

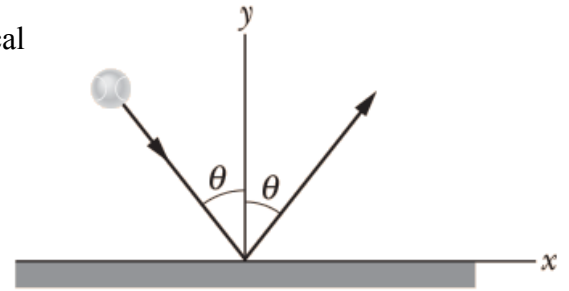
PHYSICS – problem solving exercises

5a. Dynamics: momentum and collisions

Problem 1:

The figure shows an overhead view of a ball bouncing from a vertical wall without any change in its speed. Consider the change $\Delta\mathbf{p}$ in the ball's linear momentum.

- (a) Is Δp_x positive, negative, or zero?
- (b) Is Δp_y positive, negative, or zero?
- (c) What is the direction of $\Delta\mathbf{p}$?



Problem 2:

Body 1 and body 2 are in a completely inelastic one-dimensional collision. What is their final momentum if their initial momenta are, respectively, (a) 10 kg.m/s and 0; (b) 10 kg.m/s and 4 kg.m/s; (c) 10 kg.m/s and -4 kg.m/s?

Problem 3:

A 91 kg man lying on a surface of negligible friction shoves a 68 g stone away from himself, giving it a speed of 4.0 m/s. What speed does the man acquire as a result?

Problem 4:

An initially stationary block of 5 kg mass lying on a frictionless floor explodes in two pieces sliding in the opposite directions. The 250 g piece moves with a speed of 85.0 m/s. What is the mass and the speed of the second piece?

Problem 5:

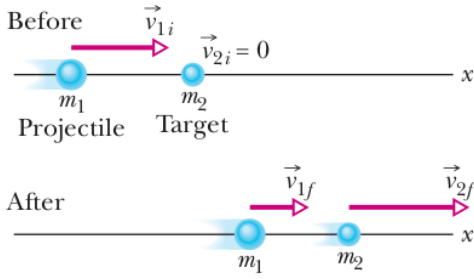
A 100 g projectile hits an initially stationary target with a speed of 85 m/s. After this collision both objects remain connected and move with a speed of 15 m/s. What is the mass of the target?

Problem 6:

A 1.0 kg particle P_1 is moving along the x axis with a speed of 3.0 m/s and collides with a particle P_2 moving in the same direction and having a double mass but a half speed than P_1 . The collision is inelastic and both particles then move joined together. What is the speed of P_1+P_2 object?

Problem 7:

What is the final linear momentum of the target in the figure if the initial linear momentum of the projectile is 6 kg.m/s and the final linear momentum of the projectile is (a) 2 kg.m/s and (b) -2 kg.m/s? (c) What is the final kinetic energy of the target if the initial and final kinetic energies of the projectile are, respectively, 5 J and 2 J?



Problem 8: optional

A cart with mass 340 g moving on a frictionless linear air track at an initial speed of 1.2 m/s undergoes an elastic collision with an initially stationary cart of unknown mass. After the collision, the first cart continues in its original direction at 0.66 m/s. (a) What is the mass of the second cart? (b) What is its speed after impact?

Problem 9:

An initially stationary device with a mass of 18 kg lying on a frictionless floor explodes in two pieces sliding in the opposite directions. Magnitudes of their velocities are 8 m/s and 28 m/s, respectively. What are the masses of both pieces?

Problem 10:

A 20 g arrow hits an initially stationary target of a mass 0.3 kg. After a completely inelastic collision both objects remain connected and move with a speed of 3.5 m/s. What was the arrow speed before the contact?

Problem 11:

A billiard ball with a speed of 10 m/s hits another billiard ball of the same mass which is at rest. What is the final velocity of (a) the first ball, and (b) the second ball, if the collision is completely elastic?

5b. Dynamics: impulse of force

Problem 12:

A 2 kg particle moving along the x axis was stopped by an impulse of 140 N.s. What was its impact speed?

Problem 13:

A force of 460 N acts on a 20 kg body during 30 ms. What is the final speed of the body which was originally at rest? Assume no air and surface friction.

Problem 14:

A 1200 kg car crashed into a wall and was stopped immediately with an impulse of 24 kN.s. What was its speed during the contact?

Problem 15:

A 1.2 kg ball drops vertically onto a floor, hitting with a speed of 25 m/s. It rebounds with an initial speed of 10 m/s. (a) What impulse acts on the ball during the contact? (b) If the ball is in contact with the floor for 0.020 s, what is the magnitude of the average force on the floor from the ball?

Problem 16:

A 2 kg body moves along the x axis and changing its velocity (a) from 4 m/s to 10 m/s during 3s, (b) from 10 m/s to 4 m/s in 2 s, and (c) from 4 m/s to -10 m/s in 2 s. What are the impulse and the average force (magnitude and direction) acting on the body?

Problem 17:

A force of 140 N acting on a box results to the change of momentum of 70 kg.m/s. How much time does the force act on the box?