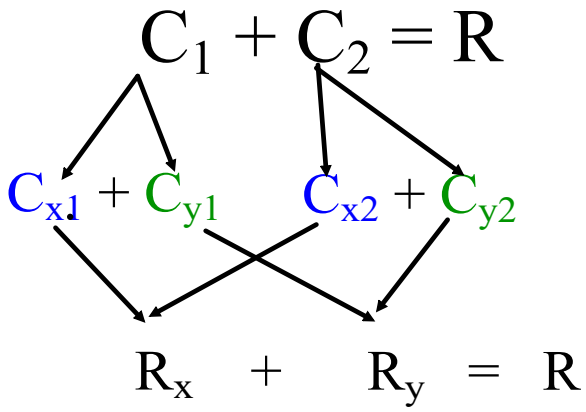
Vector Addition: adding components using the rules of vector addition to find the resultant.

$$C_1 + C_2 = R$$

Vector Resolution: Breaking a vector (component) down into its parts



Mathematical Analysis:

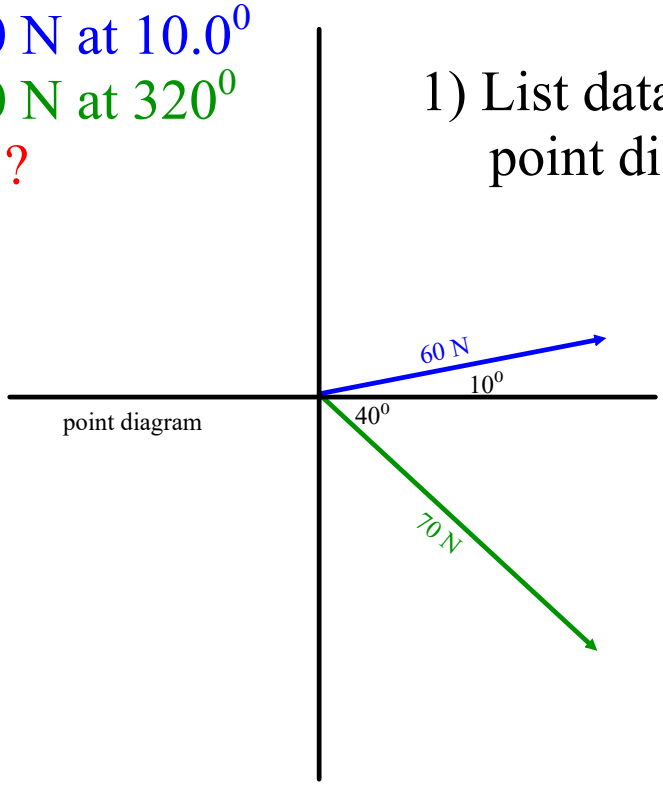
Sum of the "X" sum of the "Y"

60.0 N at 10.0^0

70.0 N at 320^0

R = ?

1) List data and draw point diagram



Mathematical Analysis:

Sum of the "X" sum of the "Y"

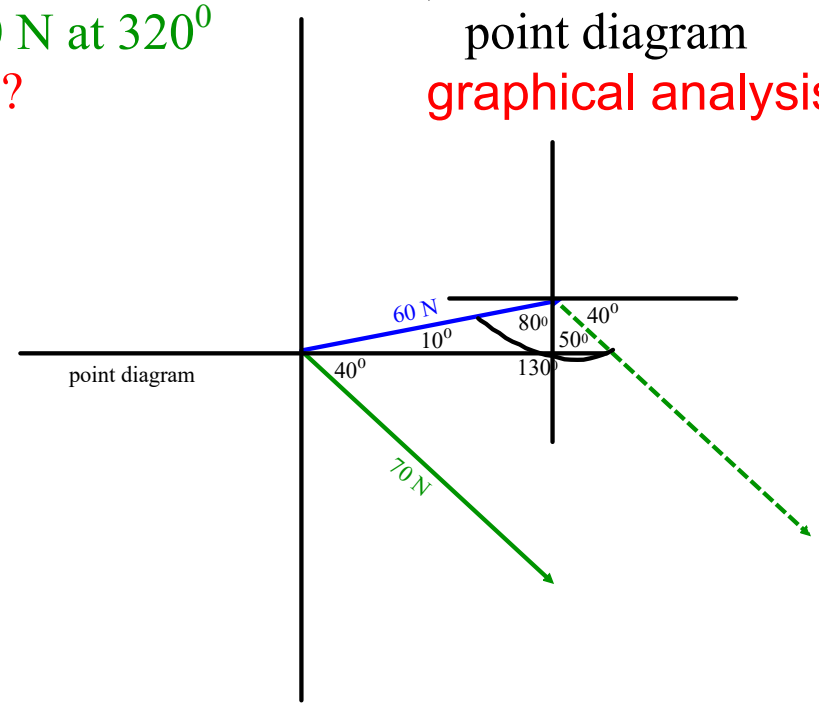
60.0 N at 10.0^0

70.0 N at 320^0

R = ?

1) List data and draw point diagram

graphical analysis



Mathematical Analysis:

Sum of the "X" sum of the "Y"

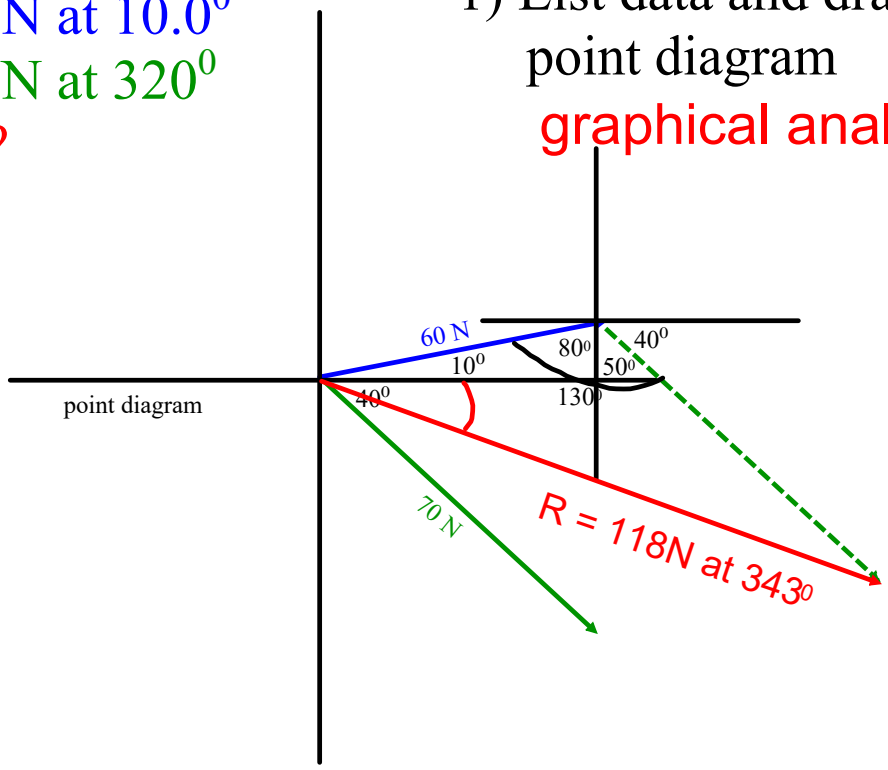
60.0 N at 10.0^0

70.0 N at 320^0

R = ?

