Welcome Back MYP Math 9!

	Assignment Effort Grade (Circle One)	Comments (What was interesting or challenging?)
Monday Date: 11/13 Topic: 20E Problem Solving	0 1 2	
Tuesday Date: 11/14 Topic: Quiz 3.1 Review	0 1 2	
Wednesday Date: 11/15 Topic: Quiz 3.1 - No homework	0 1 2	
Thursday Date: 11/16 Topic: 13AB Ratios of Trigonometry	0 1 2	
Friday Date: ______ Topic: ____________	0 1 2	

ADVISORY BELL SCHEDULE (w/3 lunches)

Lunch A		
1st Hour	8:05-8:48	43 minutes
2nd Hour	8:53-9:36	43 minutes
Advisory	9:41-10:25	44 minutes
3rd Hour	10:30-11:13	43 minutes
Lunch A	11:18-11:48	30 minutes
4th Hour (Late)	11:53-12:36	43 minutes
5th Hour (Late)	12:41-1:24	43 minutes
6th Hour	1:29-2:12	43 minutes
7th Hour	2:17-3:00	43 minutes

Lunch B		
1st Hour	8:05-8:48	43 minutes
2nd Hour	8:53-9:36	43 minutes
Advisory	9:41-10:25	44 minutes
3rd Hour	10:30-11:13	43 minutes
4th Hour (Early)	11:18-12:01	43 minutes
Lunch B	12:06-12:36	30 minutes
5th Hour (Late)	12:41-1:24	43 minutes
6th Hour	1:29-2:12	43 minutes
7th Hour	2:17-3:00	43 minutes

Lunch C		
1st Hour	8:05-8:48	43 minutes
2nd Hour	8:53-9:36	43 minutes
Advisory	9:41-10:25	44 minutes
3rd Hour	10:30-11:13	43 minutes
4th Hour (Early)	11:18-12:01	43 minutes
5th Hour (Early)	12:06-12:49	43 minutes
Lunch C	12:54-1:24	30 minutes
6th Hour	1:29-2:12	43 minutes
7th Hour	2:17-3:00	43 minutes

"Trigonometry," first appeared as the title of a book Trigonometria (literally, the measuring of triangles), published by Bartholomeo Pitiscus in 1595.

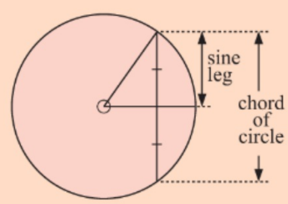
http://ualr.edu/lasmoller/trig.html

HISTORICAL NOTE

The origin of the term "sine" is quite fascinating. **Aryabhata**, a Hindu mathematician who studied trigonometry in the 5th century AD, called the sine-leg of a circle diagram "ardha-jya" which means "half-chord". This was eventually shortened to "jya".

When Arab scholars later translated Aryabhata's work into Arabic, they initially translated "jya" phonetically as "jiba". Since this meant nothing in Arabic, they very shortly began writing the word as "jaib", which has the same letters but means "cove" or "bay".

In 1150, **Gerardo of Cremona** translated this work into Latin. He replaced "jaib" with "sinus", which means "bend" or "curve" but was commonly used in Latin to refer to a bay or gulf on a coastline. The term "sine" that we use today comes from this Latin word.



The term "cosine" comes from the fact that the cosine of an angle is equal to the sine of its complement. In 1620, **Edmund Gunter** introduced the abbreviated "co sinus" for "complementary sine".

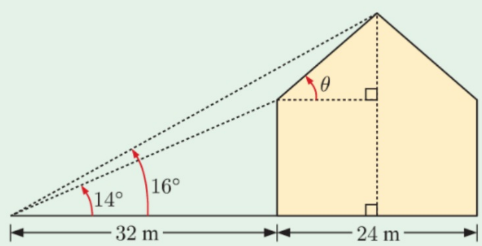
C FINDING SIDE LENGTHS

Warm-up:

OPENING PROBLEM

A group of students is asked to measure the height of the school gymnasium. It is a symmetric building 24 m wide, as shown.

From a point 32 m from the side wall, the students measure the angles of elevation to the top of the side wall, and to the top of the roof.



Things to think about:

- **a** How high is:
  - **i** the side wall of the gymnasium
  - **ii** the top of the roof?
- **b** Can you find the angle θ which is the pitch of the roof?

