

Use pen for Free-Response

Bring:

- Multiple Pencils
- Pen
- Eraser
- Calculator(s)
- Ruler
- Go Card

Experimental Design Free-Response Question

1. Equipment, Setup and Procedure

A. Most questions start off by listing the equipment needed for the lab and the procedures to use that equipment to measure/calculate the variables in question.

a. Common Equipment:

1. Motion Sensors: for position, velocity and/or acceleration of objects moving towards or away from the sensor
2. Photogate: for speed and/or period

of objects moving through it (need to know/measure the length of the object for the photogate to calculate the speed)

3. Stopwatch: for time
4. Force sensor: for force (similar to a newton spring scale but can be used to push as well)
5. Voltmeter: for voltage
6. Ammeter: for current

- B. Describe the setup clearly and with a neatly drawn picture to help with the description.
 - a. Include labels on your diagrams
- C. Describe the procedures to be followed, talking about what measurements would be made and what you are using to make those measurements.
 - a. Be specific when describing what measurements need to be taken (e.g "the time for five revolutions" rather than just "time")
- D. Talk about repeating either multiple trials or by changing something related to one of the variables in question to see how the

- other variable in question responds.
- a. Multiple trials can be used to address uncertainty

Note: Calculations do not belong here; include only the steps required to collect the raw measured data. (e.g. If you are measuring mass and speed, you do not need to include a step that says "use the equation $K = 1/2 mv^2$ to get velocity")

2. **Analysis of data**

- A. In this section you are going to describe how you calculate the variables in question from the data you collected.
 - a. State the equation(s) required to calculate the required variable. (e.g. do not simply say "calculate the kinetic energy")
- B. If a variable were measured directly, you do not need to go into further detail.
- C. You will also usually be creating some sort of graph that plots the two variables against one another to see how they are related – and you would discuss how you

know they are proportional or obey a certain principle based on the shape of the graph and the expected shape of the graph.

Paragraph-length Response

REASON

R: Indicate and walk through relevant **relationship(s)** from allowed knowledge

E: Indicate quantities that are **equal** and why they are equal

A: Indicate quantities that are **altered or different** and why they are altered or different

So: **So what?**

N: Is there any quantity to analyze **next?**