1) List data and draw point diagram

graphical analysis



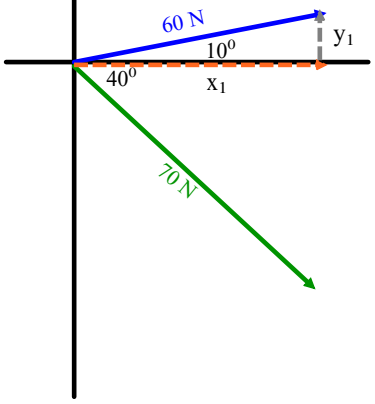
2) Break each vector component into its "X" and "Y" components

from slide #7 (*Remember*, right is "+", left is "-", up is "+", down is "-")

$\sin\theta_1 = y_1/60\ N$ $\quad \cos\theta_1 = x_1/60\ N$

$y_1 = \sin 10^0(60\ N)$ $\quad x_1 = \cos 10^0(60\ N)$

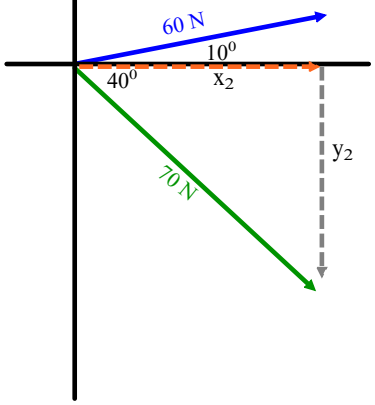
$y_1 = +10.\ N$ $\quad x_1 = +59\ N$



$\sin\theta_2 = y_2/70\ N$ $\quad \cos\theta_2 = x_2/70\ N$

$y_2 = \sin 40^0(70\ N)$ $\quad x_2 = \cos 40^0(70\ N)$

$y_2 = -45\ N$ $\quad x_2 = +54\ N$



3) Add the "X" and "Y" components together

$\sin\theta_1 = y_1/60\ N$ $\quad \cos\theta_1 = x_1/60\ N$

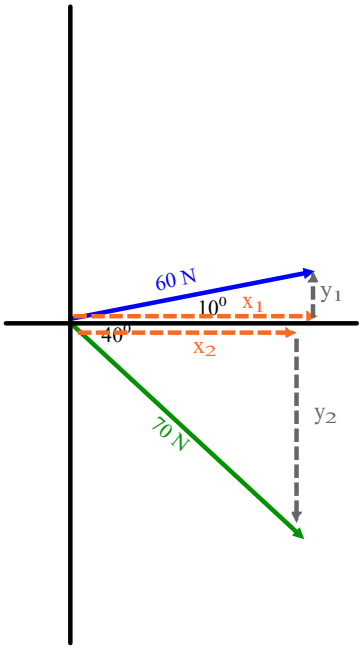
$y_1 = \sin 10^0(60\ N)$ $\quad x_1 = \cos 10^0(60\ N)$

$y_1 = +10.\ N$ $\quad x_1 = +59\ N$

$\sin\theta_2 = y_2/70\ N$ $\quad \cos\theta_2 = x_2/70\ N$

$y_2 = \sin 40^0(70\ N)$ $\quad x_2 = \cos 40^0(70\ N)$

$y_2 = -45\ N$ $\quad x_2 = +54\ N$



$$\Sigma X = x_1 + x_2 = +59\ N + 54\ N$$

$$\Sigma X = +113\ N$$

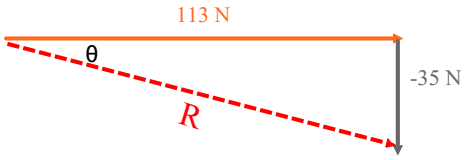
$$\Sigma Y = y_1 + y_2 = +10.\ N + (-45\ N)$$

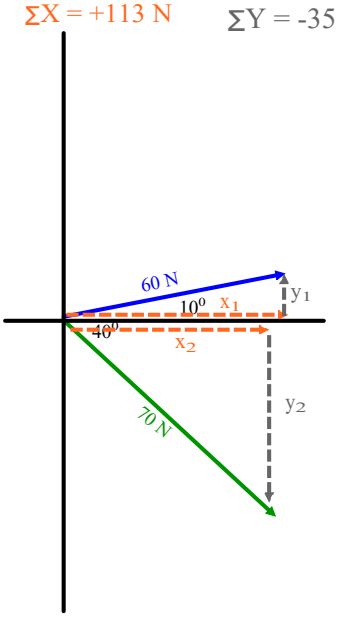
$$\Sigma Y = -35\ N$$

4) The ∑X's and ∑Y's are the "X" and "Y" components of your *Resultant*

∑X	∑Y
$x_1 = 59$ N	$y_1 = 10.$ N
+ $x_2 = 54$ N	+ $y_2 = -45$ N
∑X = +113 N	∑Y = -35 N

∑X = +113 N ∑Y = -35 N





5) Use Pythagorean Theorem to find magnitude of resultant

$R = \sqrt{(113\text{ N})^2 + (35\text{ N})^2}$

R = 118 N

R = 118 N at 343^0

6) use Tangent function to find angle of resultant and then convert to a direction

Tan θ = 35 N/113 N

$\theta = 17^o$

The 17^o is down (clockwise) from 0/360, therefore you would subtract the 17^o from the 360^o to get the direction of 343^o

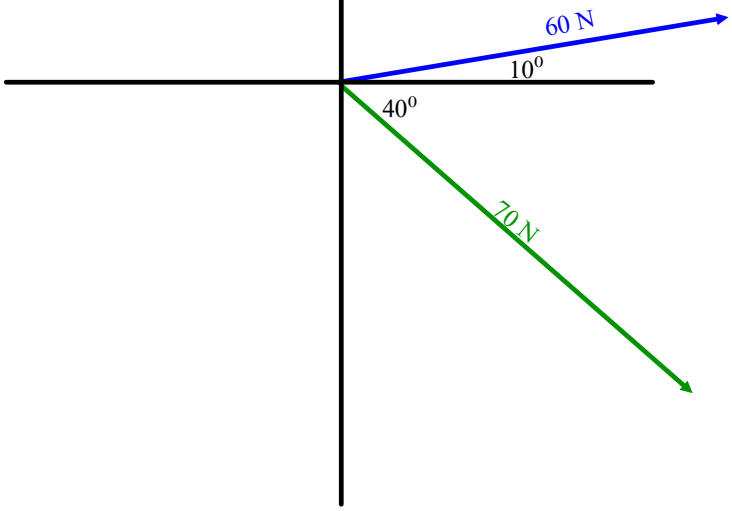
360
-17
343

Graphical Analysis of Vectors

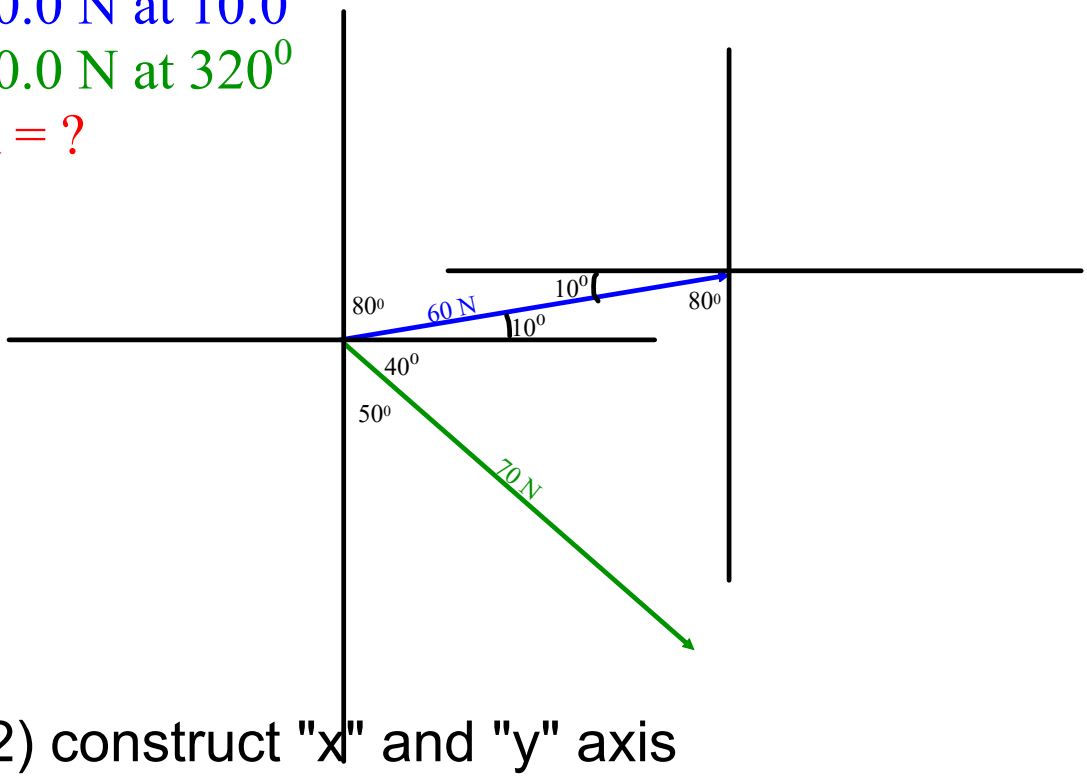
(using a ruler and protractor to find the resultant)

