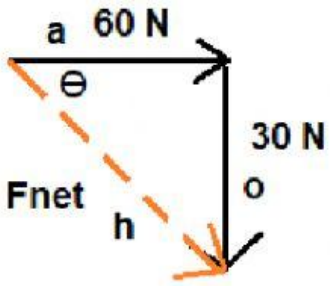
Newton worksheet 3

Eg 1. An object is pulled to the right at 60N and pushed down at 30N

Calculate the net/resultant force acting on the box



We have the opposite and adjacent side

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

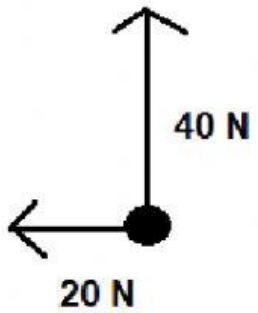
$\tan \Theta =$ ———

$\Theta =$ °

*This is not the final answer for the **direction**, we need to actually calculate the bearing, but we'll leave it there for now.*

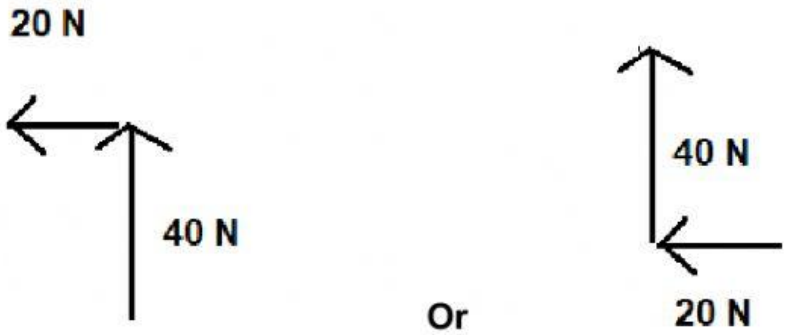
Eg 2. An object is pulled up at with a force of 40 N and pulled to the left with 20N.

Step 1: Draw a free body diagram of the forces



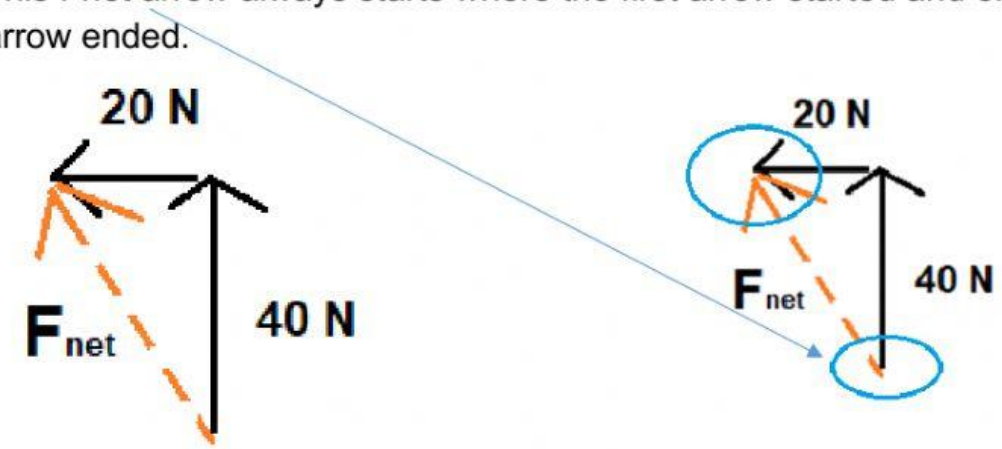
Step 2: **Redraw the diagram - head to tail** (where the first arrow ends, the next one starts. There will always be two ways to do this – and both are always correct.

Thus it makes no difference which force you draw first.

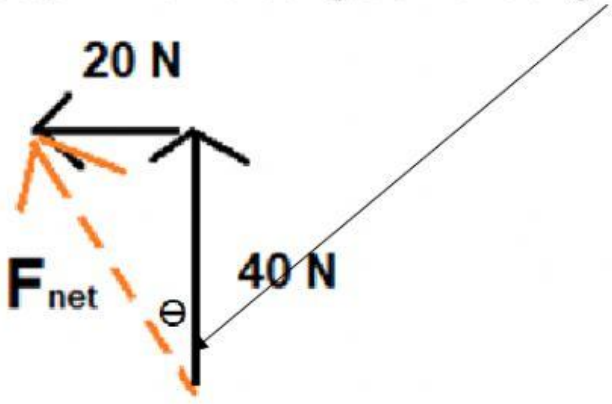


Step 3: Draw the net/resultant force (I'm just going to choose the first triangle)

This Fnet arrow always starts where the first arrow started and ends where the last arrow ended.



