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Solution 39

a) According to the law of conservation of momentum: When two (or more) bodies act upon one another, their total momentum remains constant (or conserved) provided no external forces are acting. It means that when one body gains momentum, then some other body loses an equal amount of momentum i.e. momentum is neither created nor destroyed.

b)

a. Rocket taking off from the ground: The chemicals inside the rocket burn and produce very high velocity blast of hot gases. These gases pass out through the tail nozzle of the rocket in the downward direction with tremendous speed and the rocket moves up to balance the momentum of the gases. The gases have a very high velocity ang hence a very large momentum. An equal momentum is imparted to the rocket in the opposite direction, so that it goes up with a high velocity.

b. Flying of jet aeroplane: In jet aeroplanes, a large volume of gases produced by the combustion of fuel is allowed to escape through a jet in backward direction. Due to high velocity, the backward rushing gases have a large momentum. They impart an equal and opposite momentum to the jet aeroplane due to which it moves forward with a great speed.

Solution 40

a) If of a balloon filled with compressed air and its mouth untied is released with its mouth in the downward direction, the balloon moves in the upward direction because the air present in the balloon rushes out in the downward direction. The equal and opposite reaction of downward going air pushes the balloon upwards.

b) Mass of the unloaded truck, m_1= 2000 kg

Acceleration $a_1 = 0.5\ m/s^2$

Mass of loaded truck, m_2 = 2000+ 2000 = 4000 kg

Acceleration a_2

$m_1 \times a_1 = m_2 \times a_2$

b) Mass of the unloaded truck, m_1= 2000 kg

Acceleration $a_1 = 0.5\ m/s^2$

Mass of loaded truck, m_2 = 2000+ 2000 = 4000 kg

Acceleration a_2

$m_1 \times a_1 = m_2 \times a_2$

$$a_2 = \frac{2000 \times 0.5}{4000} = 0.25\ m/s^2$$

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Solution 51

Car seat-belts are somewhat stretchable so as to increase the time taken by the passengers to fall forward. Due to this, the rate of change of momentum of passengers is reduced and hence less stopping force acts on them. So the passengers do not get hurt.

Solution 52

The paratroopers roll on landing to increase the time taken to reduce the momentum of their body. Thus, the rate of change of momentum is reduced and hence less force is exerted on their legs and they do not get hurt.

Solution 53

An aircraft needs air because air moving under the wings of aircraft is strong enough to hold it up and air is also required to burn the fuel in aircraft engines. Since there is no air on moon, an aircraft cannot fly on moon.

Solution 54

It is possible for a small animal to fall from a considerable height without being injured because a small animal has small mass, so the momentum produced is less. When the small animal falls to the ground with less momentum, less opposing force of ground acts on it and hence no injury is caused to it

Solution 55

Mass of the boy, m_1= 50 kg
Speed of boy, u_1 = 5 m/s
Mass of trolley m_2 = 20 kg
Speed of trolley u_2 =1.5 m/s
Combined mass of boy and trolley, m = 20+ 50 = 70 kg
Combined velocity v
Acc. to the law of conservation of momentum

$m_1u_1 + m_2u_2 = mv$

$50 \times 5 + 20 \times 1.5 = 70 \times v$

$v = \frac{250 + 30}{70} = 4$ m/s

Solution 56

Mass of the boat m_b = 300 kg
Velocity of boat v_b
Mass of girl m_g = 50 kg
Velocity of girl v_g = 3 m/s
Acc. to the law of conservation of momentum

$m_bv_b=m_gv_g$

$300 \times v_b = 50 \times 3$

$v_b = \frac{50 \times 3}{300} = 0.5$ m/s

Solution 57

Mass of first truck, m_1= 500 kg
Speed of first truck, u_1 = 4 m/s
Mass of second truck, m_2 = 1500 kg
Speed of second truck, u_2 =2 m/s
Combined mass of both trucks, m = 1500 + 500 = 2000 kg
Combined velocity v
Acc. to the law of conservation of momentum

$m_1u_1 + m_2u_2 = mv$

$500 \times 4 + 1500 \times 2 = 2000 \times v$

$v = \frac{2000 + 3000}{2000} = 2.5$ m/s

Solution 58

Mass of the ball x, $m_1 = 1$ kg
Speed of ball x, $u_1 = 2$ m/s
Mass of ball y, $m_2 = 1$ kg
Speed of ball y, $u_2 = 0$ m/s (at rest)
Velocity of ball x after collision, $v_1 = 0$ m/s
Velocity of ball y after collision, v_2
Acc. to the law of conservation of momentum
$m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$
$1 \times 2 + 1 \times 0 = 1 \times 0 + 1 \times v_2$
$v_2 = \frac{1 \times 2}{1} = 2$ m/s

Solution 59

Mass of car A, $m_1 = 2000$ kg
Speed of car A, $v_1 = 10$ m/s
Mass of car B, $m_2 = 500$ kg
Speed of car B, v_2
Acc to law of conservation of momentum
$m_1v_1 = m_2v_2$
$2000 \times 10 = 500 \times v_2$
$v_2 = \frac{2000 \times 10}{500} = 40$ m/s

Solution 60

Mass of the man, $m_1 = 80$ kg
Speed of man, v_1
Mass of bullet $m_2 = 20$ g $= 0.02$ kg
Speed of bullet $v_2 = 400$ m/s
Acc to law of conservation of momentum
$m_1v_1 = m_2v_2$
$80 \times v_1 = 0.02 \times 400$
$v_1 = \frac{400 \times 0.02}{80} = 0.1$ m/s

*********** END **********