6 Further Graphics (pb355)

(a) The challenge of simulation sickness (sim sickness) in Virtual Reality is a crucial hurdle in creating engaging virtual content.

(i) When it comes to avoiding sim sickness, what is the cardinal rule of VR? [1 mark]

(ii) Succinctly explain the triggers and effects of sim sickness. [2 marks]

(iii) List the constraints that sim sickness imposes on user interface design in VR. For each constraint give a one-sentence explanation of how developers must adapt to compensate. [5 marks]

(b) A mathematician tells you that a mystery shape is composed of polygons forming a closed, connected, manifold mesh without border. They claim that the mesh has 832 vertices, 1,648 edges, and 600 faces. The mathematician wants to know if it is possible that there is a loop of connected polygon edges in the mesh which, if all of those edges were cut apart, would not split the mesh into disconnected parts.

(i) • If you say no, they will want to know why.

• If you say that you cannot answer, they will want to know why not.

• If you say yes, they will ask you why; and then they will ask you to find the greatest possible number of such loops that could simultaneously be cut in the mesh.

What do you tell them? [5 marks]

(ii) If the mathematician had instead said that the mesh had 832 vertices, 1,648 edges, and 900 faces, would your answer to their question have been different? If so, how? [2 marks]

(c) Implement a Signed Distance Field method cylinder() which returns the signed distance from point \( p \) to a finite cylinder segment. The cylinder should go from point \( a \) to point \( b \) with flat ends and radius \( r \).

\[
\text{float cylinder(vec3 p, vec3 a, vec3 b, float r) }
\]

// ...

} [5 marks]