FBISE 9th Class Physics New Book Notes Chapter 3

NUMERICAL RESPONSE QUESTIONS

Q1. A boy is holding a book of mass 2 kg. How much force is he applying on the book? If he moves it up with acceleration of 3 ms^{-2}, how much should he apply total force on the book? (Ans. 19.6 N, 25.6 N)

Solution:

Given data: mass of book = **m = 2kg**

acceleration due to gravity = $a_1 = g = 9.8\ ms^{-2}$

Acceleration moving up = $a_2 = 3\ ms^{-2}$

Required: (a) Force on holding the book = F_1 = ?

(b) Total force on book = F_T = ?

(a) Holding a book stationary in air is equivalent to applying a force equal to its weight. So, the force applying by the boy in holding a book is given by:

$$F_1 = mg \Rightarrow F_1 = 2 \times 9.8 \Rightarrow F_1 = 19.6\ N$$

(b) First, we will find the force that is moving up the book:

$$F_2 = ma_2 \Rightarrow F_2 = 2 \times 3 \Rightarrow F_2 = 6\ N$$

Now the total force acting on the book in moving it up with an acceleration of 3 ms^{-2} will become:

$$\text{Total force } = F = F_1 + F_2 = 19.6\ N + 6\ N = 25.6\ N$$

Q2. A girl of mass 30 kg is running with velocity of 4 ms^{-1}. Find her momentum.

(Ans. 120Ns)

Solution:

Given data: mass = $m = 30$ kg velocity = $v = 4\ ms^{-1}$

Required: momentum = **p** = ?

The momentum of a body is given by: **p** = mv

Putting values: $p = 30 \times 4 \Rightarrow p = 120\text{Ns}$

Q3. A 2 kg steel ball is moving with speed of 15 ms^{-1}. It hits with bulk of sand and comes to rest in 0.2 second. Find force applied by sand bulk on the ball.

(Ans. -150 N)

Solution:

Given data: mass of ball = **m = 2kg**

initial speed of ball = $v_1 = 15\ ms^{-1}$

Time taken = $\Delta t = 0.2$ s

final speed of ball = $v_f = 0\ ms^{-1}$

Required: applied force = **F** = ?

The rate of change of momentum is given by.

$$F = \frac{\Delta p}{\Delta t} = \frac{p_1 - p_1}{\Delta t}$$

Putting in above equation:

$$F = \frac{mv_f - mv_i}{\Delta t}$$

Putting values we get

$$F = \frac{2 \times 0 - 2 \times 15}{0.2} \Rightarrow F = -150\ \text{N}$$

The force will be opposite to the direction of motion of ball, that's why negative sign is there

Q4. A100 grams bullet is fired from 5 kg gun. Muzzle velocity of bullet Is 20 ms^{-1}. Find recoll velocity of the gun. (Ans. 0.4 ms^{-1})

Solution:

Given data: mass of bullet = $m_b = 100$ g = 0.1 kg

mass of gun = $m_g = 5$ kg

Velocity of bullet = $v_b = 20$ m/s

Required: velocity of gun = v_g = ?

From conservation of momentum:

momentum before firing = momentum after firing

As momentum before firing is zero (because gun and bullet are at rest), therefore, momentum after firing must also be zero:

$$P_{\text{after}} = 0 \Rightarrow (p_b + p_g)_{\text{after}} = 0$$

As **p** = **mv**, putting in above equation:

$$m_b v_b + m_g v_g = 0 \Rightarrow v_g = -\frac{m_b v_b}{m_g}$$

Putting values: $v_{\text{E}} = -\frac{0.1 \times 20}{5} \Rightarrow v_{\text{g}} = -0.4 \text{ ms}^{-1}$

Negative sign shows recoil of the gun.

Q5. A robotic car of 15 kg is moving with 25 ms^{-1}. Brakes are applied to stop it. Brakes apply constant force of 50 N. How long does the car take to stop?

(Ans. 7.5 s)

Solution:

Given data: mass of robotic car = $m = 15$ kg

initial speed of robotic car = $v_1 = 25 \text{ ms}^{-1}$

Brakes force in opposite direction = $\boldsymbol{F} = -50$ N

final speed of robotic car = $v_{\text{f}} = 0 \text{ ms}^{-1}$

Required: time to stop the car = Δt = ?

The rate of change of momentum is given by:

$$F = \frac{\Delta p}{\Delta t} = \frac{P_i - p_i}{\Delta t} \Rightarrow \Delta t = \frac{P_i - P_i}{F}$$

As $p = mv$, putting in above equation: $\Delta t = \frac{mv_f - mv_1}{F}$

$$\text{Putting values: } \Delta t = \frac{15 \times 0 - 15 \times 25}{-50} = \frac{-375 \text{ s}}{-50} \Rightarrow \Delta t = 7.5 \text{ s}$$