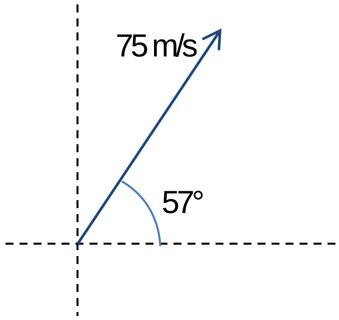
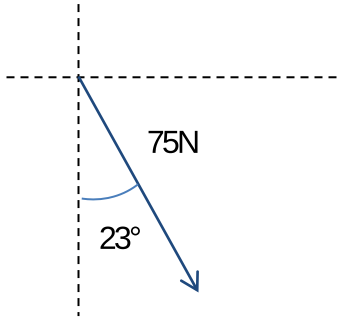
Vector Practice

1. Draw the components of each vector in the following diagrams. Then calculate the length of each component.

a)



b)



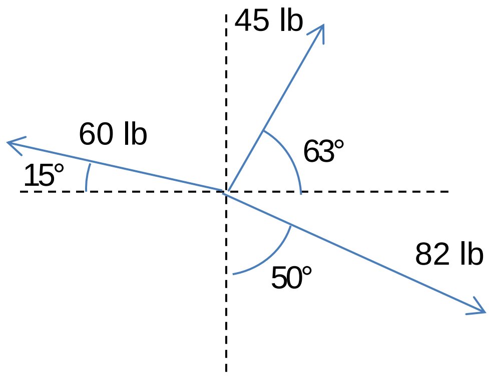
2. For each of the following, draw the given vectors tip to tail, draw the resultant vector including angle, then calculate the magnitude and direction of the resultant vector.

a) I travel 17m West, then 14m South.

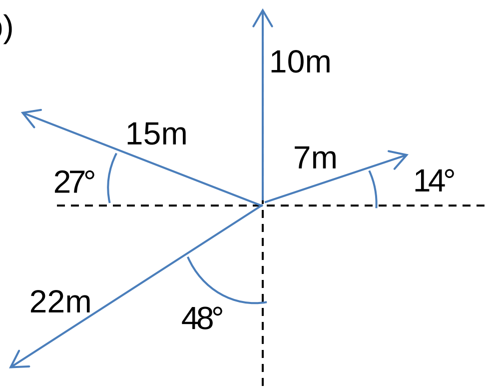
b) The components of an objects velocity are 26 m/s N and 35 m/s E.

3. For each case, add the vectors (calculate the resultant vector).

a)

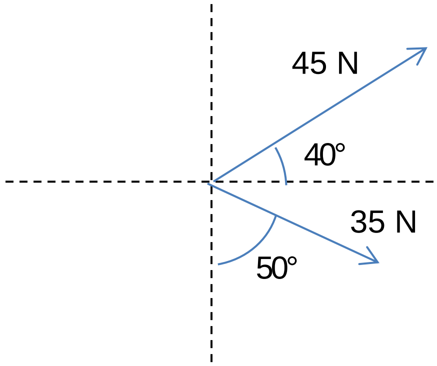


b)

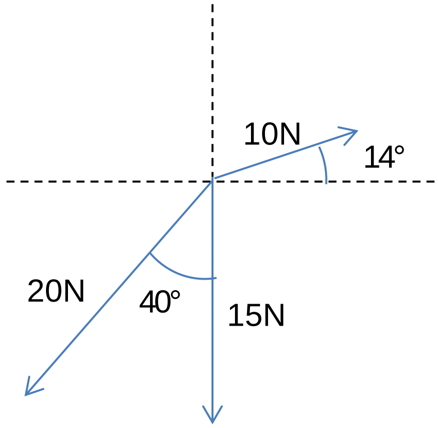


4. The following forces act on an object. For each, calculate the force that will cause the object to remain in equilibrium.

a)



b)



5. If I walk 20 miles North, then 15 miles East, then 10 miles at 35° South of East,

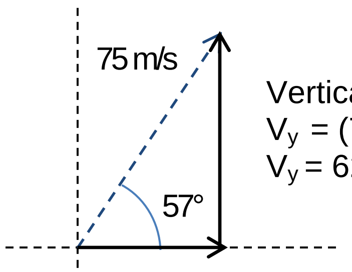
   a) What distance have I traveled?

   b) What is my displacement?

   c) If I travel the entire distance in 4 hours, then what is my average velocity?

