

COSC A280 – Introduction to Computer Graphics
Final Exam – Fall 2021

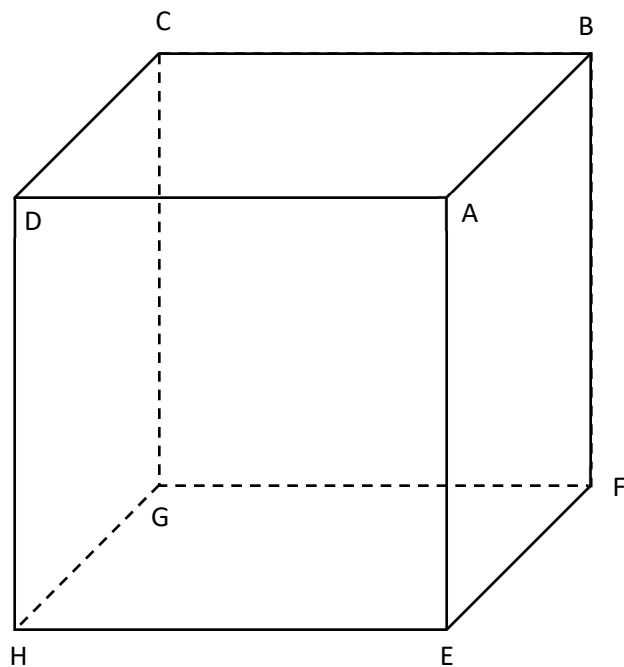
Name: _____

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? How are each used in computer graphics? [10 pts]
2. List the seven the callback functions used in this class and briefly explain the purpose of each. Explain the arguments for each function. [14 pts]

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

4. Given the diagram below, [12 pts]
- Label the coordinates for each of the eight points. Assume the cube is centered at the origin and that it is $2 \times 2 \times 2$ units large. Write the coordinates directly to the right of each label letter.
 - Using just the labels (letters, not coordinates), list the points needed to represent the **right** face in the correct order.
 - Using just the labels (letters, not coordinates), list the points needed to represent the **back** face in the correct order.
 - Using just the labels (letters, not coordinates), list the points needed to represent the **left** face in the correct order.



5. 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. [12 pts]

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);`

6. 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. [10 pts]

```
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
    glLoadIdentity();                 // 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);
    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();
}
```

7. Given the two vectors $\mathbf{v1}$ [1.0, 2.0, 2.5] and $\mathbf{v2}$ [-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. [12 pts]
- Normalize $\mathbf{v1}$
 - Normalize $\mathbf{v2}$
 - Calculate the dot product of $\mathbf{v1} \cdot \mathbf{v2}$
 - Calculate the unnormalized cross product of $\mathbf{v1} \times \mathbf{v2}$

- c. Rotate by 26 degrees around the y-axis

9. 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 2.3 x 1.1 x 1.3 units. [10 pts]
10. Define (in words, not formulas) the operations normalize, dot product, and cross product? Also, what is the output for each operation? [12 pts]