Name: Key Date: _____

**UNIT 6** **LESSON 8**

90°

**AIM: WHAT ARE COFUNCTIONS?**

*Do Now:* If two ***complementary*** angles are represented by $4x$ and $7x - 9$, what is the value of x?

$4x + 7x - 9 = 90$

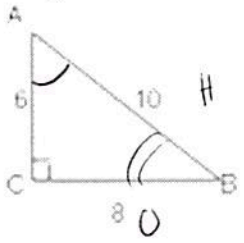
$11x - 9 = 90$

$+9 \quad +9$

$11x = 99$

$\boxed{x = 9}$

Determine the following:




sinA = $\frac{8}{10} = \frac{4}{5}$

cosB = $\frac{8}{10} = \frac{4}{5}$

What is the *measure* of angle A? 53.1301

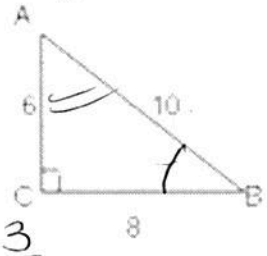
What is the *measure* of angle B? 36.8699

What is the relationship between these angles?

$53.1301 + 36.8699 = 90°$

They are complementary!

Determine the following:




sinB = $\frac{6}{10} = \frac{3}{5}$

cosA = $\frac{6}{10} = \frac{3}{5}$

What is the *measure* of angle A? 36.8699

What is the *measure* of angle B? 53.1301

What is the relationship between these angles?

$36.8699 + 53.1301 = 90°$

They are complementary!

**SINE AND COSINE OF COMPLEMENTARY ANGLES**

If A and B are complementary angles,

$$\boldsymbol{sinA = cosB}$$
$$\boldsymbol{cosA = sinB}$$

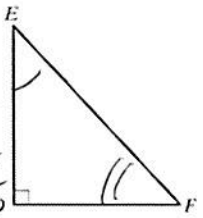
When $0° < \theta < 90°$, $sin(90° - \theta) = cos\theta$ and $sin\theta = cos(90° - \theta)$

**Therefore, sine and cosine are called** COFUNCTIONS **!**

1. In right triangle DEF, where $m\angle D = 90^\circ$, which of the following statements is always true?

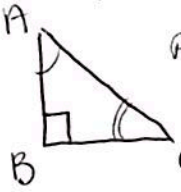
1) $\sin D = \cos F$
2) $\tan E = \cos F$
3) $\sin F = \cos E$
4) $\tan D = \sin E$

$E + F = 90^\circ$
$\sin E = \cos F$
$\sin F = \cos E$



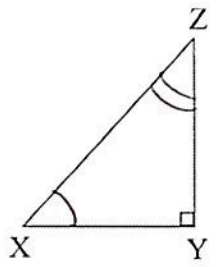
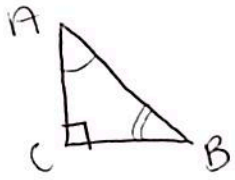
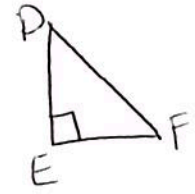
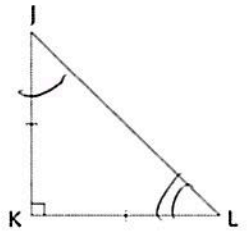

2. In right triangle ABC, where $m\angle B = 90^\circ$, which of the following statements is always true?

1) $\sin A = \cos B$
2) $\sin A = \cos C$
3) $\tan A = \cos C$
4) $\sin A = \tan B$



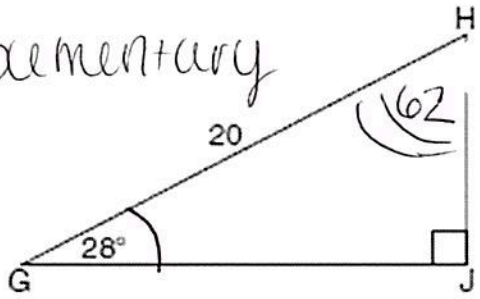

$A + C = 90$
$\sin A = \cos C$
$C \sin C = \cos A$

3. Each of the following diagrams and examples is a right triangle. Fill in the blanks based on the sine & cosine of angles that add to 90°

| | | | |
|---|---|---|---|
|   | Right Triangle ABC with $m\angle C = 90^\circ$.   | Right Triangle DEF with $m\angle E = 90^\circ$.   |   |
| $\sin X = \cos Z$ or $\sin Z = \cos X$ | $\sin A = \cos B$ or $\sin B = \cos A$ | $\sin D = \cos F$ or $\sin F = \cos D$ | $\sin I = \cos L$ or $\sin L = \cos I$ |

