Unit 13: Drag Force Deployment

Pressure drag plays enormous roles in perambulation from the ejection of microscopic dust pollen to whales swimming.

Objectives: To provide diagrammatic, graphical, written and mathematical solutions for the coefficient of drag in air for an object at terminal velocity.

1) Sketch a kinematics stack for an object released from rest to some time "t_t" after it has reached terminal velocity. Explain your answer below (1 pt).

2) Draw a force diagram on the object at terminal velocity to scale in the grid below assuming buoyancy is one fourth of the weight. In the space at left write a mathematical statement for these forces solving for the pressure drag ONLY in terms the mass of the balloon and the gravitational field. You may ignore viscous drag (3 pts).

Generic force equation using labels from your diagram at right:

Specific solution: $F_{dp} =$
3) Based on your knowledge of pressure drag (for example from class notes and readings), predict what the graph of terminal velocity versus mass will look like in the graph at right. Explain your answer below (1 pt).

4) From the measured terminal velocity \(v_t\) for the object of measured mass \(m\) and area \(A\), calculate the coefficient of drag of the object, \(C_d\). (5 pts.)

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\begin{align*}
\text{Measured or calculated area } A: & \quad \_\_\_\_\_\_ \\
\text{Measured mass } m: & \quad \_\_\_\_\_\_ \\
\text{Measured terminal velocity } v_t: & \quad \_\_\_\_\_\_ \\
\text{Density of air: } & \quad \_\_\_\_\_\_ \\
\text{Predicted coefficient of drag } C_d: & \quad \_\_\_\_\_\_ \\
\text{Calculated } C_d: & \quad \_\_\_\_\_\_ \\
\text{You can get the predicted value from the web during lab.}
\end{align*}
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