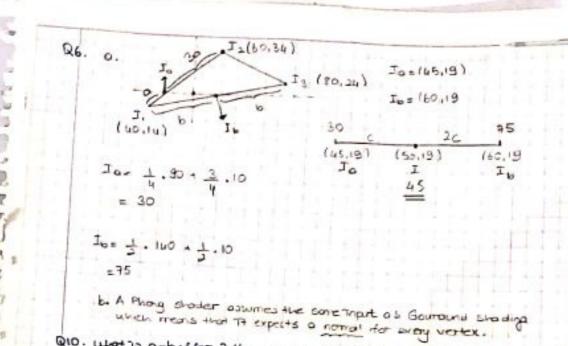
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- and outstaining by why a buffer?
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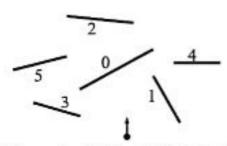
- office o pivel color to be computed as a combination of different out face octors for transporting and out-alliang effects

- · At each fixed, monton a list of polypons sorted by depth.
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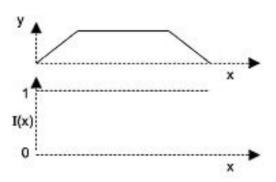
but about remove forther polygons.

- · Algorithm : Rendering pass (At each pixel, toverse buffer using paypon colors and covarge masks to coloride compasse purel story
- · Advantage: con do more ton 2 buffer
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- · Disodulatage: not in provented in hardware and software timp. is slow



- Q6 Consider a triangle in the image plane. The intensities I(x,y) at the three vertices are
  - I1 I(40, 14) 10
  - 12-1(60, 34)-90
  - 13 1(80, 24) 140
  - (a) Using Gouraud shading, calculate the intensity at the point (50,19), i.e. I(50, 19).
  - (b) Describe how you could modify your method in order to calculate the intensities using Phong shading?
- Q7 The top part of the diagram below represents the cross section of a surface, with light source and viewing position. On the graph template below it sketch the ambient, diffuse, and specular illumination as functions of x. Assume the Phong illumination model, i.e.
  - $I = kaIa + kaIa(N.L) + ksIs(R.V)^n,$
- where ka = 0.2, kd = 0.6, ks = 0.6, Ia = Id = Is = 1.0, n = 300.
  - eye

light



Q8. a) Given the following function call to gluPerspective: gluPerspective(60.0,0.8,4.0,100);

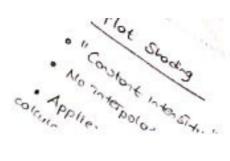
where the first parameter is the viewing angle, the second parameter is the aspect ratio of the clipping window (width/height), the third parameter is the distance of the near plane to the viewing origin, and the forth parameter is the distance of the far plane to the viewing origin. Find the glFrustum parameters:

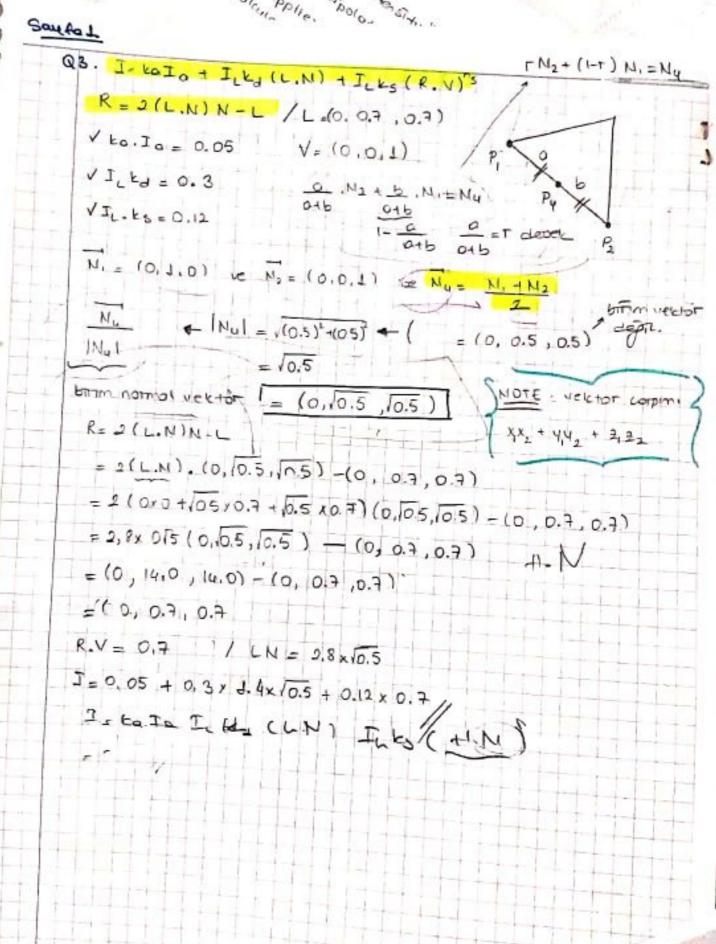
glFrustum (xwmin, xwmax, ywmin, ywmax, dnear, dfar)

c) How can we obtain an oblique perspective projection using glFrustum function?

