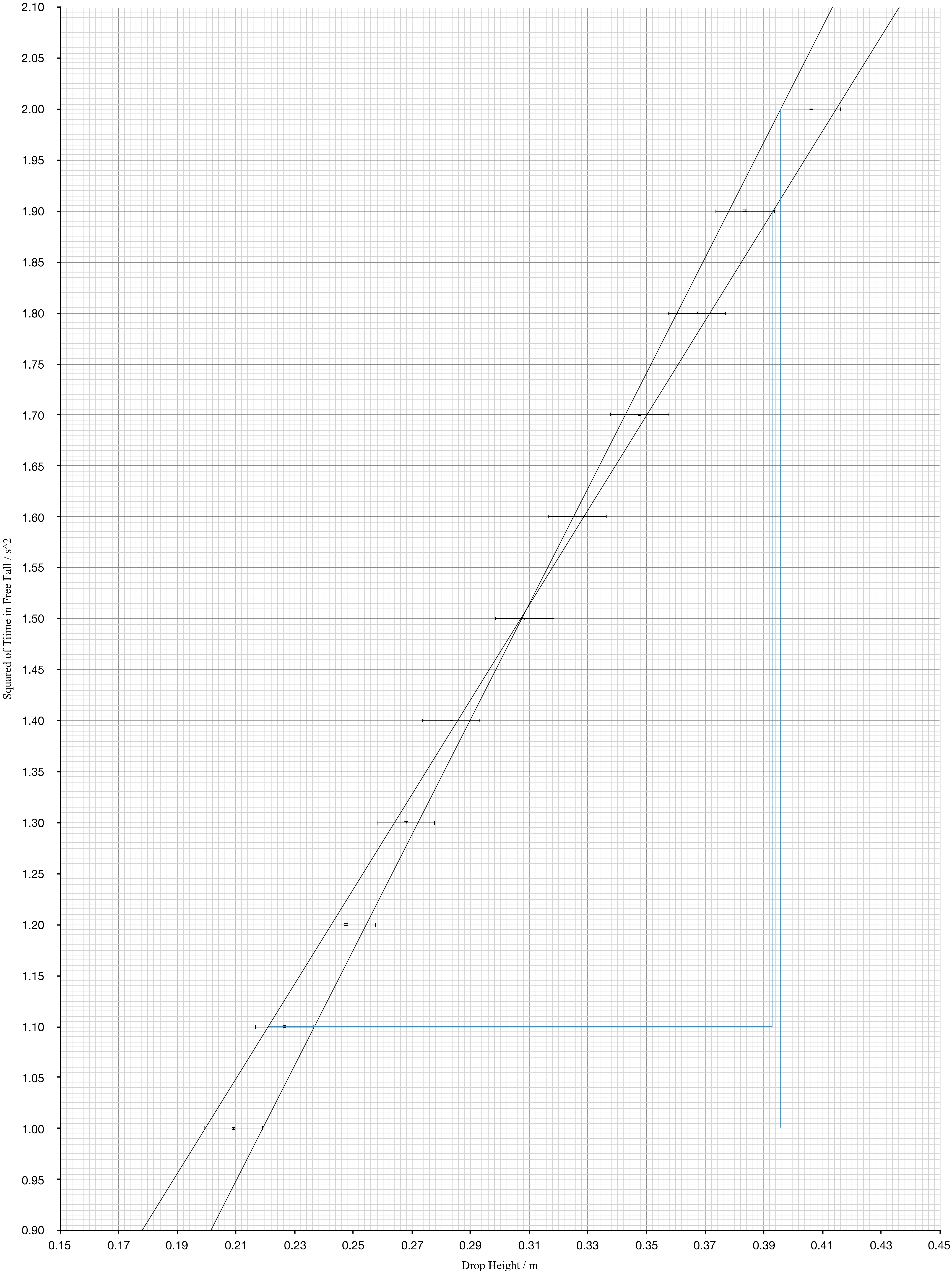
Diagram 1. Investigation of Free Fall Acceleration Through Dropping Balls

Table 1. Drop Height and Time in Free Fall

Raw				*Processed*	
Drop Height / m	**Time in Free Fall / s**				**Square of Time / s^2**
	Trial 1	*Trial 2*	*Trial 3*	*Average*	
±0.01	±0.005				
1.00	0.4530	0.4600	0.4590	0.4573	0.2092 ± 0.0010
1.10	0.4870	0.4720	0.4690	0.4760	0.2266 ± 0.0010
1.20	0.5120	0.4930	0.4880	0.4977	0.2477 ± 0.0010
1.30	0.5270	0.5120	0.5140	0.5177	0.2680 ± 0.0010
1.40	0.5290	0.5390	0.5290	0.5323	0.2834 ± 0.0010
1.50	0.5470	0.5520	0.5670	0.5553	0.3084 ± 0.0010
1.60	0.5710	0.5620	0.5810	0.5713	0.3264 ± 0.0010
1.70	0.5880	0.5860	0.5950	0.5897	0.3477 ± 0.0010
1.00	0.6080	0.6070	0.6030	0.6060	0.3672 ± 0.0010
1.10	0.6230	0.6180	0.6170	0.6193	0.3836 ± 0.0010
1.20	0.6390	0.6360	0.6370	0.6373	0.4062 ± 0.0010

Table 1. Drop Height against Squared of Time in Free Fall



Reconciliation of Results

The relationship between distance fallen *(d)* and clasped time *(t)* can be obtained from the kinematics equation:

$$d = ut + \frac{1}{2}at^2$$

where:

d: displacement

u: initial velocity

a: acceleration

t: clasped time

As in this case the initial velocity is zero, and acceleration is equal to the gravitational acceleration *(g)* we obtain:

$$d = \frac{1}{2}gt^2$$

Thus the gradient of the graph plotting drop heigh against square of time in free fall will yield a linear relationship, whose gradient is predicted to be $0.5g = 0.5 \cdot 9.80665 = 4.903325\ m \cdot s^{-2}$ where g is exact by definition.[1] The range of uncertainty of the gradient, obtained by the worst-fit lines from the graph, is:

$$\frac{1.90 - 1.10}{0.393 - 0.216} \leq \text{gradient} \leq \frac{2.00 - 1.00}{0.396 - 0.218}$$

$$4.51977 \leq \text{gradient} \leq 5.61798$$

$$\text{gradient} = 5.1 \pm 0.5$$

Whose range includes the theoretical value of $0.5g = 4.903325\ m \cdot s^{-2}$, though with an unimpressively large uncertainty.

[1] *Anon. "Standard Acceleration of Gravity." The NIST Reference on Constants. https://physics.nist.gov/cgi-bin/cuu/Value?gn. Accessed 21 March 2019.*