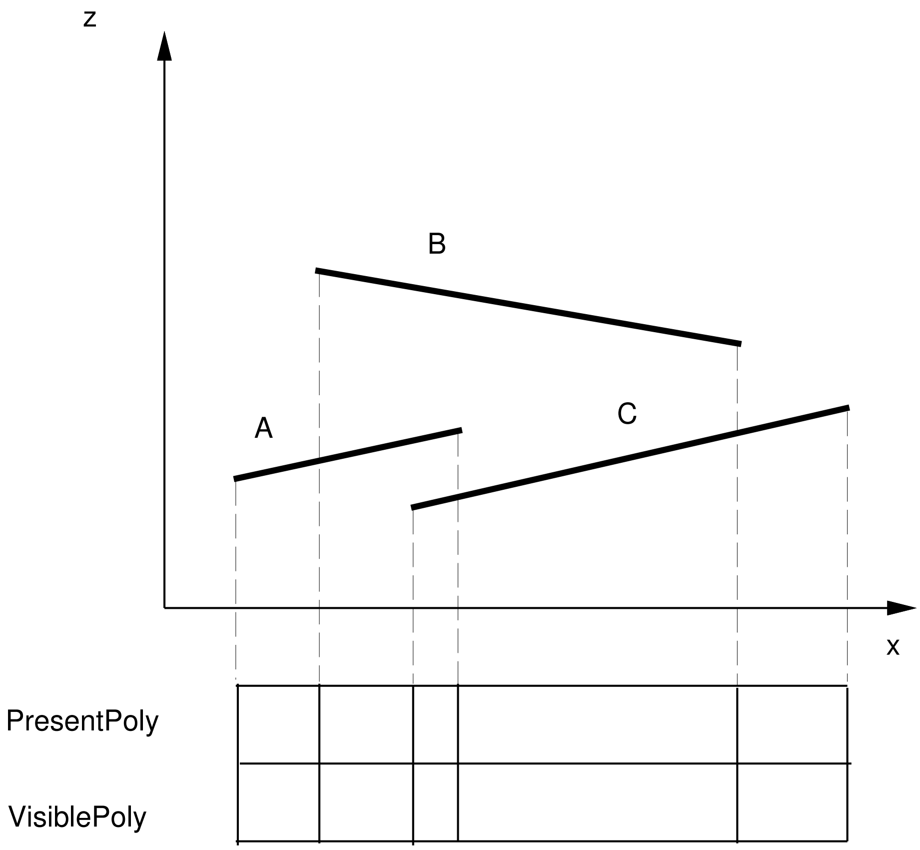
READ ME FIRST

- Don't spend too much time on any one problem.
- Amount of time spent on a problem is not necessarily proportional to the points.
- Scan through the entire test and do the easy problems first.
- If something is not clear, ASK.
- BE NEAT. We cannot give you points for something that we can't read.
- Write down your assumptions.
- Show your solutions! At least write an outline/reasoning of your solution.

1	20 points	Hidden Surfaces	
2	20 points	Lighting and Shading	
2	20 points	Projections	
4	20 points	Viewing Coordinates	
5	20 points	Parametric Curves	
	100 points	GRAND TOTAL	

1. **Hidden Surface Elimination (20 points)**

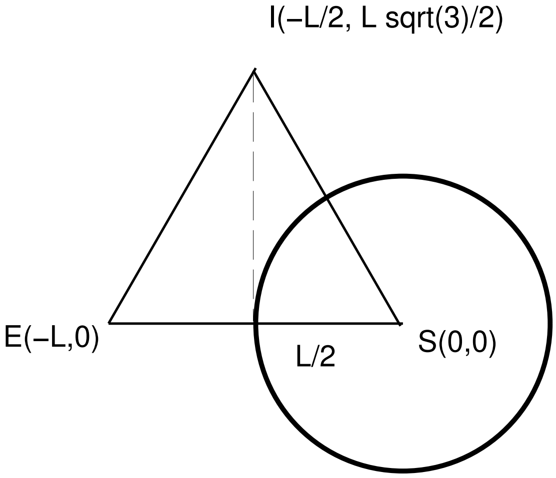
   The illustration below shows a "top" view of a cross section of a scanline. Identify what polygon(s) are in the PresentPoly and VisiblePoly lists for each span across the scanline.



2. **Lighting and Shading (20 points)**

In the figure below, the position of a point light source I, eye position E, and the center of a sphere S form an equilateral triangle (i.e. all three edges are of equal length, and all three angles are 60 degrees each). Assume that the length of each edge of this triangle is L, and the radius of the sphere is L/2. The coordinates of the three vertices of the equilateral triangle should refresh your memory about the 30-60-90 triangle.

At what point on the sphere (assume illustration shows z=0 plane) would the eyes observe the maximum specular reflection from the light?



3. **Projections (20 points)**

   Given the two points: P1:(1, 2, 3) and P2:(-10, 10, 20).

   (a) (**Orthographics projection: 10 points**) Assume a canonical orthographic projection onto the xy-plane, what are the orthographic projections of these two points?

   (b) (**Perspective projection: 10 points**) Assume a canonical perspective projection onto the xy-plane with the center of projection at z = -10, what are the perspective projections of these two points?

4. **Viewing Coordinates (20 points)**

   Given a viewing situation where the eye (Lookfrom point) is located at E:(1, 2, 3), the Lookat point is located at O:(0, 0, 0), and the sun is located at S:(51, 62, 73). Assume that the viewer's Up orientation is always aligned towards the sun. 5 points each.

   (a) What is the Up vector?

   (b) What is the view plane normal VPN?

   (c) What is the x axis Vx of the viewing coordinates?

   (d) What is the y axis Vy of the viewing coordinates?

5. **Parametric Curves (20 points)**

   A "designer" parametric curve is charaterized by the following matrix:

   $$M_d = \begin{bmatrix} 1 & -1 & -1 & 1 \\ 0 & -2 & 1 & 1 \\ -3 & 3 & 0 & 0 \\ 2 & 0 & 0 & -1 \end{bmatrix}$$

   where the parametric curve is represented by:

   $P(t) = TM_dG = [t^3\ t^2\ t\ 1]M_dG$

   where G is the geometry vector composed of 4 points.

   (a) (**3 points**) What is the degree of the curve?

   (b) (**8 points**) What are the blending functions?

   (c) (**6 points**) What are the weights for each point in G at P(0), P(1/2), and P(1)?

   (d) (**3 points**) Does the curve lie within the convex hull of G? Why/why not?