AP Physics – Gravity Force Lab **Name:**_____

Today, you will use the Gravity Force Lab PhET Simulation to investigate what the gravitational force between two objects depends on and experimentally determine the Universal Gravitational constant, G.

PreLab and Beginning Observations (Individual)

1) Write the formula for the force of gravity (Law of Universal Gravitation). Label each variable and constant and include its units. Use your formula sheet if you do not remember it.

2) Open the Gravity Force PhET Simulation. What can you change about the simulation?

Part 1 – Qualitative Observations (Individual)

3) Look at the formula above. What three things can you change in the formula that you can also change in the simulation?

4) Systematically change each variable and record what happens to the gravitational force as you change it. Be specific with your language (i.e. use terms like increase, decrease, remains constant).

Part 2 – Quantitative Measurements (Partner – 1, Write-Up Per Group on a separate sheet of paper.)

In this section of the lab, you will develop your own method for determining the gravitational constant G in the formula for gravity using the simulation and LoggerPro / Google Sheets.

Possible ideas

- Change mass 1 and keep mass 2 and the distance constant and record gravitational force.
- Change distance and keep mass 1 and 2 constant and record gravitational force.

In both of these examples, think about what you would graph and how it would allow you to determine the constant G. Will your slope represent G only? How much data should you collect given your time constraints? Write the formula for Fg in y = (m)x + b format to show what you are graphing.

You will turn in your procedure, data, data analysis (graph and calculations) and value for G.

Conclusion/Post-Lab

1. Gravitational force is always *attractive / repulsive. (circle)*

2. Newton's 3rd Law tells us that if a gravitational force exists between two objects, one very massive and one less massive, then the force on the less massive object will be *greater than / equal to / less than* the force on the more massive object.

3. *The distance between masses is measured from their edges between them / from their centers / from the edge of one to the center of the other.*

4. *As the distance between masses decreases, force increases / decreases.*

5. Doubling the mass of **both** masses would result in a change of force between the masses *of 8x / 6x / 4x / 2x / no change / 1/2x / 1/4x / 1/6x / 1/8x.*

6. Reducing the distance between two masses to half while doubling the mass of **one** of the masses would result in a change of force between the masses of *8x / 6x / 4x / 2x / no change / 1/2x / 1/4x / 1/6x / 1/8x.*

7. What is the gravitational force between two students, Dylan and Sarah, if Dylan has a mass of 75 kg, Sarah has a mass of 54 kg, and their centers are separated by a distance of .45 m? _____ N

   Work:

8. Imagine a 4820 kg satellite in a geosynchronous orbit. If an 85 kg piece of space junk floats by at a distance of 3.5 m, what force will the space junk feel from the satellite? _____ N

   Work:

9. With what acceleration will the space junk move toward the satellite? _____

   Work:

10. With what acceleration will the satellite move (if any)? _____

    Work:

The moon has a mass of 7.35x1022 kg and is a lot farther away than is shown in textbooks. The mass of the earth is 5.97x1024 kg. The moon's mean orbit distance (center-to-center) is around the earth is 3.84x108 m. With all this information determine:

11. The gravitational force on the moon by the earth. _____ N

    Work:

12. The gravitational force on the earth by the moon. _____ N

    Work:

13. The centripetal acceleration of the moon around the earth, realizing that the gravitational force is also centripetal force. _____

    Work:

14. The speed of travel of the moon around the earth, using the formula for the speed of a moving object in a circular path. _____ m/s

    Work: