Chapter- 11

Force and Energy

STUDY NOTES

Let's Learn

Force:

- A push or a pull which acts on an object is called force.

Effects of force:

A force can:

- move a stationary object.
- stop moving object.
- change the speed of a moving object.
- change the direction of a moving object.
- change the shape and size of an object.

Types of forces:

There are different types of forces.

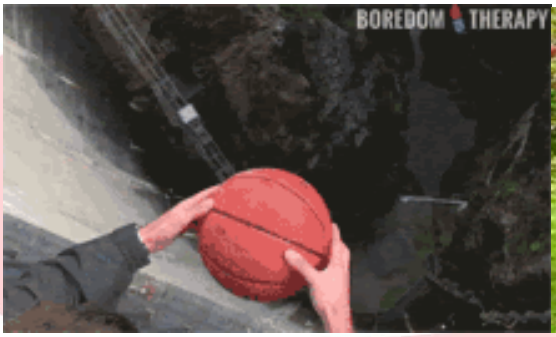
Muscular force:

- The force applied by the muscles of our body is called muscular force.

- E.g.: lifting a bag, moving a box, pushing a chair, etc.


Gravitational force:

- The attractive force that exists between any two objects is called gravitational force.
- For e.g.: we are able to stay on the ground because of gravitational force.

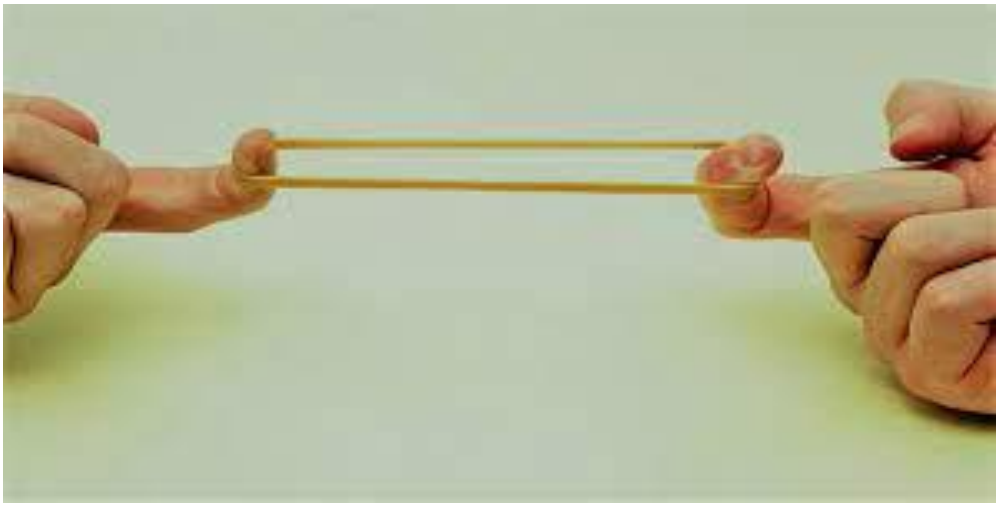


Frictional force:

- The force that opposes the movement of one object over the other is called the frictional force or friction.
- E.g.: Slowing down of a moving ball, writing on a paper, holding of objects, walking on the ground, etc.


Elastic force:

- The force that allows some materials to return to its original shape after being stretched or compressed is called the elastic force.
- E.g.: stretched rubber band regains its shape when the force is removed.



Mechanical force:

- A force that involves contact with another object and which produces a change in state of rest or motion is called mechanical force.
- E.g.: a pair of scissors is used to cut something.

Buoyant force:

- The upward force exerted by a liquid on an object present in it, is called buoyant force or upthrust.
- E.g.: a mug or a block of wood floating on water.

Machines:

- Tools that make our work easier and faster and with less effort are called machines.

Types of machines:

- There two types of machines. They are:
  - Simple machines
  - Complex machines

Simple machines:

- Machines which have only one or two simple parts are called simple machines.
- For example: nut cracker, bottle opener, ice tongs, etc.

