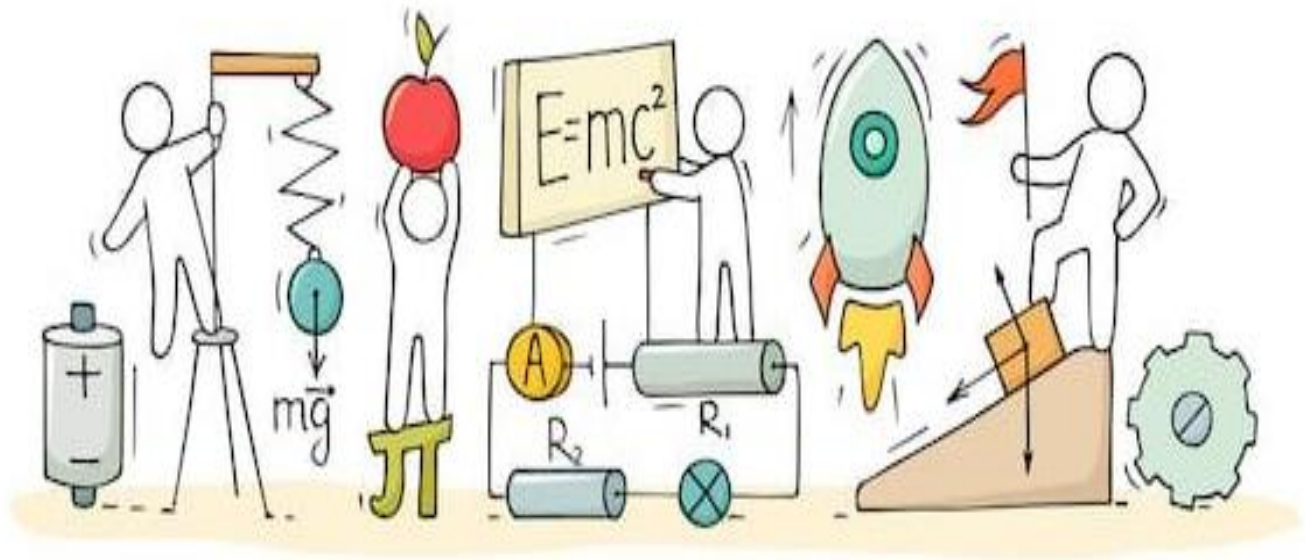


# SCIENCE

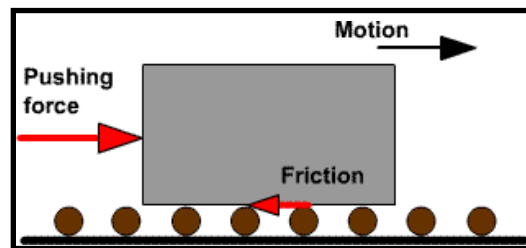
## Chapter 12 : Friction



## Friction

### Force of Friction

- Friction is the force which develops at the surfaces of contact of two bodies and opposes their relative motion.

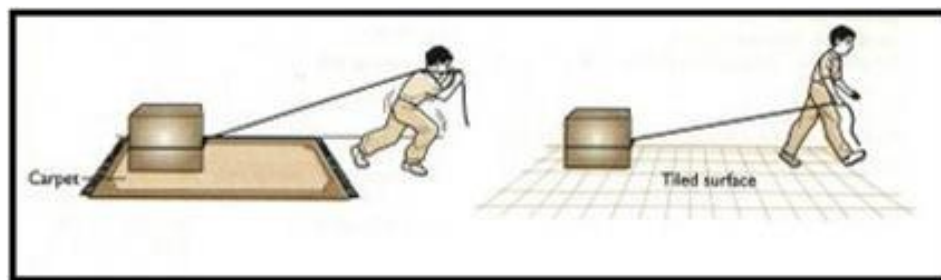


- It always acts in the direction opposite to the applied force.

