Physics 102 Oct 4, 2019

Exam 1

This is exam is open book, open note, open google. You may not consult with other people in any way–no texts, emails, or posts to any forums. If you do use a site other than your textbook or MATLAB help, please cite the source in a comment.

In all cases that say something like "output" or "display" – it means to the screen. This means it should appear in the output window (also command window) when you (or I) run your code. Use the semi-colon to turn off other things that get calculated as intermediate steps, so that only the requested output appears.

Ideally your code with run, but if you get stuck on something, you can either comment it out, or move it to the end of your file. Be sure to include a comment with the problem number.

There are a total of 100 points on the exam.

Make one .m file for all!

You are welcome to practice first in the command window, and only cut and paste what works! Call it `Yourname_exam1.m` and turn it in to me (email it!) at the end of class.

1. (5 points) Start your `Yourname_exam1.m` file with a comment that includes your name, date and title of the file. Don't forget to include comments for all the problem numbers as they appear in your .m file.

2. (25 points) Use MATLAB to evaluate the following. For each, the output should appear to the screen (command window).

   (a) $3(1.6 \times 10^{-19})$

   (b) $\sin(30^\circ)$

   (c) $\sin(\pi)$

   (d) $e^{-i\pi}$

   (e)
   $$\frac{7\pi}{10 - \sqrt{(200}}$$

   (f) Define the variables given and evaluate:
   $$\frac{q_1 q_2}{4\pi\epsilon_0 r^2}$$
   where $q_1 = q_2 = 1.6 \times 10^{-19}$ C, $\epsilon_0 = 8.854 \times 10^{-12} \frac{C^2}{N \cdot m^2}$, and $r = 5$ nm.

   (g)
   $$\begin{bmatrix} 9 & 6 & 3 \\ 8 & 5 & 2 \\ 7 & 4 & 1 \end{bmatrix} \begin{bmatrix} 1 \\ 5 \\ 9 \end{bmatrix}$$

   (h) Find the inverse of
   $$\begin{bmatrix} 3 & 2 \\ 1 & 5 \end{bmatrix}$$

3. (10 points) Write some code that converts inches to cm. There are 2.54 cm in 1 inch. Use $d = 12$in as your test case, and output the distance in cm.

4. (15 points) Multiply consecutive integers:

   (a) Write a `for` loop to multiply the integers from 25 to 100. Display the final number on the screen.

   (b) Can you vectorize this? If so, do that. If not, explain why not in a comment.

5. (10 points) Shown below is a column of angles in degrees. Complete the second column, which should be the angle converted to radians, and display both columns to the screen with their headers.

Angle (deg)	Angle (rad)
0	
30	
60	
90	
120	
150	
180	

6. (10 points) Write some code that takes any vector a and returns vector b which has all the elements of a in reverse order. For example, if $a = [1, 2, 3, 4, 5]$ then your code should return $b = [5, 4, 3, 2, 1]$. Write it so that it works for any vector a.

7. (25 points) A projectile is given an initial speed of v_0 at an angle of θ with respect to the horizontal. You may ignore air resistance. Use the test case where $v_0 = 12$m/s and $\theta = 60°$. Make three plots on two figures:

   (a) Horizontal position versus time–on the top panel of figure 1.

   (b) Vertical position versus time–on the bottom panel of figure 1.

   (c) And the trajectory (y vs x). Put this one alone on figure 2. Fix the time scale so that I can see the characteristic shape of a projectile for the test case given here.

   For each plot, title it and label the axes. Plot the first two on one figure (page), and the third on its own figure window.