Types of Forces

Starter

1. **(Review of last lesson)** A particle, P, of mass 14 kg has acceleration $\begin{pmatrix} 4a \\ -3a \end{pmatrix}$ N. Given that the force acting on P has a magnitude of 35 N, find the value of a.

Working: $\mathbf{F} = m\mathbf{a}$: $\quad \mathbf{F} = 14 \times \begin{pmatrix} 4a \\ -3a \end{pmatrix} = \begin{pmatrix} 56a \\ -42a \end{pmatrix}$

The magnitude of this force is 35 N.

$$|\mathbf{F}| = \left| \begin{pmatrix} 56a \\ -42a \end{pmatrix} \right| = \sqrt{(56a)^2 + (-42a)^2} = 35$$

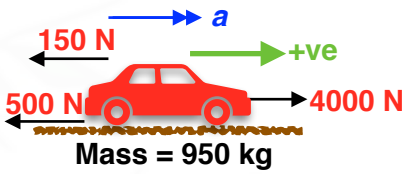
Squaring both sides and collecting like terms: $\quad 4900a^2 = 1225$

$$a = 0.5$$

E.g. 1 A driving force of 4000 N pushes a car of mass 950 kg along a road. Air resistance is 150 N and the frictional force is 500 N. Find the acceleration of the car.

Working: $F = ma$: $\quad 4000 - 150 - 500 = 950a$

$\therefore a = 3.53$ m/s² (3 s.f.)



E.g. 2 A box of mass 24 kg moves on a rough horizontal floor under the action of a constant horizontal force $(16\mathbf{i} + 11\mathbf{j})$ N. Find, in vector form, the frictional force acting on the box when it's acceleration is $(0.7\mathbf{i} - 1.1\mathbf{j})$ m/s².

Working: Let the friction force be $\mathbf{F}$

$\mathbf{F} = m\mathbf{a}$: $\quad (16\mathbf{i} + 11\mathbf{j}) + \mathbf{F} = 24(0.7\mathbf{i} - 1.1\mathbf{j})$

$$\mathbf{F} = (16.8\mathbf{i} - 26.4\mathbf{j}) - (16\mathbf{i} + 11\mathbf{j})$$

The frictional force $= (0.8\mathbf{i} - 37.4\mathbf{j})$ N.

Video: Newton's 2nd law

Solutions to Starter and E.g.s

Exercise

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