

1:

**a): What determines whether a planar figure is outward (or front facing) or backward facing?**

The order of vertices when it draws the face.

**b): What is the difference between geometry and topology?**

Geometry relates to shape, location, and position; topology is about the structure of the object. Therefore, even you did some stretching or bending, it would still be considered as the same object. (The donuts and the coffee cup example we talked about in class.)

2:

**a): To what does face culling refer in computer graphics?**

Each face of a plane has two sides. Each side would either face the user or show its back to the user; if we only one side, we will optimize the performance of rendering. Face culling determines which side we want to render.

**b): Describe what happens as you alternate your culling options with your use menu.**

From the same point of view, when you alternate the culling option (back to front, or front to back), the face that you can see will be invisible, the face that you cannot see will be visible. If you do "front and back," all will be invisible.

3:

**a): What are the barycentric coordinates of the geometric center of a triangle?**

Barycentric coordinates can be used to express the position of any point located on the triangle with three scalars. The location of this point includes any position inside the triangle, any position on any of the three edges of the triangles, or any one of the three triangle's vertices themselves.

**b): Given three (3D) points (p0, p1, p2), ordered in a counter-clockwise fashion, use an unambiguous mathematical description determining how you would compute the normal to the surface containing these points in a right hand coordinate system.**

For three points p0,p1,p2, firstly we need to get the two vectors that the triangle formed by.  $U = p1 - p0$ ,  $V = p2 - p0$ . After that, we the cross product of U and V to get the normal.

$$N_x = U_y V_z - U_z V_y$$

$$N_y = U_z V_x - U_x V_z$$

$$N_z = U_x V_y - U_y V_x$$

4:

**a): What happens to the angle between the normals and each surfaces as you experiment with different scaling factors?**

The normal will also be changed, but it is always perpendicular to the plane.

**b): What happens if scale factor is in each of these ranges: ( -inf, 0), [0,0] (0, 1), [1, 1], (1, inf )**

If the factor is 1, the size will not change since  $x*1=x$ . If the factor is 0, the size will be 0, because  $x*0 = 0$ . If it is between ( -inf, 0), each vertex will be scaled to the opposite direction. If it's (1, inf), it will scale the object bigger and bigger. On the contrary, if it's (0, 1), it will be smaller and smaller.