$$C = \begin{pmatrix} 4 \\ 6 \\ 7 \end{pmatrix} \quad ; \quad V = \begin{pmatrix} 1 \\ 2 \\ 2 \end{pmatrix} = l$$

given that plane is at $y = 0$, the normal is at $n = \begin{pmatrix} 0 \\ 1 \\ 0 \end{pmatrix}$

1) Calculate the reflected ray:

$$r = 2n \cdot \langle n, l \rangle - l$$

$$= \begin{pmatrix} 0 \\ 2 \\ 0 \end{pmatrix} \cdot 2 - \begin{pmatrix} 1 \\ 2 \\ 2 \end{pmatrix} = \begin{pmatrix} -1 \\ 2 \\ -2 \end{pmatrix}$$

2) given that $p = c + kr$

$$p = \begin{pmatrix} 4 \\ 6 \\ 7 \end{pmatrix} + k \begin{pmatrix} -1 \\ 2 \\ -2 \end{pmatrix} \rightarrow \begin{aligned} p_x &= 4 - k \\ p_y &= 6 + 2k = 0 \\ p_z &= 7 - 2k \end{aligned}$$

$$p_y = 0 = 6 + 2k \Rightarrow k = -\frac{6}{2} = -3$$

$$p_x = 4 + 3 = 7$$

$$p_z = 7 + 6 = 13 \quad \Rightarrow p = \begin{pmatrix} 7 \\ 0 \\ 13 \end{pmatrix}$$

Intensity I_d coming from diffuse reflection:

$$I_d = \rho_d \cdot \cos\phi \cdot \underline{I} = \underline{\rho_d \langle n, i \rangle \cdot \underline{I}}$$

Intensity I_s coming from specular reflection:

$$I_s = \rho_s \underbrace{(\cos\alpha)^K}_{\hookrightarrow \frac{\langle r, v \rangle}{\|r\| \cdot \|v\|} = 1} \cdot \underline{I}$$

given $K = 2$, $\underline{I} = 1$

$\|r\| \cdot \|v\| = 1$ ↓ given it is the highest point

$$\rightarrow \underline{I_d} = \frac{1}{2} \cdot \langle \bar{n}, \bar{i} \rangle \cdot 1$$

$$= \frac{1}{2} \cdot \left\langle \begin{pmatrix} 1/3 \\ 2/3 \\ -2/3 \end{pmatrix}, \begin{pmatrix} 0 \\ 1 \\ 0 \end{pmatrix} \right\rangle = \underline{\frac{1}{3}}$$

$$\rightarrow \underline{I_s} = \frac{1}{2} \cdot 1 \cdot 1 + \frac{1}{3} = \frac{3}{6} + \frac{2}{6} = \frac{5}{6}$$