

SECOND TERM SYLLABUS

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DATE: 27. AUGUST.2020 to 3. Sep.2020

DAY: THURSDAY to Thursday

UNIT: 23 # TURNING EFFECT OF FORCES

23.2 The Moment of a Force

What does the moment of a force depend on? Try loosening a nut with a spanner. Is the turning effect of the handle greater when you hold the spanner in the middle or at the end larger or a smaller force?

You will find that the turning effect depends on where you hold the spanner and the force applied. In other words, the turning effect or moment of a force depends on

- the **perpendicular distance**, d , from the line of action of the force to the pivot,
- the **force** applied, F .

To increase the moment of a force, we can increase the perpendicular distance from the line of action of the force to the pivot or the size of the applied force or both. Hence, it is easier to loosen the nut if you hold the spanner at the end of the handle and if you apply a larger force because the turning effect is larger.

The line of action of a force is the line along which the force acts. In Fig. 23.2a, the man finds it easier to close the heavy door in the position shown than that shown in Fig. 23.2b. This is because the perpendicular distance, d , from the pivot to the line of action of the force is bigger in Fig. 23.2a, hence the turning effect of the force is bigger.

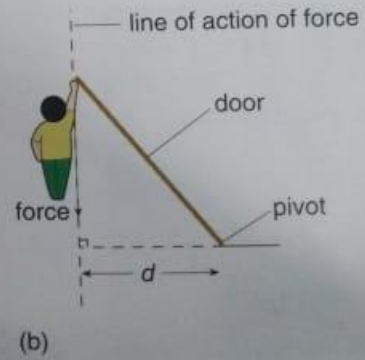
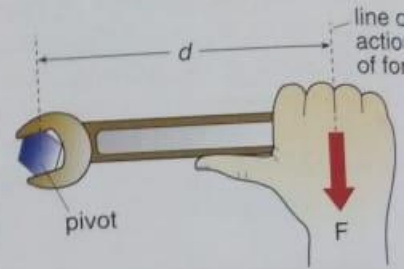
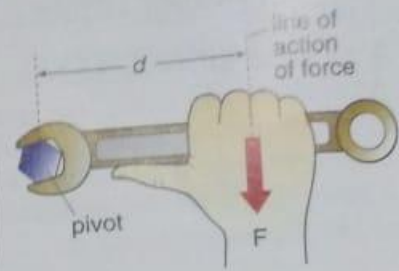
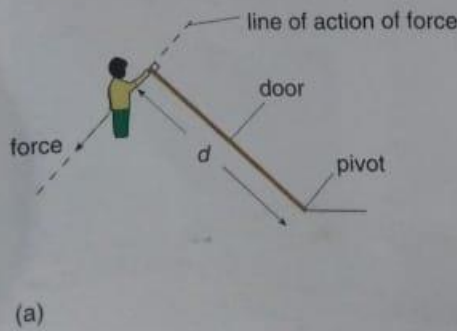


Fig. 23.2 The perpendicular distance from the line of action of a force affects the moment of the force.

23.1 Turning Effect of Forces

In Chapter 21, we learnt about the effects of forces. Forces can change the shape, size, speed and direction of objects. In this chapter, we shall learn about another effect of forces. Forces can make things turn. When we open a door, turn on a tap or steer a car, we are making use of the turning effect of forces.

The photographs in Fig. 23.1 show some situations that involve the turning effect of forces. When a force is applied on an object, it can turn the object about a certain point known as the **pivot** or the **fulcrum**. This turning effect of a force is called the **moment of a force** or **torque**. Study each situation shown in Fig. 23.1. Indicate the location of the pivot, the direction of the applied force and describe the turning effect of the force produced.



