Date ____________ First name ____________ Last name ____________

LABORATORY 4

Effective weight on other planets

This is a laboratory designed to help us to appreciate mass and weight as well as the nature and im portance of gravity. Patterns that you will note in the rotational and orbital periods of the planets ar e the same as those noted by early astronomers and that inspired the works of Kepler and Newton, among others. Before you begin, read some background information on mass, weight and gravity:

Exercise 1. Effective weight on other planets.

Below is a table of the surface gravity of other planets. You will perform calculations to determine your effective weight on other bodies in our solar system (or in other words, what y our weight would feel like under different amounts of gravity).
You will need to calculate the percent difference between gravity on another planet and that of Earth and then use this to determine your weight on the other planet.
The following is an example showing how to calculate your effective weight from the provide d information. In the example we will work on calculating an effective weight on Mercury.
In the example the weight on Earth we will use is 80 kilograms (kg).
For Mercury, Gravity = 3.7m/s.
To find out what percentage of Earth's Gravity this is, divide the value for gravity on Mercury ($3.7 m/s^2$) by the value for gravity on Earth ($9.8\ m/s^2$). As follows: 3.7/9.8 = 0.37. Therefore the force of gravity on mercury is only 37% as strong as on Earth (about a third as strong).
This means that your weight on Mercury would also only be 37% of that on Earth (about a third as heavy).
So, if your weight on Earth was 80kg , this means that on Mercury your effective weight will be 30kg. This was calculated as follows: 0.37*80kg = 30kg.

Table 1. Planets and Gravities.

Planet	Gravity (meter/second^2)
Mercury	3.77
Venus	8.87
Earth	9.8
Mars	3.72
Jupiter	24.8
Saturn	10.4
Uranus	8.87
Neptune	11.14

Task: For a person weighing 80 kilograms (kg) on Earth, calculate their effective weight on the other 8 planets, using the method described above.

A1. For a person weighing 80 kilograms (kg) on Earth, calculate their effective weight on Mercury (in kilograms)?

A2. For a person weighing 80 kilograms (kg) on Earth, calculate their effective weight on Venus (in kilograms)?

A3. For a person weighing 80 kilograms (kg) on Earth, calculate their effective weight on Mars (in kilograms)?

A4. For a person weighing 80 kilograms (kg) on Earth, calculate their effective weight on Jupiter (in kilograms)?

A5. For a person weighing 80 kilograms (kg) on Earth, calculate their effective weight on Saturn (in kilograms)?

A6. For a person weighing 80 kilograms (kg) on Earth, calculate their effective weight on Uranus (in kilograms)?

A7. For a person weighing 80 kilograms (kg) on Earth, calculate their effective weight on Neptune (in kilograms)?

A8 (short answer). Consider carefully the values for the effective weights that you have just calculated, as well as the properties of the planets (e.g., diameter & mass –Table 2) and the equation for gravitational attraction (see equation below).

With regards to how surface gravity varies on different planets, what is a critical observation that you can make from your results about what controls the force of gravity at each planets surface? (Hint: consider that Jupiter is 314 times more massive than Earth, but its surface gravity is only 2.53 times Earth's)?

Table 2. Planets' data.

Planet	Distance from the Sun	Revolution Period	Diameter	Mass	Density
units	(AU)	(year)	(km)	(10^{23} kg)	(g/cm^3)
Mercury	0.39	0.24	4878	3.30	5.4
Venus	0.72	0.62	12120	48.70	5.2
Earth	1.00	1.00	12756	59.80	5.5
Mars	1.52	1.88	6787	6.40	3.9
Jupiter	5.20	11.86	142984	18991.00	1.3
Saturn	9.54	29.46	120536	5686.00	0.7
Uranus	19.18	84.07	51118	866.00	1.3
Neptune	30.06	164.82	49660	1030.00	1.6

Equation.

$$F_g = G\frac{m_1 m_2}{r^2}$$

where

- F_g is the force
- G is the gravitational constant (6.674×10^{-11} m^3.kg^{-1}.s^{-2})
- m_1 and m_2 are the masses of the objects
- r is the distance between the centers of the objects