

SIMPLE MACHINES

100 MCQs



For RRB / Railway Exams



Detailed Solutions



Relevant Concepts & Extra Points



Numerical & Conceptual Questions



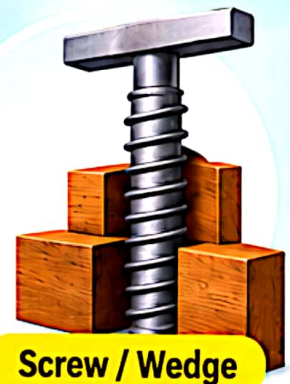
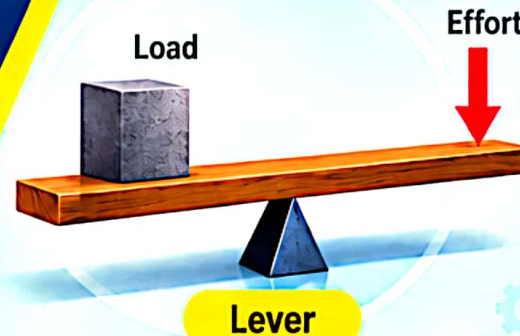
Exam-Oriented Approach



Covers All Important Topics



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1 What is a simple machine?

- A) A device that creates energy
- B) A device that makes a task easier by changing the magnitude or direction of force
- C) A device that always reduces work
- D) A device that works only with electricity

Correct Answer: B) A device that makes a task easier by changing the magnitude or direction of force

Concept

- A simple machine helps us to perform a task more easily by changing the magnitude or direction of the applied force.
- It does not create energy and does not reduce the total work done.

Explanation

- In daily life, we often need to lift or move heavy objects.
- Directly applying a large force may be difficult.
- Simple machines provide convenience by reducing the effort required or changing the direction in which the force is applied.
- Examples:** pulley, inclined plane, lever.

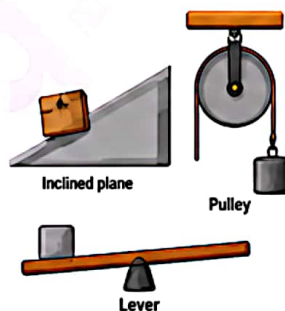
Key Points to Remember

- Simple machines can reduce the effort required.
- They can change the direction of force.
- They provide mechanical advantage.
- They do not create energy or reduce total work.

Why Option B is Correct?

- Option B correctly states the main purpose of a simple machine as given in the textbook.

Related Diagram / Examples



Textbook Point

The three simple machines discussed in this chapter are:

1. Pulley
2. Inclined plane
3. Lever

2 Which of the following is NOT one of the three simple machines discussed in the chapter?

- A) Pulley
- B) Inclined plane
- C) Lever
- D) Electric motor

Correct Answer: D) Electric motor

Concept

- The chapter discusses three simple machines: pulley, inclined plane and lever.
- An electric motor is a machine, but it is not one of the simple machines discussed here.

Key Point

- Only pulley, inclined plane and lever are discussed in this section.

Textbook Point

The three simple machines are:

1. Pulley
2. Inclined plane
3. Lever

Explanation

- Electric motor converts electrical energy into mechanical energy.
- It is not a simple machine like a pulley, inclined plane or lever.

Why Option D is Correct?

- Electric motor is not one of the three simple machines discussed in the chapter.



3 The force applied by a person to operate a machine is called:

- A) Load
- B) Effort
- C) Resistance
- D) Pressure

Correct Answer: B) Effort

Concept

- The force applied by a person to operate a machine is called effort.
- The force to be overcome is called load.
- In symbols: Effort = E, Load = L.

Explanation

- When using a simple machine (e.g., a pulley), the force applied by a person is effort.
- The object being moved or lifted exerts a load, which is the force to be overcome.

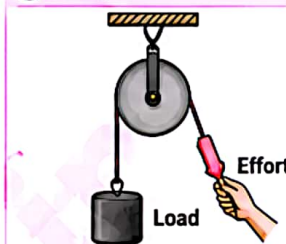
Key Points

- Effort → applied force (usually denoted by E)
- Load → force to be overcome (usually denoted by L)

Textbook Point

- The force that we apply to operate a machine is called the effort and the force that needs to be overcome is called the load.

Example



4 The mechanical advantage of a machine is defined as:

- A) Effort/Load
- B) Load/Effort
- C) Load × Effort
- D) Load + Effort

Correct Answer: B) Load/Effort

Concept

- Mechanical advantage (MA) tells us how many times the machine increases the applied force.
- It is defined as the ratio of load to effort.

Formula

$$\text{Mechanical Advantage (MA)} = \frac{\text{Load}}{\text{Effort}}$$

$$MA = \frac{L}{E}$$

Example Calculation

If Load = 400 N and Effort = 100 N,

$$MA = \frac{400}{100} = 4$$

Key Points

- If $MA > 1$ → machine provides force advantage.
- If $MA = 1$ → no force advantage.
- If $MA < 1$ → no force multiplication (used for speed or convenience).
- MA is a ratio and has no unit.

Why Option B is Correct?

- According to the textbook, mechanical advantage is defined as the ratio of load to effort (Load/Effort).

Textbook Point

- Mechanical advantage is the ratio of the load to the effort.

5 A machine has a load of 500 N and an effort of 100 N. What is its mechanical advantage?

- A) 0.2
- B) 2
- C) 5
- D) 50

Correct Answer: C) 5

Solution

$$MA = \frac{\text{Load}}{\text{Effort}}$$

Load = 500 N, Effort = 100 N

$$MA = \frac{500}{100} = 5$$

Explanation

- The mechanical advantage is 5, which means the machine allows a 5 times larger load to be overcome with the applied effort.

Key Point

- If $MA > 1$, the machine provides force advantage.



6 A pulley is essentially:

- A) A rigid bar B) A wheel with a groove C) A sloping surface D) A spring

✓ **Correct Answer:** B) A wheel with a groove

Concept

- A pulley is a wheel with a groove around its rim, over which a rope or string passes.
- It helps in changing the direction of force and may also provide mechanical advantage.

Explanation

- The grooved wheel allows the rope to move without slipping and transfer the applied effort to the load.

Key Points

- Parts: grooved wheel, rope, load, effort, support

Pulley



7 What is the main advantage of a fixed pulley?

- A) It always doubles the effort B) It changes the direction of effort
C) It removes gravity D) It creates energy

✓ **Correct Answer:** B) It changes the direction of effort

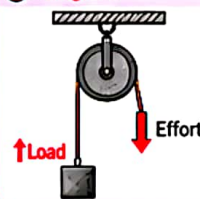
Concept

- A fixed pulley is attached to a support. It changes the direction of the applied force but does not reduce its magnitude.

