Assignment - 2

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Ans to - 1

$A = 42$, $B = 12$, $D = 21$

Bottom left ,$(C, D) = (30, 21)$

Bottom right, $(C+10+A, D) = (82, 21)$

top right: $(C+10+A, D+10+A) = (82, 73)$

Top left : $(C, D+10+A) = (30, 73)$

$$\text{Center} = \left(\left(\frac{30+82+82+30}{40} \right), \left(\frac{21+21+73+73}{4} \right) \right)$$

$$= (56, 47)$$

Firstly translate to origin $(0,0)$

$$\begin{bmatrix} x' \\ y' \\ 1 \end{bmatrix} = \begin{bmatrix} 1 & 0 & dx \\ 0 & 1 & dy \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} x \\ y \\ 1 \end{bmatrix}$$

$$T_1 = \begin{bmatrix} 1 & 0 & -56 \\ 0 & 1 & -47 \\ 0 & 0 & 1 \end{bmatrix}$$

Then rotation for, $B = -12^\circ$

$$R = \begin{bmatrix} \cos(-12^\circ) & -\sin(-12^\circ) & 0 \\ -\sin(-12^\circ) & \cos(12^\circ) & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

$$= \begin{bmatrix} +0.9781 & -0.2079 & 0 \\ +0.2079 & 0.9781 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

then back to center $(56, 47)$

$$\text{So, } T_2 = \begin{bmatrix} 1 & 0 & 56 \\ 0 & 1 & 47 \\ 0 & 0 & 1 \end{bmatrix}$$

Now, moved leftward by $B = 12$ unit. $(12, 0)$

$$T_3 = \begin{bmatrix} 1 & 0 & -12 \\ 0 & 1 & 0 \\ 0 & 0 & 1. \end{bmatrix}$$

$\therefore$ composite matrix will be, $CM = T_3 \times T_2 \times R \times T_1$

$$= \begin{bmatrix} 1 & 0 & -12 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} 1 & 0 & 56 \\ 0 & 1 & 47 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} 0.9781 & -0.2079 & 0 \\ 0.2079 & 0.9781 & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} 1 & 0 & -56 \\ 0 & 1 & -47 \\ 0 & 0 & 1 \end{bmatrix}$$

$$CM = \begin{bmatrix} 0.9781 & -0.2079 & -23.79 \\ 0.2079 & 0.9781 & -9.883 \\ 0 & 0 & 1 \end{bmatrix}$$

So, Bottom left $= CM \times \begin{bmatrix} 30 \\ 21 \\ 1 \end{bmatrix} = \begin{bmatrix} 17.3 \\ 18.5 \\ 1 \end{bmatrix}$

$\therefore$ point (Bot left) $= (17.3, 18.5)$

Bottom right $= CM \times \begin{bmatrix} 81 \\ 21 \\ 1 \end{bmatrix} = \begin{bmatrix} 66.8 \\ 29.9 \\ 1 \end{bmatrix}$

$\therefore$ point $= (66.8, 29.9)$

Top right $= CM \times \begin{bmatrix} 82 \\ 73 \\ 1 \end{bmatrix} = \begin{bmatrix} 77.2 \\ 78.6 \\ 1 \end{bmatrix}$

$\therefore$ Point $= (77.2, 78.6)$

$$\text{Top left} = CM \times \begin{bmatrix} 30 \\ 73 \\ 1 \end{bmatrix}$$

$$= \begin{bmatrix} 27.7 \\ 67.2 \\ 1 \end{bmatrix}$$

$\therefore$ point $= (27.7, 67.2)$

Ans to - 2

$A = 42$

$B = 12$

$C = 30$

$D = 21$

RGB to HSV

Here, $R = \frac{A}{99} = \frac{42}{99} = 0.424$

$G = \frac{B}{99} = \frac{12}{99} = 0.121$

$B = \frac{C}{99} = \frac{30}{99} = 0.303$

So, $C_{max} = 0.424$ and $C_{min} = 0.121$

$$\begin{aligned} \Delta &= C_{max} - C_{min} \\ &= 0.424 - 0.121 \\ &= 0.303 \end{aligned}$$

