

CLASS – 6 PHYSICS CHAPTER – 4 SIMPLE MACHINES

Test Your Understanding [Page No. 75]

1. Which of these is not a simple machine?

Answer : (c) Sewing machine

2. Which of these is essential in all levers?

Answer : (d) All of these

3. Which of the following simple machine helps us by changing the direction of force?

Answer : (b) Single fixed pulley

4. Which of the following is true for a winding road going up a hill?

Answer : (b) It is a simple machine and works like an inclined plane

5. A crew is very similar in function to a :

Answer : (c) inclined plane

6. Which of these machines decreases force?

Answer : (d) Screw

EXERCISES

A. Choose the correct option :

1. Which of the following is not a lever?

Answer : (b) An axe

2. Wedge is a modification of an inclined plane because it is made by.....

Answer : (a) Joining two inclined planes

3. Which of the following two variables determines the mechanical advantage of a simple machine?

Answer : (b) Force, distance

4. The doorknob of the house is an example of.....

Answer : (d) Wheel and axle arrangement

5. A wheelbarrow is an example of.....

Answer : (b) Class 2 lever

6. We can lift heavy loads by changing the direction of force applied, by using a/an.....

Answer : (b) pulley

7. Which of the following is not considered a simple machine?

Answer : (d) Sewing machine

Name the type of simple machines being used in the following cases.

1. A crane used to lift heavy loads.

Answer : Pulley

2. A bus going on a winding hill road.

Answer : Inclined plane

3. Cutting paper with a pair of scissors.

Answer : Class – 1 Lever

4. Picking up diamond using tweezers.

Answer : Class – 3 Lever

5. A screw jack being used to lift cars for replacing a punctured tyre.

Answer : Lever

C. Write T for True and F for False statements.

1. All simple machines increase force.

Answer : False

2. In a machine, force is increased if the effort moves a larger distance than the load.

Answer : True

3. A single fixed pulley does not increase or decrease force.

Answer : True

4. A bicycle is a simple machine.

Answer : True

5. A wheel is a simple machine.

Answer : False

6. The point at which a lever is supported is called a fulcrum.

Answer : True

7. A pair of tongs is an example of class 2 lever.

Answer : False

8. It is easier to roll a heavy iron drum on an inclined plane than carrying it up directly.

Answer : True

9. Regular oiling and polishing decreases the life of a machine.

Answer : False

D. Match the simple machine with its correct definition.

Simple Machine	Definition
1. Wheel and Axle	a. A ramp
2. Wedge	b. Something that uses a rope and can change the direction of a force.
3. Inclined Plane	c. Something similar to a see-saw that can lift an object.
4. Screw	d. Something that can hold things together or lift an object.
5. Lever	e. Something that reduces the friction of moving something
6. Pulley	f. Something that can split an object apart

Answer : 1 – (e), 2 – (f), 3 – (a), 4 – (d), 5 – (c), 6 – (b)

E. Give one word for the following :

1. A grooved wheel with a rope around it.

Answer : Pulley

2. An inclined plane wrapped around a pole.

Answer : Screw

3. A stiff bar that moves freely about a fixed point.

Answer : Lever

4. A wheel with a rod passing through its centre.

Answer : Wheel and axle arrangement

5. An object with its one slanting side ending as a sharp edge.

Answer : Wedge

F. Answer the following questions in short.

1. What is the difference between a simple and a complex machine?

Answer : **Simple Machine** : Any of various devices that function in a manner basic to any machine, such as a lever, pulley, wedge, screw, or inclined plane.

Complex Machine : A device consisting of two or more simple machines working together.

2. Name the main types of simple machines.

Answer : Lever, Pulley, Wedge, Wheel and axle, Screw, Inclined plane.

3. What is a wheel and axle arrangement?

Answer : A wheel and axle is a simple machine consisting of a wheel attached to a rod (axle).

4. Roads on hills are made to have very gentle slopes. Why?

Answer : The roads on hills are gently sloping in order to reduce the effect of steepness which causes more downward gravitational pull on the vehicle. A steeper sloped road would slow the car down to a greater extent than a gently sloping one.

5. List two ways in which a screw is more useful than a nail.

Answer : (i) It takes less force to insert a screw in wood than a nail. Therefore, a screw increases force.

(ii) Also, because of the thread, it holds the wood more firmly than a nail.