Solutions

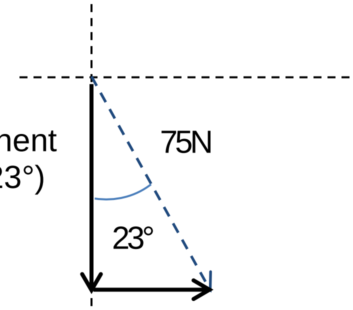
1. a)



Vertical Component: V_y
V_y = (75m/s)sin(57°)
V_y = 62.9m/s

Horizontal Component: V_x
V_x = (75m/s)cos(57°)
V_x= 40.8m/s

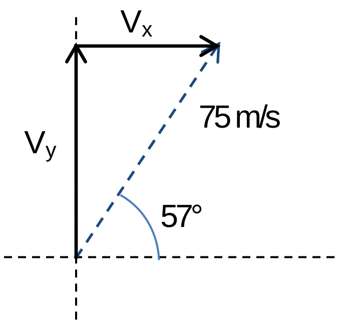
b)



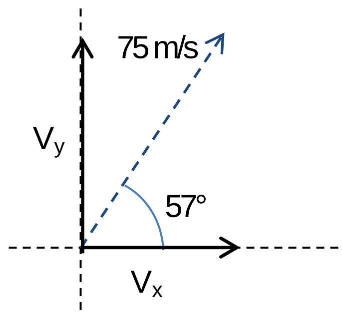
Vertical Component
F_y = (75N)cos(23°)
F_y = 69N

Horizontal Component: F_x
F_x = (75N)sin(23°)
F_x= 29.3N

****Note:** Above shows only one way of drawing components. Using 1a as an example, you may also have drawn:

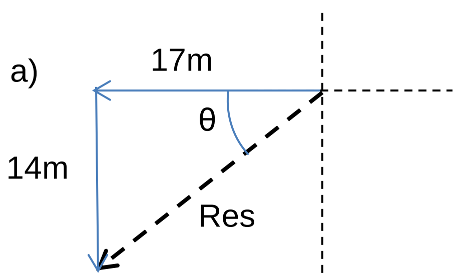


or



****Also Note:** for example, sin(57°) = cos(33°) so you can always change the angle I've given you by just remember that the angles add to 90°. (I don't bother doing that but you can and its something you should know.)

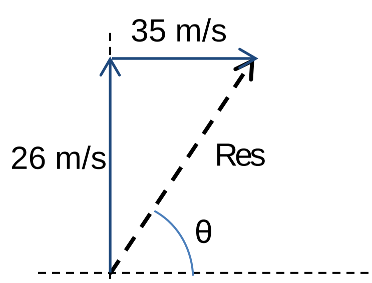
2. a)



Resultant = $\sqrt{(17m)^2 + (14m)^2}$ = 22m

Θ = $\tan^{-1}\left(\frac{14}{17}\right)$ = 39.5°

b)



Resultant = $\sqrt{(35m/s)^2 + (26m/s)^2}$ = 43.6m/s

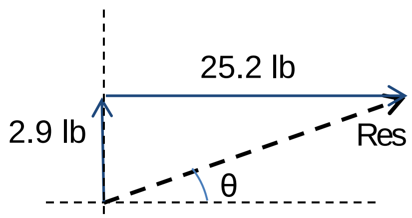
Θ = $\tan^{-1}\left(\frac{26}{35}\right)$ = 36.6°

****Note:** Angles are often referenced from the start of the resultant to a horizontal. However, as long as you draw the vector to show me the angle you are calculating, it doesn't matter.

3. Remember, the resultant vector includes both magnitude and direction.

a)

x-component	y-component
45 cos(63°) = 20.4	45 sin(63°) = 40.1
-60 cos(15°) = -58.0	60 sin(15°) = 15.5
82 sin(50°) = 62.8	-82 cos(50°) = -52.7
25.2 lb	2.9 lb