Key Point

- In an ideal fixed pulley, mechanical advantage (MA) = 1

Diagram



8 What is the mechanical advantage of an ideal fixed pulley?

- A) 0.5 B) 1 C) 2 D) 4

✓ **Correct Answer:** B) 1

Working

- In an ideal fixed pulley, Load = Effort
MA = Load/Effort = 1

Explanation

- A fixed pulley does not reduce the effort; it only changes the direction of force.

Textbook Point

- Fixed pulley provides convenience, not force multiplication.

9 A fixed pulley is used to lift a 300 N load under ideal conditions. What effort is required?

- A) 100 N B) 150 N C) 300 N D) 600 N

✓ **Correct Answer:** C) 300 N

Solution

- For a fixed pulley, MA = 1
MA = Load/Effort
1 = 300/Effort
Effort = 300 N

Explanation

Effort is equal to load in an ideal fixed pulley.

Key Point

- A fixed pulley helps in pulling downward to lift the load upward.

10 Which type of pulley arrangement can have a mechanical advantage greater than 1?

- A) Fixed pulley only B) Movable pulley or system of pulleys
C) A wheel without a rope D) None

✓ **Correct Answer:** B) Movable pulley or system of pulleys

Concept

- A movable pulley or a system of pulleys can provide MA > 1, allowing a heavier load to be lifted with a smaller effort.

Example

Used in cranes, elevators and lifting arrangements.

Key Point

- Fixed pulley: MA = 1
Movable pulley/system: MA > 1



11 What is an inclined plane?

- A) A grooved wheel B) A rigid bar rotating around a point
C) A sloping surface used to move a load to a different height D) A rotating shaft

✓ **Correct Answer:** C) A sloping surface used to move a load to a different height

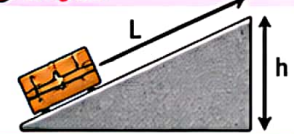
Concept

- An inclined plane is a sloping surface used to raise or lower a load to a different height with a smaller force.
- Examples:** ramps, sloping roads, inclined ladders.

Key Point

- It reduces the required force by increasing the distance over which the force acts.

Diagram



12 The mechanical advantage of an ideal inclined plane is:

- A) h/L B) L/h C) L + h D) L - h

✓ **Correct Answer:** B) L/h

Derivation

- Work done by effort = $F' \times L$
Gain in potential energy = mgh
 $F' \times L = mgh$
 $mg/F' = L/h$
MA = Load/Effort = $\frac{L}{h}$

Formula

$$MA = \frac{L}{h}$$

(L = length of inclined plane
h = vertical height)

Key Point

- A longer inclined plane provides greater mechanical advantage.

13 An inclined plane is 5 m long and 1 m high. What is its ideal mechanical advantage?

- A) 0.2 B) 4 C) 5 D) 6

✓ **Correct Answer:** C) 5

Solution

$$MA = \frac{L}{h} = \frac{5}{1} = 5$$

Explanation

- The inclined plane allows the same height to be reached with a 5 times smaller effort (in ideal case).

Key Point

- Increasing the length (L) increases MA and reduces the effort.

14 A ramp is 50 cm long and raises an object through a height of 30 cm. What is its mechanical advantage?

- A) 0.6 B) 1.67 C) 2.5 D) 3

✓ **Correct Answer:** B) 1.67

Solution

$$MA = \frac{L}{h} = \frac{50}{30} = 1.67$$

Explanation

- A longer ramp requires less force for the same height.

Related Point

- If the length of the inclined plane is increased while height remains the same, the effort required decreases.

15 If the length of an inclined plane is increased while its height remains constant, what happens to the effort required?

- A) It increases B) It decreases C) It becomes zero D) It remains the same

✓ **Correct Answer:** B) It decreases

Concept

- MA = L/h
If L increases (h constant), MA increases, so the effort required decreases.

Key Point

- Less force → greater distance. This is a trade-off, not energy creation.

Exam Tip

- Longer ramp → smaller effort



16 A lever has a load arm of 20 cm and an effort arm of 80 cm. What is its mechanical advantage?

- A) 0.25 B) 1 C) 4 D) 5

✓ **Correct Answer: C) 4**

Solution

$$MA = \frac{\text{Effort arm}}{\text{Load arm}} = \frac{80}{20} = 4$$

Explanation

- For a lever in equilibrium,

$$MA = \frac{\text{length of effort arm}}{\text{length of load arm}}$$

Key Point

- A longer effort arm provides greater mechanical advantage.

17 Which class of lever has the effort between the fulcrum and the load?

- A) First class B) Second class C) Third class D) None of these

✓ **Correct Answer: C) Third class**

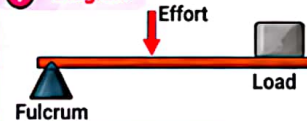
Concept

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

Example

- Examples: human arm, forceps, fishing rod.

Diagram



18 A second class lever always provides:

- A) No mechanical advantage B) Mechanical advantage less than 1
 C) Mechanical advantage greater than 1 D) Mechanical advantage equal to 1

✓ **Correct Answer: C) Mechanical advantage greater than 1**

Concept

- In a second class lever, the load is between the fulcrum and the effort, so the effort arm is always longer than the load arm.

Example

Examples: wheelbarrow, nutcracker, bottle opener.

Key Point

- Second class levers are used to lift heavy loads with a smaller effort.

Diagram



19 A third class lever always has:

- A) $MA > 1$ B) $MA = 1$ C) $MA < 1$ D) $MA = 0$

✓ **Correct Answer: C) $MA < 1$**

Explanation

- In a third class lever, the effort is between fulcrum and load, so effort arm is shorter than load arm. Hence, $MA < 1$.

Key Point

- Third class levers do not provide force advantage, but they provide speed and greater range of motion.

20 The velocity ratio (VR) of a simple machine is defined as:

- A) Load/Effort B) Effort/Load C) Distance moved by effort / Distance moved by load
 D) Work output / Work input

✓ **Correct Answer: C) Distance moved by effort / Distance moved by load**

Concept

$$\text{Velocity ratio (VR)} = \frac{\text{distance moved by effort}}{\text{distance moved by load}}$$

Key Point

- VR depends only on the geometry of the machine and not on friction.

Note

VR is always ≥ 1 for a machine that multiplies force.



21 The efficiency of a machine is given by:

- A) $MA \times 100$ B) $(MA/VR) \times 100$ C) $(VR/MA) \times 100$ D) $(\text{Load/Effort}) \times 100$

✓ **Correct Answer: B) $(MA/VR) \times 100$**

Formula

$$\text{Efficiency } (\eta) = \frac{MA}{VR} \times 100\%$$

Explanation

- Efficiency is the ratio of useful output to input, expressed in percentage.

Key Point

- η is always less than 100% due to friction.

