Your notes

GCSE Physics: revision notes

Kinetic and gravitational potential energy

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Kinetic energy

- A moving object has energy in its kinetic store: $E_k = ½ \, m \, v^2$, where m is mass in kg and v is speed in m/s.
- Doubling the mass doubles the **kinetic energy**; doubling the speed makes it four times bigger, because speed is squared.
- To find speed from **kinetic energy**: $v = \sqrt{(2E_k \div m)}$.

Gravitational potential energy

- Lifting an object increases the energy in its gravitational potential store: $E_p = m \, g \, h$.
- g is the **gravitational field strength** (9.8 N/kg on Earth) and h is the change in height in metres. AQA papers use 9.8 N/kg; Edexcel and OCR papers use 10 N/kg.
- To find height: $h = E_p \div (m \, g)$.

Elastic potential energy

- A stretched or compressed spring stores **elastic potential energy**: $E_e = ½ \, k \, e^2$.
- k is the **spring constant** in N/m and e is the **extension** in metres. This works as long as the spring is not stretched past its limit of proportionality.

Energy changes in falling and rising

- When an object falls, energy is transferred from its gravitational potential store to its kinetic store.

- If air resistance is ignored, the energy lost from the gravitational store equals the energy gained in the kinetic store: m g h = ½ m v^2.
- In real life some energy is dissipated to the surroundings by air resistance, so the object is slightly slower.

Solving energy problems

- Write down the equation, substitute the values in SI units (kg, m, m/s), then calculate.
- Convert grams to kilograms (÷ 1000) and centimetres to metres (÷ 100) first.
- Give the unit, **joules** (J), with your answer.

Worked examples

A 60 kg runner moves at 5 m/s. Find her kinetic energy.

Write the equation. **Ek = ½ × m × v^2**

Square the speed first. **5^2 = 25**

Multiply. **½ × 60 × 25 = 750**

Answer: 750 J

A 2 kg book is lifted 3 m. Find the gain in gravitational potential energy (g = 9.8 N/kg).

Write the equation. **Ep = m × g × h**

Put the numbers in. **2 × 9.8 × 3**

Answer: 58.8 J

Key terms

Kinetic energy	The energy an object has because it is moving: $E_k = ½mv^2$.
Gravitational potential energy	Energy gained when an object is raised: $E_p = mgh$.
Elastic potential energy	Energy stored in a stretched or compressed object: $E_e = ½ke^2$.
Gravitational field strength	The force of gravity on each kilogram of mass; 9.8 N/kg on Earth.
Spring constant	A measure of how stiff a spring is, in N/m.
Extension	How much longer a spring gets when it is stretched, in metres.
Joule	The unit of energy (J).

Quick questions

Cover the answers and test yourself: remembering is what makes it stick.

1. What is the kinetic energy of a 2 kg ball moving at 3 m/s?

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2. A car's speed doubles. What happens to its kinetic energy?
3. How much gravitational potential energy does a 60 kg climber gain climbing 5 m? (g = 9.8 N/kg)
4. A spring with k = 200 N/m is stretched by 0.1 m. How much elastic potential energy does it store?
5. A 10 kg box gains 490 J of gravitational potential energy. How high was it lifted? (g = 9.8 N/kg)
6. A 2 kg object has 400 J of kinetic energy. What is its speed?
7. What happens to energy when a ball falls (ignoring air resistance)?
8. What units must mass be in for $E_k = ½mv^2$?

Answers

1. 9 J
2. It becomes four times bigger
3. 2940 J
4. 1 J
5. 5 m
6. 20 m/s
7. It is transferred from the gravitational potential store to the kinetic store
8. Kilograms

What to do next

Practise 11 questions on this topic

Try 7 exam questions, with mark schemes

Read the lesson, one step at a time

Free revision for GCSE and KS3 at lycolearn.co.uk. Some notes are for one exam board only, and say so in brackets.

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