

3.4 Hooke's law

Name: _____ Class: _____ Date: _____ **Total: 15 marks**

KEY WORDS elastic potential energy 弹性势能 • hooke's law 胡克定律 • equilibrium 平衡

Objective

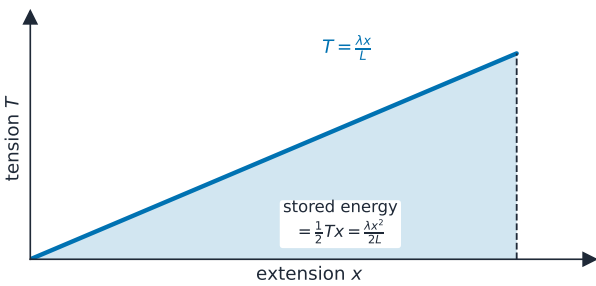
Build the skills to answer exam questions on **Hooke's law** 胡克定律 — the tension $T = \frac{\lambda x}{L}$ in an elastic string/spring, and the stored **elastic potential energy** 弹性势能 $E = \frac{\lambda x^2}{2L}$. Take $g = 10 \text{ m s}^{-2}$.

You must be able to:

- use $T = \frac{\lambda x}{L}$ to find tension, extension, or λ
- find the stored energy $E = \frac{\lambda x^2}{2L}$
- combine Hooke's law with equilibrium or energy conservation

1 Worked examples

■ Tension and energy



$T = \frac{\lambda}{L}x \quad \cdot \quad E = \frac{1}{2}Tx = \frac{\lambda x^2}{2L}$ (area under graph)

Tension rises in proportion to extension; the shaded triangle is the stored elastic energy

Natural length 2 m, modulus 50 N, extension 0.5 m: $T = \frac{50 \times 0.5}{2} = 12.5 \text{ N}$;

$$E = \frac{50 \times 0.5^2}{2 \times 2} = 3.125 \text{ J.}$$

2 Practice

2.1 A spring of natural length 1 m and modulus 30 N is stretched by 0.2 m. Find the tension. [2]

2.2 Find the energy stored in the spring in 2.1. [2]

3 Exam-style questions

3.1 Doubling the extension of an elastic string multiplies the stored energy by: [1]

- | | |
|---|---------------|
| A | 2 |
| B | 4 |
| C | $\frac{1}{2}$ |
| D | 1 |

3.2 A particle of mass 2 kg hangs in equilibrium on an elastic string of natural length 1.5 m and modulus 60 N.

(a) Find the extension of the string. [3]

(b) Find the elastic energy stored. [2]

3.3 A particle of mass 0.5 kg is attached to one end of an elastic string of natural length 2 m and modulus 40 N , the other end fixed at O . The particle is released from rest at O and falls vertically. Using energy, find its speed when the string has extension 0.5 m . [5]
