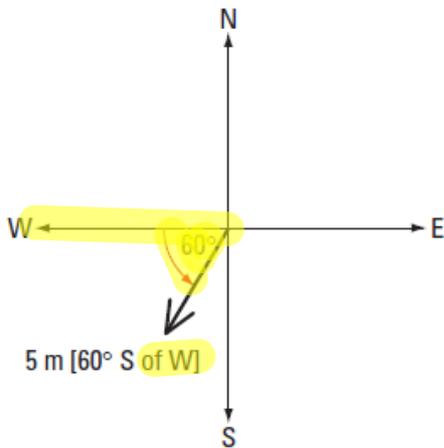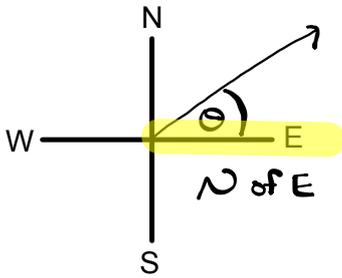# *L09 - Adding Vectors in 2-Dimensions*

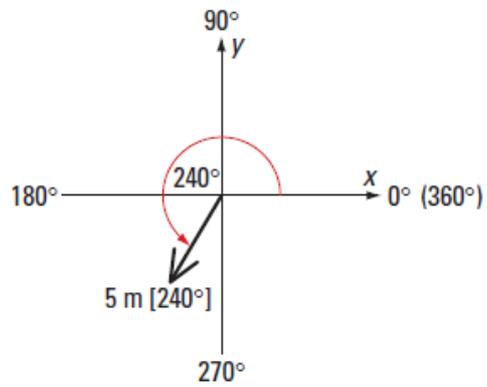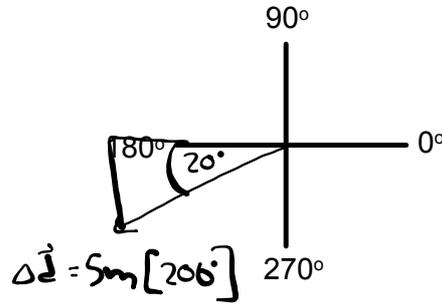**Agenda:**

- Attendance
- Today's Lesson

> *- Lesson: Vectors and Vector Components*

> *- Lesson: Relative Motion*
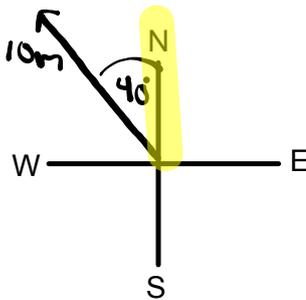
Vector Notations

Navigator Method

N
W ———— E
S

θ

N of E

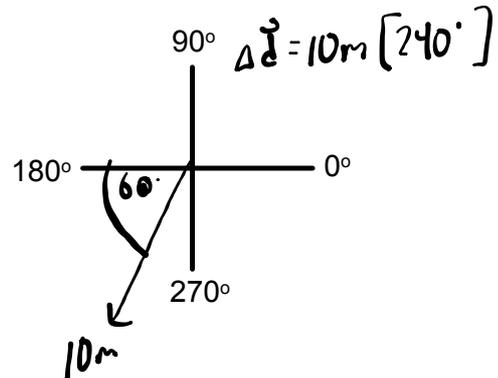### *Polar Coordinates Method*

90°
180° ———— 0°
270°

20°

$\Delta \vec{d} = 5m [200°]$

N
W ———— E
S

60°

5 m [60° S of W]

90°
180° —— x 0° (360°)
270°

240°

5 m [240°]