(a)



(b)



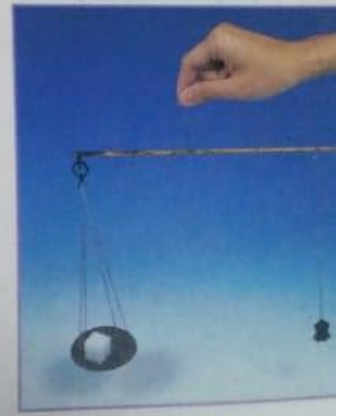
(c)



(d)



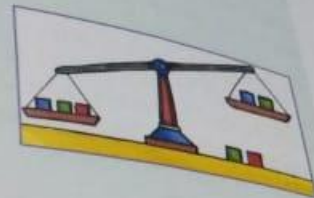
(e)



(f)

Fig. 23.1 Turning effect of forces in use

? Do You Know?



Based on what is given in each diagram, state the possible ways to balance the

- (a) see-saw, (b) beam balance.

Which quantity has been altered in each case?

13.3 Simple Machines

Name five machines in our everyday life. Does your list of machines include a spanner, a can opener or a pair of scissors? Common tools are normally not considered as machines by people. However, in science, a **machine** is any device which helps to make work easier for us. Tools such as a screwdriver, a pair of tongs and a pair of scissors are called **simple machines**.

Science Tidbits

There is no one machine which can do more work than the work you put in.



A screwdriver



A pair of tongs



A pair of scissors

Some machines make our work easier by changing the size or direction of a force. A small force is needed to lift a car using a jack, but its handle has to be moved a longer distance. Machines which can overcome a large force using a small force are called **force magnifiers**.

Other machines make our work easier by producing more movement than we put in. However, the output force is less than the input force. Step on a pedal bin. Observe and compare the movements of the pedal and the bin. Which one moves more? Machines which produce a bigger movement from a smaller movement are called **movement magnifiers** or **distance multipliers**. The fishing rod is an example of such a machine. What is its advantage?



23.4 Lever – A Simple Machine

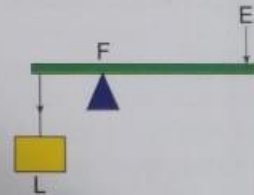
A **lever** is a simple machine which turns about a fixed point called the **fulcrum (F)** when a force called **effort (E)** is applied to overcome a resisting force known as the **load (L)**. Levers can be classified into first class lever, second class lever and third class lever based on the relative positions of the fulcrum, the effort and the load.

First Class Lever

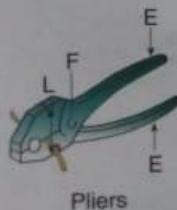
In a first class lever, the fulcrum is between the effort and the load.

Features:

1. It produces a large force from a small force ($L > E$).
2. The effort moves a longer distance than the load.
3. The fulcrum is further from the effort than the load to increase the turning effect of the effort.



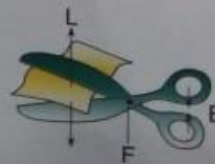
Examples



Pliers



Lid opener



Scissors



Claw hammer

Second Class Lever

In a second class lever, the load is between the fulcrum and the effort.

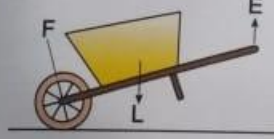
Features:

1. It produces a large force from a small force ($L > E$).
2. The fulcrum is further from the effort than the load to increase the turning effect of the effort.

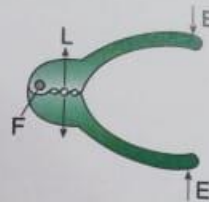
Examples



Bottle opener



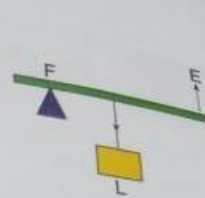
Wheelbarrow



Nutcracker



Paper cutter



Third Class Lever

In a third class lever, the effort is between the fulcrum and the load.

Features:

1. It produces a large movement from a small movement.
2. The effort moves a shorter distance, but the load moves a longer distance.
3. A large force is used to move a small load ($E > L$).

