SCIENCE FOUNDATIONS

Work and energy

Difficulty level: Intermediate

Science Foundations

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Overview of the concept

This is how you work out the energy it takes to push a loaded cart up a ramp, carry groceries up the stairs, or lift a box onto a shelf. A ramp lets you push a heavy load with less force, but you push it over a longer distance, so the energy is the same. A mover carrying boxes upstairs feels the work in their legs because every box lifted higher takes more energy. Knowing work and energy tells you how pushing, lifting, and moving all cost energy, and why a shortcut in force is never a shortcut in energy.



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Rule

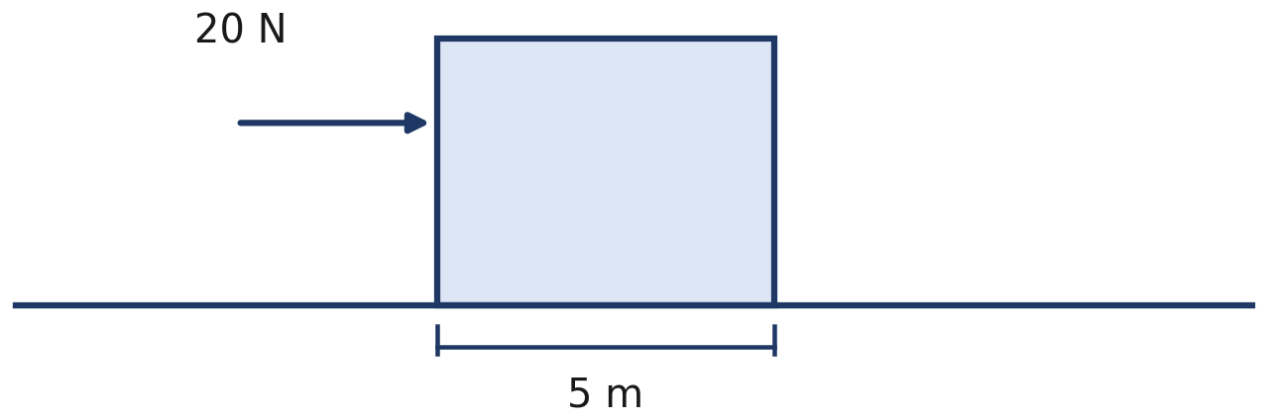
Work and energy: work equals force times distance moved in the direction of the force. W = force × distance.

If nothing moves, no work is done, and a force at right angles to the motion does no work. Work is energy transferred.

Worked examples

EXAMPLE 1

Q A 20 N push moves a box 5 m in the push direction. Work done?



SOLUTION

Write the rule:

work = force × distance.

Substitute:

work = 20 × 5 = 100 J

Write the answer in joules.

The result is work 100 J.

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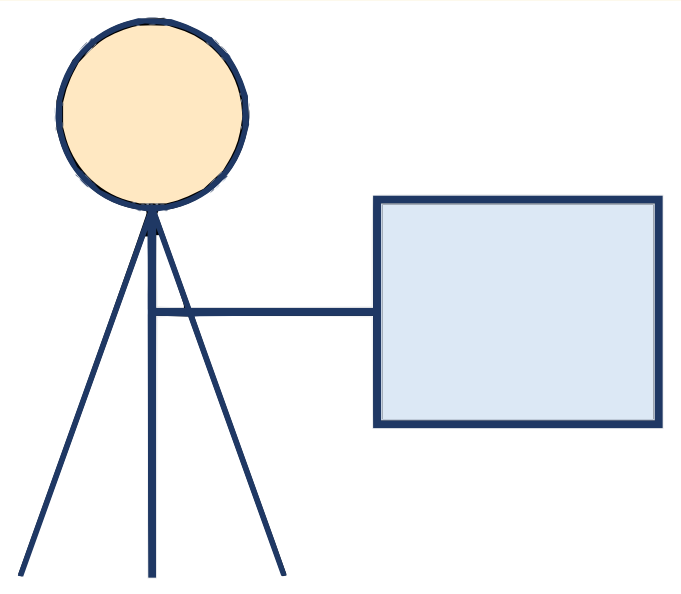
EXAMPLE 2

Q A person holds a heavy box still. Work done by the holding force?



SOLUTION

Check movement: the box does not move.

Distance moved is zero:

work = force × 0 m = 0 J

State the work.

The result is work 0 J.

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Practice questions

1

What is the formula for work?

A Force times distance

B Force divided by distance

C Mass times gravity

D Distance divided by force

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2

30 N push, 4 m: work?

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3

Work 150 J, push 25 N: distance?

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4

Units of work?

A Joules

B Newtons

C Watts

D Metres

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5

Work 30 J, distance 3 m: force?

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6 **Force at right angles to motion: work?**

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7 **Complete the sentence: Work is energy ___.**

A Transferred

B Created

C Destroyed

D Stored

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8 **A 50 N push moves a box 2 m, then a 25 N push moves it 4 m more. What is the total work?**

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9 No distance moved: work?

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10 Work done by gravity on a level carry?

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ANSWER KEY

1. Force times distance

2. 120 J

3. 6 m

4. Joules

5. 10 N

6. 0 J

7. Transferred

8. 200 J

9. 0 J

10. 0 J

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