4. When instructed to find the length of $\overline{HJ}$ in right triangle *HJG*, Jia wrote the equation $\sin 62^\circ = \frac{GJ}{20}$ while Dan wrote $\cos 28^\circ = \frac{GJ}{20}$. Are both students' equations correct? Explain why.

yes! $(62 + 28 = 90)$ G and H are complementary
so $\sin H = \cos G$.




**Sine & Cosine of Angles that add to 90°**

$\sin A = \cos B$ **if** $A + B =$ 90 °

5. Solve the following.

a) $\sin 27^\circ = \cos$ 63 °
$90 - 27 = 63$

b) $\cos 55^\circ = \sin$ 35 °
$90 - 55 = 35$

c) $\sin 17.8^\circ = \cos$ 72.2 °
$90 - 17.8 = 72.2$

d) $\cos 90^\circ = \sin$ 0 °
$90 - 90 = 0$

e) $\cos 45^\circ = \sin$ 45 °
$90 - 45 = 45$

f) $\sin 62\frac{2}{3}^\circ = \cos$ 27.3 °
$90 - 62\frac{2}{3}$ $\frac{82}{3}$

6. Find the value of $\theta$ that will make the equation $\sin\theta = \cos 37^\circ$ true when $0^\circ < \theta < 90^\circ$. Explain your answer.

$\theta = 90 - 37 = 53^\circ$ b/c sin and cos are cofunctions
so $\sin A = \cos B$ when A & B are complementary

set = to 90° ★DO NOT SET = TO EACHOTHER!★

7. In a right triangle, $\sin(2x-15)^\circ = \cos(x-12)^\circ$. What is the value of x?

$2x-15+x-12 = 90$

$3x-27=90$

$3x=117$

$\boxed{x=39}$

8. In a right triangle, $\sin(x+5)^\circ = \cos(4x+10)^\circ$. What is the value of x?

$x+5+4x+10=90$

$5x+15=90$

$-15 \quad -15$

$5x=75$

$\boxed{x=15}$

9. Find the value of $B$ that will make the equation $\sin 62^\circ = \cos B$ true when $0^\circ < B < 90^\circ$. Explain your answer.

$90-62=28^\circ=B$ b/c sin + cos are cofunctions

so $\sin A = \cos B$ when A & B are complementary

**NOW YOU TRY SOME!** For questions 1-6, find values for $\theta$ that make each statement true:

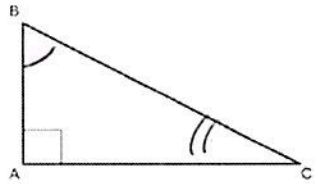
| | |
|---|---|
| 1. $sin\theta = cos25°$<br>$90-25=\boxed{65°}$ | 2. $sin80° = cos\theta$<br>$90-80=\boxed{10°}$ |
| 3. $sin\theta = cos(\theta+10)°$<br>$\theta+\theta+10=90$<br>$2\theta+10=90$<br>$\frac{2\theta}{2}=\frac{80}{2}$<br>$\boxed{\theta=40}$ | 4. $sin(\theta-45)° = cos\theta$<br>$\theta-45+\theta=90$<br>$2\theta-45=90$<br>$2\theta=135$<br>$\boxed{\theta=67.5}$ |

Name: Kelly Date: _____

**UNIT 6** **LESSON 8**

**HOMEWORK**

1. In scalene triangle *ABC* shown in the diagram below, $m\angle A = 90^o$. Which equation is always true?




1) $\cos C = \cos B$
2) $\sin C = \sin B$
3) $\sin B = \cos C$
4) $\cos B = \sin A$

