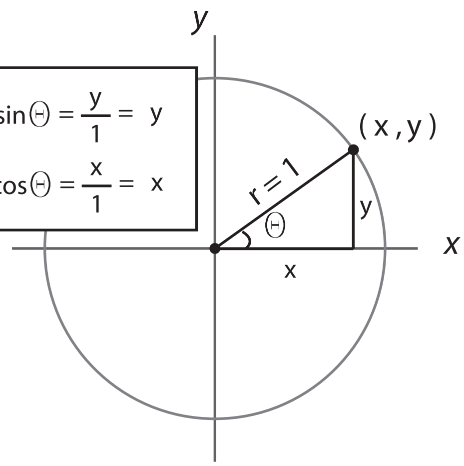
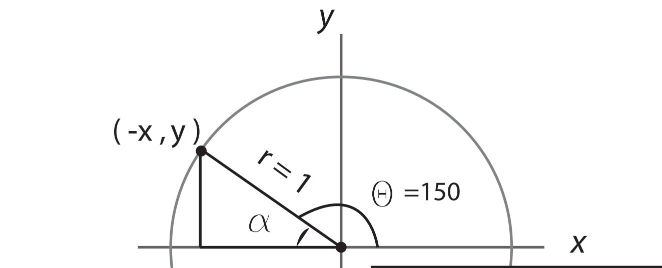
Structures I Review
Feb. 6, 2008

The Unit Circle and trigonometric functions (also called circular functions)

$\sin\Theta = \frac{y}{1} = y$

$\cos\Theta = \frac{x}{1} = x$





$\Theta = 150$

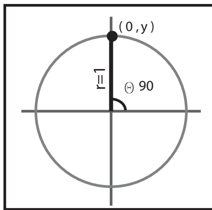
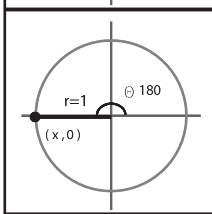
$\sin(150) = \frac{y}{1} = 0.5$

$\cos(150) = \frac{x}{1} = -0.87$

$\alpha = 30$

$\sin(30) = \frac{y}{1} = 0.5$

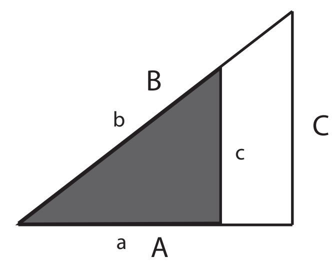
$\cos(30) = \frac{x}{1} = 0.87$

	$\Theta = 90$ $\sin(90) = \frac{y}{1} = 1$ $\cos(90) = \frac{x}{1} = 0$
	$\Theta = 180$ $\sin(180) = \frac{y}{1} = 0$ $\cos(180) = \frac{x}{1} = 1$

Question: Will a function of Θ depend of the length of r?

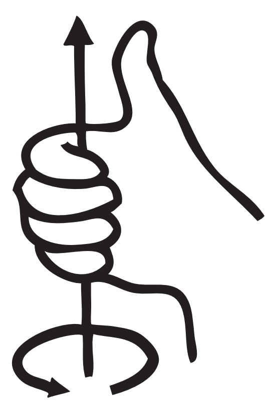
Answer: No, it will not. The functions are in terms of the ratios of the sides, not their lengths.

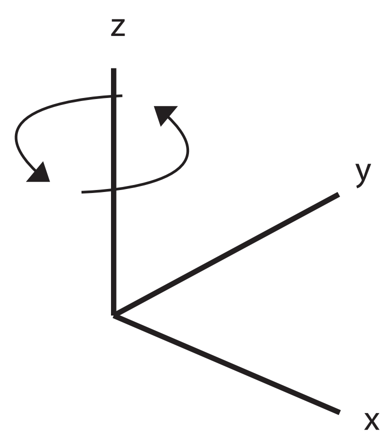
$$\frac{a}{c} = \frac{A}{C}$$



Right Hand Rule

A Cartesian coordinate system is said to be right handed provided the thumb of the right hand points in the direction of the positive z axis when the right-hand fingers are curled about this axis and directed from the positive x toward the positive y axis. Furthermore, according to this rule the z axis for a two dimensional problem would be directed outward perpendicular to the page.
Among other aspects, this can be a useful tool for remembering a counter-clockwise rotation about point is to be considered positive





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Principle of Moments

The moment of a force indicates that tendancy of a body to turn about an axis passing through a specific point O.

$M_o = Fd$

The magnitude of the moment is determined from $\mathbf{M_o = Fd}$ where d is the perpendicular of shortest distance from point O to the line of action of the force F.

Using the right hand rule, the sense of rotation is indicated by the fingers, and the thumb is directed aloing the moment axis, or line of action of the moment.

The moment of a force about a point is equal to the sum of the moments of the force's components about the point.

