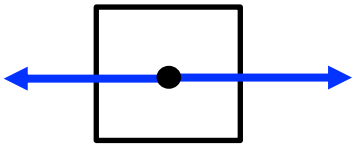
5.6.1 Resultant force and F=ma

videos

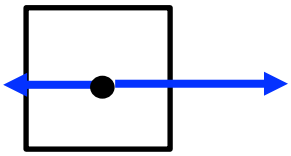
Forces are balanced if forces acting on an object are equal in size and opposite direction. The resultant force is the overall force acting on an object, once all the force vectors are added together (Look at section 5.1 if you have forgotten how to add vectors). If there is a resultant force acting on an object it will accelerate in the direction of the resultant force.

(1) For each of the following (a-c), draw an arrow to show the resultant force and describe how this will affect the motion of the block.

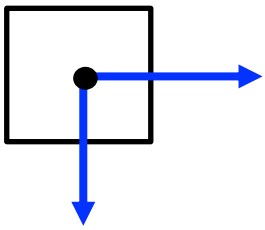
a)



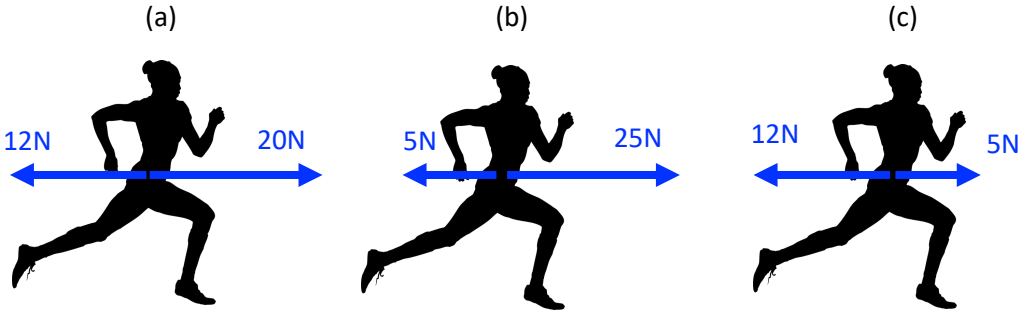
b)



c)



(2) Work out the resultant force on each of the runners. What will the motion be like in each case?



Runner a has been running at 3m/s.

Runner b has been running at 2m/s.

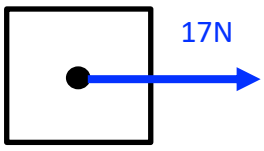
Runner c has been running at 3.5m/s.

A resultant force acting on an object causes it to accelerate (a) in the direction of the resultant force (F). If we know the mass (m) of the object, we can work out the acceleration using the formula:

$$a = \frac{F}{m}$$

(Note: The mass needs to be in kilograms. The unit for acceleration is m/s^2.)

Worked example – *A resultant force of 17N is applied to a 10kg block. What is its acceleration?*



$a = \frac{F}{m} = \frac{17}{10} = 1.7m/s^2$ (acceleration to the right)

(Note: Remember to include the units for acceleration)

(3) For the runners in question 2, above, calculate the acceleration in each case. The runner has a mass of 80kg. (Note: When the resultant force is in the opposite direction to the motion, the acceleration is negative. This is called deceleration.)

(4) Looking at the equation for acceleration, explain why a motorbike can accelerate more than a bus.

(5) Rearrange the equation to make F the subject (i.e. F=...).

(6) A 500kg motorbike accelerates at $10m/s^2$*. Calculate the driving force from the engine.*

(7) In question (6), explain why the driving force needed is likely to be bigger than the one you calculated.