Warm-up: Side wall of Gymnasium

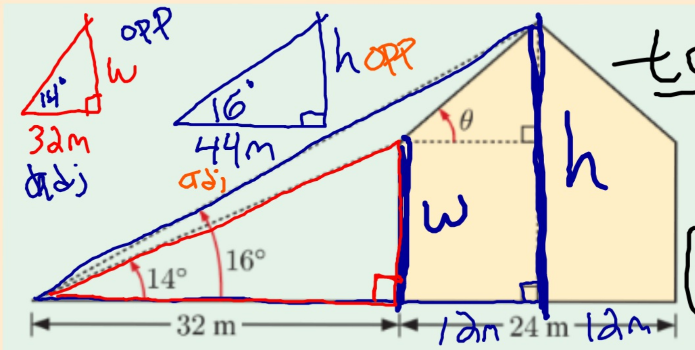
Things to think about:

a How high is:

i the side wall of the gymnasium   **ii** the top of the roof?

b Can you find the angle θ which is the pitch of the roof?

$\tan\theta = \frac{opp}{adj}$



$\frac{\tan 14}{1} = \frac{w}{32}$

$w = 32 \cdot \tan 14$

$w \approx 7.98m$

$\frac{\tan 16}{1} = \frac{h}{44}$

$h = 44 \cdot \tan 16$

$h \approx 12.62m$

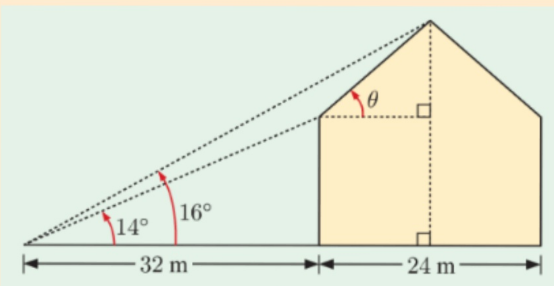
Warm-up: Top of the roof

Things to think about:

a How high is:

  i the side wall of the gymnasium **ii** the top of the roof?

b Can you find the angle θ which is the pitch of the roof?

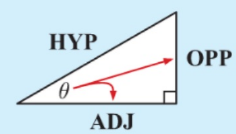


C FINDING SIDE LENGTHS

Suppose we are given the angles of a right angled triangle, and the length of a side. We can use the trigonometric ratios to find the other side lengths.

In any right angled triangle with one angle θ, we have:

$$\sin\theta = \frac{\textbf{OPP}}{\textbf{HYP}}, \quad \cos\theta = \frac{\textbf{ADJ}}{\textbf{HYP}}, \quad \tan\theta = \frac{\textbf{OPP}}{\textbf{ADJ}}$$



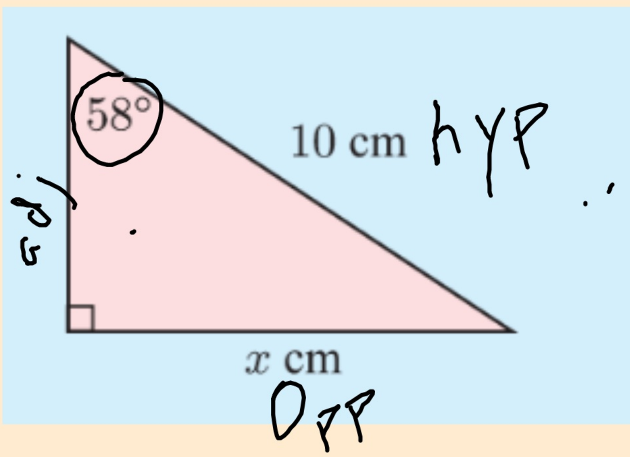
Step 1: Redraw the figure and mark on it HYP, OPP, and ADJ relative to a given angle.

Step 2: Choose an appropriate trigonometric ratio, and construct an equation.

Step 3: Solve the equation to find the unknown side length.

Example: Draw triangle in notebook.