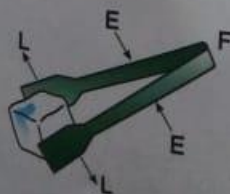
Examples



Claw hammer



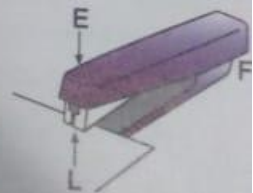
Broom



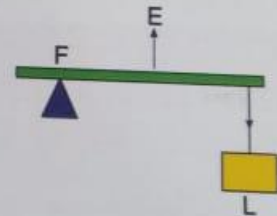
Tongs



Arm



Stapler



- Key Points**
1. The moment of a force (or torque) is the turning effect of a force.
 2. The moment of a force depends on the force applied and the perpendicular distance from the line of action of the force to the pivot.
 3. The turning effect of a force can be increased by increasing the magnitude of the force or the perpendicular distance from the line of action of the force to the pivot.
 4. A machine makes our work easier by either changing the size or direction of a force or by producing a larger movement from a smaller movement.
 5. A lever is a simple machine which turns about a fixed point, the fulcrum (F), when a force called effort (E) is applied to overcome a resisting force known as the load (L).
 6. There are three different types of levers as shown below.

Type of lever	Relative positions of F, E and L	Examples	Use
First class	F between L and E	Claw hammer, lid opener, pliers and scissors	To produce a large force from a small force
Second class	L between F and E	Wheelbarrow, bottle opener, paper cutter and nutcracker	To produce a large force from a small force
Third class	E between F and L	Fishing rod, arm, broom, ice tongs and stapler	To produce a large movement from a small movement

Review Questions

1. What does the turning effect of a force depend on?
2. What is meant by the moment of a force?
3. Give **three** examples of simple machines which make use of the turning effect of forces. State how the simple machine makes work easier in each case.

Review Exercise

ANSWER THE FOLLOWING QUESTIONS:

1. WHAT IS MEANT BY THE MOMENT OF A FORCE?

ANS: The Moment of a force is a measure of its tendency to cause a body to rotate about a specific point or axis. ... A moment is due to a force not having an equal and opposite force directly along its line of action.

2. What does the turning effect of a force depend on?

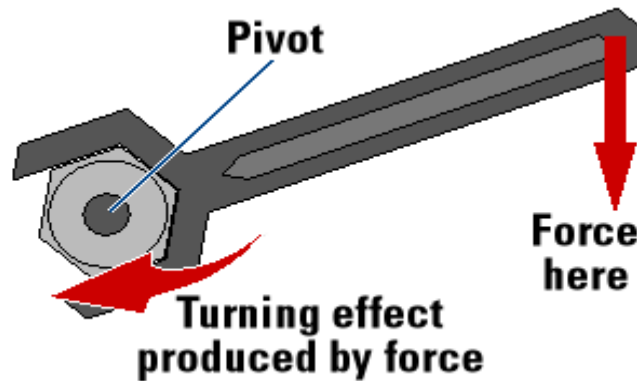
Ans: the moment of force depends on:

1. Force applied
2. Perpendicular distance from the line of action of the force to the pivot.

3. Give three examples of simple machines which make use of the turning effect of forces. State how the simple machine makes work easier in each case.

Examples of turning effect of force:

1. A person pushing a swing will make the swing rotate about its pivot.
2. A worker applies a force to a spanner to rotate a nut.
3. A person removes a bottle's cork by pushing down the bottle opener's lever.
4. A force is applied to a door knob and the door swings open about its hinge.
5. A driver can turn a steering wheel by applying a force on its rim.

