Sample Questions for Computer Graphics Exam

1. Suppose a 2-dimensional clipping rectangle has its lower left corner at (30, 50) and its upper right corner at (220, 240). Hand simulate the Cohen-Sutherland algorithm on each of the following line segments:
   (a) (40, 140) - (100, 200)
   (b) (10, 270) - (300, 0)
   (c) (20, 10) - (20, 200)
   (d) (0, 0) - (250, 250)

2. Derive Bresenham’s algorithm for drawing a line with only integer operations for the case -1 ≤ slope ≤ 0.

3. (a) What does it mean for a piecewise polynomial curve to be second order continuous?
   (b) Verify that the uniform cubic B-spline, given below, is second order continuous.

\[ P(t) = \begin{cases} 
0 & \text{if } t < -2 \\
\frac{1}{6}(2+t)^3 & \text{if } -2 \leq t < -1 \\
\frac{1}{6}(2+t)^3 - \frac{2}{3}(1+t)^3 & \text{if } -1 \leq t \leq 0 \\
-\frac{2}{3}(1-t)^3 + \frac{1}{6}(2-t)^3 & \text{if } 0 \leq t \leq 1 \\
\frac{1}{6}(2-t)^3 & \text{if } 1 \leq t \leq 2 \\
0 & \text{if } 2 \leq t 
\end{cases} \]

4. Consider the transformation necessary to scale a 2-dimensional object centered at (-1, 3) by 4 in the y-direction. The resulting object is still to be centered at (-1, 3).
   (a) List the sequence of steps necessary to accomplish this transformation.
   (b) Write the individual transformation matrices needed to implement each of the steps in (a). Use homogeneous coordinates.
   (c) Compute the composite transformation matrix which will accomplish the entire transformation.

5. Consider a polygon with the vertices (2, -1, 3), (3, 1, 5), (0, 3, 6), (-1, 1, 4), and (-2, -2, 2).
   (a) Use Newell’s method to find the normal to the polygon.
   (b) Is the polygon planar? Justify your answer.

6. We discussed Lagrange interpolation using four sample points and four blending functions. To improve the appearance of the interpolating function (i.e., to attempt to make it look smoother) consider allowing six points to exert influence in a region, thereby increasing the degree of the interpolating function. Develop the six blending functions for this interpolation. How do you handle the endpoints of the curve in this case?