22 A machine has a velocity ratio of 10 and an efficiency of 60%. What is its mechanical advantage?

- A) 4 B) 6 C) 8 D) 10

✓ **Correct Answer: B) 6**

Solution

$$\eta = \frac{MA}{VR} \times 100$$

$$60 = \frac{MA}{10} \times 100$$

$$MA = 6$$

Explanation

$$\text{Rearranging, } MA = \frac{\eta \times VR}{100}$$

$$= \frac{60 \times 10}{100} = 6$$

Key Point

- If efficiency is less than 100%, MA is always less than VR.

23 In an ideal machine (no friction), the efficiency is:

- A) 0% B) 50% C) 100% D) More than 100%

✓ **Correct Answer: C) 100%**

Concept

- In an ideal machine, there is no loss of energy due to friction, so output work equals input work.

Explanation

$$\eta = \frac{MA}{VR} \times 100$$

In an ideal machine, $MA = VR$
 $\therefore \eta = 100\%$

Key Point

- In practice, efficiency is always less than 100% due to friction.

24 A screw jack is an example of which simple machine?

- A) Lever B) Pulley C) Inclined plane D) Screw

✓ **Correct Answer: D) Screw**

Concept

- A screw is an inclined plane wrapped around a cylinder. It converts rotational motion into linear motion and provides a large force advantage.

Example

Screw jack, screw press, bench vice.

Diagram



25 The mechanical advantage of a screw is equal to:

- A) Pitch / Circumference B) Circumference / Pitch C) Pitch $\times$ Circumference D) 1 / Pitch

✓ **Correct Answer: B) Circumference / Pitch**

Formula

$$MA = \frac{2\pi r}{p} \left(\times \frac{\text{Circumference}}{\text{Pitch}} \right)$$

Explanation

- A screw works like an inclined plane wrapped around a cylinder. A larger circumference or smaller pitch gives greater mechanical advantage.

Key Point

- Smaller pitch (closer threads) provides a larger mechanical advantage.



26 Which of the following is an example of a wedge?

- A) A wheelbarrow B) A knife C) A well pulley D) A steering wheel



Correct Answer: B) A knife



Concept

- A wedge is a simple machine with two inclined planes joined back to back. It is used to split, cut or hold objects by applying force over a smaller area.



Example

- Examples: knife, axe, chisel, nail, doorstep.



Key Point

- A wedge converts a small applied force into a large force to split or cut objects.



Knife (Wedge)

27 Which of the following is NOT a wedge?

- A) Axe B) Chisel C) Nail D) Spanner



Correct Answer: D) Spanner



Explanation

- A spanner (wrench) works on the principle of a lever, not a wedge.



Examples

- Wedge: axe, chisel, nail, knife.
Spanner: lever (rotational lever).



Key Point

- Wedge → two inclined planes. Spanner → lever.



Spanner (Lever)

28 What is the main use of a wedge?

- A) To lift heavy loads B) To split or cut objects
C) To change direction of motion D) To reduce friction



Correct Answer: B) To split or cut objects



Concept

- A wedge converts the applied force into a large separating force, which helps in splitting or cutting objects.



Example

- Examples: knife (cutting), axe (splitting wood), chisel (shaping).



Key Point

- Wedges are commonly used in cutting tools and fastening devices.



Axe (Wedge)

29 A wedge with a smaller angle between its faces requires:

- A) More force B) Less force C) Same force D) Infinite force



Correct Answer: B) Less force



Concept

- A smaller angle between the two inclined faces of a wedge increases its mechanical advantage.



Explanation

- As the angle decreases, the length of the inclined surface increases, so less force is required to achieve the same effect.



Key Point

- Sharp wedges are more effective in cutting or splitting with less effort.

30 Which of the following is an example of a screw?

- A) Bottle cap B) Knife C) Axe D) Pulley



Correct Answer: A) Bottle cap



Concept

A screw is an inclined plane wrapped around a cylinder. It converts rotational motion into linear motion.



Example

- Examples: bottle cap, screw jack, bench vice, bolts, light bulb base.



Key Point

- Screws are used for fastening or lifting objects.



Bottle cap (Screw)



31 The distance moved in one complete rotation of a screw is called its:

- A) Pitch B) Circumference C) Radius D) Thread angle



Correct Answer: A) Pitch



Concept

- Pitch of a screw is the distance moved forward by the screw in one complete rotation.



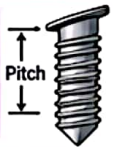
Explanation

It is equal to the distance between two successive threads.



Key Point

- Smaller pitch → larger mechanical advantage.



32 A screw jack is mainly used for:

- A) Splitting wood B) Cutting metal C) Lifting heavy loads D) Changing direction of force



Correct Answer: C) Lifting heavy loads



Concept

- A screw jack uses the principle of a screw to lift heavy loads by applying a small rotational force.



Example

- Used in cars, machines, and heavy equipment.



Key Point

Screw jack provides large mechanical advantage.



Screw Jack

33 Which factor increases the mechanical advantage of a screw?

- A) Larger pitch B) Smaller pitch C) Larger radius D) Larger load



Correct Answer: B) Smaller pitch



Formula

$$MA = \frac{2\pi R}{p} \quad (R = \text{radius}, p = \text{pitch})$$



Explanation

- If pitch (p) is smaller, the mechanical advantage increases.



Key Point

- Smaller pitch → greater MA.

34 A wheel and axle is a combination of:

- A) Two levers B) Two pulleys C) Two wheels of different sizes on the same axle
D) Two inclined planes



Correct Answer: C) Two wheels of different sizes on the same axle



Concept

- A wheel and axle consists of a large wheel and a small axle rigidly fixed together, which rotate together.



Example

Examples: door knob, steering wheel, hand drill.



Key Point

- It provides mechanical advantage by applying force at a larger radius.



Wheel and Axle

35 The mechanical advantage of a wheel and axle is equal to:

- A) $R + r$ B) $R \times r$ C) R / r D) r / R



Correct Answer: C) R / r



Formula

$$MA = \frac{R}{r} \quad R = \text{radius of wheel} \quad r = \text{radius of axle}$$



Explanation

- A larger wheel radius and a smaller axle radius provide greater mechanical advantage.



Key Point

- Used in steering wheels, hand drills, door knobs, etc.



- 36** A wheel of radius 30 cm is mounted on an axle of radius 10 cm. If an effort of 50 N is applied at the rim of the wheel, what load can be lifted?

A) 50 N B) 100 N C) 150 N D) 200 N

Correct Answer: C) 150 N

Solution

$$MA = \frac{R}{r} = \frac{30}{10} = 3$$

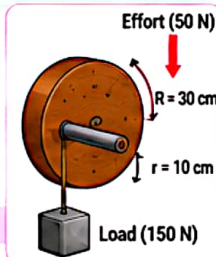
$$\text{Load} = MA \times \text{Effort} = 3 \times 50 = 150 \text{ N}$$

Explanation

- In a wheel and axle, mechanical advantage is the ratio of the radius of the wheel to the radius of the axle.

