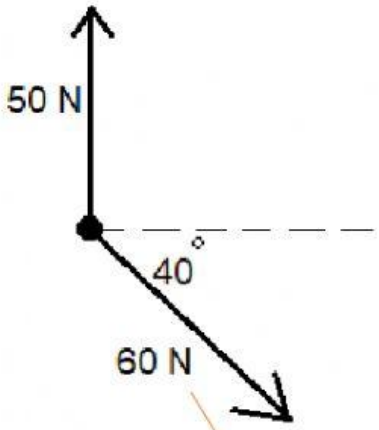
Newton's laws worksheet 6

Now let's mix forces at an angle with vertical and horizontal forces

Eg 1.

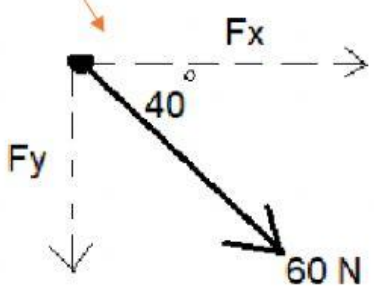


Break any forces at an angle into components first

Fx = F. cos Θ

= 60 (cos 40)

= 45,96 N right



Fy = F. sin Θ

= 60 (sin 40)

= 38,57 N downwards

Then add/subtract any forces in a straight line

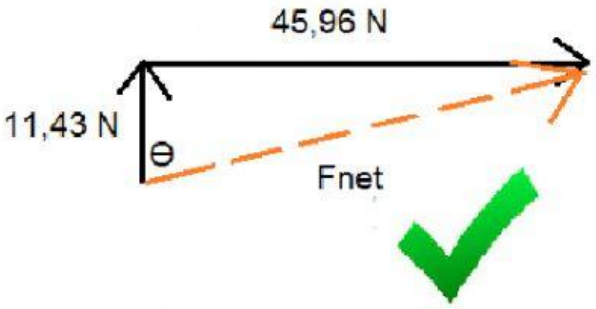
Fynet = 50 – 38,57

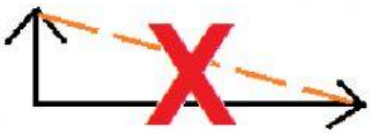
= 11,43 N upwards

Fx (there is only one force in the horizontal direction) = 45,96 N right

Now you can draw these into a triangle

Always ensure to draw the 2 forces head to tail.





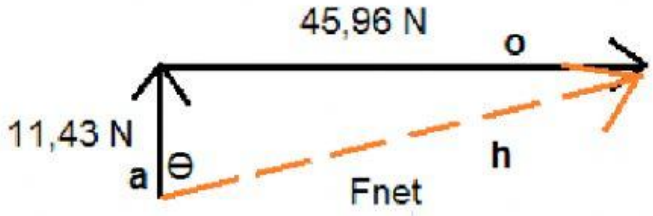
Fnet = $F_1 + F_2$

= $11{,}43^2 + 45{,}96^2$

= $\sqrt{2242{,}97}$

= 47,36 N

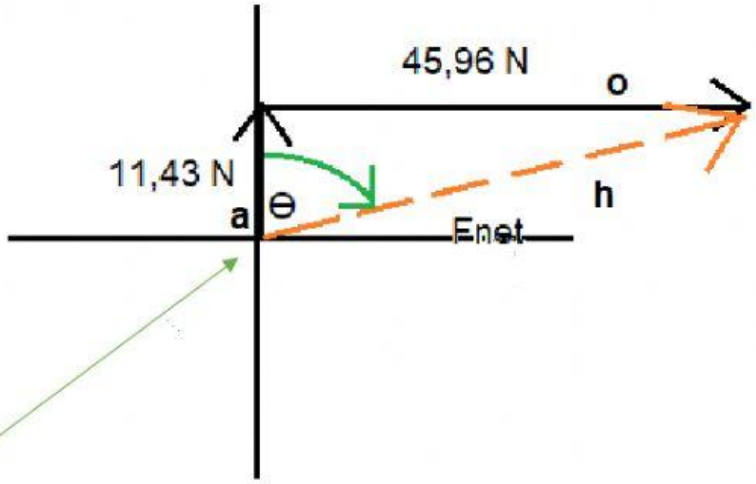
Then for the bearing:



tan Θ $= \frac{o}{a}$

$= \frac{45{,}96}{11{,}43}$

= 76,03°



Final answer:

Fnet = 47,36 N at a bearing of 76,03°

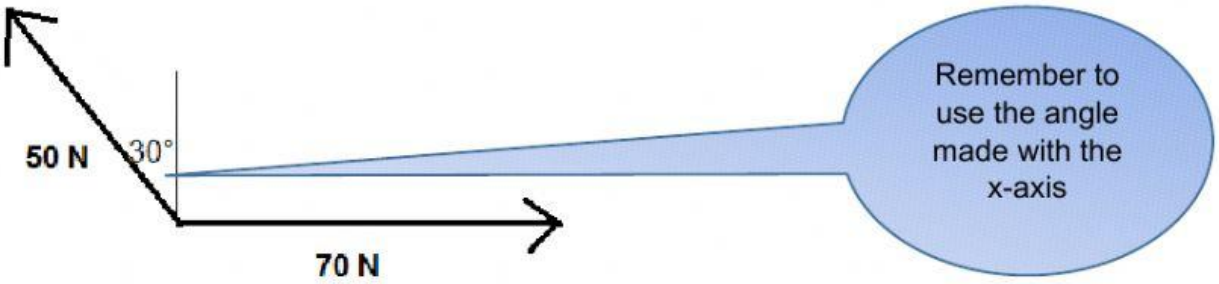
Exercise 6: resultant forces

- ✓ **Round each answer off to 2 decimal places**
- ✓ **Use this rounded off answer for the next question**

