Student 1: Low Excellence

A spring was attached to a retort stand. A 50 gram mass hook was then attached to the bottom of the spring. The mass was then pulled down 50 cm then at release the stopwatch was turned on. The period (T) was timed by using the time it took for the mass to do 10 oscillations. (1 oscillation is when the mass has returned to stationary point. This was done for the same mass three times and then repeated for the increasing masses attached to the mass hook.

Parallax error reduction was used – When I pulled down the mass hook against the ruler to keep the experiment constant I assured that I was already eye level with the units of the ruler and the extension of the mass.

Zero error – I made sure the stopwatch was calibrated to zero when using it to measure time.

Repeating and averaging – I recorded my data by repeating and averaging.

Reaction time error – the stopwatch operator ensured they were directly timing the mass hook oscillations to determine when they were completed and reduce reaction time.

m ± 4%	± Δm	T (s)	T(avg)	± ΔT	T^2
0.5	0.002	0.421, 0.472, 0.459	0.451	0.02706	0.203401 ± 0.02706
0.1	0.004	0.628, 0.631, 0.625	0.628	0.01256	0.394384 ± 0.01256
0.15	0.006	0.759, 0.766, 0.756	0.76	0.00456	0.5776 ± 0.00456
0.2	0.008	0.881, 0.866, 0.850	0.866	0.003464	0.749956 ± 0.003464
0.09	0.0086	0.594, 0.578, 0.580	0.584	0.002336	0.341056 ± 0.002336

Finding error of T^2

m = 0.05   Tavg = 0.451   ΔT = 0.02706

To square T

(0.451 ± 0.02706) x (0.451 ± 0.02706)

1) Find out % Δ of T   (0.2706/0.451) x 100
2) Add % error   (0.451 ± 6%)(0.451 ± 6%) = 0.203401 ± 12%
3) Multiply to find ΔT   0.203401 x 12/100 = 0.02706

$y = 3.6721x + 0.02 \qquad y\ ' = 3.4783'x + 0.0304'$

$y = \ 3.6721\ \pm 0.1938\ x + 0.02 \pm 0.0104$

$T^2 = \ 3.7\ \pm 0.2\ m + 0.02\ \pm 0.01$

Discussion

Viewing the graph, as Period (T^2) increases the error bars increase slightly. However, the best fit line is closely matching the data points. This suggests that the uncertainty was slightly larger when the period of the oscillation (T^2) was longer, thus reflecting on the error bars being slightly longer, possibly due to timing with the stopwatch.

There was small variation in the data. This meaning that I was confident about the relationship thus making it possible for predictions, as it was reliable.