So, $S = \frac{\Delta}{C_{max}} = \frac{0.303}{0.424} = 0.714 = 0.714 \times 100\%$

$= 71.5\%$

$\therefore V = C_{max} = 0.424$

$\therefore H = \left(\frac{G-B}{\Delta}\right) \times 60 = \frac{0.121 - 0.303}{0.303} \times 60 = -36.0396$

So, $H = -36.0396 + 360°$

$= 323.96° \approx 324°$

HSV to RGB

$A = 42$ $\qquad H = A \times 3.6^\circ$ $\qquad S = B\%$ $\qquad V = D\%$

$B = 12$ $\qquad = 42 \times 3.6^\circ$ $\qquad = 12\%$ $\qquad = 21\%$

$C = 30$ $\qquad = 151.2^\circ$ $\qquad = 0.12$ $\qquad = 0.21$

$D = 21$

So, $C = V \times S$

$= 0.21 \times 0.12$

$= 0.0252$

$$\frac{H}{60} = \frac{151.2^\circ}{60} = 2.52$$

$$2.52 \bmod 2 = 0.52$$

$$X = C \times \left(1 - \left|\left(\frac{H}{60^\circ}\right) \bmod 2 - 1\right|\right)$$

$$= 0.0252 \times (1 - |0.52 - 1|)$$

$$= 0.0201$$

As H is in $(120^\circ - 180^\circ)$ range $[H = 151.2^\circ]$

So, $R = 0$

$G = C$

$B = X$

Now, $m = v - c$

$= 0.21 - 0.0252$

$= 0.1848$

So, $R = 0 + m = 0 + 0.1848 = 0.1848$

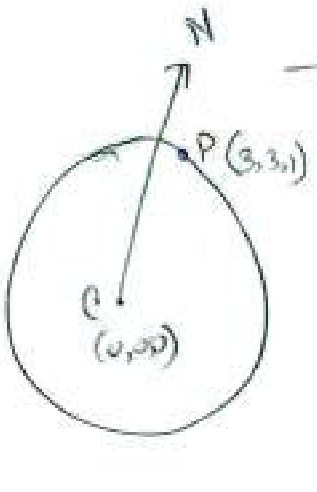
$G = 0.0252 + 0.1848 = 0.21$

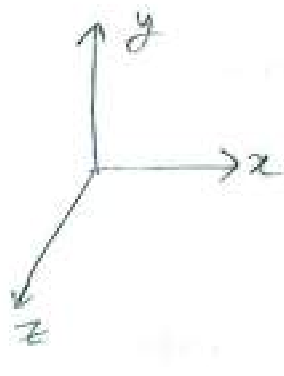
$B = 0.0201 + 0.1848 = 0.2049$

$\therefore (R, G, B) = (0.1848, 0.21, 0.2049)$

$= (47, 57, 52)$ [in (0-255) scale]

Ans to - 3





Here,

point position, $P = (3,3,1)$

Lamp, $L = (6,8,3)$

Eye, $V = (8,4,2)$

Diffuse coeff $= \frac{P}{99} = \frac{42}{99}$

specular coeff $= \frac{C}{99} = \frac{30}{99}$

Shininess $= B = 12$

Firstly,

$$\vec{L} = L - P$$
$$= (6,8,3) - (3,3,1)$$
$$= (3,5,2)$$

$$|\vec{L}| = \sqrt{(3)^2 + (5)^2 + (2)^2} = \sqrt{38}$$

$$\hat{L} = \frac{\vec{L}}{|\vec{L}|} = \left(\frac{3}{\sqrt{38}}\hat{i} + \frac{5}{\sqrt{38}}\hat{j} + \frac{2}{\sqrt{38}}\hat{k}\right)$$

