Question 1:

 $\overline{near = -2}$. far = -6. left = -2. right = 6. top = 4. bottom = -4definition:

$$\begin{bmatrix} x_{canonical} \\ y_{canonical} \\ z_{canonical} \\ 1 \end{bmatrix} = \begin{bmatrix} \frac{2}{r-l} & 0 & 0 & \frac{(r+l)}{r-l} \\ 0 & \frac{2}{t-b} & 0 & \frac{-(t+b)}{t-b} \\ 0 & 0 & \frac{2}{n-f} & \frac{-(n+f)}{n-f} \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} x_{view} \\ y_{view} \\ z_{view} \\ 1 \end{bmatrix}$$

$$\begin{bmatrix} x_{canonical} \\ y_{canonical} \\ y_{canonical} \\ z_{canonical} \\ 1 \end{bmatrix} = \begin{bmatrix} \frac{2}{6-(-2)} & 0 & 0 & \frac{-(6+(-2))}{6-(-2)} \\ 0 & \frac{2}{4-(-4)} & 0 & \frac{-(4+(-4))}{4-(-4)} \\ 0 & 0 & \frac{2}{(-2)-(-6)} & \frac{-(4+(-4))}{4-(-4)} \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} x_{view} \\ y_{view} \\ z_{view} \\ 1 \end{bmatrix}$$

$$\begin{bmatrix} x_{cunonical} \\ y_{canonical} \\ y_{canonical} \\ z_{canonical} \\ 1 \end{bmatrix} = \begin{bmatrix} \frac{1}{4} & 0 & 0 & \frac{-1}{2} \\ 0 & \frac{1}{4} & 0 & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} x_{view} \\ y_{view} \\ z_{view} \\ z_{vie$$

Question 2:

a.

$$P(x_v, y_v, z_v) = (100, 20, 20); d = 10$$

 $\frac{x_s}{d} = \frac{x_v}{z_v} = \frac{100}{20} = 5$
 $x_s = 5 \cdot d = 50$

$$\frac{x_s}{d} = \frac{x_v}{z_v} = \frac{100}{20} = 5$$

$$x_s = 5 \cdot d = 50$$

$$\frac{y_s}{d} = \frac{y_v}{z_v} = \frac{20}{20} = 1$$

 $y_s = 1 \cdot d = 10$

$$y_s = 1 \cdot d = 10$$

$$P(x_s, y_s) = (50, 10)$$

$$P(x_s, y_s) = (20, 10)$$

$$\begin{array}{ll} \frac{x_v}{z_v} = \frac{x_s}{d} = 2 & x_v = 2 \cdot z_v \\ \frac{z_v}{z_v} = \frac{y_s}{d} = 1 & y_v = 1 \cdot z_v \end{array}$$

$$\frac{\ddot{y_v}}{z_v} = \frac{\ddot{y_s}}{d} = 1$$
 $y_v = 1 \cdot z_v$

There are 3 variables, but only 2 equations, we cannot uniquely determine the 3D point's coordinate because of this.

Any point on the line $(2 \cdot z_v, 1 \cdot z_v, z_v)$ could be the original coordinate.

Question 3:

$$(f \text{ inside } s) \text{ over } b$$

$$f = \begin{bmatrix} 1, 1, 1, 1 & 1, 1, 1 & 1, 1, 1, 1 \\ 1, 1, 1, 1 & 1, 1, 1, 1 & 1, 1, 1, 1 \\ 1, 1, 1, 1 & 1, 1, 1, 1 & 1, 1, 1, 1 \end{bmatrix}$$

$$\mathbf{b} = \begin{bmatrix} 1,0,0,1 & 1,0,0,1 & 1,0,0,1 \\ 1,0,0,1 & 1,0,0,1 & 1,0,0,1 \\ 1,0,0,1 & 1,0,0,1 & 1,0,0,1 \end{bmatrix}$$

values in r,g,b,a
$$f = \begin{bmatrix} 1,1,1,1 & 1,1,1 & 1,1,1,1 \\ 1,1,1,1 & 1,1,1,1 & 1,1,1,1 \\ 1,1,1,1 & 1,1,1,1 & 1,1,1,1 \end{bmatrix} s = \begin{bmatrix} 1,1,1,1 & 0,0,0,0 \\ 0,0,0,0 & 1,1,1,1 \\ 1,1,1,1 & 1,0,0,1 & 1,0,0,1 \\ 1,0,0,1 & 1,0,0,1 & 1,0,0,1 \\ 1,0,0,1 & 1,0,0,1 & 1,0,0,1 \end{bmatrix}$$

$$(f \text{ inside } s) = f_1 = \alpha_s c_f = \begin{bmatrix} 1,1,1,1 & 0,0,0,0 & 1,1,1,1 \\ 0,0,0,0 & 1,1,1,1 & 0,0,0,0 \\ 1,1,1,1 & 0,0,0,0 & 1,1,1,1 \end{bmatrix}$$

