PhET Simulation: Gravity Force Lab

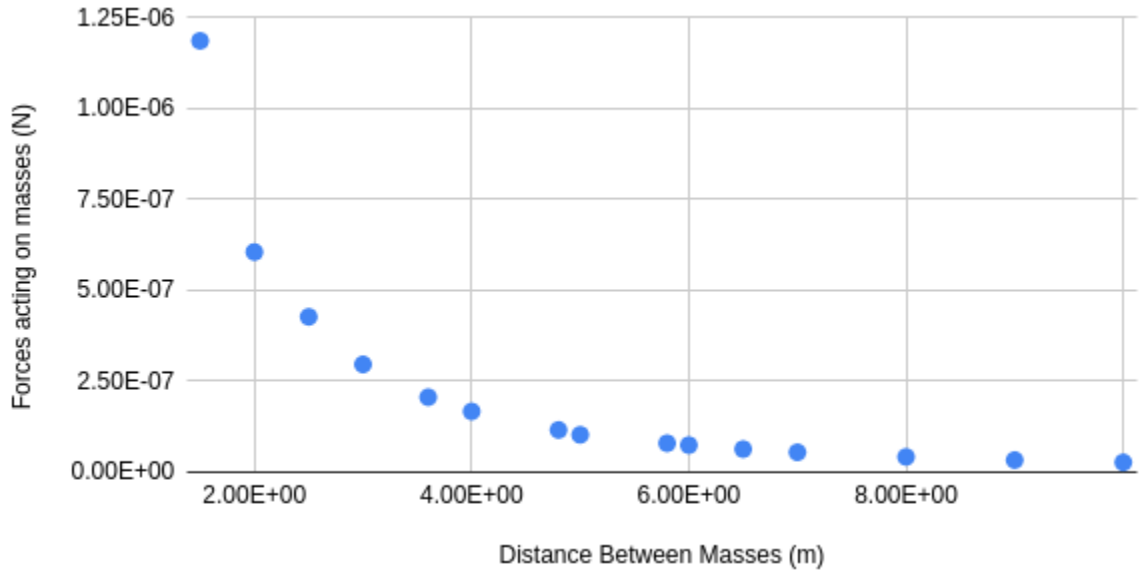
Part 1: Distance and Force

Mass 1 is **100 kg** and Mass 2 is **400 kg.**

Table 1: Separation Distance and Resulting Forces

Distance Between Masses/m	Force acting on Masses/N
4	1.66852×10^{-7}
6	7.4156×10^{-8}
3	2.96626×10^{-7}
2	6.05359×10^{-7}
1.5	1.186503×10^{-6}
5	1.02639×10^{-7}
7	5.4482×10^{-8}
10	2.6696×10^{-8}
9	3.2958×10^{-8}
8	4.1713×10^{-8}
6.5	6.3187×10^{-8}
5.8	7.9359×10^{-8}
4.8	1.15869×10^{-7}
3.6	2.0599×10^{-7}
2.5	4.27141×10^{-7}

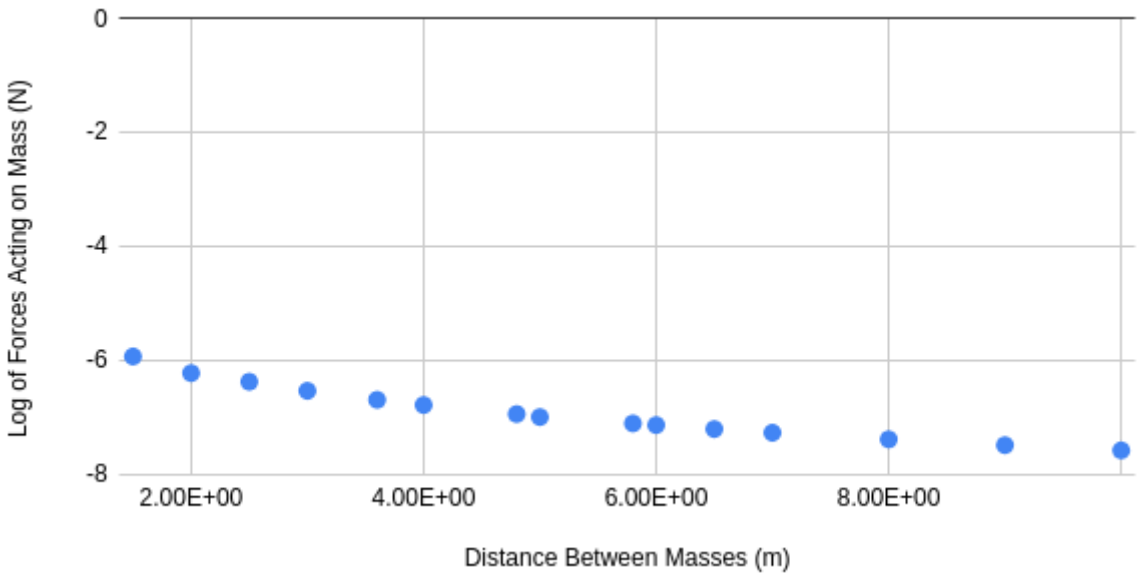
1. Create a graph to show the relationship between the separation distance and the resulting force. Title this graph "**Graph 1: Distance and its effect on Force.**"



> This is not a linear relationship. What kind of curve fit/relationship does the data fit?

