

# Mathematica Worksheet

UDIP

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## 1 Introduction

Here are a couple problems to help you get started on some of the things you might need to do in classes, along with some Tips & Tricks, and some Resources that will help you along the way

## 2 Tips & Tricks

1. Always comment your code!!! It will help you decipher what you were trying to do when you come back to it. Comment syntax: `(*COMMENT*)` (Shortcut `ctrl-/`). Some good details to include in a comment are what the purpose of a function is, or what each part of your code does.
2. Put a `Quit` command at the top of your code in case of emergency! Mathematica will remember every variable you've entered, even if it's in a different code block.
3. You can look up a function by highlighting it in Wolfram Alpha, and then pressing `F1`
4. Make sure you capitalize function names, as well as special values like `I` for the imaginary number or `E` for `e`.
5. Enter greek letters by using `esc` to enter their names. Try entering `esc-Omega-esc` or `\[CapitalOmega]` to produce an  $\Omega$ .
6. Mathematica has plenty of auto-complete options! Make use of them when you don't want to finish typing a command.
7. Use the Wolfram—Alpha query mode for access to the full Wolfram—Alpha Pro library. Access by clicking on the `+` at the bottom of your most recent entry to change the cell type.

## 3 Problems

### 3.1 Differentiation and Integration warm ups

Define a multivariable function, differentiate and integrate with respect to variable of choice, and practice doing second order differentials, or integrating twice:

1.  $\frac{1}{2x+a}$
2.  $\cosh(xyz)$

Numerically integrate the following:

1.  $e^{x \frac{\log(x)}{\cos(x)}}$
2.  $\sqrt{e^{-x^2} + 1}$

Find the solution to this linear ODE (Hint, look up the function `DSolve[]`):

$$y'(x) \sin(x) = y(x) \log_{10}(y(x)) \quad (1)$$

### 3.2 Setting up Matrices, and Eigenvector and Eigenvalue Problems

Here, we go over how to set up a Matrix, and how to find its Eigenvalues and Eigenfunctions. There are many ways to do this, this is just one of them:

$$\begin{pmatrix} a & b & c \\ d & e & f \\ g & h & i \end{pmatrix} \quad (2)$$

1. Create the above matrix and assign it to `M`.
2. Check that you've properly set up the matrix by inputting `MatrixForm[M]`
3. Use `M[[1,2]]` to reference the entry in the 1st row and 2nd column. Try using the same command to reference different entries.
4. Use `Eigenvectors[]` and `Eigenvalues[]` to find the eigenvectors and eigenvalues for the matrix.
5. Alternatively, try using `Eigensystem[]` to find both at once.

## 4 Graphing

Plot the following functions:

1.  $\frac{1}{x}$
2.  $\sin x$
3.  $\tan(\arccos(x) + \arcsin(y)) = 1$

Try changing the color of the lines, or adding a legend, title, or axis label. Refer to the following for information on [legends](#), [labels](#), and [general visualization](#).

## 5 Resources

Mathematica has fantastic documentation. but in addition to that, here are a couple resources that could prove useful in learning Mathematica:

1. [Solving ODEs and things to keep in mind](#)
2. [A Fast Introduction to Mathematica for Physicists](#)