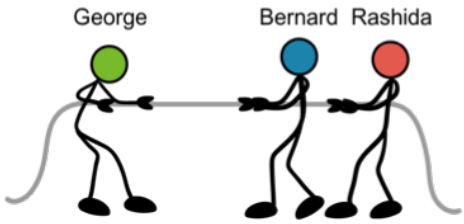
0 1 Three friends are taking part in a charity tug-o-war competition.



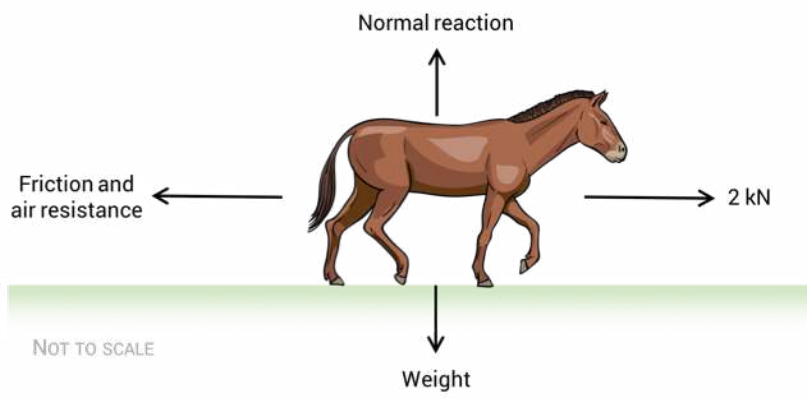
0 1 . 1 In a round in which the competitors start from rest, George and Bernard are applying forces of 640 and 510 N, respectively. Calculate the force which Rashida must apply for them to remain at rest.

Force = 640 – 510 = **130 N**

0 1 . 2 Thanks to a sudden burst of energy, Rashida then pulls with a force of 550 N. Calculate the magnitude and direction of the resultant force exerted on the centre of the rope.

Total force to left = 640 N
Total force to right = 510 + 550 = 1060 N
Resultant force to right = 1060 – 640 = **420 N**

0 2 A horse of mass 400 kg is **accelerating** forwards at a rate of 0.5 m/s^2. The forces which are acting on the horse are as shown in the below diagram.



0 2 . 1 Which of the below mathematical statements is correct? Tick **one** box.

Friction + air resistance < 2 kN ☑
Friction + air resistance = 2 kN ☐
Friction + air resistance > 2 kN ☐

0 2 . 2

Explain your previous answer.

The horse is accelerating forwards [1] which means that there must be a resultant (net) force acting on it in the forwards direction [1]. This can only happen if the sum of the forces of friction and air resistance acting on the horse to the left is less than the force to the right (2 kN).

0 2 . 3

Calculate the magnitude of the normal reaction force which is acting on the horse. Take g = 9.8 N/kg.

Mass, m = 400 kg
Weight, W = m g = 400 × 9.8 = 3920 N
In (vertical) equilibrium, total upwards force = total downwards force
Therefore normal reaction force = weight = **3920 N**

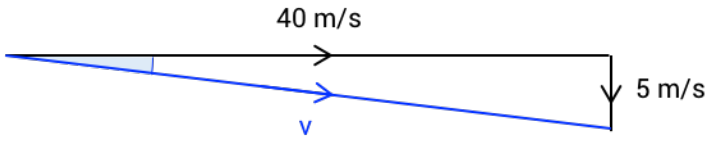
0 3

In a game of tennis, a ball is hit horizontally at a speed of 40 m/s.

After 0.5 seconds, its horizontal velocity has not changed, but it has developed a downwards component of velocity of approximately 5 m/s.

By drawing a suitable scale diagram, determine the magnitude and direction of the tennis ball after 0.5 seconds.

Choose appropriate scale (e.g. 1 cm represents 5 m/s).
Draw appropriate scale diagram.
Include horizontal (40 m/s) and vertical (5 m/s) components of velocity.
Use ruler to measure length of resultant vector (in cm) and convert to a velocity in m/s by using scale.
Use protractor to measure angle of resultant velocity to horizontal (or vertical).



Magnitude = **40.3 m/s**

Direction = **7.1° to horizontal** (or 82.9° to vertical)

Watch out: in any scale diagram questions, if you are asked to measure the angle of a resultant force, velocity, or any other vector, be sure to indicate clearly (preferably both using your diagram and in writing, as I have done above) which angle you are referring to. Writing simply 7.1° here (and not including the 'to horizontal' bit) may have lost you a mark.