2. In a right triangle, $\sin(5x + 15)° = \cos(4x - 6)°$. What is the value of x?

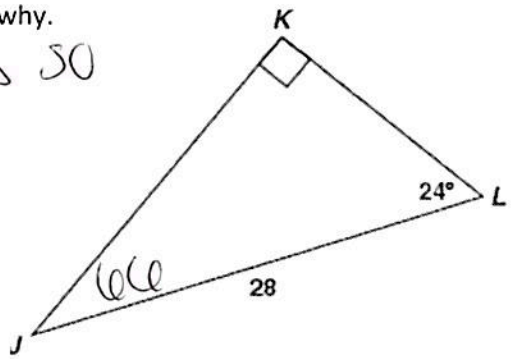
$5x + 15 + 4x - 6 = 90$
$9x + 9 = 90$
$9x = 81$
$x = 9$

4. Find the value of $B$ that will make the equation $\sin 89^o = \cos B$ true when $0° < B < 90°$. Explain your answer.

$90 - 89 = 1 = B$
sin & cos are cofunctions so $\sin A = \cos B$ when A & B are complementary

3. When instructed to find the length of $\overline{KL}$ in right triangle *HJG*, Conor wrote the equation $\cos 24^o = \frac{KL}{28}$ while Steve wrote $\sin 66^o = \frac{KL}{28}$. Are both students' equations correct? Explain why.

Yes since cos are cofunctions so sin J = cos L when J + L are complementary



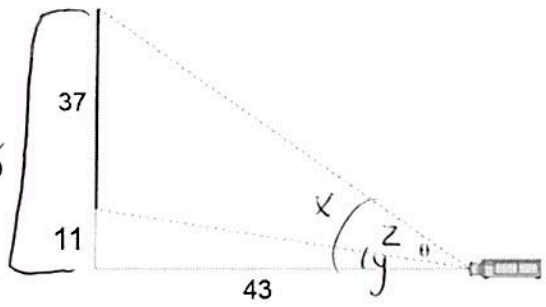
**Review Question**

5. As modeled below, a movie is projected onto a large outdoor screen. The bottom of the 37-foot-tall screen is 11 feet off the ground. The projector sits on the ground at a horizontal distance of 43 feet from the screen. Determine and state, to the *nearest tenth of a degree*, the measure of $\theta$, the projection angle.

*(Hint: Find the big angle of elevation, small angle of elevation and subtract!)*

★Big Δ: $\tan x = \left(\frac{48}{43}\right) \tan^{-1}$

$x = 48.144957468$




★small Δ: $\tan y = \frac{11}{43}$

$y = 14.34933204$

★subtract: $48.144957468 - 14.34933204 = \boxed{33.8^\circ}$

6. In the diagram below, quadrilateral *STAR* is a **rhombus** with diagonals $\overline{SA}$ and $\overline{TR}$ intersecting at *E*.
$ST = 3x + 30$, $SR = 8x - 5$, $m\angle RTA = 5y - 2$, and $m\angle TAS = 9y + 8$

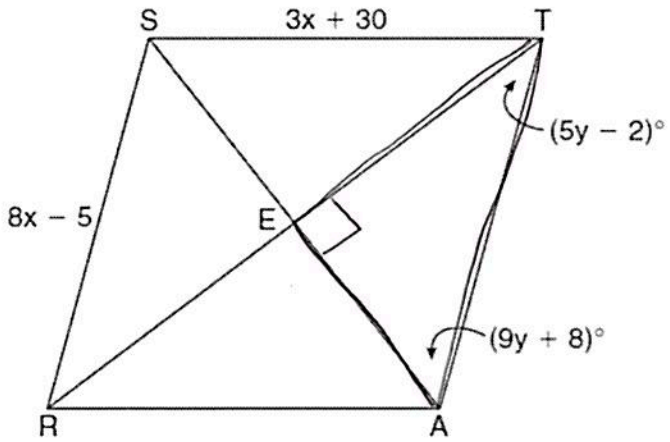
**(a) Find x:**

$8x - 5 = 3x + 30$

$-3x + 5 \quad -3x + 5$

$5x = 35$

$\boxed{x = 7}$




**(b) Find y:**

$5y - 2 + 9y + 8 = 90$

$14y + 6 = 90$

$-6 \quad -6$

$14y = 84$

$\boxed{y = 6}$