Pattern Recognition, Image Processing and Computer Graphics
Test Exam

Rendering Pipeline	true	false
The depth test is performed in the fragment processing stage.	⊗	○
Stencil tests are performed in the vertex processing stage.	○	⊗
In Phong shading, the illumination model is evaluated per vertex. In Gouraud shading, however, the illumination model is evaluated per fragment.	○	⊗
Blending combines the color of an incoming fragment with the framebuffer color at the pixel position of the incoming fragment. The resulting color replaces the respective framebuffer color.	⊗	○

Homogeneous Coordinates and Transforms	true	false
The same modelview transform is applied to all objects in a scene.	○	⊗
Affine transformations map the midpoint of a line segment to the midpoint of the transformed line segment.	⊗	○
$(9, 6, 3, 1)^\mathsf{T}$, $(-9, -6, -3, -1)^\mathsf{T}$, $(9 \cdot \sqrt{2}, 6 \cdot \sqrt{2}, 3 \cdot \sqrt{2}, 1 \cdot \frac{2}{\sqrt{2}})^\mathsf{T}$ are all homogeneous coordinates of the same point in Cartesian space.	⊗	○
$(3, 4, 0)^T$ is a point at infinity on the line $4x - 3y + 1 = 0$.	⊗	○

Projections	true	false
Perspective projection is an affine transform.	○	⊗
The orthographic projection is a combination of translation and scaling.	⊗	○
Projective transforms map from object space to clip space.	○	⊗
Perspective projections non-linearly map the z-component from camera / eye space to normalized device coordinates.	⊗	○

Lighting	true	false
In the Phong illumination model, the computation of the specular component is independent from the light source direction.	○	⊗
In Phong shading, the lighting model is evaluated per vertex, not per fragment.	○	⊗

Ray Casting	true	false
Consider a 3D plane through point $(0,0,0)^\mathsf{T}$ with surface normal $(1,0,0)^\mathsf{T}$. A ray with origin $(-1,0,0)^\mathsf{T}$ and direction $(1,1,0)^\mathsf{T}$ intersects this plane at point $(0,1,0)^\mathsf{T}$.	⊗	○
All points $\boldsymbol{p}(b_1,b_2) = (1-b_1-b_2)\boldsymbol{p}_0 + b_1\boldsymbol{p}_1 + b_2\boldsymbol{p}_2$ with $b_1 \geq 0, b_2 \geq 0, b_1 + b_2 \leq 1$ are within the triangle formed by points $\boldsymbol{p}_0, \boldsymbol{p}_1, \boldsymbol{p}_2$.	⊗	○

Curves	true	false
$\boldsymbol{x}(t) = (1-t)^2\boldsymbol{p}_0 + 2t(1-t)t\boldsymbol{p}_1 + t^2\boldsymbol{p}_2$ with $0 \leq t \leq 1$ is a quadratic Bézier curve.	○	⊗
The Bernstein polynomials of degree 2 can be written in matrix form as $\begin{pmatrix} 1 & -2 & 1 \\ 0 & 2 & -2 \\ 0 & 0 & 1 \end{pmatrix} \begin{pmatrix} 1 \\ t \\ t^2 \end{pmatrix}$.	⊗	○
Consider a quadratic Bézier curve with control points $\boldsymbol{p}_0, \boldsymbol{p}_1, \boldsymbol{p}_2$. The point $\boldsymbol{x}(t)$ on this curve for $0 \leq t \leq 1$ can be computed as $\boldsymbol{x}(t) = (1-t)\left((1-t)\boldsymbol{p}_0 + t\boldsymbol{p}_1\right) - t\left((1-t)\boldsymbol{p}_1 + t\boldsymbol{p}_2\right)$.	○	⊗
The curve $\boldsymbol{x}(t) = (1+t^3, 2)^\mathsf{T}$ is C^1 continuous.	⊗	○

Particle Fluids	true	false
In an SPH fluid solver, the density at a particle is computed as sum over adjacent particles as $\rho_i = \sum_j \rho_j W_{ij}$.	○	⊗
In an SPH fluid solver, the Verlet scheme updates particle positions and velocities with $\boldsymbol{x}^{t+h} = \boldsymbol{x}^t + h\boldsymbol{v}^t$ and $\boldsymbol{v}^{t+h} = \boldsymbol{v}^t + h\boldsymbol{a}^t$.	○	⊗