This will be a CLOSED notes and books exam.

Check to make sure you have all ? pages including this one.

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The answers to all fill-in-the-blanks questions will be provided on the actual exam, although they are not provided for sample exams. Answers may be used more than once. Sometimes more than one answer in the list may be correct for a single question.

The numbers in the above list indicate for which exam the questions are pertinent. There may be more or less questions on the actual exam.

The animation questions for the future test may change.
1. **Graphics, Digital Images, Post-Processing**

1. A digital image on the screen with resolution 12 X 20 has how many *pixels_______________*, and how many *scanlines_______________*. ANSWER 240 and 20.

2. A common format for *digital images* is ________________. ANSWER jpeg (etc.)

3. If you create an image using Photoshop which is made up of several layers, and you save this image as a .jpg image, is it possible to recreate the layers from just the .jpg image? ANSWER false

4. An individually addressable spot that can be given its own color in a digital image is a ________________. ANSWER pixel

5. Given a grid representing pixels on a screen, and a line drawing of an object on the screen, color in the pixels that would turn on to draw that object. Would the object and the pixel version be the same? ANSWER no.

6. How many colors can you choose from, at each pixel, if your frame buffer has 8 bits per pixel? __________. ANSWER 256

7. If you can stored 256 different intensities of red, green, and blue at each pixel, how many *bytes* per pixel do you need? __________. ANSWER 24

8. A graph that show how many pixels of each intensity are present in a digital image is a ________________. ANSWER histogram

9. Combining two or more digital images is called ________________. ANSWER compositing

10. Accentuating the regions of the image where intensities vary sharply is called ________________. ANSWER edge detection

11. Transparency information is stored for a digital images in the ________________. ANSWER alpha channel

12. A standard resolution used by video is ________ by ________. ANSWER 640 x 480

13. If you resample a 640x480 images so that it has 240 scan line and maintains its aspect ration, the new image resolution will be ________________. ANSWER 320x240

14. Spreading out the intensity or color values in an image so that the number of pixels with each intensity is well balanced is called ________________. ANSWER histogram equalization
15. A problem in raster graphics that diagonal lines and edges have a stair-step appearance and are jagged is called __________. ANSWER aliasing

16. How many colors can you choose from, at each pixel, if your frame buffer has 5 bits per pixel? __________. ANSWER 32
2  Hardware and Software

1. Twice the normal frame buffer size is required for animating images, because one image is displayed while another is drawn. This is called __________ ANSWER double-buffering

2. The part of computer memory where the image displayed on the screen is stored is called the __________ ANSWER frame buffer

3. Another name for computer programs or software is __________ ANSWER code

4. Software for design and manufacturing is called __________ ANSWER CAD/CAM

5. Match the following computer parts to the job each does. Each job may have more than one computer part associated with it.

COMPUTER PARTS  JOBS
_____ C.P.U.  A. Arithmetic-Logic Operations
_____ Printer  B. Input  ANSWER D,C,B,A
_____ Mouse  C. Output
_____ A.L.U.  D. Central Controller

6. An old computer language much used for scientific applications is ________________.
   ANSWER fortran

7. A very powerful computer used for scientific calculations is a ________________.
   ANSWER supercomputer

8. A modern computer language much used for internet applications is ________________.
   ANSWER java

9. A portable way to store data and carry it about with you is on a ________________.
   ANSWER zip disk

10. If you have a program in the C language that will compile and run on an IBM computer, you should be able to use the same C program on a SGI computer. (True or False?) ________________ ANSWER true

11. If you have an executable program in machine language that will run on an IBM computer, you should be able to use the same program on a SGI computer. (True or False?) ________________ ANSWER false

12. The operating system we use in the BE 109 lab is
   ________________ ANSWER Windows

13. A byte is how many bits? ____________ ANSWER 8
14. A kilobyte is how many bytes? ___________. ANSWER 1024 \(2^{10}\)

15. A gigabyte is closest in number to how many bytes?
   (1) 1000 bytes; (2) 1,000,000 bytes; (3) 1,000,000,000; (4) 1,000,000,000,000 bytes.
   Circle the correct answer. ANSWER 3

