Experimental Design

Using at least two of the materials provided, perform an experiment related to **motion**. The materials available for you to use are listed below.

- ❏ 1 meter stick
- ❏ a 6” x 6” piece of cardboard
- ❏ 3 rubber bands
- ❏ 2 small marbles
- ❏ 2 medium-sized marbles
- ❏ 2 large marbles
- ❏ 1 small car
- ❏ 1 medium-sized car
- ❏ 1 large car
- ❏ 2 pencils
- ❏ a stopwatch
- ❏ a triple beam balance

You will have 50 minutes to conduct & write-up your experiment. Please put all materials back to their original spot. Scoring will be based off the 2017-2018 rubric. Good luck!

A. Statement of problem (4 Points)

B. Hypothesis (8 points)

C. Variables (20 points)

D. Experimental Control (Standard of Comparison-SOC) (4 points)

E. Materials (6 points)

F. Procedure: Including Diagrams (12 points)

G. Qualitative Observations (8 points)

H. Quantitative Data - Data Table (12 points)

I. Graphs (10 points)

J. Statistics Division B&C (6 points)

K Analysis and interpretation of data (8 points)

L. Possible Experimental Errors (6 points)

M. Conclusion (8 points)

N. Applications and Recommendations for Further Use (8 points)

Experimental Design
Sample Response

Using at least two of the materials provided, perform an experiment related to **motion**. The materials available for you to use are listed below.

- ❏ 1 meter stick
- ❏ a 6” x 6” piece of cardboard
- ❏ 3 rubber bands
- ❏ 2 small marbles
- ❏ 2 medium-sized marbles
- ❏ 2 large marbles
- ❏ 1 small car
- ❏ 1 medium-sized car
- ❏ 1 large car
- ❏ 2 pencils
- ❏ a stopwatch
- ❏ a triple beam balance

You will have 50 minutes to conduct & write-up your experiment. Please put all materials back to their original spot. Scoring will be based off the 2017-2018 rubric. Good luck!

A. Statement of problem (4 Points)

Does the mass of the car affect the distance it travels after being rolled down a ramp?

B. Hypothesis (8 points)

If the mass of the car increases, then the distance travelled will also increase because a heavier car gathers more momentum and kinetic energy as it moves down the ramp, thus letting it travel further

C. Variables (20 points)

The independent variable is the mass of the car, operationally defined by the weight as determined by placing a car on the triple-beam balance. The first level is the smallest car, which has a weight of 10 grams. The second level is the medium-sized car and a weight of 14 grams. The third level is the largest car, which has a weight of 23 grams.

The dependent variable is the distance travelled, operationally defined by the centimeters the car has travelled after it reaches the end of the ramp.

Controlled Variables:

1) surface of the ramp
2) surface of the table
3) type of wheel on the car
4) starting height of the car

D. Experimental Control (Standard of Comparison-SOC) (4 points)

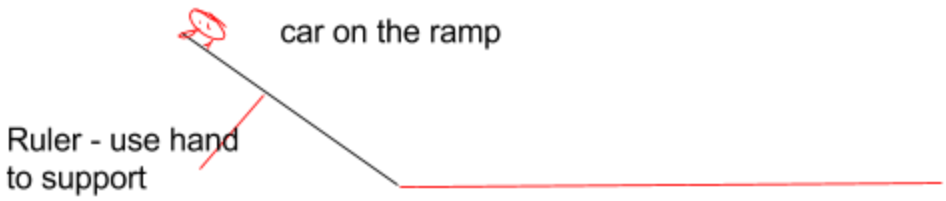
There will be no positive or negative controls for this experiment. Given the context of the experiment, neither seems fit nor appropriate.

E. Materials (6 points)

1) meter stick
2) 6” x 6” cardboard
3) small car
4) medium-sized car
5) large car
6) pencil

F. Procedure: Including Diagrams (12 points)

1) Determine the mass of the three cars by using the triple-beam balance.
2) Using a ruler, prop up the 6”x6” piece of cardboard to a 35 degree angle.
3) Place the small car at the top of the cardboard so that the rear wheels touch the very edge.
4) Let go of the car so that it goes down the ramp and onto the table
5) Use a meter stick to determine the distance travelled in centimeters.
6) Record data and repeat steps 2-5 two more times so you get three trials total
7) Repeat steps 2-6 for the medium-sized and large cars.



