Newton's laws worksheet 5

Calculating the components of a force

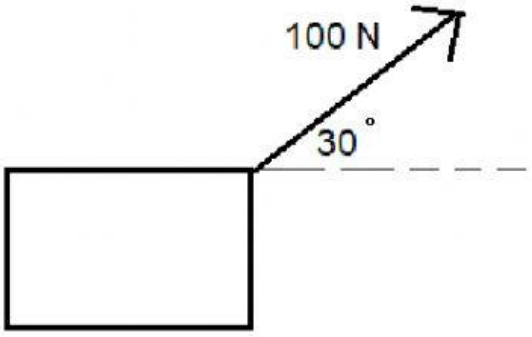
Calculate the horizontal and vertical components of the forces

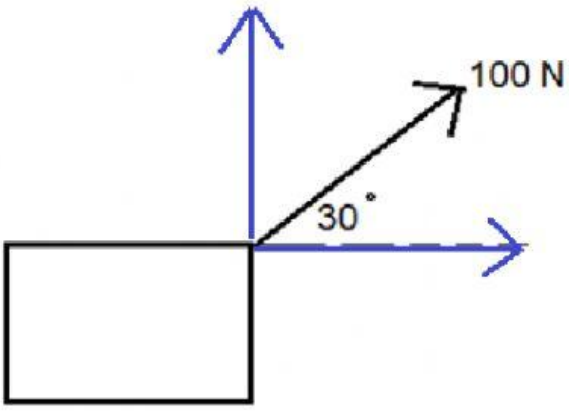
If an object is pulled at an angle then it is useful to break that force up into components.

It is tricky to work with forces at an angle

Watch this video to calculate the components of a force

Eg 1. If a box is pulled up with a force of 100 N at an angle of 30° with the horizontal

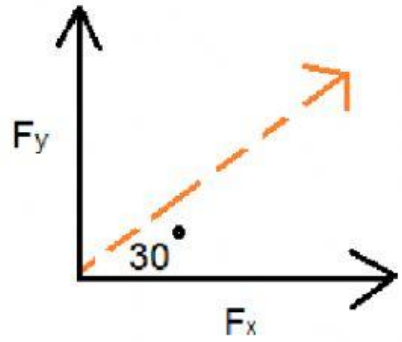




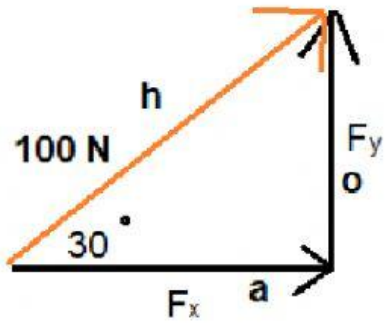
Instead of one person pulling the box with a force of 100 N at an angle of 30° - it can be broken up into two forces. One person pulling it to the right and one person pulling it up.

These 2 forces combined will have the same effect as one person pulling it with 100N at an angle. Essentially what we are doing is working backwards. It's like they have given us the net/resultant force and we have to work backwards and find the horizontal and vertical forces that made it.

To do this draw these forces into a vector triangle



The two components need to be drawn head to tail though



We want the Fx and Fy components

We have the hypotenuse and need the adjacent and opposite sides

To calculate the Fy component

$\sin \Theta = \frac{o}{h}$

$\frac{\sin 30}{1} = \frac{Fy}{100}$

cross multiply first

sin 30 (100) = Fy

Fy = 50 N upwards

To calculate the Fx component

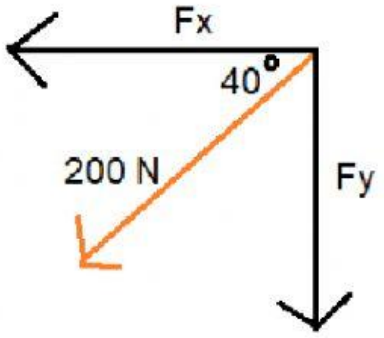
$\cos \Theta = \frac{a}{h}$

$\cos 30 = \frac{Fx}{100}$

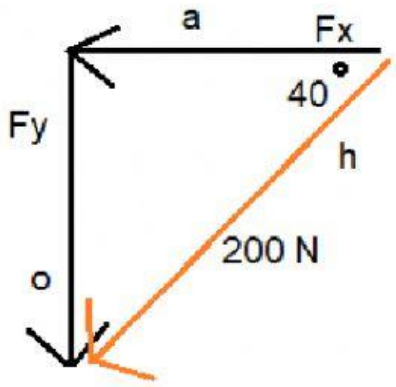
cos 30 (100) = Fx

Fx = 86,60 N right

Eg 2. If a box is pushed down at an angle with a force of 200 N at an angle of 40° with the horizontal.



You need to redraw the forces into a triangle first.