2

- Q9. Briefly explain how we apply ray casting algorithm to calculate the volume of an object in the scene? Assume the rays are parallel to z axis and a pixel has a unit area A<sub>b</sub>.
- Q10. What is a-buffer? How can we handle transperent objects in a scene and antialising by using a-buffer?

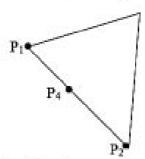




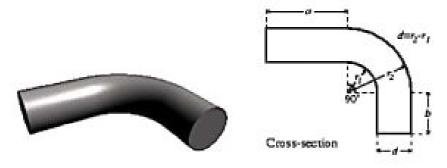
- Q1. Suppose a perspective projection is given by glFrustum (-5, 5, -5, 5, 5, 25).
  - a) Sketch the frustum in 3D.
  - b) If eye position is at P(0, 0, 0), what is the coordinates of the point P<sub>prp</sub>(3, 3, 7) on the projection plane.
- Q2. Two Bezier curves are given with control point p<sub>0</sub>, p<sub>1</sub>, p<sub>2</sub>, p<sub>3</sub> and q<sub>0</sub>, q<sub>1</sub>, q<sub>2</sub>, q<sub>3</sub>. What conditions should be met to join these two curves to have a circular closed curve? Sketch the final curve and show the control points.
- Q3. The coordinate values of the points in the following figure are given as  $P_1$ =(1,2),  $P_2$ =(5,0),  $P_4$ =(3,1) and the normal vectors on the points  $P_1$  and  $P_2$  are given as  $N_1$ =(0,1,0) and  $N_2$ =(0,0,1), respectively.

The other parameters are given as follows: V=(0,0,1), L=(0,0.7,0.7),  $I_L=0.6$ ,  $K_a=0.1$ ,  $I_a=0.5$ ,  $K_d=0.5$ ,  $K_d=0.2$ ,  $n_a=1$ ,

Find the illumination intensity at the point P4 using Phong shading model.



Q4 Work out how to represent the following object using constructive solid geometry (CSG). You may assume the following primitives whose parameters can be set: sphere, cylinder, cone, torus, box (cuboid). Describe your construction method, detailing the operations on the primitives: Draw a labelled binary tree to illustrate the processing of the primitives (leaf nodes) to create the final object (root node)



- Q5 (a) Construct the binary space partition tree for the line segments shown below, adding the objects to your tree in numerical order.
  - Note: Use the convention that the number identifier is on the front of the line segment, and segments to the front side of a segment will be represented by the right sub-tree of the corresponding node in the BSP tree.
  - (b) Show the traversal order of the BSP tree given the eye point shown with a dot and arrow in the picture. Show intermediate stages of computation of the traversal.

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Q5 (a) Construct the binary space partition tree for the limadding the objects to your tree in numerical order.

