1. Explain the two basic requirements (criteria) for knowing something scientifically and explain why the pendulum experiment is considered scientific.
   a. Requirement 1: **Independently verifiable observations, anyone else can observe all of the pendulum trials that you did**

   b. Requirement 2  **Testable claims, all of our null hypotheses can be tested**

2. State Newton’s 1st Law of Motion (Law of Inertia)? **An object at rest remains at rest and an object in motion remains in motion unless acted upon by an unbalanced force.**

3. Define gravity. **The force of attraction between all masses in the universe. The closer the masses are together, the more attraction. The larger the masses, the greater the attraction.**

4. What was the purpose of the pendulum experiment? (What question are you trying to answer?) **The purpose is to determine if the mass, angle of swing, or length of string changes the period of the pendulum.**

5. Define **period of the pendulum. The period is the amount of time required for the pendulums mass to swing over and back.**
6. Define **independent variable** as it is used in a science experiment. The variable that is changed in order to test to see if it changes the dependent variable (period of the pendulum). You tested the mass, length, and angle in this experiment.

7. State the three **null hypotheses** you tested in this experiment? Changing the mass will not change the period of the pendulum, Changing the angle will not change the period, Changing the length will not change the period

8. Which of the null hypotheses were rejected? Failed to reject? **We rejected the length null hypothesis because it was false. We failed to reject the mass and angle null hypotheses. We accept the length alternative hypothesis, “Changing the length will change the period of the pendulum.”**

9. Define **controlled variable** as it is used in a science experiment. It is a part of the experiment that is kept the same. When length was changed (independent variable), the mass and angle of the pendulum were kept the same (controlled variables).

10. What does the term **unwanted effects** mean in an experiment? Changes in your experimental technique that could change the outcome of the experiment. Example: If you started trials by timing on sight, then switched to timing by voice command it might look like the period changed, but it was your timing technique that changed.

11. How do scientists try to control unwanted effects? They keep their testing techniques the same.

12. Describe how the length of the pendulum was used as an independent variable in the experiment. The length was changed to see if it changed the period (dependent variable)

13. Describe how length was used as a controlled variable in the experiment. The length was kept the same when the mass and angle were tested.

14. Why do we try to test only one independent variable at a time during an experiment? If more than one variable is tested at one time, you won’t know which variable was responsible for a change in the outcome of the experiment. Example: If you change both the length and mass of the pendulum, the period will change, but you won’t know if it was the length or the mass caused the change.

15. Which independent variable of the pendulum changes the period of the pendulum? **Length**
16. State the relationship between this independent variable and the period of the pendulum. The shorter the length, the shorter the pendulum. The longer the length, the longer the pendulum.

17. Explain, by using a diagram for each independent variable, why the other two independent variables of the pendulum had no effect upon the period of the pendulum.

Independent Variable _______Mass_____

Diagram: Explanation: All masses fall at the same rate

Independent Variable ____Angle_____

Diagram: Explanation: As masses fall they fall faster and faster, causing the greater angle to go faster, which cancels out the greater distance it has to travel