

Chapter 7

Terms

Be able to define or discuss the following terms and ideas, with their SI units if appropriate.

1. impulse
2. momentum of a particle
3. total momentum of a system of particles
4. conservation of momentum
5. kinetic energy
6. elastic collision
7. inelastic collision
8. sticky collision (i.e. “totally inelastic” collision)

Equations

Understand the meaning and know the SI units of all symbols in these equations; know how to perform each mathematical operation, such as trig functions; know how to solve for any unknown quantity; understand how changing one quantity affects another quantity (if all other quantities remain constant); be able to apply one or more equations to solve a problem.

- impulse due to a force

$$\text{impulse} = \vec{F}\Delta t \quad (1)$$

- total impulse

$$\text{impulse} = \Sigma \vec{F}\Delta t = \Delta \vec{p} \quad (2)$$

- momentum of a particle

$$\vec{p} = m\vec{v} \quad (3)$$

- conservation of momentum: *if the net external force on the system is zero, then*

$$\vec{p}_{sys,i} = \vec{p}_{sys,f} \quad (4)$$

for a system of two particles, A and B,

$$\vec{p}_{A,i} + \vec{p}_{B,i} = \vec{p}_{A,f} + \vec{p}_{B,f} \quad (5)$$

This is a vector equation and therefore must be true for the x and y directions independently. Thus, in the x-direction

$$p_{Ax,i} + \vec{p}_{Bx,i} = \vec{p}_{Ax,f} + \vec{p}_{Bx,f} \quad (6)$$

and in the y-direction

$$p_{Ay,i} + \vec{p}_{By,i} = \vec{p}_{Ay,f} + \vec{p}_{By,f} \quad (7)$$

Skills

1. Calculate the impulse on an object, if given the net force and the time interval during which it acts.
2. Calculate the impulse on an object by calculating the change in momentum of the object.
3. Apply conservation of momentum to a collision or explosion or some other type of interaction and solve for an unknown.
4. Calculate initial and final kinetic energy of a system to determine whether a collision is elastic or inelastic.

Lab Skills

1. Measure initial and final velocities for a collision of two carts and verify that momentum is conserved.
2. Calculate initial and final kinetic energies for a collision of two carts and determine whether the collision is elastic or inelastic.
3. Use video analysis for a two-dimensional collision and verify that momentum is conserved in the x-direction and in the y-direction.
4. Use video analysis to measure the change in momentum and impulse on a football player during a collision.