16. The material in a CRT that changes color when hit by electrons is called ________________.
    ANSWER phosphor

17. Mathematical calculations are done by the ________________. ANSWER A.L.U.

18. The most common computer output device is a ________________. ANSWER C.R.T.

19. The decimal equivalent of the binary number 1 is ________________. ANSWER 1
3 Color

1. Give two color names that differ in hue. ________________ and ________________.
   ANSWER e.g., red and green

2. Give two color names that differ only in saturation, but have the same hue. ________________ and ________________.
   ANSWER e.g., red and pink

3. The brightness or intensity of a color is also called its ________________.
   ANSWER e.g., value

4. Basic colors from which other colors can be created by combination are called ________________.
   ANSWER e.g., primaries

5. All the colors that can be created by combining certain basic colors are referred to as the ________________.
   ANSWER e.g., gamut

6. The three colors associated with the cones of the eye are ________________ and ________________ and ________________.
   ANSWER e.g., red, green, and blue

7. Give two RGB triplets (representing colors) that differ only in value, that is, they have same hue and saturation. ________________ and ________________.
   ANSWER e.g., (1,1,1) and (.5,.5,.5)

8. Yellow is a metamer of a combination of two other colors. What are they? ________________ and ________________.
   ANSWER red and green

9. How would you represent the brightest magenta in the RGB model, and how would you represent a less bright magenta. ________________ and ________________.
   ANSWER (1,0,1) and (.5,.5,.5) e.g.

10. Give the RGB values of two different colors that differ in hue but have the same saturation and value. ________________ and ________________.
    ANSWER (1,0,0) and (0,0,1) e.g.,

11. A half unsaturated dark green is represented as (Green, 0.5, 0.5) in the HSV model. Circle which of these choices would be most comparable in the RGB model? (0,1,0) (0.5,0.25,0.25) (0.0,2,0) (0.25,0.5,0.25) ANSWER (.5,0.25,0.25)

12. The color green is represented as (120°,1,1) in the HSV model. The color blue is represented as (240°,1,1) in the HSV model. How would you represent cyan in the HSV model? That is, what is the hue, saturation and value of fully saturated, full intensity cyan? ANSWER (180°,1,1)
13. Explain very briefly (in one or two sentences) why is it difficult to reproduce all colors in nature on a computer screen? ANSWER limited gamut with 3 primaries

14. Somebody decides to specify all screen colors by specifying cyan, magenta and yellow components of the color instead of red, green and blue components? Will that work? Why or why not? (3 points) ANSWER yes

15. The problem that the range of colors on the screen is not the same as the range of colors that can be printed is related to the fact that ink and phosphors do not have the same ___________________. ANSWER gamut

16. The range of wavelengths of visible lights is about 400 nanometers to ____________________ nanometers. ANSWER 700

17. Name a subtractive color model _________________. ANSWER CMY or CMYK
4 Modeling and Coordinate Systems

1. Another word for perpendicular in computer graphics is (circle one): (1) normal, (2) abnormal, (3) outward. ANSWER 1. normal.

2. The three main geometrical transformations are: __________________, __________________, and ________________. ANSWER rotation, translation, scaling.

3. In a left-handed 3D coordinate system, if the X-axis is to the right, and the Y-axis is up, the Z-axis is _________________. ANSWER away from you.