Key Point

- A larger wheel radius or smaller axle radius increases MA.



- 37** Which of the following is a real-life example of a wheel and axle?

A) Door knob B) Scissor C) Crowbar D) Nutcracker

Correct Answer: A) Door knob

Concept

- A wheel and axle consists of a large wheel and a small axle fixed together, and it helps to multiply force.

Example

- Door knob, steering wheel, screwdriver, hand drill.

Key Point

- Used for applying rotational motion with greater force.



Door knob

- 38** The mechanical advantage of a wheel and axle system is always:

A) Less than 1 B) Equal to 1 C) Greater than 1 D) Equal to the number of spokes

Correct Answer: C) Greater than 1

Concept

- In a practical wheel and axle, the radius of the wheel is greater than the radius of the axle, so $MA > 1$.

Formula

$$MA = \frac{R}{r}$$

(R = radius of wheel,
r = radius of axle)

Key Point

- It provides mechanical advantage by trading distance for force.

- 39** Which instrument works on the principle of a screw?

A) Door hinge B) Nail C) Bolt and nut D) Wheelbarrow

Correct Answer: C) Bolt and nut

Concept

- A screw is an inclined plane wrapped around a cylinder.

Explanation

- Bolts, screws and nuts use the principle of an inclined plane to convert rotational motion into linear motion.

Key Point

- Screws are used for fastening and lifting.



Bolt and nut

- 40** Which of the following has the greatest mechanical advantage?

A) An inclined plane of 1 m length and 0.5 m height B) An inclined plane of 2 m length and 0.5 m height
C) An inclined plane of 3 m length and 1 m height D) An inclined plane of 1 m length and 1 m height

Correct Answer: B) An inclined plane of 2 m length and 0.5 m height

Formula

$$MA = \frac{L}{h}$$

Explanation

- MA increases with increase in length (L) and decreases with increase in height (h).

Key Point

- A longer inclined plane provides greater mechanical advantage.



- 41** A screw of pitch 2 mm is used to raise a load. If the effort is applied through one complete rotation, how much distance does the load move?

A) 1 mm B) 2 mm C) 4 mm D) 8 mm

Correct Answer: B) 2 mm

Concept

- In one complete rotation, the screw moves a distance equal to its pitch.

Explanation

- Pitch is the distance between two successive threads. So, in one rotation, the load moves by 2 mm.

Key Point

- Smaller pitch → greater mechanical advantage.



- 42** Which of the following is NOT a characteristic of a screw?

A) It converts rotational motion into linear motion B) It can provide a large mechanical advantage
C) It is used for lifting heavy loads and fastening D) It is a simple machine with no moving parts

Correct Answer: D) It is a simple machine with no moving parts

Concept

- A screw has moving parts (threads) and works on the principle of an inclined plane.

Explanation

- It converts rotational motion into linear motion and can provide large MA.

Key Point

- Screws are widely used in jacks, vices, and fasteners.

- 43** A screw jack has a pitch of 5 mm. How many rotations are required to lift a load through 10 cm?

A) 5 B) 10 C) 20 D) 50

Correct Answer: C) 20

Solution

$$\begin{aligned} \text{Distance} &= 10 \text{ cm} = 100 \text{ mm} \\ \text{Pitch} &= 5 \text{ mm} \\ \text{Number of rotations} &= \frac{100}{5} = 20 \end{aligned}$$

Explanation

$$\text{Number of rotations} = \frac{\text{Distance to be moved}}{\text{Pitch}}$$

Key Point

- A smaller pitch requires more rotations but provides greater mechanical advantage.

- 44** What is the main advantage of a screw jack over a lever?

A) It requires less effort for heavy loads B) It can move the load through a larger distance
C) It is lighter and cheaper D) It has no friction

Correct Answer: A) It requires less effort for heavy loads

Concept

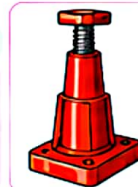
- A screw jack provides a very large mechanical advantage, so a small effort can lift a heavy load.

Example

- Used in lifting cars, heavy machinery, and for precision adjustment.

Key Point

- Screw jacks are used where a very high mechanical advantage is needed.



- 45** If the efficiency of a screw jack is 40%, it means:

A) 40% of the input energy is lost B) 40% of the input energy is converted into useful output
C) 60% of the input energy is lost D) 60% of the input energy is converted into useful output

Correct Answer: B) 40% of the input energy is converted into useful output

Concept

$$\text{Efficiency } (\eta) = \frac{\text{Useful output}}{\text{Input}} \times 100\%$$

Explanation

- If efficiency is 40%, then 40% of the input energy is converted into useful output and 60% is lost (due to friction).

Key Point

- Efficiency of simple machines is always less than 100% due to friction.



46 Which factor does NOT affect the mechanical advantage of a pulley system?

- A) Number of pulleys B) Arrangement of pulleys C) Weight of the load D) Friction in the pulleys

Correct Answer: C) Weight of the load

Concept

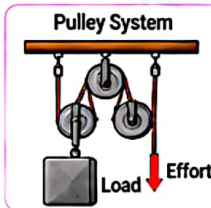
- In an ideal pulley system, MA depends on the number and arrangement of pulleys, not on the weight of the load.

Explanation

- The load only affects the effort required but does not change the mechanical advantage in an ideal case.

Key Point

- MA is determined by the geometry of the pulley system, not the magnitude of the load.



47 In a block and tackle system with 4 supporting ropes, what is the ideal mechanical advantage?

- A) 2 B) 4 C) 8 D) 16

Correct Answer: B) 4

Concept

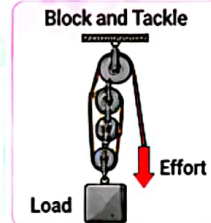
- In a block and tackle system, the ideal mechanical advantage is equal to the number of supporting ropes.

Explanation

- 4 supporting ropes mean 4 equal parts sharing the load, so MA = 4.

Formula

MA = Number of supporting ropes



48 What is the velocity ratio of a single movable pulley?

- A) 1 B) 2 C) 3 D) 4

Correct Answer: B) 2

Concept

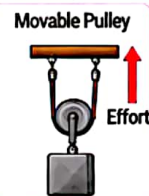
- In a single movable pulley, the load is supported by two segments of rope.

Explanation

- When the effort moves 2 units, the load moves 1 unit, so VR = 2.

Key Point

- A single movable pulley doubles the distance moved by the effort.



49 Which pulley provides a mechanical advantage greater than 1 but less than the number of supporting ropes in practical use?

