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# PHYSICS OF MATERIALS

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*Physics School Autumn 2025*

**Series 3**

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## **Exercise 1: Elastic equilibrium condition in a two-phase material**

Demonstrate that in a two-phase material (phases 1 and 2), the equilibrium condition is:

$$(1-f)\langle\sigma_1\rangle + f\langle\sigma_2\rangle = 0$$

where  $f$  is the volume fraction of phase 2.

This form of the general rule says that the volume average of stresses in a solid at equilibrium under no external forces equals zero.

## **Exercise 2: Strain tensor: cylindrical and spherical coordinates**

Calculate the strain tensor in cylindrical and spherical coordinates. This is very useful for exercise in strain analysis of defects with specific crystallographic symmetries and deformation characteristics.