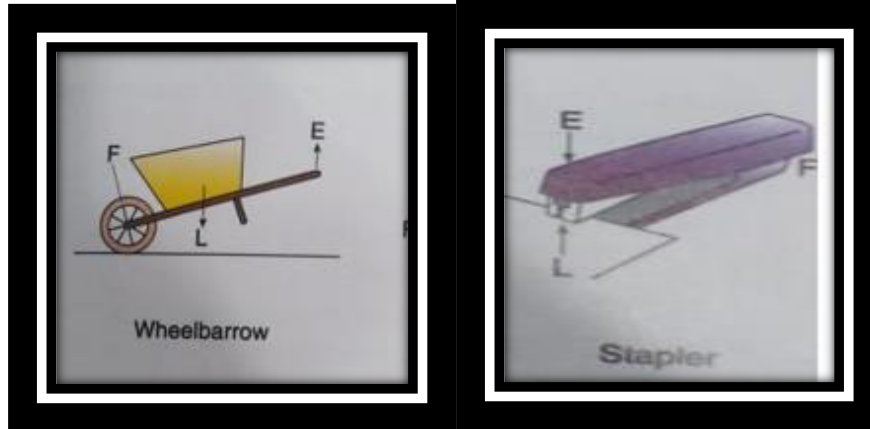


4. (a) What is a lever?
(b) State the relative positions of the fulcrum (F), effort (E) and load (L) of the following levers.
(i) wheelbarrow
(ii) stapler
(iii) scissors

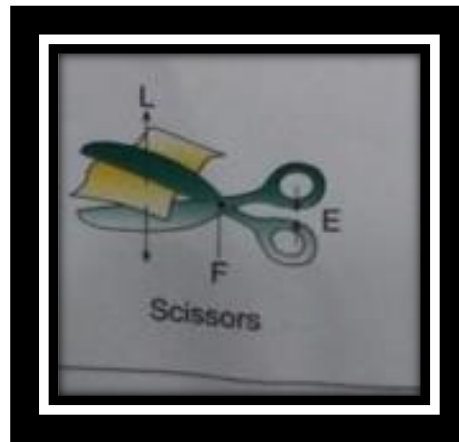
Ans: lever:

A lever is a simple machine which turns about a fixed point called the fulcrum (F) when a force called effort (E) is applied to overcome a resisting force known as the load (L).

b) Relative positions of the following lever are given below:



b)



Additional Questions

1. Define the following term:

a. Simple machine b. force magnifier c. movement magnifier

Ans: Simple Machine:

Simple machine is a device which helps to make work easier, faster and convenient for us. E.g. screwdriver, a pair of tongs, pair of scissors.

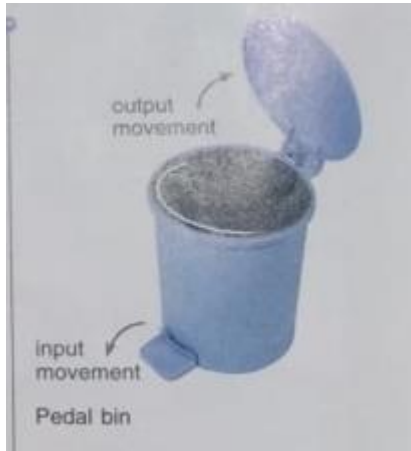
Force magnifier:

Machines which can overcome a large force using a small force are called force magnifiers.

Movement magnifier:

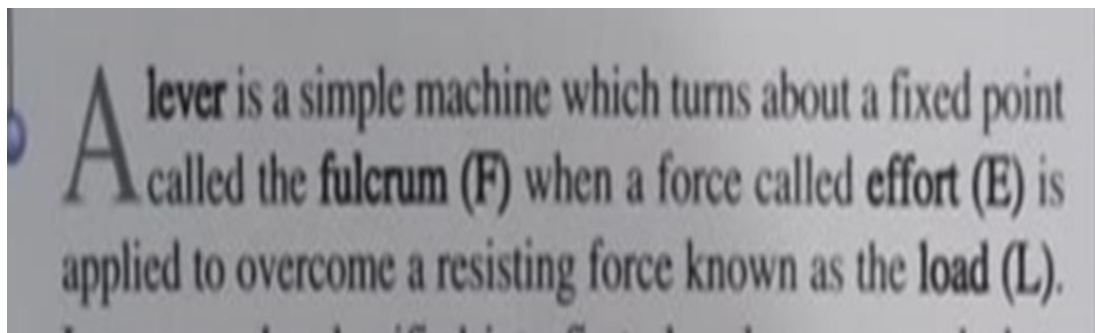
Machines which produce a bigger movement from a smaller movement are called movement magnifier or distance multipliers.

e.g. pedal bin



2. Define lever. Explain its types.

Ans: **lever:**



Types of lever:

There are three types or classes of levers, according to where the load and effort are located with respect to the fulcrum.

First kind of lever:

In first kind of lever the fulcrum is placed between the effort and load.