60.0 N at 10.0^0
70.0 N at 320^0
R = ?

1) draw a point diagram to find the angle between C1 and C2

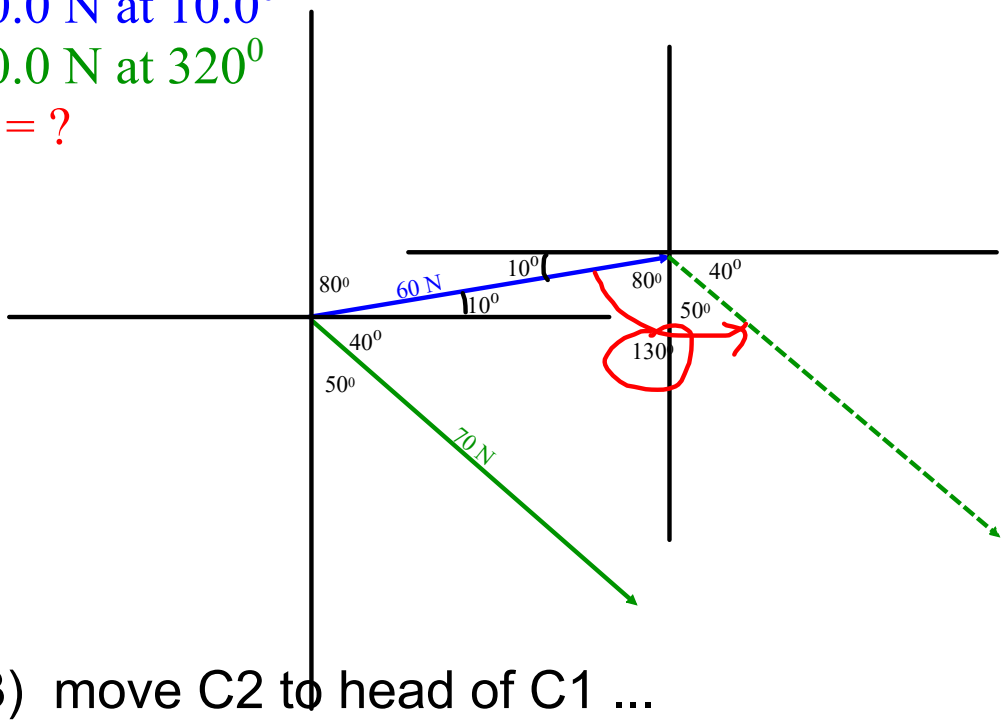


60.0 N at 10.0^0
70.0 N at 320^0
R = ?



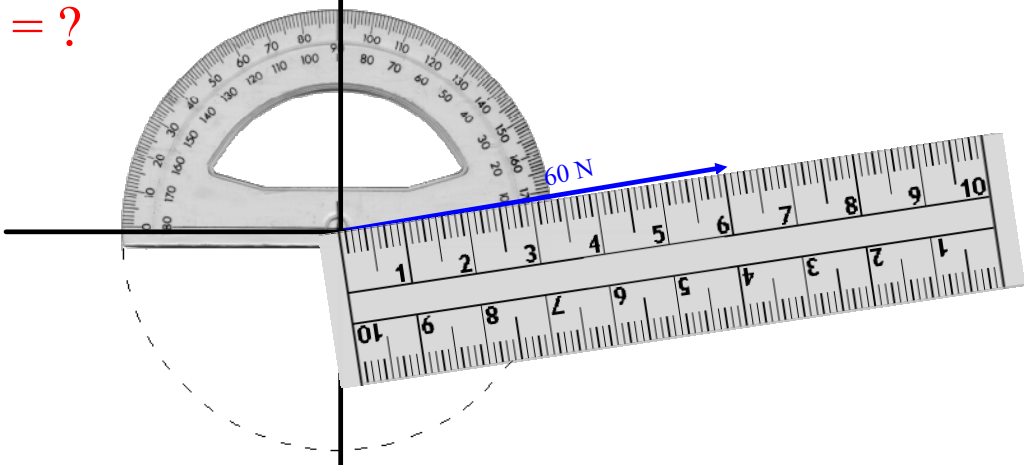
2) construct "x" and "y" axis at head of C1 ... list all angles

60.0 N at 10.0^0
70.0 N at 320^0
R = ?



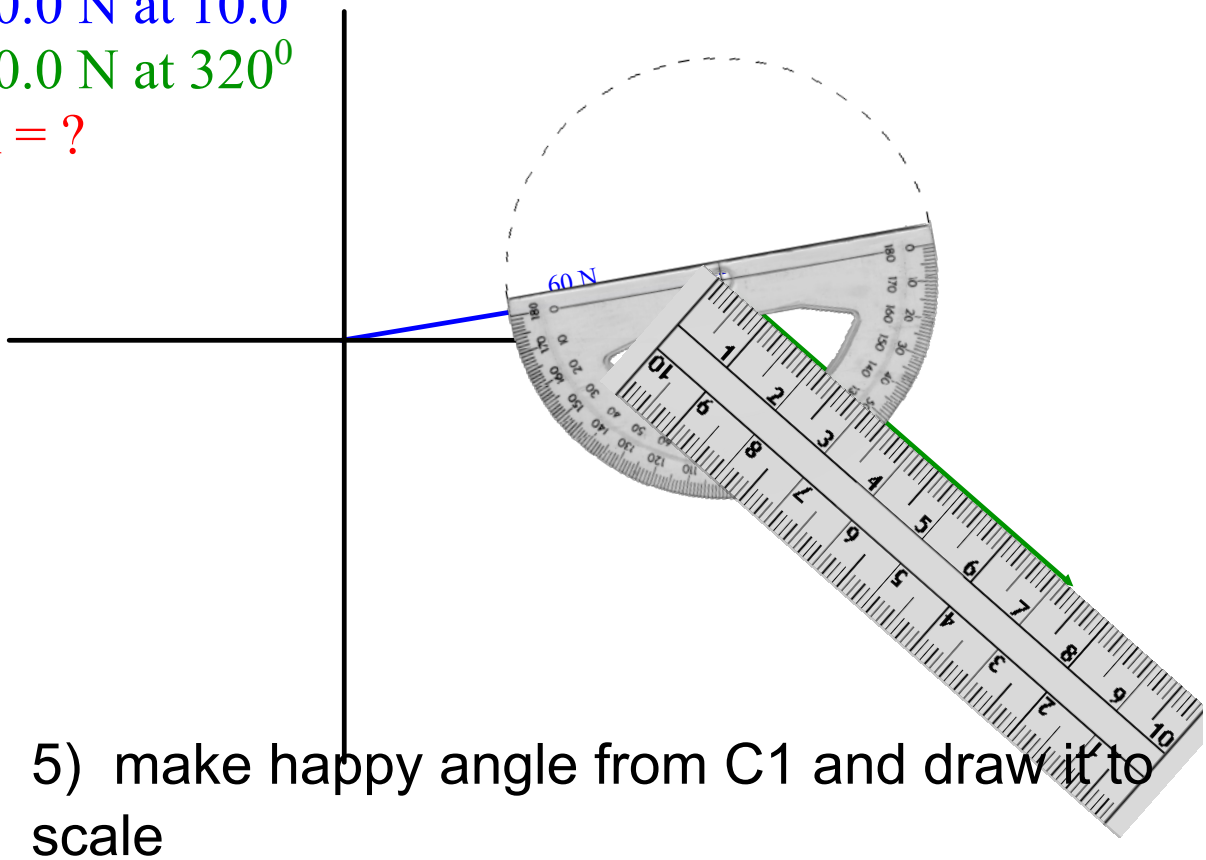
3) move C2 to head of C1 ... note it is 40^0 down from X, or 50^0 cc from Y