4. When just the outline of an object or its polygons is shown, so that you can see through it, is called a _________________. ANSWER wireframe

5. The simplest graphical primitive is a _________________. ANSWER point or vertex

6. If objects of the same size that are farther away do not appear smaller, the kind of projection used is called _________________.
   If they do appear smaller, it is called _________________. ANSWER parallel and perspective

7. When an object is approximated by a number of polygons, this is called _________________.
   ANSWER tessellation

8. One-dimensional primitives are called lines and __________________. ANSWER curves

9. When an object is shaded in as a continuous surface, the object is a _________________.
   ANSWER rendering

10. A coordinate system in which the axes are straight lines and are perpendicular to each other is _________________. ANSWER Cartesian

11. Two-dimensional primitives created by connecting points with straight lines are called _________________. If this primitive has three points it is called a __________________, and if it has four points it is called a __________________. ANSWER polygons, triangle, quadrilateral

12. The process of converting 3D information to 2D information is called _________________.
   ANSWER projection

13. A three-sided polygon in computer graphics is always planar (True or False). ANSWER True
14. Three-dimensional space can be defined in terms of _________________ axes (a number) ANSWER 3

15. A four-sided polygon is called a _________________. ANSWER quadrilateral

16. The relationship of the width of the window to the height is called the _________________. ANSWER aspect ratio
5 Geometrical Transformations

5.1 Drawing 1

In the image below, assume the pivot of the square is at the lower left corner.
1. Draw the square after it is translated in (x,y) by (-3,6) from the original position. Label it with a 1 in the square.
2. Draw the square after it is scaled by (2,3) from the original position. Label it with a 2 in the square.
3. Draw the square after it is rotated by 45 degrees from the original position. Label it with a 3 in the square.

5.2 Drawing 2

In the image below, assume the pivot of the square is at the upper left corner. Redraw the square after it is rotated by 180 degrees around the origin of the coordinate system shown.
1. In modeling an airplane flying, if the plane rotates around the direction in which it is traveling, this is a ______________________. If it rotates to its own right or left, this is a ______________________. If it puts its nose down this is a ______________________. These are transformations relative to the ______________________.

ANSWER roll, yaw, pitch, local frame

2. The point about which an object scales and rotates, but which itself does not move, is the ______________________. ANSWER pivot

3. Applying a scaling transform may cause an object to move in space, as well as change size. True or False. ANSWER true

4. Given an object defined in 2D Cartesian space: show the result of translating it by (10,5); show the result of rotating it around the world space origin by 90 degrees; show the result of rotating it about a pivot at (1,1) by 90 degrees; and of scaling it by 3 about the origin, or about a pivot point.
6 Cameras, Viewing, and Projection

1. One of three things required to specify a camera for use in graphics is ________________. ANSWER look at, look from, or twist (or roll)

2. The location of the camera itself is called the ________________. ANSWER look from

3. The direction from the camera to the object seen at the center of the window is the ________________. ANSWER line of sight

4. If objects of the same size that are farther away do not appear smaller, the kind of projection used is called ________________ projection. If they do appear smaller, it is called ________________ projection. ANSWER parallel and perspective

5. If simulated light rays from the objects in the scene converge at the camera, the type of projection is ________________ projection. ANSWER perspective

6. The region in front of the camera where objects will appear in focus on the image plane is ________________. ANSWER depth of field

7. The plane at some distance in front of the camera that will always appear in focus on the screen is called the ________________. ANSWER focal plane

8. A telephoto lens has a wider angle of view than a normal (e.g., 55 mm) lens. True or False. ________________. ANSWER false

9. Objects outside of these planes do not appear in the image. ________________. ANSWER clipping planes

10. In a long shot, peoples’ faces take up most of the image. True or false. ________________. ANSWER False

11. In ________________ format, the image is higher than wide. ANSWER portrait

12. The movement of the camera (or another object) where it rotates about its own longitudinal (front-to-back) axis, is called a ________________. ANSWER roll

13. Moving the camera left has the same effect as moving all the objects in the world ________________.
   ANSWER right
14. A point that determines the line of sight of the camera is the _________________.
   ANSWER look at

15. The depth of field of a ray-traced image is generally _________________.
   ANSWER infinite

16. 3D objects are projected onto this plane for rendering _________________.
   ANSWER image plane or projection plane

17. If the camera position (look-from) remains the same but the look-at point moves, this
    causes what geometrical transformation to the camera as an object? _________________.
    ANSWER rotation
7 More Modeling

