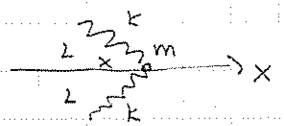
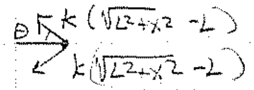
extra credit 7-49 a), c)

a) 

spring unstretched length $= L$

stretched length $= \sqrt{L^2+x^2}$

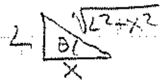
so |force| of one on particle $= k\left(\sqrt{L^2+x^2} - L\right) = F$



since springs are identical, $F_{y1} = -F_{y2} \Rightarrow \Sigma F_y = 0$

$F_{x1} = F_{x2} \Rightarrow \Sigma F_x = 2F_x$

now, $F_x = F\cos\theta = F\left(\frac{x}{\sqrt{L^2+x^2}}\right)$ in $-\hat{i}$ direction



$\therefore\ \Sigma\vec{F} = -2F_x\hat{i} = -2F\left(\frac{x}{\sqrt{L^2+x^2}}\right)\hat{i}$

$= -2k\left(\sqrt{L^2+x^2} - L\right)\left(\frac{x}{\sqrt{L^2+x^2}}\right)\hat{i}$

$= -2kx\left(\frac{\sqrt{L^2+x^2} - L}{\sqrt{L^2+x^2}}\right)\hat{i} = -2kx\left(1 - \frac{L}{\sqrt{x^2+L^2}}\right)\hat{i}$ ✓

b) $U(x) = -\int_{L}^{\sqrt{L^2+x^2}} F_x\,dx = kx^2 + 2kL\left(L - \sqrt{x^2+L^2}\right)$

c) for $L = 1.20$ m, $k = 40.0$ N/m, plot $U(x)$ vs x

stable equilibrium at $x = 0$