Worksheet: Elastic Potential Energy ($E_e = \frac{1}{2}ke^2$)

PhysicsSheets

Specification: GCSE Physics (AQA 4.1.1.1 / Edexcel SP3)

Core Equation: $E_e = \frac{1}{2}ke^2$

Rearranged Forms:

$k = \frac{2E_e}{e^2}$

$e = \sqrt{\frac{2E_e}{k}}$

Units:

E_e (Elastic potential energy, Joules, J)

k (Spring constant, Newtons per metre, N/m)

e (Extension, metres, m)

Section A: Units, Rearranging & Conversions

1. Complete the table below with the correct SI unit name and symbol for each variable:

Variable	SI Unit Name	SI Unit Symbol
Elastic potential energy (E_e)	_____	_____
Spring constant (k)	_____	_____
Extension (e)	_____	_____

2. Rearrange the formula $E_e = \frac{1}{2}ke^2$ to make:

a) $k =$ _____

b) $e =$ _____

3. Convert the following values into their standard SI units:

a) 15 cm = _____

b) 25 mm = _____

c) 0.5 kJ = _____

d) 200 kN/m = _____

e) 5 N/cm = _____

Section B: Practice Calculations

1. A spring has a spring constant of 150 N/m. It is extended by 0.08 m. a) Calculate the elastic potential energy stored in the spring.

2. A spring is extended by 12 cm and stores 0.72 J of elastic potential energy. b) Calculate the spring constant of the spring.

3. A spring stores 2.5 kJ of elastic potential energy when its spring constant is 5000 N/m. c) Calculate the extension of the spring. Give your answer in metres to 2 significant figures.

4. A spring has a spring constant of 2.5 kN/m. It is extended by 45 mm. d) Calculate the elastic potential energy stored in the spring. Give your answer in Joules.

Section C: Challenge Context

1. A student drops a 250 g mass from a height of 1.2 m onto a vertical spring, as shown in Figure 1. The spring has a spring constant of 400 N/m. Assume all the gravitational potential energy of the mass is transferred to elastic potential energy in the spring when it reaches its maximum compression. (Take $g = 9.8$ N/kg)

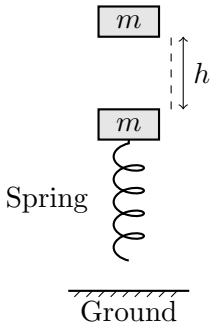

Figure 1: Mass dropped onto a spring

a) Calculate the maximum compression (extension) of the spring. Give your answer in cm to 2 significant figures.

b) A car suspension system uses springs with a spring constant of 150 N/cm.

i) Calculate the elastic potential energy stored in one of these springs when it is compressed by 8.0 cm.

ii) Explain why the formula $E_e = \frac{1}{2}ke^2$ might not accurately predict the energy stored if the spring is compressed by a very large amount, for example, 20 cm. In your answer, refer to the elastic limit and the spring constant.