Complex machines:

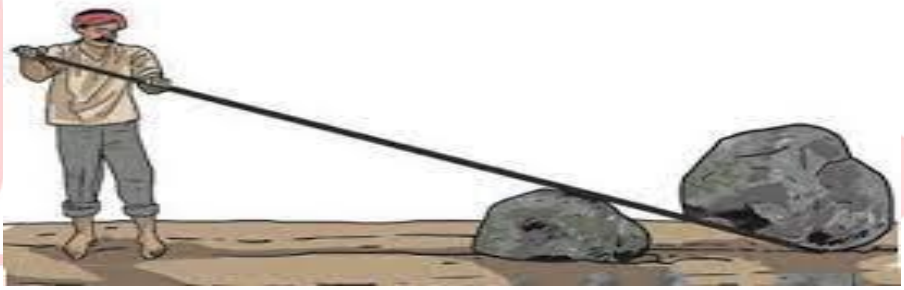
- Machines which are made by joining two or more simple machines are called as complex machines.
- For example: refrigerator, washing machine, mixer grinder, etc.

Types of simple machines:

- There are six different types of simple machines. They are:
  - Lever
  - Inclined plane
  - Pulley
  - Wheel and axle
  - Screw
  - Wedge

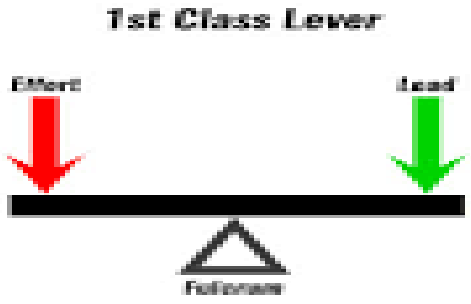
Lever:

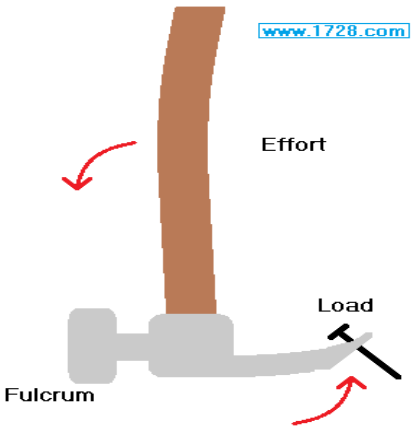
- A lever is a rigid rod arranged in such a manner that it can move freely around a fixed point.
- Fulcrum: The point of support or the pivot point of the lever.
- Effort: The force which is used to lift the object is the effort.
- Load: The weight which need to be lifted is called the load.

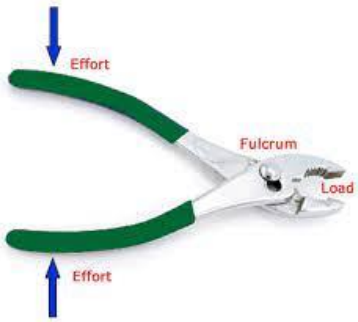


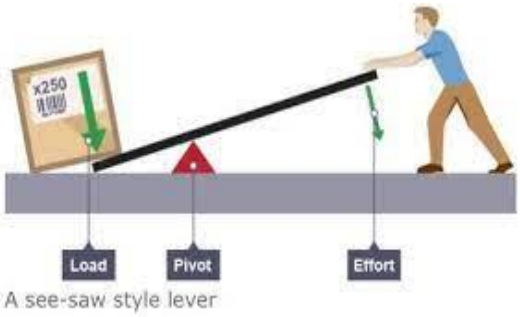
Types of levers:

- **First- class lever:**
  - When fulcrum is between load and effort, it is a first-class lever.
  - E.g.: pliers, claw hammer, scissors, etc.