To calculate the Fy component

$\sin \Theta = \frac{o}{h}$

$\frac{\sin 40}{1} = \frac{Fy}{200}$

cross multiply first

sin 40 (200) = Fy

Fy = 128,56 N upwards

To calculate the Fx component

$\cos \Theta = \frac{a}{h}$

$\cos 40 = \frac{Fx}{200}$

cos 40 (200) = Fx

Fx = 153,20 N right

There is a little shortcut you can take, so that you don't need to draw the triangle every time.

Y sin if you can **cos X**

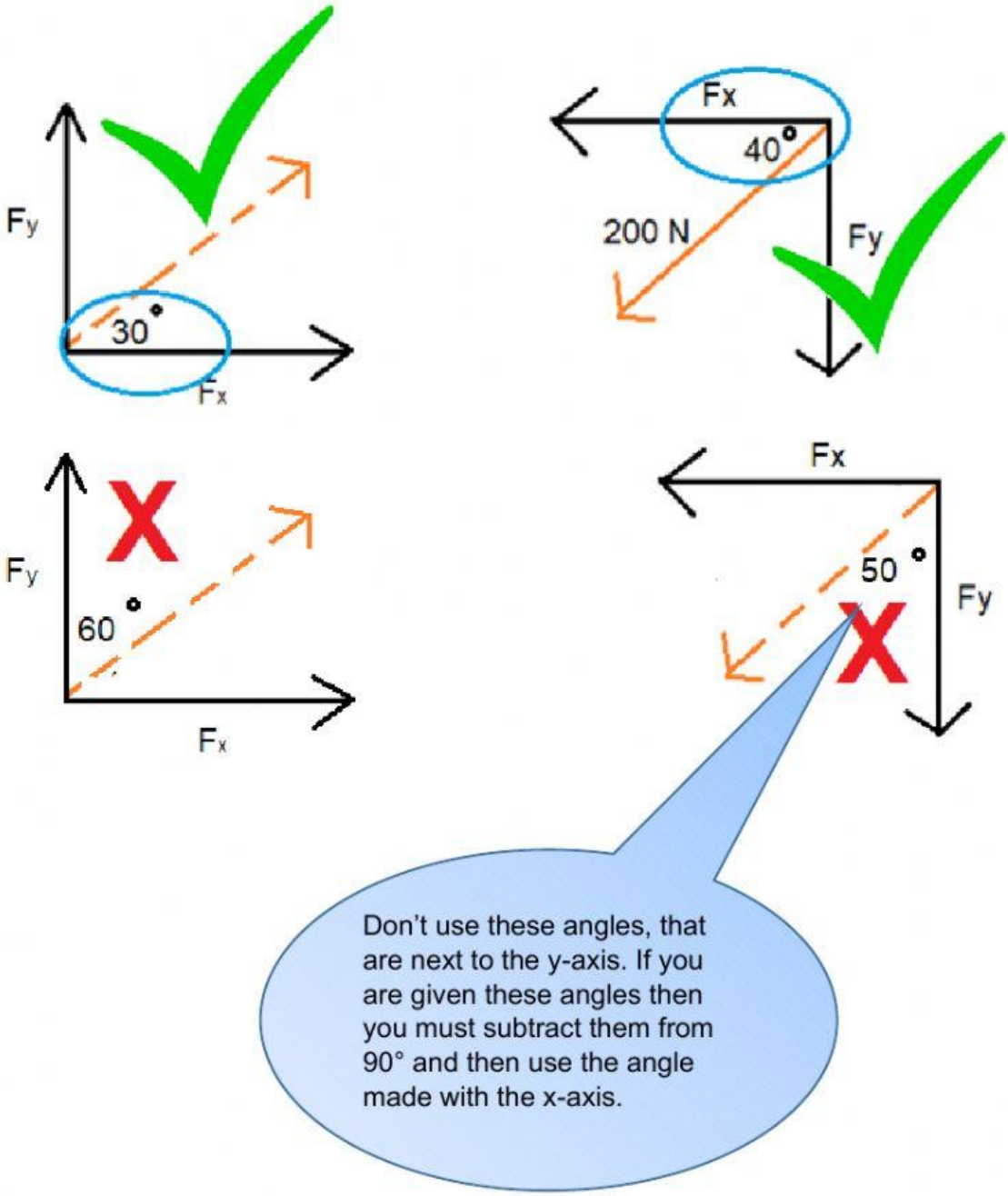
{why sine if you can cos x}

This way you can always calculate Fx and Fy as follows:

