

SCIENCE • CLASS 9

CHAPTER 7

Work, Energy, and Simple Machines

NCERT SOLUTIONS



ZERO AND NEGATIVE WORK

Pause and Ponder - Questions 1 and 2

Question 1: A weightlifter holds a barbell steady. Is she doing work on the barbell?

Answer: No mechanical work is done on the barbell while it stays still. A force is applied, but its displacement is zero.

$$W = F \times s = F \times 0 = 0 \text{ J}$$

Her muscles still use energy, so she may feel tired.

Question 2: A stack of coins slides on a rough surface. Is the work done by friction positive, negative or zero?

Answer: Negative. Friction acts opposite to the displacement and reduces the stack's kinetic energy.

$$W(\text{friction}) = -f \times s$$



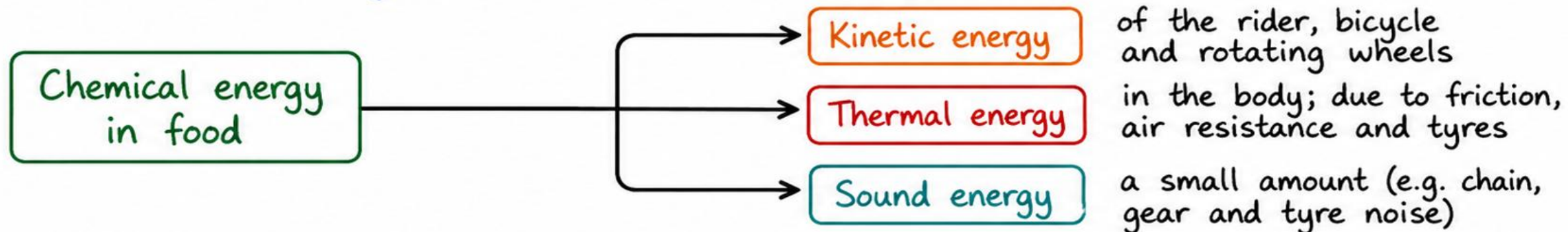
ENERGY WHILE CYCLING

Pause and Ponder - Question 3

Question: When you pedal a bicycle on a flat road, your muscles supply energy.
In what forms does this energy appear?

Answer:

- Chemical energy from food powers the muscles.
- When the bicycle speeds up, some of this energy becomes kinetic energy of the rider, bicycle and rotating wheels.
- Some energy becomes thermal energy in the body and through friction and air resistance. A small amount becomes sound.
- At steady speed, kinetic energy stays constant. Continued pedalling mainly replaces energy transferred to the surroundings.
- On a level road, gravitational potential energy does not increase.



EQUAL KINETIC ENERGY

Pause and Ponder - Questions 4 and 5

Question 4: Objects A and B have masses m and $4m$ and equal kinetic energies. Find their speed ratio.

Solution:

$$K(A) = K(B)$$

$$\frac{1}{2} m v(A)^2 = \frac{1}{2} (4m) v(B)^2$$

$$v(A)^2 = 4 v(B)^2$$

$$\frac{v(A)}{v(B)} = 2$$

Answer: $v(A) : v(B) = 2 : 1$

Question 5: Does the kinetic energy of an object moving with constant velocity change with its position?

Answer: No, if its mass is constant.

Its speed stays the same, so its kinetic energy remains unchanged.

$$K = \frac{1}{2} m v^2 = \text{constant}$$

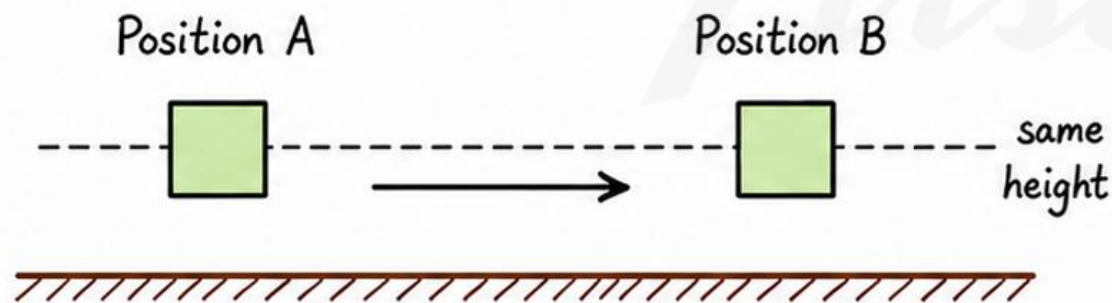
POTENTIAL ENERGY AND HEIGHT

Pause and Ponder - Question 6

Question: Near the Earth's surface, does potential energy change when an object moves horizontally at constant velocity? What if it is gradually raised vertically?

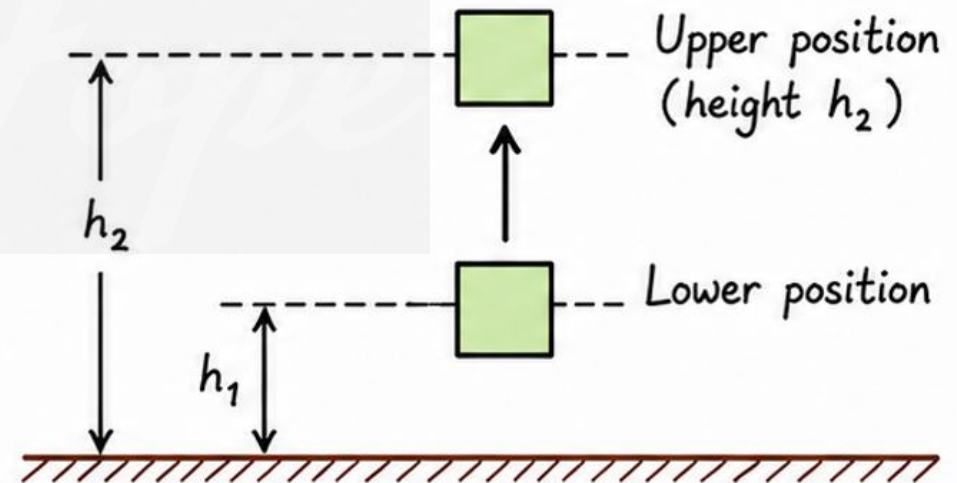
Answer:

Horizontal motion: Its height stays the same, so gravitational potential energy does not change.



$$U = mgh ; \Delta h = 0 ; \Delta U = 0$$

Vertical upward motion: Its height increases, so gravitational potential energy increases.



$$\Delta U = mg(h_2 - h_1)$$

The gain depends on the rise in height, not on how slowly the object is lifted.



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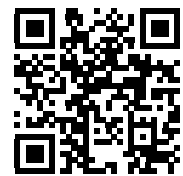


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