Midterm Exam

Name: ___________________________  SS Number: ___________________________

Instructions: Answer all questions. Partial credit is considered if you state what you would do with an intermediate result if you were able to derive it.

1. (32)

(a) Write a Matlab function that maps a year to a number expressing the world’s population if population grows at the rate of 1.3% per year and the population is known to be 6,500,000,000 in 2006.

(b) Write a Matlab function to display a table showing when the world’s population was one eighth of, one quarter of, one half of, and will be twice, four times, eight times what it is in 2006. The left column is the year and the right column is the multiplier (1/8, 1/4, 1/2, etc.).
2. (33) Recall, in Lab 2, we wrote code to input radii $R_1, R_2, R_3, R_4$ of four circles, find centers of those circles so that the $R_1$ and $R_3$ circles have centers on the $x$ axis and are tangent at the origin, the $R_2$ circle is tangent to the $R_1$ and $R_3$ circles and above them and the $R_4$ circle is tangent to the $R_1$ and $R_3$ circles and below them. The following code snippet shows how to compute the center of the $R_3$ circle.

```matlab
R1 = input('Enter radius of circle 1: '); R2 = input('Enter radius of circle 2: '); R3 = input('Enter radius of circle 3: '); R4 = input('Enter radius of circle 4: ');

% Find center of circle 2 (tangent to and above circles 1 and 3)
g2 = ((R2+R3)^2+(R1+R3)^2-(R1+R2)^2)/(2*(R1+R3)); % temp variable
cx2 = R3-g2; % x coord, circle 2 center
cy2 = (R2+R3)*sin(acos(g2/(R2+R3)))); % y coord, circle 2 center
```

Show what additional code is needed to find the centers of the $R_1, R_3,$ and $R_4$ circles and to plot all the circles.
3. (35)

(a) The EPA frequently needs to determine the movement of clouds of pollution in aquifers. Unfortunately, since aquifers are under the ground they cannot take sufficiently many measurements to get the complete story. So, they have to stick probes into the ground. But the cost of sticking a probe is extremely high so they can only stick a few. How can the EPA estimate the shape of the cloud from just a few measurements?

(b) What tools does Matlab have for helping with this?

(c) What do those tools require?

(d) How can a user satisfy this requirement? (ok, but not necessary, to write some code)

(e) Outline the design of a Matlab program to solve (or come close to solving) the EPA’s problem. Each line of your outline should express an important, needed step toward getting a solution.