APC: Kinematics Lab

Name and Partner:

Objective

Determine whether air resistance on falling coffee filters is best modeled by linear drag or quadratic drag and prove the validity of your assumption.

1) Experimental Design

Describe a procedure to measure terminal velocity v_T for varying masses m.

A) List your dependent and independent variables and the units you will measure them in. List any variables that will be controlled.

B) List all equipment needed and link each piece of equipment to the variable it will measure.

C) Write a step-by-step procedure detailing how to: manipulate the independent variable, isolate controls, and reduce uncertainty. Discuss your plan with other groups and make adjustments as needed.

2) Data Visualization

Show your data in a table and/or a graph before you manipulate any values. If you use LoggerPro, Colab, Desmos, Sheets, or Excel (or any other graphing program) you can cut and paste the result here. Include a link to the original file.

3) Data Analysis

Linearize your graph if applicable and explain the meaning of your slope. Again, if you have a separate program you used, include that work with a screenshot or a link to the original file.

4) Synthesis

Show all calculations and conclusions. Explain sources of error and specifically describe how they affected your outcomes. Use an appropriate statistical method to determine the tolerance range of your findings.

5) Perturbation Analysis

What would be the outcome if you had performed this experiment with heavier filters of mass 2x the mass of the ones you did use? Explain how your data and graphs would be different and prove your statement with calculations.

6) Student Expectations for Gemini Interaction

AI is allowed under specific conditions for this lab. Please only use Gemini through your school account.

Protocol Category	Student Guidelines	Example
Allowed AI Use	Requesting syntax, debugging errors, generating plot formatting, and fitting functions (scipy.optimize.curve_fit or np.polyfit). All AI use must be through Gemini using your Punahou account.	*"How do I import a CSV in pandas and plot a scatter plot of Mass vs Terminal Velocity with error bars using Google Colab?"*
Prohibited AI Use	Asking Gemini to generate the physical model, explain the drag derivation, or write the physics justification.	Do NOT prompt: "Derive the equation for terminal velocity and tell me what my slope means."
Documentation	Students must include an AI Appendix at the end of their report listing all prompts used.	Include full copy-paste of Gemini chat log as an appendix document and make sure the permissions allow me to view it. If I cannot view it by the due date, the entire lab will be considered late for you and your partner.

7) Ethical Audit

Anyone using AI must complete this audit. You are welcome to work with other groups and each complete one section, then bring it all together. Ideally at least two groups would complete each section so you can have a variety of perspectives. You are not expected to write a paper for each one, keep it brief and use links for references, no need for official footnote format or anything like that. You're welcome to use AI to help.

- **Resource & Labor Footprint:** Evaluate the physical resource footprint required to execute or train the utilized model, specifically noting estimated energy consumption, water overhead, or CO_2 emissions, alongside the associated human labor or intellectual opportunity costs.

- **Data Provenance & Equity:** Critically appraise the training data source. Assess potential structural biases, copyright compliance issues, security vulnerabilities, or risks associated with recursive AI feedback loops within the dataset.
- **Algorithmic Reliability:** Establish your level of confidence in the reproducibility of the generated outputs. Detail the specific validation protocols required to test the underlying script for internal bias or systemic execution flaws.
- **Epistemic Skepticism:** Challenge the inferred authority of the model's output. Identify any instances of overconfidence or sycophantic "agreeableness" where the AI prioritized human-mimicking text over physical accuracy.