College Physics 1

Vector Addition Worksheet

Please write your answer in the corresponding blank for each assigned problem. When a problem requires work to solve, please show all work next to that corresponding problem. In order to gain proper credit, all corresponding work (if applicable) must be shown to the right of and/or below the corresponding answer blank. ***All responses should ALWAYS take into account significant figures and proper applicable units.***

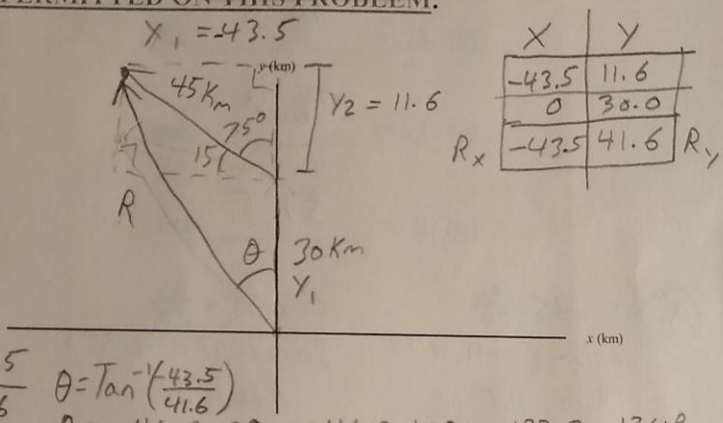
1. A car travels 30.0 km due north and then 45.0 km in a direction 75.0° west of north (*as shown similarly in lecture Figure 3.6, but with different measurements*). **(a)** Using the provided graph, find the magnitude in kilometers and **(b)** direction in degrees of a single vector that gives the net effect of the car's trip. This vector is called the car's *resultant displacement*. **YOU WILL NEED TO USE A RULER AND A PROTRACTOR FOR THIS PROBLEM WHILE APPLYING PROPER SCALING.**

NO CALCULATIONS PERMITTED ON THIS PROBLEM.

3SF

(a) $R = 60.2$ Km

(b) 46.3° west of north or 134°



	X	Y
	-43.5	11.6
	0	30.0
R_x / R_y	-43.5	41.6

① $\sin 15° = \frac{Y_2}{45}$

$45 \sin 15° = 11.647 = 11.6$

$Y_2 = 11.6$

② $\sin 75 = \frac{X_1}{45}$

$-45 \sin 75 = 43.467 = -43.5$

③ $R = \sqrt{R_x^2 + R_y^2}$

$R = \sqrt{(-43.5)^2 + (41.6)^2}$

$R = 60.1897$

$R = 60.2$

④ $\tan\theta = \frac{-43.5}{41.6}$ $\theta = \tan^{-1}\left(\frac{43.5}{41.6}\right)$

$\theta = -46.279° = -46.3 + 180 = 133.7 = 134°$

2. Find the **(a)** horizontal A_x and **(b)** vertical A_y components of the $d = 1.75 \times 10^2$ m displacement of a superhero who flies from the top of a tall building along the path 40.0° below the horizontal (*as shown similarly in lecture Figure 3.11, but with different measurements*). Instead of drawing a precise graph, **solve all of these problems mathematically**.

Suppose instead the superhero leaps in the other direction along a displacement vector $\vec{B}$ to the top of a flagpole where the displacement components are given by $B_x = -35.0$ m and $B_y = 15.0$ m. Find the **(c)** magnitude in meters and **(d)** direction in degrees.

3SF

(a) 1.34×10^2 m

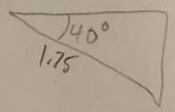
(b) -1.12×10^2 m

(c) $R = 38.1$ m

(d) 23.2° north of west or 157°

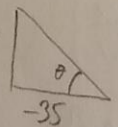
ⓐ 1.75×10^2 = Hypotenuse

$\cos 40° = \frac{X}{1.75 \times 10^2}$ $1.75 \times 10^2 \cos 40 = 1.34 \times 10^2$



ⓑ $\sin 40° = \frac{Y}{1.75 \times 10^2}$ $1.75 \times 10^2 \sin 40° = 1.12 \times 10^2$

ⓒ $R = \sqrt{(-35)^2 + (15)^2} = 38.079$



ⓓ $\tan\theta = \frac{15}{-35}$ $\theta = \tan^{-1}\left(\frac{15}{-35}\right) = -23.198 = -23.2° + 180 = 156.8$

157°

3. A hiker begins a trip by first walking 20.0 km 35.0° south of east from her base camp. On the second day she walks 30.0 km in a direction 70.0° north of east, at which point she discovers a forest ranger's tower. Determine the components of the hiker's displacements in the **(a)** first and **(b)** second days.

3SF

(Determine all of these values by applying the proper mathematical calculations – Without drawing a precise graph.) A rough sketch graph is always encouraged to be drawn as a reference; however, the actual answers should be arrived at via a calculation.

(c) Determine the components of the hiker's total displacement for the trip. **(d)** Find the magnitude and direction of the displacement from base camp

(a) A_x = 16.4 km A_y = -11.5 km

(b) B_x = 10.3 km B_y = 28.2 km

(c) R_x = 26.7 km R_y = 16.7 km

(d) R = 31.5 km θ = 32.0 °

(a.) $\sin 35 = \frac{A_y}{20}$ $\cos -35 = \frac{A_x}{20}$

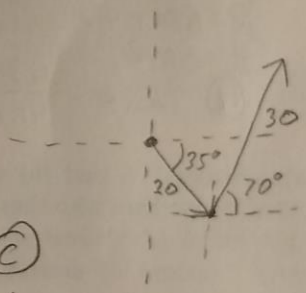
$20 \sin -35 = -11.472$ $20 \cos -35 = 16.383$

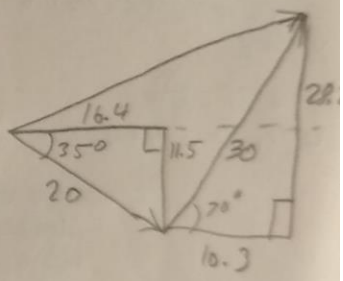
$A_y = -11.5$ $A_x = 16.4$

(b.) $\sin 70 = \frac{b_y}{30}$ $\cos 70 = \frac{b_x}{30}$

$30 \sin 70 = 28.191$ $30 \cos 70 = 16.383$

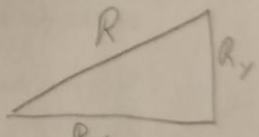
$B_y = 28.2$ $B_x = 10.3$





(c)

	X	Y	
A	16.4	-11.5	A_y
B	10.3	28.2	B_y
R	26.7	16.7	R_y



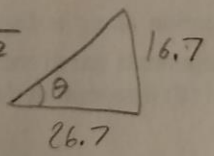
$R_x = A_x + B_x$

$R_y = A_y + B_y$

(d) $R = \sqrt{26.7^2 + 16.7^2}$

$R = 31.492$

$R = 31.5$



$\tan\theta = \frac{16.7}{26.7}$

$\theta = \tan^{-1}\left(\frac{16.7}{26.7}\right)$

$\theta = 32.024$

$\theta = 32.0$