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Practice Unit Test

Follow the instructions carefully and apply everything you learned in this unit. Show all your work on separate sheets of lined and graph paper.

1) Graph the following data with appropriate error bars.

Table 1. Distance traveled by car over time.

Trial	Time (s) (±0.03s)	Distance (m) (±0.2m)
1	0.50	1.9
2	1.00	8.1
3	1.50	15.9
4	2.00	29.0
5	2.50	47.2
6	3.00	65.7

2) Sketch the best fit line on your first graph.

3) Showing your calculations, linearize and plot your 2nd graph on another sheet of graph paper (or flip side of 1st graph).

4) Showing your calculations, draw the error bars on your 2nd graph.

5) Draw the best and worse fit lines and calculate the max, best, and min slope of your linearized graph.

6) Calculate your slope uncertainty and write down your final m_{best} slope.

Bonus: Given that the equation $d = vt + \frac{1}{2}at^2$ find the acceleration of the car including units and uncertainty.

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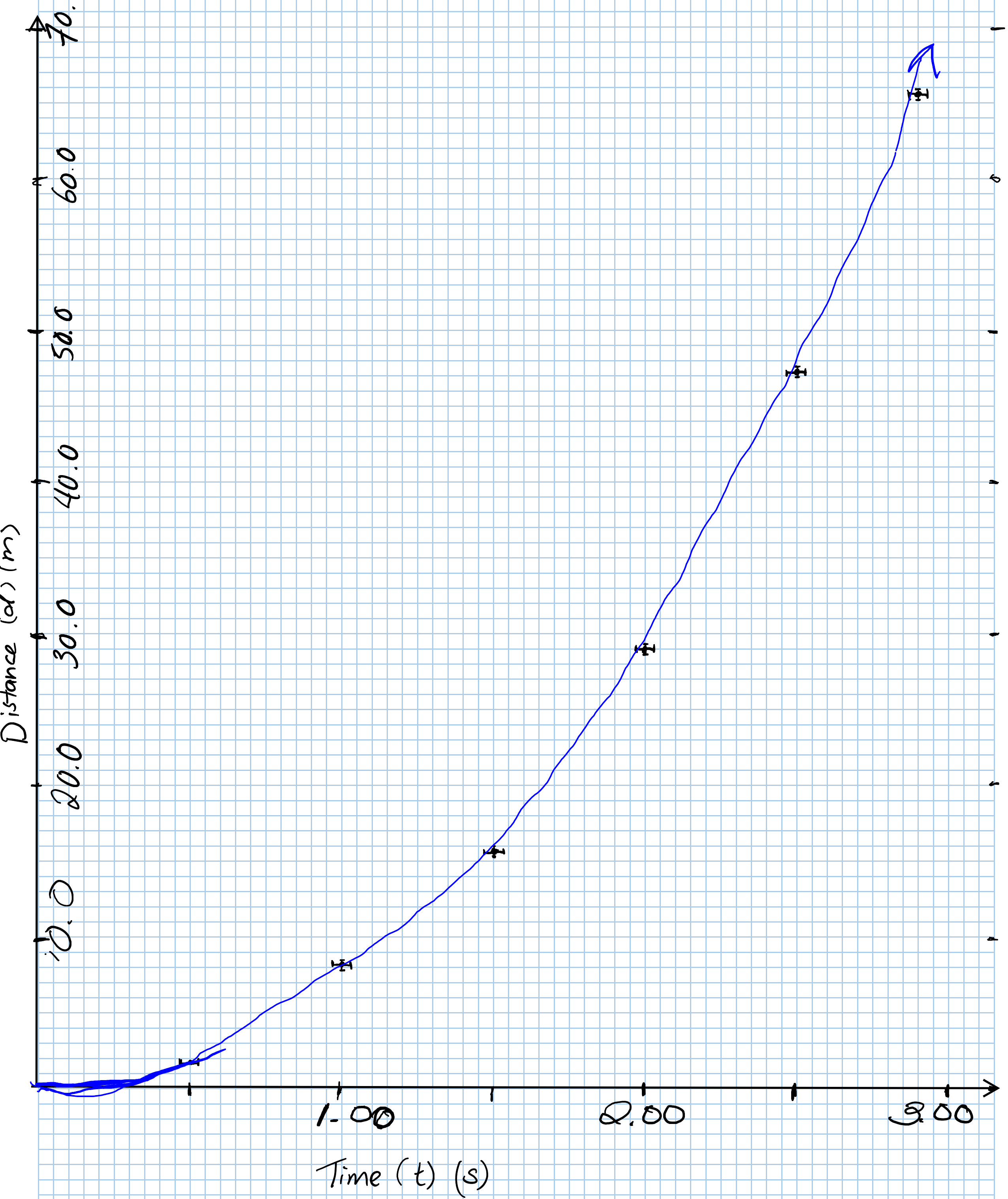
Distance covered by a car over time



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3) For 2nd graph, square the time values

ex.

x	x^2	y (Keep the same)
0.5	0.25	
1.00	1.00	
1.50	2.25	
2.00	4.00	
2.50	6.25	
3.00	9.00	

4) y's error bars stay the same.

since we took the square of x-values.

$$\Delta x^2 = \left| \frac{\Delta x}{x} \times 2 \right| \times x^2 = 0.03 \times 2 \div \begin{vmatrix} x \\ 0.5 \\ 1.00 \\ 1.50 \\ 2.00 \\ 2.50 \\ 3.00 \end{vmatrix} \times \begin{vmatrix} x^2 \\ 0.25 \\ 1.00 \\ 2.25 \\ 4.00 \\ 6.25 \\ 9.00 \end{vmatrix} = \begin{vmatrix} \Delta x^2 \\ 0.03 \\ 0.06 \\ 0.09 \\ 0.12 \\ 0.15 \\ 0.18 \end{vmatrix}$$

