

## Momentum and Impulse Equations Worksheet

Level: A-Level / AP Physics 1 | Difficulty: Intermediate | Topic: Mechanics

Practice momentum and impulse problems including conservation of momentum in elastic and inelastic collisions. 10 problems with full worked solutions.

### Equations you will need

$p = mv$	Momentum
$J = F\Delta t = \Delta p$	Impulse = force x time = change in momentum
$m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$	Conservation of momentum

### Symbol key

Symbol	Quantity	Unit
p	momentum	kg*m/s
m	mass	kg
v	velocity	m/s
J	impulse	N*s
F	force	N
$\Delta t$	time interval	s

### Practice problems

1. A 2 kg ball moves at 5 m/s. Find its momentum.
2. A 0.15 kg baseball changes velocity from -30 m/s to +40 m/s. Find the impulse.
3. A 1500 kg car decelerates from 20 m/s to 0 in 4 s. Find the average braking force.
4. A 5 kg trolley at 4 m/s collides with a stationary 3 kg trolley and they stick. Find the final speed.
5. A 2 kg ball at 6 m/s hits a 4 kg ball at rest elastically. Find both final speeds.
6. A bullet of 0.02 kg fired at 400 m/s into a 4 kg block at rest. Find the final common velocity.
7. A 70 kg skater pushes off a 50 kg skater, who moves at 2 m/s. Find the first skater's recoil speed.

8. Find the impulse from a 50 N force applied for 0.4 s.
9. A 0.05 kg ball hits a wall at 20 m/s and bounces back at 18 m/s. Find the impulse on the ball.
10. A 1000 kg rocket fires ejecting 50 kg of gas at 200 m/s. Find rocket recoil speed.

## Answer key

Full worked solutions for each problem.

1.  $p = mv = 2 \times 5 = 10 \text{ kg}\cdot\text{m/s}$
2.  $J = \Delta p = 0.15(40 - (-30)) = 10.5 \text{ N}\cdot\text{s}$
3.  $F = \Delta p/\Delta t = (1500 \times -20)/4 = -7500 \text{ N}$
4.  $(5)(4) = 8v \rightarrow v = 2.5 \text{ m/s}$
5.  $v_1 = ((2-4)/6)(6) = -2 \text{ m/s}; v_2 = ((2 \times 2)/6)(6) = 4 \text{ m/s}$
6.  $(0.02)(400) = 4.02v \rightarrow v = 1.99 \text{ m/s}$
7.  $0 = 70v + 50(2) \rightarrow v = -1.43 \text{ m/s}$
8.  $J = F\Delta t = 50 \times 0.4 = 20 \text{ N}\cdot\text{s}$
9.  $J = 0.05(-18 - 20) = -1.9 \text{ N}\cdot\text{s}$
10.  $0 = 950v + 50(200) \rightarrow v = -10.5 \text{ m/s}$