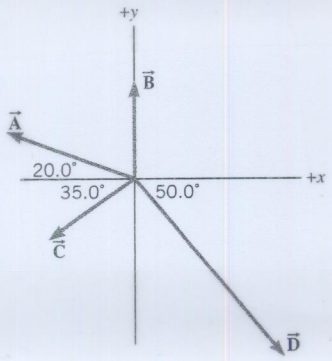
Vector Group Problems

1. The directions of four displacement vectors are shown below. Their magnitudes are: A=16 m, B=11 m, C=12 m, and D=26 m.

a. on a new set of axes, draw these vectors and the resultant vector when all four are added.

b. determine the magnitude and direction of the resultant.

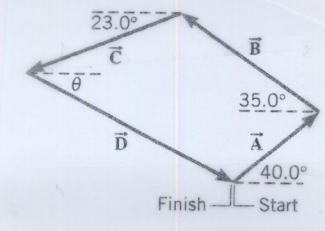


2. On a safari, a team of naturalists sets out toward a research station located 4.8 km away in a direction 42^0 north of east. After traveling in a straight line for 2.4 km, they stop and discover that they have actually been traveling 22^0 north of east, because the guide misread the compass. They need to decide what direction they should walk in now to reach the research station, and they wonder how far away it is.

a. Their starting point is the center of a coordinate system. Draw the three vectors that show where they are now, where the research station is, and the path that will get them there. Name these vectors.

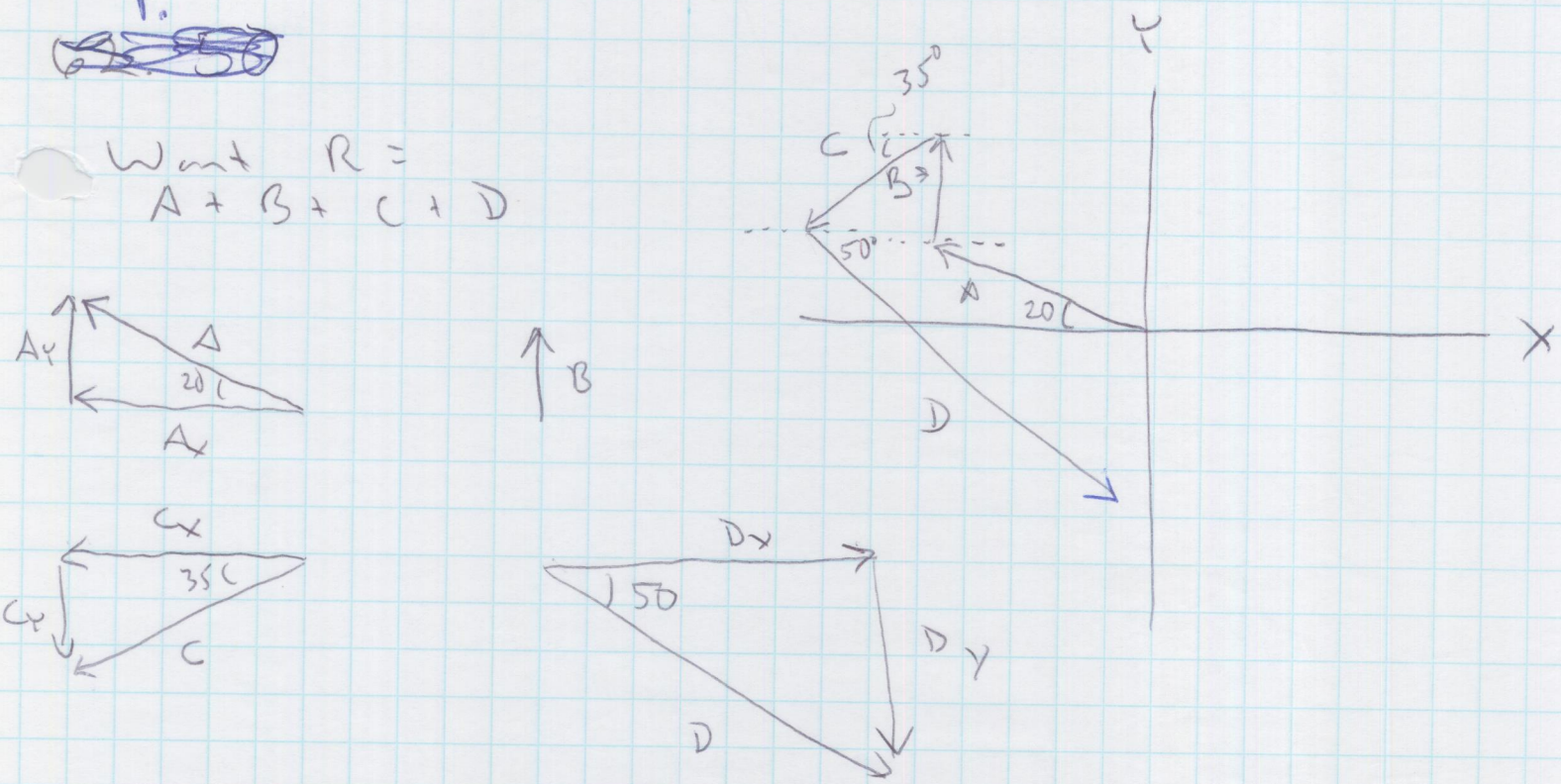
b. Find the displacement(magnitude and direction) required to get them to their destination.

