Our Dynamic Universe

Impulse & Change of Momentum

1) A 5 kg bowling ball at rest is given a kick. The kick gives an average force of 10 N. The duration of the kick is 0.8 s.

    a) Calculate the impulse given to the bowling ball.
    b) State the change of momentum of the bowling ball
    c) Determine the speed of the bowling ball immediately after it was kicked.

2) A 0.4 kg football at rest is given a kick where the average force is 60 N over a contact time of 0.5 s.

    a) Calculate the impulse given to the football.
    b) State the change of momentum of the football
    c) Determine the speed of the football just after it was kicked.

3) A space rocket of mass 1000 kg travelling at 5 ms^{-1} fires its rocket which provides a constant thrust of 9000 N. The rocket is fired for 5 seconds.

    a) Calculate the impulse given to the rocket.
    b) State the change of momentum of the rocket
    c) Determine the final speed of the rocket.

4) A small rocket cart is travelling at 10 ms^{-1}. It fires a rocket which provides a thrust of 100 N for a time of 3 seconds. The rocket cart has a mass of 5 kg.

    a) Calculate the impulse given to the small cart.
    b) State the change of momentum of the rocket cart
    c) Determine the final speed of the rocket cart.

5) State the units of momentum and impulse.

6) A 2,500 kg car travelling at 15 ms^{-1} is stopped by a crash barrier. The collision with the car and crash barrier lasts for 0.5 seconds.

   a) Calculate the change in momentum of the car
   b) Calculate the size and direction of the impulse given to the car by the crash barrier.
   c) Find the size and direction of the average force given to the car.

7) A rubber ball of mass 30 g is thrown towards a wall with speed of 4 ms^{-1} and rebounds with speed of 2 ms^{-1}. The time of contact during the collision is 0.5 s.

   a) Calculate the change of momentum of the ball.
   b) State the size and direction of the impulse given to the ball by the wall.
   c) Calculate the size of the average force given to the ball by the wall.

8) A tennis player serves a ball from rest to a velocity of 45 ms^{-1}. The tennis ball has a mass of 56 g and the bat was in contact with the ball for 0.004 s.

   a) Calculate the change of momentum of the ball. [2.52 kg ms^{-1}]
   b) Determine the impulse given to the ball.
   c) Find the average force given to the ball by the bat. [630 N]

9) A hockey player strikes a stationary puck of mass 0.05 kg with an average force of 600 N. The hockey stick is in contact with the puck for 0.008 seconds.

   a) Calculate the impulse given to the puck
   b) State the change of momentum of the puck
   c) Determine speed the puck would leave the hockey stick.

10) A space rocket of mass 10,000 kg is travelling at 120 ms^{-1} to the right. It has side thrusters which when fired can provide a constant force of 1000 N either to the left or right of the space rocket.

   a) Determine the size and direction of the impulse from the thrusters to bring the rocket to a stop.
   b) How long should the thrusters be fired for to stop the space rocket.

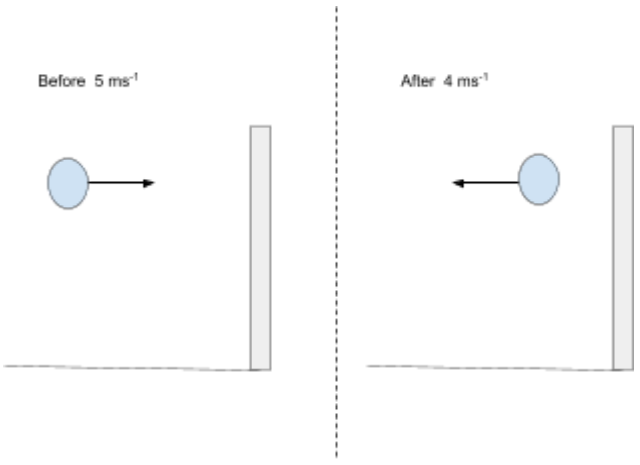
11) A 50 kg girl lands on a trampoline at a speed of 2 ms^{-1}. She is in contact with the trampoline for 0.4 s. She then rises up with a speed of 1.8 ms^{-1}

a) Determine the girl's change of momentum.
b) State the size of the impulse received by the girl from the trampoline.
c) Calculate the size of the average force the girl received from the trampoline.

12) A 60 kg boy lands on a trampoline with a speed of 8 ms^{-1} . He receives an impulse of 900 Ns from the trampoline. He is in contact with the trampoline for 0.5 seconds.

a) State the boy`s change of momentum.
b) Determine the upward speed he has just as he leaves the trampoline.
c) Calculate the height the boy reaches after leaving the trampoline.

13) A 2 kg rubber ball is thrown onto a wall with a speed of 5 ms^{-1}. It is in contact with the wall for 0.2 s and rebounds with a speed of 4 ms^{-1}



a) Find the size and direction of the change of momentum of the ball.
b) State the size and direction of the impulse given to the ball.
c) Determine the size and direction of the average force which acted on the ball.

Answers

1) a) 8 Ns b) 8 kg ms^{-1} c) 1.6 ms^{-1}

2) a) 30 Ns b) 30 kg ms^{-1} c) 75 ms^{-1}

3) a) 45000 Ns b) 45000 kg ms^{-1} c) 50 ms^{-1}

4) a) 300 Ns b) 300 kg ms^{-1} c) 70 ms^{-1}

5) change of momentum units kg ms^{-1}
impulse units Ns

6) a) - 37,500 kg ms^{-1}
b) 37,500 Ns to the left.
c) 75,000 N to the left.

7) a) - 0.18 kg ms^{-1}
b) 0.18 Ns to the left
c) 0.36 N (only asking for size of force)

8) a) 2.52 kg ms^{-1}
b) 2.52 Ns
c) 630 N

9) a) 4.8 Ns
b) 4.8 kg ms^{-1}
c) 96 ms^{-1}

10) a) - 1,200,000 kg ms^{-1}
b) 1,200,000 Ns to the left.
c) 1200 seconds = 20 minutes

11) a) 190 kg ms^{-1}
b) 190 Ns upwards
c) 475 N (just size not direction asked)

12) a) 900 kg ms^{-1}
b) 7 ms^{-1}
c) 2.5 m

13) a) -18 kg ms^{-1}
b) 18 Ns to the left, ie from the wall.
c) 90 N to the left.