This data has an exponential relationship.

> Linearize your graph. Explain, below, what you did to linearize your data, and show 1 sample calculation for that process



I took the logarithm of the forces acting on the mass.

$$\log(1.67 \times 10^{-7}) = \boxed{-6.777}$$

> What is the equation for your linearized graph?

$$N = -0.182m - 5.95$$

> Slope?

$$-0.182\ N/m$$

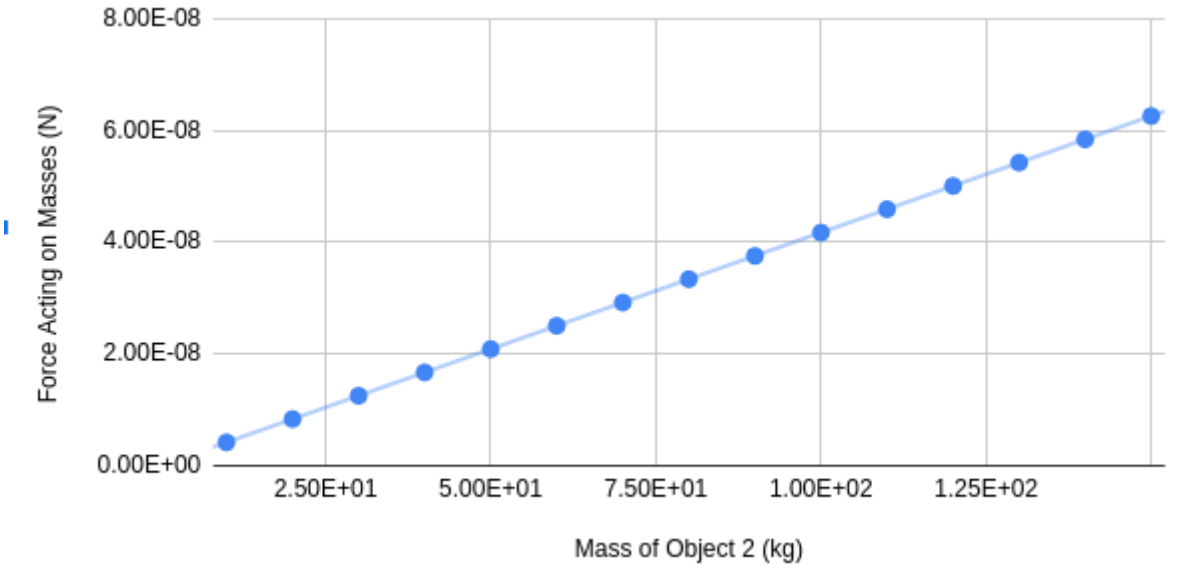
Part 2: Mass and Force

The constant mass of object 1 is **100 kg** and the constant separation distance is **6 meters.**

Table 2: Mass of Object 2 and Resulting Forces

Mass of Object 2 / kg	Force acting on Masses / N
10	4.171×10^{-9}
20	8.343×10^{-9}
30	1.251×10^{-8}
40	1.669×10^{-8}
50	2.086×10^{-8}
60	2.503×10^{-8}
70	2.9199×10^{-8}
80	3.337×10^{-8}
90	3.754×10^{-8}
100	4.171×10^{-8}
110	4.588×10^{-8}
120	5.006×10^{-8}
130	5.423×10^{-8}
140	5.840×10^{-8}
150	6.257×10^{-8}

> Create a graph to show the relationship between the changing mass and the resulting force. Title this graph “Graph 3: Mass and its effect on Force”.



> What is the equation for your graph? Replace the “x” and “y” with the proper symbols representing what you put on each axis.

$$4.17 \times 10^{-10} kg - 2 \times 10^{-9} = N$$

> What is your slope, including units?

$$4.17 \times 10^{-10}\ N/kg$$

3. Data-based prediction: How might the relationships be connected? Are there any similarities among your results?

The relationships might be connected due to Newton's law of gravitation, which establishes a linear relationship between force and mass. Additionally, it establishes an exponential relationship between distance and force.