1. A load of 12 N stretches a spring by 0.040 m. What is the spring constant?

   _____ N/m

2. Past the elastic limit, an object returns to its original length when the load is removed.

   ☐ True ☐ False

3. Within Hooke's law, doubling the load doubles the extension.

   ☐ True ☐ False

4. The energy stored in a stretched material equals the _____ under the force–extension graph.

   _____

5. The straight-line law $F = kx$ holds only up to the:

   ☐ limit of proportionality

   ☐ centre of gravity

   ☐ breaking point

   ☐ plastic region

6. A spring of constant 200 $\dfrac{\text{N}}{\text{m}}$ is stretched by 0.10 m. How much elastic PE is stored?

   _____ J

7. A complete statement of Hooke's law contains which of these? Select **all** that apply.

   ☐ the constant of proportionality is the spring constant

   ☐ provided the limit of proportionality is not exceeded

   ☐ provided the material is a metal

   ☐ the extension is directly proportional to the applied force

   Tick every correct option.

8. Two springs are pulled with the **same force**. The softer spring (smaller k) stores:

   ☐ the same energy

   ☐ less energy

   ☐ more energy

   ☐ no energy

9. Two identical springs (each constant k) are joined in series. The combined spring constant is:

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   ☐ $4k$

   ☐ $\frac{1}{2}k$

   ☐ k

10. When a stretched spring is released onto a mass, its elastic PE becomes _____ energy.

    _____

1. **300 N/m**

   $k = \dfrac{F}{x} = \dfrac{12}{0.040} = 300\ \dfrac{\text{N}}{\text{m}}$.

2. **False**

   No – in the plastic region a permanent extension stays after unloading.

3. **True**

   Yes – $F = kx$ is a straight-line (proportional) relationship, so x scales with F.

4. **area**

   Work done = area under the force–extension graph (a triangle for a Hooke material).

5. **limit of proportionality**

   Beyond the limit of proportionality the F–x graph curves and $F = kx$ no longer applies.

6. **1 J**

   $E_{\text{P}} = \frac{1}{2}kx^2 = \frac{1}{2} \times 200 \times 0.10^2 = 1.0$ J.

7. **provided the limit of proportionality is not exceeded; the extension is directly proportional to the applied force**

   The condition is part of the law, not an extra. Rubber obeys nothing like it, and a metal stops obeying it beyond the straight line.

8. **more energy**

   Same F, smaller $k \rightarrow$ larger extension $x \rightarrow$ larger area $\frac{1}{2}Fx$, so more energy is stored.

9. $\frac{1}{2}k$

   $\dfrac{1}{k_{\text{total}}} = \dfrac{1}{k} + \dfrac{1}{k} = \dfrac{2}{k}$, so $k_{\text{total}} = \frac{1}{2}k$ – the pair stretches more easily.

10. **kinetic**

    Set $\frac{1}{2}kx^2 = \frac{1}{2}mv^2$ (plus mgh if it rises) to find the speed.

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