Announcements

- We will be remote on Monday!
  - CompDay's are a chance to focus on gaining computational skills in solving physics problems.
  - We can gather in Discord for an Introduction and then you can split up to work in rooms.
  - You will want to ensure that you can run Python and a Jupyter Notebook on whatever system you plan to use. Let me know if you need help getting that setup!
- PSA: All my lecture notes from the semester are available on the website (typed!)
- Read the rest of Chapter 2 for next Wednesday.
- Question responses: `rembold-class.ddns.net`

Today's Objectives

- Understanding the physical and mathematical setup for velocity dependent, drag type problems
- Identifying when certain types of drag will dominate
- Being able to identify general movement patterns in linear drag situations
- Comparing linear drag projectile motion to non-drag projectile motion

Q1

Projectile drag is a resistive force, and thus always points opposite the direction of motion. True or False? If True, can you explain why this has to be the case? If False, can you come up with at least two counter examples?

A) True

B) False

Q2

A nice property of drag problems is that we can usually rewrite the equation of motion to be just in terms of velocity (and the derivative of velocity), effectively simplifying our differential equation to simply a 1st order DE. Which of the below equations of motion could not be simplified in this fashion? You can assume all values of F are just constants here.

A) $m\ddot{\vec{\boldsymbol{r}}} = -mg\hat{\boldsymbol{y}} + F_1\hat{\boldsymbol{x}}$

B) $m\ddot{\vec{\boldsymbol{r}}} = F_1\hat{\boldsymbol{x}} + F_2\dot{x}\hat{\boldsymbol{y}}$

C) $m\ddot{\vec{\boldsymbol{r}}} = F_1 y\hat{\boldsymbol{x}} - (mg + \dot{y})\hat{\boldsymbol{y}}$

D) $m\ddot{\vec{\boldsymbol{r}}} = F_1\sqrt{\dot{x}^2 + \dot{y}^2}\,\hat{\boldsymbol{x}}$

Q3

A puffy piece of spherical cotton has a radius of 0.6 cm and a mass of 0.5 g. It is floating down through the air at a rate of approximately 5 cm/s. What term of the drag force dominates?

A) Linear
B) Quadratic
C) They are about the same
D) There is no drag in this situation

Q4

In the simple linear horizontal drag situation, you have an equation of motion that looks like:

$$\dot{v}_x = -\frac{b}{m} v_x$$

Suppose you have two different spherical drops which are the same size. Drop A happens to be twice the mass of Drop B, but is moving half as fast initially. Which drop will travel the furthest before coming to a stop?

A) Drop A

B) Drop B

C) They will come to a stop at the same location

D) Linear drag by itself will never completely stop the forward progress of either drop

Q5

You have two droplets of water ($\rho = 1\,\mathrm{g/cm^3}$), with Drop A having twice the radius of Drop B. You drop both from rest at a height of $100\,\mathrm{m}$, and they plummet under the effect of gravity and linear drag. Which droplet is traveling faster when it strikes the ground?

A) Drop A
B) Drop B
C) They are traveling the same speed
D) Both drops would be halted by drag before they reached the ground.

Q6

Under drag-less conditions, the optimal angle to fire a projectile to get maximum range is 45°. Suppose instead you were flicking a tiny drop of mist, with a terminal velocity of 1.3 m/s, with a launch speed of 1 m/s. What would be the optimal launch angle in this linear drag dominating situation?

A) 40°

B) 45°

C) 53°

D) This can not be solved analytically