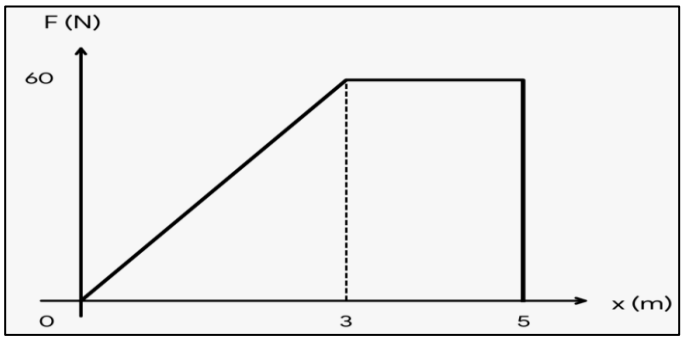
	INDIAN SCHOOL AL WADI AL KABIR	
Class: IX	**DEPARTMENT OF SCIENCE: 2026-27** **SUBJECT: PHYSICS**	**Date: 14/11/2026**
Worksheet No: 3 **WITH ANSWERS**	**CHAPTER: WORK, ENERGY AND SIMPLE MACHINES**	**Note:** **A4 FILE FORMAT**
CLASS & SEC:	**NAME OF THE STUDENT:**	**ROLL NO.**

I. OBJECTIVE TYPE QUESTIONS (1 MARK)

1. A force of 12 N displaces an object by 5 m in the direction of the force. The work done is:
   a) 17 J
   b) 60 J
   c) 2.4 J
   d) 0 J
2. A student pushes a rigid wall with great force, but the wall does not move. The work done on the wall is:
   a) Positive
   b) Negative
   c) Zero
   d) Maximum
3. The work done by friction on a block sliding on a rough horizontal surface is generally:
   a) Positive
   b) Negative
   c) Zero
   d) Infinite
4. What is the kinetic energy of a ball of mass 0.5 kg moving with a velocity of 10 m/s?
   a) 50 J
   b) 5 J
   c) 100 J
   d) 25 J
5. The SI unit of both work and energy is:
   a) Watt
   b) Newton
   c) Joule
   d) Metre
6. Which one of the following statements about work is incorrect?
   a) Work has magnitude and direction.
   b) The unit of work is newton metre (N m) or joule (J).
   c) Work done is positive when the force is in the direction of displacement.
   d) Work done is negative when the force acts opposite to the direction of displacement.

7. A girl is carrying a school bag of mass 3 kg on her back and moves 200 m on a level road. The work done against the gravitational force will be ($g = 10\ m\ s^{-2}$)
   a) 6×10^3 J
   b) 6 J
   c) 0.6 J
   d) zero
8. The force-displacement graph of an object starting from rest is shown alongside. What is the total work done on the object from x = 0 to x = 5 m?



   a) 90 J
   b) 120 J
   c) 210 J
   d) 300 J
9. A car is accelerated on a level road and attains a velocity 4 times its initial velocity; in this process, the potential energy of the car
   a) does not change.
   b) becomes twice its initial value.
   c) becomes 4 times its initial value.
   d) becomes 16 times its initial value.
10. If a machine lifts a load of 500 N using an effort of 250 N, what is its mechanical advantage?
   a) 0.5
   b) 250
   c) 1
   d) 2

ASSERTION AND REASONING

DIRECTIONS: In the following questions, a statement of assertion (A) is followed by a statement of reason (R). Mark the correct choice as:
(a) Both assertion (A) and reason (R) are true, and reason (R) is the correct explanation of assertion (A).
(b) Both assertion (A) and reason (R) are true, but reason (R) is not the correct explanation of assertion (A).
(c) Assertion (A) is true, but reason (R) is false.
(d) Assertion (A) is false, but reason (R) is true.
(e) Both Assertion and Reason are false.

11. **Assertion:** Work done is zero when the force is perpendicular to the displacement.
    Reason: There is no displacement in the direction of the force.

12. **Assertion**: A moving object possesses kinetic energy.
Reason: Kinetic energy depends on the object's mass and speed.