$\vec{V} = r - P$

$= (8,4,2) - (3,3,1)$

$= 5,1,1$

$|\vec{V}| = \sqrt{5^2+1^2+1^2} = \sqrt{27}$

$\hat{V} = \frac{\vec{V}}{|\vec{V}|} = \left(\frac{5}{\sqrt{27}}\hat{i} + \frac{1}{\sqrt{27}}\hat{j} + \frac{1}{\sqrt{27}}\hat{k}\right)$

$\vec{N} = P - c$

$= (3,3,1) - (0,0,0)$

$= (3,3,1)$

$|\vec{N}| = \sqrt{3^2+3^2+1^2} = \sqrt{19}$ so, radius is also $\sqrt{19}$

$\therefore \hat{N} = \frac{\vec{N}}{|\vec{N}|} = \left(\frac{3}{\sqrt{19}}\hat{i} + \frac{3}{\sqrt{19}}\hat{j} + \frac{1}{\sqrt{19}}\hat{k}\right)$

Attenitution, $f_{att} = \max\left(1 - \left(\frac{d}{r}\right)^2, 0\right)$

$= \max\left(1 - \left(\frac{10}{\sqrt{19}}\right)^2, 0\right)$ [d = 10 unit]

$= 0$

Now,

$$\vec{R} = 2(\hat{N}\cdot\hat{L})\hat{N} - \hat{L}$$

So, $\hat{N}\cdot\hat{L} = \left(\frac{3}{\sqrt{19}}\hat{i} + \frac{3}{\sqrt{19}}\hat{j} + \frac{1}{\sqrt{19}}\hat{k}\right)\cdot\left(\frac{3}{\sqrt{38}}\hat{i} + \frac{5}{\sqrt{38}}\hat{j} + \frac{2}{\sqrt{38}}\hat{k}\right)$

$$= 0.7843$$

$$\therefore \vec{R} = 2(0.7813)\left(\frac{3}{\sqrt{19}}\hat{i} + \frac{3}{\sqrt{19}}\hat{j} + \frac{1}{\sqrt{19}}\hat{k}\right) - \left(\frac{3}{\sqrt{38}}\hat{i} + \frac{5}{\sqrt{38}}\hat{j} + \frac{2}{\sqrt{38}}\hat{k}\right)$$

$$= (0.593\hat{i} + 0.268\hat{j} + 0.0354\hat{k})$$

$$|\vec{R}| = \sqrt{(0.593)^2 + (0.268)^2 + (0.0354)^2}$$

$$= 0.65$$

$$\hat{R} = \frac{\vec{R}}{|\vec{R}|} = (0.912\hat{i} + 0.412\hat{j} + 0.05\hat{k})$$

For diffusion case,

$I_d = 4$, $K_d = 0.42$

$$D = I_p \times K_d \times \max(\hat{L}\cdot\hat{N}, 0)$$

$$= 4 \times 0.42 \times \max(0.7843, 0)$$

$$= 1.3176$$

For specular,

$$S = I_p \times K_s \times \left(\max\left(\hat{V}\cdot\hat{R}, 0\right)\right)^n$$

$$\hat{V}\cdot\hat{R} = \left(\frac{5}{\sqrt{27}}\hat{i} + \frac{1}{\sqrt{27}}\hat{j} + \frac{1}{\sqrt{27}}\hat{k}\right)\cdot\left(0.912\hat{i} + 0.412\hat{j} + 0.05\hat{k}\right)$$