$$f_1 \text{ over } b = \alpha_s c_t = c_t + (1 - \alpha_s) c_t = c_t$$

$$f_1 \text{ over } b = \alpha_s c_f = c_{f_1} + (1 - \alpha_{f_1}) c_b =$$

$$f_1 \text{ over } b = \alpha_s c_f = c_{f_1} + (1 - \alpha_{f_1}) c_b = \begin{bmatrix} 1, 1, 1, 1 & 0, 0, 0, 0 & 1, 1, 1, 1 \\ 0, 0, 0, 0 & 1, 1, 1, 1 & 0, 0, 0, 0 \\ 1, 1, 1, 1 & 0, 0, 0, 0 & 1, 1, 1, 1 \end{bmatrix} + \begin{bmatrix} 0, 0, 0, 0 & 1, 0, 0, 1 \\ 1, 0, 0, 1 & 0, 0, 0, 0 \\ 0, 0, 0, 0 & 1, 0, 0, 1 \end{bmatrix}$$

$$\begin{bmatrix} 1, 1, 1, 1 & 1, 0, 0, 1 & 1, 1, 1, 1 \\ 1, 0, 0, 1 & 1, 1, 1, 1 & 1, 0, 0, 1 \\ 1, 1, 1, 1 & 1, 0, 0, 1 & 1, 1, 1, 1 \end{bmatrix}$$

$$\begin{bmatrix} 1, 1, 1, 1 & 1, 0, 0, 1 & 1, 1, 1, 1 \\ 1, 0, 0, 1 & 1, 1, 1, 1 & 1, 0, 0, 1 \end{bmatrix}$$

$$1.\,1,1,1 \qquad 1,0,0,1 \qquad 1,1,1,1 \,\, \rfloor$$

$$\begin{array}{ccccccc}
1, 1, 1, 1 & 0, 0, 0, 0 & 1, 1, 1, 1 \\
0, 0, 0, 0 & 1, 1, 1, 1 & 0, 0, 0, 0
\end{array}$$

$$[1, 1, 1, 1, 0, 0, 0, 0, 0, 1, 1, 1, 1, 1]$$

$$\begin{bmatrix} 0,0,0,0 & 1.0,0.1 & 0.0,0,0 \\ 1,0,0,1 & 0.0,0,0 & 1.0,0,1 \end{bmatrix} =$$

$$[0,0,0,0]$$
 $[1,0,0,1]$ $[0,0,0,0]$

$$\begin{bmatrix} u \\ v \\ 1 \end{bmatrix} = \begin{bmatrix} a & b & c \\ d & e & f \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} x \\ y \\ 1 \end{bmatrix}$$

$$u = a \cdot x + b \cdot y + c$$

$$u = a \cdot x + b \cdot y + c$$

 $v = d \cdot x + e \cdot y + f$

$$v = a \cdot x + e \cdot y + f$$

 $u = a \cdot 1 + b \cdot 1 + c$ $a + b + c = \frac{\sqrt{3} + 1}{2}$

$$v = d \cdot 1 + e \cdot 1 + f$$
 $d + e + f = \frac{\sqrt{3}-1}{2}$

$$u = a \cdot 0 + b \cdot 0 + c \qquad c = 1$$

$$v = d \cdot 0 + e \cdot 0 + f$$
 $f = -1$
 $u = a \cdot 1 + b \cdot 0 + c$ $a + c = \frac{\sqrt{3}}{2}$

$$u = a \cdot 1 + b \cdot 0 + c \qquad a + c = \frac{\sqrt{3} + 2}{2}$$

$$v = d \cdot 1 + e \cdot 0 + f \qquad d + f = \frac{-1}{2}$$

$$a = \frac{\sqrt{3}+2}{2} - c = \frac{\sqrt{3}+2}{2} - 1 = \frac{\sqrt{3}}{2}$$

$$d = -\frac{1}{2} - f = -\frac{1}{2} - (-1) = \frac{1}{2}$$

$$a = -\frac{1}{2} - J = -\frac{1}{2} - (-1) = \frac{1}{2}$$

$$b = \frac{\sqrt{3}+1}{2} - a - c = \frac{\sqrt{3}+1}{2} - \frac{\sqrt{3}}{2} - 1 = -\frac{1}{2}$$

$$0 = \frac{\sqrt{3} - 1}{2} - d - c = \frac{\sqrt{3} - 1}{2} - \frac{\sqrt{3}}{2} - 1 = -\frac{1}{2}$$

$$e = \frac{\sqrt{3} - 1}{2} - d - f = \frac{\sqrt{3} - 1}{2} - \frac{1}{2} - (-1) = \frac{\sqrt{3}}{2}$$

$$a = \frac{\sqrt{3}}{2} b = -\frac{1}{2} c = 1 d = \frac{1}{2} e = \frac{\sqrt{3}}{2} f = -1 \begin{bmatrix} \frac{\sqrt{3}}{2} \\ \frac{1}{2} \\ \frac{1}{2} \end{bmatrix} \begin{pmatrix} -\frac{1}{2} \\ \frac{\sqrt{3}}{2} \\ -1 \end{bmatrix}$$

$$\frac{-\frac{1}{2}}{\frac{\sqrt{3}}{2}}$$
 -1