COSC A280 – Introduction to Computer Graphics
Final Exam – Fall 2020

Name: _____

Please answer as concisely as possible when appropriate. Keep it simple, brief, and to the point. And always show your work! You **must** show your work to get credit! All answers must be written in your own words! All answers must be **handwritten** in the spaces provided.

1. What is the difference between a normal vector and a normalized vector?

2. List the seven the callback functions used in this class and briefly explain the purpose of each. Explain the arguments for each function.

3. Using the standards established in class and in the assignments, convert the following. Label each component of the converted values (do not assume I know the order!). Use degrees (not radians).
   a. Vector [1.0, 0.0, 0.0] to a **Spherical**

   b. Vector [0.0, -1.0, 0.0] to a **Spherical**

   c. Spherical [-90.0, 0.0, 1.0] to a **Vector**

   d. Spherical [0.0, 180.0, 1.0] to a **Vector**

   e. Spherical [180.0, 0.0, 1.0] to a **Vector**

4. What is the purpose of the following functions? Briefly explain what each function accomplishes and how it effects the graphics pipeline. Include a brief explanation of all of the parameters used for each function. Also, detail any corresponding required or linked function and how they interact.

   a. `glPushMatrix();`

   b. `glEnable(GL_DEPTH_TEST);`

   c. `glViewport(0, 0, width/2, height/2);`

   d. `glutBitmapWidth(font, *c);`

   e. `glutTimerFunc(millisec, &timer, millisec);`

   f. `glMatrixMode(GL_PROJECTION);`

g. `gluLookAt(0.0f, 2.0f, 22.0f, 0.0f, 2.0f, 21.0f, 0.0f, 1.0f, 0.0f);`

h. `glBindTexture(GL_TEXTURE_2D, 4);`

i. `gluPerspective(45.0f, aspect, 0.1f, 100.0f);`

j. `glutInitDisplayMode(GLUT_DOUBLE);`

k. `glutPostRedisplay();`

l. `glFrontFace(GL_CCW);`

5. What is wrong with the following display function? This is being used for the GLUT callback function for drawing the display, as we worked through in class. There are at least ten things wrong (hint, only one per line). Circle the ten problems and explain what is incorrect and/or how to fix each.

```
void display(void)
{
enableLights();

// Clear out the color and buffer bit
glClear(GL_COLOR_BUFFER_BIT | GL_DEPTH_BUFFER_BIT);

glMatrixMode(GL_PROJECTION);     // Go into model mode
glEnable(GL_CULL_FACE);         // Draw or don't draw the back sides
glLoadIdenty();               // Reset stuff in the current mode
glTranslatef(10.0f);

// Draw the center object
glPushMatrix();
glRotatef(rotationY, 1.0f, 1.0f, 0.0f);
glScalef(0.55f, 0.65f, 0.55f);
glutSolidCube();
glPopMatrix();

// Draw the orbiting object
glPushMatrix();
glScalef(0.2f, 0.2f, 0.2f);
glRotatef(orbitRotation, 1.0f, 0.0f, 0.0f);
glTranslatef(2.0f + locationX, 0.0f, 0.0f);
glRotatef(-objectRotation, 0.0f, 1.0f, 0.0f);
glRotatef(rotationY, 0.0f, 1.0f, 0.0f)
glutSolidTeapot(1.0);

glutPostRedisplay();
}
```

6. Given the two vectors ***v1*** [1.0, 2.0, 2.5] and ***v2*** [-0.4, 0.2, 2.0], calculate the following. You can use a calculator. **You must show your work!** Limit the precision to four decimal places.
   a. Normalize ***v1***

   b. Normalize ***v2***

   c. Calculate the dot product of ***v1*** · ***v2***

   d. Calculate the unnormalized cross product of ***v1*** x ***v2***

7. Write out the 4x4 (homogeneous) transformation matrix for each of the following:
   a. Translate 2.0 units in the x-direction, -4.5 units up the y-axis, and 5.5 units in the z-direction

   b. Scale the current object in by 4.2 in all directions

   c. Rotate by 28 degrees around the y-axis

8. Write out the code needed to draw a rectangle using the `glutSolidCube` function, given the following. You must include the drawing function as well as any code to perform the transformations. You can assume the program is ready to draw otherwise. Rotate the rectangle by 25° around the x-axis and also 35° around the z-axis. Move the rectangle to be exactly located at the coordinates 2.0, 4.0, -5.0. Let the dimension be exactly 3.3 x 2.1 x 1.4 units.

9. Define (in words, not formulas) the operations normalize, dot product, and cross product? Also, what is the output for each operation?