- A) Fixed pulley B) Movable pulley C) Block and tackle D) Single pulley

Correct Answer: C) Block and tackle

Concept

- In practical cases, due to friction, the actual MA is less than the ideal MA (number of supporting ropes).

Explanation

- A block and tackle can provide MA > 1, but friction reduces its actual MA, making it less than the number of supporting ropes.

Key Point

- Actual MA < Ideal MA due to frictional losses.

50 A man uses an inclined plane of length 5 m and height 1 m to raise a load of 200 N. If friction is negligible, what effort is required?

- A) 20 N B) 40 N C) 100 N D) 200 N

Correct Answer: B) 40 N

Formula

$$MA = \frac{L}{h} \quad \text{Effort} = \frac{\text{Load}}{MA}$$

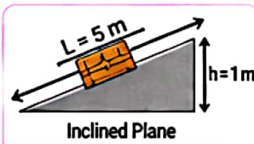
Solution

$$MA = \frac{5}{1} = 5$$

$$\text{Effort} = \frac{200}{5} = 40 \text{ N}$$

Key Point

- A longer inclined plane requires less effort to raise the same load.



51 If the efficiency of an inclined plane is 80%, what percentage of the input work is lost due to friction?

- A) 10% B) 20% C) 40% D) 80%

Correct Answer: B) 20%

Concept

- Efficiency (η) is the ratio of useful output work to input work, expressed in percentage.

Solution

- If efficiency = 80%, then loss due to friction = $100\% - 80\% = 20\%$.

Key Point

- Efficiency is always less than 100% in real machines due to frictional losses.

52 Which of the following increases the efficiency of a machine?

- A) Increasing friction B) Better lubrication C) Increasing load D) Making the machine heavier

Correct Answer: B) Better lubrication

Concept

- Efficiency increases when friction is reduced, usually by proper lubrication.

Explanation

- Lubrication reduces friction between moving parts, so less energy is lost and efficiency increases.

Key Point

- Less friction → higher efficiency.

53 Which simple machine changes the direction of force but does not provide a mechanical advantage?

- A) Fixed pulley B) Movable pulley C) Inclined plane D) Screw

Correct Answer: A) Fixed pulley

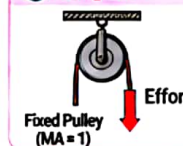
Concept

- A fixed pulley only changes the direction of the applied force and has MA = 1.

Explanation

- It does not reduce the magnitude of force, but makes it convenient to apply force in a different direction.

Diagram



Key Point

- Fixed pulley → changes direction of force only, MA = 1.

54 A load of 600 N is lifted by a system with a velocity ratio of 6 and efficiency of 75%. What is the effort required?

- A) 75 N B) 100 N C) 120 N D) 150 N

Correct Answer: C) 120 N

Formula

$$\text{Efficiency } (\eta) = \frac{MA}{VR} \times 100$$

$$\Rightarrow MA = \frac{\eta}{100} \times VR$$

Solution

$$MA = \frac{75}{100} \times 6 = 4.5$$

$$\text{Effort} = \frac{\text{Load}}{MA} = \frac{600}{4.5} = 120 \text{ N}$$

Key Point

- When efficiency is given, first calculate actual MA using $MA = (\eta/100) \times VR$.

55 Which of the following is a real-life example of a lever of second class?

- A) Scissors B) Nutcracker C) Tweezers D) Crowbar

Correct Answer: B) Nutcracker

Concept

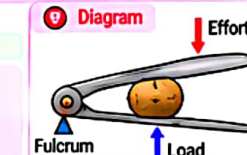
- In a second class lever, the load is between the fulcrum and the effort, providing MA > 1.

Example

- Nutcracker, wheelbarrow, bottle opener.

Key Point

- Second class lever → load is between fulcrum and effort.





- 56** A wheel and axle has a wheel radius of 40 cm and an axle radius of 10 cm. If an effort of 50 N is applied at the rim of the wheel, what load can be lifted?

A) 50 N B) 100 N C) 150 N D) 200 N

✓ **Correct Answer: D) 200 N**

⚙️ **Formula**

$$MA = \frac{R}{r}$$

$$\text{Load} = MA \times \text{Effort}$$

⚙️ **Solution**

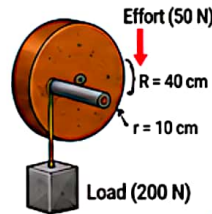
$$MA = \frac{40}{10} = 4$$

$$\text{Load} = 4 \times 50 = 200 \text{ N}$$

📌 **Key Point**

- In a wheel and axle, MA increases with increase in wheel radius or decrease in axle radius.

Wheel and Axle



- 57** Which of the following is the correct statement about an ideal simple machine?

A) Efficiency is less than 100% B) $MA < VR$ C) $MA = VR$ D) $MA > VR$

✓ **Correct Answer: C) $MA = VR$**

💡 **Concept**

- In an ideal simple machine (no friction), mechanical advantage is equal to velocity ratio.

⚙️ **Key Point**

- In real machines, MA is always less than VR due to frictional losses.

📌 **Example**

- Ideal pulley, ideal lever, ideal inclined plane etc. have $MA = VR$.

- 58** A fixed pulley is used. Which of the following remains unchanged?

A) Direction of force B) Magnitude of force C) Work done D) Mechanical advantage

✓ **Correct Answer: C) Work done**

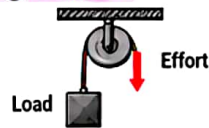
💡 **Concept**

- A fixed pulley only changes the direction of the applied force, not its magnitude. Work done remains the same (ignoring friction).

⚙️ **Key Point**

- Simple machines do not multiply work; they only change the magnitude or direction of force.

Diagram



- 59** What is the velocity ratio of a screw with pitch 5 mm and circumference of the handle 40 cm?

A) 10 B) 20 C) 40 D) 80

✓ **Correct Answer: B) 20**

⚙️ **Formula**

$$VR = \frac{\text{Distance moved by effort}}{\text{Distance moved by load}} = \frac{\text{Circumference of handle}}{\text{Pitch}}$$

⚙️ **Solution**

$$\begin{aligned} \text{Circumference} &= 40 \text{ cm} = 400 \text{ mm} \\ VR &= \frac{400}{5} = 20 \end{aligned}$$

📌 **Key Point**

- A larger handle or smaller pitch gives greater VR.

- 60** Which arrangement provides the greatest mechanical advantage?

A) Single fixed pulley B) Block and tackle with 4 supporting ropes
C) Single movable pulley D) Inclined plane

✓ **Correct Answer: C) Block and tackle with 4 supporting ropes**

💡 **Concept**

- MA of an ideal block and tackle system is equal to the number of supporting ropes.

