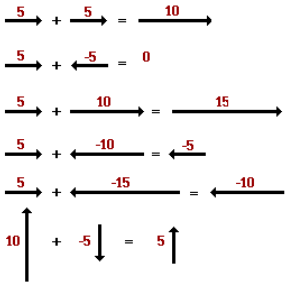
Unit 3 Vectors & Projectile Motion

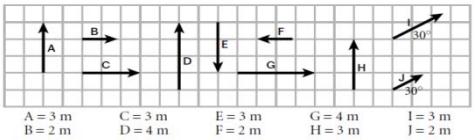
Also Known as 2-D Kinematics

- Vector quantities are often represented by vector diagrams.
- An arrow (with arrowhead) is drawn in a specified direction; thus, the vector has a *head (tip)* and a *tail*.
- The magnitude and direction of the vector is clearly labeled.
- The length of the arrow indicates the magnitude of the vector.
- Sooo…vector arrows give the magnitude and direction

Vector Addition



Examples

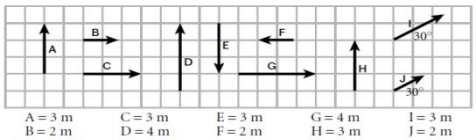


1. **Which vectors have the same magnitude?**
   (A, C, E, H, I) (B, F, J) (D, G)

2. **Which vectors have the same direction?**
   (A, D, H) (B, C, G) (I, J)

3. **Which arrows, if any, represent the same vector?**
   (A, H)

Examples



4. **The resultant of vector B and vector C is** ___*5*___ **meters.**

5. **The resultant of vector D and vector E is** ___*1*___ **meters.**

6. **The resultant of vector A and vector H is** ___*6*___ **meters.**

7. **The resultant of vector I and vector J is** ___*5*___ **meters.**

8. **Vector arrows indicate** ___***magnitude***___ **and** ___***direction***___**.**

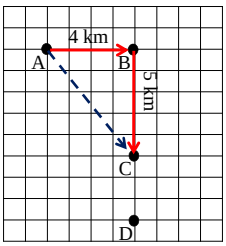
From Point A you travel 4 km east to point B and then turn south and travel 5 km south to point C. What is the magnitude of your displacement? Vectors are drawn tip to tail.

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

$$(4km)^2 + (5km)^2 = c^2$$

$$c = \sqrt{16 + 25}$$

$$c = 6.4km$$



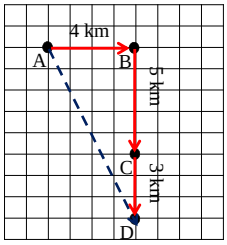
You then continue traveling south for another 3 km to Point D. What is the magnitude of your displacement from your original starting point A?

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

$$(4km)^2 + (8km)^2 = c^2$$

$$c = \sqrt{16 + 64}$$

$$c = 8.94km$$



Helpful Trig. Formulas

YOUR CALCULATOR MUST BE IN DEGREES!!!!

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

SOH CAH TOA

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

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

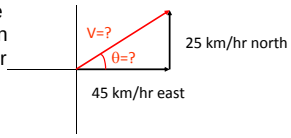
$$\tan\theta = \frac{opp}{adj}$$

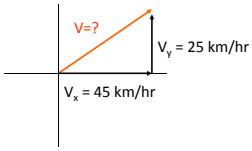
Vector Addition

You travel east at 45 km/hr and then north at 25 km/hr. What is your resultant velocity? (magnitude and direction)

45 km/hr east + 25 km/hr north

ALWAYS draw the "X" vector and then draw the "Y" vector (tip to tail)





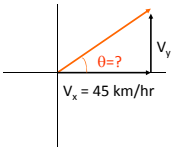
To get the **magnitude** of the resultant you use the Pythagorean theorem.

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

$$(45km/hr)^2 + (25km/hr)^2 = V^2$$

$$\sqrt{2025km^2/hr^2 + 625km^2/hr^2} = V$$

$$51.48km/hr = V$$



To get the **direction** you use $\tan^{-1}$ (arctan). If you drew the "X" vector first and then the "Y" vector it will always be y/x

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

$$\theta = \tan^{-1}\frac{opp}{adj}$$

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

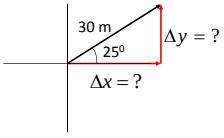
$$\theta = \tan^{-1}\frac{25km/hr}{45km/hr}$$

$$\theta = \tan^{-1} 0.556$$

$\theta = 29.05^0$ north of east

Resolving Vectors

You travel 30 meters at an angle that is 25^0 north of east. Resolve this vector into its components



$$\sin 25^0 = \frac{\Delta y}{30m}$$

$$(30m)\sin 25 = \Delta y$$

$$12.68m = \Delta y$$

$$\cos 25^0 = \frac{\Delta x}{30m}$$

$$(30\ m)\cos\ 25\ = \Delta x$$

$$27.19m = \Delta x$$