60.0 N at 10.0^0
70.0 N at 320^0
R = ?



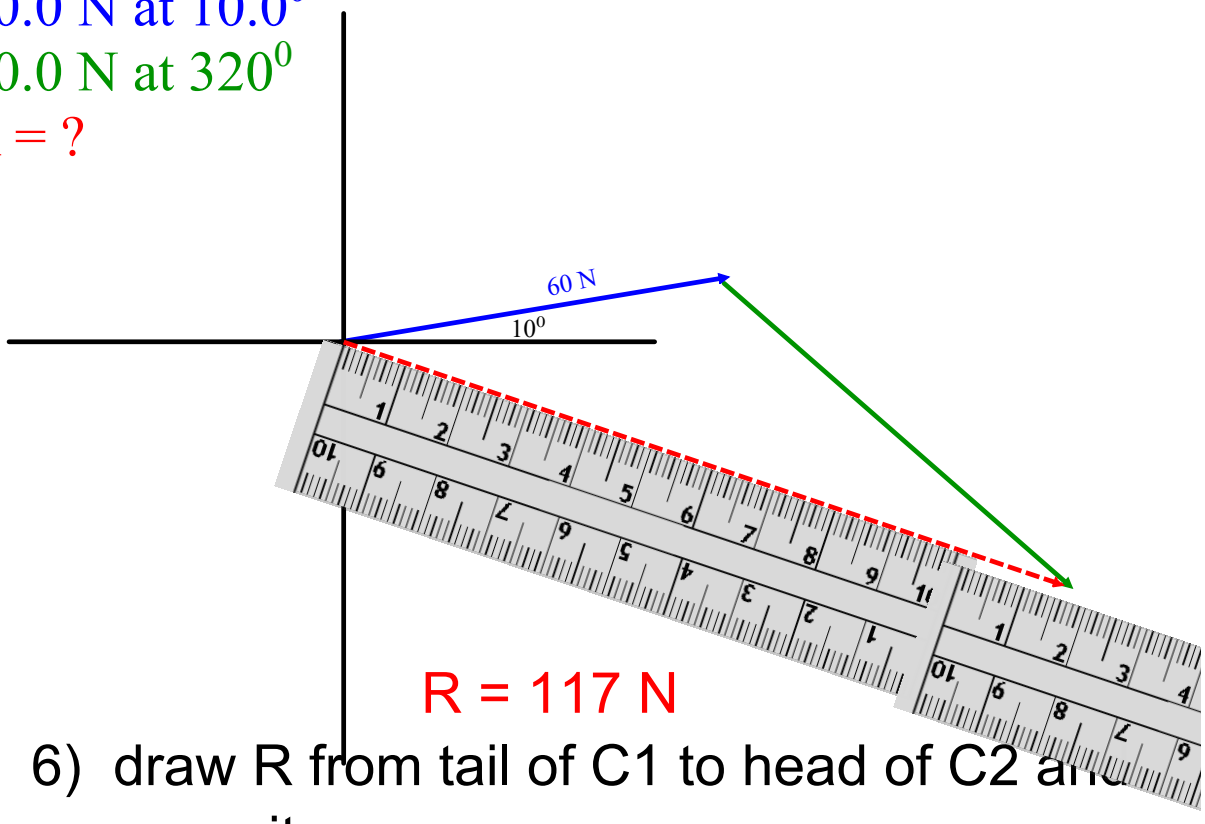
4) mark off angle of C1 and draw vector to scale

60.0 N at 10.0^0
70.0 N at 320^0
R = ?



5) make happy angle from C1 and draw it to scale

60.0 N at 10.0^0
70.0 N at 320^0
R = ?

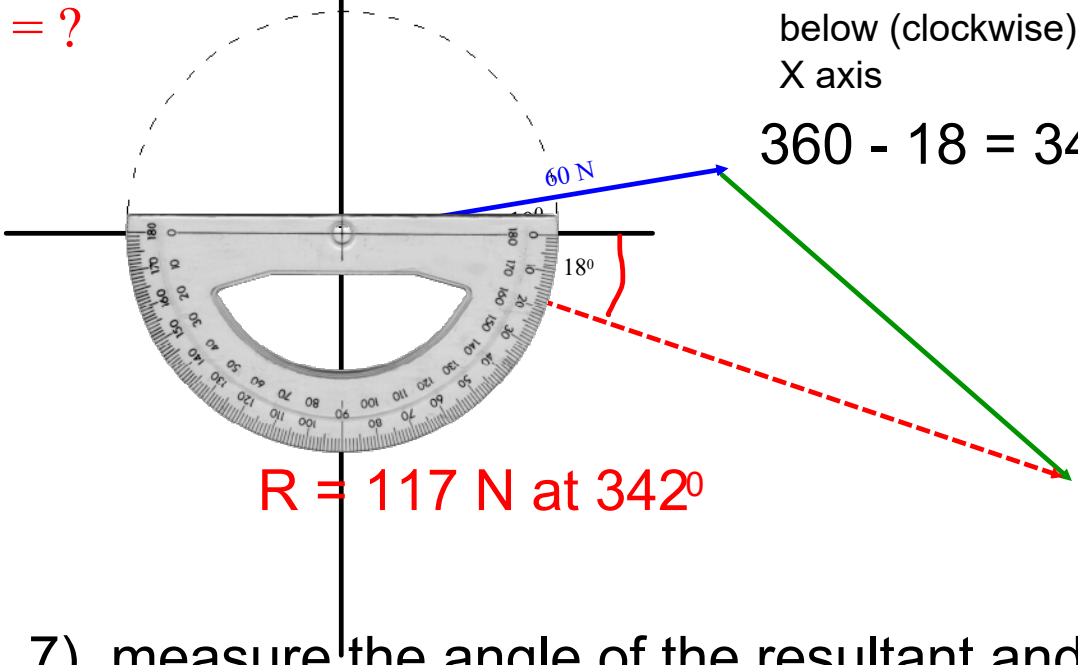


6) draw R from tail of C1 to head of C2 and measure it

60.0 N at 10.0^0

70.0 N at 320^0

R = ?