Find x, giving your answer rounded to 2 decimal places:



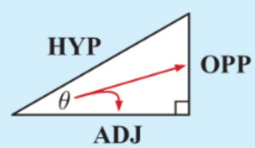
$\frac{\sin(58)}{1} = \frac{x}{10}$

$x = 10\sin(58)$

$x \approx 8.48$ cm

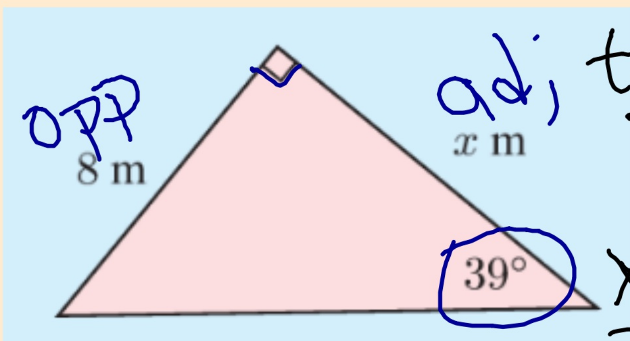
In any right angled triangle with one angle θ, we have:

$\sin\theta = \frac{\textbf{OPP}}{\textbf{HYP}}$, $\cos\theta = \frac{\textbf{ADJ}}{\textbf{HYP}}$, $\tan\theta = \frac{\textbf{OPP}}{\textbf{ADJ}}$



Example: Draw triangle in notebook.

Find x, giving your answer rounded to 2 decimal places:



$\tan\theta = \frac{opp}{adj}$

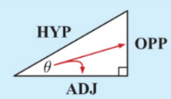
$\frac{\tan 39}{1} = \frac{8}{x}$

$\frac{x(\tan 39)}{\tan(39)} = \frac{8}{\tan(39)}$

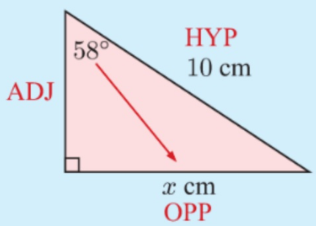
$x = \frac{8}{\tan 39} \approx 9.88\ m$

In any right angled triangle with one angle θ, we have:

$\sin\theta = \frac{\text{OPP}}{\text{HYP}}, \quad \cos\theta = \frac{\text{ADJ}}{\text{HYP}}, \quad \tan\theta = \frac{\text{OPP}}{\text{ADJ}}$



The relevant sides are OPP and HYP, so we use the *sine* ratio.

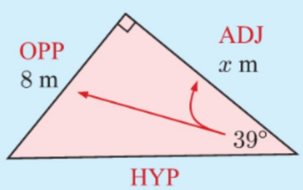


$$\sin 58° = \frac{x}{10} \qquad \{\sin\theta = \frac{\text{OPP}}{\text{HYP}}\}$$

$$\therefore\ \sin 58° \times 10 = x \qquad \{\text{multiplying both sides by } 10\}$$

$$\therefore\ x \approx 8.48 \qquad \{\text{calculator}\}$$

The relevant sides are OPP and ADJ, so we use the *tangent* ratio.



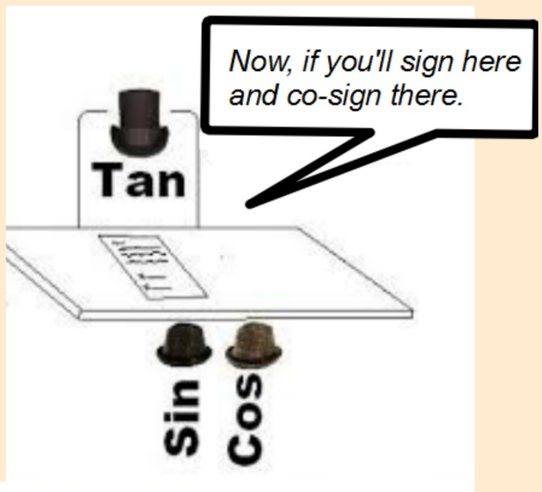
$$\tan 39° = \frac{8}{x} \qquad \{\tan\theta = \frac{\text{OPP}}{\text{ADJ}}\}$$

