Phys234, 2018, Problem set #3: In-lab questions, Thursday Lab

Question 1:

Approximations to $\sin(x)$ and $\cos(x)$ are given, respectively, by the truncated series $s(x)$ and $c(x)$,

$$s(x) = x - \frac{x^3}{3!} + \frac{x^5}{5!} \qquad c(x) = 1 - \frac{x^2}{2!} + \frac{x^4}{4!}$$

Calculate both the **relative** and **absolute** errors in using these formulas (compared with the true values of $\sin(x)$ and $\cos(x)$) for $x = 20, 35, 50$ and 65 degrees. Present your answer for each of these two cases in a function file called `ps3q1thursday.m`. Organize your answer such that execution of the function `ps3q1thursday` results in a printout of two tables, one each for the result of the $s(x)$ and $c(x)$. Each table should have 4 rows (1 for each angle) and 4 columns. Elements in the 4 columns should be 1) the angle, 2) the value of $s(x)$ or $c(x)$, 3) the relative error, 4) the absolute error. Use the function `fprintf` to display your results, and make sure that your table prints at least a few significant digits. Also make sure to identify which case corresponds to which table you printout. Your `ps3q1thursday` file should be organized in the following way:

```
function ps3q1
% Solution to question 1, problem set 3
%

% define angles

... % operations to define your 4 angles

% --- sine approximation

... % operations to calculate s(x), relative error, absolute error

... % operations to printout table


% --- cosine approximation

... % operations to calculate c(x), relative error, absolute error

... % operations to printout table

end
```

Question 2:

In a function file `ps3q2thursday.m`, create a vector `x = logspace(-12, 0, 50)`. Then evaluate the hyperbolic sine at all values of x using the formula $sh(x) = \frac{1}{2}(e^x - e^{-x})$. Calculate the absolute and relative error obtained by using this formula compared with the built-in `sinh` Matlab function, which we can assume to give the correct value of $\sinh(x)$. Present your answer as a loglog plot, with x on the x-axis and the relative and absolute errors on the y-axis, plotted as symbols. **Make sure to include a legend and axis labels**. Execution of your `ps3q2thursday` file should only produce the plot (no other printout outputs).