6. How does a screw jack work?

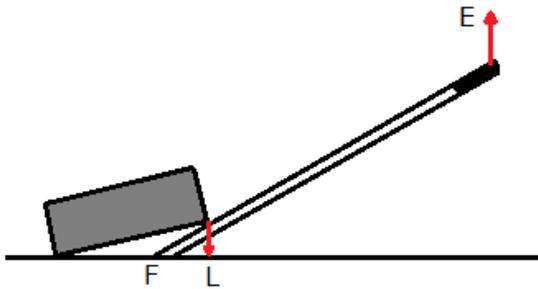
Answer : The screw jack that is used to lift a car for changing wheel works on the principle of a screw. When you turn the handle, the screw of the jack turns around and lifts the heavy car. The screw jack therefore increases the force applied on the handle. However, the handle on which the force is applied, moves a much larger distance than the car.

7. A single fixed pulley does not increase or decrease force. How then is it useful as a simple machine?

Answer : A single fixed pulley does not increase or decrease force. It simply changes its direction. It is difficult to pull a bucket of water from a well. A pulley makes it easier by changing the direction in which the force is applied.

8. In your exercise book, draw an illustration of a lever that reduces force. Mark the position of the load, flucrum and effort on it.

Answer :



9. How simple machines reduce effort?

Answer : Simple machines make work easier by multiplying, reducing, or changing the direction of a force. The scientific formula for work is $w = f \times d$, or, work is equal to force multiplied by distance. Simple machines cannot change the amount of work done, but they can reduce the effort force that is required to do the work.

10. What is mechanical advantage?

Answer : It is the ratio of the load to the effort. It is represented as M.A.
Therefore, $M.A. = \text{Load}/\text{Effort}$

G. Answer the following questions in detail.

1. With the help of a screw jack, even a small child can raise a heavy car. What makes this possible?

Answer : A jackscrew, or screw jack, is a type of jack that is operated by turning a leadscrew. It is commonly used to lift moderately heavy weights, such as vehicles; to raise and lower the horizontal stabilizers of aircraft; and as adjustable supports for heavy loads, such as the foundations of houses.

2. Archimedes, the ancient Greek inventor, once said, "Give me a lever long enough, and

I can move the earth." Do you think this can be done?

Answer : No, this is not possible. But, according to the statement given by Archimedes, he says that, we can move anything with the help of a lever because lever increases the force applied by us.

3. A wheel is not a simple machine in itself because it cannot decrease or increase force or change its direction. What is done to convert it into a simple machine?

Answer : A wheel alone is not a machine. It becomes a simple machine when attached to a rod called an axle. A wheel with a rod attached to it is known as wheel and axle arrangement. It is used in all vehicles and many other machines.

A trolley bag is a common example of this type of simple machine.

4. Discuss about mechanical advantage for a second and third class lever. Justify the statement, "Lever of class 2 are force multiplier; whereas, class 3 is a distance multiplier."

Answer : Second class levers have a positive mechanical advantage whereas third class levers have a mechanical disadvantage, this is because you use more force than the force of the load you lift.

In case of Class-2 levers, the load is placed between the fulcrum and the effort. That's why class-2 levers are known as force multiplier whereas in case of Class-3 levers, the effort is applied between the fulcrum and the load. That's why they are known as distance multiplier.

H. Numerical-based questions :

1. The effort arm of a lever is 4 m long and the load arm is 8 m long. Find the effort required to lift a load of 20 N.

Answer : Effort arm = 4 m

Load arm = 8 m

Load = 20 N

We know that,

Load x Load arm = Effort x Effort arm

$20 \text{ N} \times 8 \text{ m} = \text{Effort} \times 4 \text{ m}$

Effort = $20 \times 8/4$

Effort = 40 N

2. An effort force of 20 N is used to lift a load of 60 N by a machine. Calculate the mechanical advantage of the machine.

Answer : Effort = 20 N

Load = 60 N

We know that,

M.A. = Load/Effort

M.A. = 60/20

M.A. = 3

3. The effort arm of a lever is 50 m and the load arm is 5 m. Calculate the effort force required to lift a load of 200 N.

Answer : Effort arm = 50 m

Load arm = 5 m

Load = 200 N

Effort force = ?