Step 4: mark the angle Θ – this angle is always where the Fnet starts



Step 5: use pyth to calculate the Fnet

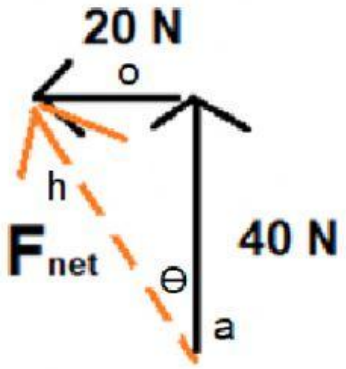
$Fnet^2 = F_1^2 + F_2^2$

$Fnet = \sqrt{40^2 + 20^2}$

$Fnet = \sqrt{2000}$

Fnet = N {2 decimals}

Step 6: Use trig to calculate the angle Θ



We have the adjacent and opposite sides to the angle

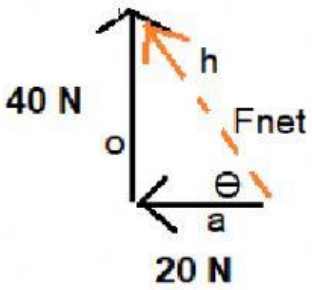
Thus use tan

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

$\tan \Theta =$ ———

$\Theta \quad =$ °

Or (since the triangle can be drawn in 2 ways)



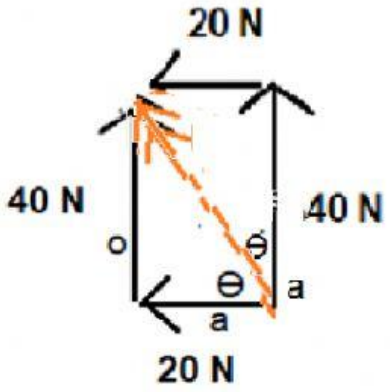
$\tan \Theta = \frac{o}{a}$

$\tan \Theta =$ ———

$\Theta \quad =$ °

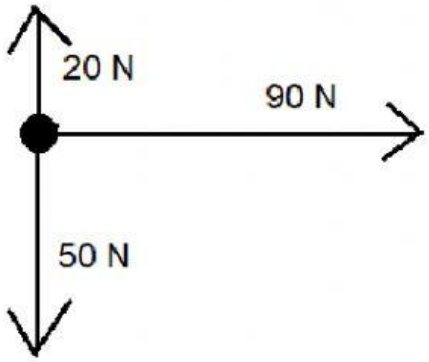
Both options for the angles are correct – you'll understand why when we start calculating the bearing.

For interest sake: notice that the 2 angles, when added together, will give you 90°



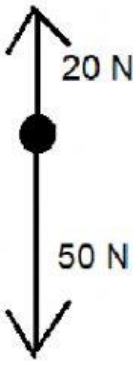
Eg 3. A 50 N force is exerted on an object downwards and a force of 20 N upwards. A force of 90N is exerted to the right on the object.

Step 1: draw a free body diagram



Step 2: Subtract (if they are in opposite directions) or add any forces (that are in the same directions) that are in a straight line.

*this step is different, since there are 3 forces. (Normally we would have drawn the forces into a head-to-tail triangle now)



These forces are allowed to be **subtracted** because they are in a straight line

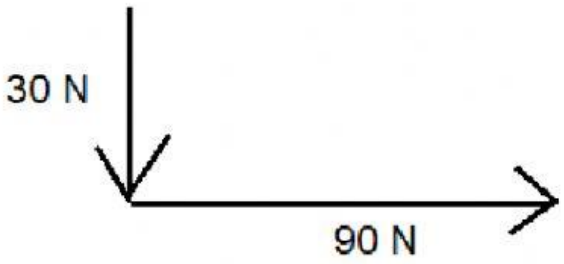
The forces are on the y-axis of the Cartesian plane, thus you need to find the net force on the y component.

