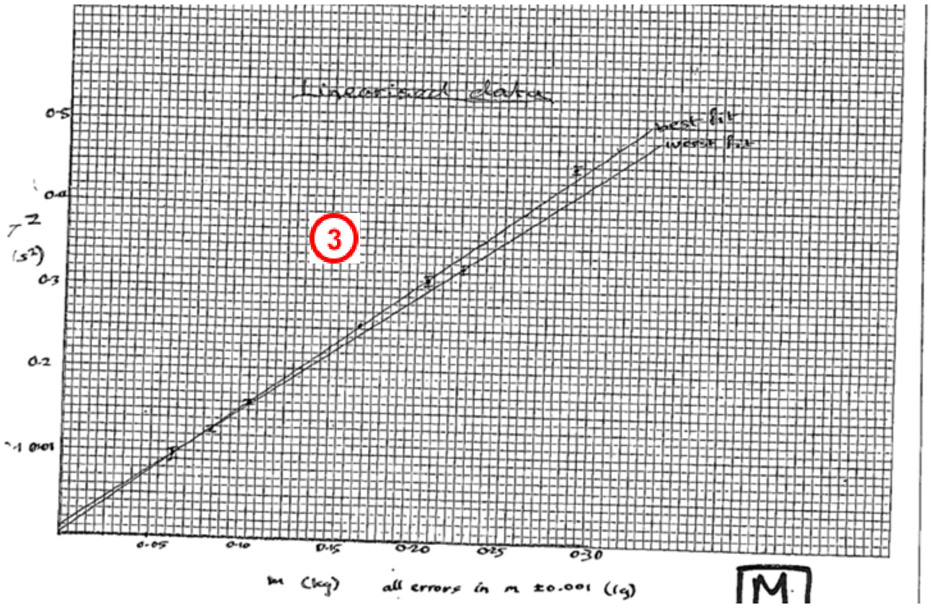
Student 3: Low Merit

Intended for teacher use only



$T^2=\frac{4\pi^2}{k}m$ $k=29\pm1Nm^{-1}$

Mass	**∆m** (2)	**s** **t 20sw** (1)	**S** **T**	**S** **∆T±** (2)	**%∆T**	**s^2** **T^2 to level of accuracy in errors**	**Abs err T^2 1sf**
63	±1	6.2 6.4 ~~6.9~~ ~~6.1~~ ~~6.4~~	0.314	0.0075	2	0.099	0.004
105	±1	8.0 8.0 8.0 7.9	0.399	0.0025	0.6	0.159	0.002
168	±1	10.1 10.1 10.1 10.1	0.505	0	0	0.255	0
226	±1	11.5 11.4 ~~11.2~~ 11.6 11.4	0.574	0.005	0.9	0.329	0.006
290	±1	~~12.9~~ 13.3 13.4 13.5	0.670	0.005	0.7	0.449	0.006
84	±1	7.1 7.2 7.1 7.2	0.358	0.0025	0.7	0.128	0.002
206	±1	11.2 11.0 11.1 11.3	0.558	0.0075	1	0.311	0.006

From calculator: best fit = $T^2 = 1.513\ m + 7.5\text{x}10^{-5}$

From graph: worst fit=$T^2 = \frac{0.329-0.0886}{0.226-0.063}\ m + 0.01$

$T^2 = 1.41m + 0.01$

Δgradient= 1.41-1.51= 0.1 (1sf)

∴ relationship: $T^2 = (1.5 \pm 0.1)\ m + 7.5 \times 10^{-5}$

±7%

4 Test the physics theory does $1.5 \pm 0.1 = \frac{4\pi^2}{k}$?

$\frac{4\pi^2}{k} = \frac{4\pi^2}{29 \pm 1}$ =1.36 ± 0.05 or $k = \frac{4\pi^2}{1.5}$ = 26 ± 2Nm^{-1}

The errors are within range of each other, and the %age difference is 10% so the theory could be considered accurate, although more accurate testing would be needed to confirm its validity.

The experiment seems simple enough, but as usual, some unforeseen error comes in somewhere. In this experiment, it was in the bouncing of the mass. With larger masses, something in the system started it swinging like a pendulum, which had slightly different frequency, leading it to periodic increases and decreases in the amount the mass bounced, at times making it difficult to count the oscillations and possibly causing me to count 19 or 21 oscillations instead of the required 20. This reduced the accuracy of the readings taken with larger masses.

Also, something that couldn't be accounted for was the mass of the spring. This mass meant that, even with no mass, the spring would oscillate, leading to a systematically longer time period and the zero error in my final relationship. This would have to be taken into account when designing the bay bouncer itself would add mass to the system, increasing the time period.

Issues regarding the spring's dimensions for the bay bouncer are also raised. To allow a comfortable bouncing speed, a longer time period (>1second) should be aimed for, while still having the spring capable of holding 5 -10 Kg without reaching its elastic limit. This requires a heavy-duty spring with a low spring constant and high extension so it will probably be made of thick wire and quite long.

There was only one other variable to control in this experiment-the spring constant-and I still managed to allow errors into that. The clamp stand used for the experiment was seen bending when using the heavier masses, which would have decreased the spring constant slightly, thus increasing the time period slightly, as with the results compared to the theory-slightly higher than predicted.

Also, although it notes in the instructions that the uncertainty in the mass of the washers used as weight was 4 %, I didn't know how to apply that information. Instead I guessed an appropriate mass, then weighed it on a balance to make sure. Thus, my error in mass was ±1g instead of 4%.