

Written Assignment #1
15-462 Computer Graphics, Fall 2007
(Update: 09/16/2007 6:40PM)

The work must be your own. Please use any resources available to you (the book, the web, etc.), but write up the answers in your own words, explaining all of the steps. Also please cite any external references you use (other than the textbook) to come up with your answers.

1. Prove that if vectors **a**, **b**, **c**, and **d** lie in the same plane when positioned with a common initial point, then $(\mathbf{a} \times \mathbf{b}) \times (\mathbf{c} \times \mathbf{d}) = \mathbf{0}$. (**0** is the zero vector, a vector whose all components are zero).
2. Find a parametric equation form for
 - a) A line intersecting the x -axis at $x = 2$ and the y -axis at $y = 3$, parameterized upward.
 - b) The ellipse $\frac{x^2}{9} + \frac{y^2}{4} = 1$, parameterized clockwise.
3. What is the implicit equation of the plane whose points are equidistant from $(2, -1, 1)$ and $(3, 1, 5)$? What is the parametric equation? What is the normal vector to this plane?
4. Explain why a gamma-corrected 24-bit color image has better image quality than a linear 24-bit color image. (Hint: think in terms of the precision of luminance).
5. Suppose we want to draw an opaque polygon together with a translucent polygon. Explain how we can use a function **glDepthMask(GLboolean flag)** to ensure a correct final image without ordering the polygons ourselves.
6. Describe in words what this 2D transform matrix does:

$$\begin{bmatrix} -1 & 0 & 1 \\ 1 & -1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

7. Find the 3 by 3 matrix that create a 2D reflection about a line $y = mx + c$.
8. Find the 4 by 4 matrix that rotates a rigid body by θ around the point $(x_p, 0, z_p)$ and about the y -axis.
9. M is an $n \times n$ orthogonal matrix if the transformation M preserves length, that is, $\|M\vec{x}\| = \|\vec{x}\|$, for all \vec{x} in \mathcal{R}^n .
 - a) A square matrix A is an orthogonal matrix if and only if $A^T A = I_n$. Use this fact to show that any rotation matrix is an orthogonal matrix.
 - b) Given a rotation matrix M . What is the transformation formula for rotating points? rotating normals?