note that R is 18^0 below (clockwise) the X axis

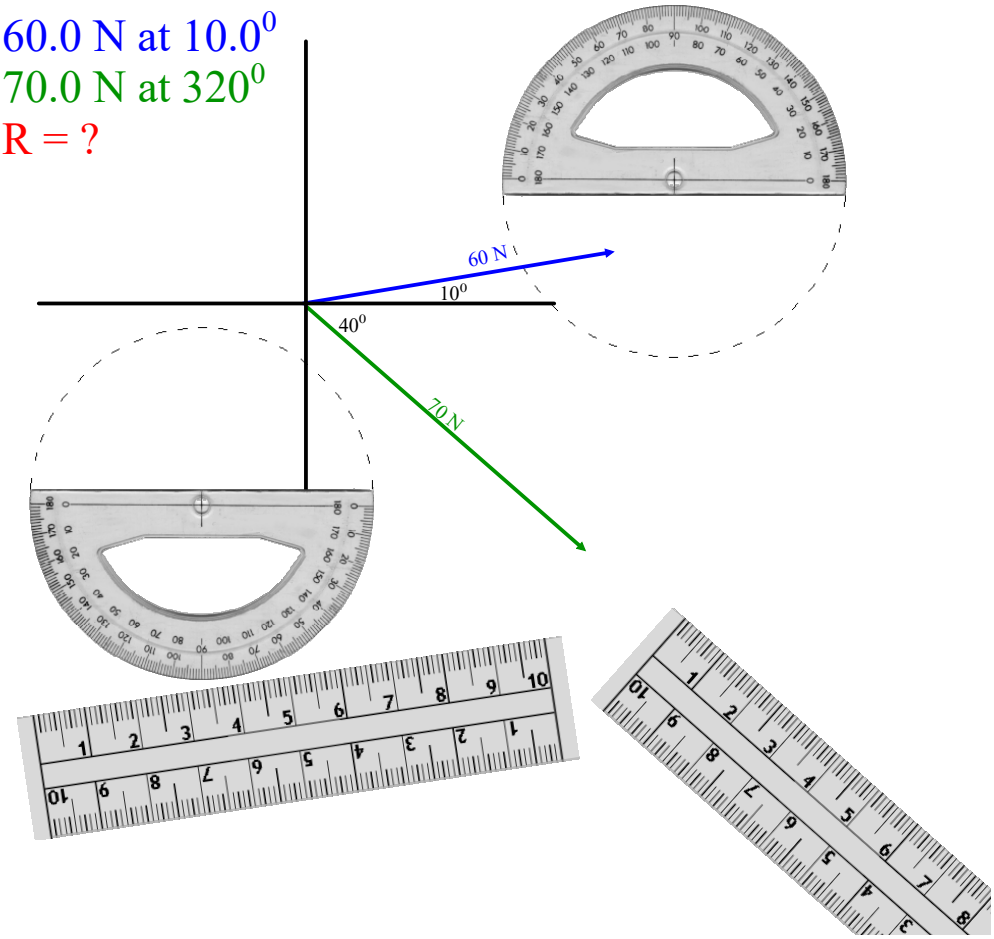
$360 - 18 = 342^0$

R = 117 N at 342^0

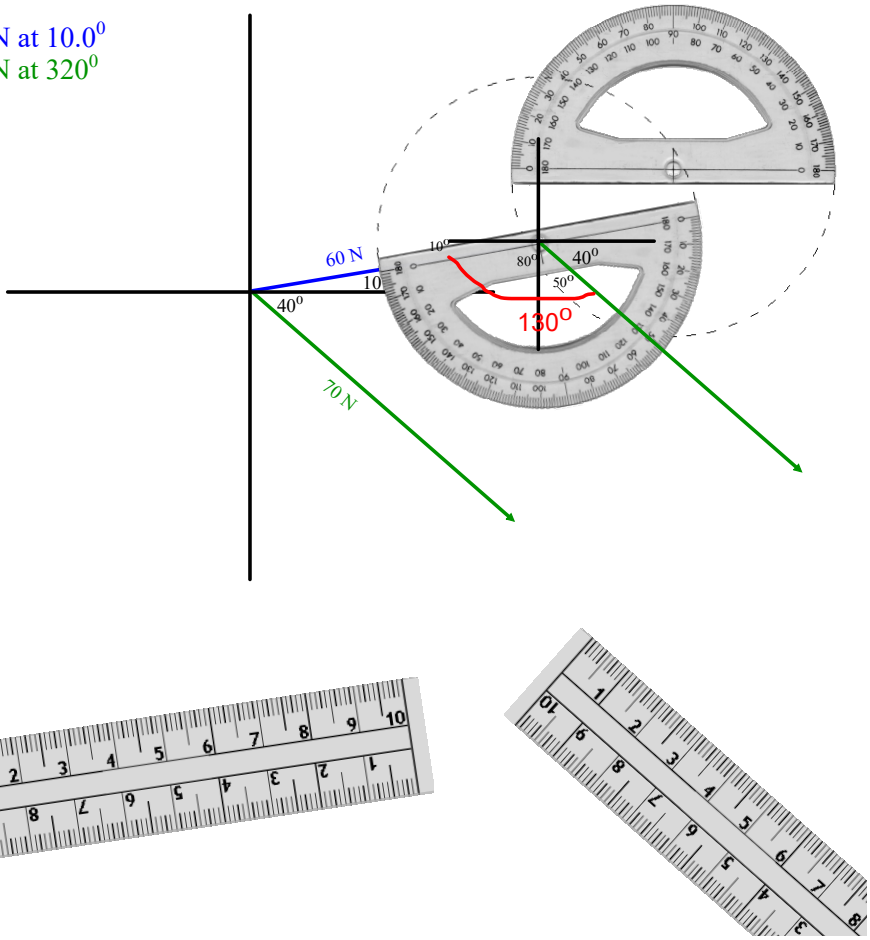
7) measure the angle of the resultant and list it from 0/360

