Solutions

Each answer shows the steps, then the **result**.

2.1

- **elastic**: the object **returns** to its original length when the load is removed
- **plastic**: a **permanent** extension remains

2.2

- the **work done** on the material (elastic potential energy stored, within the elastic region)

2.3

- $E_\mathrm{P} = \frac{1}{2}kx^2$

$$E_\mathrm{P} = \tfrac{1}{2}(50\ \mathrm{N\ m^{-1}})(0.20\ \mathrm{m})^2 = \mathbf{1.0}\ \mathrm{J}$$

2.4

- a **permanent extension** (it does not return to its original length)

3.1 C

- elastic potential energy stored in a spring is $\frac{1}{2}kx^2$

3.2

- $E_\mathrm{P} = \frac{1}{2}Fx$ (because $F = kx$)

$$E_\mathrm{P} = \tfrac{1}{2}(8.0\ \mathrm{N})(2.0 \times 10^{-3}\ \mathrm{m}) = \mathbf{8.0 \times 10^{-3}}\ \mathrm{J}$$

3.3

- elastic deformation is **reversible** — the material returns to its original shape
- plastic deformation is **permanent** — it stays deformed after the load is removed

3.4

- past the elastic limit some deformation is permanent, so unloading returns to a **non-zero** (permanent) extension
- the unloading line is parallel to but shifted from the loading line
- the area between them is the **energy transferred to thermal energy** in the material