$

19 **a** **i** triangular slices each ≈ 41.6 cm^2,
kite slice ≈ 60.9 cm^2
ii no
b $x° \approx 33.7°$, $y° \approx 22.6°$, $z° \approx 33.7°$

20 $\theta \approx 15.6°$

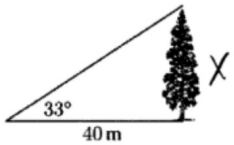
1 A see-saw has length 5.2 m. When one end is resting on the ground, it makes an angle of 23° with the ground. How far is the other end above ground level?



$\sin(23^\circ) = \frac{X}{5.2}$ $X = 5.2\sin(23^\circ)$

$X \approx 2.0318\text{m}$

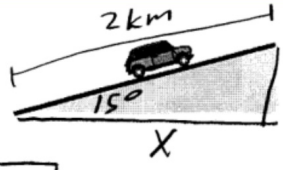
2



The shadow of a tree is 40 m long. The angle from the end of the shadow to the top of the tree is 33°. Find the height of the tree.

$\tan(33^\circ) = \frac{X}{40}$ $X = 40\tan(33^\circ)$ $X \approx 25.9763\text{m}$

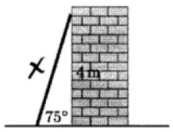
3 A driver travels 2 km up a long steady incline angled 15° to the horizontal. How far has the driver moved horizontally?



$\cos(15^\circ) = \frac{X}{2}$ $X = 2\cos(15^\circ)$

$X \approx 1.9139\text{ km}$

4



A ladder makes an angle of 75° with the ground, and rests 4 m up a wall.
Find the length of the ladder.

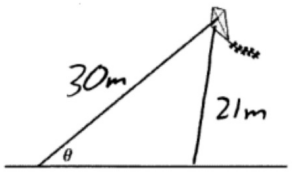
$\sin(75°) = \frac{4}{x}$

$x \cdot \sin(75°) = 4$

$x = \frac{4}{\sin(75°)}$

$x \approx 4.1411 m$

5 A kite is attached to a 30 m long string. The other end of the string is secured to the ground. If the kite is flying 21 m above ground level, find the angle θ that the string makes with the ground.

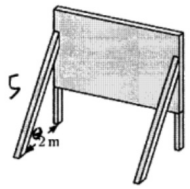


$\sin(\theta) = \frac{21}{30}$

$\theta = \sin^{-1}\left(\frac{21}{30}\right)$

$\theta \approx 44.43°$

6



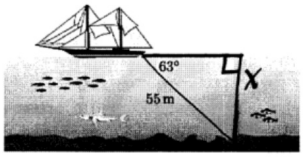
A billboard for advertising by a highway is supported by two 5 m long beams. Find the angle that the beams make with the ground.

$\cos(\theta) = \frac{2}{5}$

$\theta = \cos^{-1}\left(\frac{2}{5}\right)$

$\theta \approx 66.42°$

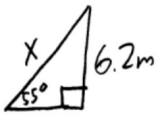
7 A boat has an anchor rope of length 55 m. The boat drifts with the ocean current so that the rope makes an angle of 63° with the surface of the water. Find the depth of the water at the point where the anchor lies on the bottom.



$\sin(63°) = \frac{X}{55}$ $\quad 55\sin(63°) = X$

$X \approx 49.0054 \text{ m}$

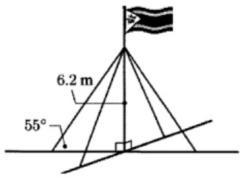
8 A flagpole is supported by four metal braces. Each brace makes an angle of 55° with the ground and meets the pole 6.2 m above ground level. Find the total length of the metal braces.



$\sin(55°) = \frac{6.2}{X}$

$X = \frac{6.2}{\sin(55°)}$ one brace

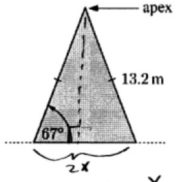
$X \approx 7.5688\text{m}$



All 4 Braces:

$\frac{4 \cdot 6.2}{\sin(55°)} \approx \boxed{30.2752\text{m}}$

9



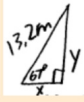
An A-frame house has the shape of an isosceles triangle with base angles 67°. The walls are 13.2 m long. Find:

a the width of the building at ground level $\boxed{10.3153\text{m}}$

b the height of the apex above the ground. $\boxed{12.1507\text{m}}$

$\sin(67°) = \frac{y}{13.2}$ $\quad y = 13.2\sin(67°)$

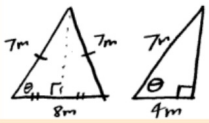
$y \approx 12.1507\text{m}$



$\cos(67°) = \frac{x}{13.2}$

$x = 13.2\cos(67°) \Rightarrow 2x = 2 \cdot 13.2\cos(67°) \approx 10.3153\text{m}$

'10 An isosceles triangle has sides 7 cm, 7 cm, and 8 cm in length. Find the measure of the base angles.

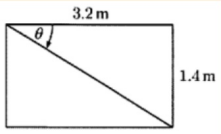


$\cos(\theta) = \frac{4}{7}$

$\theta = \cos^{-1}\left(\frac{4}{7}\right)$

$\boxed{\theta \approx 55.15°}$

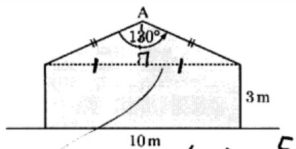
11 The metal frame of a rectangular gate has height 1.4 m and length 3.2 m. A diagonal strut is welded in place to support the frame. Find the measure of the angle θ between this diagonal strut and the top of the frame.



