4.9.3 Energy stored in springs

videos

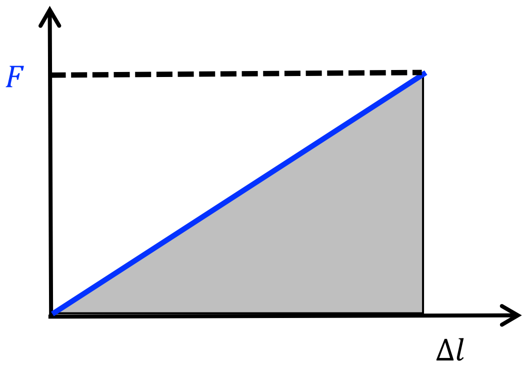
When a spring is stretched (below its limit of proportionality) we find the extension (Δl) is proportional to the applied force (F):

$$F = k\Delta l$$

where k is the spring constant.

This is called Hooke's Law – after the English scientist Robert Hooke.

Consider the graph of force against extension for the spring:



We can see that the force increases as the spring extends.

For a constant force, the work done in stretching the spring is given by:

$$W = force \times distance\ moved$$
$$\therefore W = F \times \Delta l$$

However, force is not a constant – it increases with extension. Therefore, the work done is the area under the graph above:

$$W = area = \frac{1}{2}F \times \Delta l$$

(1)✎Use Hooke's law to substitute for F in the equation for work, above.

(2)✎Does this formula look familiar? What is the work done equal to?

A conservation of energy problem:

(3)✎A spring is used to fire a ball bearing with mass 0.01kg into the air. The spring constant is 10000 Nm^{-1}, and it is initially stretched by 0.1m. What initial speed will the ball bearing have? What maximum height will the ball bearing reach? (Hint: assume the elastic potential energy lost is transferred to kinetic energy and then to gravitational potential energy.)