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a	b	c	d
3	7	6	5

1. $-3 \le x \le 3$, $-7 \le y \le 7$, $-6 \le z \le 6$

```
glMatrixMode(GL_PROJECTION);
glLoadIdentity();
glOrtho(-3, 3, -6, 6, 7, -7);
glRotatef(-90, 1, 0, 0)
glTranslatef(0, 6, 0)
```

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2.

U_x	U_y	U_z	V_x	V_y	V_z	W_x	W_y	W_z
4	8	6	3	8	3	5	6	8

$\overrightarrow{VW} = W - V = (2, -2, 5)$

$\overrightarrow{UV} = V - U = (-1, 0, -3)$

Two points determine the vector;

a. Explicit form $\Rightarrow V + a(W-V) = \overrightarrow{VW}$

Implicit form $\Rightarrow 2a + (-2)b + 5c + d = 0$

b. parametric equation of $\overrightarrow{UV}$:

$x(a) = aX_0 + (1-a)X_1$ $\quad x = 4a + (1-a)3 = a + 3$

$y(a) = ay_0 + (1-a)y_1 \Rightarrow y = 8a + (1-a)8 = 8$

$z(a) = az_0 + (1-a)z_1$ $\quad z = 6a + (1-a)3 = 3 + 3a$

c. $a = \frac{d}{17} = \frac{5}{10} = \frac{1}{2}$, $X = 3.5, y = 8, z = 4.5$

D. $\bar{x} = (1, 0, 3)$

$\bar{y} = (2, -2, 5)$

$\bar{z} = (3, -2, 8)$

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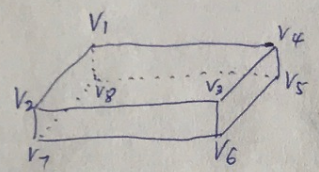
3. Assume:



Distance: $D_1 = \sqrt{V_3 - V_2}$ ⟹ X axis

Distance: $D_2 = \sqrt{V_7 - V_2}$ ⟹ y axis

$D_1 / D_2 = w$ ⟹ $D_1 = w D_2$

if we need $1/w$, we make $\frac{w D_2}{w^2 D_2} = \frac{1}{w}$

it means we make D_2 to $w^2 D_2$

```
glScalef(1, w*w, 1);

double D1 distance(V3, V2);
double D2 distance(V7, V2);
D1/D2 = w;
glScalef(1, w*w, 1);
```

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4. $a = 3$, $b = 7$, $c = 6$, $d = 5$

$p = 1/a = 1/3$

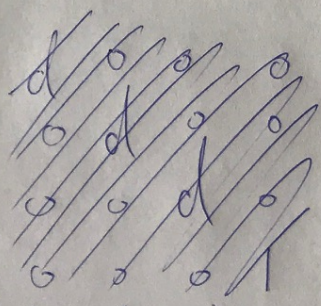
$q = 2/3 = 1 - p$

$y = \frac{1}{3} \cdot (2/3)^{k-1}$, $1 \le k < 10 \times c = 60$

a.

```
glBegin(GL_POINTS);
    double y = 0.0;
    for (int k = 1; k < 60; k = k + 0.1) {
        y = 1/3 * pow(2/3, k-1);
        glVertex2f(k, y);
    }
glEnd();
glFlush();
```

b.



1) translate to (c, a, b)

$$\begin{bmatrix} 1 & 0 & 0 & -a \\ 0 & 1 & 0 & -b \\ 0 & 0 & 1 & -c \\ 0 & 0 & 0 & 1 \end{bmatrix} \cdot \begin{bmatrix} d & 0 & 0 & 0 \\ 0 & d & 0 & 0 \\ 0 & 0 & d & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} 1 & 0 & 0 & a \\ 0 & 1 & 0 & b \\ 0 & 0 & 1 & c \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

$$\Downarrow$$

$$\begin{bmatrix} d & 0 & 0 & ad - a \\ 0 & d & 0 & bd - b \\ 0 & 0 & d & cd - c \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

b. (c, a, b, 1) ⇒ (6, 3, 7, 1)

1) glTranslate(6, 3, 7, 1); d = 5

2) glScalef(d, d, d, 1);

3) glTranslate(-6, -3, -7, 1);

$$\begin{bmatrix} 1 & 0 & 0 & -a' \\ 0 & 1 & 0 & -b' \\ 0 & 0 & 1 & -c' \\ 0 & 0 & 0 & 1 \end{bmatrix} \cdot \begin{bmatrix} d & 0 & 0 & 0 \\ 0 & d & 0 & 0 \\ 0 & 0 & d & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \cdot \begin{bmatrix} 1 & 0 & 0 & a' \\ 0 & 1 & 0 & b' \\ 0 & 0 & 1 & c' \\ 0 & 0 & 0 & 1 \end{bmatrix} = \begin{bmatrix} d & 0 & 0 & a'd - a' \\ 0 & d & 0 & b'd - b' \\ 0 & 0 & d & c'd - c' \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

1) 2) 3)

$$= \begin{bmatrix} 5 & 0 & 0 & 24 \\ 0 & 5 & 0 & 12 \\ 0 & 0 & 5 & 28 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$