$\tan(\theta) = \frac{1.4}{3.2}$

$\theta = \tan^{-1}\left(\frac{1.4}{3.2}\right)$ $\boxed{\theta \approx 23.63^\circ}$

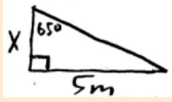
12



The diagram shows the end wall of a garage. Find:

a the height of the apex A above ground level

b the area of this wall.



a. $\tan(65^\circ) = \frac{5}{X}$

$X = \frac{5}{\tan(65^\circ)} \approx 2.3315\text{m}$

$2.3315\text{m} + 3\text{m} = \boxed{5.3315\text{m}}$

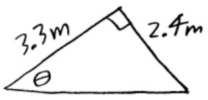
b. $\text{Area}_\triangle \approx \frac{1}{2}(2.3315 \cdot 10)$

$= 11.6575\text{m}^2$

$\text{Area}_\square = 3 \cdot 10 = 30\text{m}^2$

$\text{Area} = 11.6575 + 30 = \boxed{41.6575\text{m}^2}$

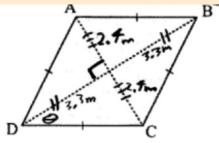
13 In the rhombus ABCD alongside, AC = 4.8 m and BD = 6.6 m. Find the measure of $B\hat{D}C$.



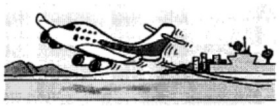
$\tan(\theta) = \frac{2.4}{3.3}$

$\theta = \tan^{-1}\left(\frac{2.4}{3.3}\right)$

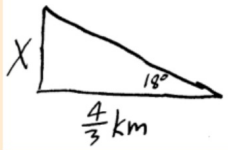
$\theta \approx 36.03°$



15 An aeroplane takes off at an angle of 18°. Its average speed in the first 20 seconds of flight is 240 km/h. What is the altitude of the plane at the end of this time?



$\frac{240\text{ km}}{1\text{ hr}} \cdot \frac{1\text{ hr}}{60\text{ min}} \cdot \frac{1\text{ min}}{60\text{ sec}} \cdot \frac{20\text{ sec}}{1} = \frac{4}{3}\text{ km}$

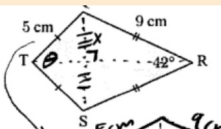


$\tan(18°) = \frac{X}{\frac{4}{3}}$

$X = \frac{4}{3}\tan(18°)$

$X \approx 0.4332\text{ km}$

16 For the kite QRST illustrated, find the measure of $Q\hat{T}S$.



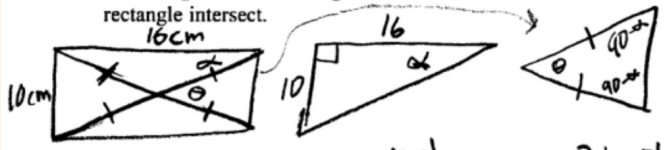
$\sin(21°) = \frac{x}{9} \Rightarrow x = 9\sin(21°)$

$\sin\left(\frac{1}{2}\theta\right) = \frac{9\sin(21°)}{5}$

$\frac{1}{2}\theta = \sin^{-1}\left(\frac{9\sin(21°)}{5}\right)$

$\theta = 2\sin^{-1}\left(\frac{9\sin(21°)}{5}\right) \approx 80.341°$

17 A rectangle is 16 cm long and 10 cm wide. Find the acute angle at which the diagonals of the rectangle intersect.



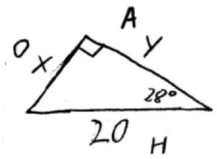
$\theta = 180 - 2(90 - \alpha)$

$= 180 - 180 + 2\alpha$

$\theta = 2\alpha$

$\tan(\alpha) = \frac{10}{16}$ $\alpha = \tan^{-1}\left(\frac{10}{16}\right)$

$\theta = 2\tan^{-1}\left(\frac{10}{16}\right) \approx \boxed{64.01^\circ}$

18. a) 

$\sin(28°) = \frac{x}{12}$ $\quad \cos(28°) = \frac{y}{20}$

$20\sin(28°) = x$ $\quad 20\cos(28°) = y$

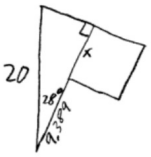
$9.389 = x$ $\quad 17.659 = y$

$Perimeter = 20 + 9.389 + 17.659$

$\boxed{Perimeter = 47.048\,cm}$

b) $Area = \frac{1}{2}(9.389)(17.659)$

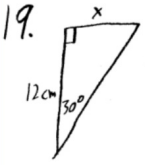
$\boxed{Area = 82.9\,cm^2}$

c) 

$x = 17.659 - 9.389 = \boxed{8.27\,cm}$

d) $\frac{(8.27)^2}{20^2} = 0.1709$ $\quad \boxed{17.1\%}$

19.



a) $\tan(30°) = \frac{x}{12}$

$12 \cdot \tan(30°) = x$

$6.928_{cm} = x$

i) $\frac{1}{2}(6.928)(12) = 41.568$

$\text{Area}_{\triangle} = 41.568 cm^2$

$\text{Area}_{\triangle} = 41.568 cm^2$

ii) $12^2 - 2(41.568) = 60.864$

$\text{Area}_{\square} = 60.864 cm^2$

b) $12^2 = 144$

$144 \div 3 = 48$

Each piece needs to be $48 cm^2$.

$\frac{1}{2}(12 \cdot \alpha) = 48$

$\alpha = 8$

$\tan(x°) = \frac{8}{12}$

$x = 33.69°$

$z = 33.69°$

$y = 22.62°$

$90 - 2(33.69) = 22.62°$