INKPHYSICS FLASHCARDS

Materials

Year 12 · 12 cards · fronts and backs

Print double-sided, flipping on the long edge, and each answer lands behind its question. Cut along the card borders.

Definitions in mark-scheme wording, the equations that are not on the data sheet, each lesson's check question, and the misconceptions that lose marks. The same cards run on the website with spaced-repetition scheduling, at inkphysics.co.uk/flashcards.

DEFINITION

Define: Density.

DENSITY AND HOOKE'S LAW

DEFINITION

Define: Hooke's law.

DENSITY AND HOOKE'S LAW

DEFINITION

Define: Limit of proportionality.

DENSITY AND HOOKE'S LAW

DEFINITION

Define: Elastic limit.

DENSITY AND HOOKE'S LAW

CHECK YOURSELF

A spring with spring constant 25 N m^{-1} is stretched by 0.20 m, within its limit of proportionality. Find (a) the force applied and (b) the energy stored. (c) If the extension were doubled, still within the limit, what would the stored energy become?

Hint: Energy depends on the square of the extension.

DENSITY AND HOOKE'S LAW

SPOT THE ERROR

Say what is wrong with this claim:

Hooke's law holds right up until the spring snaps.

DENSITY AND HOOKE'S LAW

DEFINITION

Define: Tensile stress.

STRESS, STRAIN AND THE YOUNG MODULUS

DEFINITION

Define: Tensile strain.

STRESS, STRAIN AND THE YOUNG MODULUS

DEFINITION

The force needed to stretch a spring is proportional to the extension, $F = k\Delta L$, up to the limit of proportionality.

DENSITY AND HOOKE'S LAW

DEFINITION

Mass per unit volume: $\rho = m/V$, in kg m^{-3}.

DENSITY AND HOOKE'S LAW

DEFINITION

The point beyond which a stretched object no longer returns to its original length when the force is removed.

DENSITY AND HOOKE'S LAW

DEFINITION

The point beyond which force is no longer proportional to extension, so Hooke's law ceases to apply.

DENSITY AND HOOKE'S LAW

SPOT THE ERROR

Hooke's law fails long before the spring breaks: beyond the limit of proportionality the force-extension graph curves, and beyond the elastic limit the spring no longer springs back. The straight line is only the opening chapter.

DENSITY AND HOOKE'S LAW

CHECK YOURSELF

(a) $F = k\Delta L = 25 \times 0.20 = 5.0$ N.

(b) $E = 1/2k(\Delta L)^2 = ½ \times 25 \times 0.20^2 = 0.50$ J.

(c) Doubling ΔL quadruples the energy, because of the square: 2.0 J. Picture the triangle under the force-extension line: doubling the extension doubles both its base and its height.

DENSITY AND HOOKE'S LAW

DEFINITION

The extension per unit original length: strain $= \Delta L/L$, a ratio with no unit.

STRESS, STRAIN AND THE YOUNG MODULUS

DEFINITION

The force applied per unit cross-sectional area: stress $= F/A$, in pascals.

STRESS, STRAIN AND THE YOUNG MODULUS

DEFINITION

Define: Young modulus.

STRESS, STRAIN AND THE YOUNG MODULUS

DEFINITION

Define: Breaking stress.

STRESS, STRAIN AND THE YOUNG MODULUS

CHECK YOURSELF

A wire of length 1.8 m and diameter 0.40 mm extends by 1.8 mm under a load of 25 N. Calculate the Young modulus of the material.

Hint: Find the area from the diameter first, working in metres.

STRESS, STRAIN AND THE YOUNG MODULUS

SPOT THE ERROR

Say what is wrong with this claim:

The spring constant tells you how stiff the material is.

STRESS, STRAIN AND THE YOUNG MODULUS

DEFINITION

The maximum stress a material can withstand before it fractures.

STRESS, STRAIN AND THE YOUNG MODULUS

DEFINITION

The ratio of tensile stress to tensile strain for a material within the limit of proportionality.

STRESS, STRAIN AND THE YOUNG MODULUS

SPOT THE ERROR

The spring constant k describes one particular object — change its length or thickness and k changes. The Young modulus is stress over strain, which cancels the geometry and characterises the material itself.

STRESS, STRAIN AND THE YOUNG MODULUS

CHECK YOURSELF

Area: $A = \pi d^2/4 = \pi \times (0.40 \times 10^{-3})^2 / 4 = 1.26 \times 10^{-7}\ m^2$.

Stress: $F/A = 25 / 1.26 \times 10^{-7} = 1.99 \times 10^{8}$ Pa.
Strain: $\Delta L / L = 0.0018 / 1.8 = 1.0 \times 10^{-3}$.

Young modulus: $E = 1.99 \times 10^{8} / 1.0 \times 10^{-3} = 2.0 \times 10^{11}$ Pa, the textbook value for steel. A strain of one part in a thousand from a 25 N pull is the Young modulus of a metal doing its job.

STRESS, STRAIN AND THE YOUNG MODULUS