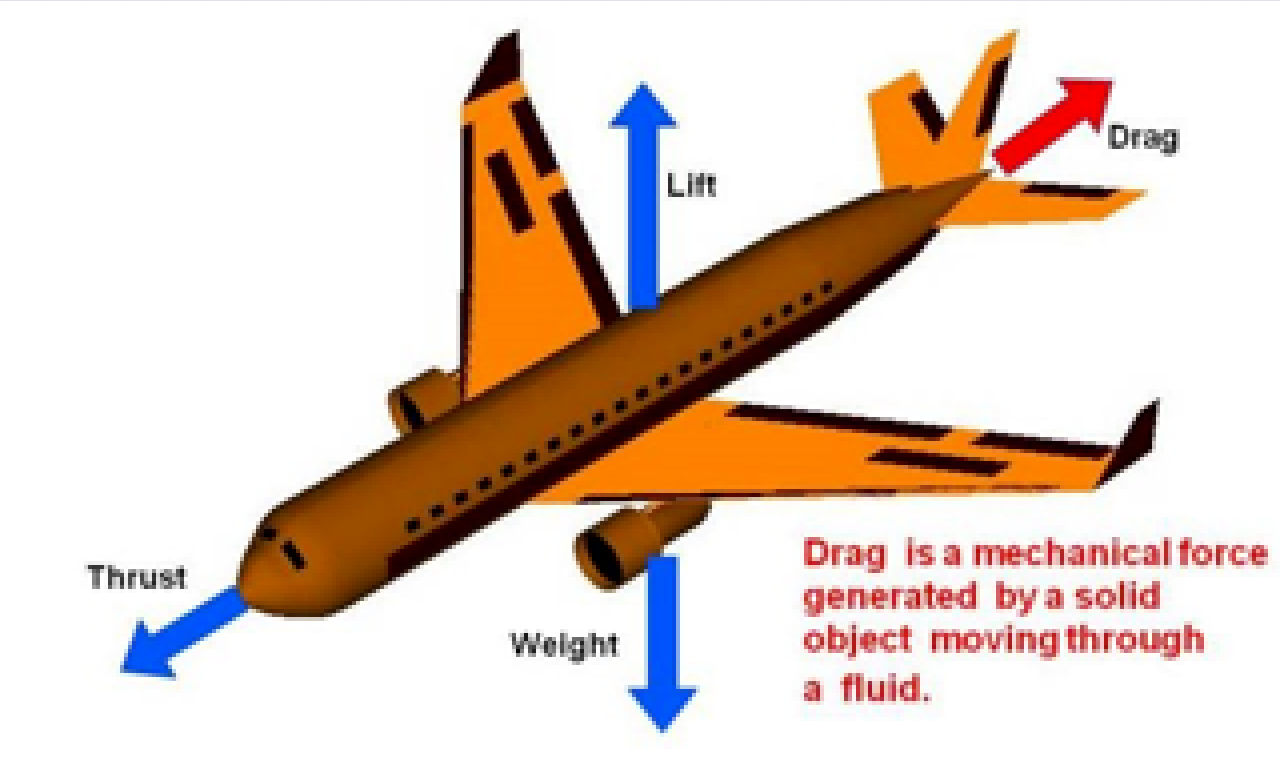
Day 07 - Drag Forces



Announcements

- Homework 2 is due Friday
- Video recordings will cease; I will try to record my tablet writing next week.
  - Class can still join zoom with password: phy321
- Updated office hours (Danny-DC; Elisha-EA):
  - Monday 4-5pm (DC) - change?
  - Tuesday 5-6pm (EA)
  - Wednesday 4-5pm (DC)
  - Thursday 5-6pm (EA)
  - Friday 10-12pm (DC then EA); 3-4pm (DC)

Calendar changes and apologies

- I'm very behind on class prep. And I'm very distracted right now.
- The notes for next week will be posted by Friday.
  - If you need anything or I'm missing, just drop me a note. I probably just missed it.
- There will be no homework 9, and there will be no new material for the last week of class.
  - Instead, that week will be final prep for your projects that will be due Monday of finals week at midnight.
  - More details soon, but we will also use homework and midterms to help you make progress on your final projects.

Seminars this week

WEDNESDAY, January 29, 2025

- Astronomy Seminar, 1:30 pm, 1400 BPS, Michiel Lambrechts, Univ. of Copenhagen, *Planet formation*
- FRIB Nuclear Science Seminar, 3:30pm., FRIB 1300 Auditorium, Brenden Longfellow of Lawrence Livermore National Laboratory, *From Tensor Current Limits to Solar Neutrinos: 8Li and 8B Studies with the Beta-decay Paul Trap*

Tomorrow's Seminar

Goals for Week 3

- Be able to answer the following questions.
  - What is Mathematical Modeling?
  - What is the process for analyzing these models?
- Be able to solve "Simple" Motion Problems with Newton's Laws.

Our man, Reynolds

- The Reynolds number is a dimensionless quantity.
- It is a ratio of inertial forces to viscous forces.

$$Re = \frac{\rho v L}{\mu}$$

- ρ - density of the fluid
- v - velocity of the object
- L - characteristic length
- μ is the dynamic viscosity

Our man, Reynolds

BTW, this is not a photo of Reynolds.

- This is Stokes.
  - He developed the concept of the Reynolds number.
  - Reynolds "popularized" it according to the Wikipedia.

$$Re = \frac{\rho v L}{\mu}$$

Discussion: What kinds of systems have a high/low Reynolds number?

Clicker Question 6-2

Assuming a **linear model** for Air Resistance $\sim bv$, we obtained this EOM for a falling ball:

$$\ddot{y} = -g + \frac{b}{m}\dot{y}$$

What happens when $\ddot{y} = 0$?