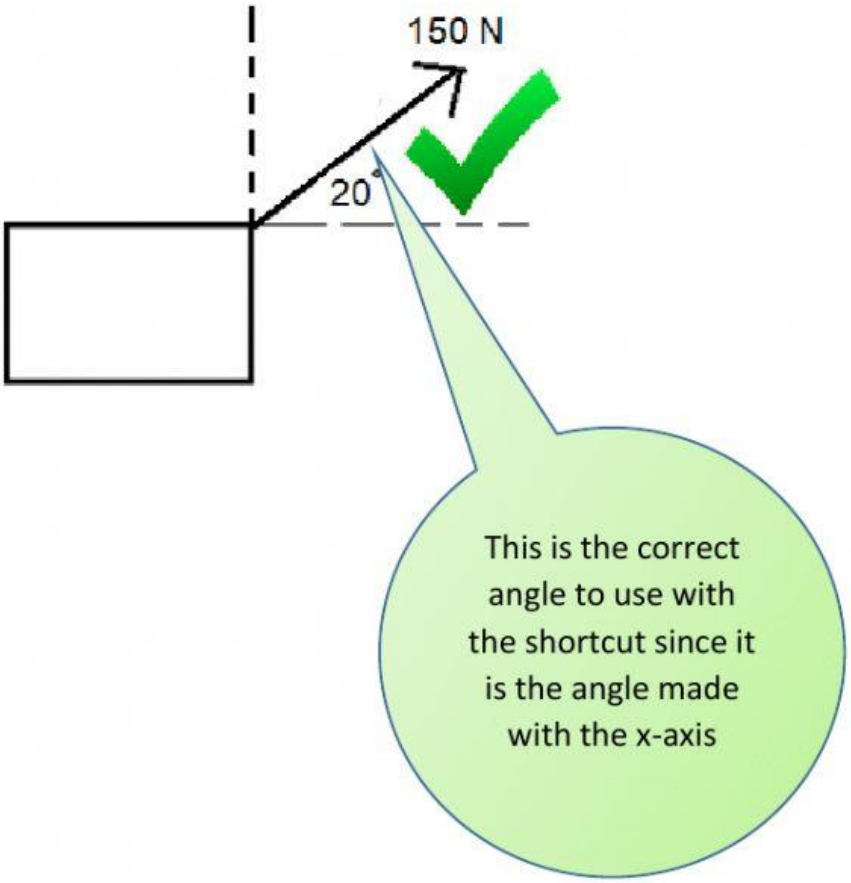
$F_y = F.\sin \Theta$

$F_x = F.\cos \Theta$

However the Θ must be the angle made with the horizontal (or x-axis)



Eg 3. Calculate the horizontal and vertical components of the following:



$F_y = F. \sin \Theta$

$= 150 (\sin 20)$

$= 51{,}30$ N upwards

$F_x = F.\cos \Theta$

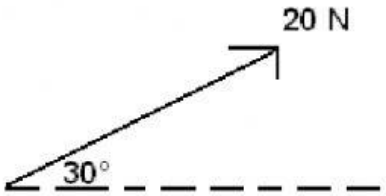
$= 150 (\cos 20)$

$= 140$ N right

Exercise 5: Calculate the horizontal and vertical components of the following

- ✓ **Round each answer off to 2 decimal places**
- ✓ remember that force is a vector and needs direction and magnitude

5.1



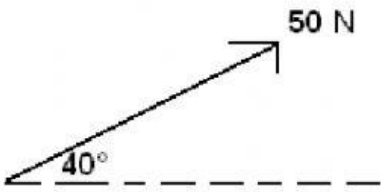
Fx = = _____ _____

Answer value and unit

Direction

Fy = _____ _____

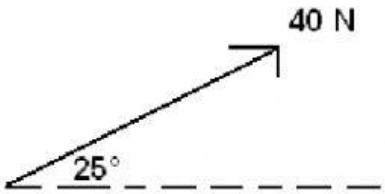
5.2



Fx = _____ _____

Fy = _____ _____

5.3



Fx = _____ _____

Fy = _____ _____

5.4 A lawnmower is pushed with a force of 25 N downwards at an angle of 35° to the horizontal.

Fx = _____ _____

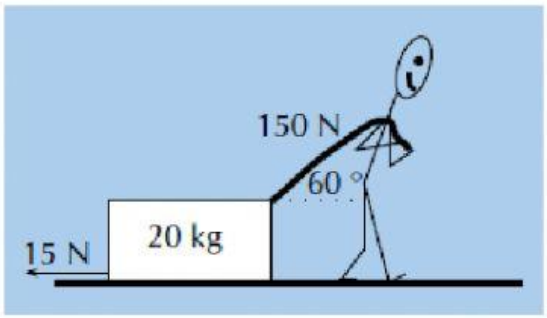
Fy = _____ _____

5.5 A lawnmower is pushed with a force of 50 N downwards at an angle of 40° to the horizontal.

Fx = _____ _____

Fy = _____ _____

5.6



Fx = _____ _____

Fy = _____ _____