Trevor & Katherine PHYS 121 LAB 3 CME Station 14

Spring Weight (g)	Potential energy position (cm)
50.0	82.25
55.0	80.90
60.0	79.15
65.0	77.35
70.0	75.75
75.0	74.35
80.0	72.85
85.0	71.70
90.0	69.65
95.0	68.25
100.0	66.50

We put a metrestick next to the string, parallel and looked perpendicular to both the spring & metrestick and recorded the position of the end of the spring

Unstretched Pos: 93.90cm

Max. Evursion: ~~5[illegible]~~ [illegible]

mass: 100.0g

Rstm: 66.55cm

$$y = \frac{mg}{k} + x_0$$

$$x = \frac{g}{k} m + x_0$$

$\frac{g}{k} = -3.13 \pm 0.04$ (From Origin)

$x_0 = 0.979 \pm 0.003$

m = 100.0g Unstretched = 93.90cm

Trial	Max (cm)	[illegible] Rstm (cm) position
1	42.80	66.55
2	42.95	66.55
3	40.35	66.55
4	41.10	66.55
Mean	41.8	
Std. Er.	0.6	

$$k = \frac{g}{-3.13} = -3.134185 \text{ N/m}$$

$$\delta_k = \delta_{kJ} = \delta_s \cdot \frac{-g}{s^2} =$$

$$0.003 \cdot \frac{-9.81}{3.13^2} = 0.003 \text{ N/m}$$

$k = 3.134 \pm 0.003$ N/m

Mean movement = 93.90 − 41.8 = $\boxed{52.1 \pm 0.6 \text{ cm}}$

Spring Weight (g)	Potential energy (cm) Position
50.0	82.25
55.0	80.90
60.0	79.15
65.0	77.35
70.0	75.75
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95.0	68.25
100.0	66.50

We put a metrestick next to the string, parallel and looked perpendicular to both the spring & metrestick and recorded the position of the end of the spring

Unstretched x_{eq}: 93.90cm

Max. Eversion: ~~5[illegible]~~ [illegible]

mass: 100.0g

Rest: 66.55cm

$m = 100.0g$ Unstretched = 93.90cm

Trial	Max (cm)	~~[illegible]~~ Rest Position (cm)
1	42.80	66.55
2	42.95	66.55
3	40.35	66.55
4	41.10	66.55
Mean	41.8	
Std. Er.	0.6	

$$x = \frac{mg}{k} + x_0$$

$$x = \frac{g}{k} m + x_0$$

$\frac{g}{k} = -3.13 \pm 0.04$ (From Origin)

$x_0 = 0.979 \pm 0.003$

$k = \frac{5}{-3.13} = -3.134185$ N/m

$\delta_k = \delta_{ks} = \delta_s \cdot \frac{-g}{s^2} =$

$0.003 \cdot \frac{-9.81}{3.13^2} = 0.003$ N/m

$k = 3.134 \pm 0.003$ N/m

Mean movement = $93.90 - 41.8 = \boxed{52.1 \pm 0.6 \text{cm}}$

$\frac{1}{2}kx^2$ mgh

Position (cm)	Spring Energy (J)	Grav. Energy (J)
0	0	0
52.1 (±0.6)	0.4253	−0.51058

$$\varepsilon = \frac{U_{kf} + U_{gf}}{|U_{gf}|} = \boxed{0.1670}$$

$x_i = 0$ $\quad x_f = 52.1 \pm 0.6$

$U_{ki} = 0$ $\quad U_{kf} = \frac{1}{2}kx^2 = 0.4253$

$U_{gi} = 0$ $\quad -mgx = -0.51058$

$$\delta_\varepsilon = \sqrt{\delta_{\varepsilon U_{kf}}^2 + \delta_{\varepsilon U_{gf}}^2}$$

$$\delta_{\varepsilon U_{kf}} = \delta_{U_{kf}} \frac{1}{|U_{gf}|}$$

$$\delta_{\varepsilon U_{gf}} = \delta_{U_{gf}} \cdot \frac{U_{kf}}{U_{gf}^2}$$

$$\delta_\varepsilon = \sqrt{\left(\delta_{U_{kf}} \frac{1}{|U_{gf}|}\right)^2 + \left(\delta_{U_{gf}} \cdot \frac{U_{kf}}{U_{gf}^2}\right)^2}$$

$$\delta_{U_{gf}} = \delta_{U_{gfh}} = \delta_m mg \quad \text{(mass \& } g \text{ errors are negligible)}$$

$$\delta_{U_{kf}} = \sqrt{\delta_{U_{kfk}}^2 + \delta_{U_{kfx}}^2}$$

$$\delta_{U_{kfk}} = \delta_k \cdot \tfrac{1}{2}x^2$$

$$\delta_{U_{kfx}} = \delta_x \cdot kx$$

$$\delta_{U_{kf}} = \sqrt{\left(\delta_k \tfrac{1}{2}x^2\right)^2 + \left(\delta_x kx\right)^2} =$$

$$\delta_\varepsilon = \sqrt{\frac{\left(\delta_k \frac{1}{2}x^2\right)^2 + \left(\delta_x kx\right)^2}{U_{gf}^2} + \left(\delta_m mg \frac{U_{kf}}{U_{gf}^2}\right)^2}$$

$= \cancel{2.352}\ 0.02$

$$\boxed{\varepsilon = 0.18 \pm 0.02}$$