ENG1004: Engineering Physics 1

Tutorial 4: Momentum and Impulse

Conceptual questions

a) If a falling ball were to make a perfectly elastic collision with the floor, would it rebound to the same height? Why?

b) A rocket following a parabolic path through the air suddenly explodes into many pieces ("many" means > 2). What can you say about the motion of this system of pieces?

c) How can a rocket change direction when it is far out into space and essentially a vacuum?

Question 1

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?

Adapted from Walker, "Halliday and Resnick Fundamentals of Physics", 9th Edition, John Wiley & Sons, Inc., 2011.

Answer

(a) 42 Ns;   (b) 2.1 kN

Question 2

In Anchorage, collisions of a vehicle with a moose are so common that they are referred to with the abbreviation MVC. Suppose a 1000 kg car slides into a stationary 500 kg moose on a very slippery road, with the moose being thrown through the windshield (a common MVC result). (a) What percent of the original kinetic energy is lost in the collision to other forms of energy? A similar danger occurs in Saudi Arabia because of camel–vehicle collisions (CVC). (b) What percent of the original kinetic energy is lost if the car hits a 300 kg camel? (c) Generally, does the percent loss increase or decrease if the animal mass decreases?
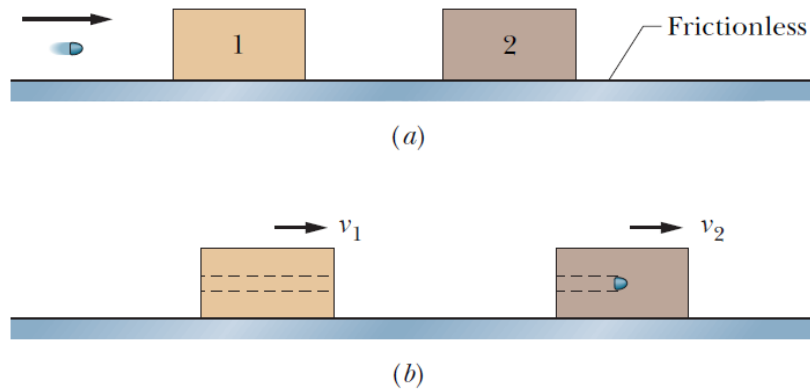
Adapted from Walker, "Halliday and Resnick Fundamentals of Physics", 9th Edition, John Wiley & Sons, Inc., 2011.

Answers

(a) 33%;   (b) 23%;   (c) decreases

Question 3

A 3.50 g bullet is fired horizontally at two blocks at rest on a frictionless table. The bullet passes through block 1 (mass 1.20 kg) and embeds itself in block 2 (mass 1.80 kg). The blocks end up with speeds v_1 = 0.630 m/s and v_2 = 1.40 m/s. Neglecting the material removed from block 1 by bullet, find the speed of the bullet as it (a) leaves and (b) enters block 1.

(a)

(b)

Answer

(a) 721 m/s;   (b) 937 m/s