Practice

$\Delta \vec{d} = 10m [40° W \text{ of } N]$

N
W ———— E
S

40°

10m

$\Delta \vec{d} = 10m [300°]$

2   90°   1
180° ———— 0°   360°
3   270°   4

30°   60°

$\Delta \vec{d} = 10m [20° S \text{ of } E]$

N
W ———— E
S

20°

10m

$\Delta \vec{d} = 10m [240°]$

90°
180° ———— 0°
270°

60°

10m

2
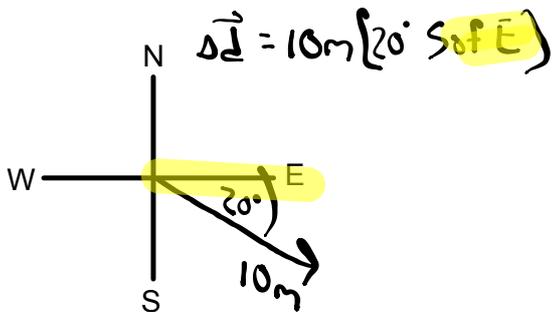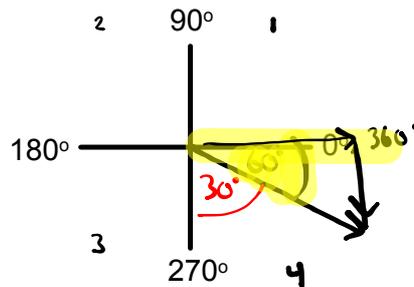
Adding Vectors Graphically
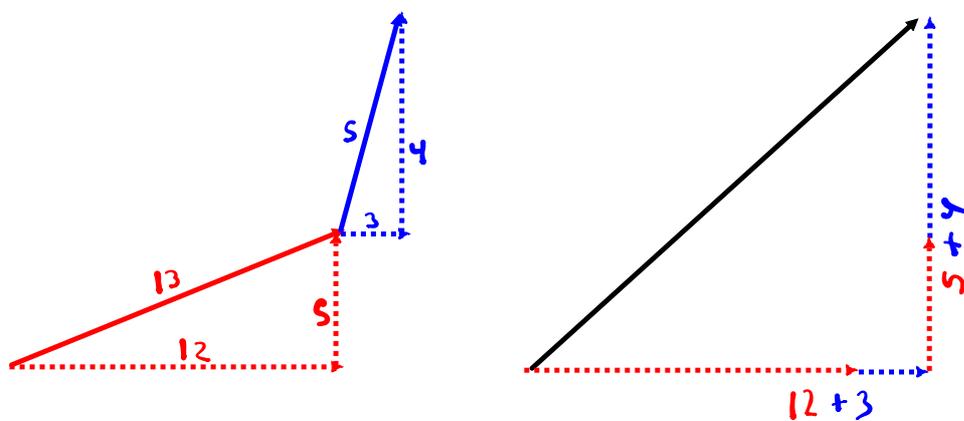
① Break into x and y
② Add x's, add y's
③ Rebuild triangle

Adding Vectors Algebraically

Q1: A person walks 15m [35° N of E], then turns and walks 20m [60° N of E]. What is their total displacement (Magnitude and Direction)?

SohCahToa
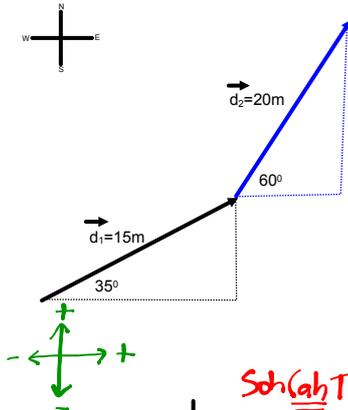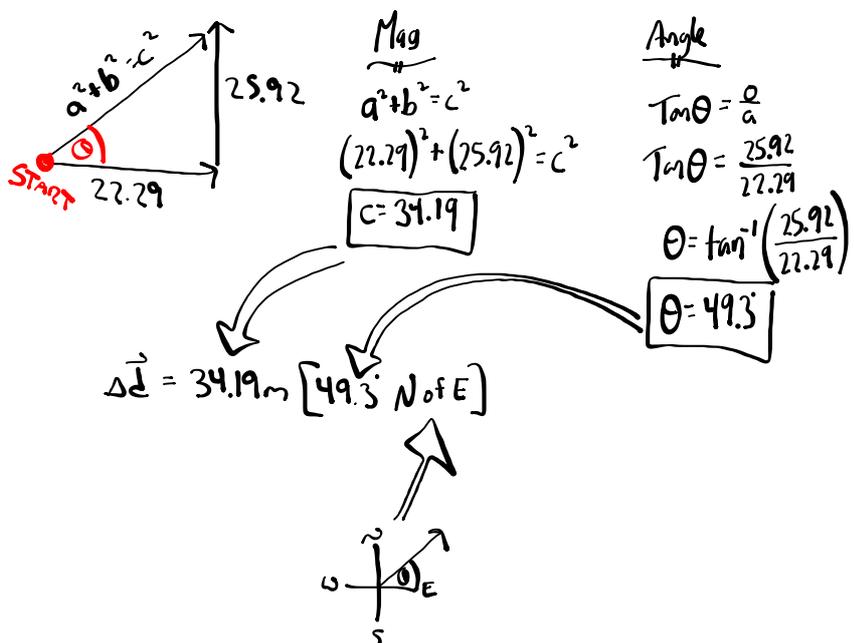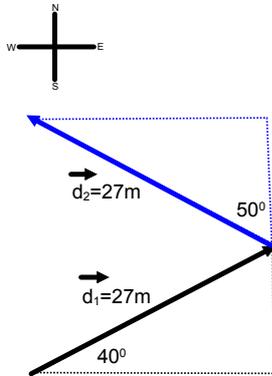
Vector	x-Component	y-Component	Unit Vectors
$15 = h$ $35°$ o a	$\cos\theta = \frac{a}{h}$ $\cos 35 = \frac{d_x}{15}$ $0.819 = \frac{d_x}{15}$ $d_x = +12.29$	$\sin\theta = \frac{o}{h}$ $\sin 35 = \frac{d_y}{15}$ $0.574 = \frac{d_y}{15}$ $d_y = +8.60$	
20 60 o a	$\cos\theta = \frac{a}{h}$ $\cos 60 = \frac{d_x}{20}$ $d_x = +10$	$\sin\theta = \frac{o}{h}$ $\sin 60 = \frac{d_y}{20}$ $d_y = +17.32$	
Resultant	$d_{TOT_x} = +22.29$	$d_{TOT_y} = +25.92$	

