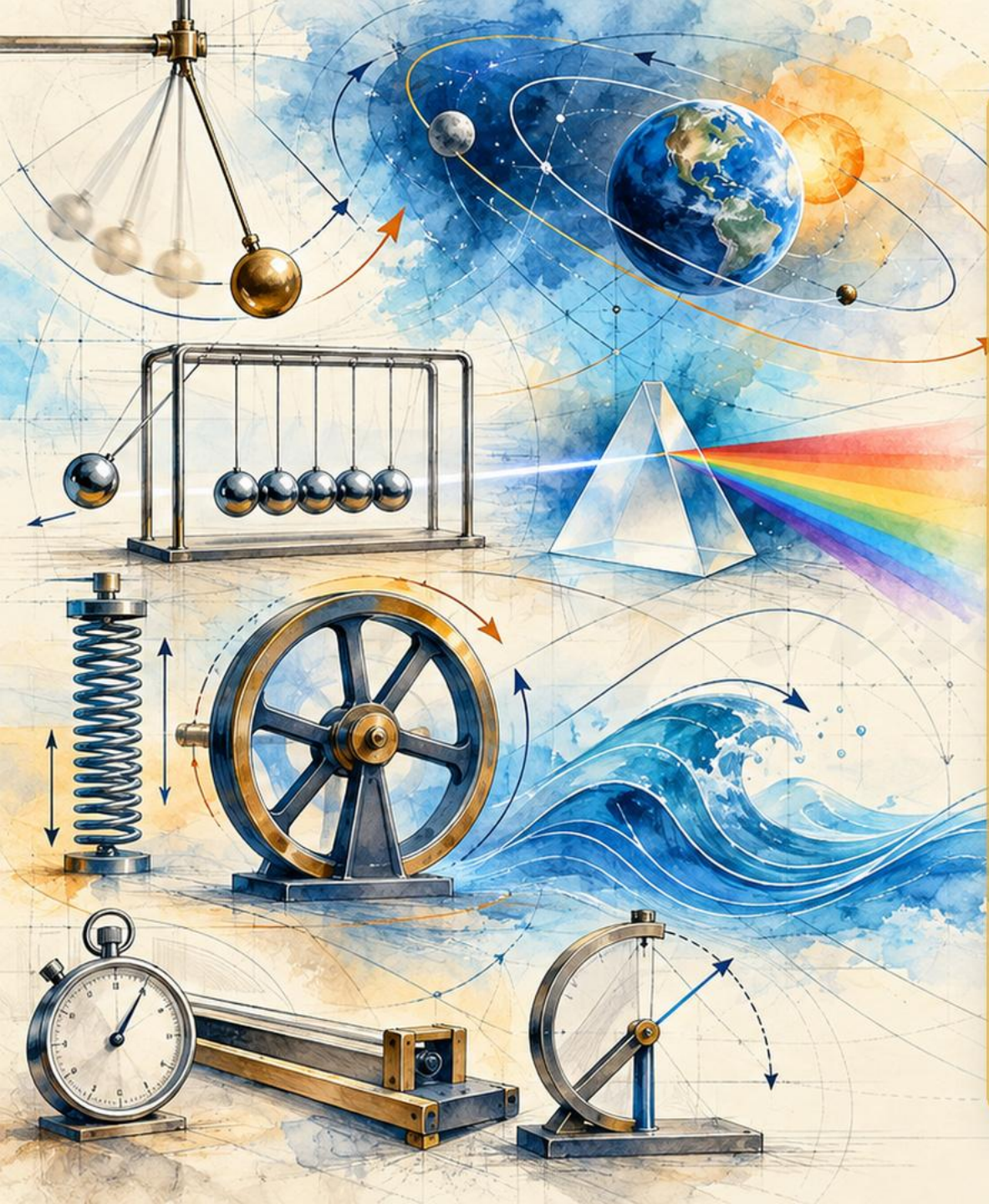




PHYSICS • CLASS 11

5

CHAPTER

Work, Energy and Power

NCERT SOLUTIONS

EXERCISE SOLUTION: QUESTION 5.1

State carefully whether the work done by each specified force is positive or negative.