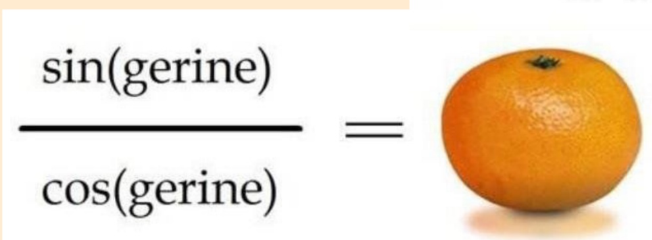
$$\therefore\ x \times \tan 39° = 8 \qquad \{\text{multiplying both sides by } x\}$$

$$\therefore\ x = \frac{8}{\tan 39°} \qquad \{\text{dividing both sides by } \tan 39°\}$$

$$\therefore\ x \approx 9.88 \qquad \{\text{calculator}\}$$

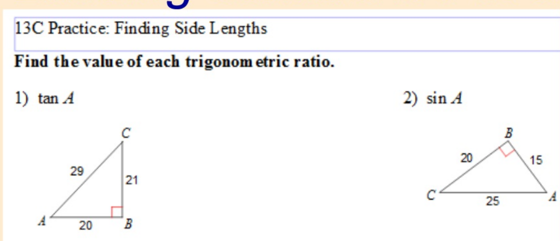
Joke break!


Now, if you'll sign here and co-sign there.
Tan
Sin
Cos


sin(gerine)
cos(gerine)
=

<u>Choose Your Class Practice:</u>

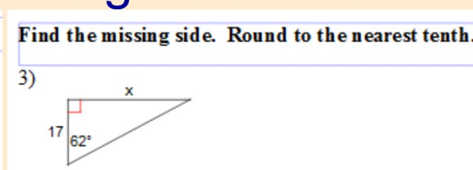
Building confidence in solving for sides?


13C Practice: Finding Side Lengths

Find the value of each trigonometric ratio.

1) tan *A*

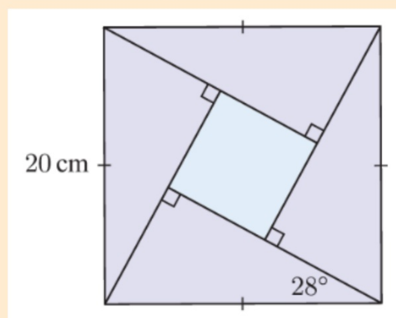
2) sin *A*


Find the missing side. Round to the nearest tenth.

3)

Confident solving for sides using trig?

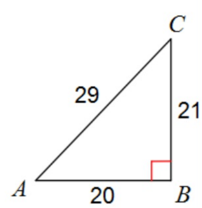
Square Tiling Pattern



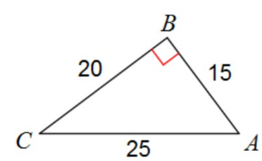
Example:

Find the value of each trigonometric ratio.

1) tan A

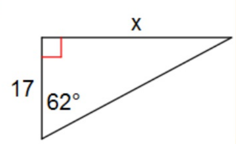


2) sin A

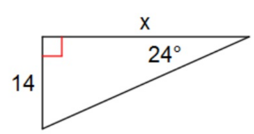


Find the missing side. Round to the nearest tenth.

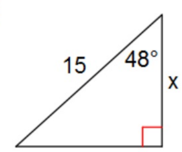
3)



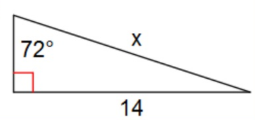
4)



5)



6)



Solutions

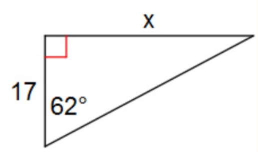
1) $\frac{21}{20}$ 2) $\frac{4}{5}$ 3) 32.0 4) 31.4

5) 10.0 6) 14.7 7) 20.6 8) 10.9

Any problems we need to go over?

Find the missing side. Round to the nearest tenth.

3)



Example: Work at your tables

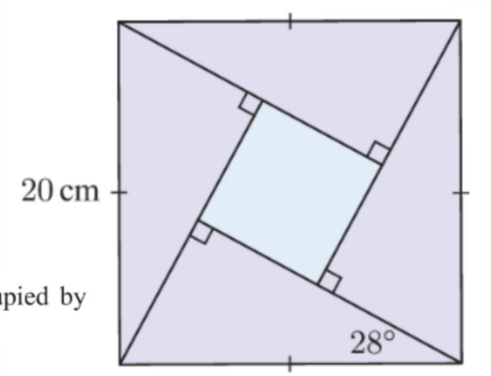
A square tiling pattern is created from four identical triangular tiles and a smaller central square tile, as shown. Find:

a the perimeter of each triangular tile

b the area of each triangular tile

c the side length of the central square tile

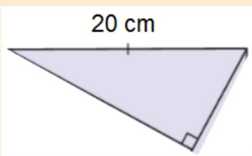
d the percentage of the pattern which is occupied by the central square tile.



