# Math Review – Scalars & Vectors

Hall defines a scalar as:

> "…physical quantity that is completely described by its magnitude."

Examples – mass, volume, length, speed.

A vector is defined as:

> "…physical quantity that posses both magnitude and direction."

Examples – force, weight, velocity, torque.

# Math Review – Order of Operations/Precedence

In solving an equation such as

$$x = \frac{4a(a \cdot b)^3 + 9c - 5(b - c)}{(b + c)^3}$$

the order to follow is

1) Parentheses

2) Exponents

3) Multiplication/division (left to right)

4) Addition/subtraction (left to right)

# Practice Algebra Problems

1. $3x = 7$

2. $\frac{x}{5} = 13$

3. $\frac{x}{3} + 21 = 14$

4. $2(5 - x) = 10(20x - 7)$

5. $\frac{15}{x} + 37 - 9x = 0$

6. $5x^2 = 17$

7. $\frac{1}{4}x^2 - \frac{3}{5} = \frac{5}{7}$

8. $\frac{3x}{8} - \frac{1}{3} = 15$

9. $d = \frac{1}{2}at^2$ solve for t in terms of a and d

10. $v_f^2 = 2ad$ solve for d in terms of a and $v_2$

(1) $x = 2.33$

(2) $x = 65$

(3) $x = -21$

(4) $x =$ [redacted] .396

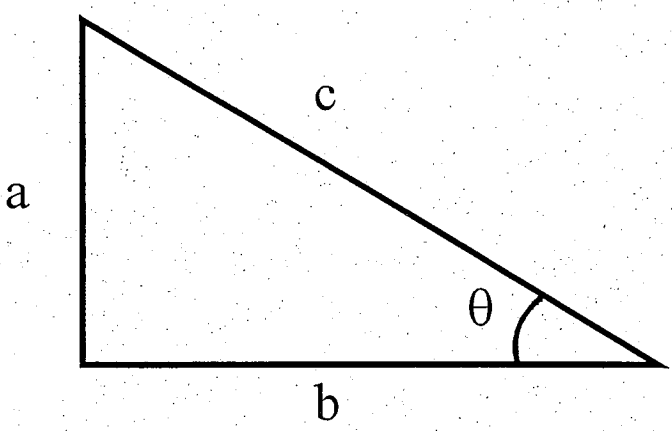
(6) $x = 1.84$

(8) $x =$ [redacted] 40.889

(9) $t = \sqrt{\frac{d}{1/2\,a}}$

(10) $d = \frac{v_f^2}{2a}$

# Math Review – Trigonometry




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

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

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

$$c^2 = a^2 + b^2$$

a is opposite side
b is adjacent side
c is hypotenuse

In vector applications, c will be the resultant vector, θ will be the direction of the resultant vector, a will be the vertical component, and b will be the horizontal component.

Type 1 problem:
Given a triangle with side c and θ known, find sides a and b. Or, given a vector with magnitude (c) and direction (θ), find the vertical (a) and horizontal (b) components.

Use: $\sin\theta = \frac{a}{c} \Rightarrow a = c \cdot \sin\theta$

$\cos\theta = \frac{b}{c} \Rightarrow b = c \cdot \cos\theta$

Type 2 problem:
Given a triangle with sides a and b known, find side c and θ. Or, given the vertical (a) and horizontal (b) components of a vector, find its magnitude (c) and direction (θ).

Use: $c^2 = a^2 + b^2 \Rightarrow c = \sqrt{a^2 + b^2}$

$\tan\theta = \frac{a}{b} \Rightarrow \theta = \tan^{-1}\left(\frac{a}{b}\right)$

Practice Trig Problems

The resultant ground reaction force is 900 N, oriented at an angle of 50° relative to the horizontal. Find the horizontal and vertical components.

A long jumper takes of with a horizontal velocity of her center of mass of 9.0 m/s and a vertical velocity of her center of mass of 2.0 m/s. Find the resultant velocity of her center of mass.

The horizontal component of the ground reaction force is 578.51 N and the vertical component is 689.44 N. Find the resultant ground reaction force.

A long jumper takes of with the velocity of her center of mass equal to 9.22 m/s oriented 12.5 deg above the horizontal. Find the horizontal and vertical components of the velocity of her center of mass