Exercise -3(D)

1. **State the usefulness of Newton's third law of motion.**
   Solution:
   Newton's third law unlike the first and second law of motion, explains how the force acts on the object.

2. **State Newton's third law of motion.**
   Solution:
   Newton's third law of motion states that:
   "To every action there is always an equal and opposite reaction".

3. **State and explain the law of action and reaction, by giving two examples.**
   Solution:
   The law of action and reaction is the Newton's third law of motion which states that to every action there is always an equal and opposite reaction. This can be explained with the help of the following examples:
   (a) A book on a table – a book exerts a force equal to its weight W when it is placed on a table top which is the action in downwards direction. The table balances it by exerting an equal force known as reaction that acts in an upward direction on the book.
   (b) Pushing a wall – when you apply a force on a wall by pushing your palm against it, that becomes an action and the force which you experience in turn from the wall, forms the reaction that is applied by the wall on your palm.

4. **Name and state the action and reaction in the following cases:**
   (a) Firing a bullet from a gun,
   (b) Hammering a nail,
   (c) A book lying on a table,
   (d) A moving rocket,
   (e) A person walking on the floor,
   (f) A moving train colliding with a stationary train
   Solution:
   The names and action, reactions in each of the cases are as follows:

Cases	Action	Reaction
Firing a bullet from a gun	Force exerted on the bullet	Gun experiences an equal recoil
Hammering a nail	Force exerted on the nail by the hammer	Force exerted by the nail on the hammer
A book lying on a table,	Force exerted by the book on the table	Force experienced by the book from the table in the upwards direction
A moving rocket	Force exerted by the rocket backwards on the gases	Force exerted by the gases on the rocket causing it to propel forward
A person walking on the floor	Force exerted by the	Force experienced by the

	person's feet in backward direction on the ground	ground on the person's feet in the forward direction
A moving train colliding with a stationary train	Force applied by a moving train on a train at rest	Force experienced by the train at rest on a moving train

5. Explain the motion of a rocket with the help of Newton's third law

Solution:

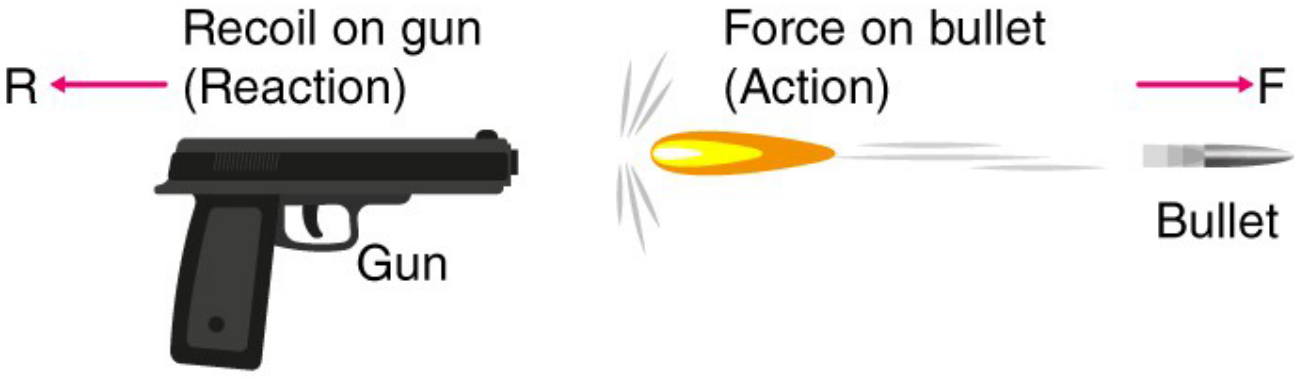
Newton's third law states that for every action there is always an equal and opposite reaction. The motion of a rocket can be explained with the help of this law. In a rocket, fuel burning inside is expelled as burning gases. The gases are expelled at a higher temperature and pressure through the nozzle of the rocket causing the rocket to exert a force F on the gases to expel them through a nozzle in the backwards direction.

The outgoing gases put forth an equal and opposite force R (reaction) on the rocket because of which it propels forward.

6. When a shot is fired from a gun, the gun gets recoiled. Explain.

Solution:

When a bullet is fired from a gun, force F is exerted on the bullet which forms the action. The gun in turn experiences an equal recoil R which forms the reaction.



