NEWTON'S LAWS OF MOTION | KEY POINTS

Newton's First Law:

- An object continues to move with constant velocity, or remains at rest, unless acted on by a force.

Newton's Second Law:

- The acceleration of an object is directly proportional to the magnitude of the net force applied to the object.
  - $F = ma$
- A resultant force (or net force) is a single force that produces the same acceleration as several forces acting together.
- If the resultant force acting on an object is zero, the object is said to be in 'equilibrium'.

FORCES IN 1 DIMENSION | EXAMPLE-PROBLEM PAIRS

1E. Andy and Dave are pushing a skip of mass $300\ \text{kg}$ along a straight road.
They apply forces of $200\ \text{N}$ and $240\ \text{N}$ respectively in the direction of the road.
Motion is resisted by a frictional force of $380\ \text{N}$.

(a) Draw a diagram to show the forces acting on the skip.

(b) Calculate the acceleration of the skip.

1P. An object of mass $3\ \text{kg}$ is being pulled along a rough surface by a force of $12\ \text{N}$ (acting parallel to the surface).
It experiences a resistance force of $5\ \text{N}$ directly opposing the motion.

(a) Draw a diagram to show the forces acting on the skip.

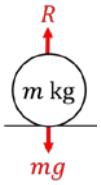
(b) Calculate the acceleration of the skip.

2E. A ball of mass $1.2\ \text{kg}$ is rolled across the floor at a speed of $3.6\ \text{ms}^{-1}$. It slows down due to a constant friction force of magnitude $9\ \text{N}$.
How far does the ball travel before coming to rest?

2P. A man pushes a car with a force of $127.5\ \text{N}$ along a straight horizontal road.
He manages to increase the speed of the car from $1\ \text{ms}^{-1}$ to $2.8\ \text{ms}^{-1}$ in $12\ \text{s}$.
Calculate the mass of the car.

VERTICAL FORCES | KEY POINTS

- The weight of an object is the force acting on the object due to gravity.
  - $W = mg$
- The normal contact force or reaction force acts to prevent two objects passing through each other.



VERTICAL FORCES | EXAMPLE-PROBLEM PAIR

3E. A helicopter raises wooden crate with a mass of $80\ \text{kg}$ with an acceleration of $0.5\ \text{ms}^{-2}$.
Find the tension in the winch.

3P. Andrea is lowering a box of mass $12\,\text{kg}$ from a rooftop. The tension in the rope is $95\ \text{N}$.
Calculate the acceleration of the box.

NORMAL CONTACT FORCE | EXAMPLE-PROBLEM PAIR

4E. Andre is standing on a lift platform. He has a mass of $82\ \text{kg}$. Andre and the platform are travelling upwards at constant speed.
Calculate the normal contact force which acts on Andre.

4P. **In this question, use $g = 9.81\ \text{ms}^{-2}$. Give your answer to a suitable degree of accuracy.**
Andreas is standing on a lift platform. Andres has a mass of $60.5\ \text{kg}$. The normal contact force acting on Andreas is $612\ \text{N}$.

(a) Calculate the magnitude of the acceleration of the lift.

(b) State the direction in which the lift is accelerating.