COMPUTER SCIENCE TRIPOS Part IA – 2025 – Paper 3

4 Introduction to Graphics (fz261)

(*a*) Answer the following questions about geometric transformations.

(*i*) Given a cylinder defined at the origin with radius 1 and its ends at $(0, 0, 0)$ and $(0, 0, 2)$, how would you transform it to have radius 2 and its ends at $(1, 2, 5)$ and $(4, 6, 5)$ if the order of transformations is set to be scaling, rotation, and translation? You do not need to compute the matrices, but you should explicitly describe what each transformation does.   [6 marks]

(*ii*) How would you obtain the transformation for the normal using the above scaling, rotation, and translation? Simplify the transformation if possible.   [2 marks]

(*b*) Answer the following questions about the graphics pipeline.

(*i*) In rasterization, what information does the Z-buffer store? Why is this information needed, and how was it computed?   [3 marks]

(*ii*) In the OpenGL rendering pipeline, can you give 4 examples of vertex attributes and uniforms, respectively?   [4 marks]

(*iii*) Explain the main difference between uniform variables and vertex attributes.   [2 marks]

(*iv*) What are barycentric coordinates, and where are they needed in the OpenGL rendering pipeline?   [3 marks]