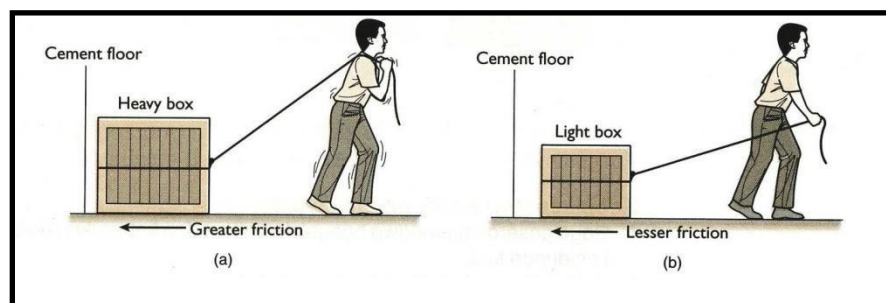
### Factors Affecting Friction

The factors which affect friction are

- The nature of the two surfaces in contact.
- The force with which the two surfaces are pressed together.
- A rough surface produces greater friction as compared to a smooth surface.
- It is caused by irregularities on the surfaces of the objects in contact.



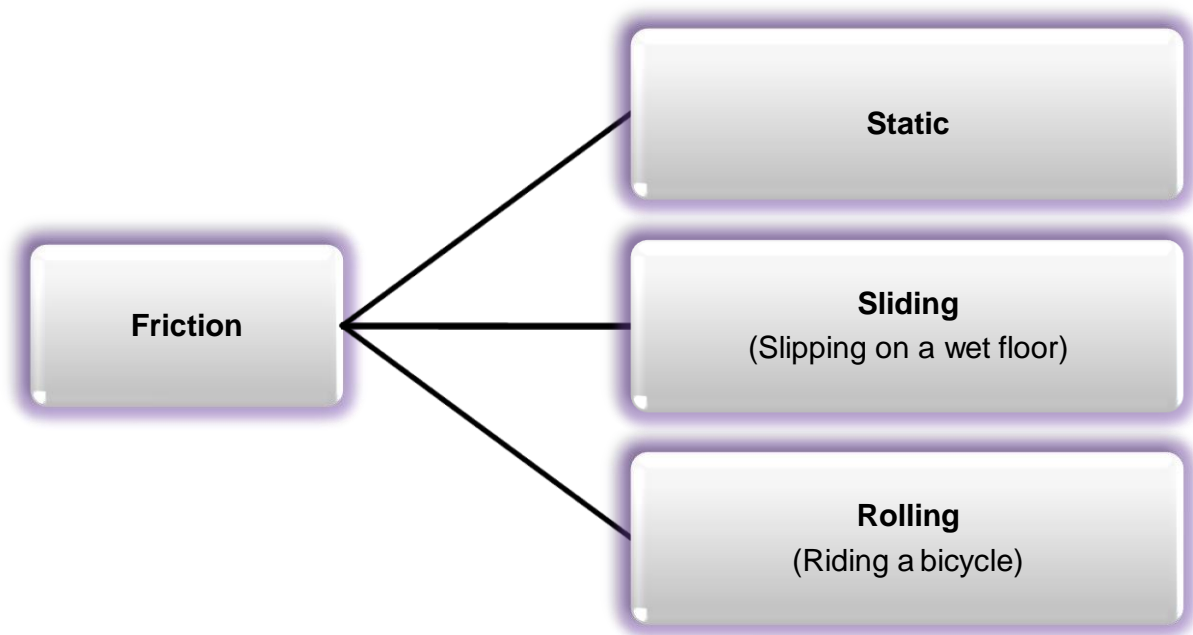
- We are more likely to slip while walking on a wet floor, because the wet floor is slippery and produces less friction.
- The force of friction increases if the surfaces are pressed harder.



- A heavier object exerts a greater frictional force as it presses the floor harder.

## Types of Friction

- There are three types of friction:



### Static Friction

- The force required to overcome friction at the instant an object starts moving from rest is the measure of static friction.

### Sliding Friction

- The force required to keep an object moving with the same speed is the measure of sliding friction.
- Sliding friction is always lesser than static friction.

### Rolling Friction

- The frictional force which comes into action when an object rolls over a surface is called rolling friction.
- This force slows down the motion of a rolling object.

## Friction: A Necessary Evil

- Friction is a necessary evil. There are instances in daily life where friction is a necessity.
- Without friction, we cannot hold objects in our hands, we cannot walk and we cannot light a matchstick.
- Friction has both advantages and disadvantages.

**Advantages of Friction**

- Construction of buildings is possible only because of friction.
- We are able to write because of the friction between the paper and the tip of a pen.
- Without friction between our shoes and the ground, we will not be able to walk.
- We can also change the direction of a car because of friction.