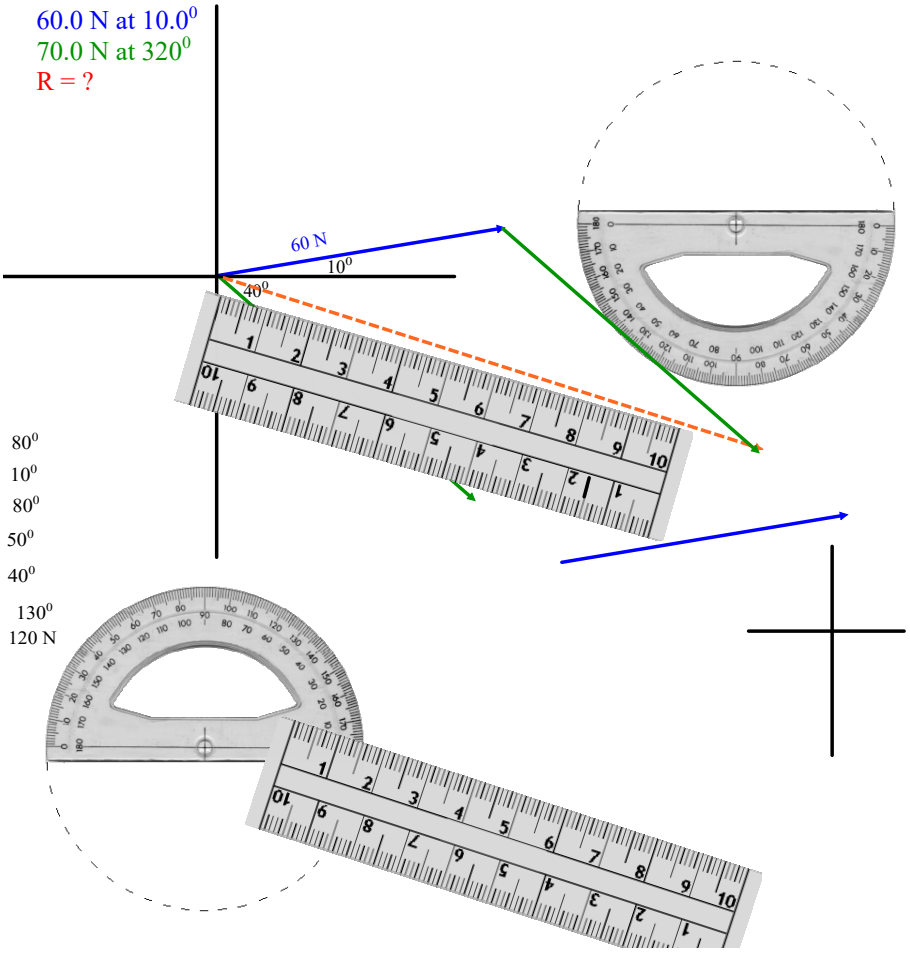
Same problem done slightly differently

60.0 N at 10.0^0
70.0 N at 320^0
R = ?



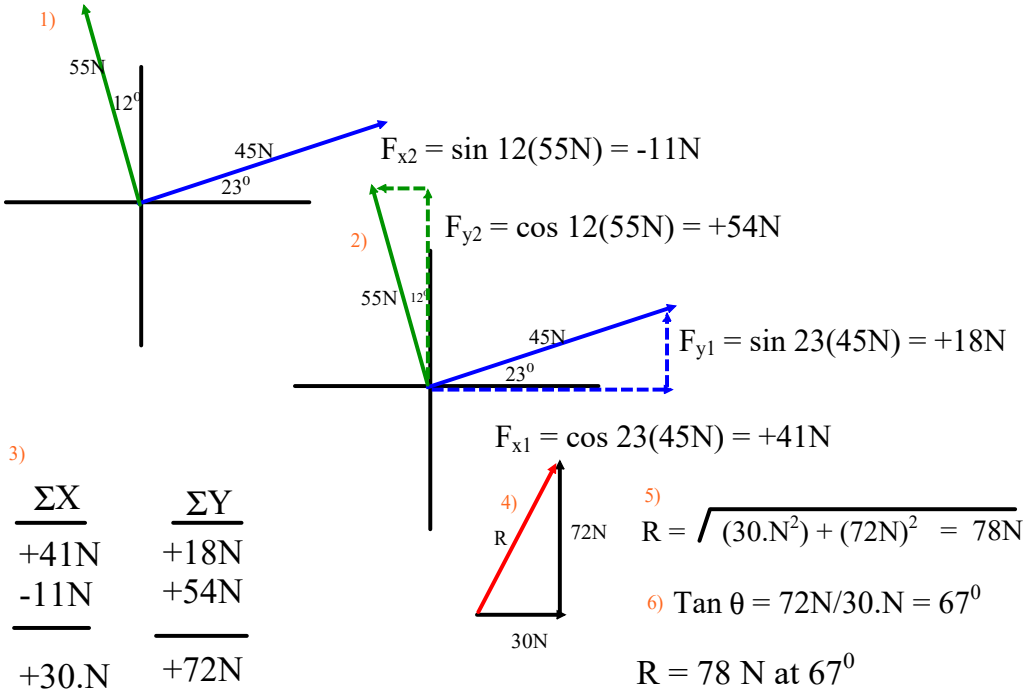
60.0 N at 10.0^0
70.0 N at 320^0
R = ?





Sum of the "X"s sum of the "Y"s

What is the resultant of 45 N at 23^0 and 55 N at 102^0
Use the sum of the "X"s and "Y"s to solve.



$F_{x2} = \sin 12(55N) = -11N$

$F_{y2} = \cos 12(55N) = +54N$

$F_{y1} = \sin 23(45N) = +18N$

$F_{x1} = \cos 23(45N) = +41N$

ΣX	ΣY
+41N	+18N
-11N	+54N
+30.N	+72N

$R = \sqrt{(30.N^2) + (72N)^2} = 78N$

Tan θ = 72N/30.N = 67^0

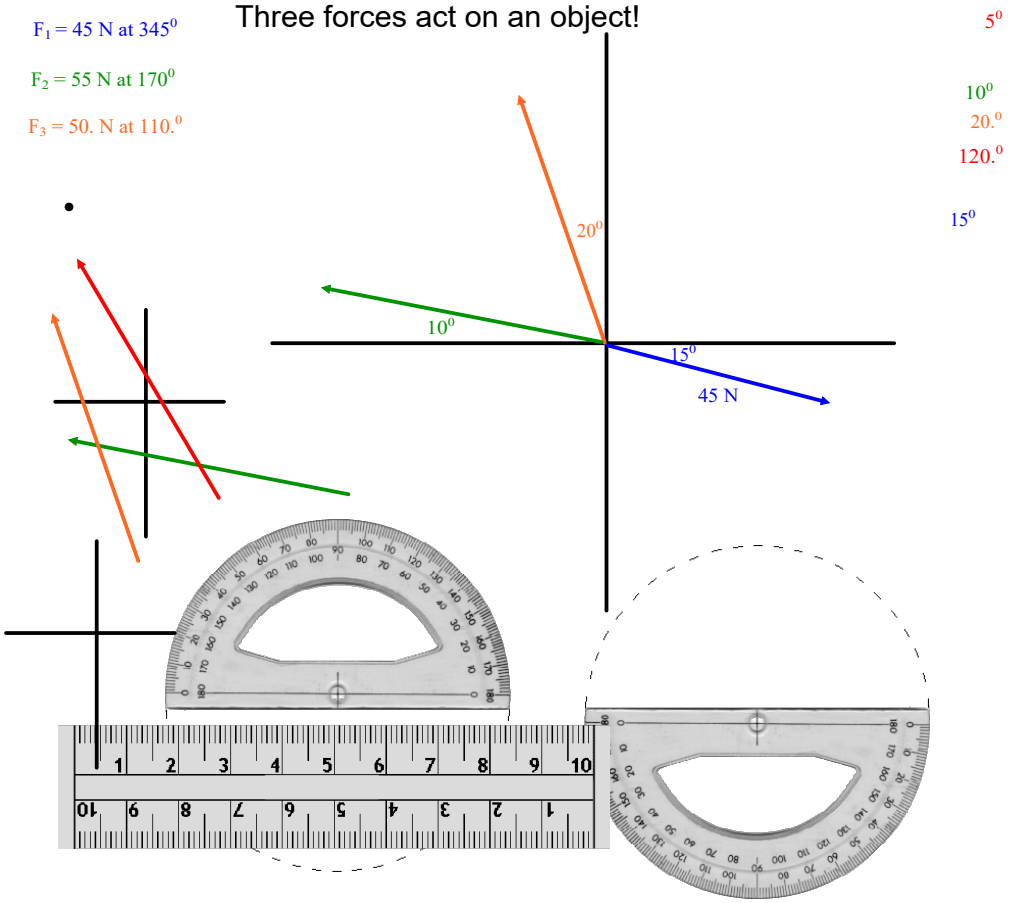
R = 78 N at 67^0

Three forces act on an object!

