Tech exercise and CRQ

Chapter 3

1. **What kind of changes in motion may be produced by a force?**

Ans: A force can cause an object to **accelerate, decelerate, stop, or change direction**.

2. **Give 5 examples of contact forces.**

Ans: Friction, Drag, Thrust, Normal Force, Air Resistance.

3. **An object moves with constant velocity in free space. How long will the object continue to move with this velocity?**

Ans: The object will continue to move with the **same velocity indefinitely** because there is **no external force or friction** in free space.

4. **Define impulse of force.**

Ans: Impulse is the product of a **force (F) and the time interval (Δt)** during which it acts. It equals the **change in momentum** of the object Impulse $=F\times\Delta t$

5. **Why has Newton's first law not been proved on the Earth?**

Ans: Newton's first law has not been proved on Earth because **external forces like friction always act** on objects, preventing perfect uniform motion.

6. **When sitting in a car which suddenly accelerates from rest, you are pushed back into the seat. Why?**

Ans: Your body **resists the sudden change in motion** due to **inertia**, so you feel pushed back while the car moves forward.

7. **The force expressed in Newton's second law is a net force. Why is it so?**

Ans: It is a **net force** because it represents the **total of all forces** acting on an object, which determines its **acceleration**.

8. **How can you show that rolling friction is lesser than sliding friction? (3.8)**

Ans: Rolling friction is much **smaller than sliding friction** because the wheel **touches the surface at a point without sliding**, so there is **less resistance** compared to sliding.

9. **Define terminal velocity of an object. (3.8)**

Ans: Terminal velocity is the constant velocity a falling object reaches when **upward air resistance balances downward gravity**.

10. **An astronaut walking in space wants to return to his spaceship by firing a hand rocket. In what direction does he fire the rocket? (3.8)**

Ans: The astronaut should **fire the rocket away from the spaceship**.
Reason: By **Newton's third law**, the rocket's backward force pushes him **toward the spaceship**.

CRQ

1. **Two ice skaters weighing 60 kg and 80 kg push off against each other on a frictionless ice track. The 60 kg skater gains a velocity of 4 m/s. Explain how Newton's third law applies. (3.4)**

Ans: The skaters **exert equal and opposite forces** on each other, so the 60 kg skater moves at **4 m/s** and the 80 kg skater moves in the opposite direction at **3 m/s**, conserving momentum. This illustrates **Newton's third law**: every action has an equal and opposite reaction.

2. **Inflatable airbags are installed in vehicles as safety equipment. In terms of momentum, what is the advantage of airbags over seatbelts? (3.10)**

Ans: Airbags **increase the time** over which a passenger's momentum decreases during a collision, reducing the **force experienced** ($F=\Delta p/\Delta t$), making them safer than seatbelts that stop the passenger more suddenly.

3. **A horse refuses to pull a cart. The horse argues, "According to Newton's third law, whatever force I exert on the cart, the cart will exert an equal and opposite force on me. Since the net force will be zero, I have no chance of accelerating the cart." What is wrong with this reasoning? (3.4)**

Ans: The horse's reasoning is wrong because it **ignores friction** between its hooves and the ground.
With friction, there is a **net force**, allowing the horse to **accelerate and pull the cart**.

4. **When a cricket ball is hit high, a fielder tries to catch it. While holding the ball, why does he/she draw hands backward? (3.9)**

Ans: The fielder **draws hands backward** to **increase the time** over which the ball's momentum becomes zero, reducing the **force on the hands** and making the catch safer and easier ($F=\Delta p/\Delta t$)

5. **When someone jumps from a small boat onto the river bank, why does the jumper often fall into the water? Explain. (3.4)**

Ans: When the jumper pushes off, the boat moves **backward** due to Newton's third law, causing the jumper to **lose balance** and often fall into the water.

6. **Imagine that if friction vanishes suddenly from everything, then what could be the scenario of daily life activities? (3.8)**

Ans: Without friction, we **cannot walk, drive, hold objects, or use tools**, because there would be **no grip**, making daily activities nearly impossible.