1. A method of creating a surface across several separate curves or polygons is called _______________. ANSWER lofting

2. A method of created a radially symmetric surface from a curve is called _______________. ANSWER lathe or revolve

3. A method of created a 3D surface my translating a 2D curve or polygon through space along another 2d curve is called _______________. ANSWER extrude

4. A method (in Maya) of creating multiple copies of an object that may be translated and or rotated is called _______________. ANSWER duplicate

5. Surfaces created by dividing larger surfaces into smaller pieces are called _______________. ANSWER subdivision surfaces

6. Which tool for surface creation is best for creating a simple radially symmetric vase? _______________. ANSWER revolve or lathe

7. Points that determine where a continuous spline curve goes are called _______________. ANSWER control points

8. Points that determine where a curve goes and are actually on the curve are called _______________. ANSWER edit points

9. Splines that pass through all control points are called _______________ splines. ANSWER interpolating
8 Shading, Lighting, and Rendering

1. Which one of these objects most requires specular reflection for realistic shading? [An Apple, Velvet Cloth, Skin] ______________________. ANSWER apple

2. Which of the standard light types best simulates a flashlight?_____________________. ANSWER spotlight

3. Which of the standard light types best simulates the sun?_____________________. ANSWER directional light

4. Which of the standard light types best simulates a light bulb?_____________________. ANSWER point light

5. A magenta light specified as (1,0,1) in the RGB model is shining on a diffuse cyan object. This object has coefficients of reflectivity that allow it to reflect 50% of incoming cyan light. Give the values of these reflectivity coefficients as a 3D vector._____________________. What is the color (word) of the light that you will see when the magenta light is reflected off of the cyan object? ______________________. Give the numeric values of the maximum amount of the incoming light (1,0,1) that can diffusely reflect from this object. _________________. ANSWERS (0.5,0.5); blue; (0,0,0.5)

6. What is one parameter of a spotlight that a point light doesn’t have? ______________________. What is a parameter of a point light that a directional light doesn’t have? ______________________. ANSWERS angle; location

7. Name an object that is best modeled using diffuse reflection? ______________________. ANSWER velvet

8. A kind of light used in computer graphics that is not comparable to any light in the “real world” is ______________________. What effect will rotating such a light have? ______________________. ANSWER ambient light, none

9. If you want to create the effect of the sun shining on an outdoor scene, what kind of a light would you use? ______________________. ANSWER directional

10. If you want to see inter-object reflections, what kind of renderer do you use? ______________________. ANSWER ray tracer

11. What are three parameters of a spotlight that a point light doesn’t have? ______________________ and ______________________ and ______________________. ANSWERS penumbra, angle, direction
12. What is one parameter of a directional light that a point light doesn’t have?  
   ANSWER direction

13. Which rendering method uses a second buffer for hidden surface removal?  
   ANSWER z-buffer

14. Applying a two-dimensional digital image to a surface is called  
   ANSWER texture mapping

15. The bending of light rays when they go through a transparent object is  
   ANSWER refraction

16. Which gives a better image, ray-casting or ray-tracing?  
   ANSWER ray tracing

17. What phenomena are always missing from ray casting?  
   ANSWER reflections itemize

18. What rendering method can produce realistic diffuse inter-reflections?  
   ANSWER radiosity

19. What map can produce reflections of a surrounding world on visible objects?  
   ANSWER environment mapping

20. What object property can cause an object to be visible even if there are no lights in the scene?  
   ANSWER incandescence or emission

21. What numeric value would you give to the specular reflection to make a shaded object appear non-shiny?  
   ANSWER zero

22. The shiny spot on an object that shows that it is specular is called a  
   ANSWER highlight

23. A technique where surface normal vectors are slightly perturbed to yield a non-smooth appearance is called  
   ANSWER bump mapping

24. A technique where actual surface vectors are slightly perturbed to yield a non-smooth appearance is called  
   ANSWER displacement mapping
8.1 Light Effects

Draw where a point light should be located to create a specular reflection in the eye.

