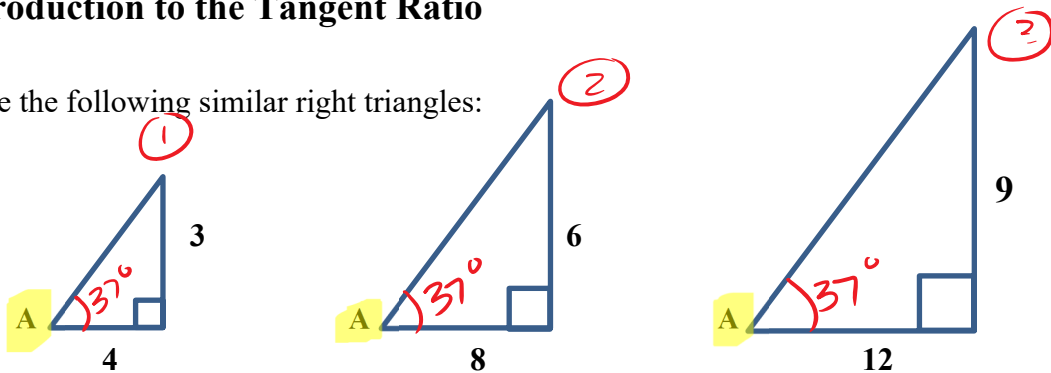


2.1 The Tangent Ratio & Using the Tangent Ratio to Calculate Lengths

A. Introduction to the Tangent Ratio

Compare the following similar right triangles:



Measure of $\angle A$: $\angle A_1 = 37^\circ$ $\angle A_2 = 37^\circ$ $\angle A_3 = 37^\circ$
* ANGLES ARE EQUAL

Calculate the ratio of sides:

① $\frac{3}{4} = 0.75$ ② $\frac{6}{8} = 0.75$ ③ $\frac{9}{12} = 0.75$
* RATIOS ARE EQUAL

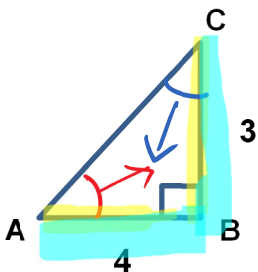
Tangent Ratio: the ratio between the opposite & adjacent sides of a right triangle (90°)

$\tan \theta = \frac{\text{opposite}}{\text{adjacent}}$

"toa"

Examples:

- 1) Determine $\tan A$ and $\tan C$.

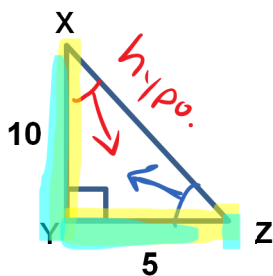


$$\begin{aligned} \tan A &= \frac{0}{a} \\ &= \frac{BC}{AB} \\ &= \frac{3}{4} \\ &= 0.75 \end{aligned}$$

$$\begin{aligned} \tan C &= \frac{0}{a} \\ &= \frac{AB}{BC} \\ &= \frac{4}{3} \\ &= 1.\overline{3} \end{aligned}$$

2) Calculate $\tan X$ and $\tan Z$.

$$t = \frac{o}{a}$$



$$\begin{aligned} \tan X &= \frac{YZ}{XY} \\ &= \frac{5}{10} \\ &= 0.5 \end{aligned}$$

$$\begin{aligned} \tan Z &= \frac{XY}{YZ} \\ &= \frac{10}{5} \\ &= 2 \end{aligned}$$

B. Calculating Tangent Ratio from Side Lengths

Steps:

1) Label triangle: H, O, A, θ

Hint: label angle first, then H, O, A sides.

2) Write tangent ratio equation. $\tan \theta = \frac{o}{a}$

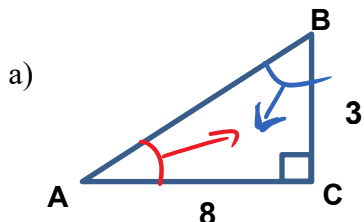
3) Fill in known values into equation.

4) Simplify (reduce fraction if possible) or calculate angle (and round decimal).

Examples: Determine the tangent ratios for $\angle A$ and $\angle B$.