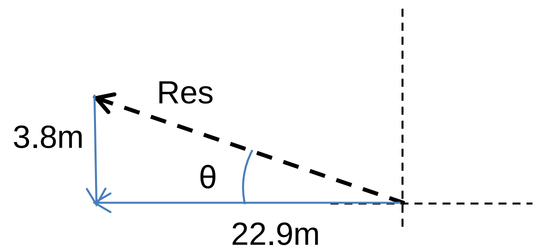


Resultant = $\sqrt{(25.2lb)^2 + (2.9lb)^2}$ = 25.4lb

Θ = $\tan^{-1}\left(\frac{2.9}{25.2}\right)$ = 6.6°

b)

x-component	y-component
7 cos(14°) = 6.8	7 sin(14°) = 1.7
0	10
-15 cos(27°) = -13.4	15 sin(27°) = 6.8
-22 sin(48°) = -16.3	-22 cos(48°) = -14.7
-22.9 m	3.8 m

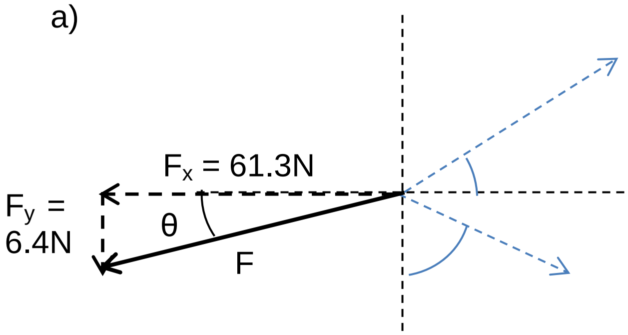


Resultant = $\sqrt{(22.9m)^2 + (3.8m)^2}$ = 23.2m

Θ = $\tan^{-1}\left(\frac{3.8}{22.9}\right)$ = 9.4°

4. In order to find the force needed for equilibrium, we must find the components of the resultant vector and change the signs.

a)

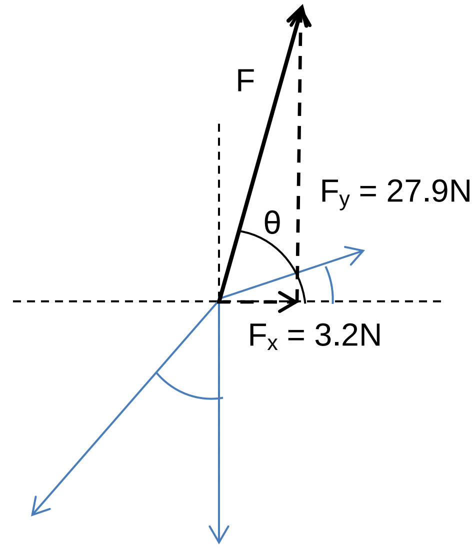


x-component	y-component
45 cos(40°) = 34.5	45 sin(40°) = 28.9
35 sin(50°) = 26.8	-35 cos(50°) = -22.5
61.3 N	6.4 N

F = $\sqrt{(61.3N)^2 + (6.4N)^2}$ = 61.6N

Θ = $\tan^{-1}\left(\frac{6.4}{61.3}\right)$ = 9.4°

b)



x-component	y-component
10 cos(14°) = 9.7	10 sin(14°) = 2.4
-20 sin(40°) = -12.9	-20 cos(40°) = -15.3
0	-15
-3.2 N	-27.9 N

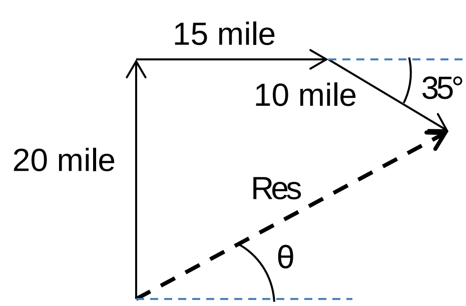
F = $\sqrt{(3.2N)^2 + (27.9N)^2}$ = 28.1N

Θ = $\tan^{-1}\left(\frac{27.9}{3.2}\right)$ = 83.5°

5. a) Distance = 20mile + 15mile + 10 mile = 45 miles

b)

x-component	y-component
0	20
15	0
10 cos(35°) = 8.2	10 sin(35°) = 5.7
23.2 miles	25.7 miles



Res = $\sqrt{(23.2miles)^2 + (25.7miles)^2}$ = 34.6 miles

Θ = $\tan^{-1}\left(\frac{25.7}{23.2}\right)$ = 48°

c) V = Displacement / time = 34.6 miles / 4 hours = 8.65 mph