⚙️ **Key Point**

- More supporting ropes → larger MA → greater mechanical advantage.

Diagram



- 61** A man pushes a box of 200 N up an inclined plane of length 5 m and height 1 m. If there is no friction, what is the required effort?

A) 20 N B) 40 N C) 100 N D) 200 N

✓ **Correct Answer: B) 40 N**

⚙️ **Formula**

$$MA = \frac{L}{h}$$

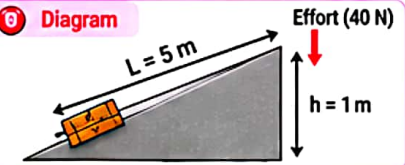
$$\text{Effort} = \frac{\text{Load}}{MA} = \frac{\text{Load} \times h}{L}$$

⚙️ **Solution**

$$MA = \frac{5}{1} = 5$$

$$\text{Effort} = \frac{200}{5} = 40 \text{ N}$$

Diagram



- 62** What is the main advantage of using an inclined plane over lifting a load vertically?

A) It changes the direction of force B) It reduces the effort C) It increases the speed D) It provides a larger load

✓ **Correct Answer: B) It reduces the effort**

💡 **Concept**

- An inclined plane allows the same load to be raised through a larger distance, so a smaller effort is required.

📌 **Key Point**

- The work done ideally remains the same, but less effort is needed.

📌 **Example**

- Ramps, sloping roads, and inclined planes are commonly used to reduce effort.

- 63** Which type of simple machine has an efficiency always less than 100% due to friction?

A) Ideal lever B) Real lever C) Ideal pulley D) Ideal inclined plane

✓ **Correct Answer: B) Real lever**

💡 **Concept**

- In real machines, some energy is lost due to friction, so efficiency is always less than 100%.

📌 **Key Point**

- Ideal machines (no friction) have 100% efficiency, but real machines always have less than 100%.

📌 **Example**

- Real levers, pulleys, inclined planes, screws etc. have efficiency < 100%.

- 64** A force of 300 N is used to lift a load of 900 N using a simple machine. What is the mechanical advantage?

A) 0.25 B) 0.33 C) 3 D) 9

✓ **Correct Answer: C) 3**

⚙️ **Formula**

$$MA = \frac{\text{Load}}{\text{Effort}}$$

⚙️ **Solution**

$$MA = \frac{900}{300} = 3$$

📌 **Key Point**

- Mechanical advantage shows how many times the effort is multiplied.

- 65** A block slides down an inclined plane with friction. Which statement is correct?

A) Friction increases the mechanical advantage B) Friction decreases the mechanical advantage
C) Friction does not affect the mechanical advantage D) Friction makes MA equal to VR

✓ **Correct Answer: B) Friction decreases the mechanical advantage**

💡 **Concept**

- Friction opposes the motion, so a larger effort is required, reducing the mechanical advantage.

📌 **Key Point**

- In the presence of friction, $MA < VR$.

Diagram





66 Which of the following changes the direction of force without providing any mechanical advantage?

- A) Fixed pulley B) Movable pulley C) Inclined plane D) Screw



Correct Answer: A) Fixed pulley



Concept

- A fixed pulley only changes the direction of the applied force. It has $MA = 1$.



Explanation

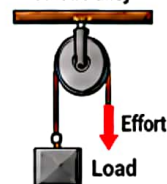
- In a fixed pulley, load and effort are equal, but the force is applied in a convenient direction.



Key Point

- Fixed pulley $\rightarrow$ changes direction only, no mechanical advantage.

Fixed Pulley



67 If the length of an inclined plane is doubled while the height remains the same, its mechanical advantage will:

- A) Become half B) Remain same C) Become double D) Become zero



Correct Answer: C) Become double



Formula

$$MA = \frac{L}{h}$$



Explanation

- If L is doubled (h constant), MA increases, so MA becomes double.



Key Point

- Mechanical advantage of an inclined plane is directly proportional to its length.

68 A load of 300 N is lifted using a lever with an effort of 50 N. What is the mechanical advantage?

- A) 3 B) 6 C) 10 D) 15



Correct Answer: B) 6



Formula

$$MA = \frac{\text{Load}}{\text{Effort}}$$



Solution

$$MA = \frac{300}{50} = 6$$



Key Point

- Mechanical advantage is the ratio of load to effort.

69 Which part of a lever remains fixed?

- A) Effort B) Load C) Fulcrum D) None of these



Correct Answer: C) Fulcrum



Concept

- The fulcrum is the fixed point about which the lever rotates.



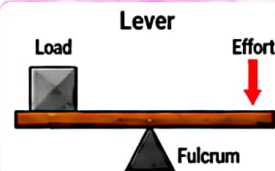
Explanation

- Effort and load act on either side of the fulcrum, which remains fixed.



Key Point

- Fulcrum is the point of support in a lever.



70 Which of the following is a characteristic of an ideal machine?

- A) Some energy is lost due to friction B) Output work is less than input work
C) Input work equals output work D) Efficiency is always less than 100%



Correct Answer: C) Input work equals output work



Concept

- In an ideal machine, there is no friction, so input work equals output work.



Explanation

- No energy is lost. Therefore, efficiency is 100% and input work = output work.



Key Point

- Ideal machine: Efficiency = 100%
Input work = Output work



71 A person uses a movable pulley to lift a load. If the effort applied is 100 N, what is the load lifted? (Assume an ideal pulley)

- A) 50 N B) 100 N C) 150 N D) 200 N



Correct Answer: D) 200 N



Concept

- A movable pulley provides $MA = 2$ (in an ideal case).



Formula

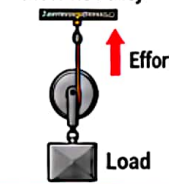
$$\text{Load} = MA \times \text{Effort} \\ = 2 \times 100 = 200 \text{ N}$$



Key Point

- In a single movable pulley, $MA = 2$, so load is twice the effort.

Movable Pulley



72 The velocity ratio (VR) of an inclined plane is 10 and its efficiency is 60%. What is the mechanical advantage?

- A) 4 B) 6 C) 10 D) 16



Correct Answer: B) 6



Formula

$$\eta = \frac{MA}{VR} \times 100 \\ MA = \left(\frac{\eta}{100} \right) \times VR \\ = \frac{60}{100} \times 10 = 6$$



Explanation

- Using efficiency and VR, we can find MA .



Key Point

- MA is always less than VR in real machines due to friction.

73 Which of the following is NOT a type of simple machine?

- A) Lever B) Pulley C) Gear D) Inclined plane



Correct Answer: C) Gear



Concept

- The six classical simple machines are: lever, pulley, inclined plane, wheel and axle, screw, and wedge.



Explanation

- A gear is a combination of wheels and axles and is not one of the six classical simple machines.