Calculate the resultant/net force of the following:

Because there are 2 ways to draw the triangle, you will notice on the memo that there is always 2 correct answers for Θ, but the bearing will only have one correct option.

1.



Fx of the 50N force = _____ _____

Answer value and unit

Direction

Fy of the 50N force = _____ _____

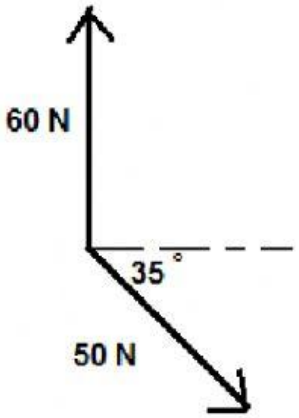
Fxnet = _____ _____

Fnet = _____ _____

Θ =

At a bearing of = _____°

2.



Fx of the 50N force = _____ _____

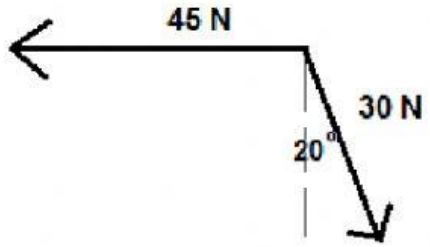
Fy of the 50N force = _____ _____

Fynet = _____

Fnet = _____ _____

At a bearing of = _____°

3.



Fx of the 30N force = _____ _____

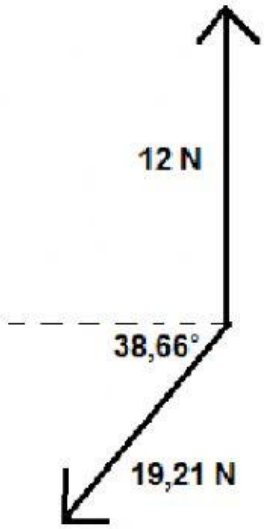
Fy of the 30N force = _____ _____

Fxnet = _____ _____

Fnet = _____ _____

At a bearing of = _____°

4.



Fx of the 50N force = _____ _____

Fy of the 50N force = _____ _____

Fynet = _____

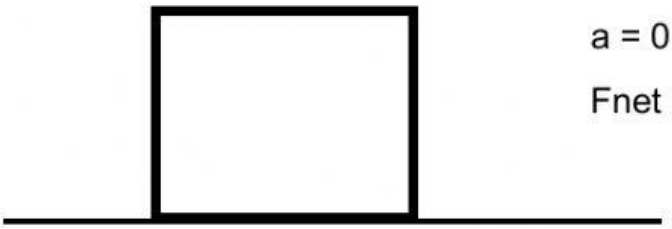
Fnet = _____ _____

At a bearing of = _____°

Newton's first law:

An object continues in a state of rest or uniform (moving with constant) velocity unless it is acted upon by an unbalanced (net or resultant) force.

Which means that if an object is at rest, it will remain at rest unless a net force acts on it.



$v = 0 m.s^{-1}$

$a = 0\ m.s^{-2}$

$F_{net} = 0\ N$

Or if an object is already in motion and moving at a constant velocity the object will continue to move at a constant velocity, unless acted upon by an external net force.

For example, if you we cycling along the beachfront and exerting a force of 100 N while cycling to the left. (assume there is no friction)

v = constant

$a = 0\ m.s^{-2}$

$F_{net} = 0\ N$

Then you reach a grassy patch and the frictional force exerted on the bicycle is 100N to the right.

Because these 2 forces equal, the object will continue to move, but move at a **constant velocity** (thus zero acceleration).