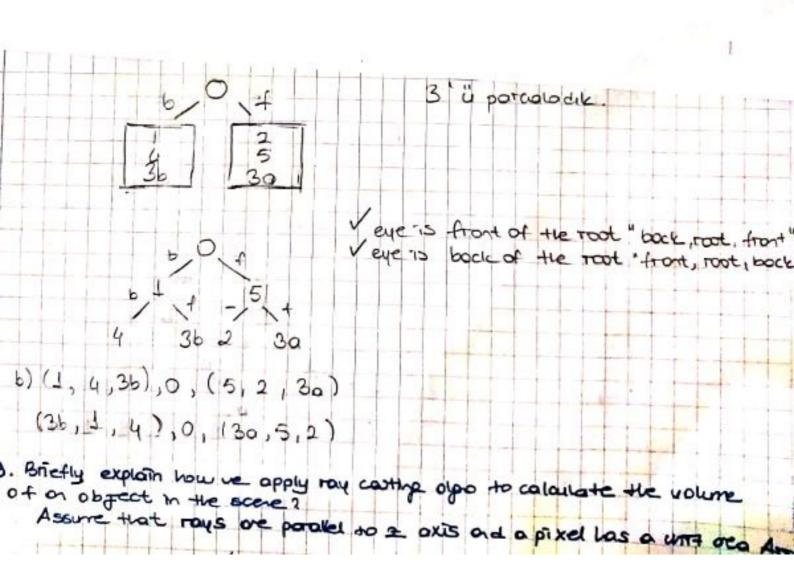
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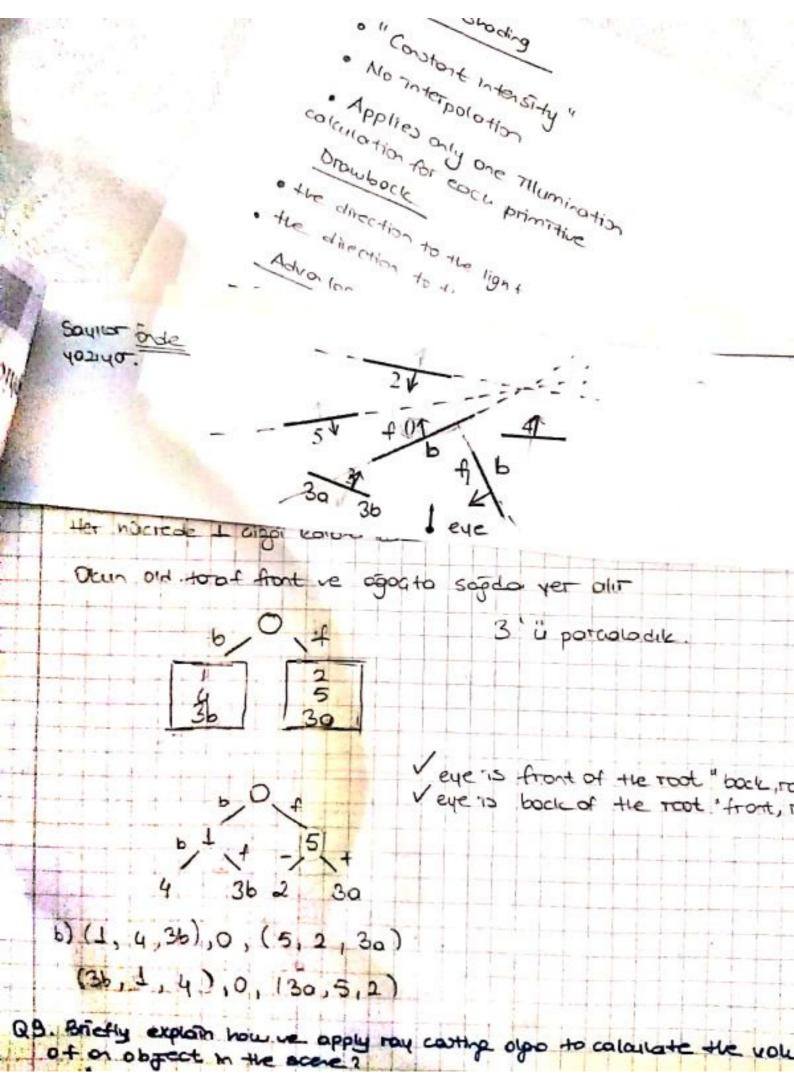
(b) Show the traversal order of the BSP tree given the arrow in the picture. Show intermediate stages of cor-

