ECS175: Computer Graphics
Practice Midterm

Please write your answers ON THESE SHEETS. Attach extra sheets if necessary. The size of the space indicates roughly the size of the answer we are expecting.

1. (3 points) True or false: An affine transformation of two perpendicular vectors might produce two vectors which are not perpendicular. Explain your answer with a calculation or one or two sentences.

2. (3 points) Consider the following matrix product:

$$\begin{bmatrix} 2 & 0 & 0 \\ 0 & 2 & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} 0.866 & -0.5 & 0 \\ 0.5 & 0.866 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

a) Describe this transformation as a sequence of motions of the "turtle", or graphics cursor, within its local coordinate system.

b) Describe the transformation as a sequence of operations in the global coordinate system of an outside observer.

3. (6 points) Describe, using two or three words (eg. dark grayish blue, hot pink), the color produced by each of the OpenGL commands below.
a) glColor3f(.9, .9, .5);

b) glColor3f(.3, 0, .3);

c) glColor3f(.5, .5, .5);

4. (4 points) A bug in the color interpolation program causes the triangle color along an edge connecting a bright red vertex with a bright blue vertex to change smoothly from red to dark blue, then suddenly become purple and then change smoothly to bright blue. Give a reasonable hypothesis for what the bug might be, in two or three sentences.

5. (4 points) We are given two floating-point 3D points $p = (p_x, p_y, p_z)$ and $q = (q_x, q_y, q_z)$ and a floating-point number a. Write an algebraic expression, using the given data, for the point (x, y, z) on the line through p and q with $z = a$.

6. (6 points) Find the barycentric coordinates of the point $(-1, 1)$ with respect to the triangle with vertices $(-4, 0)$, $(-1, 2)$ and $(1, 0)$.

7. (7 points) Below are the first three levels of a vine defined by an L-system.
a) Draw the next level of the plant.

b) Write down an L-system describing the growth of the vine. Be sure to say how the symbols you use correspond to the leaves, stems, etc. which are drawn, and include the Axiom (Level 0 starting string), as well as the transformation rules describing how one level is transformed into the next. You may use the following operators:

[,] - push and pop
+, − - turn left, turn right
↑, ↓ - scale up, scale down.

8. (4 points) Each of the control polygons below is used to produce a Bezier curve.
   a) Sketch the curve for each control polygon.
   b) under each curve, write the degree of the Bezier blending functions which are used to generate it.