1. (1 point) An animation is a time-sequence visual change in a picture. If the pictures are generated offline and then glued together in a video, then we refer to this as frame-by-frame animation.

2. (2 points) As described in lecture, the loop to create animations had four main steps. List and briefly describe them in correct order (assume double buffering):
   (a) Update the state of the world
   (b) Clear the back frame buffer
   (c) Draw the state of the world in the back frame buffer
   (d) Swap the back and front frame buffers

3. (1 point) A detailed picture (or description of a picture) in an animation sequence is called a key-frame. Intermediate pictures, called in-betweens, are generated through interpolation, e.g., linearly.

4. (1 point) List one animation technique and one motion specification technique:
   (a) Squash-and-stretch, timing, morphing, or motion capture
   (b) Direct, Goal-directed, Kinematics/Dynamics, Periodic, Articulated

5. (1 point) A Physically-based Model is a system of equations that governs the behavior of an object. Name an example (do not state equations):
   Point-mass, Particle system, Rigid body, Flocking, or Spring-mass-damper

6. (1 point) The evolution of a system (equations) often involves integration. We discussed Euler integration in class. Given a state $S^n$, its derivative $\dot{S}^n$ at time $n$, and time-step $\Delta t$, what is the state $S^{(n+1)}$ at time $n + 1$?
   $S^{(n+1)} = S^n + \Delta t \dot{S}^n$
   To help determine $\dot{S}^n$ you compute forces and apply Newton’s second law of motion.

7. (1 point) A Particle system is a set of independent point-masses acting under a set of forces. Generators assist in randomizing the initial conditions of each point-mass.

8. (1 point) A method that determines the observable objects in a scene from a given view position is called a Visible-surface detection method. Those that work on projected objects (pixel level) are called Image-space approaches.
9. (1 point) Back-face culling is the removal of surfaces that are not oriented to be viewed by the camera. Let $\vec{N}$ be a surface normal and $\vec{z}_v$ be the z-axis of your view. What is the inequality that governs this approach? 
\[ \vec{z}_v \cdot \vec{N} > 0 \]

10. (2 points) Depth-buffering is a technique where depth values with each pixel are stored in memory. When an object is scan-line converted, if a depth value is closer than the previously stored depth, then the color is updated in the frame buffer. An extension of this, Accumulation-buffer, handles transparency.

11. (1 point) Depth sorting approaches are often referred to as painter’s algorithms because they draw the farthest objects before the closest objects, like artists do. Name one augmenting data structure that helps with depth sorting:
Binary-space Partition tree or Oct-tree

12. (1 point) True or False (Circle one): The closest object to the screen from a given pixel can be determined by computing the intersections of a ray with objects in a scene. This is called ray-tracing.

13. (1 point) True or False (Circle one): Depth-cueing dims (makes less bright) objects based on their distance from the viewing plane.

14. (1 point) Bonus. Define a hierarchical model and degree of freedom.
A hierarchical model is a tree-based description of a system, where a model is a single representation within the system. A degree of freedom is one axis of motion, i.e., one parameter affecting the placement of a model within the hierarchical description.