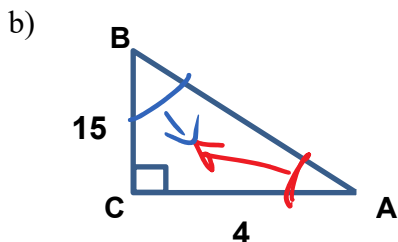
i) as a ratio

ii) as a decimal (4 places)



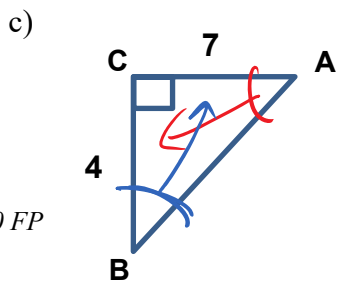
$$\begin{aligned} \tan A &= \frac{3}{8} \\ \tan A &= 0.3750 \end{aligned}$$

$$\begin{aligned} \tan B &= \frac{8}{3} \\ &= 2.6667 \end{aligned}$$



$$\begin{aligned} \tan A &= \frac{15}{4} \\ &= 3.7500 \end{aligned}$$

$$\begin{aligned} \tan B &= \frac{4}{15} \\ &= 0.2667 \end{aligned}$$



$$\begin{aligned} \tan A &= \frac{4}{7} \\ &= 0.5714 \end{aligned}$$

$$\begin{aligned} \tan B &= \frac{7}{4} \\ &= 1.7500 \end{aligned}$$

C. Calculating Tangent Ratio Given an Angle

- 1) Make sure your calculator is in degree mode (DEG or DRG or D).
- 2) Use the "tan" button your calculator.

Calculator instructions: $\boxed{\tan}(\text{angle})\boxed{=}$

or $(\text{angle})\boxed{\tan}$

Examples: Calculate the tangent ratio of the following angles to 4 decimal places.

a) $\theta = 35^\circ$

$$\tan(35) = 0.7002$$

b) $\theta = 27^\circ$

$$\tan(27) = 0.5095$$

c) $\theta = 72^\circ$

$$\tan(72) = 3.0777$$

D. Calculating an Angle Given the Tangent Ratio

- 1) Make sure your calculator is in degree mode (DEG or DRG).
- 2) Do the opposite of tan to both sides of the equation. Use the inverse tan or $\boxed{\tan^{-1}}$ button on your calculator.

inverse tan or $\boxed{\tan^{-1}}$
shift
2ndF

Calculator instructions:

$$\tan \theta = \text{ratio}$$

$$\cancel{\tan^{-1}} \cancel{\tan} \theta = \cancel{\tan^{-1}} \text{ratio}$$

$$\theta = \tan^{-1}(\text{ratio})$$

\swarrow $\div \tan$

$$\tan^{-1} = \frac{1}{\tan}$$

$$\boxed{2ndF} \boxed{\tan} (\text{ratio}) \boxed{=}$$

Examples: Calculate the angle of the following tangent ratios to the nearest degree.

a) $\tan \theta = 0.8693$

$$\theta = \tan^{-1}(0.8693)$$

$$= 41^\circ$$

$$\cancel{\tan} \theta = 0.8693$$

$$\cancel{\tan}$$

\tan^{-1}

b) $\tan \theta = 2.1445$

$$\theta = \tan^{-1}(2.1445)$$

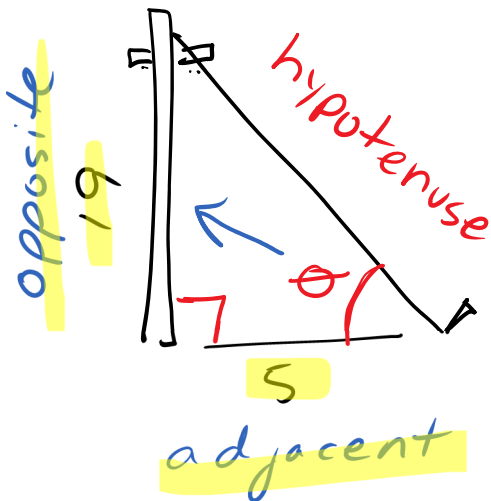
$$= 65^\circ$$

c) $\tan \theta = \frac{5}{6}$

$$\theta = \tan^{-1}(5 \div 6)$$

$$= 40^\circ$$

- d) A support cable is anchored to the ground 5 m from the base of a telephone pole. The pole is 19 m high. The cable is attached near the top of the pole. What angle, to the nearest degree, does the cable make with the ground?



$$\tan \theta = \frac{19}{5}$$

$$\tan \theta = \frac{19}{5}$$

$$\theta = \tan^{-1}\left(\frac{19}{5}\right)$$

$$= 75^\circ$$