F_{ynet} = 50 – 20

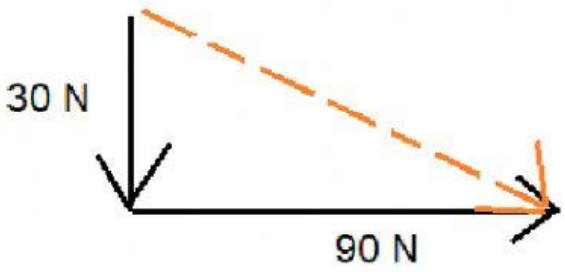
F_{ynet}= _____ _____

F_{xnet} = 90 N right (since there is only one force on the x-axis)

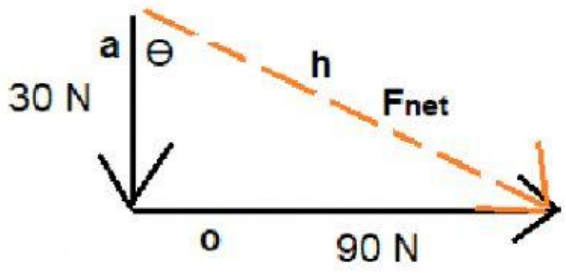
Step 3: Redraw the diagram - head to tail



Step 4: : Draw the net/resultant force



Step 5: mark the angle Θ – this angle is always where the Fnet starts



$F_{net}^2 = F_1^2 + F_2^2$

$F_{net} = \sqrt{30^2 + 90^2}$

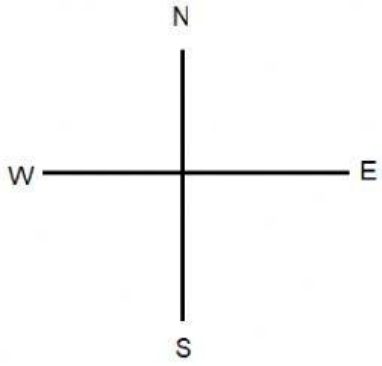
$F_{net} = \sqrt{9000}$

$F_{net} =$ N

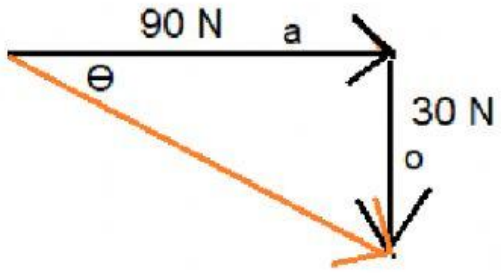
$\tan \Theta = \frac{o}{a}$

$\tan \Theta =$ ——

$\Theta =$ °



Or – the other way to draw the triangle



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

$\tan \Theta =$ ——

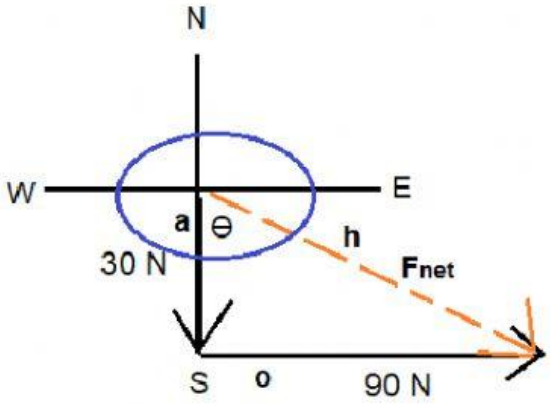
$\Theta =$ °

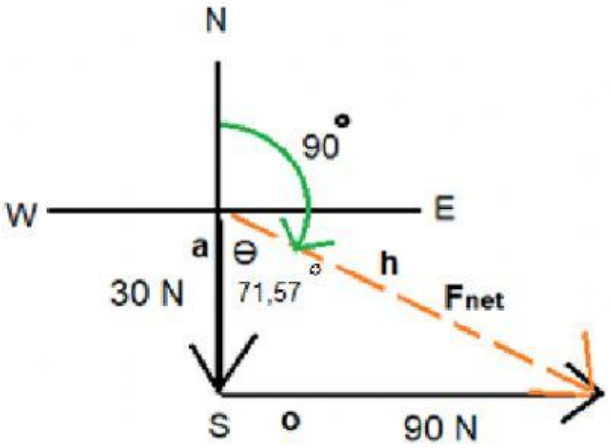
We actually need to give the angle as a **bearing.**