7. **When you step ashore from a stationary boat, it tends to leave the shore. Explain.**

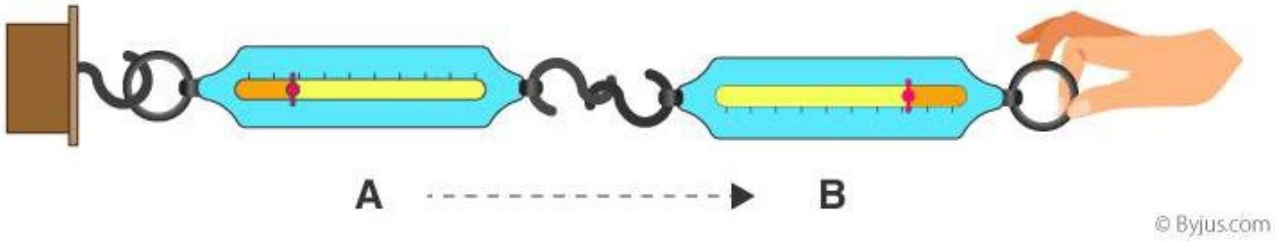
Solution:

By stepping into a boat, when a man exerts a force (action), the force of reaction causes him to step of the boat and the boat is inclined to leave the shore because of the force applied by the man.

8. **When two spring balances joined at their free ends, are pulled apart, both show the same reading. Explain.**

Solution:

The figure shows two spring balances A and B that are coupled. When the balance B is pulled, both the balances tend to indicate the same reading depicting that both the forces of reaction and action are opposite and equal in nature. In such a condition, the pull of either of the two spring balances can be considered as action and other balance as the reaction.



9. **To move a boat ahead in water, the boatman has to push the water backwards by his oar. Explain.**
   Solution:
   The boatman pushes the water in the backward direction (action) to move a boat with his oar. The water in turn exerts an equal and opposite force (reaction) in the forward direction on the boat because of which the boat moves forward.

10. **A person pushing a wall hard is liable to fall back. Give reason.**
    Solution:
    A person experiences a force (reaction) by the wall on his palm in the opposite direction when he pushes the wall hard (action) by his palm. This is why he is liable to fall back.

11. **"The action and reaction both act simultaneously." Is this statement true?**
    Solution:
    Yes, the statement is true.

12. **"The action and reaction are equal in magnitude". Is this statement true?**
    Solution:
    Yes, the statement is true.

13. **A light ball falling on ground, after striking the ground rises upwards. Explain the reason.**
    Solution:
    A ball exerts a force when it strikes the ground. The ground in turn exerts a force on the ball in an opposite direction. Hence the ball rises in the upward direction.

14. **Comment on the statement 'the sum of action and reaction on a body is zero'.**
    [Hint: The statement is wrong]
    Solution:
    The statement is wrong.
    As per the Newton's third law of motion, action and reaction act at the same time on different objects. Consequently, they do not negate each other.

Multiple choice type:

1. **Newton's third law:**
   (a) Defines the force qualitatively

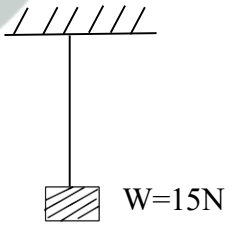
(b) Defines the force quantitatively
(c) Explains the way a force acts on a body
(d) Gives the direction of force.
Solution:
(c) Explains the way a force acts on a body
It states that to every action there is always an equal and opposite reaction.

2. **Action and reaction act on the:**
(a) Same body in opposite directions
(b) Different bodies in opposite direction
(c) Different bodies, but in same direction
(d) Same body in same direction.
Solution:
(b) Different bodies in opposite direction
As per Newton's third law, action and reaction are equal and opposite.

Numericals:

1. **A boy pushes a wall with a force of 10N towards east. What force is exerted by the wall on the boy?**
Solution:
The boy experiences an equal force of 10N exerted by the wall in the opposite direction, i.e., the west.

2. **In figure, a block of weight 15N is hanging from a rigid support by a string. What force is exerted by**



(a) Block on the string
(b) String on the block
Name them and show them in the diagram.
Solution:
(a) The force exerted by the block on the string is 15N acting downwards because of the weight of the block
(b) The force exerted by the string on the block is 15N acting upwards because of the tension generated.