1. (20 points) Is it possible to specify two quadratic Bezier curves such that they are joined with C0 and C1 continuity? How must control points be positioned such that these constraints are satisfied? Provide a mathematical proof that justifies your answer.

2. (10 points) Is a Hermite spline an interpolating or approximating spline? Is a Bezier curve an interpolating or approximating spline? Briefly justify your answers.

3. (20 points) Give the precise mathematical steps in an algorithm for the display of any 3D quadratic, parametric curve using forward differences to calculate points along the curve.

4. (20 points) Give the homogeneous transformation matrix that will reflect a 3D point about an arbitrary plane. Assume that you are given the plane equation $Ax + By + Cz + D = 0$.

5. (15 points) Prove that the quaternion rotation matrix of Eq. 11-40 in the textbook reduces to the matrix representation in Eq. 11-5 when the quaternion describes a rotation about the $z$ coordinate axis.

6. (15 points) We are given the perspective-projection transformation matrix:

$$
M_{\text{per}} = \begin{bmatrix}
1 & 0 & 0 & 0 \\
0 & 1 & 0 & 0 \\
0 & 0 & -z_{vp}/d_p & z_{vp}(z_{prp}/d_p) \\
0 & 0 & -1/d_p & z_{prp}/d_p
\end{bmatrix},
$$

where $d_p = z_{prp} - z_{vp}$ is the distance of the view plane from the projection reference point, as described in the text on pp. 444-445.

(a) Assume that we move the camera such that projection reference point is at the origin of the world coordinate system ($z_{prp} = 0$). In the limit, what does this transformation matrix look like as $d_p$ tends to infinity? Give an expression for $M_{\text{per}}$ in this special case.

(b) Now assume that we move the camera such that $z_{vp} = 0$. In the limit, what does this matrix look like as $d_p$ tends to infinity? Give an expression for $M_{\text{per}}$ in this special case.

(c) Which of the above two cases corresponds to orthographic projection matrix? Explain your answer.

7. (20 points CS680 required, CS480 extra credit) Splines can be used for smoothly interpolating colors in image warping and resampling. Instead of 3D position, each control point for the interpolating spline is given by a RGB triple. Conduct research in the library or on the WWW to find information about an algorithm for image warping and resampling that employs splines. Give an overview of the mathematical formulation, what type of spline is employed, what order, etc.