1. The ball stops moving ($v = 0$).
2. The ball reaches a velocity of mg/b.
3. The ball reaches a terminal velocity.
4. I'm not sure.

Clicker Question 6-3

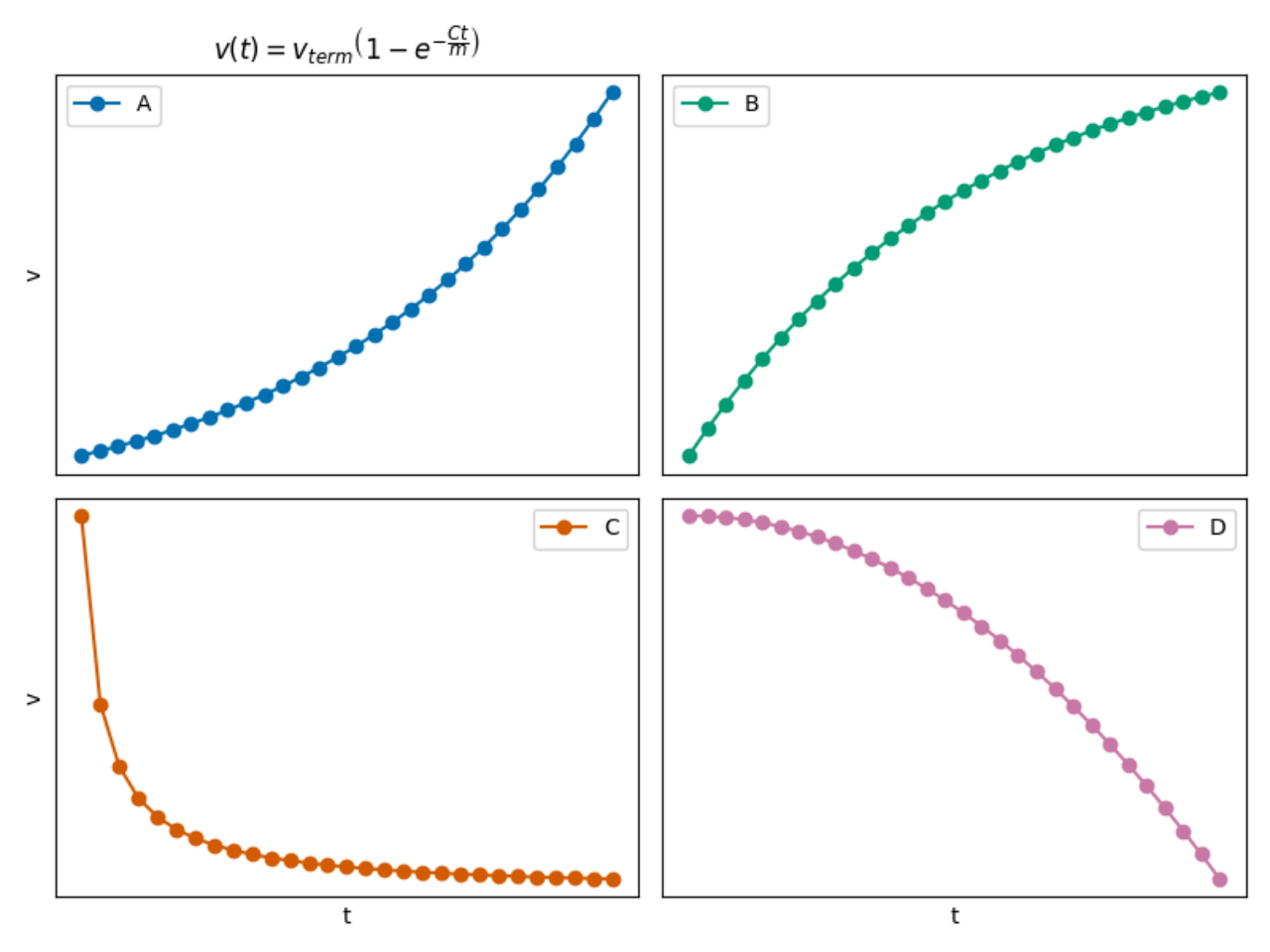
For the system of **Linear Drag in 1D**, we found a solution for the velocity as a function of time, with $v = 0$ at $t = 0$.

$$v(t) = v_{term}\left(1 - e^{-\frac{bt}{m}}\right)$$

where $v_{term} = \sqrt{\frac{mg}{b}}$.

CQ 6-3

Which sketch could be correct for the velocity of the ball?



Clicker Question 6-4

For the system of **Quadratic Drag in 1D**, we found a solution for the velocity as a function of time, with $v = 0$ at $t = 0$.

$$v(t) = v_{term} \tanh(gt/v_{term})$$

where $v_{term} = (mg/c)^{1/2}$. Do the units make sense? What are the units of $[gt/v_{term}]$?

1. Yes, the units for $[gt/v_{term}]$ are m/s;both sides have the same units.
2. No, the units for $[gt/v_{term}]$ are m/s; each side has different units.
3. Yes, the units for $[gt/v_{term}]$ are unit-less; both sides have the same units.
4. No, the units for $[gt/v_{term}]$ are unit-less; each side has the different units.

Clicker Question 6-5

For the system of **Quadratic Drag in 1D**, we found a solution for the velocity as a function of time, with $v = 0$ at $t = 0$.

$$v(t) = v_{term} \tanh(gt/v_{term})$$

where $v_{term} = \sqrt{mg/c}$. What happens when $t \to \infty$?

1. The object stops moving.
2. The object travels at a constant velocity.
3. The object travels at an increasing velocity.
4. The object travels at a decreasing velocity.
5. I'm not sure.