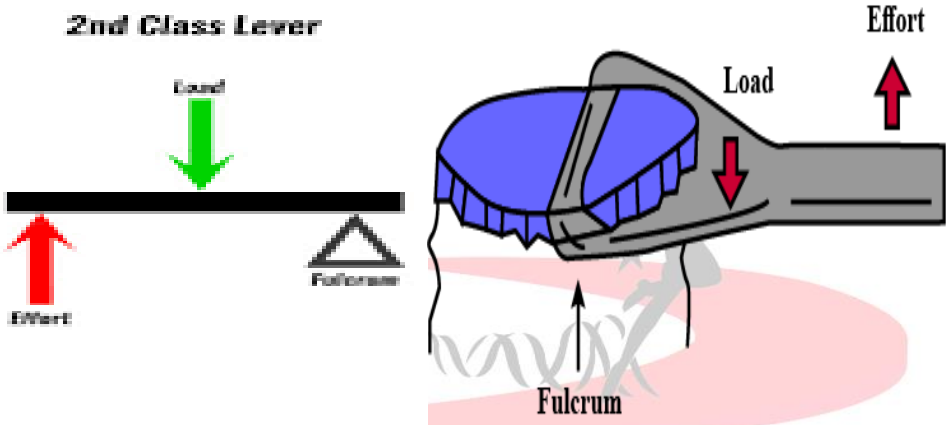


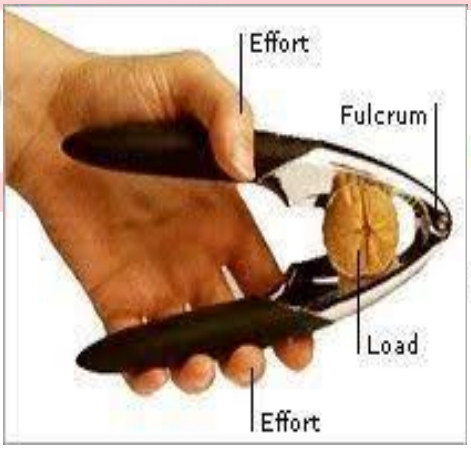


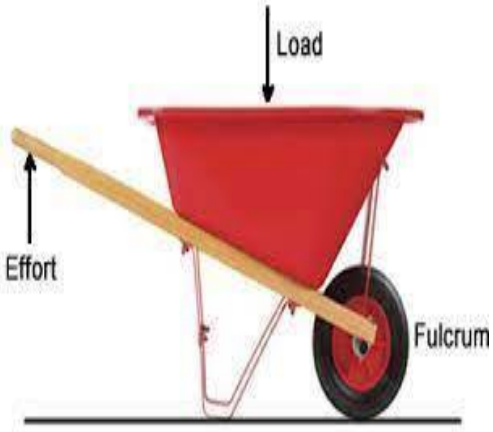


A see-saw style lever

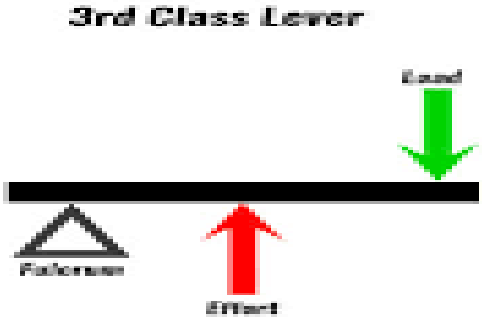
- **Second-class lever:**
  - When load is between fulcrum and effort, it is a second-class lever.
  - E.g.: nutcracker, wheel barrow, bottle opener, etc.

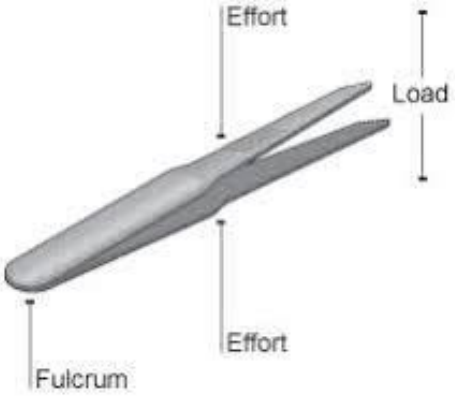






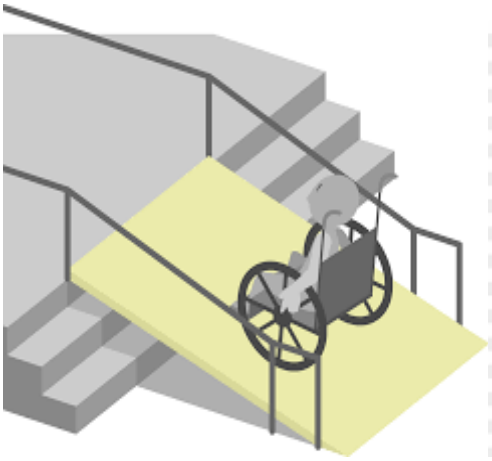
- **Third-class lever:**
  - When effort is between fulcrum and load, it is a third-class lever.
  - E.g.: fishing rod, tweezers, ice tongs, etc.





