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NOTE:

For this exam, use the naming convention as given: Problem 1 should be called csexam31.m; Problem 2 called csexam32.m; Problem 3 called csexam33.m; Problem 4 called csexam34.m; Problem 5 called csexam35.m; Problem 6 called csexam36.m; and, Problem 7 called csexam37.m. *All programs must be original work – no working together on problems or getting help other than clarifying problem statement.*

1. Define h and k constants, h = 0.7 and k = 8.85, and x, y and z vectors, x = 1 through 5 (incremented by 1), y = 2.1 through 1.7 (decremented by 0.1) and z = 2 through 4 (incremented by 0.5). Then, calculate G using the following equation:

$$G = \frac{hx + ky}{(x+y)^h} + \frac{e^{\left(\frac{hy}{z}\right)}}{z^{\left(y/x\right)}}$$

2. A model for exponential growth of a quantity is given by:

$$A(t) = A_0 e^{kt}$$

$$k = \frac{1}{t}\ln\left(\frac{A(t)}{A_0}\right)$$

where $A(t)$ and A_0 are the quantity at time t and time 0, respectively, and k is a constant that is unique to the specific application. Write a user-defined function that uses this model to predict the quantity $A(t)$ at time t from knowing A_0 and $A(t_1)$ at some time t_1. For function name and arguments, use At = csexam32(A0, At1, t1, t), where the output argument *At* corresponds to $A(t)$ and the input arguments are *A0*, *At1*, *t1* and *t*. Your function should verify that the *t* input value is a single value (not a matrix) before continuing to do the calculations. You do not need to submit a test program for this function. (Hint: first solve for *k*, then solve for *At*) (13 points)

3. The Taylor polynomial is a powerful mathematical tool that helps approximate the value of various functions within a reasonable range of approximation. For example, it helps in the calculation of an irrational number like e (the exponential function).

The Taylor polynomial of degree n for e^x for any x is given by:

$$e^x = 1 + \frac{x}{1!} + \frac{x^2}{2!} + \frac{x^3}{3!} + \frac{x^4}{4!} + \ldots + \frac{x^n}{n!}$$

Using n = 10, write a MATLAB program to calculate the value of e^2 (x = 2 in the formula). Print out the final answer as: **e^2 is equal to XXX.XX**. NOTE: The estimation of this function is a summation of the form: $1 + \sum_{n=1}^{\infty} \frac{x^n}{n!}$ (because there is a repetitive nature to this summation, a loop would be one possible solution).

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Due: Friday, July 28, 2017 at 5:00 PM (all M-files must be uploaded to Learn by this time)

4. A thermocouple is a sensor used for measuring temperature. It is made by joining two wires made from dissimilar materials. To measure temperature, two thermocouples are connected in a circuit. One thermocouple is placed in a medium with known constant temperature T_{ref} (e.g. ice water), and the other is placed where the temperature T is to be measured. A voltage v is generated when the two temperatures are not the same. The voltage v can be modeled as a function temperature by an expression of the form: $v = K_s(T - T_{ref})$ where K_s is a constant that depends on the two materials that are used for the thermocouple. Using the following data and linear regression, determine the value of K_s (NOTE that this variable is the slope of the equation). Also, plot the original data with the determined linear function and find the approximate value of v when $T = 240.56$. You can find the approximate value two different ways but the results will be slightly different (you will only notice it if you go to format long).

T (Celsius)	25	100	200	300	400	500	600	700
v (mV)	1.11	4.03	8.16	12.62	16.54	20.90	23.7	29.15

5. Given a tank of Height H that has a center that is cylindrical with radius r and has half spherical caps on each end (also of radius r), find the volume of the liquid in the tank. Your program will prompt the user to enter the Height and radius of the tank and the height (h) of the liquid. Use the following criteria to find the volume:

If the height of the liquid is less than the radius, $v = \frac{1}{3}\pi h^2(3r - h)$.

If the height of the liquid is greater than the radius but less than the Height of the tank minus the radius, $v = \frac{2}{3}\pi r^3 + \pi r^2(h - r)$.

If the height of the liquid is greater than the Height of the tank minus the radius,

$v = \frac{4}{3}\pi r^3 + \pi r^2(H - 2r) - \frac{1}{3}\pi(H - h)^2(3r - H + h)$.

An error will occur if the height of the liquid is negative or greater than the Height of the tank. NOTE: assume h, r and H are all scalar values.

6. Write a function that has two input arguments and two output arguments. This function will accept both the height and radius and calculate the area and volume of a cylinder. To do this, you will need to use the following equations (r and h could be matrices and assume to be the same size):

$v = \pi r^2 h$

$a = 2\pi r h + 2\pi r^2$

7. Create a program that solves the following system of linear equations.

$$6x + 3w - 2y = 10$$
$$4y - 2x + w - z = -2$$
$$5w - 2z + 3x - y = 5$$
$$4x + 2w + 2y - z = 0$$

Solve the system using either the backslash operator, the inverse command or operator, or the rref() function AND using the symbolic toolkit. Your answer needs to be printed out using fprintf commands. (13 points)

Make sure that your programs are properly named so your work can be checked correctly!