Work Done by Variable Forces

$W = \int_{x_i}^{x_f} F(x)\,dx$

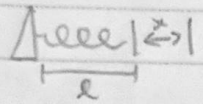
Area under the curve is the work done by the force

Springs: $\vec{F} = -k\vec{x}$

$W_{spring} = \int_{x_i}^{x_f} -kx\,dx$

$= \frac{1}{2}k(x_i^2 - x_f^2)$

In Hooke's Law, x is not the length of the spring



x is the change in position of the spring from equilibrium

$PE_e = \frac{1}{2}kx^2$

$m = 4kg \quad k = 700\ N/m \quad v = 1\ m/s$

Find max compression in spring

$KE_i + PE_{g_i} + PE_{e_i} = KE_f + PE_{g_f} + PE_{e_f}$

$\frac{1}{2}mv_0^2 + 0 + 0 = 0 + 0 + \frac{1}{2}kx^2$

$\frac{1}{2}(4)(1^2) = \frac{1}{2}(700)x^2$

$x = 7.6\ cm$

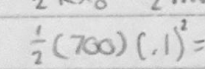
$x_2 = 10\ cm$, Find v_{max}

$\frac{1}{2}kx_0^2 = \frac{1}{2}mv^2$

$\frac{1}{2}(700)(.1)^2 = \frac{1}{2}(4)v^2$

$v = 1.3\ m/s$

Find v after rough patch



$d = 5cm$

$\mu_k = .415$

$\frac{1}{2}kx_i^2 = \frac{1}{2}mv^2 + \mu_k mgd$

$\frac{1}{2}(700)(.1)^2 = \frac{1}{2}(4)v^2 + .415(4)(9.8)(.05)$

$v = 1.2\ m/s$

With friction

$E_i = E_f + W_{NC}$

$-W_{NC} = E_i - E_f$

$-W_{NC} = f_k d = \mu_k mgd$

3 Find P_{avg}

44 $t = 15$ $W = 44(9.8)(3) = 1293.6\ J$

$P = 1293.6/15 = 86.2\ W$