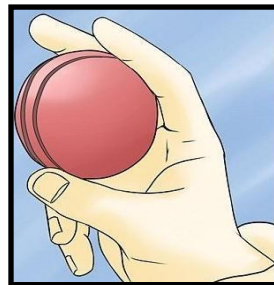
**Disadvantages of Friction**

- Friction produces heat in the moving parts of machines which causes wear and tear of the parts.
- A lot of energy is wasted in overcoming friction.
- It causes the wear and tear of the soles of the shoes.
- It also causes the damage of various parts of machines and equipment.

**Increase and Decrease in Friction**

Ways to increase friction:

Providing grooves to shoes and grips to balls



Treading tyres of vehicles



Threading screws



Using brake pads in the brake system of bicycles and automobiles



Ways to decrease friction:

By lubricants (i.e. grease, oil and graphite)



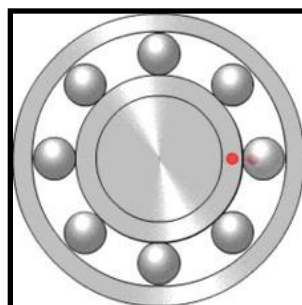
By polishing surfaces

Example: Sprinkling powder on a carom board to make it smooth



By using wheels

Example: Using ball bearings or roller wheels in luggage

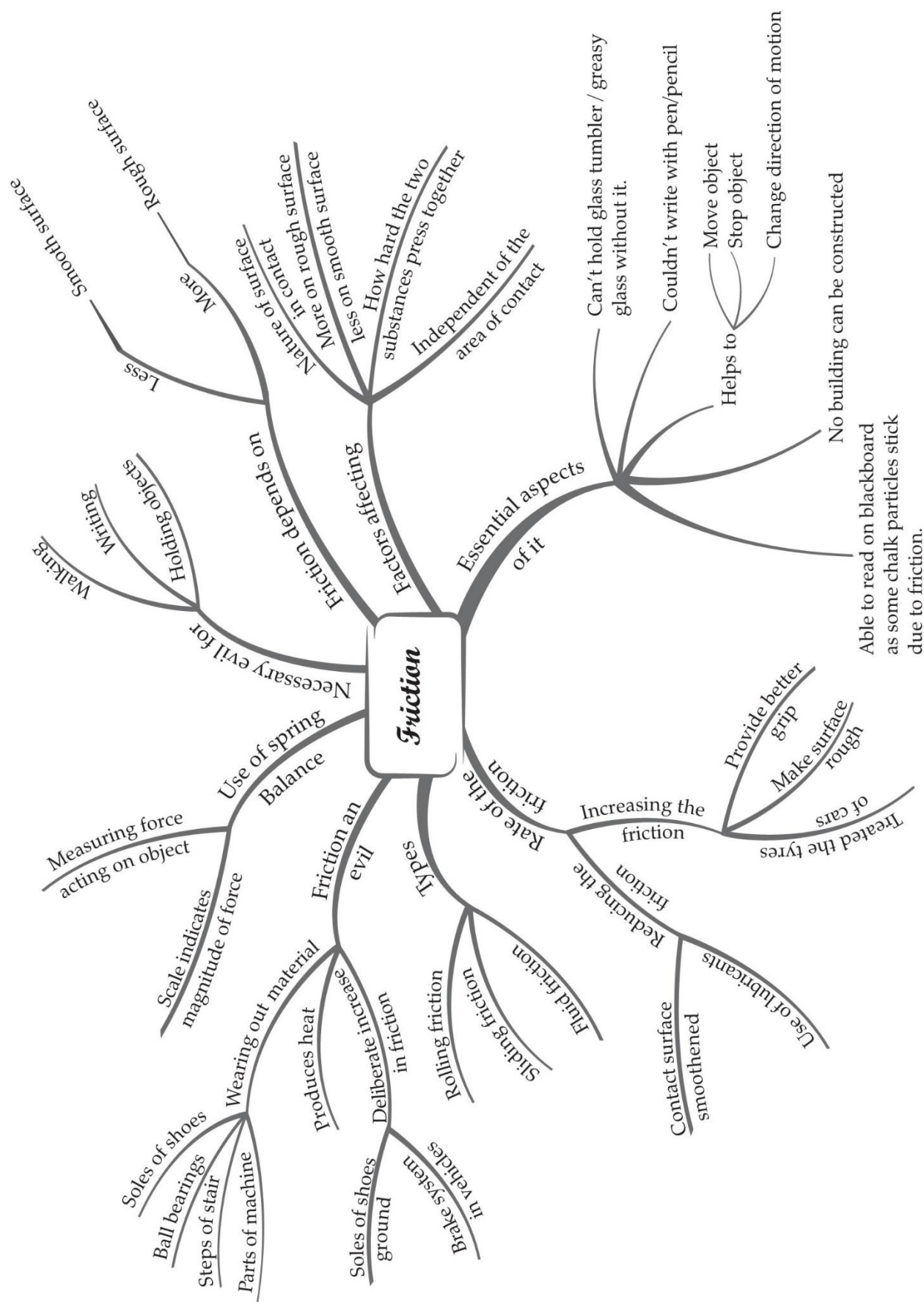


## Fluid Friction

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- Liquids and gases are together known as fluids.
- Substances which are able to flow easily are called fluids.
- The frictional force exerted by fluids is known as drag.
- The frictional force on an object moving through a fluid depends on its speed with respect to the fluid.
- When objects move through a fluid, the friction
  - Reduces the speed of the object
  - Leads to losing some of the energy possessed by the object in overcoming it
- Fluid friction is reduced by designing streamlined shapes.
- An aeroplane has a streamlined shape in order to reduce air drag.
- Speed boats are provided with streamlined shapes in order to reduce water drag.

# MIND MAP : LEARNING MADE SIMPLE CHAPTER-10





# Important Questions

## Multiple Choice questions-

Question 1. Friction is a

- (a) non-contact force
- (b) contact force
- (c) magnetic force
- (d) electrostatic force

Question 2. Which of the following produces least friction?

- (a) Sliding friction
- (b) Rolling friction
- (c) Composite friction
- (d) Static friction

Question 3. Friction always

- (a) opposes the motion
- (b) helps the motion
- (c) both (a) and (b)
- (d) none of these

Question 4. Friction can be reduced by using

- (a) oil
- (b) grease
- (c) powder
- (d) all of these

