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.

(ii) If you say yes, they will want to know 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 \( r \).

```c
float cylinder(vec3 p, vec3 a, vec3 b, float r) {
    // ...
}
```

[5 marks]