For example: claw hammer, scissors, lid opener

Second kind of lever:

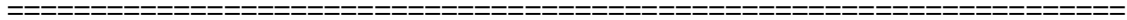
In second kind of lever the load in-between the effort and the fulcrum.

For example: wheel barrow . nut cracker and bottle opener

Third Kind of lever:

In third kind of lever the effort between the load and the fulcrum.

For example: arm, broom and stapler



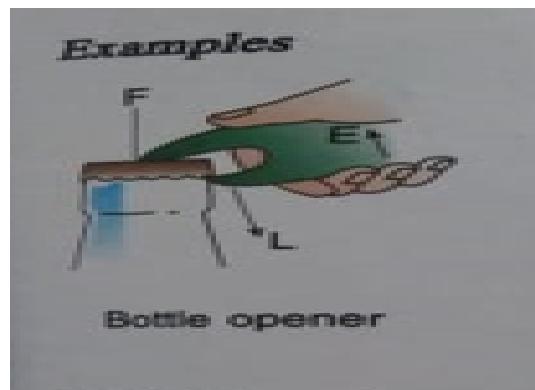
SOLVED WORKSHEET

Qno1: fill it

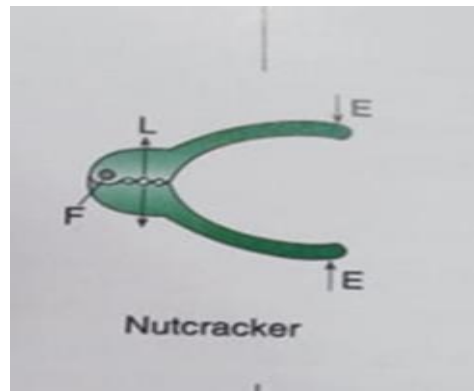
<u>Type of lever</u>	<u>Relative positions of F, E and L</u>	<u>Examples</u>	<u>Use</u>
<u>First class</u>	F between L and E.	Lid opener, plier and scissors.	It produces a large force from a small force.
Second class	<u>L between F and E</u>	Wheel barrow , bottle opener , nut cracker	It produces a large force from a small force.
<u>Third Class</u>	E between F and L	Arm, tongs and stapler.	It produces a <u>large movement</u> from a small <u>movement</u> .

Qno2: show the relative positions of FULCRUM, LOAD and EFFORT.

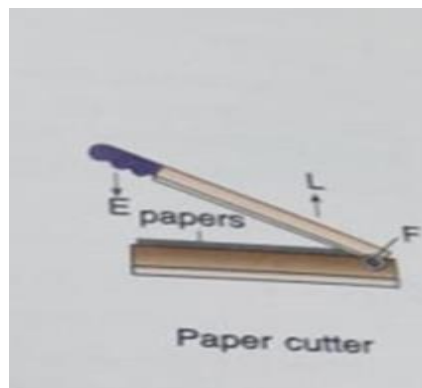
1. Bottle opener



2. Nut cracker



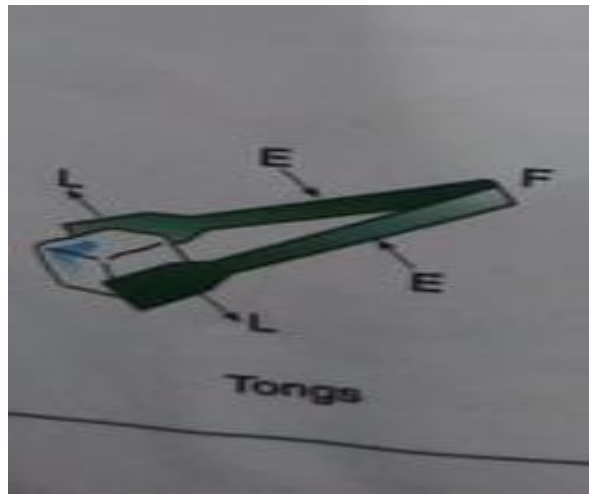
3. Paper cutter



4. Broom



5. Tongs



6. Arms

