Name: ______________________________ Date: ______________ Per: ________

Deriving the Pendulum Equation

Newton's second law of motion ($F_{net} = ma$) and the ideal gas law ($PV = nRT$) were derived by generalizing from empirical data. In this activity, you will develop part of an equation for the period (the time of one cycle) of a pendulum to see how it relates to mass and length. The period of a pendulum is the time required for the pendulum to return to its original position. To determine the period, measure 10 cycles and take the average.

1. Measure the average period for the corresponding string lengths and fill in the table below:

Length (cm)	Period (s)
10	
20	
30	
40	
50	
60	
70	
80	

mass = 500 g

Independent variable(s): ______________________

Dependent variable(s): ______________________

Constant(s): ______________________________

After filling out the table, add your data to the class Google Sheet.

2. Measure the average period for the corresponding pendulum masses and fill in the table below:

Mass (g)	Period (s)
100	
200	
300	
400	
500	
600	
700	
800	

length = 50 cm

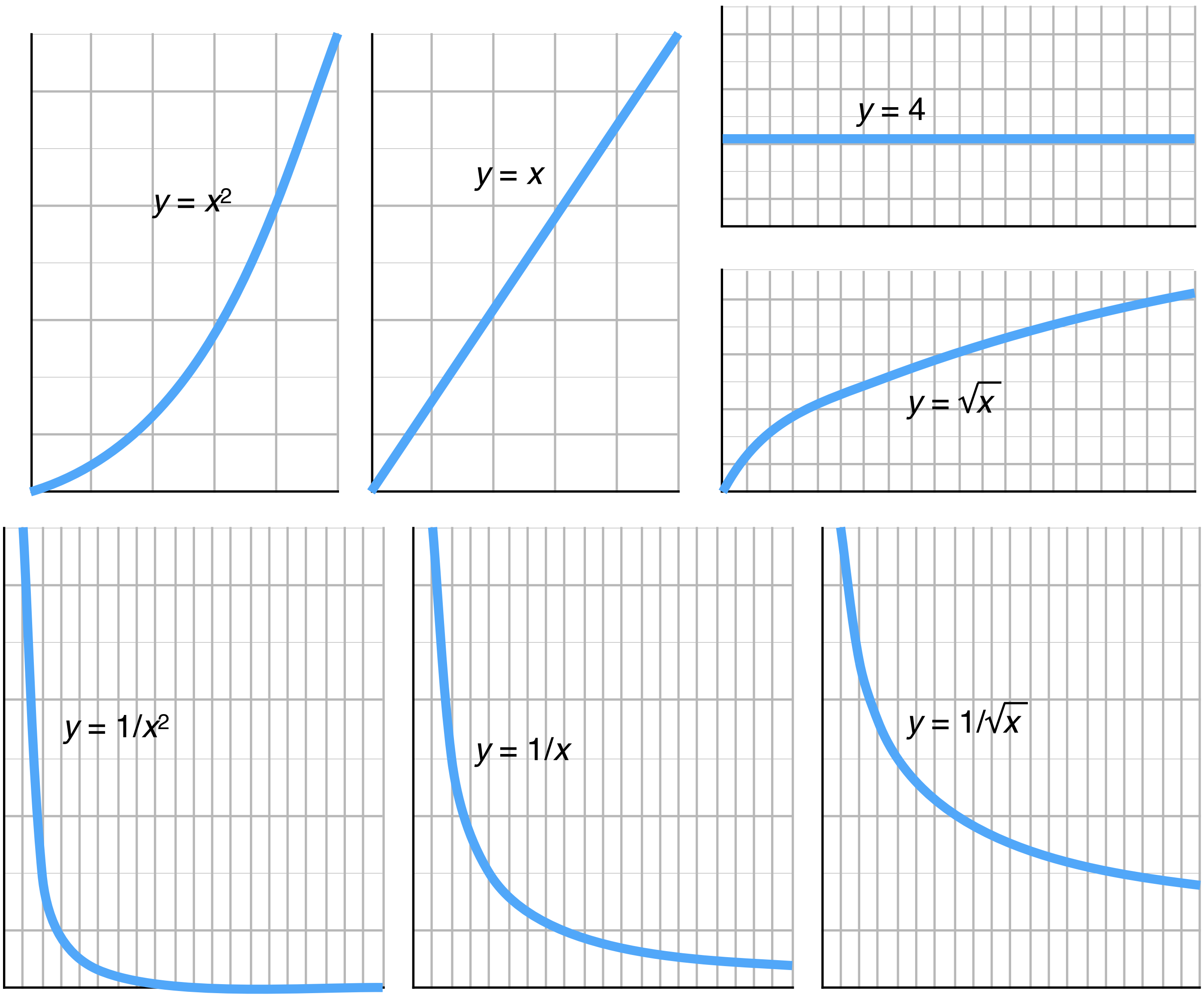
Independent variable(s): ______________________

Dependent variable(s): ______________________

Constant(s): ______________________________

After filling out the table, add your data to the class Google Sheet.

The figures below show some common graphical relationships. If, for example, the graph is a horizontal line, such as $y = 4$, then there is no relationship between the dependent and independent variables.



3. Which relationship best represents how period changes with **string length**? ________________

4. Which relationship best represents how period changes with **mass**? ________________________

5. Which of the following mathematical expressions is consistent with you data? (T = period, L = length of the pendulum, m = mass of the pendulum. The other factors are constants)

(a) $T = 2\pi g\sqrt{m/L}$

(b) $T = \frac{2\pi m\sqrt{L}}{g}$

(c) $T = 2\pi gLm$

(d) $T = 2\pi\sqrt{L/g}$

(e) $T = L^2m^2/2\pi g$