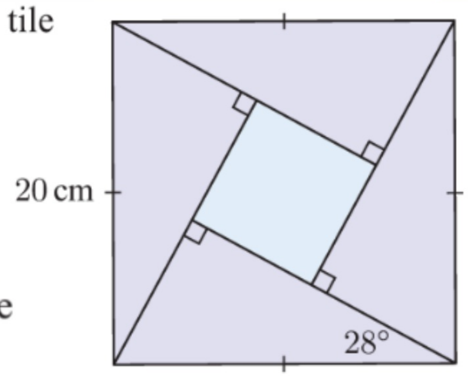
Example:

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



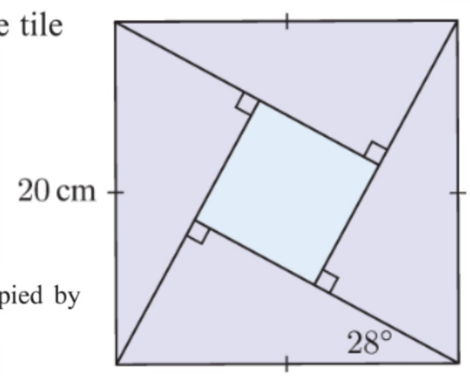
b the area of each triangular tile



Example:

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

c the side length of the central square tile



d the percentage of the pattern which is occupied by the central square tile.

Example:

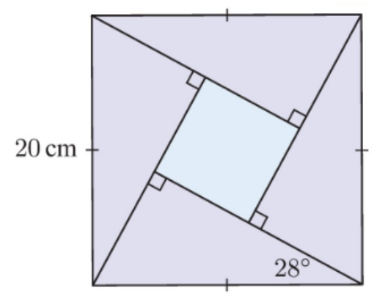
A square tiling pattern is created from four identical triangular tiles and a smaller central square tile, as shown. Find:

a the perimeter of each triangular tile

b the area of each triangular tile

c the side length of the central square tile

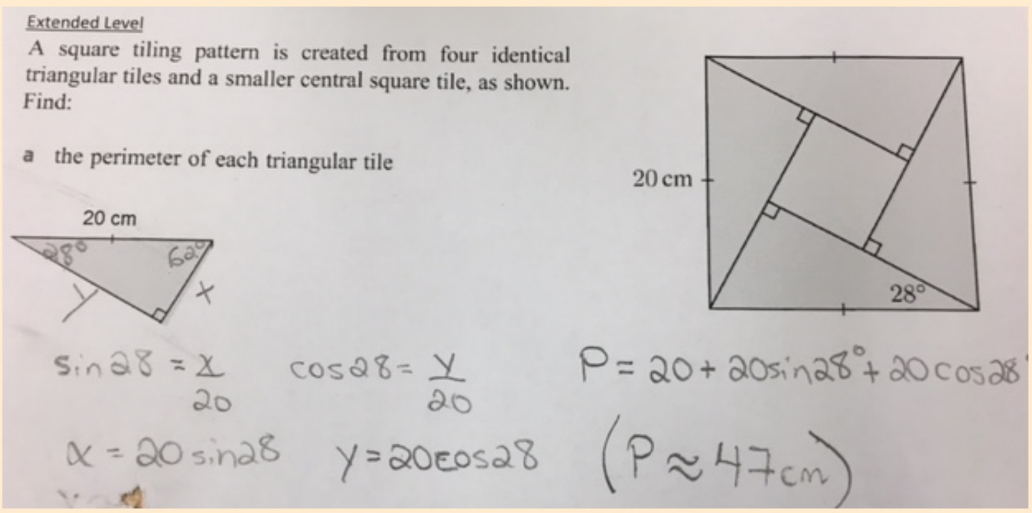
d the percentage of the pattern which is occupied by the central square tile.