Question 5. Static friction is less than

- (a) sliding friction
- (b) rolling friction
- (c) both (a) and (b)
- (d) none of these

Question 6. Whenever the surfaces in contact tend to move or move with respect to each

other, the force of friction comes into play

- (a) only if the objects are solid.
- (b) only if one of the two objects is liquid.
- (c) only if one of the two objects is gaseous.
- (d) irrespective of whether the objects are solid, liquid or gaseous.

Question 7. To sharpen the blade of a knife by rubbing it against a surface, which of the following will be most suitable?

- (a) Stone
- (b) Plastic block
- (c) Wooden block
- (d) Glass block

Question 8. The shape of an aeroplane is like a

- (a) dog
- (b) bird
- (c) car
- (d) all of these

Question 9. Friction is

- (a) foe
- (b) friend
- (c) both (a) and (b)
- (d) none of these

Question 10. Friction due to fluids is called

- (a) force
- (b) pressure
- (c) friction
- (d) drag

Question 11. Which of the following is not a smooth surface?

- (a) Surface of wet soap
- (b) Surface of tyres

- (c) Glazed tiles
- (d) Surface of mirror

Question 12. A toy car released with the same initial speed will travel farthest on

- (a) muddy surface
- (b) polished marble surface
- (c) cemented surface
- (d) brick surface

Question 13. If we apply oil on door hinges, the friction will

- (a) increase
- (b) decrease
- (c) disappear altogether
- (d) will remain unchanged

Question 14. Lubricant

- (a) reduce friction
- (b) increase friction
- (c) both (a) and (b)
- (d) none of these

Question 15. Force of friction depends on

- (a) roughness of surface
- (b) smoothness of surface
- (c) inclination of surface
- (d) all of these

### Very Short Question:

1. What is the force of friction?
2. What is the cause of friction?
3. What is the force responsible for wearing out of bicycles tyres?
4. Is the friction same for all objects?
5. Why are wheels of vehicles made circular?
6. What is the direction of force of friction acting on a moving object?

7. Why do pieces of luggage fit with rollers?
8. Why does a matchstick catch fire when rubbed on the rough surface of the box?
9. What is the name of special shape given to objects moving in fluids?
10. Give one example where ball bearings are used.

