

**UNIT 5 Vectors**

**5.2 – Analytical Method of Vector Addition**

Vector addition is dealt in three conceptually equivalent ways:

1. graphical methods
2. analytical methods
3. algebraic methods

Sin law  $\frac{\sin A}{a} = \frac{\sin B}{b} = \frac{\sin C}{c}$   
Cos law  $c^2 = a^2 + b^2 - 2ab \cos C$

Recall the tools needed to solve vector problems:

Pythagorean Theorem  $C^2 = a^2 + b^2$   
 $C = \sqrt{a^2 + b^2}$

Primary Trig Ratios  $\sin \theta = \frac{b}{c}$   $\cos \theta = \frac{a}{c}$   $\tan \theta = \frac{b}{a}$

**Vector addition: graphical method**

If two vectors are represented by two sides of a triangle in sequence, then third closing side of the triangle, in the opposite direction of the sequence, represents the sum (or resultant) of the two vectors in both magnitude and direction.



For adding  $\vec{A} + \vec{B} = \vec{B} + \vec{A}$

$\vec{A} + \vec{B} = \vec{B} + \vec{A}$

$\vec{A} - \vec{B} = \vec{A} + (-\vec{B})$



**Vector addition: Analytical method**

We shall analyze vector addition in the form of triangle law to obtain the magnitude of the sum of the two vectors. Let P and Q be the two vectors to be added, which make an angle  $\theta$  with each other. We arrange the vectors in such a manner that two adjacent sides OA and AB of the triangle OAB, represent two vectors P and Q respectively as shown in the figure.



Get the 2 main components for vector Q

x-comp =  $Q \cos \theta$

y-comp =  $Q \sin \theta$



$R_x = P + Q \cos \theta$   
 $R_y = Q \sin \theta$

$R = \sqrt{(P + Q \cos \theta)^2 + (Q \sin \theta)^2}$

**Angle Directions** – using an x – y plane we define angle directions in the following way:

$\angle \alpha = \tan^{-1} \frac{y}{x}$

$\angle \alpha = \tan^{-1} \frac{Q \sin \theta}{P + Q \cos \theta}$

**Example:** An airplane flying toward  $\theta$  at 90.0 km/h is being blown toward  $90^\circ$  at 50.0 km/h. What is the resultant velocity of the plane?



$R = \sqrt{90^2 + 50^2} = \sqrt{8100 + 2500} = \sqrt{10600} = 102.96 \text{ km/hr}$   
 $\approx 103 \text{ km/hr}$

$\theta = \tan^{-1} \frac{y}{x} = \tan^{-1} \frac{50}{90} = 29.1^\circ$

$|R| = 103 \text{ km/hr } [29^\circ \text{ N of E}]$

# Two Dimensional Motion And Vectors Worksheet Answers

**Rosina Ehmman**



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