

## Newton's Laws Equations Worksheet

Level: GCSE / AP Physics 1 / IB SL | Difficulty: Intermediate | Topic: Mechanics

Master Newton's three laws of motion with 10 problems covering net force, weight, friction, and tension. Each problem includes a full worked solution.

### Equations you will need

$F = ma$	Newton's 2nd law: net force = mass x acceleration
$W = mg$	Weight: mass x gravitational field strength
$f = \mu N$	Friction: coefficient x normal force
$\sum F = 0$	Newton's 1st law (equilibrium)
$F_{1\ 2} = -F_{2\ 1}$	Newton's 3rd law (equal and opposite)

### Symbol key

Symbol	Quantity	Unit
F	force	N (newtons)
m	mass	kg
a	acceleration	m/s <sup>2</sup>
W	weight	N
g	gravitational field strength	9.8 m/s <sup>2</sup> (Earth)
$\mu$	coefficient of friction	dimensionless
N	normal force	N

### Practice problems

1. A 5 kg box is pushed with a horizontal force of 20 N on a frictionless surface. Find the acceleration.
2. Find the weight of a 70 kg person on Earth. ( $g = 9.8 \text{ m/s}^2$ )
3. A 2 kg object accelerates at  $3 \text{ m/s}^2$  across a rough surface. The applied force is 10 N. Find the friction force.
4. A 10 kg block sits on a surface with  $\mu = 0.3$ . Find the friction force needed to start moving it. ( $g = 9.8 \text{ m/s}^2$ )
5. Two forces act on a 4 kg object: 12 N right and 8 N left. Find the acceleration.

6. A car of mass 1200 kg decelerates from 20 m/s to rest in 5 s. Find the braking force.
7. A 3 kg mass hangs from a rope. Find the tension when it is stationary. ( $g = 9.8 \text{ m/s}^2$ )
8. Same 3 kg mass now accelerates upward at  $2 \text{ m/s}^2$ . Find the new tension.
9. A 50 kg sled is pulled by a 200 N force on ice ( $\mu = 0.1$ ). Find acceleration. ( $g = 9.8 \text{ m/s}^2$ )
10. An 80 kg astronaut pushes off a 200 kg satellite with a force of 100 N for 0.5 s. Find each one's acceleration.