Ans 1. point :- (2,2) , (2,5) , (5,5) & (5,2)

$$U = \left(0, \frac{1}{4}, \frac{1}{2}, \frac{2}{3}, \frac{3}{4}, 1\right)$$

$$Q(U) = P_0(1-U)^3 + P_1 3U(1-U)^2 + P_2 3U^2(1-U) + P_3 3U^3$$

$$Q(0) = [2,2](1)^3 + (2,5)(0) + [5,5](0) + (3(0)[5,2]$$

$$Q(0) = [2,2]$$

$$Q\left(\frac{1}{4}\right) = [2,2]\left(\frac{3}{4}\right)^3 + [2,5]\frac{3}{4}\left(\frac{3}{4}\right)^2 + \left[5,5\right]\frac{3}{4^2}\left(\frac{3}{4}\right) + [5,2]\,3\left(\frac{3}{4}\right)^3$$

$$Q\left(\frac{1}{4}\right) = \left[\frac{27}{32}, \frac{27}{32}\right] + \left[\frac{27}{32}, \frac{135}{64}\right] + \left[\frac{45}{64}, \frac{45}{64}\right] + \left[\frac{405}{64}, \frac{81}{32}\right]$$

$$= \left[\frac{558}{64}, \frac{315}{64}\right]$$

$$Q\left(\frac{1}{2}\right) = [2,2]\frac{1}{8} + [2,5]\frac{3}{2}\left(\frac{1}{2}\right)^2 + (5,5)\left[\frac{1}{4}\right]\left[\frac{1}{2}\right] +$$

$$= \left[\frac{1}{4}, \frac{1}{4}\right] + \left[\frac{3}{4}, \frac{15}{8}\right] + \left[\frac{5}{8}, \frac{5}{8}\right] + [5,2]\left[\frac{1}{2}\right]$$

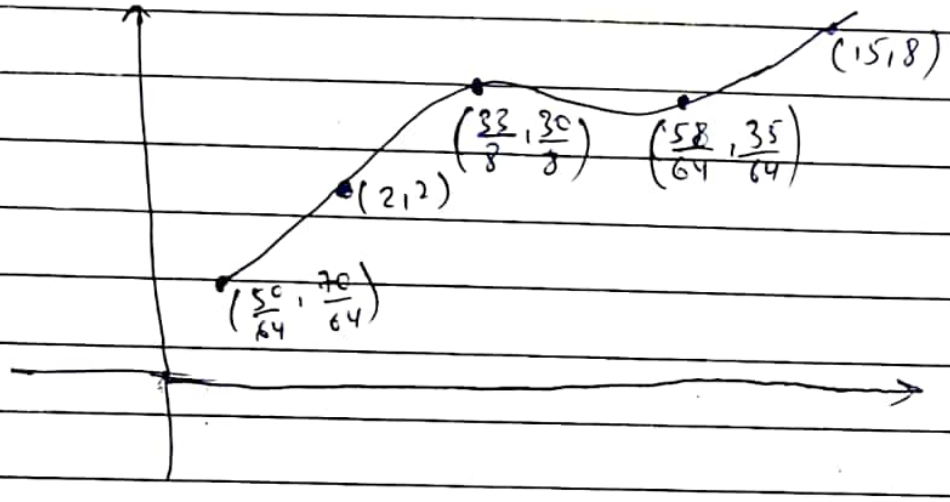
$$+ \left[\frac{5}{2}, 1\right] +$$

$$\Rightarrow \left[\frac{33}{8}, \frac{30}{8}\right]$$

$$q\left(\frac{3}{4}\right) = [2,2]\left(\frac{1}{4}\right)^3 + [2,5]\left(\frac{9}{64}\right) + [5,5]\left(\frac{3}{64}\right) + (5,2)\left[\frac{3}{64}\right]$$

$$= \left[\frac{50}{64}, \frac{70}{64}\right]$$

(8) $f(1) = [5,2]\,3(1)^3 = [15,8]$



Ans:- In analytics geometry sphere with center (x_0, y_0, z_0) & radius or with point (x, y, z)

$$(x-x_0)^2 + (y-y_0)^2 + (z-z_0)^2 = r^2$$

In vector

$$|P - C|^2 = r^2$$

when ray intersect, intersection point are shared by both equations search for point that are on ray and sphere i.e Combining eqn solving for t

