

**Q.1 a. How is symmetric nature of a circle is used in drawing it? Give an example.**

**Answer:** If  $(x, y)$  is a point on the circumference of a circle, then seven other points:  $(y, x)$ ,  $(x, -y)$ ,  $(-y, x)$ ,  $(-x, y)$ ,  $(y, -x)$ ,  $(-x, -y)$  and  $(-y, -x)$  are also on the circumference of the circle

**d. What is vanishing point? Explain the concept of three vanishing points and its application in projection.**

**Answer:** Refer to the Parallel projection topic in the text book by Hearn and Baker or Rogers.

**e. What is knot and how is it similar to or different from control point on a curve?**

**Answer:** See Bezier curve /Spline definition in text book by Hearn and Baker or Rogers.

**f. Prove that three successive 2D-rotations are associative i.e.  
 $R(\theta_1) [R(\theta_2) R(\theta_3)] = [R(\theta_1) R(\theta_2)] R(\theta_3)$**

**Answer:** It is derived from the fact that matrix multiplication is associative.

**g. What are the situations when Cohen Sutherland clipping algorithms fails to work?**

**Answer:** It works only on the rectangular clipping area, and when lines to be clipped are coinciding with any the edges of the rectangular window then the algorithm fails. For details refer to the book by Hearn and Baker or Rogers.

**Q.2 a. What do you mean by shearing? Develop a transformation matrix for shearing a shape along Y-axis.**

**Answer:** Refer to the 2D transformation topic in the text book by Hearn and Baker or Rogers.

**b. Write the DDA algorithm to draw a line between two points. What are the limitations of this algorithm?**

**Answer:** Refer to the Line drawing topic in the text book by Hearn and Baker or Rogers.

**Q.3 a. Derive a transformation matrix to rotate a line  $3y = 4x + 5$  by  $45^\circ$  about the straight line  $4y = 3x + 6$ .**

**Answer:** Find the intersection point of the line  $4y = 3x + 6$  with x-axis ( or y -axis), move the point of intersection to origin, rotate the line  $4y = 3x + 6$  to align it to x-axis ( or y -axis) and then rotate the given line by  $45^\circ$ . After that restore the line  $4y = 3x + 6$  to its original position.

- b. Suppose a rectangular window ABCD is defined such that A (-1,-2) and C (3, 1). Using Cyrus Beck algorithm, clip the line segment joining the points P (-20, 0) and Q (20, 30).

**Answer:** Refer to the Line drawing topic in the text book by Rogers.

- Q.4** a. Derive transformation matrices for projecting  
(i) front view  
(ii) side view  
(iii) top view of a 3D object using parallel projection.

**Answer:** See the parallel projection chapter in the text book by Hearn and Baker.

- b. See the parallel projection chapter in the text book by Hearn and Baker.

**Answer:** See Animation in multimedia section of the book by Hearn and Baker or Rogers.

- Q.5** a. How does diffuse reflection differ from specular reflection? Derive an equation to find out total intensity of light reflected from a point on surface.

**Answer:** See the topic Shading in the book by Hearn and Baker.

- b. Write the Ray tracing method and its area of application specifically in rendering of surface.

**Answer:** See the Hidden surface removal (HSR) chapter in the book by Hearn and Baker.

- Q.6** a. What is the hidden surface and why is its removal considered important in computer graphics? Write the A-Buffer algorithm for hidden surface removal.

**Answer:** See the introduction to the HSR in the book by Hearn and Baker.

- b. Demonstrate, with a simple example, the ordered edge list algorithm for scan conversion.

**Answer:** See the filling area algorithm in the book by either Foley or Van dam.

### Text Book

**Computer graphics with OpenGL by Hearn and Baker, Third Edition, 2009 (Indian Edition) Pearson Education**