Key Point

- Gear is a derived or compound machine, not a simple machine.



Gear (Not a simple machine)

74 Which simple machine is commonly used to split wood?

- A) Screw B) Lever C) Wedge D) Pulley



Correct Answer: C) Wedge



Concept

- A wedge is a simple machine with two inclined planes used to split or cut objects.



Explanation

- It converts an applied force into a large separating force.



Key Point

- Examples: axe, knife, chisel, nail.



Wedge (Axe)

75 A screw is an example of an inclined plane wrapped around a:

- A) Cone B) Cylinder C) Sphere D) Prism



Correct Answer: B) Cylinder



Concept

- A screw is an inclined plane wrapped around a cylinder.



Explanation

- The inclined plane (thread) is wound around a cylindrical shaft.



Key Point

- Screws are used for fastening, lifting, and precision adjustment.



Screw



76 Which of the following is a real-life example of an inclined plane?

- A) Slide B) Door knob C) Steering wheel D) Screw

Correct Answer: A) Slide

Concept

- An inclined plane is a sloping surface used to raise or lower a load with less effort.

Explanation

- Slides, ramps, sloping roads and staircases are real-life examples of inclined planes.

Key Point

- An inclined plane provides mechanical advantage by increasing the distance over which the effort is applied.



77 What happens to the effort required to move a load up an inclined plane if the angle of inclination is increased?

- A) Increases B) Decreases C) Remains same D) Becomes zero

Correct Answer: A) Increases

Concept

- A steeper incline (larger angle) means a smaller mechanical advantage, so more effort is required.

Explanation

- As the angle increases, the length of the inclined plane decreases, thus MA decreases and effort increases.

Key Point

- Smaller angle → less effort. Larger angle → more effort.

78 A inclined plane of length 10 m and height 2 m is used to raise a load of 400 N. What is the ideal effort required (neglecting friction)?

- A) 20 N B) 40 N C) 80 N D) 200 N

Correct Answer: B) 40 N

Formula

$$MA = \frac{L}{h}$$

$$\text{Effort} = \frac{\text{Load}}{MA}$$

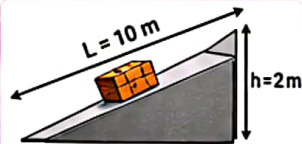
Solution

$$MA = \frac{10}{2} = 5$$

$$\text{Effort} = \frac{400}{5} = 80 \text{ N}$$

Key Point

- A longer inclined plane requires less effort.



79 Which of the following is an example of a compound machine?

- A) Lever B) Pulley C) Sewing machine D) Wedge

Correct Answer: C) Sewing machine

Concept

- A compound machine is made up of two or more simple machines working together.

Explanation

- A sewing machine uses a wheel and axle, lever, and gears together.

Key Point

- Compound machines combine simple machines to make work easier.



80 Which type of machine is more efficient in real life, ideal or actual?

- A) Ideal machine B) Actual machine C) Both are same D) Neither

Correct Answer: B) Actual machine

Concept

- Ideal machines have 100% efficiency (no friction), which is not possible in real life.

Explanation

- Actual machines always have some friction, so their efficiency is less than 100%, but they are used in real life.

Key Point

- Ideal machine → theoretical (100%). Actual machine → practical (< 100%).



81 Which of the following is NOT a commonly used simple machine in daily life?

- A) Lever B) Pulley C) Gear D) Flywheel

Correct Answer: D) Flywheel

Concept

- A flywheel is not considered a simple machine. It is a heavy wheel used to store rotational energy.

Explanation

- Simple machines include lever, pulley, wheel and axle, inclined plane, wedge and screw. A flywheel is not one of them.

Key Point

- Flywheel is a machine, but not a simple machine.



Flywheel
(Not a simple machine)

82 In a real machine, the output work is always:

- A) Equal to input work B) Greater than input work C) Less than input work D) None of these

Correct Answer: C) Less than input work

Concept

- Due to friction, some energy is lost, so the output work is always less than the input work in a real machine.

Explanation

- Output work = Input work – Energy lost (due to friction), so output work < input work.

Key Point

- In real machines, efficiency is less than 100%.

83 Which of the following increases the mechanical advantage of a pulley system?

- A) Decreasing the number of pulleys B) Increasing the number of pulleys C) Using thinner rope D) Using a heavier load

Correct Answer: B) Increasing the number of pulleys

Concept

- In a pulley system, the mechanical advantage is approximately equal to the number of supporting ropes.

Explanation

- More pulleys → more supporting ropes → greater MA → less effort required.

Key Point

- MA ∝ Number of supporting ropes.



84 Which of the following statements is correct for a screw?

- A) It converts circular motion into linear motion B) It increases speed C) It provides mechanical advantage D) It is used only to fasten objects

Correct Answer: C) It provides mechanical advantage

Concept

- A screw is an inclined plane wrapped around a cylinder and provides mechanical advantage by converting rotational motion into linear motion.

Explanation

- A screw makes it easier to lift or hold objects, and is widely used for fastening, lifting and precision adjustment.

Key Point

- Screw is also an inclined plane.



85 What is the main use of a wheel and axle?

- A) To split objects B) To increase rotational speed C) To reduce effort in moving a load D) To measure distance

Correct Answer: C) To reduce effort in moving a load

Concept

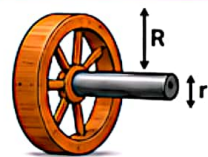
- A wheel and axle reduces the effort needed to lift or move a load by increasing the radius of the wheel relative to the axle.

Explanation

- A larger wheel radius provides greater mechanical advantage.

Key Point

- Wheel and axle $MA = \frac{R}{r}$





- 86** A ramp of length 4 m is used to raise a load to a height of 1 m. If the effort applied is 100 N and friction is negligible, what is the load lifted?

A) 100 N B) 200 N C) 300 N D) 400 N



Correct Answer: B) 200 N



Formula

$$MA = \frac{L}{h}$$

$$\text{Load} = MA \times \text{Effort}$$

$$MA = \frac{4}{1} = 4$$

$$\text{Load} = 4 \times 100 = 200 \text{ N}$$



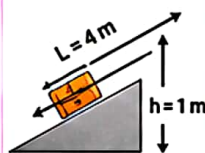
Explanation

- For an inclined plane (no friction), $MA = L/h$. Hence, load = $MA \times \text{effort}$.



Key Point

- A longer inclined plane reduces the effort required to lift a load.



- 87** Which of the following tools is an example of a wedge?

A) Knife B) Screw C) Pulley D) Wheelbarrow



Correct Answer: A) Knife



Concept

- A wedge is a simple machine with two inclined planes used to split or cut objects.



Explanation

- A knife has a sharp edge and works as a wedge to cut or split materials.



Key Point

- Wedge converts an applied force into a large separating force.