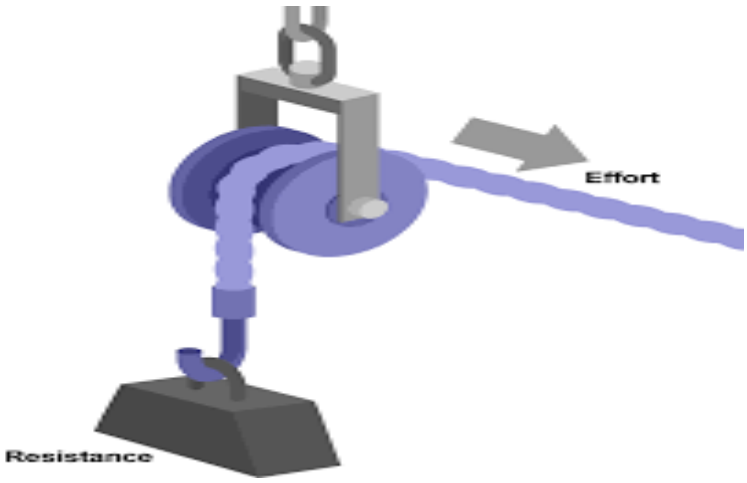
Inclined plane:

- An inclined plane is a slope which makes work easier.
- E.g.: workers can easily load or unload on a truck using a plank of wood.
- In hospitals and some other buildings inclined planes called ramps are provided next to stairs which helps them in pushing up wheelchairs.



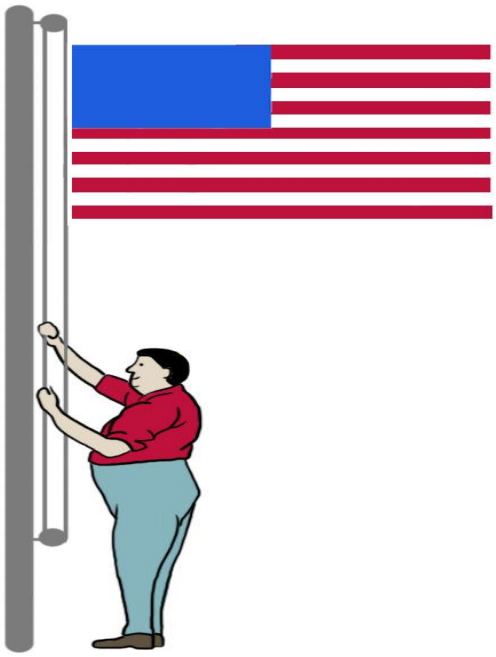
Pulley:

- A pulley is a small wheel with a groove around its outer edge that can hold a rope in position.
- A pulley together with a chain or a rope is used to lift heavy objects.

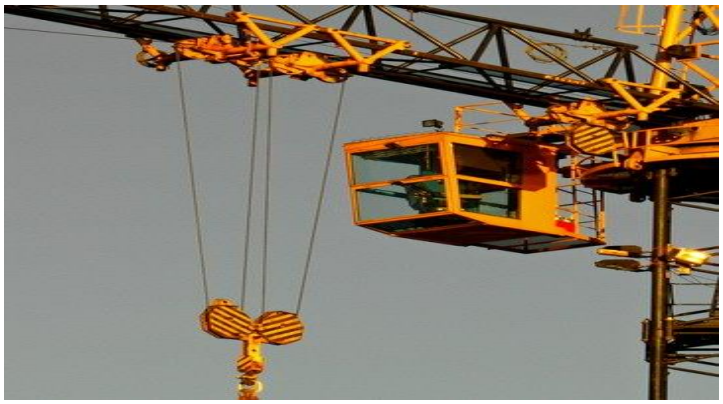


Types of pulleys:

- **Fixed pulley:**
  - When pulley is fitted to some support and does not move, then it is called a fixed pulley.
  - It is used to change the direction of the force needed to lift a load.
  - A force is exerted downward in order to lift the load upward.

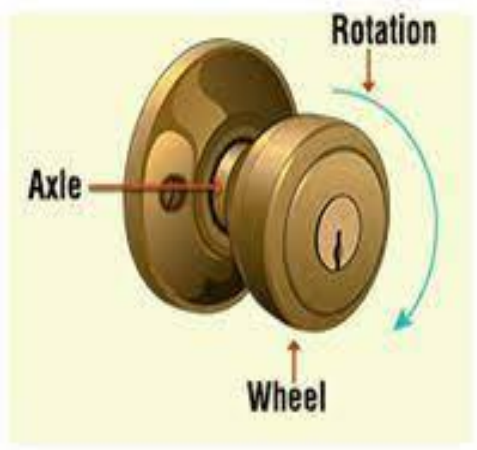


- **Movable pulley:**
  - A movable pulley is a pulley that is attached to a support and can move such that its axis of rotation is not fixed.
  - It can move up and down.
  - E.g.: construction cranes, modern elevators etc.