### Short Questions :

1. If we push the book on the table, it stops after sometime. Why?
2. Why are the worn-out tyres discarded?
3. Why are the worn-out tyres discarded?
4. Give some examples to show that friction produces heat.
5. Give some examples of smooth and rough surfaces.
6. What is a spring balance?
7. How does the friction depend on the nature of the surface?
8. What are the two factors on which the force of friction depends?
9. When the two surfaces are pressed harder, friction increases. Explain why?
10. What is a measure of static friction?

### Long Questions :

1. What are the various types of friction? Explain.
2. What are the causes of friction? Explain in detail.
3. Explain increasing and decreasing friction with suitable examples.
4. What do you mean by fluid friction? How can fluid friction be reduced?
5. Write advantages and disadvantages of friction.

## ANSWER

### MCQ Answer :

1. Answer: (b) contact force
2. Answer: (b) Rolling friction
3. Answer: (a) opposes the motion
4. Answer: (d) all of these
5. Answer: (d) none of these
6. Answer: (d) irrespective of whether the objects are solid, liquid or gaseous.
7. Answer: (a) Stone
8. Answer: (b) bird

9. Answer: (c) both (a) and (b)
10. Answer: (d) drag
11. Answer: (d) drag
12. Answer: (b) polished marble surface
13. Answer: (b) decrease
14. Answer: (a) reduce friction
15. Answer: (a) reduce friction

### Very Short Answer:

1. **Answer:** The force acting on a moving object equal and opposite to the direction of motion is called force of friction.
2. **Answer:** The irregularities on the two surfaces in contact is the cause of friction.
3. **Answer:** Frictional force
4. **Answer:** No
5. **Answer:** Rolling friction is less than sliding friction.
6. **Answer:** Opposite to the direction of moving objects.
7. **Answer:** To reduce friction and to pull them easily.
8. **Answer:** Due to friction between the stick and rough surface a matchstick catches fire.
9. **Answer:** Streamlined
10. **Answer:** Ceiling fan

### Short Answer :

1. **Answer:** When we push the book on a table, a force is applied on it in the opposite direction of the motion called force of friction. This force opposes the movement and the book stops.
2. **Answer:** The worn out tyres are discarded because their tread are worn off and limiting their effectiveness of providing required amount of friction.
3. **Answer:** Fish can easily swim in water because it has a streamlined body which produces less friction. So it easily cuts through water and moves in it very easily.
4. **Answer:** The examples are:
  - Rubbing of our hands to keep us warm in winter.
  - Rubbing of matchsticks on the rough surface to make fire.
5. **Answer:** Smooth surfaces: Surface of the mirror, surface of wet soaps, glazed tiles, surface of an oily pot, etc.  
Rough surfaces: Surface of plyboard, unpainted wall, brick, tyres, etc.

**Long Answer:****1. Answer:**

There are mainly three types of friction:

(i) Static friction: The friction existing between a stationary object and the surface on which it's resting is called static friction. This type of friction is more powerful than others. We need a lot of energy to overcome such type of friction.

(ii) Sliding friction: The friction between the two surfaces in contact when one of them just slides, over the other is called sliding friction. It is also known as kinetic friction. It is less than static friction.

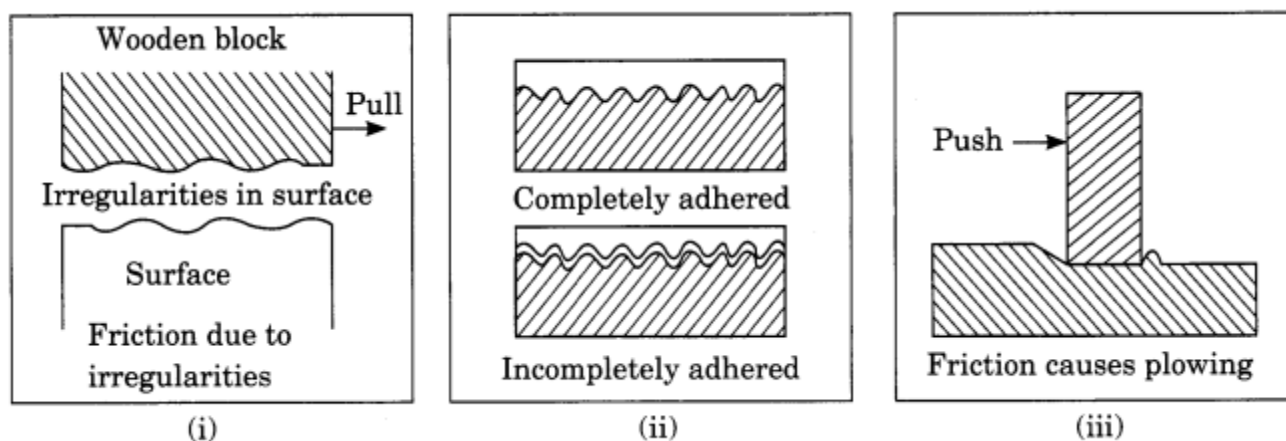
(iii) Rolling friction: When one body rolls over the surface of another body, the resistance of its motion is called rolling friction. Rolling friction is less than sliding friction. It is thus the least friction of three types of friction, i.e., Static friction > Sliding friction > Rolling friction.

