1) (6 pts) What is the difference between perspective and orthographic projection? Draw a picture to illustrate the difference. Which one does your eye use?
2) (8 pts, total) **Vectors:**
   a) (6 pts) What is a vector? Give two examples.

   b) (2 pts) Dot Products: If $A$ and $B$ are vectors, what is the value of $A \cdot B$?
   
   Ans=______________

3) (9 pts total) **Colors:** 32 bit RGBA
   a) (3 pts) What color is $00000000000000001111111111111111$? Ans=______________

   b) (3 pts) What color is $11111111111111111111111111$? Ans=______________

   c) (3 pts) If I had to write the binary number in part 3b in Hex (base 16), what would the Hex number be?
   
   Ans=______________

4) (10 pts, total) **Phong Model:**
   a) (3 pts) How would you qualitatively describe a surface that has a large specular component? Include an example of such a surface.

   b) (7 pts) What is the mathematical formula for the specular component? Define all your terms. Include a picture, labeling all the relevant items.
5) (15 pts) **Trig Functions:**

a) (7 pts) Suppose I want to draw a curve of spheres as shown. Assume that the curve oscillates in the y-direction between 5 and -5.

```
#declare cnt = -50;
#while (cnt < 50)
  #declare myAngle = radians(cnt*20);
  sphere { <0,1,0>, 0.5  // center and radius
    pigment { Blue }
    translate //complete this line
  }
  #declare cnt = cnt + 1;
#end
```

b) (8 pts, total) What is the value of the following trig functions:

i) (2 pts) $$\sin (90^\circ) = \text{__________}$$

ii) (2 pts) $$\sin (270^\circ) = \text{__________}$$

iii) (2 pts) $$\cos (180^\circ) = \text{__________}$$

iv) (2 pts) $$\sin (\pi \text{ radians}) = \text{__________}$$
6) (24 pts total) **Matrices:**
   a) (12 pts total) What are the 2x2 matrices for the following 2D transformations?
      i) (4 pts) Scale by an amount 2 along x and 4 along y.
      ii) (4 pts) A rotation by 40 degrees about the origin.
      iii) (4 pts) A uniform scale of 10 about the point (3,9). (you must use homogeneous coordinates)

   b) (4 pts) What does the 2x2 matrix \[
   \begin{pmatrix}
   -1 & 0 \\
   0 & 1
   \end{pmatrix}
   \] do to an image? If you can’t figure it out, try it on several points to see what happens.
c) (8 pts) Suppose you have the following triangle:

That happens to the triangle (i.e. draw the result on the above picture) after you apply the transformation \[
\begin{pmatrix}
2 & 0 \\
1 & 0.5
\end{pmatrix}
\]?
7) (10 pts) **Ray Tracing**: Povray renders images through a technique called ray tracing. What is ray tracing and how does it work? Give as many details as you can remember.
(Please write in complete sentences). Include a picture (or pictures) to support your description.