a ≈ 47.0 cm **b** $\approx 82.9\text{ cm}^2$ **c** ≈ 8.27 cm

d $\approx 17.1\%$

<u>Example:</u> **solution**



Extended Level

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

$\sin 28 = \frac{x}{20}$ $\cos 28 = \frac{y}{20}$ $P = 20 + 20\sin 28° + 20\cos 28°$

$x = 20\sin 28$ $y = 20\cos 28$ $(P \approx 47\text{cm})$

Example: **solution**

b the area of each triangular tile

$A = \frac{1}{2}bh$

$A = \frac{1}{2}(20\sin 28)(20\cos 28)$

$A = 200(\sin 28)(\cos 28)$

$A \approx 82.9\ cm^2$

c the side length of the central square tile

Large Square Area = 20×20

$A_L = 400 cm^2$

$A(4\Delta's) = 4(82.9) \approx 331.6$

Square Area = $400 - 331.6$

Square Area $\approx 68.4 cm^2$

Side of square = $\sqrt{68.4}$

$S \approx 8.27 cm$

d the percentage of the pattern which is occupied by the central square tile.

$\frac{\text{Central Square}}{\text{Large Square}} = \frac{68.4}{400} = .171$

About 17.1%

C FINDING SIDE LENGTHS

Exercises...

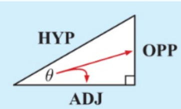
13C p.257 #1(g-i), 2 (a-c,j-l), 3

Challenge! 13B p.255 #6 (a-f)

SUPER HOT #6 (g-i)

In any right angled triangle with one angle θ, we have:

$\sin\theta = \frac{\text{OPP}}{\text{HYP}}$, $\cos\theta = \frac{\text{ADJ}}{\text{HYP}}$, $\tan\theta = \frac{\text{OPP}}{\text{ADJ}}$



(Use technology or print outs to access exercises)

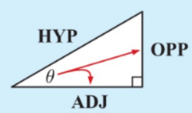
Exercises...

13B p.255 #6

13C p.257 #1(g-i), 2 (a-c,j-l), 3

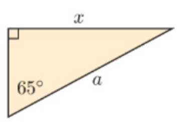
In any right angled triangle with one angle θ, we have:

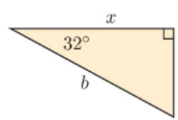
$\sin\theta = \frac{\textbf{OPP}}{\textbf{HYP}}$, $\cos\theta = \frac{\textbf{ADJ}}{\textbf{HYP}}$, $\tan\theta = \frac{\textbf{OPP}}{\textbf{ADJ}}$

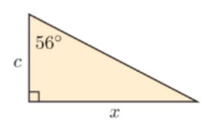


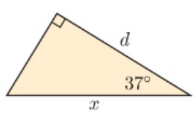
EXERCISE 13C

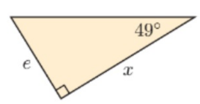
1 Write down a trigonometric equation connecting the angle and the sides given:

