Problem Set 2

Differential Equations

Fall 2025

As we have dived into the contents of first order linear differential equations, you should have noticed many techniques, such as method of separation, integrating factors, or exactness (about to come). Meanwhile, we are about the see practice on these solving techniques and explore an explanation of such concept.

Clubs & Orgs Bulletin

Promote your club! https://forms.gle/V19BipzLyuAaWMyz8

- A Place to Talk: Need to vent about something or talk through an issue? Come visit an APTT room! Want to encourage your organizations' members to be more compassionate and welcoming? Schedule listening and empathy training by emailing apttexternaltraning@gmail.com.
  Learn more: `@jhuaptt` or https://pages.jh.edu/aptt/
- Johns Hopkins Alzheimer's Disease Research Center (JHADR) Volunteer Program: Are you passionate about spreading knowledge on healthy aging, brain health, memory loss, and Alzheimers disease? Apply to be a college student volunteer at the Johns Hopkins Alzheimers Disease Research Center (JHADRC). We are looking for dedicated students to join our team and contribute to our mission of improving the understanding, treatment, and care of memory loss and Alzheimers disease. Student volunteers will be placed in one of two teams:
  - JHADRC and Memory & Aging Community Advisory Board (MACAB) - focusing on community outreach among older adults
  - CAN (Curing Alzheimers Now) Dream Foundation - focusing on providing Alzheimers education to kids in K-12 settings

  Application Form (link) | Primary (Sun 9/7), Final (Wed 9/17) Information Session (link) | Tues 9/2, 6:00 PM Contact: jhadrc@jhmi.edu

Tip of the Week

Future Fest 2025 has started! Future Fest is a two week series of events (Sep. 5 - Sep 19) organized by the Life Design Lab to help students explore possible internships and careers. Check out the schedule here (or just stop by the Imagine Center for the free coffee).

1. (Another Separable ODE). Solve the following initial value problems (IVPs) on $y = y(x)$, and specify the domain for your solution:

$$\begin{cases} y' = y(y+1), \\ y(0) = 1. \end{cases}$$

2. (Integrating Factor). Solve for the general solution to the following ODEs with $y = y(t)$:
   (a) $2y' + y = 3t$.
   (b) $y' + \log(t)y = t^{-t}$.

3. (Linearity of Solutions). Let $y = y_1(t)$ be a solution to $y' + p(t)y = 0$, and let $y = y_2(t)$ be a solution to $y' + p(t)y = q(t)$. Show that $y = y_1(t) + y_2(t)$ is then also a solution to $y' + p(t)y = q(t)$.

4. (Integrating Factor for IVP). Given an initial value problem:

$$\begin{cases} \dfrac{dy}{dt} - \dfrac{3}{2}y = 3t + 2e^t, \\ y(0) = y_0. \end{cases}$$

   (a) Find the integrating factor $\mu(t)$.

   (b) Solve for the particular solution for the initial value problem.

   (c) Discuss the behavior of the solution as $t \to \infty$ for different cases of y_0.