1. Find the 4x4 homogeneous 3D transformation matrix that translates by $(3, 5, 2)$, rotates by 45 degrees about the Z-axis, and finally, scales by $(3, 1, 2)$.

2. Suppose you wish to apply the transformation in question 1 to the normal vectors in a 3-D model. What is the transformation matrix that needs to be applied to the normal vectors in order to preserve the normals' perpendicular orientation relative to the surface of the object?

3. In the graphics pipeline shown on slide 146 in the lecture notes, note that the vertex shader takes as input the vertex coordinates as well as the normal vector. When rendering a tetrahedron how many unique (vertex, normal vector) pairs would this vertex shader be expected to process?

4. A triangular face, which is part of a larger 3-D model, is defined by vertices at the points $(1, 0, 1), (3, 2, 4)$ and $(5, 3, 1)$

   (a) If the convention is vertices for front-facing triangles are provided anti-clockwise, find the surface normal of the triangle defined by these three vertices.

   (b) Explain why the normal vector at the vertices might not be set to the vector you found in part (a) in the 3-D model. What visual effect is this intended to produce?

5. Consider a scene with V vertices, N objects, and T triangles being rendered to a display with P pixels. Assuming a single fragment shader and no anti-aliasing, what is the upper bound of how many times the fragment shader will be run?

6. A triangle with vertices $(0.0, 0.0, 0.0)$, $(1.0, 0.5, -0.5)$, $(-1.0, 3.0, 0.0)$ has the following texture coordinates mapped to each vertex: $(0.0, 0.0)$, $(0.5, 0.5)$, $(0.0, 1.0)$, respectively.

   What texture coordinate corresponds to the point $(0.0, 0.875, -0.125)$ in the triangle?

7. A bump/normal-mapped object can be made to appear bumpy when in fact the geometry is smooth. Given a bumpy-looking object, explain what characteristics can be used to determine whether the object has bumpy geometry or is making use of bump-mapping.

8. Explain why there are no colours lying outside of the curve formed by the pure colours in the CIE chromaticity diagram.