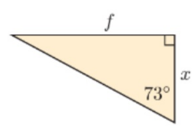
a


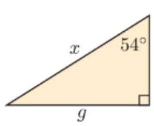
b


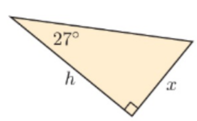
c


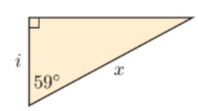
d


e


f


g


h


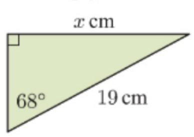
i


13C p.257 #1(g-i), 2 (a-c,j-l), 3

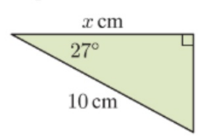
13B p.255 #6

2 Find x, rounding your answer to 2 decimal places:

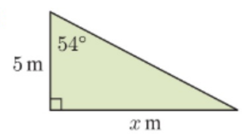
a



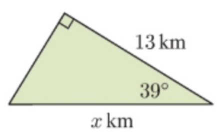
b



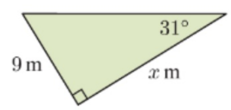
c



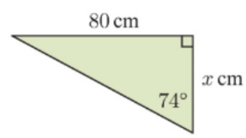
d



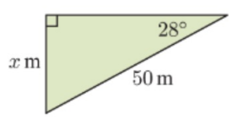
e



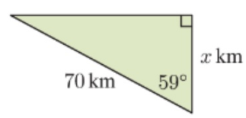
f



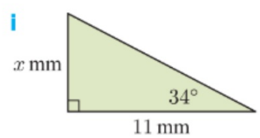
g



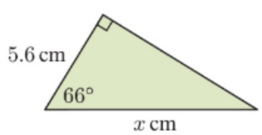
h



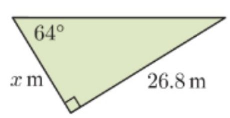
i



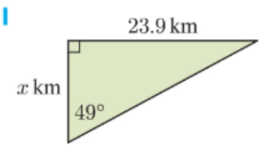
j



k



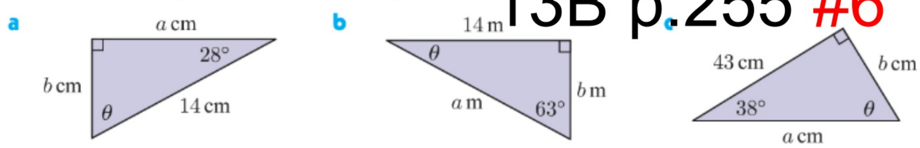
l



13C p.257 #1(g-i), 2 (a-c,j-l), 3

3 Find, to 1 decimal place, *all* unknown angles and sides:

13B p.255 #6



SOLUTIONS

EXERCISE 13C

1 a $\sin 65° = \frac{x}{a}$ b $\cos 32° = \frac{x}{b}$ c $\tan 56° = \frac{x}{c}$

d $\cos 37° = \frac{d}{x}$ e $\tan 49° = \frac{e}{x}$ f $\tan 73° = \frac{f}{x}$

g $\sin 54° = \frac{g}{x}$ h $\tan 27° = \frac{x}{h}$ i $\cos 59° = \frac{i}{x}$

2 a $x \approx 17.62$ b $x \approx 8.91$ c $x \approx 6.88$

d $x \approx 16.73$ e $x \approx 14.98$ f $x \approx 22.94$

g $x \approx 23.47$ h $x \approx 36.05$ i $x \approx 7.42$

j $x \approx 13.77$ k $x \approx 13.07$ l $x \approx 20.78$

3 a $\theta = 62°$, $a \approx 12.4$, $b \approx 6.6$

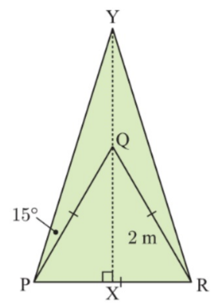
b $\theta = 27°$, $a \approx 15.7$, $b \approx 7.1$

c $\theta = 52°$, $a \approx 54.6$, $b \approx 33.6$

EXERCISE 13B

13B p.255 #6

6



In the diagram alongside, PQR is an equilateral triangle with side lengths 2 m.
Use the diagram to prove that:

