

Question 2: OpenGL/GLUT (12 points)

List everything that is wrong with the following sequence of OpenGL commands. How would the program behave? Explain.

```
glMatrixMode(GL_PROJECTION);  
glTranslatei(5,6,8);  
glScalei(0.5, 0.5, 0.5);  
glutSolidCube(1.0);
```

Question 3: Window-to-Viewport Mapping (18 points)

Derive a mapping from a screen window with extents of (left, right, bottom, top) = (128, 540, 72, 442) to a polyline file with extents (left, right, bottom, top) = (-2.4, 4.8, -1.2, 3.6). Using your mapping, if a user clicked on the screen point (180, 240), what point would it correspond to in the polyline file?

Question 4: (6 points) Fractals

(5 points) Briefly explain how Koch snowflakes use recursion on a computer.

Question 5: OpenGL transforms (24 points)

```
glMatrixMode(GL_MODELVIEW);  
glLoadIdentity( );  
glPushMatrix( );  
glTranslate(2, 5, 6);  
glScale(2, 3, 5);  
glutSolidCube(1.0);  
glPopMatrix( );
```

- a. (10 points) Given the following OpenGL code sequence above, write out the matrix at the top of the OpenGL modelview matrix right after the glPopMatrix command. Show all your work.

- b. (14 points) Give a transformation matrix to perform a 45-degree z -roll on an object about an arbitrary point $(5,10,15)$. Multiply out your matrices to get a final answer.

Question 6: Cohen-Sutherland Clipping (20 points)

- a. (10 points) You decided to implement the Cohen-Sutherland clipping algorithm. You got the algorithm working. Then, your roommate decided to play a prank on you and deleted the tests for trivial accept and trivial reject in the Cohen-Sutherland clipping algorithm while you were away. You continued to work on the program without knowing (since it compiled okay) and turned it in. Will the algorithm still perform correctly without these tests? Why? Describe in some details the effects of this attempted sabotage on your program.
- b. (10 points) You are given a Cohen-Sutherland clipping implementation that chops each end point of a line in the order (bottom, top, left, right). Calculate and show all intermediate lines and final resultant line if a line with endpoints $P1 = (7, 1)$ and $P2 = (3, 5)$ is clipped against a window with $(\text{left, right, bottom, top}) = (4, 8, 2, 6)$? Show all your work