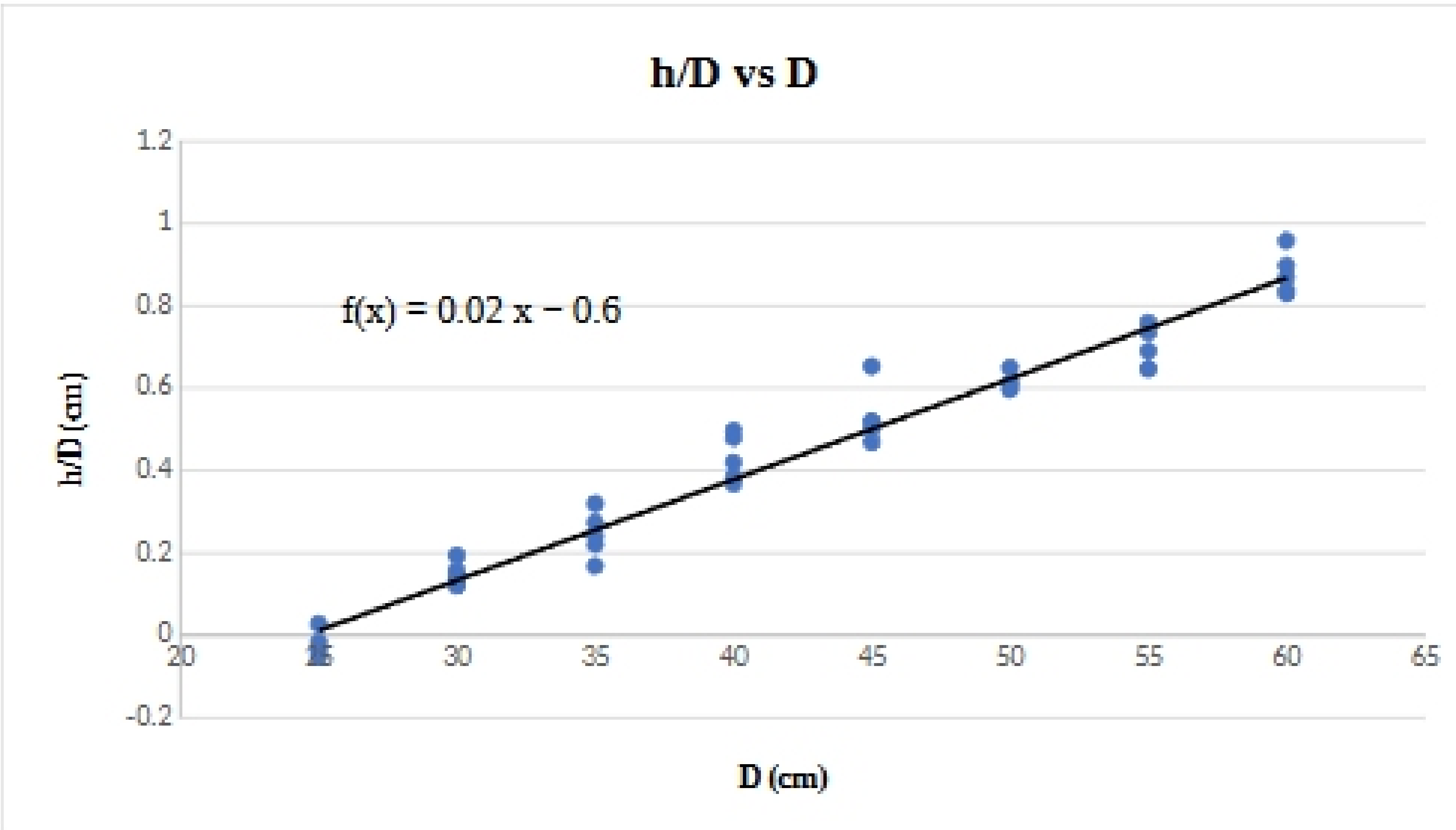
VI-1

D (cm)	h (cm)	h/D
25	-1.3	-0.052
25	-1.3	-0.052
25	0.7	0.028
25	-0.9	-0.036
25	-0.4	-0.016
30	4.2	0.14
30	3.6	0.12
30	5.8	0.19333333
30	3.9	0.13
30	4.7	0.15666667
35	5.9	0.16857143
35	7.7	0.22
35	8.4	0.24
35	11.2	0.32
35	9.6	0.27428571
40	16.8	0.42
40	14.7	0.3675
40	19.2	0.48
40	19.9	0.4975
40	15.4	0.385
45	29.4	0.65333333
45	23.3	0.51777778
45	21.1	0.46888889
45	23.4	0.52
45	22.5	0.5
50	30.6	0.612
50	29.9	0.598
50	32.5	0.65
50	30.6	0.612
50	29.9	0.598
55	38	0.69090909
55	35.6	0.64727273
55	40.5	0.73636364
55	35.6	0.64727273
55	41.8	0.76
60	50.2	0.83666667
60	57.5	0.95833333
60	53.9	0.89833333
60	49.8	0.83
60	52.2	0.87

VI-2



VI-3

Using the LINEST function in Excel, I calculated the slope (s), intercept (b), and the uncertainty for both quantities.

Slope, *s*	0.02448088	-0.6006873	y-intercept, *b*
Slope uncertainty σ_s	0.00076553	0.03369643	Intercept uncertainty σ_b

Using the y-intercept, the experimental launch angle, θ_e , was calculated by using the following formula: $b=-¿$, and the uncertainty was calculated using the formula $\sigma_{\theta_e}=\frac{\sigma_b}{1+b^2}$.

For the calculations, we have the following:

We use $b=-¿$ and rearrange it so we have $-\tan^{-1}(b)=\theta_e$

$-\tan^{-1}(b)=\theta_e$

$-\tan^{-1}(-0.6006873)=\theta_e$

$30.99° \quad 31° = \theta_e$

$$\sigma_{\theta_e} = \frac{\sigma_b}{1+b^2}$$

$$\sigma_{\theta_e} = \frac{(0.03369643)}{(1+(-0.6006873)^2)}$$

$$\sigma_{\theta_e} = 0.02°$$

I then calculated θ_m by averaging all of the angles that were measured with the protractor on the launch track during the experiment. After this, I calculated the uncertainty in the measured angle, σ_{θ_m}, by taking half of the minimum and maximum values measured with the protractor.

$$\theta_m = \frac{\theta_1 \theta_2 \theta_3}{3}$$

$$\theta_m = \frac{45°+34°+40°}{3}$$

$$\theta_m = 39.7°$$

$$\sigma_{\theta_m} = \frac{\theta_{max} - \theta_{min}}{2}$$

$$\sigma_{\theta_m} = \frac{45° - 34°}{2}$$

$$\sigma_{\theta_m} = 5.5°$$

$\theta_e \pm \sigma_{\theta_e} = 31° \pm 0.02°$
$\theta_m \pm \sigma_{\theta_m} = 39.7° \pm 5.5°$

Although these values are similar, they have different uncertainties. Even though these uncertainties are different, I feel that θ_e is more reliable than θ_m. This is because I used the y-intercept that LINEST calculated in Excel. This value is more precise because unlike θ_m, we measured using the naked eye which can produce a greater amount of uncertainty as seen above.