3. A sailboat race course consists of four legs, as shown. The magnitudes of the first three legs are A=3.2 km, B=5.1 km, and C=4.8 km. The finish line of the course coincides with the starting point. Find the distance of the fourth leg and the angle θ.



1.

Want R =
A + B + C + D



	A	B	C	D
X	$\pm 16 \cos 20$	$11 \cos 90$	$-12 \cos 35$	$+26 \cos 50$
Y	$+16 \sin 20$	$+11 \sin 90$	$-12 \sin 35$	$-26 \sin 50$

$R_x = -15.0 + 0 + -9.83 + 16.7 = -8.13$

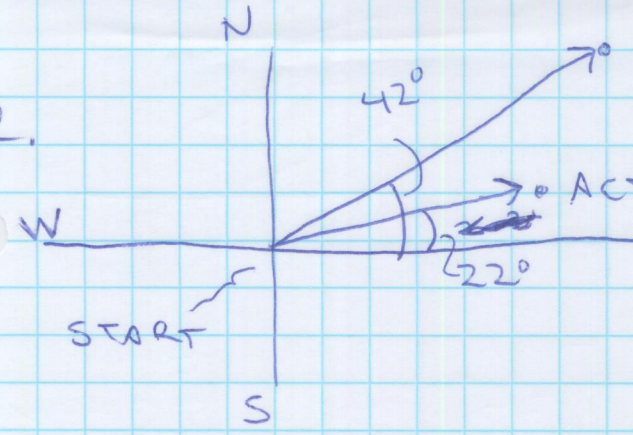
$R_y = +5.47 + 11 + -6.88 + -19.9 = -10.31$

(Reasonable?)

$R = \sqrt{R_x^2 + R_y^2} = 13.1$ m

$\theta = \arctan \frac{R_y}{R_x} = 50°$

2.



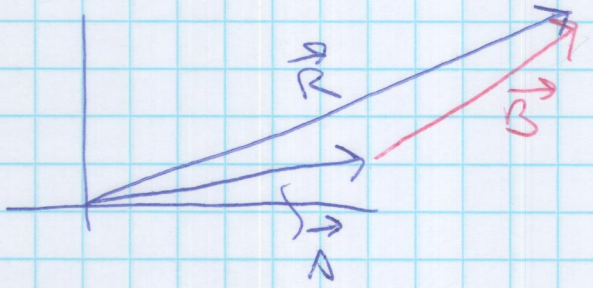
SHOULD HAVE GONE 4.8 km at 42°

ACTUALLY WENT 2.4 km at 22°

So to reach station, add this displacement to what already did.