This needs to be measured from North, and clockwise

Thus you need to draw a Cartesian plane over the triangle

The Cartesian plane needs to be drawn where the two tails meets





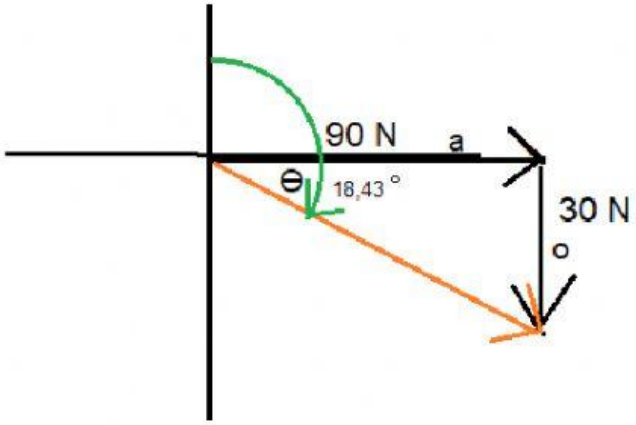
To calculate this green angle, you need to go all the way to 180° and then subtract the Θ.

Bearing = 180° - 71,57°

Bearing = **108,43°**

The final answer is Fnet = 94,57N at a bearing of 108,43°

Or (if you drew the triangle the other way)



To calculate this green angle, you need to go to the way to 90° and then add the Θ.

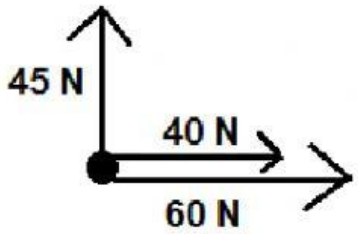
Bearing = 90° + 18,43°

bearing = **108,43°**

Notice the bearing is the same answer for both options – and that is why you can draw the triangle either way and still get the correct final answer.

Eg 4. A force of 60 N is exerted on an object to the right, another force of 40 N is also exerted to the right. A third force of 45 N is exerted upwards.

Step 1: draw a free body diagram



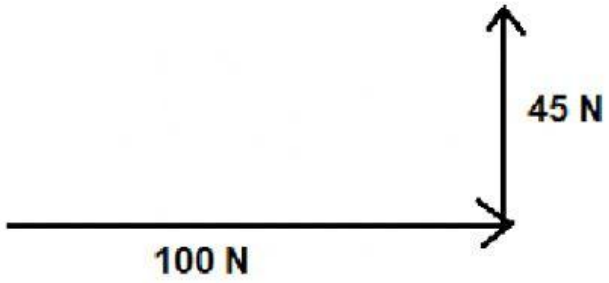
Step 2: Add the two forces on the x-axis together (since they are acting in the same directions)

Fxnet = 40 + 60

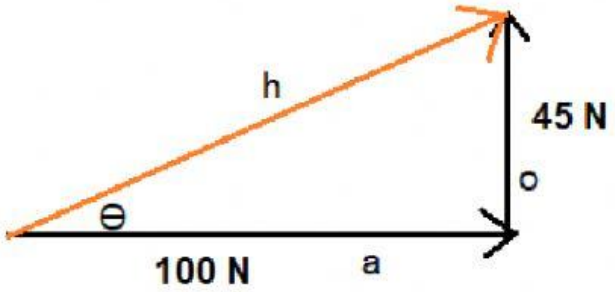
Fxnet= 100 N right

Fy = 45 N upwards

Step 3: Draw into a head-to-tail diagram



Step 4: Draw in the Fnet



$Fnet^2 = F_1^2 + F_2^2$

$Fnet = \sqrt{100^2 + 45^2}$

$Fnet = \sqrt{12025}$

$Fnet = 109{,}66\ N$

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

$\tan \Theta = \frac{45}{100}$

$\Theta = 24{,}23°$

The next worksheet will calculate the bearing