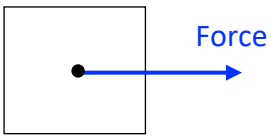
5.1.1 Scalars and vectors

videos

Physical quantities can be divided into scalars and vectors. Vector quantities, such as force, have a size and a direction. Scalar quantities, such as mass, have a size only.

(1) Divide the following physical quantities into scalars or vectors: speed, velocity, temperature, distance, displacement, acceleration, time

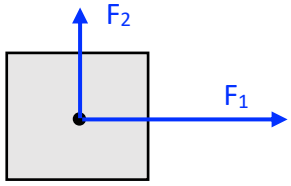
We can represent vector quantities (such as force) using arrows. The length of the arrow gives an indication of the size of the physical quantity and the direction is shown by the direction the arrow points.

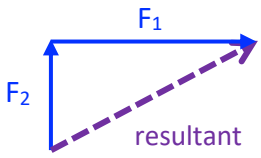


The diagram above shows a force acting on an object. The dot in the centre of the object represents the centre of mass of the object.

Adding vectors

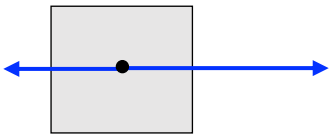
Often, more than one force will act simultaneously on the object. If this is the case, we need to work out the resultant force. We can do this by adding force vectors together. When we add vectors, we add them tip-to-tail, and the resultant vector is an arrow drawn from the tail of the first vector to the tip of the last vector:



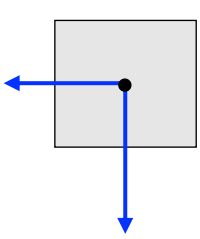


(2) Draw resultant force vectors for the following:

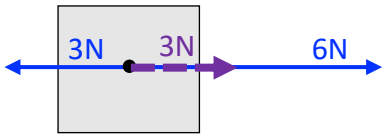
(i)



(ii)

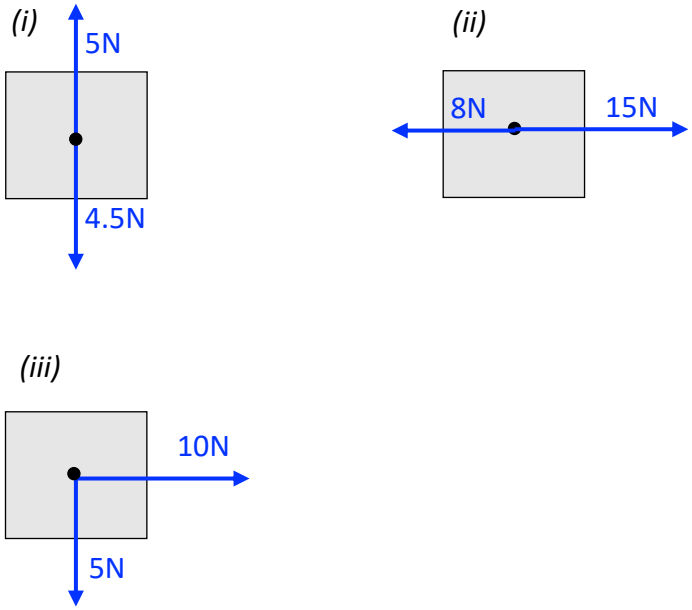


If vectors are in opposite directions to each other, we can subtract one from the other to find the resultant:



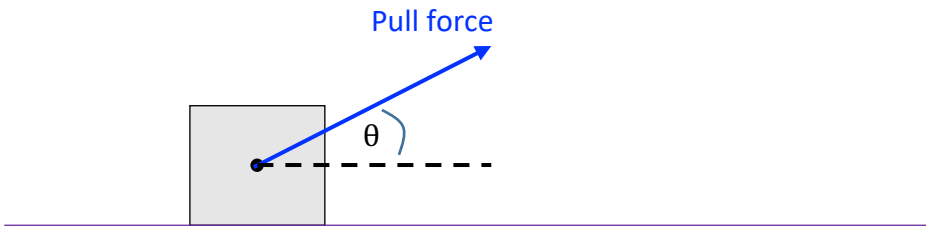
The resultant force is 6 – 3 = 3N to the right.

(3) Work out the resultant force for the following: (Note - the arrows haven't been drawn to scale and you will need to calculate the resultant force and say what direction the resultant force acts.)

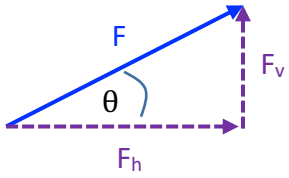


Resolving vectors

We have seen that we can add vectors together to make a resultant vector. We can also do the reverse and separate one vector into a number of different vectors. This is often useful in analysing situations where we are interested the vector components acting in certain directions. Let us look at an example:



In the situation above we have an object which is being pulled along a surface, but the pull force is at an angle to the surface. We might be interested in the size of the force which contributes to the horizontal movement. To find this we resolve the pull force into a horizontal (F_h) and vertical component (F_v):



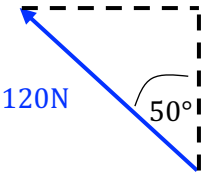
We can find the magnitude (size) of the horizontal and vertical forces by using a scale drawing, or (if your maths skills are up to it!) using some trigonometry.

$$F_h = F \times cos(\theta)$$

$$F_v = F \times sin(\theta)$$

(4) By either drawing a scale diagram or trigonometry, resolve the following force vector into a vertical and horizontal component.

(i)



(ii)