Answer using $W = F s \cos \theta$.

- (a) A man lifts a bucket out of a well using a rope.

Answer: Positive, $W > 0$.

His upward force and the bucket's upward displacement have the same direction.

- (b) Gravitational force on that bucket during lifting.

Answer: Negative, $W < 0$.

Gravity acts downward while the bucket moves upward.

- (c) Friction on a body sliding down an inclined plane.

Answer: Negative, $W < 0$.

Friction acts up the plane, opposite to sliding.

- (d) Applied force on a body moving at uniform velocity on a rough horizontal plane.

Answer: Positive, $W > 0$.

The applied force acts along the displacement; friction balances it.

- (e) Air resistance on a vibrating pendulum as it comes to rest.

Answer: Negative, $W < 0$.

The resistive force opposes the bob's motion and removes mechanical energy.

EXERCISE SOLUTION: QUESTION 5.2

A 2 kg body starts from rest under a horizontal applied force of 7 N on a table. The coefficient of kinetic friction is 0.1. In 10 s, find work by the applied force, friction, net force, and the change in kinetic energy. Interpret the results.

Use $g = 9.8 \text{ m s}^{-2}$.

Solution:

$$f_k = \mu_k mg = 0.1 \times 2 \times 9.8 = 1.96 \text{ N}$$

$$F_{\text{net}} = 7 - 1.96 = 5.04 \text{ N}$$

$$a = \frac{F_{\text{net}}}{m} = \frac{5.04}{2} = 2.52 \text{ m s}^{-2}$$

$$s = \frac{1}{2} at^2 = \frac{1}{2} \times 2.52 \times 10^2 = 126 \text{ m}$$

$$v = at = 2.52 \times 10 = 25.2 \text{ m s}^{-1}$$

The net work equals the change in kinetic energy. Friction removes part of the energy supplied by the applied force.

$$W_{\text{net}} = \Delta K.$$

(a) Work by the applied force:

$$W_{\text{applied}} = Fs = 7 \times 126 = 882 \text{ J}$$

(b) Work by friction:

$$W_{\text{friction}} = -f_k s = -1.96 \times 126 = -246.96 \text{ J} \\ \approx -247 \text{ J}$$

(c) Work by the net force:

$$W_{\text{net}} = 882 - 246.96 = 635.04 \text{ J} \approx 635 \text{ J}$$

(d) Change in kinetic energy:

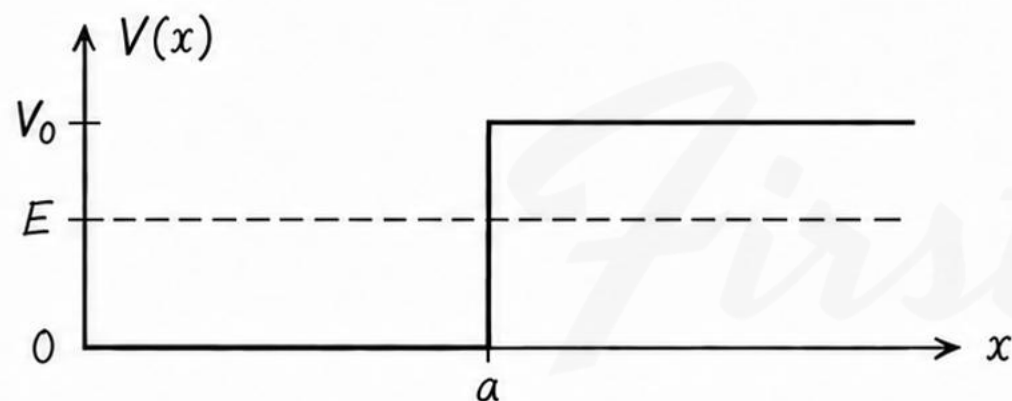
$$\Delta K = \frac{1}{2} mv^2 - 0 = \frac{1}{2} \times 2 \times 25.2^2 \\ = 635.04 \text{ J} \approx 635 \text{ J}$$

EXERCISE SOLUTION: QUESTION 5.3 (a-b)

For each shown potential-energy function, state the forbidden regions at the marked total energy E , the minimum possible total energy, and a simple physical context.

