Laboratory Report

Customer's Name

Academic Institution

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1. The accepted value for gravity (g) on Earth is 9.8 m/s^2. Is gravity constant? Explain. Lunar gravity accelerates objects at 1.6m/s^2. If you were working atop a 600 meter tower on the moon and dropped you hammer: (a) what would its velocity be after 12 seconds of falling? (b) how far would the hammer have traveled after 15 seconds?

Answer: Gravity is not constant. It is dependent on the location and what body exerts it. This means that the gravity on the moon's surface or any object in the universe is not equal to the gravity on the surface of the Earth.

a. Because the hammer was dropped, the initial velocity is zero.

$$v = g_{moon}t = 1.6(12) = 19.2\ m/s$$

Answer: 19.2 m/s downward

b. $$d = \frac{gt^2}{2} = \frac{1.6(15)^2}{2} = 180\ m$$

Answer: 180 m

2. Is there a difference in your calculation of gravity between the heavy ball and the light ball in part I? Should there be? Explain.

$$d = 6 = \frac{g_{heavy}{t_{heavy}}^2}{2} = \frac{g_{heavy}(1.1)^2}{2}$$

$$g_{heavy} = 9.91\frac{m}{s^2}$$

$$d = 6 = \frac{g_{light}{t_{light}}^2}{2} = \frac{g_{lighty}(1.1)^2}{2}$$

$$g_{light} = 9.91\frac{m}{s^2}$$

Answer: There is no difference between the calculated gravity of the heavy ball and light ball. It is expected that there is none because gravity is independent of the mass of the object acted but is constant on Earth.

3. An astronaut on one of the Apollo Moon Landings performed the experiment of dropping a rock hammer and a feather while on the moon. Can you predict the results?

Answer: Both will fall at the same time if dropped from the same height. Gravity is constant because they are on the same location so it follows that they will fall at the same time with an acceleration of 1.6 m/s^2.

4. Is there an effect of mass on the relationship between T and L in Part II? Should there be? Explain.

Answer: The mass has no effect on the relationship between T and L, which is expected. Mass is not part of the equation relating T and L and so mass has no effect on L and T relationship.

5. If you had a 6m pendulum on the moon, how long would it take to complete one swing?

$$\boldsymbol{T = 2\pi\sqrt{\frac{L}{g}} = 2(3.14)\sqrt{\frac{6}{1.6}} = 12.16\ s}$$

Answer: 12.16 seconds

6. How does the period (T) respond when L is increased or decreased? Is this response predicted from the equation? Explain. A simple experiment to determine how the length of a pendulum

influences the period (T) would be to calculate T for (1) a pendulum of length 10m, and then (2) a pendulum of length 15m. Assume this experiment is done on the earth.

For L= 10 m,

$$T = 2\pi\sqrt{\frac{L}{g}} = 2(3.14)\sqrt{\frac{10}{9.8}} = 6.34\ s$$

For L=15 m,

$$T = 2\pi\sqrt{\frac{L}{g}} = 2(3.14)\sqrt{\frac{15}{9.8}} = 7.77\ s$$

Answer: The calculations above shows that L increases as T increases, which is predicted by the equation. It can be noticed that g, π and 2 are constants and so T will only be affected by L. If L is increased, $\sqrt{L}$ will also increase, making the whole right side of the equation increase. Because the only parameter on the left side is T, T must also increase.

7. From your results, describe why a pendulum is ideally suited for use in a clock. What length (L) should a pendulum be to have a swing (back and forth) period of exactly 6 seconds?

Answer: The only parameter that would change the value of T is L. Because L will also be constant for a given pendulum, T will also be constant. This means that pendulums are ideally suited for instruments that tell time, such as a clock.

$$T = 2\pi\sqrt{\frac{L}{g}} = 2(3.14)\sqrt{\frac{L}{9.8}} = 6\ s$$

$$L = 8.95\ m$$

Answer: 8.95 m

8. Suppose that we had done the ball drop experiment. In this case we dropped a heavy ball 10 times a distance of 11 meters. The average time to hit was 1.5 seconds. What would your experimental calculation for the acceleration due to gravity be based on this data? (Show calculations)

$$d = \frac{gt^2}{2} = \frac{g(1.5)^2}{2} = 11$$

$$g = 9.78\frac{m}{s^2}$$

Answer: Acceleration due to gravity is 9.78 m/s^2

9. Now we repeated the above experiment, but used a very light-weight Styrofoam ball. The average time to hit in this case was 1.8 seconds. What is the experimental calculation for acceleration due to gravity based on this data. What might account for the difference between our experimental value and the actual value?

$$d = \frac{gt^2}{2} = \frac{g(1.8)^2}{2} = 11$$

$$g = 6.79\frac{m}{s^2}$$

Answer: Acceleration due to gravity is 6.79 m/s^2. This value is less than the value computed in 8 because of the effect of air resistance. In real life situation, air resists the motion of objects. Because the weight of the Styrofoam ball is light, it is affected more by air resistance and so the apparent acceleration due to gravity would be much less than the accepted value.