**2. Answer:**

Friction is mainly caused by the following factors:

(i) The interlocking of surfaces: The force of friction arises due to interlocking of the irregular projections on the two surfaces. All surfaces have many irregularities. When we attempt to move one object over the other, we have to apply a force to overcome interlocking of the irregularities in their surfaces and friction is produced. The roughness varies from surface to surface due to varying irregularities on the surfaces. So the more is the roughness of the surface, the larger is the number of irregularities and hence the greater will be the friction.

(ii) Force of adhesion: When the two rough surfaces come in contact, it leads to the formation of various contact points. The atoms or molecules present at such points of contact give rise to attractive forces of adhesion that opposes the relative motion of the bodies. Hence, the force of adhesion acting between two surfaces cause friction.



(iii) Deformations: Soft materials will deform when under pressure. This also increases the resistance of motion. For example, when you stand on a sand bed, you sink slightly, which causes resistance when you try to drag your feet along the sand surface. In this case, you must plow through to move, thus creating resistive force.

(iv) Weight of the body: The greater is the weight of the body, the greater will be the force of friction. If we push a heavy box, it will require greater force to move as the force of friction is greater. On the other hand, it is easier to move a lighter box because it produces less friction.

### 3. Answer:

In our daily life, in many cases we increase or decrease friction for our own convenience. Some examples are given below:

Increasing friction:

- Soles of our shoes are grooved to provide the shoes better grip on the floor so that we can move safely. Similarly tyres of vehicles are treaded to increase friction to provide better grip.
- We increase friction by using brake pads in the brake system of bicycles and automobiles.
- Gymnasts apply some coarse substance on their hands to increase friction for better grip.
- Kabaddi players rub their hands with soil for a better grip of their opponents.
- Roads are made rough to prevent from slipping.
- Handle of cricket and tennis are made of rough materials to get better grip.

Decreasing friction:

In some situations, however, friction is undesirable and we would want to minimise it.

For example:

- A few drops of oil are poured on the hinges of a door, the door moves smoothly.
- A bicycle and motor mechanic uses grease between the parts of these machines to reduce friction.
- By polishing surfaces, sprinkling powder on carrom board, we reduce friction.
- Wheel and ball bearings are used in machines and vehicles to reduce friction.

### 4. Answer:

The gases and liquids are called fluid. All of them exert force of friction on solid bodies moving in either of them. The force exerted by fluid is called drag. It depends on speed of the object with respect to fluid. It also depends on the shape of the object and the nature of the fluid. It is obvious that when objects move through fluids, they have to overcome friction acting on them.

In process they lose energy. Efforts are, therefore, made to reduce friction. So, the objects are given special shapes. Birds and fishes have to move about in fluids all the time. Their bodies must have evolved to shapes which would make them lose less energy in overcoming friction. Such shapes are called streamlined. This is why shapes of aeroplanes,

ships and all vehicles are designed to have shapes which minimise fluid friction.

**5. Answer:**

Some points are given below which show that friction is both a friend and a foe:

(a) Friction as friend:

- It allows us to grip and catch any object.
- It helps us to walk comfortably on the floor.
- It helps to minimise the speed or to stop any moving object.
- It helps us to write.

(b) Friction as foe:

- It causes wear and tear in objects.
- It causes damage to the parts of machines and tools which further require money to get them repaired.
- It reduces the speed of moving objects, so more force is required.
- It produces hurdles in moving any object freely.