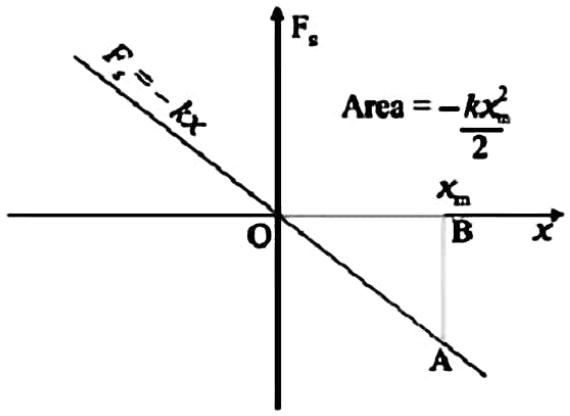
Assignment

Obtain the expression for work done by the Spring force from the Force - displacement graph.

(d)

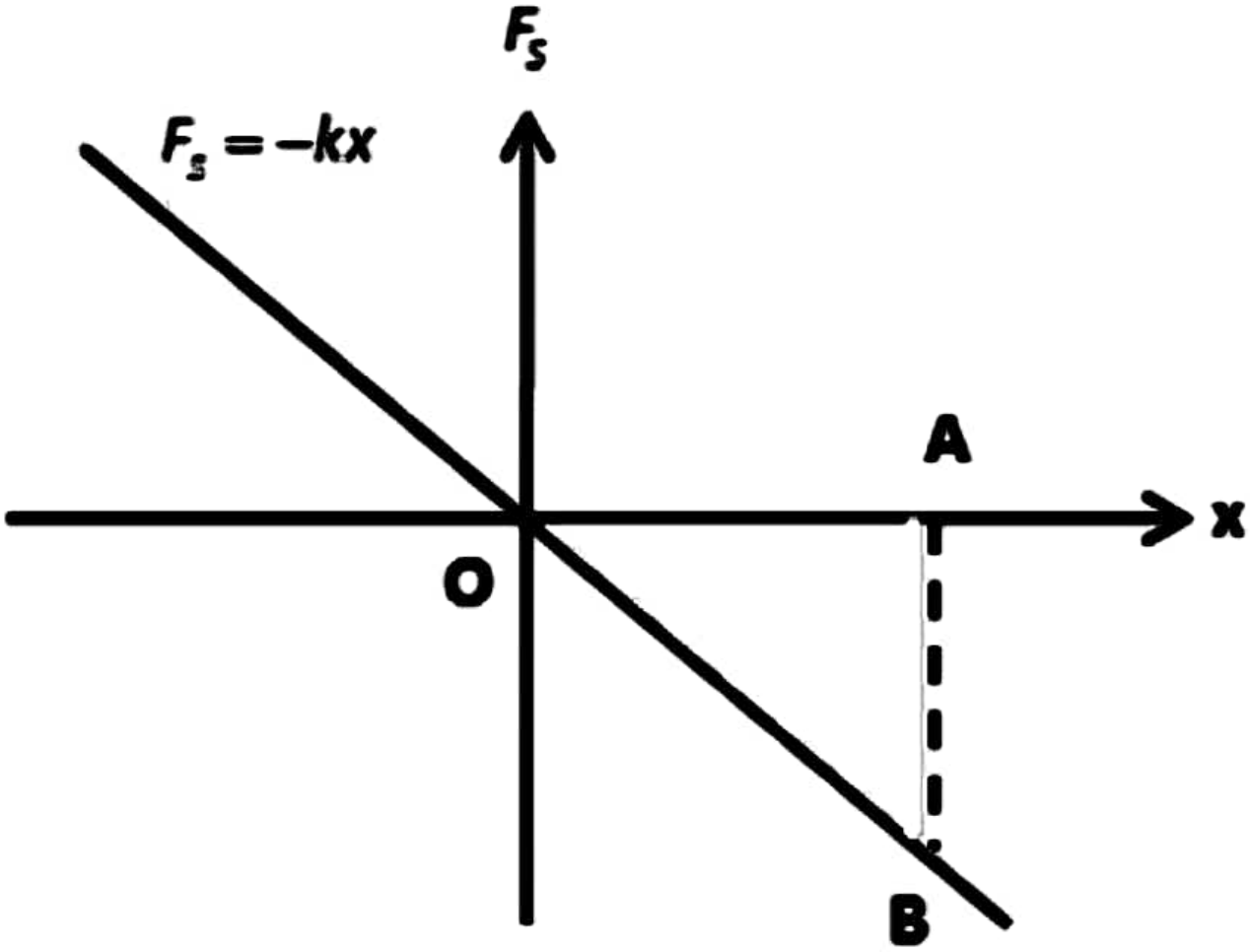


We have according to Hooke's law; the restoring force is proportional to the displacement of the spring. We can express Hooke's law as,

$F = -kx$, where, k is the spring constant and

x is the displacement of the spring from its mean position.

The negative sign indicates that the restoring force opposes the applied force. Since the restoring force is proportional to the negative of the displacement, we can draw the graph between spring force and positive displacement of the spring as shown in the figure below,



b) The area under the curve of the force is the area of the triangle ΔOAB. The area of the above triangle is,

$$A = \frac{1}{2}(AB)\,(OA)$$

$$\Rightarrow A = \frac{1}{2}(-kx)\,(x)$$

$$\Rightarrow A = -\frac{1}{2}kx^2$$

The expression on the right hand side of the above equation is the potential energy of the spring due to restoring force. Therefore, we can write,

$$P.E = -\frac{1}{2}kx^2$$

We know that the restoring force is equal to the applied force on the spring but in the opposite direction. Therefore, the potential energy stored in the spring due to the applied force equals to,

$$\therefore P.E = \frac{1}{2}kx^2$$