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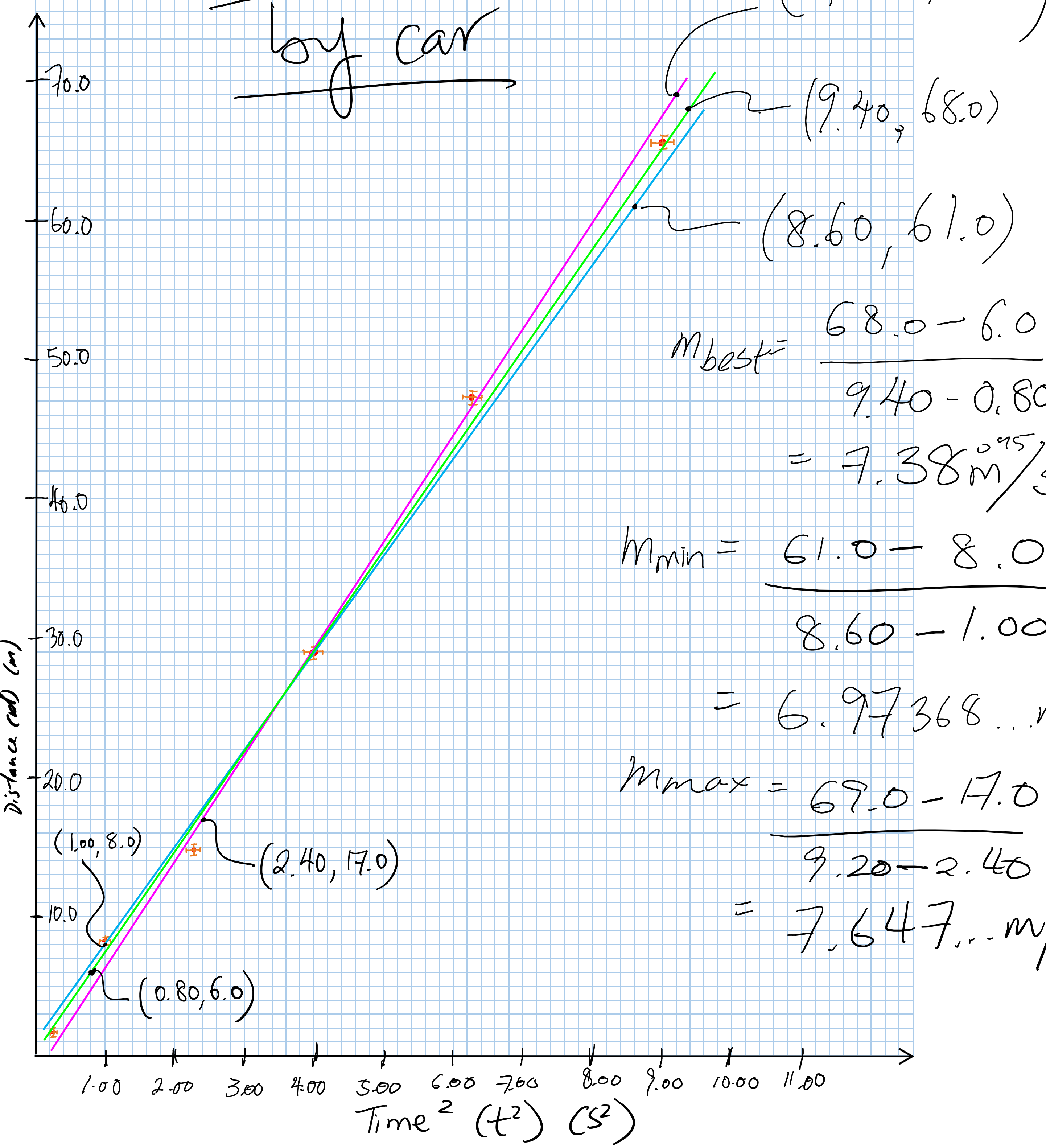
Linearized graph of distance traveled toy car



$$m_{best} = \frac{68.0 - 6.0}{9.40 - 0.80} = 7.38095\ldots \ m/s^2$$

$$m_{min} = \frac{61.0 - 8.0}{8.60 - 1.00} = 6.97368\ldots \ m/s^2$$

$$m_{max} = \frac{69.0 - 17.0}{9.20 - 2.40} = 7.647\ldots \ m/s^2$$

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6) $\Delta m_{best} = \frac{m_{max} - m_{min}}{2}$

$= \frac{7.647... - 6.97368...}{2}$

$= 0.336689... \, m/s^2$

$m_{best} = \boxed{7.4 \pm 0.3 \, m/s^2}$

Bonus

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

or

$d = \frac{1}{2}at^2 + vt$ .. similar to

$y = m_{best}x + b$; $b = vt$

$\frac{1}{2}at^2 = m_{best}x$ so $\frac{1}{2}a = m_{best}$

$a = 2m_{best} = 2(7.38095..)$

$= 14.76... \, m/s^2$

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a's absolute error: $2 \times \Delta m_{best}$

$= 2(0.0336689\ldots) =$

$0.673378\ldots\ m/s^2$

$a_{experimental} = \boxed{14.8 \pm 0.7\ m/s^2}$