

## Dynamics

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Dynamics is the study of moving objects. In previous chapters we have considered the sum total of forces on a body (resultant) and our next consideration is the movement that these forces bring about. Forces of friction, thrust, gravity and tension will be considered and the subsequent motion will be measured by the application of constant acceleration equations and the equation of motion. As in most mechanics questions a certain amount of modeling will have to be used in our working.

Our first area of study of moving objects will involve the application of Newton's laws.

### Newton's Laws

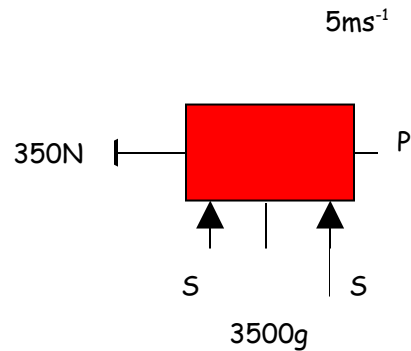
#### Newton's First Law

A body will remain at rest, or will continue to move with constant velocity, unless external forces force it to do otherwise.

A change in state of motion of a body is caused by a force. The unit of force is the Newton, (N).

Example 1

A body of mass 3500Kg moves horizontally at a constant speed of  $5\text{ms}^{-1}$  subject to the forces shown. Find P and S.



There is no vertical motion therefore:

$$2S = 3500\text{g}$$

$$S = 1750\text{g}$$

The horizontal acceleration is zero, therefore:

$$P = 350\text{N}$$

### Newton's Second Law

The force  $F$  applied to a particle is proportional to the product of mass of the particle and the acceleration produced.

A force of 1N produces an acceleration of  $1\text{ms}^{-2}$  in a body of mass 1kg. Newton's Second Law is summarized by the equation:

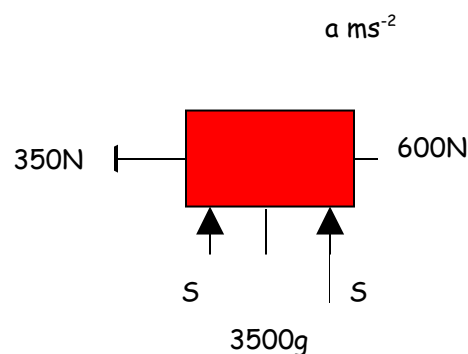
$$F = ma$$

this is often termed **the equation of motion**.

**It is vitally important to realise that  $F$  is the overall resultant and not Friction ( $F_R$ ).**

### Example 2

If the object in Example 1 is slightly modified to take account of the fact that there is a pushing force 600N, calculate the acceleration.



The resultant of the two horizontal forces is 250N pushing the object to the right. So by setting up an equation of motion:

$$F = ma$$

$$250 = 3500 \times a$$

$$a = 0.07\text{ms}^{-2}$$