- 88** What is the mechanical advantage of a screw jack if the effort is 50 N and the load lifted is 1000 N?

A) 10 B) 20 C) 50 D) 100



Correct Answer: B) 20



Formula

$$MA = \frac{\text{Load}}{\text{Effort}} = \frac{1000}{50} = 20$$



Explanation

- Mechanical advantage is the ratio of load to the effort.



Key Point

- Screw jacks provide high mechanical advantage.



- 89** Which of the following is a characteristic of a pulley system with more pulleys?

A) Less mechanical advantage B) More mechanical advantage
C) No change in effort D) Difficult to use



Correct Answer: B) More mechanical advantage



Concept

- In a pulley system, increasing the number of pulleys increases the mechanical advantage.



Explanation

- More supporting ropes reduce the effort required to lift a load.



Key Point

- MA increases with the number of supporting ropes.



- 90** Which statement is correct for a wheel and axle?

A) Radius of wheel is smaller than axle B) Effort is applied on the axle
C) Load is applied on the wheel D) It multiplies force and provides mechanical advantage



Correct Answer: D) It multiplies force and provides mechanical advantage



Concept

- A wheel and axle multiplies force because the effort is applied at a larger radius (wheel).



Explanation

- Mechanical advantage = Radius of wheel / Radius of axle. Since $R > r$, $MA > 1$.



Key Point

- Effort at larger radius gives greater force on the axle.



- 91** A screw has a pitch of 4 mm. How much linear distance will it move in 5 complete rotations?

A) 4 mm B) 8 mm C) 16 mm D) 20 mm



Correct Answer: D) 20 mm



Formula

$$\text{Distance} = \text{Pitch} \times \text{Number of rotations}$$

$$= 4 \text{ mm} \times 5 = 20 \text{ mm}$$



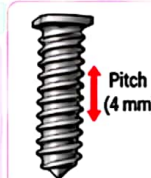
Explanation

- In one complete rotation, a screw moves a distance equal to its pitch. So, in 5 rotations, distance = 5 × pitch.



Key Point

- Larger pitch → greater distance per rotation.



- 92** Which of the following is NOT a use of an inclined plane?

A) Loading heavy goods into a truck B) Raising a flag on a pole
C) Climbing a hill D) Cutting wood



Correct Answer: D) Cutting wood



Concept

- An inclined plane is used to raise or lower a load to a height with less effort.



Explanation

- Loading, raising, and climbing use inclined planes. Cutting wood is done using a wedge, not an inclined plane.



Key Point

- Inclined plane helps in moving loads to a higher or lower level.



- 93** If the efficiency of a simple machine is 50% and the input work is 400 J, what is the useful output work?

A) 100 J B) 200 J C) 300 J D) 400 J



Correct Answer: B) 200 J



Formula

$$\text{Efficiency } (\eta) = \frac{\text{Useful output}}{\text{Input}} \times 100\%$$

$$\text{Useful output} = \frac{50}{100} \times 400 = 200 \text{ J}$$



Explanation

- Efficiency = 50% means half of the input work is converted into useful output.



Key Point

- Some energy is lost due to friction.

- 94** Which of the following machines has the highest ideal mechanical advantage?

A) Lever B) Pulley C) Inclined plane D) Screw jack



Correct Answer: D) Screw jack



Concept

- Screw jack provides a very high mechanical advantage because of its small pitch.



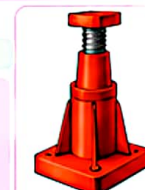
Explanation

- For a screw jack, $MA = \frac{2\pi R}{p}$, which can be very large for small pitch (p).



Key Point

- Screw jack is used for heavy loads.



- 95** Which of the following pairs of simple machines is correctly matched with their function?

A) Lever – changes direction of force B) Pulley – multiplies force
C) Wedge – splits or cuts objects D) Screw – changes rotational motion into linear motion



Correct Answer: C) Wedge – splits or cuts objects



Concept

- Different simple machines have different functions based on their design.



Explanation

- Wedge is used to split or cut objects by converting a small force into a large separating force.



Key Point

- Each simple machine is designed for a specific purpose.





96 A wheelbarrow is used to lift and move a load with less effort. Which simple machine does it mainly combine?

- A) Lever and pulley B) Lever and wheel and axle C) Inclined plane and pulley D) Screw and wedge

Correct Answer: B) Lever and wheel and axle

Concept

- A wheelbarrow is a combination of a lever and a wheel and axle.

Explanation

- The handles act as a lever to lift the load and the wheel with axle reduces friction and makes it easier to move.

Key Point

- Combination of simple machines can provide greater mechanical advantage.



Wheelbarrow

97 By using an inclined plane of length 5 m and height 1 m, a load is raised. What is the mechanical advantage (neglecting friction)?

- A) 1 B) 2 C) 5 D) 10

Correct Answer: C) 5

Formula

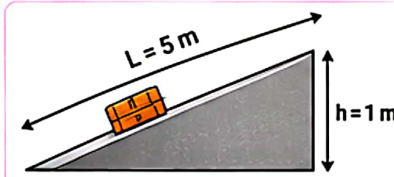
$$MA = \frac{L}{h}$$

Solution

$$MA = \frac{5}{1} = 5$$

Key Point

- A longer inclined plane requires less effort to raise the same load.



98 What is the velocity ratio (VR) of a simple machine if the distance moved by the effort is 6 m and the distance moved by the load is 2 m?

- A) 2 B) 3 C) 6 D) 12

Correct Answer: B) 3

Formula

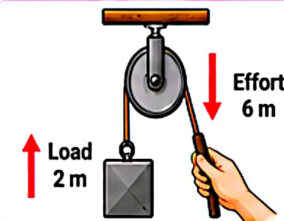
$$VR = \frac{\text{Distance moved by effort}}{\text{Distance moved by load}}$$

Solution

$$VR = \frac{6}{2} = 3$$

Key Point

- Velocity ratio shows how many times the effort distance is greater than the load distance.



99 Which of the following is an example of a real-life use of a pulley system?

- A) Flag hoisting B) Cutting wood C) Opening a door D) Tightening a screw

Correct Answer: A) Flag hoisting

Concept

- Pulleys are commonly used to lift loads vertically, such as in flag hoisting.

Explanation

- A fixed pulley changes the direction of the applied force, making it easier to raise a load.

Key Point

- Pulleys are widely used in real life for lifting heavy objects.



100 A force of 50 N is used to lift a load of 200 N using a simple machine. What is the mechanical advantage?

- A) 2 B) 3 C) 4 D) 5

Correct Answer: C) 4

Formula

$$MA = \frac{\text{Load}}{\text{Effort}}$$

Solution

$$MA = \frac{200}{50} = 4$$

Key Point

- Mechanical advantage is the ratio of load to effort.