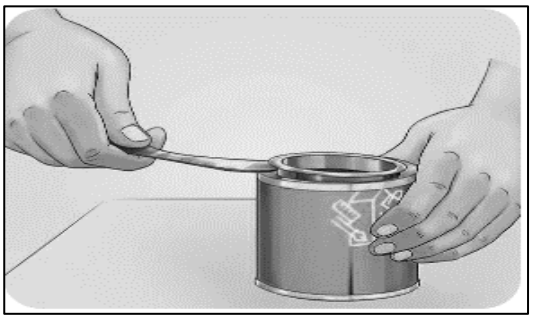
13. **Assertion:** A fixed pulley reduces the magnitude of the effort required to lift a load.
Reason: A fixed pulley changes the direction of the applied effort.

II. SHORT ANSWER QUESTIONS (2 MARKS)

14. Define work done by a constant force. Write its SI unit.
15. A girl carries a schoolbag horizontally while walking at a constant height. Explain why the work done by the upward force exerted by the girl on the bag is zero.
16. Distinguish between positive work and negative work with one example each.
17. State the law of conservation of mechanical energy and give an example.

III. SHORT ANSWER QUESTIONS (3 MARKS)

18. A goalkeeper applies a force of 150 N opposite to the motion of a ball. The ball moves through 20 cm before coming to rest. Calculate the work done by the goalkeeper on the ball. State the sign of the work.
19. A body of mass 2 kg is moving at 4 m s^{-1}. Its speed increases to 8 m s^{-1}. Calculate the change in its kinetic energy. Hence, find the work done on the body.
20. A coconut of mass 1.5 kg falls from the top of a coconut tree onto the wet sand on a beach. The tree is 10 m tall. On impact, the coconut comes to rest, leaving a depression in the sand.
    (i) Calculate the velocity of the coconut just before it hits the sand.
    (ii) Assume that the average resistive force of sand is 3000 N and all of the coconut's energy is used to create the depression in the sand. Calculate the depth of the depression the coconut makes in the sand. Assume g =10 ms^{-2}
21. Why do you push an object closer to scissors (fulcrum) when you want to cut a hard object?
22. Why is it easier to open the lid of a can by using a spoon as shown in the figure given below?



IV. LONG ANSWER QUESTIONS (5 MARKS)

23. (i) Derive an expression for the kinetic energy of an object of mass (m) moving with velocity (v).
    (ii) If the velocity of an object is doubled, what will be the change in its kinetic energy?
24. Explain the energy transformations that occur in a simple pendulum and why it eventually stops swinging.

25. (i)Two objects A and B of mass m and 4m have the same kinetic energy. What is the ratio of the magnitudes of the velocities of A and B?

(ii) "Does the kinetic energy of an object moving with constant velocity change when its position changes? Explain."

26. For the situation depicted below, calculate the mechanical energy of the object just before it hits the ground and show that even at this position, it is mgh.

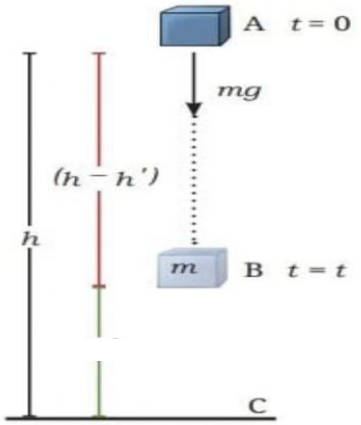


Fig. 7.19 An object falling freely due to gravity

V. CASE STUDY QUESTIONS

27. **Read the source below and answer the questions that follow:**

Rohan was helping his father move boxes in their warehouse. He first lifted a single box of mass 4 kg from the floor to a shelf 2 m above the ground. He then noticed that lifting three such boxes together to the same height required three times the effort. Later, he tried pushing a heavy cupboard against a wall with all his strength, but the cupboard did not move at all, even though he felt very tired after the attempt. His father explained that, in the scientific sense, Rohan had done work only in one of these situations. He also told him that the SI unit of work is named after a famous scientist. Take $g = 10\ m\ s^{-2.}$

A. Calculate the work done by Rohan in lifting one 4 kg box to a height of 2 m.

B. Explain why Rohan did no work (in the scientific sense) when he pushed the cupboard with all his strength but it did not move. Also state what the SI unit of work is and define it.

