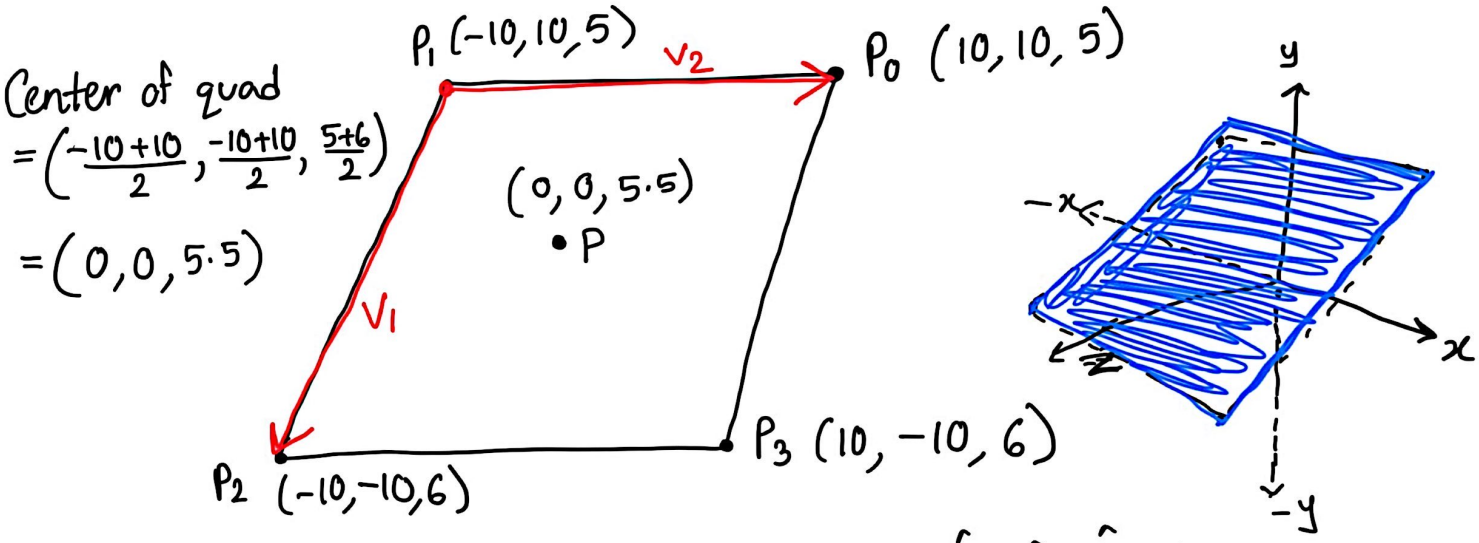
11. Let (50, 70, 100) be the coordinates of a light source of intensity 0.95 units. The light is illuminating a quad consisting of $P_0(10, 10, 5)$, $P_1(-10, 10, 5)$, $P_2(-10, -10, 6)$ and $P_3(10, -10, 6)$ vertices. Determine the intensity of the reflected light at the center of the quad using the diffuse reflection model. Given that the diffuse absorption coefficient of the quad surface is 0.8 units.



$$\bar{V}_1 = P_2 - P_1$$
$$= (-10,-10,6) - (-10,10,5)$$
$$= (0,-20,1)$$

$$\bar{V}_2 = P_0 - P_1$$
$$= (10,10,5) - (-10,10,5)$$
$$= (20,0,0)$$

$$\bar{V}_1 \times \bar{V}_2 = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 0 & -20 & 1 \\ 20 & 0 & 0 \end{vmatrix}$$
$$= (0, 20, 400)$$

$$\hat{n} = \frac{\bar{V}_1 \times \bar{V}_2}{|\bar{V}_1 \times \bar{V}_2|} = \frac{20j + 400k}{\sqrt{160400}}$$

$$\bar{L} = (50,70,100) - (0,0,5.5)$$
$$= (50, 70, 94.5)$$

$$\hat{L} = \frac{50i + 70j + 94.5k}{\sqrt{16330.25}}$$

$$\hat{L} \cdot \hat{n} = \left(\frac{50}{\sqrt{16330.25}} \times 0\right) + \left(\frac{70}{\sqrt{16330.25}} \times \frac{20}{\sqrt{160400}}\right) + \left(\frac{94.5}{\sqrt{16330.25}} \times \frac{400}{\sqrt{160400}}\right)$$
$$= 0.766$$

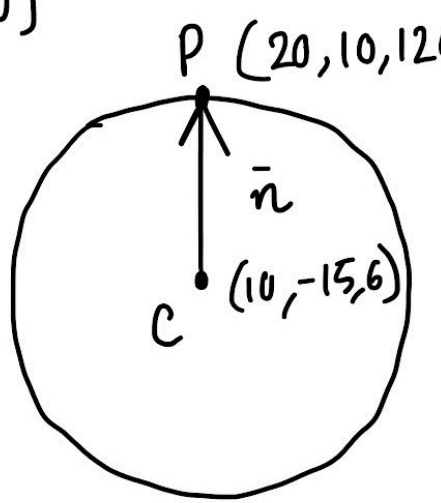
$$\therefore D = I_p k_d (L \cdot n)$$
$$= 0.95 \times 0.8 \times 0.766 = 0.581$$

