SCIENCE FOUNDATIONS

Kinetic and gravitational potential energy

Difficulty level: Advanced

Science Foundations

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Overview of the concept

This is how you compare a slow truck and a fast bicycle to see which is harder to stop, or work out how much energy water falling over a dam can turn into electricity. A truck rolling slowly still carries more energy than a bicycle flying along, because its mass is so much bigger. A hydro dam stores energy in water held high up, then turns it into motion and electricity as the water falls. Knowing kinetic and gravitational potential energy tells you how movement and height each store energy, and how one turns into the other.



Rule

Kinetic energy: $KE = \frac{1}{2} \times m \times v^2$.

Gravitational potential energy: $PE = m \times g \times h$.

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Worked examples

EXAMPLE 1

Q Find the kinetic energy of a 2 kg object moving at 10 m/s.

SOLUTION

Write the rule:

$KE = \frac{1}{2} \times m \times v^2$

Substitute:

$KE = \frac{1}{2} \times 2 \times 10^2$

$KE = 100\ J$

The result is kinetic energy 100 J.

EXAMPLE 2

Q Find the potential energy of a 2 kg object 5 m up (g is 9.8).

SOLUTION

Write the rule:

$PE = m \times g \times h$

Substitute:

$PE = 2 \times 9.8 \times 5$

$PE = 98\ J$

The result is potential energy 98 J.

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Practice questions

1 Kinetic energy formula?

- A $\frac{1}{2}mv^2$
- B mgh
- C mv^2
- D $2mv^2$

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2 Potential energy formula?

- A mgh
- B $\frac{1}{2}mv^2$
- C mv
- D mg

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3

3 kg at 6 m/s: kinetic energy?

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2 kg at 10 m: potential energy?

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Units of energy?

A Joules

B Newtons

C Watts

D Metres

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6 Double the speed: kinetic energy becomes?

- A Two times
- B Four times
- C Eight times
- D Sixteen times

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7 Double the height: potential energy becomes?

- A Half
- B Double
- C Four times
- D Stays the same

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8 A 2 kg object falls and loses 98 J of potential energy. How much kinetic energy does it gain (ignoring air resistance)?

- A 98 J
- B 196 J
- C 49 J
- D 0 J

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9 What happens to the potential energy if the mass is doubled and the height is halved?

- A It stays the same
- B It doubles
- C It halves
- D It becomes four times as large

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10

Which is larger: kinetic at 10 m/s or potential at 5 m for 2 kg?

A Kinetic

B Potential

C They are equal

D Neither, both are zero

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ANSWER KEY

1. $\frac{1}{2}mv^2$

2. mgh

3. 54 J

4. 196 J

5. Joules

6. Four times

7. Double

8. 98 J

9. It stays the same

10. Kinetic

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