Wheel and axle:

- A wheel with a rod attached to it is known as a wheel and axle.
- This arrangement is used in big machines.



Screw:

- A screw is a simple machine used to hold things tightly.
- A screw is actually an inclined plane wrapped around a rod.
- Screw is a nail with grooves around it.
- Biggest screws, called screw jacks, are used to lift cars and other heavy objects.

Wedge:

- A wedge is an object with one pointed edge and one thick edge.
- It is actually two inclined planes joined together.
- It is used to cut things.

Energy:

- Energy is the ability to do work.
- Energy is everywhere in nature: sunlight, water, wind, plants and animals.

Different sources of energy:

- The sun- which gives us solar energy.
- The wind - which provides us wind energy.
- The water- which provides us with hydro energy.
- The hot interior of the earth- which provides us with geothermal energy.

Solar energy:

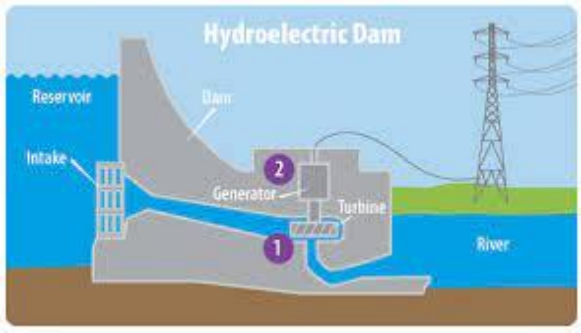
- It is the most readily available source of energy.
- It is nonpolluting.
- We can use solar energy to dry our clothes.
- It can also be used for cooking food, heating water, etc.

Wind energy:

- Wind energy is a renewable, widely distributed, clean and nonpolluting sources of energy.
- It is considered to be the most environmentally friendly energy source.
- Wind energy can be converted into electricity by using wind turbines.

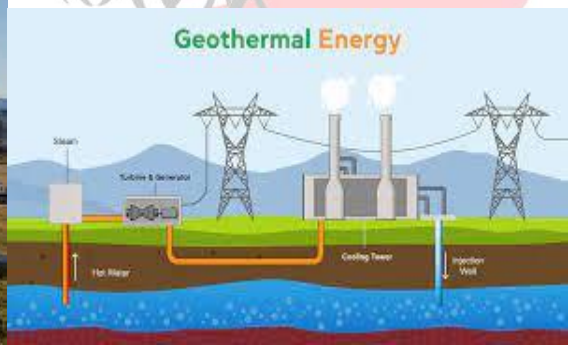
Hydropower/ water energy:

- It is another one important renewable sources of energy for generating power
- It is one of the oldest sources of energy
- Wind energy is used to turn paddlewheel to grind grain since thousands of years ago.



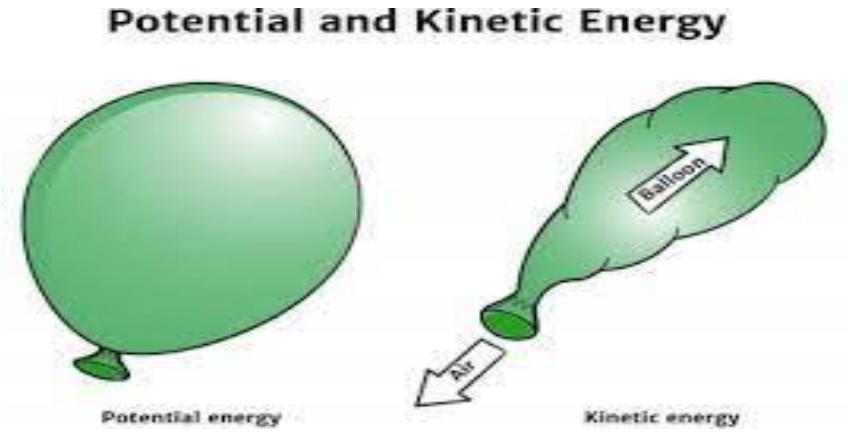
Geothermal energy:

- The word geothermal comes from the Greek words Geo meaning earth and therme means heat. So, geothermal energy is heat from within the earth.
- It is a renewable source of energy because of the water cycle which continuously goes on in our atmosphere.