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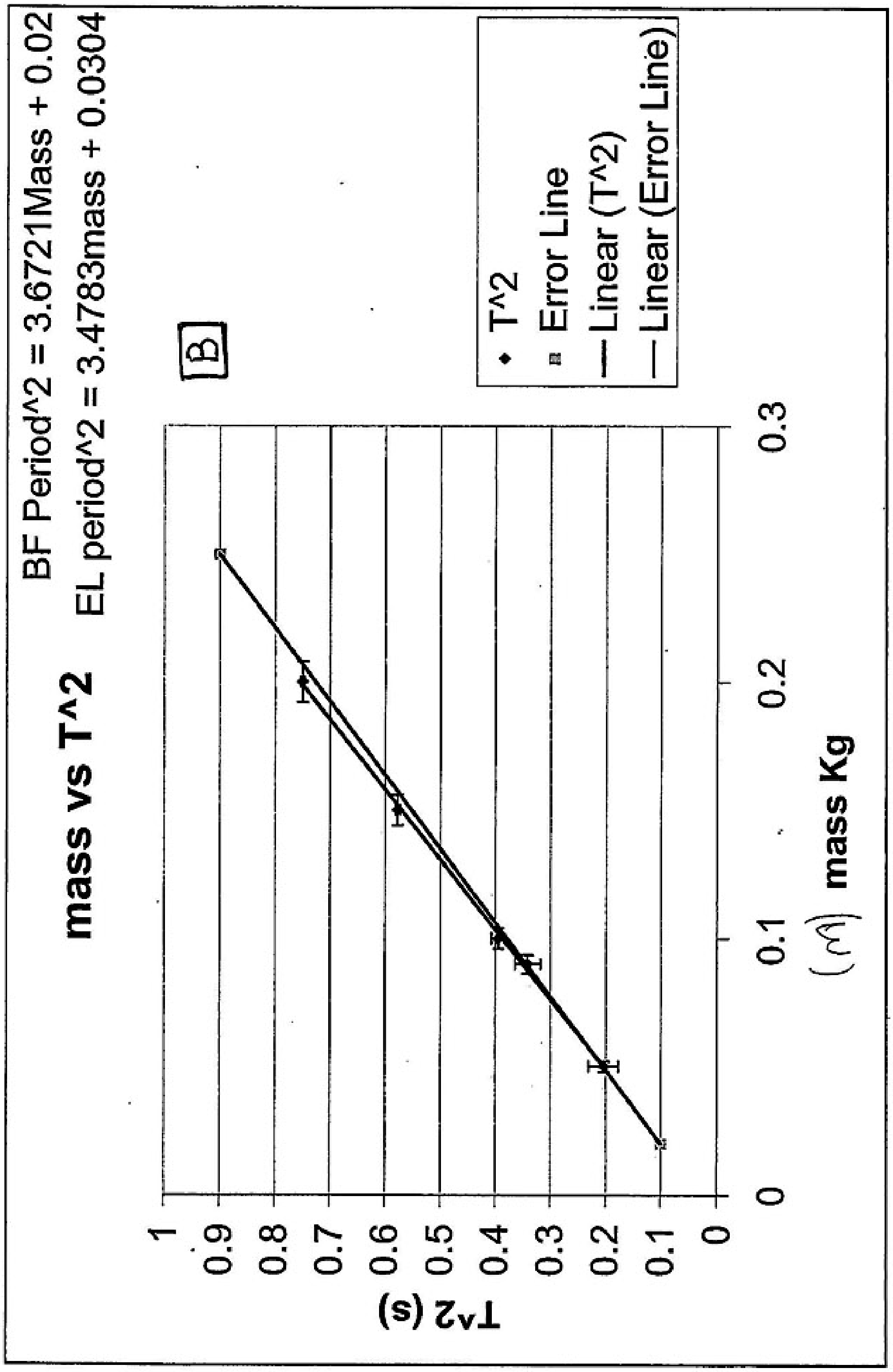

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For the masses that I used for the experiment, the greatest was 0.2kg. This is nowhere near the mass of a baby what the experiment was designed to model. My data fits the graph well and there is little variation, however I cannot be assured that this period will occur for the actual mass of a baby. This means that the final analysis possibly won't be valid in real life.

This experiment was designed to model a baby on a baby bouncer but there are some flaws: the spring is not the same shape as the double elastic harness, and it is not built of the same material. There it is not known whether the spring would behave and oscillate the same way as a double elastic harness. However, without a real double elastic harness this can't be tested.

On a baby bouncer the mass (baby) bounces knees up with their feet inputting their own energy into the oscillation. The resultant force of this would vary. This meaning that the period of oscillation in a real life baby bouncer wouldn't be able to be replicated by my experiment. As in my experiment this was not taken into consideration. Also the fact the baby lifts off its feet demonstrates that the baby bouncer is not SHM. Where in my model the mass was oscillating with SHM, meaning in a real life model conclusions wouldn't be valid, and the equation $T = 2\pi \sqrt{\frac{m}{k}}$ is not applicable to my model/equation.

The relationship I determined was: $T^2 = 3.7 \pm 0.2\ m + 0.02 \pm 0.01$
The theoretical formula is:

$$T = 2\pi \sqrt{\frac{m}{k \pm 5\%}} \qquad k = 11\ \mathrm{Nm^{-1}} \pm 5\%$$

(Square to make it equivalent to mine)

$$T^2 = \frac{4\pi^2 m}{k \pm 5\%}$$

$$T^2 = 3.589m \qquad T^2 = 3.6m\ (2\mathrm{sf})$$

The gradient of this fits with my experimental relationship, as the gradient is within the gradient range. However, the y-intercept of C is not within my y-intercept range. This means there could possibly be a constant systematic error. This is probably due to the reaction time error when timing T. Although this was reduced it can't be completely eliminated, possibly resulting in the intercept being out of range.