We know that,

Load x Load arm = Effort x Effort arm

200 N x 5 m = Effort x 50 m

Effort = 200 x 5/50

Effort = 20 N

4. A lever used to lift a heavy box has an effort arm of 4 meters and a load arm of 0.8 metres. What is the mechanical advantage of the lever?

Answer : Effort arm = 4 m

Load arm = 0.8 m

We know that,

M.A. = Effort arm length/Load arm length

M.A. = 4 m/0.8 m

M.A. = 5

5. A rake is held so that its input arm is 0.4 meters and its output arm is 1.0 metres. What is the mechanical advantage of the rake?

Answer : Input arm = 0.4 m

Output arm = 1.0 m

We know that

M.A. = Effort arm length/Load arm length

M.A. = 0.4/1.0

M.A. = 4

6. A child's toy rake is held so that its output arm is 0.75 meters. If the mechanical advantage is 0.33, what is the input arm length?

Answer : Output arm = 0.75 m

M.A. = 0.33

We know that

M.A. = Effort arm length/Load arm length

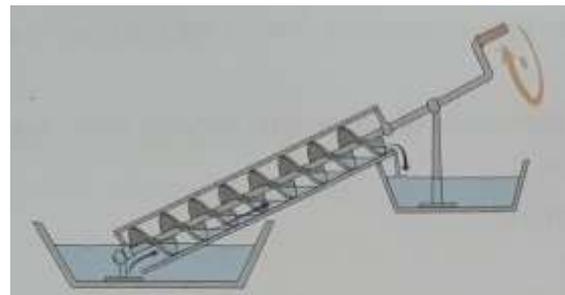
0.33 = Effort arm/0.75

Effort arm = 0.33 x 0.75

Effort arm = 0.24

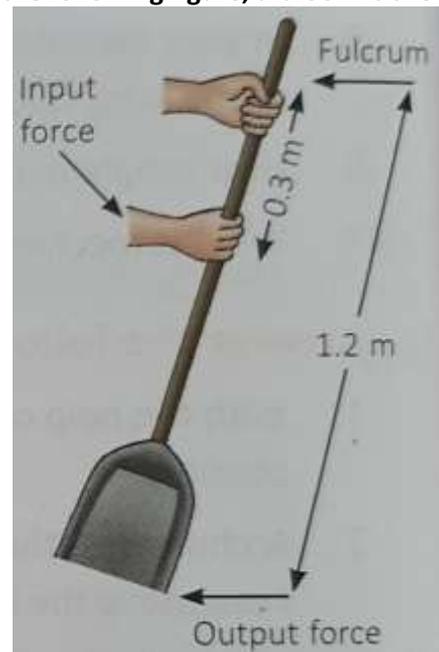
Picture-based Questions

1. Archimedes used the principle of the screw to make the machine shown, to draw water from a river. Find out the name given to this machine. Discuss about working of this machine.



Answer : The water screw, popularly known as the Archimedes' screw and also known as the screw pump. Archimedean screw, or Egyptian screw, is a machine used for transferring water from a low-lying body of water into irrigation ditches. Water is pumped by turning a screw-shaped surface inside a pipe. Archimedes screws are also used for materials such as powders and grains.

2. In the following figure, a broom is shown :



(a) Name the category of simple machine this object belongs to.

(b) Calculate mechanical advantage of this tool?

(c) Is the value calculated in part (b) is less than one? Discuss the importance of tool on the basis of result found in part (b).

Answer : (a) Class-1 lever

(b) Effort arm = 0.3 m

Load arm = 1.2 m

We know that

M.A. = Load/Effort

M.A. = 1.2/0.3

M.A. = 4

(c) No, the value is greater than one. This is because the tool belongs to Class-1 lever where load is greater than effort.

The importance of this tool is that it converts a downward moving force into a lifting force.

Application-based Questions

1. Look around and find as many simple machines as you can. When you find a simple machine, write it down in the correct category the table below. If you find a compound machine (one that combines more than one simple machine), record it in the compound machine row. (Find at least three in each category).

Simple Machine	Examples
Lever	Knife, Tweezers, Scissor
Pulley	Elevators, Cranes, Cargo lift system
Inclined Plane	Ladder, Sidewalk curb ramp, Slide
Wheel and axle	Screwdriver, Windmill, Pizza cutter
Wedge	Needle, Ice picks, Teeth
Screw	Bolt, Light bulb, Bottle caps
Compound Machine	Washing machine, Sewing machine, Grinder and mixer