a $\cos 60° = \frac{1}{2}$

b $\sin 60° = \frac{\sqrt{3}}{2}$

c $\tan 60° = \sqrt{3}$

d $\cos 30° = \frac{\sqrt{3}}{2}$

e $\sin 30° = \frac{1}{2}$

f $\tan 30° = \frac{1}{\sqrt{3}}$

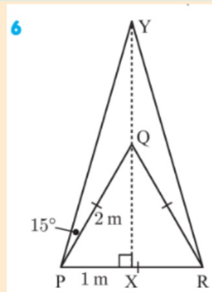
g $\tan 75° = \sqrt{3} + 2$

h $\tan 15° = 2 - \sqrt{3}$

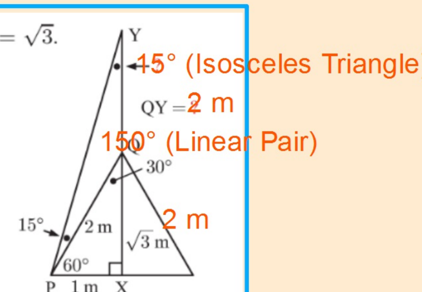
i $\cos^2 75° = \frac{2-\sqrt{3}}{4}$

SOLUTION

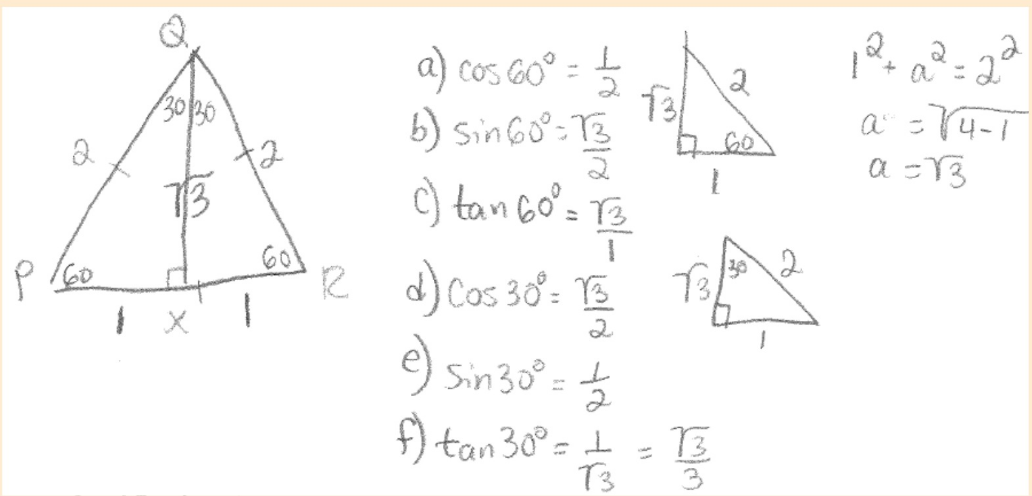
6



- Show $QX = \sqrt{3}$.
- Consider:

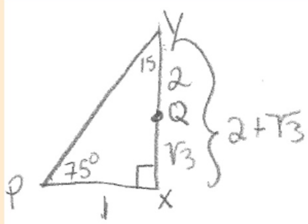


SOLUTION



Q
2
2
30
30
√3
P
60
60
R
1
x
1
a) cos 60° = 1/2
b) sin 60° = √3/2
c) tan 60° = √3/1
d) Cos 30° = √3/2
e) sin 30° = 1/2
f) tan 30° = 1/√3 = √3/3
√3
2
60
1
√3
30
2
1
1² + a² = 2²
a = √4-1
a = √3

SOLUTION

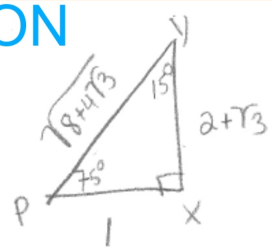


g) $\tan 75 = 2+\sqrt{3}$

h) $\tan 15° = \dfrac{1}{(2+\sqrt{3})}\left(\dfrac{2-\sqrt{3}}{2-\sqrt{3}}\right)$

$= \dfrac{2-\sqrt{3}}{4-2\sqrt{3}+2\sqrt{3}-3} = \dfrac{2-\sqrt{3}}{4-3} = \boxed{2-\sqrt{3}}$

SOLUTION



$$PY^2 = 1^2 + (2+\sqrt{3})^2$$

$$PY^2 = 1 + 4 + 2\sqrt{3} + 2\sqrt{3} + 3$$

$$PY^2 = 8 + 4\sqrt{3}$$

$$PY = \sqrt{8+4\sqrt{3}}$$

$$\cos 75^\circ = \frac{1}{\sqrt{8+4\sqrt{3}}}$$

$$\cos^2 75^\circ = \left(\frac{1}{\sqrt{8+4\sqrt{3}}}\right)^2 = \left(\frac{1}{\sqrt{8+4\sqrt{3}}}\right)\left(\frac{1}{\sqrt{8+4\sqrt{3}}}\right) = \frac{1}{8+4\sqrt{3}}$$

$$\cos^2 75^\circ = \frac{1}{8+4\sqrt{3}}\left(\frac{8-4\sqrt{3}}{8-4\sqrt{3}}\right) = \frac{8-4\sqrt{3}}{64 - \cancel{32\sqrt{3}} + \cancel{32\sqrt{3}} - 48}$$

$$= \frac{8-4\sqrt{3}}{16} = \boxed{\frac{2-\sqrt{3}}{4}}$$