$F_1 = 45$ N at 345^0

$F_2 = 55$ N at 170^0

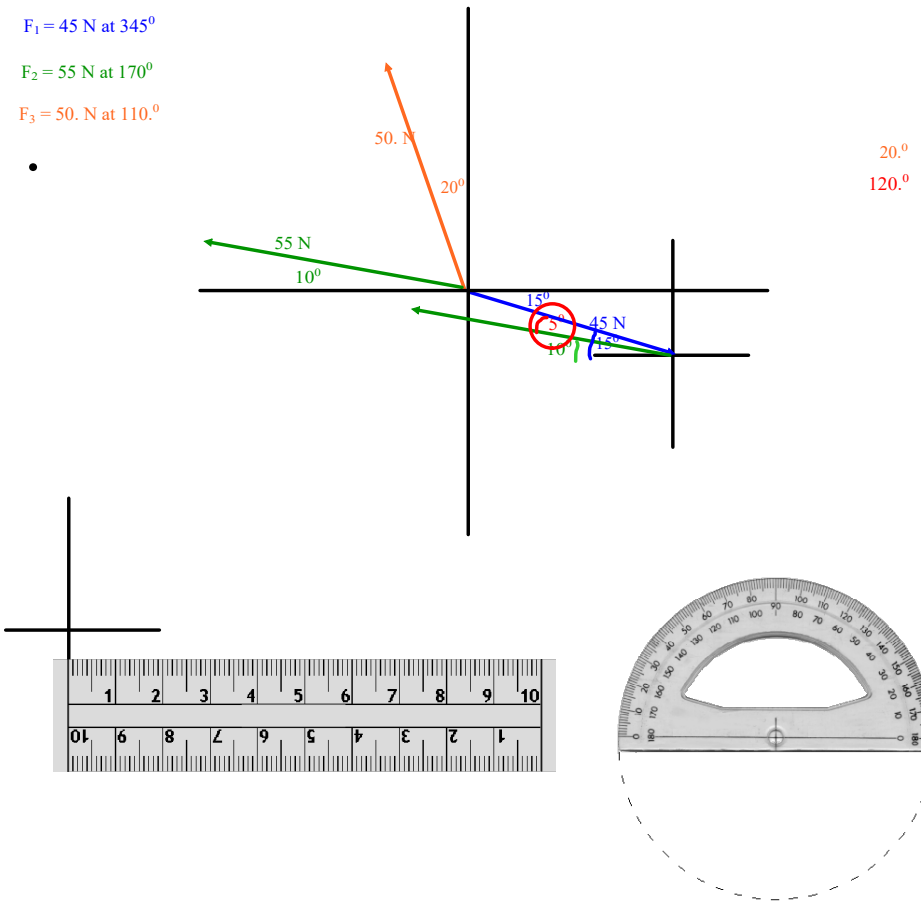
$F_3 = 50.$ N at $110.^0$



$F_1 = 45$ N at 345^0

$F_2 = 55$ N at 170^0

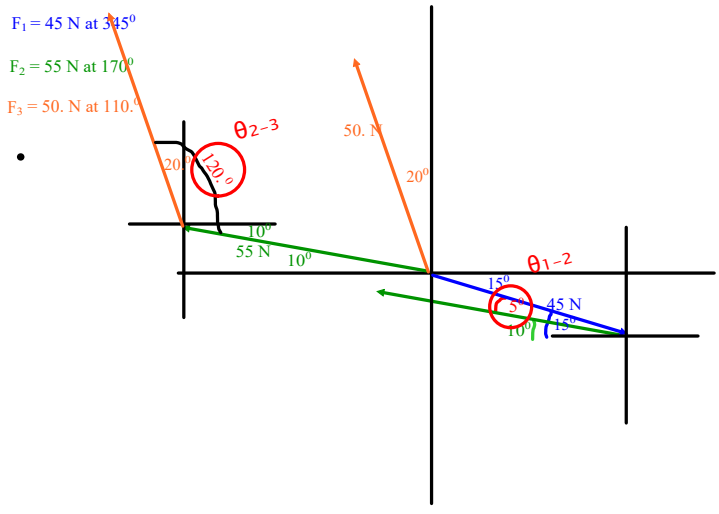
$F_3 = 50.$ N at $110.^0$

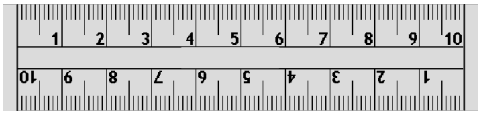


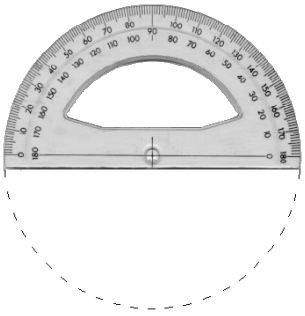
$F_1 = 45$ N at 345^0

$F_2 = 55$ N at 170^0

$F_3 = 50.$ N at $110.^0$



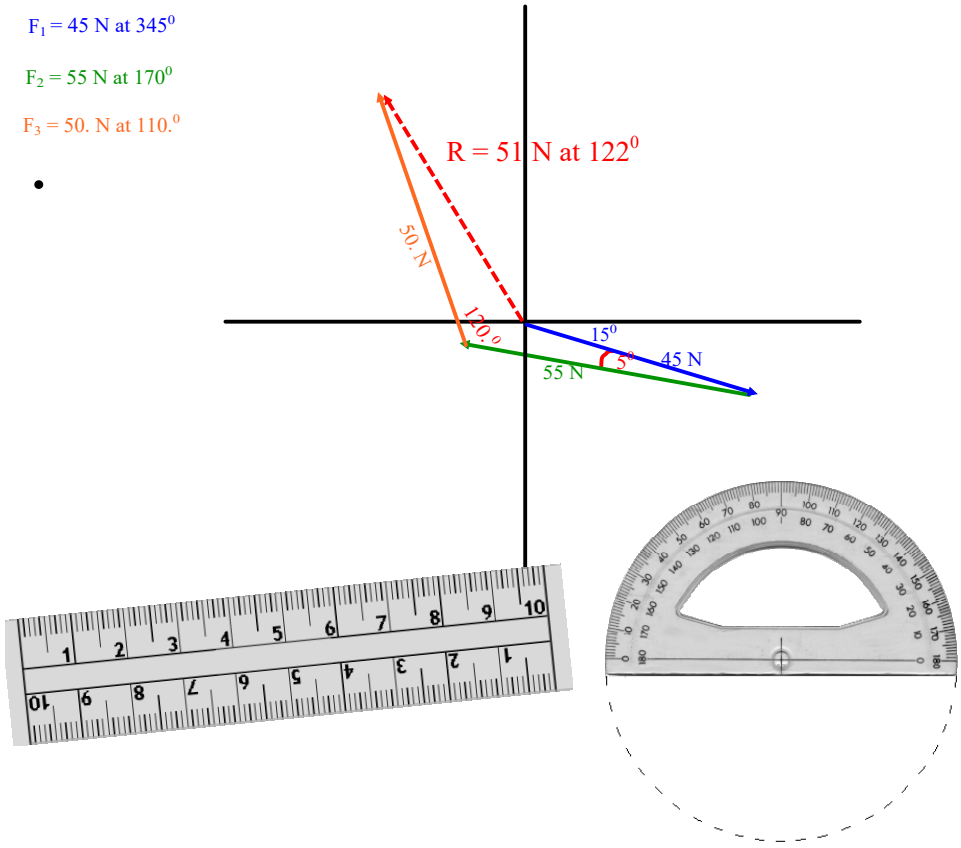




$F_1 = 45$ N at 345^0

$F_2 = 55$ N at 170^0

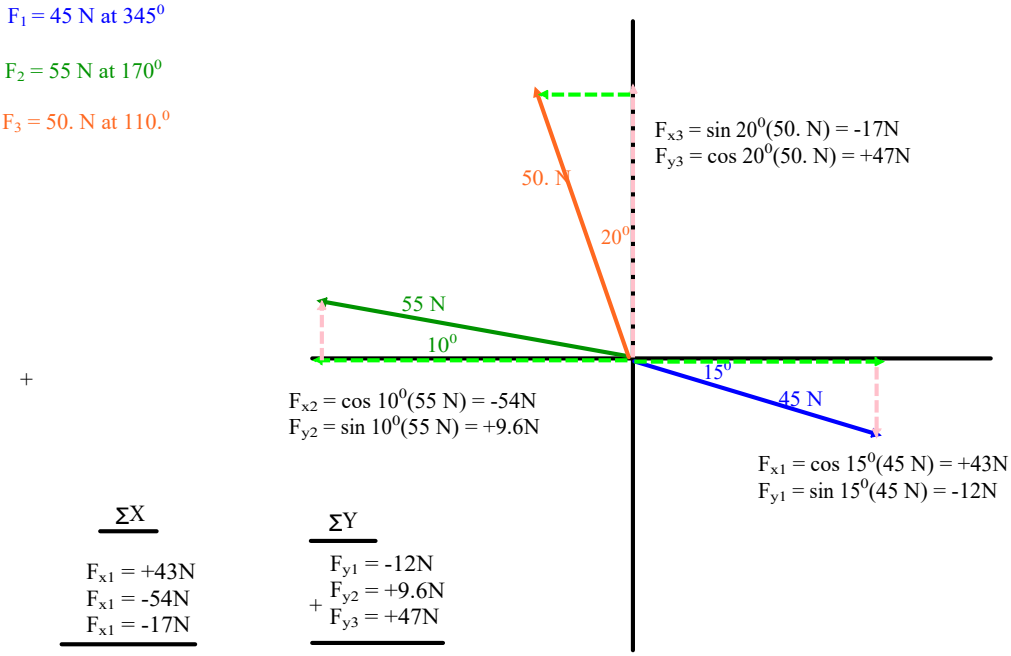
$F_3 = 50.$ N at $110.^0$



$F_1 = 45$ N at 345^0

$F_2 = 55$ N at 170^0

$F_3 = 50.$ N at $110.^0$



+

ΣX

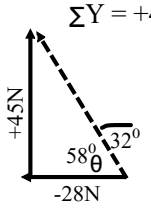
$F_{x1} = +43N$
$F_{x1} = -54N$
$F_{x1} = -17N$

$\Sigma X = -28N$

ΣY

$F_{y1} = -12N$
$+ \quad F_{y2} = +9.6N$
$F_{y3} = +47N$

$\Sigma Y = +45N$



$R = \sqrt{(28N^2 + (45N)^2}$

$R = 53N$ at 122^0

$\tan \theta = 45N/28N$

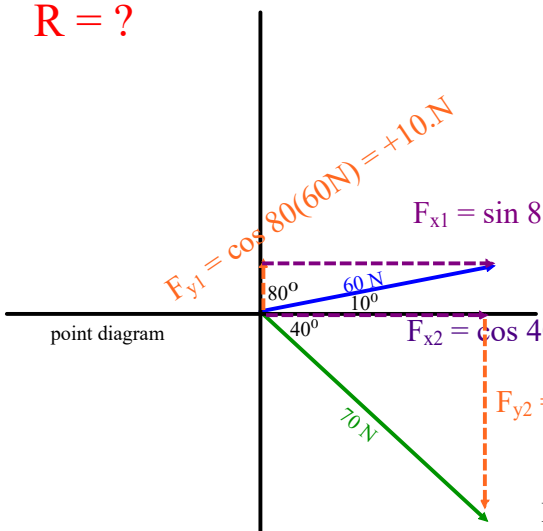