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

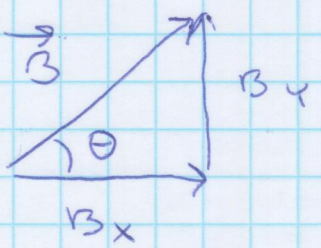
$$\vec{B} = \vec{R} + -\vec{A}$$



	R	−A
x	$4.8\cos 42$	$-2.4\cos 22$
y	$4.8\sin 42$	$-2.4\sin 22$

$$B_x = R_x + -A_x$$
$$B_x = 4.8\cos 42 + -2.4\cos 22$$
$$B_x = 1.34$$

$$B_y = R_y + -A_y$$
$$B_y = 4.8\sin 42 - 2.4\sin 22$$
$$B_y = 2.31$$



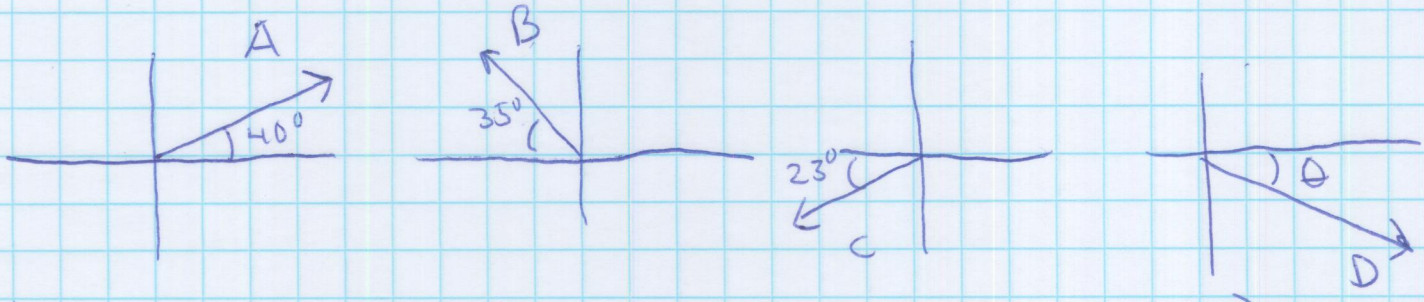
$$B = \sqrt{B_x^2 + B_y^2}$$

$$B = 2.67 \text{ km}$$

$$\theta = \arctan B_y/B_x$$

$$\theta = 60°$$

3.



	A	B	C	D
x	$+3.2\cos 40°$	$-5.1\cos 35$	$-4.8\cos 23$	$D\cos\theta$
y	$+3.2\sin 40°$	$+5.2\sin 35$	$-4.8\cos 23$	$-D\sin\theta$

$\vec{A} + \vec{B} + \vec{C} + \vec{D} = 0$, so

$A_x + B_x + C_x + D_x = 0$

$3.2\cos 40 - 5.1\cos 35 - 4.8\cos 23 + D\cos\theta = 0$

$D\cos\theta = 6.15$

or $D_x = 6.15$

$A_y + B_y + C_y + D_y = 0$

$3.2\sin 40 + 5.2\sin 35 - 4.8\cos 23 - D\sin\theta = 0$

$D\sin\theta = -3.1$

or $D_y = -3.1$

$$\frac{D\sin\theta}{D\cos\theta} = \frac{-3.1}{6.15}$$

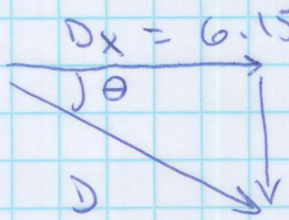
$\tan\theta = -3.1/6.15$

$\theta = -26.7$ so $26.7°$ below x-axis

$D\cos(-26.7°) = 6.15$

$D = 6.9$ km

OR:



$D = \sqrt{D_x^2 + D_y^2}$

$D = 6.9$ km

$\theta = \arctan\frac{D_y}{D_x}$

$\theta = 26.7°$ below x axis