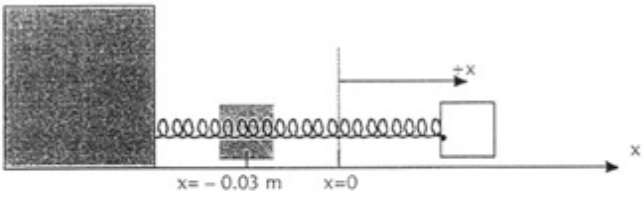
QUESTION 3 [Marks 10]

A 3 kg block resting on a rough horizontal surface is attached to a spring, as shown below.
The spring has a spring constant $k = 2.0 \times 10^3$ N.m^{-1}.
The spring is initially compressed to position $x = -0.03$ m from its unstretched position at $x = 0$, and the block is then released from rest.
There is a constant kinetic frictional force from the surface acting on the block of f_k=10 N.



(a) Determine the work done by the spring on the block between $x = -0.03$ m and $x = 0$.
(b) Determine the work done by the frictional force on the block between $x = -0.03$ m and $x = 0$.
(c) Determine the speed v of the block as it passes through the equilibrium position of the spring at $x = 0$.

(a) Work Done by spring = – change in Potential Energy of spring

$W_{D_{spring}} = -\left(\frac{1}{2}kx_f^2 - \frac{1}{2}kx_i^2\right)$

$= -\frac{1}{2} 2\times10^3 \left(0 - (-0.03)^2\right)$

$= 0.9$ J

(b) Friction force is constant and is in opposite direction to displacement

$\therefore W_{D_{friction}} = -f_k d$

$= -10 \times (0.03)$

$= -0.3$ J

(c) Use change in kinetic energy = total work done
only friction and spring do work on object

$\therefore W_{D_{total}} = W_{D_{spring}} + W_{D_{friction}}$

$= 0.9 - 0.3 = 0.6$ J