$$= (0.877 + 0.07 + 0.009) = 0.956$$

So, $S = 4 \times 0.42 \times \left(\max\left(0.956, 0\right)\right)^{12}$

$$= 0.9790$$

Now,

Total light, $I = A + D + S$

$$= 0 + f_{att}(D + S)$$

$$= 0 + 0(1.3176 + 0.9790)$$

$$= 0$$

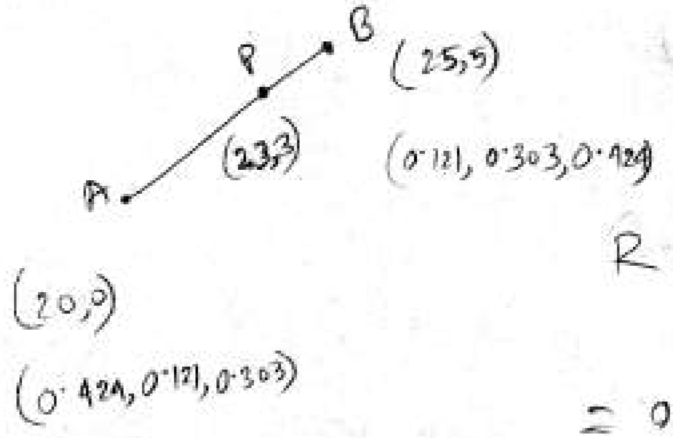
Ans 6-4

$$\frac{A}{99} = \frac{42}{99} = 0{\cdot}424$$

$$\frac{B}{99} = \frac{12}{99} = 0{\cdot}121$$

$$\frac{C}{99} = \frac{30}{99} = 0{\cdot}303$$

Val	points		R G B
A	$\rightarrow (20,0)$	$\rightarrow$	$(0{\cdot}424, 0{\cdot}121, 0{\cdot}303)$
B	$\rightarrow (25,5)$	$\rightarrow$	$(0{\cdot}121, 0{\cdot}303, 0{\cdot}424)$
C	$\rightarrow (30,0)$	$\rightarrow$	$(0{\cdot}303, 0{\cdot}121, 0{\cdot}121)$
D	$\rightarrow (35,5)$	$\rightarrow$	$(0{\cdot}121, 0{\cdot}303, 0{\cdot}303)$
E	$\rightarrow (40,0)$	$\rightarrow$	$(0{\cdot}303, 0{\cdot}121, 0{\cdot}121)$



$$R = C_A + \left[(C_B - C_A) \times \frac{3-0}{5-0}\right]$$

$$= 0{\cdot}424 + \left[(0{\cdot}121 - 0{\cdot}424) \times \frac{3}{5}\right]$$

$$= 0{\cdot}2422$$

$$G = 0.121 + \left([0.303 - 0.121] \times \frac{3}{5} \right)$$

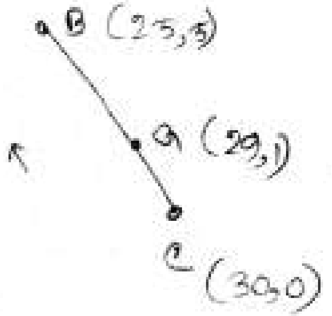
$$= 0.2302$$

$$B = 0.303 + \left([0.424 - 0.303] \times \frac{3}{5} \right)$$

$$= 0.3756$$

$$\therefore P(0.2422,\ 0.2302,\ 0.3756)$$

Now, point $\rightarrow$ Q



$$R = C_C + \left[(C_B - C_C) \times \frac{1-0}{5-0} \right]$$

$$= 0.303 + \left[(0.121 - 0.303) \times \frac{1}{5} \right]$$

$$= 0.266$$

$$G = 0.121 + \left[(0.303 - 0.121) \times \frac{1}{5} \right]$$

$$= 0.1574$$

$$B = 0.121 + \left[0.424 - 0.121) \times \frac{1}{5} \right]$$

$$= 0.1816$$

$$\therefore Q(0.266,\ 0.1574,\ 0.1816)$$

Point $\rightarrow$ R

R

C (33,0) E

(30,0) (40,0)

(0·303, 0·121, 0·121) (0·303, 0·121, 0·121)

$$R = C_c + \left[(C_E - C_c) \times \frac{33-30}{40-30} \right]$$

$$= 0·303 + \left[(0·303 - 0·303) \times \frac{3}{10} \right]$$

$$= 0·303$$

$$G = 0·121 + \left[(0·121 - 0·121) \times \frac{3}{10} \right]$$

$$= 0·121$$

$$B = 0·121 + \left[(0·121 - 0·121) \times \frac{3}{10} \right]$$

$$= 0·121$$

So, R (0·303, 0·121, 0·121)