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 = muN	Friction: coefficient x normal force
SumF = 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^2
W	weight	N
g	gravitational field strength	9.8 m/s^2 (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 m/s^2)

3. A 2 kg object accelerates at 3 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 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 m/s^2)

8. Same 3 kg mass now accelerates upward at 2 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 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.

Answer key

Full worked solutions for each problem.

1. a = F/m = 20/5 = 4 m/s^2
2. W = mg = 70 x 9.8 = 686 N
3. F_net = ma -> 10 - f = 2(3) -> f = 4 N
4. N = mg = 98 N; f = muN = 0.3(98) = 29.4 N
5. F_net = 12 - 8 = 4 N; a = 4/4 = 1 m/s^2
6. a = -4 m/s^2; F = ma = 1200(-4) = -4800 N (4800 N opposing motion)
7. T = mg = 3(9.8) = 29.4 N
8. T - mg = ma -> T = m(g + a) = 3(11.8) = 35.4 N
9. f = 0.1(50)(9.8) = 49 N; F_net = 151 N; a = 3.02 m/s^2
10. a_astronaut = 100/80 = 1.25 m/s^2; a_satellite = 100/200 = 0.5 m/s^2 (opposite direction)