1. If a camera center is located at (1, 1, 0) and it is looking at the origin, with the +X as its up vector, compute the Modelview matrix of this camera.

2. Suppose a perspective camera has horizontal and vertical viewing angles $\theta_h$ and $\theta_v$.
   
   (a) What is the aspect ratio of this camera?
   
   (b) Describe how to compute the projection matrix for this camera if you are given the NEAR and FAR parameters.

3. In Phong reflection model, shading result at each surface point consists of three components: ambient intensity, diffuse intensity and specular intensity. For each of the three components, which of the following factors affect the result (pick all that apply): surface normal, viewing angle, light source position, material property, size of the object, number of polygons in the scene.

4. Let the angle between the halfway vector and the normal be $\beta$, and the angle between the view vector and the reflection vector be $\phi$.
   
   (a) Derive a relationship between $\phi$ and $\beta$ if the view vector, the normal, and the light vector are co-planar.
   
   (b) Discuss the differences you might expect to see in the appearance of specular reflections modeled using these two angles.

5. Suppose you are designing an integer z-buffer for flight simulation where all of the objects are at least 1 foot thick, are never closer to the viewer than 10 feet, and may be as far away as 5000 feet. How many bits are needed in the z-buffer to ensure there are no visibility errors (Show the derivation process)?