12. Let (30, 10, 500) be the coordinates of a light source of intensity 0.5 units. The light is illuminating a sphere whose center is at C(10, -15, 6). Determine the total intensity of the reflected light from a point P(20, 10, 120) on the sphere using the diffuse reflection model. Given that the diffuse absorption coefficient of the surface is 0.8 units.

$\bar{L} = (30,10,500) - (20,10,120)$

$= (10, 0, 380)$

$\hat{L} = \dfrac{10i + 380k}{\sqrt{144500}}$



$\bar{n} = P - C$

$= (20,10,120) - (10,-15,6)$

$= (10, 25, 114)$

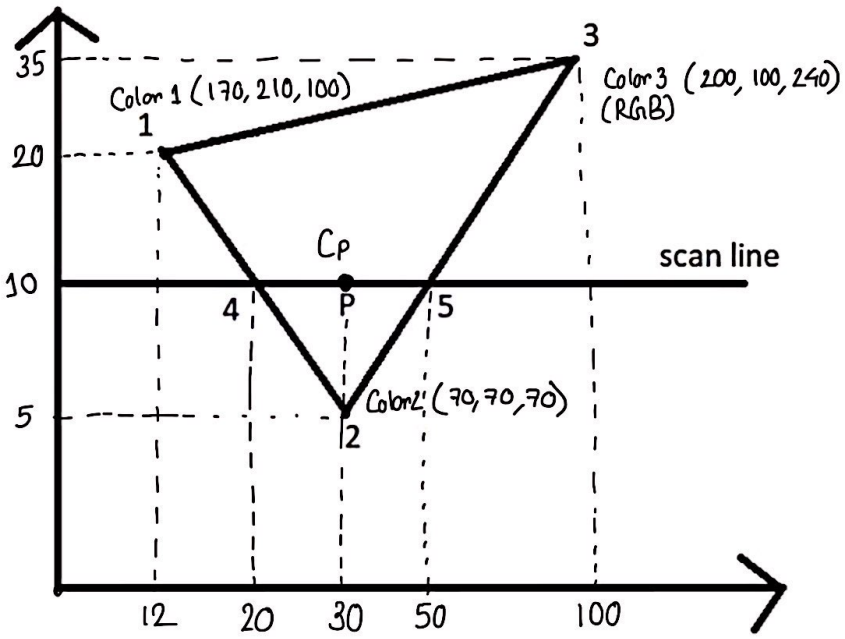
$\hat{n} = \dfrac{10i + 25j + 114k}{\sqrt{13721}}$

$\hat{L} \cdot \hat{n} = \left(\dfrac{10}{\sqrt{144500}} \times \dfrac{10}{\sqrt{13721}}\right) + 0 + \left(\dfrac{380}{\sqrt{144500}} \times \dfrac{114}{\sqrt{13721}}\right)$

$= 0.975$

$\therefore D = 0.5 \times 0.8 \times 0.975$

$= 0.39$



$$C_5 = C_2 + \left[(C_3 - C_2) \times \frac{y_5 - y_2}{y_3 - y_2} \right]$$

$$= (70,70,70) + \left[(200,100,240) - (70,70,70) \times \frac{10-5}{35-5} \right]$$

$$= (70,70,70) + \left[(130,30,170) \times \frac{1}{6} \right]$$

$$= (70,70,70) + (21.67, 5, 28.33)$$

$$= (91.67, 75, 98.33)$$

$$C_4 = C_2 + \left[(C_1 - C_2) \times \frac{y_4 - y_2}{y_1 - y_2} \right]$$

$$= (70,70,70) + \left[(170,210,100) - (70,70,70) \times \frac{10-5}{20-5} \right]$$

$$= (70,70,70) + \left[(100,140,30) \times \frac{1}{3} \right]$$

$$= (70,70,70) + (33.33, 46.67, 10)$$

$$= (103.33, 116.67, 80)$$

$$C_p = C_4 + \left[(C_5 - C_4) \times \frac{x_p - x_4}{x_5 - x_4} \right]$$

$$= (103.33, 116.67, 80) + \left[(91.67, 75, 98.33) - (103.33, 116.67, 80) \frac{30-20}{50-20} \right]$$

$$= (103.33, 116.67, 80) + \left[(-11.66, -41.67, 18.33) \times \frac{1}{3} \right]$$

$$= (103.33, 116.67, 80) + (-3.89, -13.89, 6.11)$$

$$= (99.44, 102.78, 86.11)$$