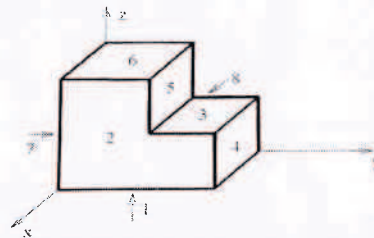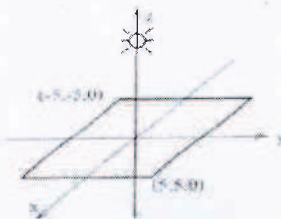## Computer Graphics, End–Sem Exam, 03 May 2019

(Full Marks: 60, Time allowed: 3 hours)

1. Build the BSP tree for the object shown, where faces are used as splitting planes in the face number order. Label the nodes with split faces with sub-letters (if face 1 was to be split, the pieces would be 1a and 1b). Assume that the positive side of the splitting planes is the side that is "outside" the object. (10)

2. A unit square is transformed by 2 x 2 transformation matrix. The resulting position vector are :-
   $\begin{bmatrix} 0 & 2 & 8 & 6 \\ 0 & 3 & 4 & 1 \end{bmatrix}$, what is the transformation matrix? (8)

3. Explain the steps by using Cohen Sutherland algorithm to clip line P1 (70,20) and P2(100,10) against a window lower left hand corner (50,10) and upper right hand corner (80,40). Diagrammatically show the final clipped line with cut point and boundary. (8)

4. What are the final coordinates after $45°$ rotation of a triangle A(0,0), B(1,1), C(5,2) about the point (-1,-1). (6)

5. Write Painter's Algorithm. Diagrammatically explain all the 5 cases with the solution where it doesn't work. (12)

6. This question explores the effect of the distant light source and distant viewer approximations. Assume you have a white point light source of intensity 1 located along the positive z-axis illuminating a white square with side length 10 located in the x-y plane and centered at the origin, with diffuse reflection & specular reflection coefficient 0.5 each, with no ambient reflectance. Assume the viewer is at the point (5, 0, 5) looking at the origin. For these questions do not include a term for the distance from the light source to a point. The situation is pictured below

   a) Assume the light is at the point (0, 0, 10). What is the diffuse intensity at the center of the square? (2)

   b) Again assume the light is at the point (0, 0, 10). What is the diffuse color component at a corner of the square? (2)

   c) At what light position, is the difference between the intensity at the center of the square and the intensity at the corner equal to 0.01? This could be considered a reasonable distance for the distant light assumption to be valid. (4)

7. Derive how in the Z-buffer algorithm, one can compute the z-values of the corresponding pixels in a given scan line and for the next scan line, without going for extensive computations? (8)