(b) when the spring has maximum compression, the block has zero velocity

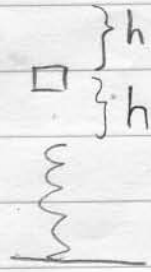
$$E_K + mgh + mgx = \frac{1}{2}kx^2$$

$$x = \frac{mg}{k} + \sqrt{\left(\frac{mg}{k}\right)^2 + \frac{mv_0^2 + 2mgh}{k}}$$

$$= \frac{0.23\times 9.8}{550} + \sqrt{\left(\frac{0.23\times 9.8}{550}\right)^2 + 0.23\,\frac{1.5^2 + 2\times 9.8\times 1.5}{550}}$$

$$\doteq 0.12\ \text{m}$$

(c)



$$E_K + mgh = mg(h+h')$$

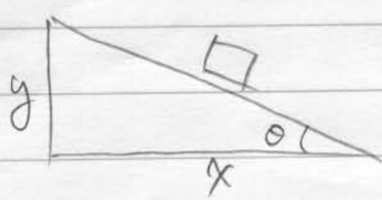
$$E_K = mgh' = \frac{1}{2}mv_0^2$$

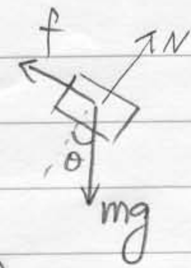
$$h' = \sqrt{\frac{v_0^2}{2g}} = \sqrt{\frac{1.5^2}{2\times 9.8}} \doteq 0.34\ \text{m}$$

$$l = h + h' = 1.5 + 0.34\ \text{m} \doteq 1.84\ \text{m}$$

The block can attain $l = 1.84\text{m}$ above the string.

3 (a) $W = \int \vec{F}\cdot d\vec{s}$



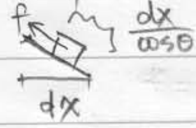


$$f = \mu N = \mu mg\cos\theta$$

$$\tan\theta = \frac{y}{x} \qquad \cos\theta = \frac{x}{\sqrt{x^2+y^2}}$$

$$W = -\mu mg \frac{x}{\cancel{\sqrt{x^2+y^2}}} \cancel{\sqrt{x^2+y^2}} = -\mu mgx$$

(b) suppose we seperate the ramp into N small pieces. each one is small enough. They can be solved by the method above.



$f = \mu N$ but $N = mg\cos\theta$ is basically not correct because it may have acceleration perpendicular to the ramp

Then the total work isn't $-\mu mgx$ generally.