Different forms of energy:

- **Mechanical energy:**
  - The energy which is posed by an object due to its motion or due to its position is called mechanical energy.
  - Mechanical energy can be either kinetic energy or potential energy.
  - The energy which is posed by an object due to its position is called potential energy.
  - The energy which is posed by an object to its motion is called kinetic energy.
  - For example- water that is behind a dam, a raised weight, a book on a table before it falls, etc. are examples of potential energy whereas a falling ball, a moving car, a moving cycle, etc. are examples of kinetic energy.



- **Heat energy:**
  - Heat is a form of energy.
  - It is used for cooking our food, boiling water, etc.
  - Heat energy comes from burning of fuels like coal, kerosene, petrol etc.

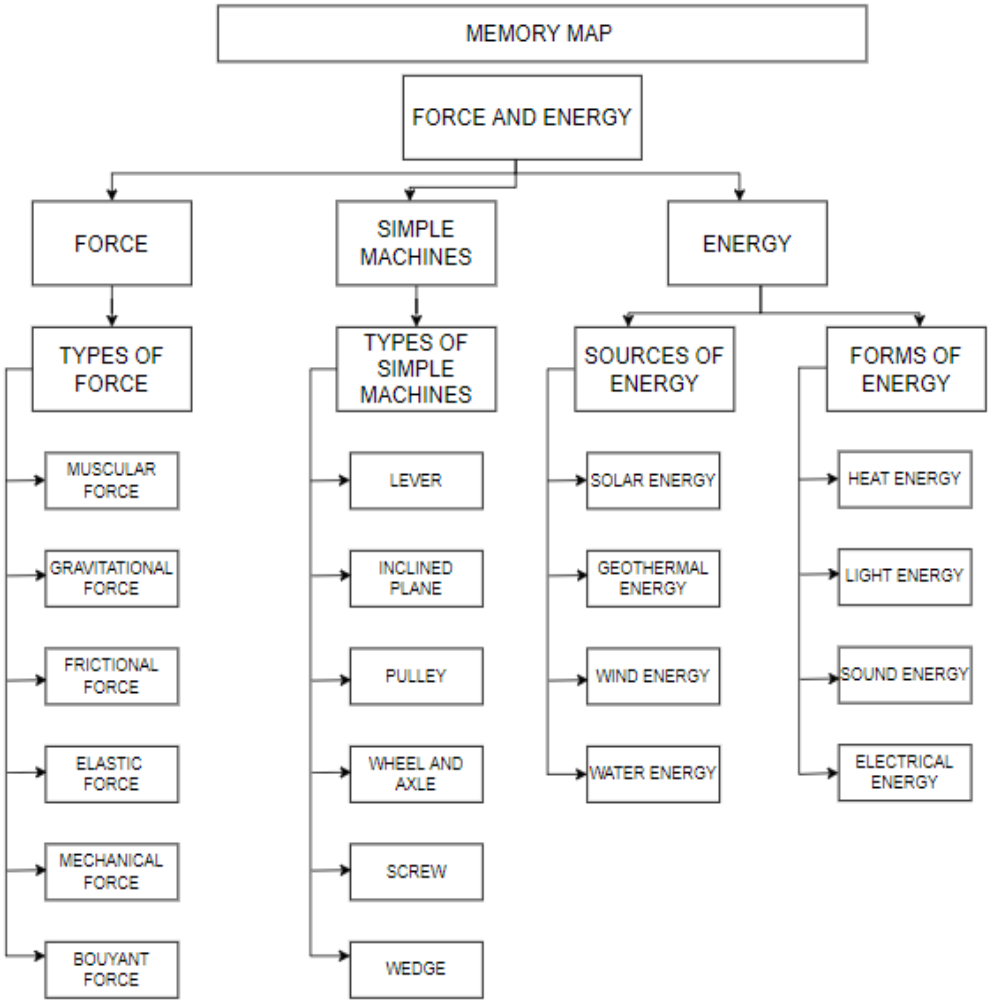
- **Light energy:**
  - Light is also a form of energy.
  - We naturally get light energy from the sun.
  - Artificial sources of light energy are bulbs, tube lights, burning candle, etc.

- **Sound energy:**
  - Sound is a form of energy.
  - It is produced by the vibration of an object.
  - Some sources of sound energy are music system, musical instruments, radio, etc.