ments shown below,

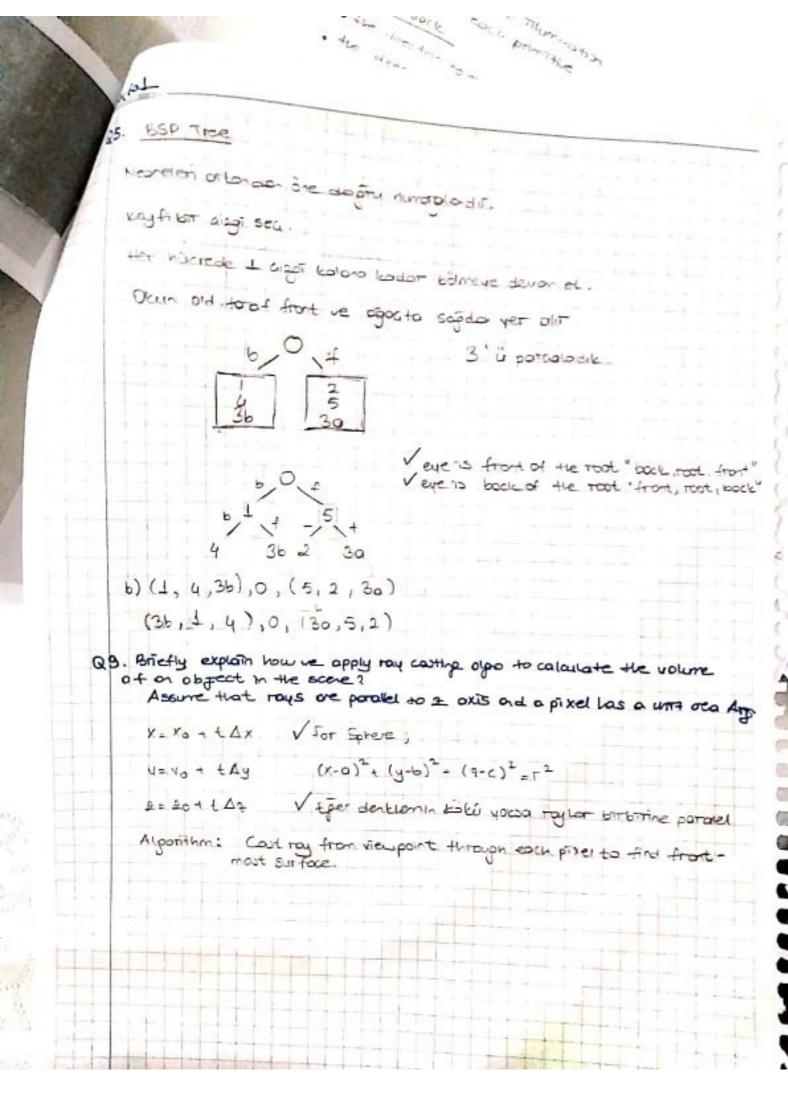
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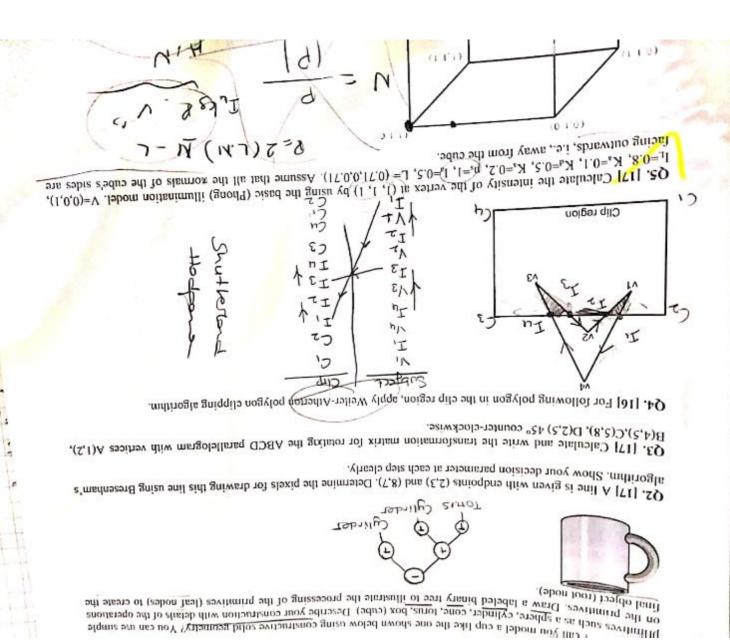


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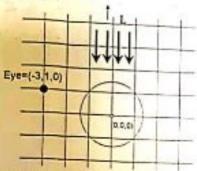
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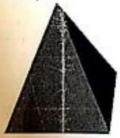
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20 points for each question

Q1. The scene below shows a sphere of radius  $\sqrt{2}$  centred at the origin. There is only a directional light in the scene towards the direction (0, -1, 0) as shown. The eye location is at (-3, 1, 0).



- (i) At what point (coordinates) on the sphere will we get maximal specular reflection? Explain your answer.
- (ii) At what point (coordinates) on the sphere will we get maximal diffuse reflection? Explain your answer.
- Q2. We discussed three surface rendering methods in the course. These were flat shading, Gouraud shading, and Phong shading. Explain these methods briefly and state their advantages and disadvantages.
- Q3. Write an OpenGL program to display a solid pyramid object on screen using perspective projection. Each face of the pyramid should be a different color. Your program output should be similar to the image below (but in color).



- Q4. Calculate 3 different points that will be on the Bezier curve created using control points p1=(1,4), p2=(3,7), p3=(11,5), and p4=(7,1).
- Q5. We have two triangles: one with vertices P1=(2,1,-1), P2=(4,2,-1), and P3=3,3,-2); and the other with Q1=(2,4,-1), Q2=(3,4,-3), and Q3=(4,5,-2). Determine an order between these polygons using Depth-sort algorithm. Explain your steps and final decision clearly.