Решение кубического уравнения (9кл., 1965г.)

$$ax^3 + bx^2 + cx + d = 0 \quad (a \neq 0) \qquad (1.0)$$

1. $x = y - \frac{b}{3a}$

$$a\left(y - \frac{b}{3a}\right)^3 + b\left(y - \frac{b}{3a}\right)^2 + c\left(y - \frac{b}{3a}\right) + d = 0$$

$$ay^3 - 3ay^2\cdot\frac{b}{3a} + 3ay\cdot\frac{b^2}{9a} - a\cdot\frac{b^3}{27a^3} + by^2 - 2by\cdot\frac{b}{3a} + b\cdot\frac{b^2}{9a^2} + cy - c\cdot\frac{b}{3a} + d = 0$$

$$ay^3 + c_1 y + d_1 = 0 \qquad (1.1)$$

2. $y = \sqrt{\frac{c_1}{3a}}\, z$

$$a\cdot\frac{c_1}{3a}\cdot\sqrt{\frac{c_1}{3a}}\, z^3 + c_1\sqrt{\frac{c_1}{3a}}\, z + d_1 = 0$$

$$z^3 + 3z + d_2 = 0 \qquad (1.2)$$

3. $z = u - \frac{1}{u}$

$$u^3 - 3u^2\cdot\frac{1}{u} + 3u\cdot\frac{1}{u^2} - \frac{1}{u^3} + 3u - 3\cdot\frac{1}{u} + d_2 = 0$$

$$u^3 - \frac{1}{u^3} + d_2 = 0 \qquad (1.3)$$

4. $u^3 = v$

$$v - \frac{1}{v} + d_2 = 0$$

$$v^2 + d_2 v - 1 = 0 \qquad (1.4)$$