**This question paper consists
of 2 printed pages each
of which is identified by the Code COMP5812M**

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School of Computing

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COMP5812M: Foundations of Modelling & Rendering

Answer all FIVE questions

Time allowed: 2 hours

Question 1
(a) Give two quaternions q_1, q_2 , describe how you find the quaternion whose action is exactly halfway between them   **[5 marks]**
(b) Given a ray $p + \vec{v}t$ and a triangle ΔABC in space, describe how to find the intersection of the ray and the triangle. Where possible, express your answer mathematically.
                                                                                                                         [5 marks]
                                                                                                               [10 marks total]

Question 2
Give the pseudocode for a modern raytracer.

                                                                                                               [10 marks total]

Question 3
Suppose you have a simple model of a toad that is already parameterised for textures. You have been asked to upgrade it to a model of a toad with warty skin, but no artist is available to provide you with additional assets.

Describe how you could build a better model of the toad in which the warts are geometrically described and textured (complete with slime, if desired). If you use textures for the purpose, you should also describe how you will generate the textures.

State any technical assumptions you make. You are not required to show actual equations, but may choose to do so if it is a clear explanation.
                                                                                                               [10 marks total]

Question 4
You have been given a model built with Bézier tensor patches. Explain how you would convert them to triangles for rendering. Include full details of how you find texture coordinates and normal vectors.

                                                                                                               [10 marks total]

Question 5
You have been given a minimal raycaster using the Blinn-Phong model. Describe how you would modify it to add:

a)   Refraction through a transparent solid.   **[4 marks]**
b)   Subsurface scattering.   **[3 marks]**
c)   Polarised reflection from a water surface.   **[3 marks]**
                                                                                                               [10 marks total]