C. If Rohan lifts three such boxes together to the same height of 2 m, how much total work does he do? Justify your answer.

D. State the condition under which the work done by a force on an object is zero, even when a force is applied. Give one example other than the cupboard situation.

ANSWER KEY	
1.	b) 60 J. Work = F × s = 12 × 5 = 60 J.
2.	c) Zero, because there is no displacement.
3.	b) Negative, because friction acts opposite to displacement.
4.	d) 25 J
5.	c) Joule
6.	a) Work has magnitude and direction.

	"Work is a scalar quantity, so it has magnitude but no directional component in space."
7.	d) zero
8.	c) 210 J (**Total Work:**90J+ 120 J= 210J
9.	a) does not change. (Potential energy depends on height. Since the car travels along a ompletely level road, its elevation does not change.
10.	(d) 2
11.	(a) Both assertion (A) and reason (R) are true, and reason (R) is the correct explanation of assertion (A).
12.	(a) Both assertion (A) and reason (R) are true, and reason (R) is the correct explanation of assertion (A).
13.	(d) Assertion (A) is false, but reason (R) is true.
14.	The work done by a constant force acting on an object is defined as the product of the magnitude of the force and the displacement of the object in the direction of the force**.** $W = F \times s$. SI unit: joule (J).
15.	The upward force is perpendicular to the horizontal displacement. Hence, there is no displacement in the direction of this force, and the work done by it is zero.
16.	Positive work is done when the force and displacement act in the same direction. For example, when a person pushes a wheelchair forward, the applied force and the displacement are in the same direction. Negative work is done when the force and displacement act in opposite directions. For example, when a goalkeeper stops a moving ball, the goalkeeper applies a force opposite to the ball's motion.
17.	The law of conservation of mechanical energy states that the total mechanical energy of an object remains constant when only the force of gravity does work on it. Mechanical energy is the sum of kinetic energy and potential energy. For example, when an object falls freely, its potential energy decreases while its kinetic energy increases. The total mechanical energy remains constant during the fall.
18.	Displacement in the direction of the applied force = −0.20 m. Work done = $F \times s = 150 \times (-0.20) = -30$ J. The work is negative because the force is opposite to the displacement.
19.	Change in KE = $\frac{1}{2}m(v^2 - u^2) = \frac{1}{2} \times 2 \times (8^2 - 4^2) = 64 - 16 = 48$ J. By the work–energy theorem, work done = change in kinetic energy = 48 J.
20.	(i)Velocity just before hitting the sand, $mgh = \frac{1}{2} mv^2$ $v = \sqrt{2gh}$ $= \sqrt{2 \times 10\ ms^{-2} \times 10\ m}$ $= \sqrt{200} \approx$ (ii) Work done by the resistive force of the sand brings the coconut to rest.

	Energy at impact = mgh = 1.5 kg × 10 ms^{-2} × 10 m = 150 J F × d = Energy at impact 3000 N × d = 150 J d = $\frac{150}{3000}$ m = 0.05 m (or 5 cm)
21.	In a pair of scissors, the pivot acts as the fulcrum. When the hard object is placed closer to the fulcrum, the load arm decreases, which increases the mechanical advantage. As a result, the same effort applied at the handles produces a larger cutting force at the blades.
22.	A spoon used to open a can lid acts as a lever, with the rim of the can as the fulcrum. Since the handle of the spoon (effort arm) is much longer than the tip inserted under the lid (load arm), the mechanical advantage is greater than 1. A small effort applied at the handle therefore produces a much larger force at the lid, making it easier to open.
23.	**(i)** Consider an object of mass (m) initially at rest. Let a constant force (F) act on it and produce an acceleration (a), so that its velocity becomes (v) after moving through a distance (s). To simplify the situation, let us assume that the force *F* acting on the object is constant. In that case, the acceleration *a* is also constant, and the kinematic equations can be used. We can then write $v^2 = u^2 + 2as$ $s = \frac{(v^2 - u^2)}{(2a)}$ From the definition of work, the work done *W* by the force is $W = F \times s$ Using Newton's second law, $F = ma$, we get $W = ma \times s$ Substituting the value of s Substituting the value of s $W = ma \times \frac{(v^2 - u^2)}{(2a)}$ $W = \frac{1}{2}m(v^2 - u^2)$ If the initial velocity of the object is $u = 0$, the change in the energy of the object is equal to its final kinetic energy. Thus, the kinetic energy of an object of mass *m* moving with a velocity *v* is $KE = \frac{1}{2}mv^2$

