Make sure to write down your procedure clearly and answer exactly what the problem is asking for. Points will be taken off for incomplete, unintelligible, and sloppy procedures and solutions. Include comments in all MATLAB programs.

Follow the five step problem solving in engineering and science whenever required. Graphs are often useful ways to check your calculations.

(20 points) 12.9 A pendulum is a rigid object suspended from a frictionless pivot point (see Figure P12.9). If the pendulum is allowed to swing back and forth with a given inertia, we can find the frequency of oscillation with the equation

$$2\pi f = \sqrt{\frac{mgL}{I}}$$

where

f = frequency,
m = mass of pendulum,
g = acceleration due to gravity,
L = distance from the pivot point to the center of gravity of the pendulum, and
I = inertia.

Use MATLAB's symbolic capability to solve for the length L.

(20 points) 12.29 Determine the first and second derivatives of the following functions, using MATLAB's symbolic functions:

(a) $f1(x) = y = x^3 - 4x^2 + 3x + 8$
(b) $f2(x) = y = (x^2 - 2x + 1)(x - 1)$
(c) $f3(x) = y = \cos(2x)\sin(x)$
(d) $f4(x) = y = 3xe^{4x^2}$

(20 points) 12.30 Use MATLAB's symbolic functions to perform the following integrations:

(a) $\int (x^2 + x)dx$
(b) $\int_{0.3}^{1.3} (x^2 + x)dx$
(c) $\int (x^2 + y^2)dx$
(d) $\int_{3.5}^{24} (ax^2 + bx + c)dx$

(20 points) 13.9 Resistance and current are inversely proportional to each other in electrical circuits:

$$I=V/R$$

Consider the following data collected from an electrical circuit to which an unknown constant voltage has been applied (Figure P13.9):

Resistance, ohms	Measured current, amps
10	11.11
15	8.04
25	6.03
40	2.77
65	1.97
100	1.51

(a) Plot resistance ® on the x-axis and measured current (I) on the y-axis.
(b) Create another plot with 1/R on the x-axis and I on the y-axis.
(c) Use polyfit to calculate the coefficients of the straight line shown in your plot in part (b). The slope of your line corresponds to the applied voltage.
(d) Use poyval to find calculated values of current (I) based on the resistors used. Plot your results in a new figure, along with the measured data.

(20 points) 13.21 Solve the following differential equation for values of t between 0 and 1, with the initial condition of y=0 when t=0.

$$\frac{dy}{dt} = t^2 + y$$