$$K = E - V(x) \geq 0; \text{ allowed only where } E \geq V(x).$$

(a) Step potential



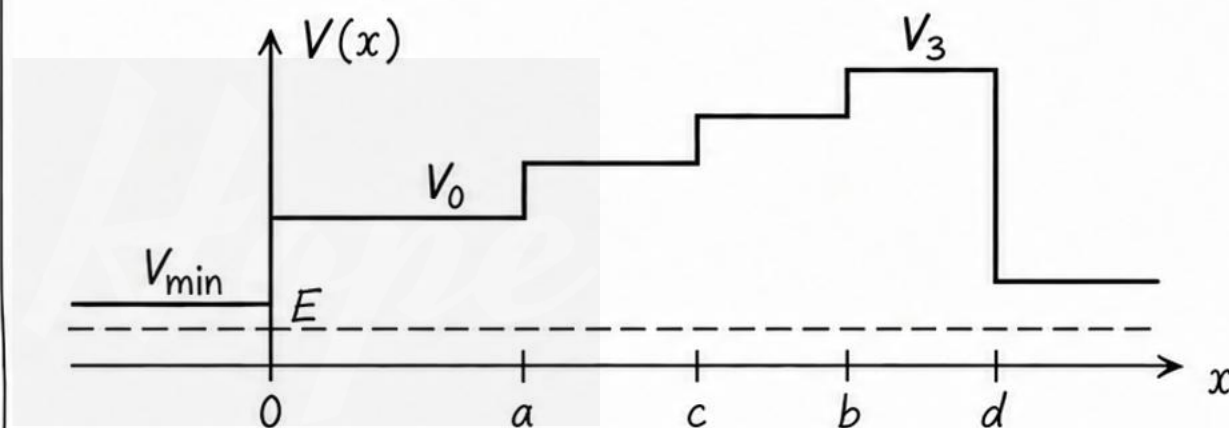
Answer: To the right of the step, potential energy exceeds the given total energy, which would require negative kinetic energy.

Forbidden region: $x > a$.

Minimum total energy: $E_{\min} = 0$.

Physical context: An idealised particle facing a sudden increase in gravitational height.

(b) Stepped potential



Answer: The marked energy lies below every step, so no position is allowed.

Forbidden region: all x .

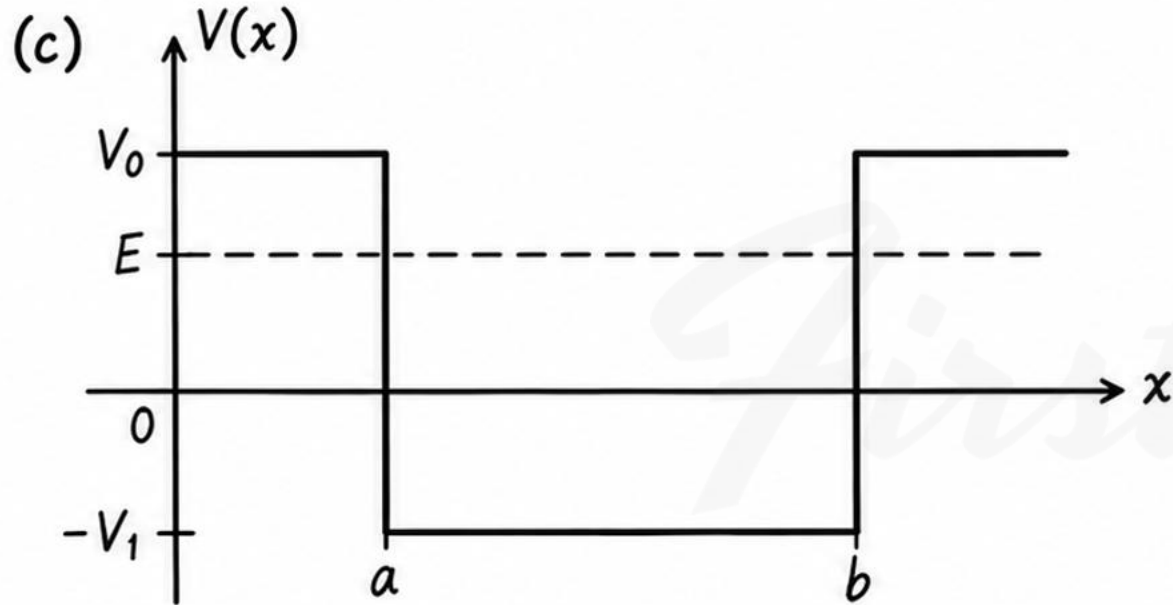
Minimum total energy: $E_{\min} = V_{\min} = \min V(x)$.