G. Qualitative Observations (8 points)

The cars travelled in a straight line for the most part.
The cars sped up as they went further down the ramp.
The large car had a much larger frame than the other two cars.
The small car had the smallest frame.
The person stabilizing the ruler slipped and had to take the ruler off and place it under again.

H. Quantitative Data - Data Table (12 points)

Raw Data

Distance Travelled (cm)

Total Mass of Car (g)

	Trial 1	Trial 2	Trial 3
10	10	11	9
14	12	7	7
23	3	2	1

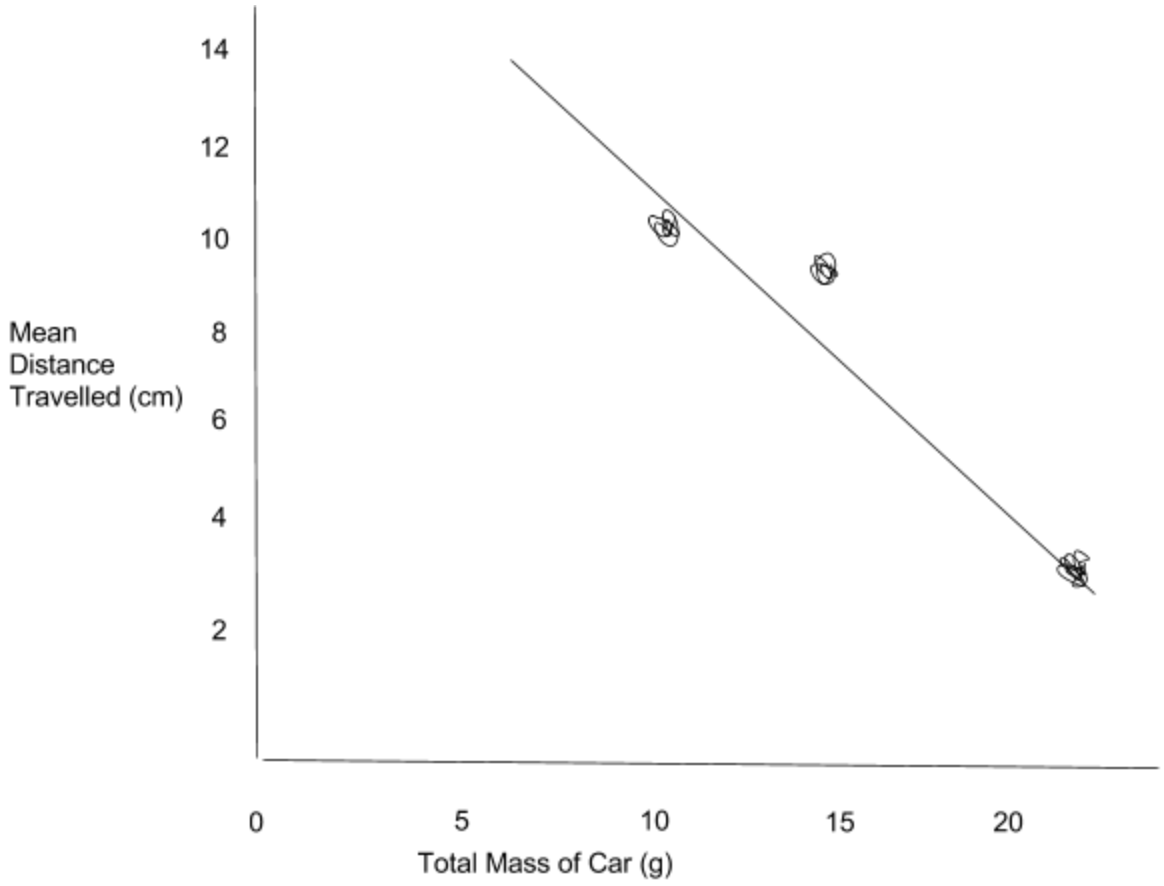
Important Data (condensed)

Total mass (g) Distance Travelled (cm)

	Mean	Standard Deviation
10	10	1
14	8.7	2.9
23	2	1

Sample Calculations:
Mean of 10g car: (10+11+9)/3 = 10cm
Standard Deviation of 10g car: sqrt[[(10-10)^2+(11-10)^2+(9-10)^2]/2] = 1cm

I. Graphs (10 points)



J. Statistics Division B&C (6 points)

Mode: most. 7 for 14g car. Others don't have a mode
Range: 10g car: 11-9=2cm
14g car: 12-7=5cm
23g car: 3-1=2cm
Median: middle value. 10g car: 10cm. 14g car: 7cm. 23g car: 2cm.

