Chapter : 3 Force

Be Prompt

A. 1. rest
2. interact
3. decrease
4. break-shoe
5. energy
6. heat, periodic

B. 1. False
The force acting on a body <u>increases</u> the mass of the body. (does not affect)
2. True
3. True
4. False
<u>Less</u> force will be required to move a heavier body than a lighter one. (More)
5. True
6. <u>Only solid</u> surfaces experience friction. (All)

C. 1. (d) 2. (c) 3. (c) 4. (b) 5. (c) 6. (d)

D. 1. (d) 2. (e) 3. (a) 4. (b) 5. (c)

SHORT & PRECISE

B 1. The force applied on a body does not affect the mass of the body because the applied force does not change the composition of matter that is present in the body.

2. When a toothpaste tube is squeezed, a force is applied so that the material or paste inside the tube comes out easily by changing its shape and size.
3. The static friction is more than kinetic friction, therefore, the force required to start a motion is maximum as compared to the force required to keep a body in motion.
4. Friction causes wear and tear of the surfaces in contact. It results in wearing out of the sole of our shoes.
5. Since rolling friction is lesser than the sliding friction, so the heavy objects are moved using rollers or wheels.
6. On rubbing our palms, they get warm because friction produces heat.
7. We put talcum powder on a carrom board to make the surface smooth. This reduces the friction between the surface of the carrom board and the strikers.

8. Friction is a necessary evil because it has both advantages and disadvantages.
9. The presence of water, oil or soap solution on the floor reduces the unevenness of the surfaces and thus friction is reduced. Therefore, the floor becomes slippery.

C. 1. An object is said to be at rest if its position does not change with time with respect to its surroundings.
2. Magnetic force, electrostatic force and gravitational force are the non-contact forces.
3. The interaction between two magnets can either be attractive or repulsive. Iron, nickel, cobalt and steel are the materials that can be attracted by a magnet.
4. Friction arises due to irregularities on the surfaces of the objects. The more are the irregularities, more is the friction.
5. All three states of matter namely, solids, liquids and gases exert frictional force.
6. Static friction > Sliding friction > Rolling friction
7. Lubricants form a thin layer between the two surfaces in contact and fill the depressions present on the surfaces. This reduces the unevenness of the surfaces and thus friction is reduced.
8. Friction can be increased by grooving on the surfaces and by making the surfaces rough.
9. The presence of streamline shape in airplanes reduces the friction and helps them to move through air with minimum resistance or friction.

At Length

A. 1. Force can be defined as a pull or push acting on a body which tends to change its state of rest or motion, or the speed of direction of motion, or its shape or size. Force is usually denoted by the letter F. For the force to act, the two bodies must interact with each other in some way.
2. Friction is the force that opposes or resists the relative motion between two bodies or surfaces in contact with each other. Friction always acts in the direction opposite to the direction of motion. It is caused due to irregularities present on the surfaces of objects in contact.

3. The friction existing between a body and a surface when the body slides over it is called sliding friction.
4. The friction that exists when the bodies in contact are at rest with respect to each other is called static friction.
5. The friction existing between an object and a surface when the body rolls over it is called rolling friction.
6. The substances like oil, grease and powdered graphite that form a thin layer between the two surfaces in contact and fill the depressions present on the surfaces are called lubricants.

B. 1.

Contact Forces	Non-contact Forces
⋄ The forces in which the two interacting bodies are in physical contact with each other are called contact forces.	⋄ The forces which do not require a physical contact between the two interacting bodies and act at a distance are called non-contact forces.
⋄ There are various kinds of contact forces like applied force, normal force, tension, muscular force, collision force, friction and mechanical force.	⋄ The various kinds of non-contact forces are magnetic force, electrostatic force and gravitational force.

2.

Static Friction	Kinetic Friction
⋄ The friction that exists when the bodies in contact are at rest with respect to each other is called static friction.	⋄ Kinetic friction is the friction that exists between two bodies when the applied force overcomes static friction and bodies start moving.
⋄ It has no types.	⋄ Sliding friction and rolling friction are two types of kinetic friction.

3

Sliding Friction	Rolling Friction
⋄ The friction existing between a body and a surface when the body slides over it is called sliding friction.	⋄ The friction existing between an object and a surface when the body rolls over it is called rolling friction.
⋄ It requires more force to slide an object on a surface than to roll it. Therefore, sliding friction is more than the rolling friction.	⋄ It is less than the sliding friction.

C.

• If there is water on the floor it is <u>easier</u> to walk. (difficult)

• On putting sand or gravel on the ground, the slipperiness of the ground <u>increases</u>. (decreases)

• This is because the sand <u>decreases</u> the friction between our foot and ground. (increases)

D. 1. Some examples of push and pull that we see in our daily life are listed below.

• Two teams pulling the rope with enough force in a tug of war game

• Pulling a chair to sit on it

- Pulling a rubber band to expand it
- Pushing a wheelbarrow
- Pushing a pram (babycart) to move it ahead
- Pushing a refrigerator door to close it

2. The various effects of force are discussed below.

- **Effect of Force on Mass of a Body**: The force applied on a body does not affect the mass of the body. This is because the applied force does not change the composition of matter that is present in the body.
- **Force Can Produce Motion**: Force when applied on an object by pushing, pulling or hitting it with another object can make the first object move. For example, on pushing a heavy box to move it, pulling a car door to open it, hitting a stationary ball with a bat to move it, etc. In all these examples, the objects move in the direction of force. However, if the applied force is not sufficient, the object may not move.
- **Force Can Stop Motion**: The motion of a moving body can be stopped by applying force in the direction opposite to the direction of its motion. For example, a moving pram can be stopped by pulling it from behind and a moving ball can be stopped with our hands by applying force.
- **Force Can Change the Speed of Motion**: The speed of a moving object can be increased by applying force in the direction of its motion. For example, by kicking a moving football in the direction of its motion, its speed increases. Similarly by applying force in the direction opposite to the direction of the motion of a body, its speed decreases.
- **Force Can Change the Direction of Motion**: The direction of a moving body can be changed by applying force in the desired direction. For example, in cricket when a batsman hits the moving ball with his bat, the direction of the ball changes.
- **Force Can Change the Shape and Size of an Object**: The shape and size of an object can be changed by applying force. For example, the shape and size of a spring, rubber band, sponge, dough and many other things can be changed by applying force on them.