Physical context: An idealised stepped gravitational track. $V_{\min}$ names the lowest, unlabelled step in the supplied figure.

EXERCISE SOLUTION: QUESTION 5.3 (c-d)

For the two potential-energy graphs, state forbidden regions, minimum total energy and a simple physical context.

Rule: $K = E - V(x) \geq 0$.

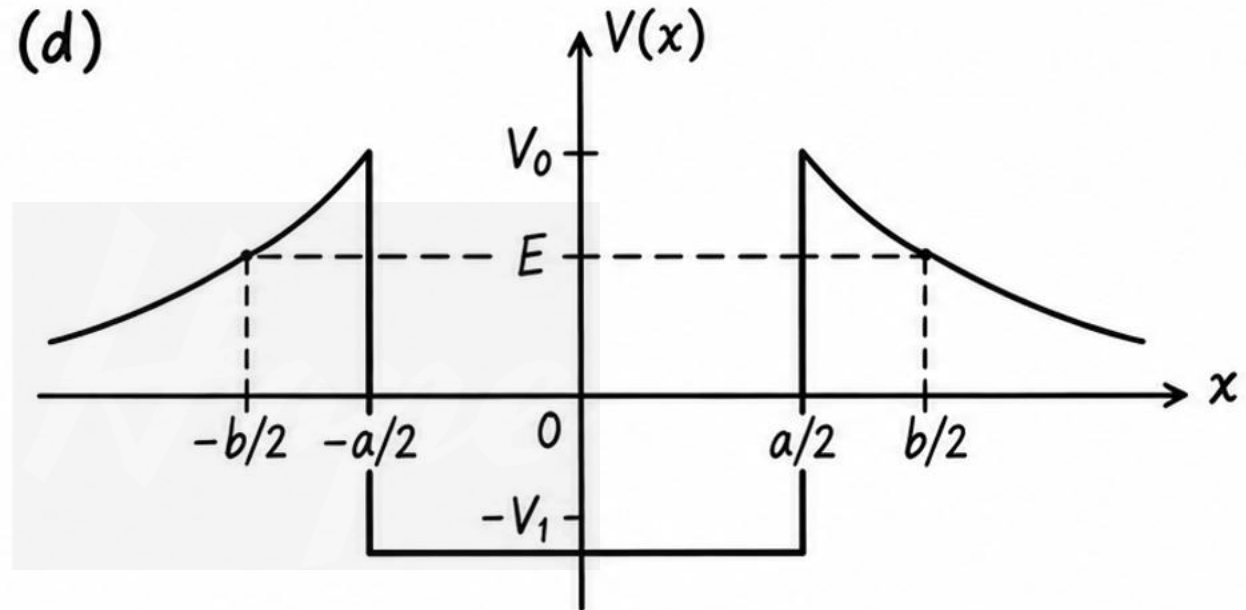


Forbidden regions: $x < a$ and $x > b$.

Minimum energy: $E_{\min} = -V_1$.

Explanation: Only the well is allowed, because its potential lies below the total energy.

Context: A particle in a simple attractive well.



Forbidden regions: $-b/2 < x < -a/2$ and $a/2 < x < b/2$.

Minimum energy: $E_{\min} = -V_1$.

Explanation: These are the barrier regions where potential energy exceeds the total energy.

Context: A simplified nuclear well with repulsion outside.

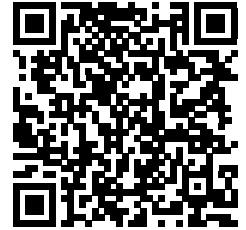


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