**Chapter 5 Summary of terms**

**Forces and Interactions**

* Force is a push or pull
* No push or pull ever occurs alone
* Every force is part of an interaction between one thing and another
* We hit the table, the table hits us back. The harder we hit the table, harder the table hits our hand. Another example do Hi-fives with your neighbor
* These forces occur in pairs
* These forces are equal in magnitude and opposite in direction
* An interaction requires a pair of forces acting on two separate objects

**Newton’s Third Law of Motion**

* It is the law of action and reaction
* Whenever one object exerts a force on a second object, the second object exerts an equal and opposite force on the first
* Forces occurs in pairs, one action and the other reaction, which together constitute the interaction between one object and the other
* Action and reaction always occur simultaneously and acts on different objects
* Neither force exist without the other

**Defining our System**-

**Question** – Since action and reaction forces are equal and opposite, why don’t they cancel to zero?

**Answer**-

* Because the two forces act on two different and separate bodies, instead of both forces acting on just one body
* Internal forces in a system cancel if they are equal and opposite
* Two forces may be equal and opposite, but unless they act on different objects they are not an action-reaction pair

Example- orange and apple

**Check Point page 70**

* On a cold rainy day, you find yourself in a car with a dead battery. You must push the car to move it and get it started. Why can’t you move the car by remaining comfortable inside and pushing against the dashboard?
* We know that Earth pulls on the Moon. Does it follow that Moon also pulls on Earth?

**Action and reaction on different masses**-

* A falling object pulls upward on Earth with as much force as Earth pulls it downward. The resulting acceleration of object is evident, while the upward acceleration of Earth is too small to detect
* When a cannon is fired, there is an interaction between the cannon and the cannonball
* A pair of forces acts, on both cannon and cannonball
* The force exerted on the cannonball = reaction force exerted on the cannon.

Hence the cannon recoils

* From Newton’s Second Law of Motion:
* Acceleration = Force **/** mass
* Let F: represent both action and reaction force
* m: represent the mass of the cannonball
* and M:represent the mass of the massive cannon
* Acceleration of cannonball = F/m
* Because m is small, **a** is large ==> Large **a** for cannonball =F**/**m
* Acceleration of cannon = F**/**M
* Because M is large, **a** is small ==> Small **a** for cannon = F **/** M
* Therefore,
* change in velocity of the cannonball **>>>** change in velocity of cannon
* Back to falling object and Earth: Same force F on both the object and Earth,
* Small mass of falling object 🡺 large acceleration of falling object
* Large mass of Earth 🡺small acceleration of Earth

**Examples:**

* Cannon recoils from the ball it fires
* Rocket recoils from the ejected exhaust gas
* Both rocket and recoiling cannon accelerate because of the reaction forces exerted by the material they fire
* Balloon expels air downward, and it accelerates upward
* A fish pushes the water backward with its fins, and the water pushes the fish forward
* When the wind pushes against the branches of a tree and the branches push back on the wind, we have whistling sounds

**Check Point page 73**

* A car accelerates along a road. Identify the forces that move the car.
* A high speed bus and an innocent bug have a head on collision. The force of impact splatters the poor bug over the windshield. Is the corresponding force that the bug exerts against the windshield greater, less or same? Is the resulting deceleration of the bus greater than, less than, or same as that of the bug?

**Exercises**-

3. When you rub your hands together, can you push harder on one hand than the other?

7. Consider a baseball player batting a ball.

(a) Identify the action – reaction pairs when the ball is being hit

9. If you drop a rubber ball on the floor, it bounces back up.

What force acts on the ball to provide the bounce?

11. Is it true that when you drop from a branch to the ground below, you pull upward on Earth? If so, then why is the acceleration of Earth not noticed?

19. Why does a rope climber pull downward on the rope to move upward?

21. You push a heavy car by hand. The car in turn, pushes back with an opposite but equal force on you. Doesn’t this mean that the forces cancel one another, making acceleration impossible? Why or why not?

31. Which of the following are scalar quantities

Which are vector quantities, and which are neither?

1. Velocity
2. Age
3. Speed
4. Acceleration
5. Temperature

35. When, if ever, can a vector quantity be added to a scalar quantity?

41. A balloon floats motionless in the air. A balloonist begins climbing the supporting cable. In which direction does the balloon move as the balloonist climbs? Defend your answer.