3. Gravitational force can be defined as the force with which any two masses or objects pull each other. It is due to gravitational force or gravity that all objects either remain on the ground or always fall back on the ground. Gravitational force between any two bodies depends on their masses and the distance between them. The gravitational force keeps us bound to the earth. The revolution of the moon and other satellites around the earth and the motion of other planets around the sun are also due to gravitational force. Unlike electrostatic and magnetic forces, gravitational force always attracts.

4. Friction is caused due to irregularities on the surfaces of objects in contact. If we carefully observe the surfaces of objects through magnifying lens, we see that there are tiny hills and grooves (valleys). When any two surfaces come in contact with each other, these hills and grooves interlock with one another and thus oppose motion. To be able to move any of these surfaces, we have to apply force to overcome interlocking. When the applied force is sufficient, the interlocking breaks and the object begins to move.
Friction always acts in the direction opposite to the direction of motion. So, while moving a table towards north, the force of friction will act on the table towards south. Similarly, when a bucket of water kept on the floor is moved towards left , then friction will act between the floor and the bucket towards right.

5. Friction has the following properties.

- Friction always opposes relative motion. Hence, it slows down and ultimately stops a moving body.
- Friction produces heat. This is why we feel warm on rubbing our hands together and touching our cheeks with them. Even the tyres of a moving vehicle and the moving parts of a machine become hot due to friction.
- Friction causes wear and tear of the surfaces in contact. It results in wearing out of the sole of our shoes and tyres of moving vehicles. Also, the parts of a machine wear out due to friction and one has to replace them from time to time.

6. Friction depends on the following factors.

- **Nature of surfaces in contact**: Friction arises due to irregularities on the surfaces of the objects. The more are the irregularities, the more is the friction. Since a smooth surface has lesser irregularities as compared to a rough surface, hence friction is less for smooth surface and more for rough surface.
- **Weight of the body**: A body kept on the ground experiences the normal force exerted by the ground, which is equal to the weight of the body. So if the body is heavier, then the normal force exerted on it will be more. Greater the normal force experienced by a body, greater is its frictional force. In other words, more force will be required to move a heavier body than a lighter one.

7. The various types of friction are listed below.

- **Static friction**: The friction that exists when the bodies in contact are at rest with respect to each other is called static friction.
- **Kinetic friction**: Kinetic friction is the friction that exists between two bodies when the applied force overcomes static friction and bodies start moving. Sliding and rolling friction are types of kinetic friction.

(a) **Sliding friction**: The friction that exists between a body and a surface when the body slides over it is called sliding friction.

(b) **Rolling friction**: When an object rolls over a surface, the friction that exists between them is called rolling friction.

8. Friction plays an important role in our life. In fact, friction is said to be a necessary evil. Some advantages of friction are as follows.

- Friction between our feet or footwear and the ground helps us to walk without slipping. That is why it is difficult to walk on ice or on a smooth polished floor.
- The friction between treaded tyres and rough surface of the road enables vehicles to move safely on the road.
- Friction between the brake-shoe and the wheel slows down or stops a moving vehicle.
- Friction between a pencil or a pen and paper helps us to write. That is why it is difficult to write on smooth surfaces like plastic and glass.
- We are able to light a matchstick, sew clothes, cut anything, tie a knot or fix a nail on the wall because of friction.
- We are able to hold objects with our hands due to friction.

- We rub our hands in winter to make them warm as friction produces heat. Some of the disadvantages of friction are as given below.
- Friction causes wear and tear of the rubbing surfaces. It causes wearing of the moving parts of a machine with time, wearing of tyres of vehicles and even that of soles of our footwear.
- As friction produces heat, different parts of the rotating machines get damaged with time and need periodic replacement. Also, there is a need to make provisions for constant cooling of moving parts of big machines which further increases the cost of maintenance.
- Friction causes wastage of energy. So extra power is applied to machines to overcome friction. This decreases the efficiency of machines.

9. In order to minimise friction, the following methods are used.
- **Polishing**: By polishing a surface, its irregularities are minimised and become smooth, so the friction decreases.
- **Lubricating**: Friction can be reduced by lubricating the two surfaces in contact. Substances like oil, grease, powdered graphite, etc. known as lubricants form a thin layer between the two surfaces in contact and fill the depressions present on the surfaces. This reduces the unevenness of the surfaces and thus friction is reduced. Even detergent solutions act as lubricant, making the floor slippery if spilled.
- **Streamlining**: When a body moves through a liquid or a gas, it experiences friction. It is found that this resistance or friction is minimum, if the body has a streamline shape, i.e., narrow in the front and broad at the back. Birds and fish have a streamline shape which helps them to move through fluids (liquids and gases) with minimum resistance. The shapes of boats, ships, aeroplanes, rockets, etc. are streamlined to reduce friction.
- **Using rollers or ball bearings**: Since rolling friction is lesser than the sliding friction, so the sliding friction is converted into rolling friction by fitting wheels in vehicles, luggage trollies, etc. Friction in machines can be decreased by use of ball bearings in between the moving surfaces.

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