	(ii) When the velocity of an object is doubled, i.e., $v' = 2v$ $$KE' = \frac{1}{2} m(v')^2$$ $$\Rightarrow KE' = \frac{1}{2} m(2v)^2 = \frac{1}{2} m \cdot 4v^2 \Rightarrow KE' = 4\left[\frac{1}{2} mv^2\right]$$ $$\Rightarrow KE' = 4\,KE$$ $\therefore$ If the velocity of an object is doubled, its kinetic energy increases four times.
24.	• At either extreme position, the pendulum bob is momentarily at rest. It has maximum potential energy and minimum kinetic energy. • As the bob moves towards the centre, its potential energy changes into kinetic energy. At the lowest point, the bob has maximum kinetic energy and minimum potential energy. • As the bob rises towards the other extreme position, its kinetic energy changes back into potential energy. • In an ideal situation, the total mechanical energy remains constant. In reality, air resistance and friction use up some of this energy, changing it into heat and sound. • As a result, the pendulum swings through smaller distances and eventually stops.
25.	(i) Kinetic energy is given by $K = \frac{1}{2}mv^2$. Since both objects have the same kinetic energy, $\frac{1}{2}mv_A^2 = \frac{1}{2}(4m)v_B^2$ $mv_A^2 = 4mv_B^2$ $v_A^2 = 4v_B^2$ $v_A = 2v_B$ Therefore, the ratio of their velocities is $v_A : v_B = 2:1$. (ii)No. The kinetic energy of an object is $K = 1/2\ m\ v^2$. If the mass and velocity remain constant, its kinetic energy also remains constant, even when the object changes its position.

26.	Just before the ball reaches the ground, its height is zero. $PE = mgh = mg \times 0 = 0$ From the equation of motion, $v^2 = u^2 + 2gh$ For a ball released from rest, $u = 0$. Therefore, $v^2 = 2gh$ The kinetic energy just before the ball reaches the ground is $KE = \frac{1}{2}mv^2$ $KE = \frac{1}{2}m(2gh) = mgh$ Hence, the mechanical energy is $ME = KE + PE = mgh + 0 = mgh$ This is equal to the mechanical energy at the initial height, where the potential energy is mgh and the kinetic energy is zero.
27. A.	Work done $=$ force $\times$ displacement in the direction of the force Force required to lift the box $= mg = 4 \times 10 = 40\ N$ $W = F \times s$ $W = 40\ N \times 2\ m$ $W = 80\ J$
B.	Work is done in the scientific sense only when a force produces displacement in the direction of the force. Since the cupboard did not move, its displacement was s= 0. Therefore, $W = F \times s = F \times 0 = 0J$ Rohan felt tired because his muscles used energy, but no work was done on the cupboard in the scientific sense. The SI unit of work is the joule (J). One joule of work is done when a force of 1 N moves an object through 1 m in the direction of the force. Thus, $1J = 1\ N \times 1m$.
C.	Work done on one box $= 80\ J$ For three identical boxes, $W_{\text{total}} = 3 \times 80\ J$ $W_{\text{total}} = 240\ J$ The boxes are lifted through the same distance, but their total mass and the required force are three times greater. Therefore, the total work is also three times greater.
D.	Work done by a force is zero when there is no displacement, even though a force is applied. It is also zero when the force and displacement are perpendicular to each other.

	Example: When a girl carries a bag while walking horizontally, the force applied by her to support the bag acts upwards, whereas the displacement is horizontal. Since the force and displacement are perpendicular, the work done by the supporting force on the bag is zero.

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