Sphere: $\text{dot}((P-C),(P-C)) = r^2$

Ray: $P(t) = At + B$

Combined: $\text{dot}(At+B-C, At+B-C) = r^2$

eq: $at^2 + bt + c = 0$

$a = dot(B, B)$

$b = 2 \cdot dot(B, A - C)$

$C = dot(A - C, A - C) - r^2$

$\therefore t = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

$D = b^2 - 4ac$

$D < 0 \Rightarrow$ ray not intersect

$D = 0 \Rightarrow$ ray touches sphere

$D > 0 \Rightarrow$ Touch sphere at 2 points

Ans 8. Transparency Shadow

A transparency surface produces both reflected and transmitted light the relative constructed of transmitted light depends on degree of transparency of surface

$I = (1 - K) I_{\lambda} + K_t I_t$

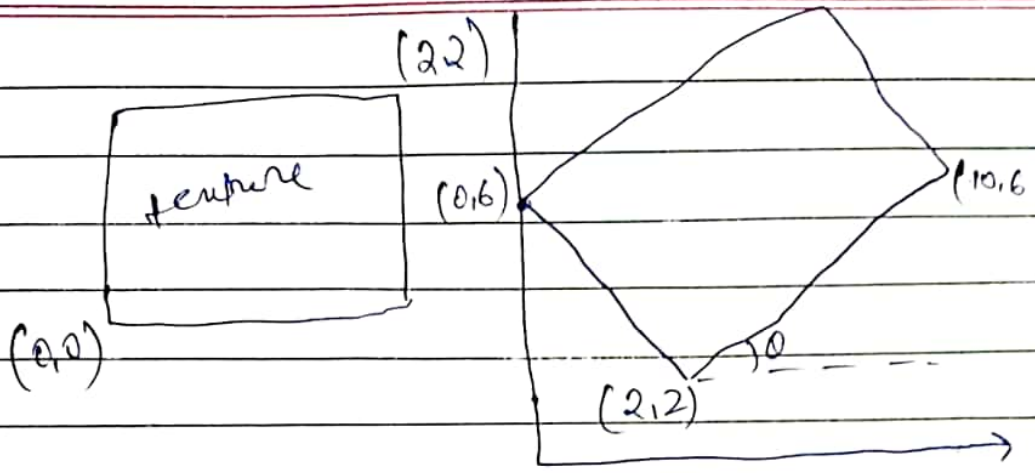
* Gouraud shading is an interpolation method used in computer graphics to produce continuous shading of surface represented by polygon meshes

Ex :- mach bands that appear on surface

* Phong shading :- it is an interpolation method for surface shading in 3D computer graphics. Also referred as normal vector interpolation shading

Ex :- mirror, highly polished metal

Ans 4



(1) Scaling

$$S_x = \frac{\sqrt{(10-2)^2 + (6-2)^2}}{2} = 4.4721$$

$$S_y = \frac{\sqrt{(0-2)^2 + (6-2)^2}}{2} = 2.2360$$

$$[S_{xy}] = \begin{bmatrix} 4.4721 & 0 & 0 \\ 0 & 2.2360 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

(2) Anticlockwise Rotation

$$\sin\theta = \frac{6-2}{\sqrt{(10-2)^2 + (6-2)^2}} = 0.4472$$

$$\cos\theta = \frac{10-2}{\sqrt{64+16}} = 0.8944$$

$$[R\theta] = \begin{bmatrix} \cos\theta & -\sin\theta & 0 \\ \sin\theta & \cos\theta & 0 \\ 0 & 0 & 1 \end{bmatrix} = \begin{bmatrix} 0.8944 & -0.4472 & 0 \\ 0.4472 & 0.8944 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

(3) Translation to bring (0,0) ⟶ (2,2)

$$[T_{2,2}] = \begin{bmatrix} 1 & 0 & 2 \\ 0 & 1 & 2 \\ 0 & 0 & 1 \end{bmatrix}$$

Final composite matrix [X]

$$[X] = [T_{2,0}] \times [R_0] = [S_{xy}]$$

$$= \begin{bmatrix} 1 & 0 & 2 \\ 0 & 1 & 2 \\ 0 & 0 & 1 \end{bmatrix} \times \begin{bmatrix} 0.8944 & -0.4472 & 0 \\ 0.4472 & 0.8944 & 0 \\ 0 & 0 & 1 \end{bmatrix} \times \begin{bmatrix} 4.4721 & 0 & 0 \\ 0 & 2.2360 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

$$= \begin{bmatrix} 3.99 & -0.99 & 2 \\ 1.99 & 1.99 & 2 \\ 0 & 0 & 1 \end{bmatrix}$$

Fractal Geometry → There are very complete picture generated by computes from a single formula. They are treated using Iteration. This means one formula is Repeated with slightly different value over and over again taking in account Result from previous Iteration.

Hidden line Elimination → it is the method of computing which edge are not hidden by four of parts for a specified view & display of parts in projection of magic into 2-D plane. It is utilized by CAD to display virtual lines.