TRIG RATIOS PART 1

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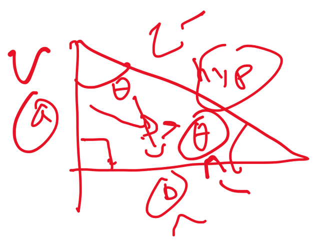
## Trig review

- Primary trig ratios:

  1. sine → SOH → $\sin\theta = opp/hyp$
  2. cosine → CAH → $\cos\theta = adj/hyp$
  3. tangent → TOA → $\tan\theta = opp/adj$




SOH CAH TOA

## Special angles:

1. Isosceles triangle → (45-45-90)

$\sin\theta = \frac{opp}{hyp}$ $\tan\theta = \frac{opp}{Adj} = \frac{a}{b}$

$\cos\theta = \frac{adj}{hyp}$

1, a, 45, 90, 45, b, 1, $\sqrt{2}(a)$ / $\sqrt{2}(b)$

0, 30°, 60°, 90°, 45°

$\cos 45 = \frac{1}{\sqrt{2}(a)}$ $\sin 45 = \frac{1}{\sqrt{2}}$

$\theta$ = arc = $\sin^{-1}$, $\cos^{-1}$, $\tan^{-1}$

Characteristic:
- Both legs (a and b) are equal
- Hyp is $\sqrt{2}$ times the length of a leg

2. Half-equivalent triangle → (30-60-90)

$\sqrt{3}$, 30, 2, 90, 60, 1

Characteristics:
- Sides have ratios $1 : \sqrt{3} : 2$ → $2 : \sqrt{6} : 4$
- Shortest side across from 30° angle

$\tan 60 = \frac{\sqrt{3}}{1}$

2, 60, 4, 30, $\sqrt{6}$

$\sqrt{6}$, 30, 4, 60, 2

## Rationalizing the denominator:

- To rationalize denominator multiply numerator and denominator by radical in original denominator

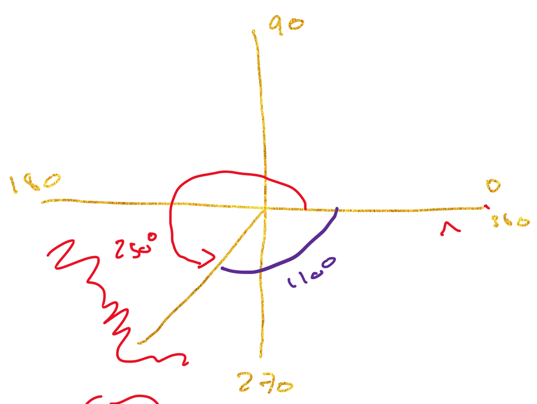
$$\left[\frac{1}{\sqrt{3}} \times \frac{\sqrt{3}}{\sqrt{3}}\right] = \frac{\sqrt{3}}{\sqrt{3}\sqrt{3}} = \frac{\sqrt{3}}{\sqrt{9}} = \frac{\sqrt{3}}{3}$$

$$\frac{2}{\sqrt{2}} \times \frac{\sqrt{2}}{\sqrt{2}} = \frac{2\sqrt{2}}{\sqrt{2}\sqrt{2}} = \frac{2\sqrt{2}}{\sqrt{4}} = \frac{2\sqrt{2}}{2} = \sqrt{2}$$

cos45

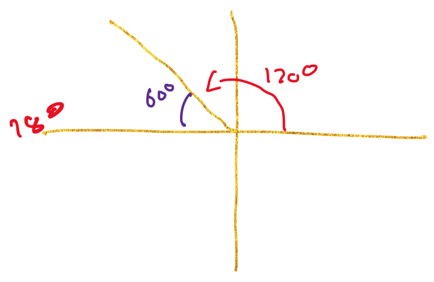
## Reference angle:

- Defined as the acute angle between the terminal arm of an angle in standard position and the closest x-axis, when the terminal arm lies in quadrant 2,3,4.
- Helpful for determining trig ratios for obtuse angles and angles >180°




180 2750 2270

Principal angle: 250° → Reference: 360 − 250 = 110°




Principal angle: 120 → Reference angle: 180 − 120 = 60°

CAH

$\cos\theta = \frac{b}{6}$

$6\cos\theta = b$

$b = 6\cos 30$

$b = 6\left(\frac{\sqrt{3}}{2}\right)$

b

$\sin\theta = \frac{opp}{hyp}$

$\sin 30 = \frac{a}{6}$

$a = 6\sin 30$

$= 6\left(\frac{1}{2}\right)$

$\sin 30 = \frac{1}{2}$

$\sqrt{2} \cdot 2$

$2\sqrt{2}$

45, 90

$$\sin 45 = \frac{2}{2\sqrt{2}} \times \frac{\sqrt{2}}{\sqrt{2}} = \frac{2\sqrt{2}}{2\sqrt{4}} = \frac{2\sqrt{2}}{2 \cdot 2} = \frac{2\sqrt{2}}{4} = \frac{1\sqrt{2}}{2}$$

$\sqrt{2} \times \sqrt{2}$, $\sqrt{4}$, 2

## Evaluating trig ratios for any angle:

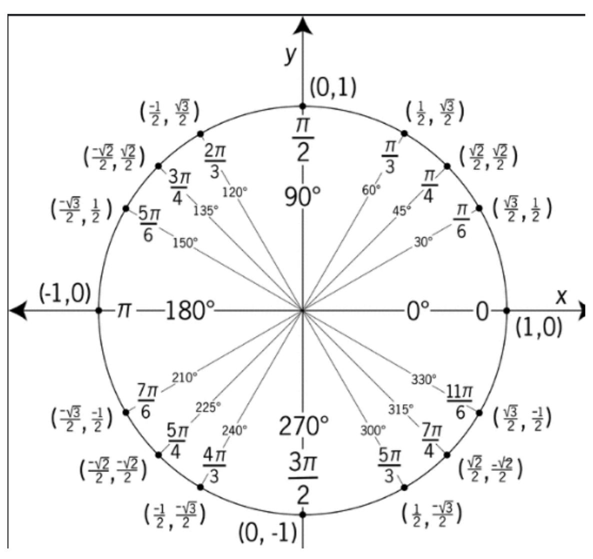
- CAST Rule helps remember which quadrant contains positive values for trig ratios.

| | |
|---|---|
| Q2: sin → + <br> cos, tan → − | Q1: sin, cos, tan → + |
| Q3: tan → + <br> sin, cos → − | Q4: cos → + <br> sin, tan → − |

Examples:
- sin 210°
- cos 240
- tan 315

## Unit circle:

- Simplifies computation of trig ratios
- x-coordinate of a point on unit circle represents $\cos\theta$, y-coordinate represents $\sin\theta$




## Negative and co-terminal angles:

- Co-terminal angles share same terminal arm in standard position
- Negative angles are measured clockwise from positive x-axis
- To find coterminal angles:
  - Degrees: Add and subtract 360°
  - Radians: Add and subtract $2\pi$