- **Electrical energy:**
  - Electrical energy is the movement of electrical charges.
  - electrical charges moving through a wire is called electricity.
  - Electricity helps in working of many appliances-like computers, washing machines, television, bulbs, fans, etc.

Law of conservation of energy:

- Energy can neither be created nor destroyed.
- Energy just changes from one form to another.
- The total energy of an object never decreases or increases.



Let's Know More

I. Choose the correct answer.

1. When the fulcrum is in between the load and the effort it is a first-class/ second-class/ third-class lever.
2. A pulley/ screw/ lever is a small wheel with a groove around its outer edge.
3. A pulley does not reduce the effort. It changes the direction/ magnitude of applied force.

Let's Do

A. Tick the correct answer.

1. We are able to stay on the ground because of
    a. gravitational force
    b. elastic force
    c. buoyant force

d. frictional force

2. A screw jack used to lift a car is a
   a. first class lever
   b. pulley
   c. second class lever
   d. screw
3. The most readily available source of energy is
   a. wind energy
   b. solar energy
   c. geothermal energy
   d. water energy
4. The upward push of water on a floating object is called
   a. buoyant force
   b. volume
   c. density
   d. pressure

B. Fill in the blanks.

1. Most simple machines make use of _____ force.
2. There is no _____ force in space.
3. Simple machines change the _____ of applied force.
4. A moving car possesses mechanical energy due to its _____.
5. An inclined plane is a _____ which makes work easier.

C. Change the underlined words to correct these statements.

1. A stretched rubber band regains its original position on being released because of gravitational force.
2. Geothermal energy is a non-renewable source of energy.
3. The pulley used for drawing water from a well is a movable pulley.
4. Simple machines make our work complicated.
5. We are able to walk because of elastic force.

Understand and Answer

D. Write short answers.

1. Name the different types of forces.
2. What are simple machines?
3. Why is geothermal energy referred to as a renewable source of energy?
4. From where does most of the heat energy come?
5. Name four different forms of energy.

E. Answer these questions.

1. What is a lever? On what basis are levers classified?
2. What is an inclined plane? How is it useful for us?
3. Does a screw join two pieces of wood better than a nail? How?

4. What does the law of conservation of energy state?
5. How is wind energy more environment friendly than heat energy?

Teacher's Note

- The model of well where pulley is used.

Improve Your GK

- Sir Isaac Newton was the first the scientists to study gravity and force.

Answer Key

I.

1. First-class lever
2. Pulley
3. Direction

A.

1. Gravitational force
2. Screw
3. solar energy
4. buoyant force

B.

1. Muscular
2. Gravitational
3. Direction
4. Motion
5. plane

C.

1. Elastic
2. Renewable
3. fixed
4. easier
5. frictional

D.

1. The different types of forces are:
    a. muscular force
    b. gravitational force
    c. frictional force
    d. elastic force
    e. mechanical force
    f. buoyant force

2. Tools that make our work easier, faster and with less force are called simple machines. They have only few simple parts.
3. Geothermal energy is referred to as a renewable source of energy because the heat is continuously produced inside the earth.
4. Most of the heat energy comes from the sun and from the burning of fuels like coal, kerosene and petrol.
5. The four different forms of energy are:
    a. heat energy
    b. light energy
    c. sound energy
    d. electrical energy

E.

1. A lever is a rigid rod arranged in such a manner that it can move freely around a fixed point.

   Levers can be classified on the basis of the position of the fulcrum, the load and the effort.

- When the fulcrum is in between the load and the effort, it is a first-class lever.
- When the load is in between the fulcrum and the effort, it is called a second-class lever.
- When the effort is in between the fulcrum and the load, it is a third-class lever.

2. An inclined plane is a slope which makes work easier.

   It is useful to us in the following ways:

- Workers can easily load or unload on a truck using a plank of wood.
- In hospitals and some other buildings inclined planes called ramps are provided next to stairs which helps them in pushing up wheelchairs.

3. When we join things together with the screw they are held together through a longer distance and thus cannot be forced apart easily.

   On the other hand, when we join things with the nail they are held together only for a short distance, that is through the length of the nail. That is why a screw is better than a nail.

4. The law of conservation of energy states that energy can neither be created nor destroyed. It can change from one form to another.
5. Wind energy is plentiful and renewable, widely distributed, clean and nonpolluting. Therefore, it is considered to be more environment friendly than heat energy.