Equations of Equilibrium

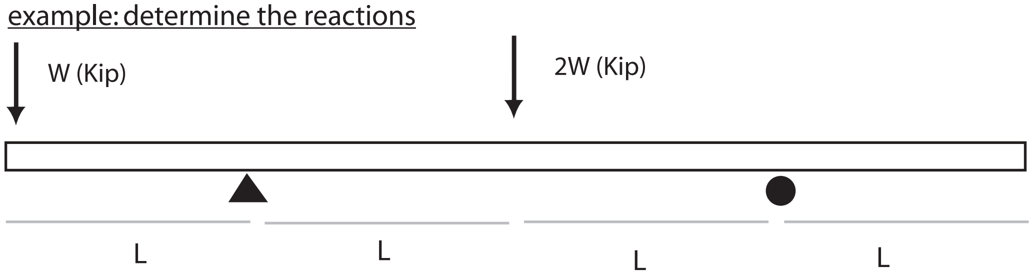
When the body is subjected to a system of forces, which all lie in the x-y plane, then the forces can be resolved into their x and y components.

$\sum F_x \quad \sum F_y \quad \sum M_O$

represent, repectively, the algebraic sums of the x and y components of all the forces acting on a body, and the algebraic sum of the moments of all the force components about an axis perpendicular to the x-y plane and passing through the arbitrary point O.

$\sum F_x = 0$
$\sum F_y = 0$
$\sum M_o = 0$

example: determine the reactions

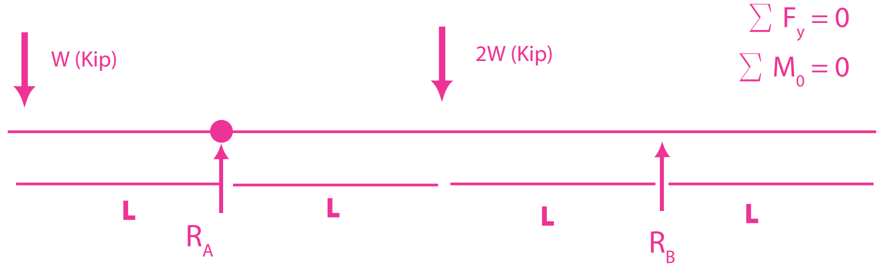


note: what does ▲ versus ● mean?

~~$\sum F_x = 0$~~
$\sum F_y = 0$
$\sum M_o = 0$

The first three steps

1. Draw free body diagram
2. Choose reference point
3. Write equalibrium equations



$\sum F_y = 0 = -W + R_A + -2W + W/2$

$\sum F_y = 0 = -3W + R_A + W/2$

$\sum F_y = 0 = -6/3W + R_A + W/2$

$R_A = 5/2W = 2.5\ W\ kip$

$\sum M_o = 0 = (-W\ kip)(-L\ ft) + (-2W\ kip)(L\ ft) + (R_B)(2L\ ft)$

$\sum M_o = 0 = (W\ L\ kip\ ft) + (-2W\ L\ kip\ ft) + (R_B)(2L\ ft)$

$\sum M_o = 0 = (-W\ L\ kip\ ft) + (R_B)(2L\ ft)$

$(W\ L\ kip\ ft)/(2L\ ft) = R_B$

$R_B = W/2\ kip = 0.5\ W\ kip$

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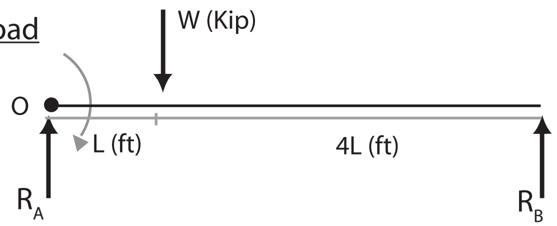
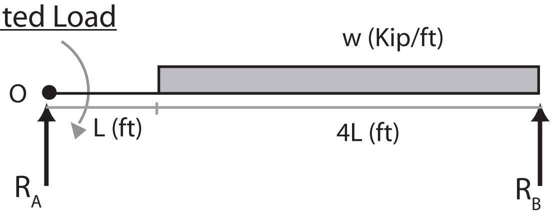
Point Load



Moment Equation

$$M_o = (-W)\,L + (R_B)\,(L + 4L) = 0$$

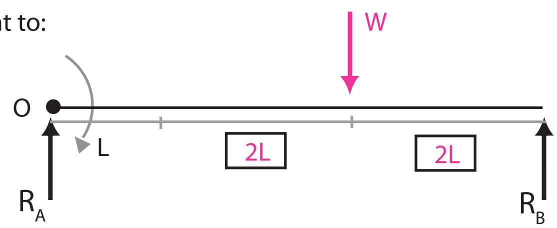
Distributed Load



Equivalent Point Load

W = w (Kip/~~ft~~) 4L (~~ft~~) = w4L (kip)

Eqivalent to:



Moment Equation

$$M_o = (-W)\,3L + (R_B)\,5L = 0$$