Engineering Models II: Homework #3

Problem 1: Use the ***solve*** command to determine the points (if any) where the two circles described by the equations below intersect. Include your MATLAB commands and results.

$$(x-1)^2 + y^2 = 16$$

$$(x-5)^2 + (y-1)^2 = 2$$

Problem 2: The voltage across a resistor, V_R, in a series RL circuit is:

$$V_R = V_s[\,1 - e^{(-Rt/L)}\,]$$

Vs is the source voltage (in volts) and t is the time in seconds.

a) Use the ***solve*** function in MATLAB to solve the equation symbolically for t. Include both your result and your MATLAB commands.

b) Assume Vs = 9V, R = 220 Ω, and L = 3 H. Use your results from part (a) and the ***subs*** function to solve for the time when the resistor voltage is 2V, the time when the voltage is 6V, and the time when the voltage is 8.5V. Record your results in the table below and include your MATLAB commands.

Resistor Voltage (V)	Time to Reach Voltage (sec)
2	
6	
8.5	

Problem 3: The equations of motion for the x and y position of a projectile fired at an initial velocity of Vo (m/s) and at an angle of θ (degrees) assuming an initial position of (x_o, y_o) are:

$$y = -\frac{1}{2} \cdot g t^2 + V_0 \sin(\theta)\, t + y_o$$

$$x = V_0 \cos(\theta)\, t + x_o$$

$$g = 9.81\ m/s^2$$

Assume the initial position of the projectile is (0, 6m), the initial velocity is 75 m/s, and the launch angle is 45°. Suppose there is a target located at (400m, 115m).

a) Use the solve command to determine the time, t, at which the projectile hits the ground.
b) Create a vector of time values based on your calculation in part (a). Compute the x and y position of the projectile at your time values. Plot the target as a point (use a * or diamond so

it shows up) and the path of the projectile (x position on x-axis and y position on y-axis). Turn in your plot and the associated MATLAB commands.

c) The plot should show that the projectile misses the target. Use your vectors of x and y positions from part (a) to estimate how close the projectile gets to the target and the time at which it is closest. Include your results and calculations. (Hint: Distance Formula)

Problem 4: Use all of the same values from Problem 3 except for the initial velocity.

a) Using the ***solve*** function in MATLAB, find the initial velocity, V_0, required to hit the target and find the time of impact with the target. Hint: solve the two motion equations simultaneously plugging in all known values – the only unknowns should be the two variables that you are solving for.

b) Verify your solution by plotting the target and the projectile path. Turn in your plot and the associated MATLAB commands.

Problem 5: Use all of the same values from Problem 3 except for the launch angle.

a) Using the ***solve*** function in MATLAB, find all possible launch angles that will allow the projectile to hit the target and find the associated time of impact with the target for each launch angle.
b) Verify your solution by plotting the target and all possible projectile paths that hit the target. Turn in your plot and the associated MATLAB commands.

Problem 6: Assuming the same initial projectile position and target position given in Problem 3, find the initial velocity and launch angle required so that the time to impact the target is exactly 15 seconds. Include results and MATLAB commands. Verify solution with a plot.

Problem 7: Assuming the same initial projectile position and target position given in Problem 3, is it possible to hit the target if the launch angle is 15^o? Justify your answer.