# *Power Relationships*

**General Relationships**

A power relationship is one that can be described with $y = A\,x^n$ where A is some constant. Often in discovering relationships, it is the power that is unknown. One of best ways to gain access to the power is to use logarithms.

Taking the log of both sides of the equations:

$$log(y) = log(Ax^n)$$

$$log(y) = n\,log(x) + log(A)$$

When the result is graphed on a set of axes evenly scaled for the log values, the result is a straight line. This means the relationship follows the equation.

$$y = mx + b$$

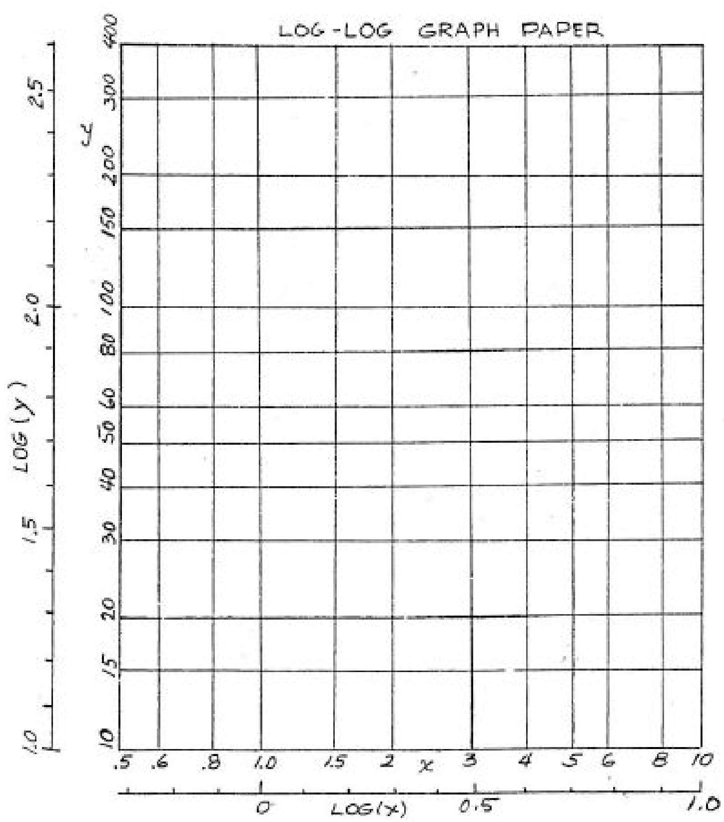
The slope of this line is the power, *n*.

Fill in the table below. Enter the slope after you graph each relationship.

| y=20x | | $y=10x^2$ | | $y=10x^3$ | | y=50 | | y=100/x | | $y=1000/x^2$ | | $y=20+x^2$ | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| x | y | x | y | x | y | x | y | x | y | x | y | x | y |
| 0.5 | 10 | 1 | | 1 | | 1 | | 0.5 | | 2 | | 1 | |
| 1 | 20 | 2 | | 2 | | 3 | | 1 | | 5 | | 2 | |
| 2 | | 4 | | 3 | | 5 | | 2 | | 10 | | 3 | |
| 4 | | 6 | | | | 10 | | 5 | | | | 5 | |
| 10 | | | | | | | | 10 | | | | 10 | |
| Power | 1 | Power | 2 | Power | 3 | Power | 0 | Power | -1 | Power | -2 | Power | NA |
| Slope | | Slope | | Slope | | Slope | | Slope | | Slope | | Slope | |

On the graph at the right, plot the points for each relationship. Use the internal scale to plot the points. If the result is a straight line, fit a best-fit line through the data points.

Find the slope of each relationship and record it above. Use the outer scale to find the values for slope calculations. Show your calculations in the space below.



**Gravitational Data**

Suppose a lab is performed to find the relationships between the masses of two spheres ($m_1$, $m_2$), the distance between the spheres (r) and the force between the spheres (F). The units of mass, distance and force have been adjusted for ease of scaling.

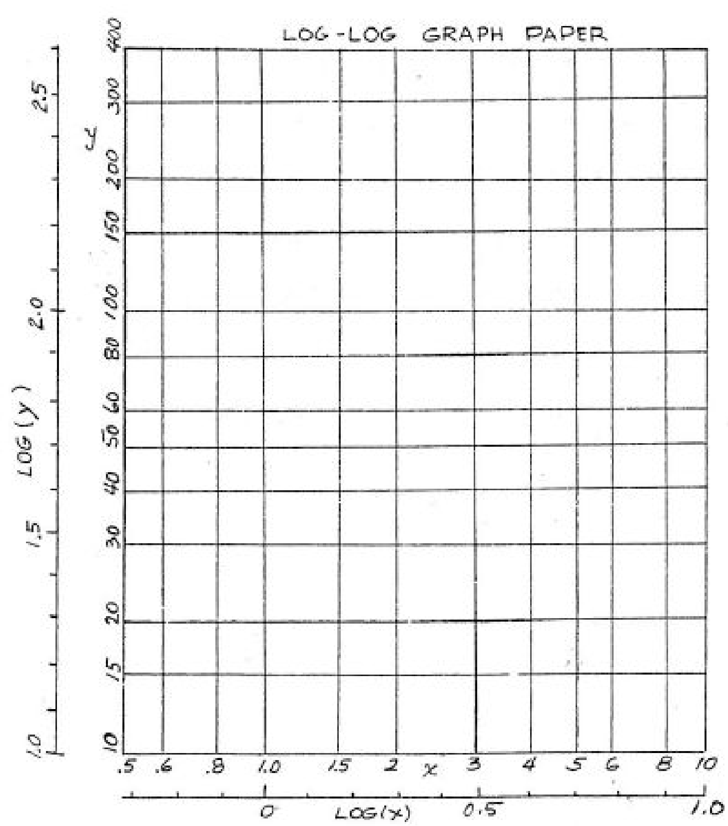
Case 1: Two spheres are held a given distance apart. The mass of one of the spheres is changed and the force between the spheres is measured.

Case 2: A repeat of the previous case with the other mass changed.

Case 3: The masses are held constant and the distance between them is changed.

| Case 1 | | Case 2 | | Case 3 | |
|---|---|---|---|---|---|
| Mass 1 | Force | Mass 2 | Force | Separation | Force |
| 0.5 | 10 | 1 | 10 | 1 | 400 |
| 1 | 20 | 2 | 20 | 2 | 100 |
| 2 | 40 | 3 | 30 | 4 | 25 |
| 4 | 80 | 6 | 60 | | |
| Slope | | Slope | | Slope | |
| Power | | Power | | Power | |

Find the power of each relationship.




Combine all of the relationships into a single equation that relates F, $m_1$, $m_2$ and r.