Give the 3D coordinates of the light.

Draw where a point light should be located to create the maximum amount of diffuse light reaching the eye.

Give the 3D coordinates of the light.
9 Animation

1. Frames shot from a single camera without interruption are called a
   ______________________. ANSWER shot

2. A sound track is created after the animation is finished. True or False.
   ______________________. ANSWER false

3. Motion caused as a side-effect of another motion (such as hair swinging as a character
   moves) is called
   ______________________ motion. ANSWER secondary

4. Inbetweens are created before keyframes. True or False.
   ______________________. ANSWER false

5. Keyframe animation was first developed by what company early in the twentieth
   century?
   ______________________. ANSWER Disney

6. An animation method where the computer interpolates between two or model objects
   which have different shapes is called
   ______________________. ANSWER morphing

7. What method is good for getting very realistic motion of a human dancing?
   ______________________. ANSWER motion capture

8. What higher-level method of animation is good for flocks and herds?
   ______________________ animation. ANSWER behavioral animation

9. When the animation includes more interpolated frames near keyframes (so that the
   animation appears to slow down there), this is called
   ______________________. ANSWER slow-in/slow-out

10. Transparent sheets used in compositing early 2D Disney-type animation are called
    ______________________.
    ANSWER cels

11. Randomly trying various motions and selecting the best is a characteristic of what kind
    of animation?
    ______________________. ANSWER evolving
12. Another word for temporal anti-aliasing is _______________. ANSWER motion blur

13. The use of Newton’s second law of motion to control the animation is called _______________. ANSWER physical simulation

14. When a clip that is starting pushes a clip that is ending across the screen so that it disappears, this is called a _______________. ANSWER wipe

15. When objects have sensors and rules and determine their own behavior this is called _______________. ANSWER behavioral

16. When motion is measured from a real person or animal and used for animating virtual creatures, this is called _______________. ANSWER motion capture
**Motion Graphs (16 points)**

Suppose you want to simulate a ball shot from a cannon from the time it exits until it hits the ground. The pictures below show the ball at 4 keyframes that you set at times 0, 8, 12, and 16 seconds.

In the top figure below, fill in the interpolating keyframes so that there is a frame every 1 second, according to the interpolation method given below each image. Draw the interpolated balls are circles. (6 points)

![Constant Velocity Inbetweens](image)

Constant Velocity Inbetweens

![Slow–In/Slow–Out Inbetweens](image)

Slow–In/Slow–Out Inbetweens

In the lower figure, draw filled-in circles for the keyframes in Y. (The keyframes in X are already shown.) Also, draw curves for the motion in X and Y during this motion. Clearly label which curve is X and which is Y. (10 points)
Speed (8 points)

Label the Graphs below on the dotted lines. The possible answers are:

*No Motion, Constant Speed, Accelerating, Decelerating.*
10 Character Animation

Fill-In Questions

1. A way of moving a hierarchy by specifying the world space goal and having the computer find joint angles is___________________. Answer inverse kinematics

2. In a hierarchy, when you move the parent, the child moves. True or False?___________________. Answer true

3. Once a motion is captured for a particular human being, it is easy to use it on humans of different sizes and on similar animals. True or False___________________. ANSWER false

4. The study of how humans fit in and interact with their work places and environments is called___________________. ANSWER ergonomics

Discussion (6 points)

Describe the process by which the most realistic facial animation is done, including both how the motion is developed and how the face surface properties (color etc.) are found.
10.1 Figure Questions

1. Draw the hierarchical tree structure of the figure shown. (6 pts)

2. The parent of node C is? 
   ___________________________ ANSWER A

3. The child(ren) of node A is (or are)? 
   ___________________________ ANSWER D

4. If the joint between A and B is rotated, which nodes will change position? Give their letters. _________________.

5. If the joint between A and H is rotated, which nodes will change position? Give their letters. _________________.

6. If the root is free to move in the world, and each body segment can rotate freely, how many degrees of freedom does this body have? _________________.

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