Your notes

GCSE Physics: revision notes

Forces and elasticity (Hooke's law)

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Changing shape

- To stretch, bend or compress an object, more than one force must be applied to it.
- **Elastic deformation**: the object returns to its original shape when the forces are removed.
- **Inelastic deformation**: the object does not return to its original shape when the forces are removed.

Hooke's law

- The **extension** of an elastic object, such as a spring, is directly proportional to the force applied, provided the **limit of proportionality** is not exceeded.
- F = k e: force (N) = **spring constant** (N/m) × **extension** (m).
- A stiffer spring has a bigger **spring constant**. The same equation applies to compression.
- Beyond the **limit of proportionality**, the force–**extension** graph curves and **extension** is no longer proportional to force.

Energy in springs

- A force that stretches or compresses a spring does work, and **elastic potential energy** is stored in the spring.
- Provided the spring is not inelastically deformed, the work done equals the **elastic potential energy** stored: $E_e = ½ k e^2$.
- The area under a force–**extension** graph (up to the **limit of proportionality**) equals the energy stored.

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Required practical: force and extension

- Hang a spring from a clamp stand next to a vertical ruler. Record the position of the bottom of the spring with no load.
- Add masses one at a time (for example 100 g = 0.98 N) and record the new position each time.
- **Extension** = new length – original length. Plot force against **extension**; the gradient of the straight part is the **spring constant**.
- Wear eye protection, and don't overload the spring.

Key terms

Elastic deformation	A change of shape that is reversed when the forces are removed.
Inelastic deformation	A change of shape that remains when the forces are removed.
Extension	The increase in length of a spring or elastic object.
Spring constant	The force needed per metre of extension, in N/m.
Hooke's law	Extension is directly proportional to force, up to the limit of proportionality.
Limit of proportionality	The point beyond which extension is no longer proportional to force.
Elastic potential energy	Energy stored in a stretched or compressed object: $E_e = \frac{1}{2}ke^2$.

Quick questions

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

1. What is elastic deformation?
2. What does Hooke's law say?
3. A spring has k = 25 N/m and is stretched 0.2 m. What force is applied?
4. A 6 N force stretches a spring with k = 30 N/m. What is the extension?
5. What does a bigger spring constant mean?
6. What happens to the graph beyond the limit of proportionality?
7. How do you work out extension?
8. What does the gradient of a force–extension graph give?

Answers

1. A change of shape that is reversed when the force is removed
2. Extension is directly proportional to force, up to a limit
3. 5 N
4. 0.2 m
5. A stiffer spring

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6. It curves
7. New length – original length
8. The spring constant

What to do next

Practise 10 questions on this topic

Try 7 exam questions, with mark schemes

Read the lesson, one step at a time

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