Mag

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

$(22.29)^2 + (25.92)^2 = c^2$

$\boxed{c = 34.19}$

Angle

$\tan\theta = \frac{o}{a}$

$\tan\theta = \frac{25.92}{22.29}$

$\theta = \tan^{-1}\left(\frac{25.92}{22.29}\right)$

$\boxed{\theta = 49.3}$

$\Delta\vec{d} = 34.19m \; [49.3° \text{ N of E}]$

4

Q2: A person walks 27m [40^0 N of E], then turns and walks 27m [50^0 W of N]. What is their total displacement (Magnitude and Direction)?
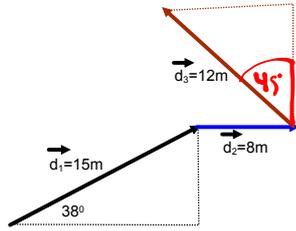
N
W —|— E
S

d_2=27m

50^0

d_1=27m

40^0

| Vector	x-Component	y-Component	Unit Vectors
E→N 27 40 S a O	$\cos\Theta = \frac{a}{h}$ $\cos 40 = \frac{dx}{27}$ $dx = +20.68$	$\sin\Theta = \frac{o}{h}$ $\sin 40 = \frac{dy}{27}$ $dy = +17.36$	
E→N O 27 50 a S	$\sin\Theta = \frac{o}{h}$ $\sin 50 = \frac{dx}{27}$ $dx = -20.68$	$\cos\Theta = \frac{a}{h}$ $\cos 50 = \frac{dy}{27}$ $dy = +17.36$	
Resultant	$d_{TOT} = 0$	$dy = +34.72$	

34.72m $\Delta \vec{d} = 34.72m [N]$

Q3: A person walks 15m [38° N of E], turns and walks 8m [E], then turns again and walks 12m [45° W of N]. What is their total displacement (Magnitude and Direction)?

Vector	x-Component	y-Component	Unit Vectors
	$Cos\Theta = \frac{a}{h}$ $Cos38 = \frac{dx}{15}$ $dx = +11.82$	$Sin\Theta = \frac{o}{h}$ $Sin38 = \frac{dy}{15}$ $dy = +9.23$	
	$dx = +8$	$dy = 0$	
~~Resultant~~	$Sin\Theta = \frac{o}{h}$ $Sin45 = \frac{dx}{12}$ $dx = -8.49$	$Cos\Theta = \frac{a}{h}$ $Cos45 = \frac{dy}{12}$ $dy = +8.49$	
Resultant	$d_{TOT_x} = +11.33$	$d_{TOT_y} = +17.72$	
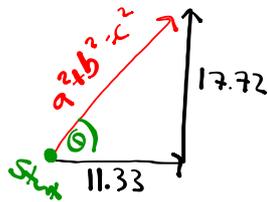
Mag
$a^2 + b^2 = c^2$
$(11.33)^2 + (17.72)^2 = c^2$
$c = 21.03$

Angle
$Tan\Theta = \frac{o}{a}$
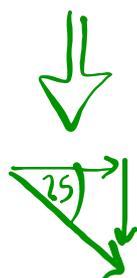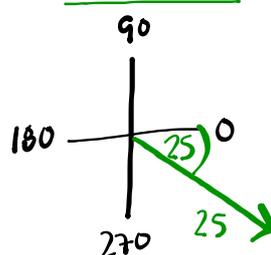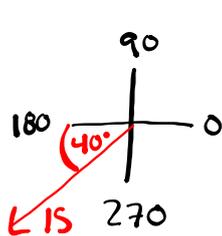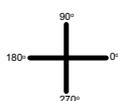$\Theta = tan^{-1}\left(\frac{17.72}{11.33}\right)$
$\Theta = 57.4°$

$\Delta \vec{d} = 21.03m [57.4° \text{ N of E}]$

or $[32.6° \text{ E of N}]$

Q4: Use components to determine the displacement of a cross-country skier who travelled 15.0 m [220°] and then 25.0 m [335°]

Additional Practice

Pg 84, Practice Problems #1-3

Pg 88, Practice Problems #1-3