

ECE 478 Computer Graphics

Mid-Term Examination

March 4th 2010

1 hour

Name:

Student Number:

Marks will be given for demonstrating your thought processes as well as the correct answer. Make sure you show all the steps you use for each of your answers.

Question 1

- a)** Describe what is meant by: scalars; vectors; affine space; reference frames. **(4 marks)**
- b)** Give two of the three main frames of reference used in computer graphics when working in three dimensions. **(2 marks)**
- c)** What types of transformation are required to convert between two reference frames? **(4 marks)**
- d)** Write down the transformations required to **rotate** the world around a camera at position **\mathbf{p}** in the world. Use **\mathbf{T}** for translation, **\mathbf{S}** for scaling and **\mathbf{R}** for rotation. (*The order of transformations matters.*) **(4 marks)**
- e)** Write down the transformations required to **rotate** and **scale** an object at position **\mathbf{p}** in the world. Use the same notation as for the previous question. (*The order of transformations matters.*) **(4 marks)**

Question 2

- a)** What are the two main differences between orthographic and perspective viewing? **(2 marks)**
- b)** Derive the perspective projection equations: start by drawing diagrams to illustrate your approach, then describe each step you take (*most marks are given for the work you show*) **(6 marks)**

Question 3

- a) What is a homogeneous coordinate? **(2 marks)**
- b) What is the difference between the homogeneous representations of points and vectors? **(2 marks)**
- c) Write down the homogeneous matrix for any two of the following transformations: Scaling; Rotation around the x-axis; Rotation around the y-axis; Rotation around the z-axis; Translation. **(4 marks)**
- d) Give two reasons why homogeneous matrices and coordinates are used for transformations in computer graphics. **(4 marks)**
- e) Vertices must be converted in the pipeline from homogeneous representation into the standard representation (e.g. from 4D to 3D). How is this conversion accomplished? **(2 marks)**

