Elastic Potential Energy

Potential Energy

1. Gravitational Potential Energy : $V_g = mgh$
2. Elastic Potential Energy : $V_e = \frac{1}{2}kx^2$

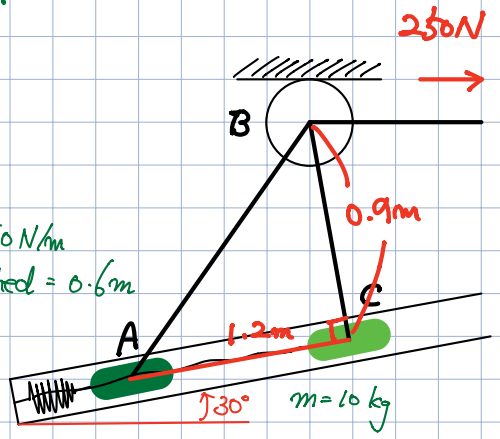
* U' : the work of all external forces other than gravitational forces and spring forces.

$$U'_{1-2} = \Delta T + \Delta V$$

$$= (T_2 - T_1) + (V_2 - V_1)$$

$$T_1 + V_1 + U'_{1-2} = T_2 + V_2$$

Example > 3.17



The 10kg slider moves with negligible friction up the inclined guide

The spring is stretched 0.6m in position A, where the slider is released from the rest

Calculate the velocity v_c of the slider as it passes point C

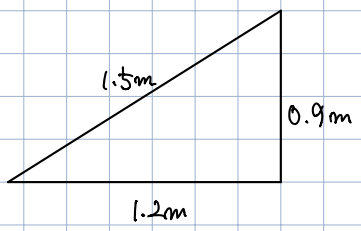
U_{1-2} : the work of all external forces

$U_{1-2} = (250\,N) \cdot (\overline{AB} - \overline{BC})$

$= (250\,N) \cdot (1.5m - 0.9m)$

$= (250N) \cdot (0.6m)$

$= 150\,N\cdot m = 150\,J$



1. Gravitational PE

$V_A = 0$, $V_c = mgh = (10\,kg) \cdot (9.81\,m/s^2) \cdot (1.2m - \sin 30°) = 58.9\,J$

2. Elastic PE

$V_A = \frac{1}{2}kx_A^2 = \frac{1}{2} \cdot (60\,N/m) \cdot (0.6m)^2 = 10.8\,J$

$V_c = \frac{1}{2}kx_c^2 = \frac{1}{2}(60\,N/m) \cdot (1.8m)^2$

$= 97.2\,J$

3. KE

$T_A = 0$, $T_c = \frac{1}{2}mv_c^2$

$$T_1 + V_1 + U_{1-2} = T_2 + V_2$$

$$U_{1-2} = (T_2 - T_1) + (V_2 - V_1)$$

$$= \Delta T + \Delta V$$

$U_{1-2} = 150\,J$, $\Delta T = \frac{1}{2}mv_c^2$, $\Delta V = (58.9 - 0) + (97.2 - 10.8)$

$= 145.3\,J$

$150\,J = \frac{1}{2}mv_c^2 + 145.3\,J$

$\frac{1}{2}(10)v_c^2 = 150 - 145.3 = 4.7$

$v_c^2 = 4.7/5$ $\therefore v_c = 0.97\,m/s$ Ans.