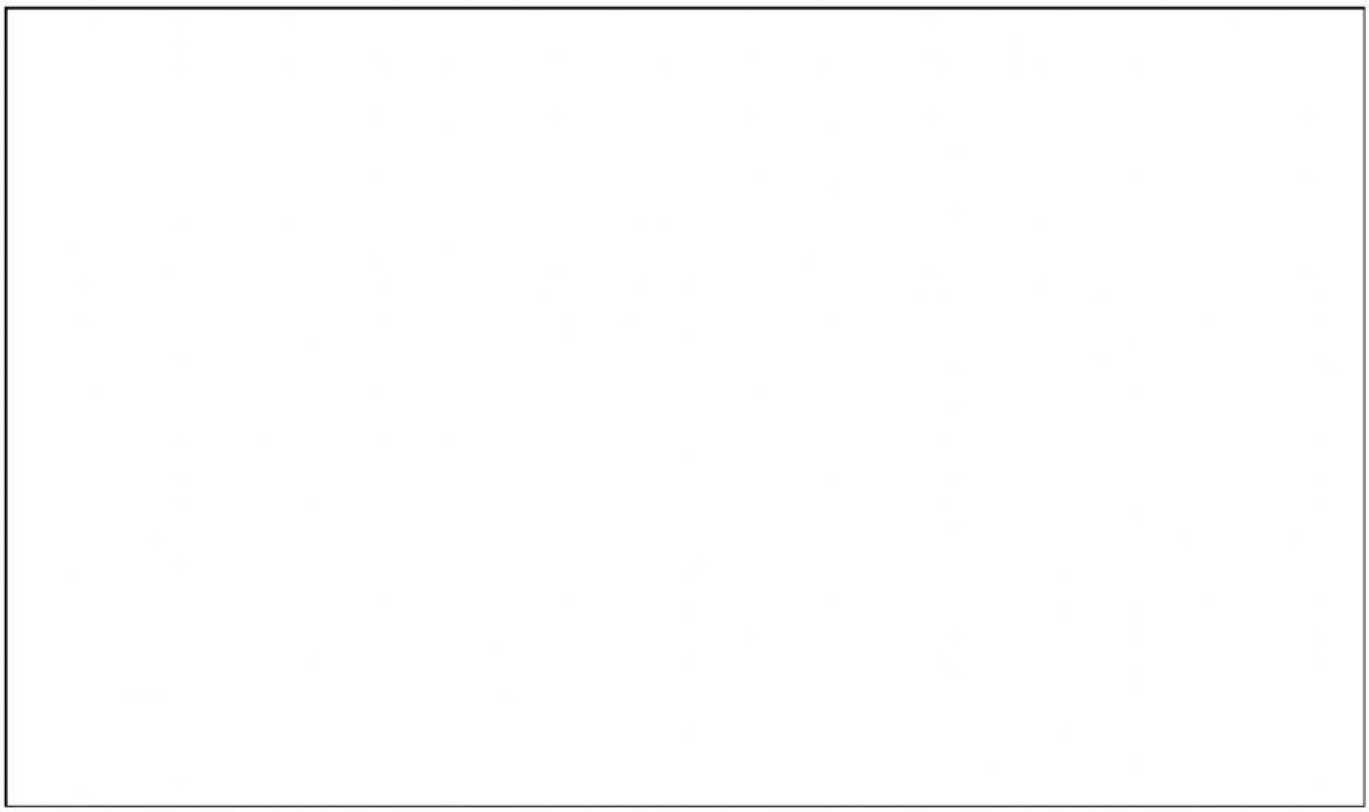
Objects are not always stationary when the forces balance out.

If the object was already in motion, the objects will continue to move, but always at a constant velocity

A link to the phet simulation you can use to experiment:

https://phet.colorado.edu/sims/html/forces-and-motion-basics/latest/forces-and-motion-basics_en.html

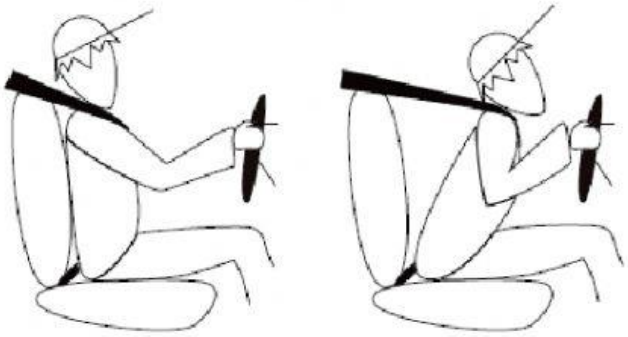
Watch this quick video on using the phet simulation to verify Newton's first law



Inertia

Inertia is the tendency of a body to resist a change in its motion or rest. It is an object's tendency to remain at rest or continue moving at a constant velocity.

A good example of inertia is when we are sitting in a car and driving at 20m.s^{-1} and the car comes to a stop. Your body will continue moving forward at that velocity in a straight line because of inertia, and the function of the seatbelt is exert a force on you in the opposite direction to stop your body from moving forward (through the windshield).



If you pull a table cloth from underneath cutlery lying on a table, the cutlery will remain on the table, because of its tendency maintain its state of rest.

If you are sitting in the car and place a pencil on the dashboard of the car and the car then starts to move the pencil will move backwards and fall on the floor. Because the pencil wants to maintain its state of rest.

In summary

If the object was stationary to start with and the horizontal and vertical forces are balanced out, then the object will remain stationary.

If the object was already in motion and the horizontal and vertical forces are balanced out, then the object will keep moving, but at a constant velocity.

If the forces are not balanced and the bigger force is to the right, then the object will accelerate to the right.

If the forces are not balanced and the bigger force is to the left, then the object will accelerate to the right.

If the forces are not balanced and the bigger force is to the upwards, then the object will accelerate to the upwards.

If the forces are not balanced and the bigger force is to the downwards, then the object will accelerate to the downwards.