4 Introduction to Graphics (rkm38)

(a) The two screenshots below show two different OpenGL rendering artifacts. Identify the artifacts, explain their cause and how to avoid them. [6 marks]

(b) The simple GLSL shader below puts a yellow diffuse material on an object:

```cpp
in vec3 N;
in vec2 tex_uv;
in vec3 wc_frag_pos;
out vec3 color;

void main() {
    const vec3 I_a = vec3(1, 1, 1) * .008;
    const float k_d = 0.4;
    const vec3 I = vec3(1, 1, 0.9);
    const vec3 L = vec3(1, -3, 1);
    vec3 C_d = vec3(1, 1, 0);
    vec3 linear_color = C_d*I_a + C_d*k_d*I*max(0, dot(N, L));
    color = tonemap(linear_color);
}
```

Add a few lines of code that generate a black-and-yellow checkerboard pattern as shown in the image next to the code. Assume that the correct uv coordinates have been passed from the vertex shader but no texture has been specified. You may use an arbitrary scale of the pattern on the surface. [7 marks]

(c) You measure red, green and blue primaries of a standard dynamic-range display to be \([X_r \ Y_r \ Z_r], \ [X_g \ Y_g \ Z_g], \ [X_b \ Y_b \ Z_b]\). The gamma of the display is \(\gamma\). Write the equation for mapping from linear colour \([R_{\text{in}} \ G_{\text{in}} \ B_{\text{in}}]\) in the ITU-R 2020 colour space to the display-encoded RGB in the native colour space of the display. You are provided with the matrix \(M_{\text{R2020toXYZ}}\) mapping from ITU-R 2020 to XYZ colour space. [7 marks]