$\theta = 58^0$

$32^0 + 90^0 = 122^0$
or, $180^0 - 58^0 = 122^0$

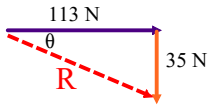
60.0 N at 10.0^0

70.0 N at 320^0

R = ?



ΣX	ΣY
+59N	+10N
+54N	-45N
+113.N	-35N



$R = (113\ N)^2 + (35N)^2 = 139\ N$

$\text{Tan}\ \theta = 35N/113.N = 17^0$

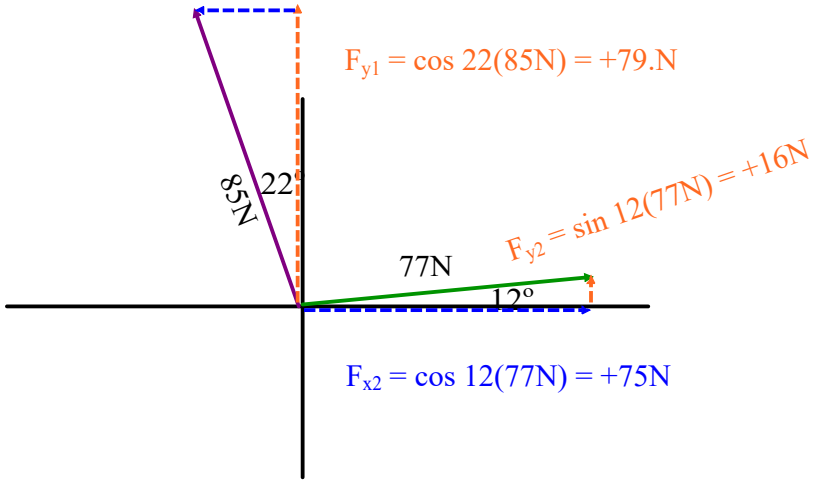
$360^0 - 17^0 = 343^o$

R = 118 N at 343^o

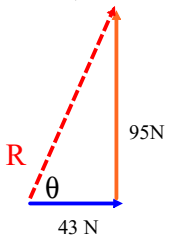
F_1 = 85 N at 112^o

F_2 = 77 N at 12^o

R = ?



ΣX	ΣY
+-32N	+79N
+75N	+16N
+43.N	+95N



$R = (43\ N)^2 + (95N)^2 = 104\ N$

$\text{Tan}\ \theta = 95N/43.N = 66^o$

R = 104 N at 66^o

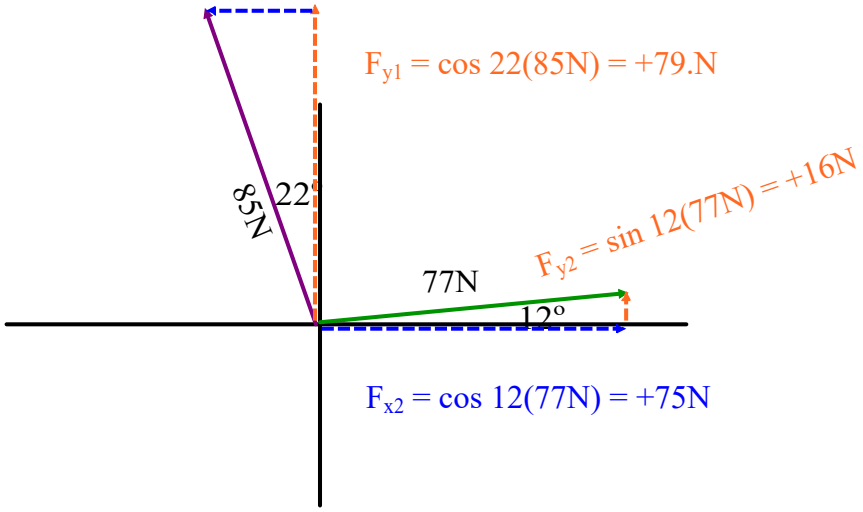
F_1 = 85 N at 112°

F_2 = 77 N at 12°

R = ?

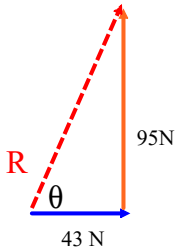
F_{x1} = sin 22(85N) = -32N

F_{y1} = cos 22(85N) = +79.N



F_{x2} = cos 12(77N) = +75N

ΣX	ΣY
+-32N	+79N
+75N	+16N
+43.N	+95N



R = $(43\ N)^2 + (95N)^2$ = 104 N

Tan θ = 95N/43.N = 66°

R = 104 N at 66°