Regression Line: y = 17-0.64x
r = -0.99
r^2 = 0.98

K Analysis and interpretation of data (8 points)

As the total mass of the car increased, the distance travelled decreased. Specifically, as the mass of the car increased from 10g to 14g to 23g, the mean distance travelled decreased from 10cm to 8.7cm to r2cm. There was an unusual point in Trial 1 of the 14g car. The car travelled 12cm, which was further than all the trials in the 10g car. This was unexpected, and increased the standard deviation to 2.9cm, significantly higher than that of the other two cars. The regression line has a negative slope, and its correlation value r is -0.99. This suggests a strong, negative linear relationship. The r^2 value is 0.98, showing that 98% of the variation of the distance travelled is supported by the variation in the car mass.

L. Possible Experimental Errors (6 points)

A possible error was that the angle of the ramp was not consistent. This could have altered the results in either direction and it may have attributed to the high standard deviation in the 14g car. Another potential error was that we did not wipe the table beforehand. Debris preexisting on the table may have caused the car to slow down which could have decreased travel distance.

M. Conclusion (8 points)

We hypothesized that as the mass of the car increased, the distance travelled would also increase. Our data counters this. Instead, we see the trend that increasing the mass of the car decreases travel distance. This is clearly shown by the graph and the r value of -0.99.

N. Applications and Recommendations for Further Use (8 points)

We believe this could be because our ramp was not long enough, thus not allowing the cars to gather enough momentum. In the future, we could increase the ramp length and redo this experiment to see if the current trend holds up. As for improvements on our experiment, we could use a protractor to calculate the precise angle and use something more stable than a human hand to support the ruler. Instead of looking it at from a mass vs distance perspective, we could do length of car vs distance. Practical applications include using this experiment as a model to see how far real cars roll if set in neutral mode. Additionally, it could be used to evaluate car races that involve custom model cars that slide down a ramp.

Experimental Design

Using at least two of the materials provided, perform an experiment related to **solubility**. The materials available for you to use are listed below.

- ❏ 3 250ml beakers
- ❏ sugar
- ❏ table salt
- ❏ a 100ml graduated cylinder
- ❏ food coloring (red, green, blue)
- ❏ a stirring rod
- ❏ olive oil
- ❏ a stopwatch
- ❏ tap water

You will have 50 minutes to conduct & write-up your experiment. Please put all materials back to their original spot. Scoring will be based off the 2017-2018 rubric. Good luck!

A. Statement of problem (4 Points)

B. Hypothesis (8 points)

C. Variables (20 points)

D. Experimental Control (Standard of Comparison-SOC) (4 points)

E. Materials (6 points)

F. Procedure: Including Diagrams (12 points)

G. Qualitative Observations (8 points)

H. Quantitative Data - Data Table (12 points)

I. Graphs (10 points)

J. Statistics Division B&C (6 points)

K Analysis and interpretation of data (8 points)

L. Possible Experimental Errors (6 points)

M. Conclusion (8 points)

N. Applications and Recommendations for Further Use (8 points)

Experimental Design

Using at least two of the materials provided, perform an experiment related to **flight**. The materials available for you to use are listed below.

- ❏ 10 sheets of 8x11 paper
- ❏ 6 rubber bands
- ❏ 10 paper clips
- ❏ 2 pencils
- ❏ a meter stick
- ❏ a stopwatch

Note: More paper can be given out per request.

You will have 50 minutes to conduct & write-up your experiment. Please put all materials back to their original spot. Scoring will be based off the 2017-2018 rubric. Good luck!

A. Statement of problem (4 Points)

B. Hypothesis (8 points)

C. Variables (20 points)

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