$\forall y \in P;\ x_0 \to y + x_0;\ x = x_1 + y + x_0 = (x_1 + y) + x_0 \Rightarrow x \in R$

1443 $\varphi_x = (2x_1 + x_2,\ x_1 + x_3,\ x_3^2)$

$\forall x = (x_1, x_2, x_3),\ y = (y_1, y_2, y_3) \in R_3$

$\varphi(x+y) = \varphi(x_1 + y_1, x_2 + y_2, x_3 + y_3) = (2x_1 + x_2 + y_1,\ x_1 + x_3 + y_2,\ x_3^2 + x_3 + y_3)$

$\varphi(y) = (2y_1 + y_2,\ y_1 + y_3,\ y_3^2)$

$\exists\ x = (0, 1, 0),\ \exists y = (0, 0, 0)$

$\varphi(x) + \varphi(y) = (2x_1 + x_2 + 2y_1 + y_2,\ x_1 + x_3 + y_1 + y_3,\ x_3^2 + y_3^2) =$

$\varphi(x) + \varphi(y) = (1, 0, 0)$

$\varphi(x+y) = (1, 0, 0)$!

1444 $\varphi(x) = (x_1 - x_2 + x_3,\ x_3,\ x_2)$

$\varphi(x+y) = (x_1 - x_2 + x_3 + y_1,\ x_3 + y_2,\ x_2 + y_3)$

$\varphi(y) = (y_1 - y_2 + y_3,\ y_3,\ y_2)$

$\varphi(y) + \varphi(x) = (x_1 - x_2 + x_3 + y_1 - y_2 + y_3,\ y_3 + x_3,\ x_2 + y_2)$

$\exists\ x = (0, 1, 0),\ \exists y = (0, 0, 0)$

$\varphi(y+x) = (-1, 1, 1)$

$\varphi(y)+\varphi(x) = (-2, 0, 2)$

(1445) $a_1 = (2, 3, 5)$ $\quad b_1 = (1, 1, 1)$

$a_2 = (0, 1, 2)$ $\quad b_2 = (1, 1, -1)$

$a_3 = (1, 0, 0)$ $\quad b_3 = (2, 1, 2)$

$A = [\varphi]_e - ?$

$$\left(a_1 \mid a_2 \mid a_3 \mid E\right) \underset{\sim}{\text{e.n.r.}} \left(E \mid A^{-1}\right)$$

$$\left(\begin{array}{ccc|ccc} 2 & 0 & 1 & 1 & 0 & 0 \\ 3 & 1 & 0 & 0 & 1 & 0 \\ 5 & 2 & 0 & 0 & 0 & 1 \end{array}\right) \sim \cancel{\left(\begin{array}{ccc|ccc} 1 & 0 & -1 & 1 & 0 & 0 \\ 2 & 0 & 1 & & & \\ 1 & 2 & -2 & -2 & 0 & 1 \end{array}\right)}$$

$$\sim \left(\begin{array}{ccc|ccc} 1 & 0 & \frac{1}{2} & \frac{1}{2} & 0 & 0 \\ 0 & 1 & -\frac{3}{2} & -\frac{3}{2} & 1 & 0 \\ 0 & 2 & -\frac{5}{2} & -\frac{5}{2} & 0 & 1 \end{array}\right)_{-\text{II}} \sim \left(\begin{array}{ccc|ccc} 1 & 0 & \frac{1}{2} & \frac{1}{2} & 0 & 0 \\ 0 & 1 & -\frac{3}{2} & -\frac{3}{2} & 1 & 0 \\ 0 & 0 & \frac{1}{2} & \frac{1}{2} & -2 & 1 \end{array}\right) + \frac{3}{2}$$

$$\sim \left(\begin{array}{ccc|ccc} 1 & 0 & \frac{1}{2} & \frac{1}{2} & 0 & 0 \\ 0 & 1 & 0 & 0 & -5 & 3 \\ 0 & 0 & 1 & 1 & -4 & 2 \end{array}\right) + -\frac{1}{2}(\text{III}) \sim \left(\begin{array}{ccc|ccc} 1 & 0 & 0 & 0 & 2 & -1 \\ 0 & 1 & 0 & 0 & -5 & 3 \\ 0 & 0 & 1 & 1 & -4 & 2 \end{array}\right)$$

A_E

$e_1 = a_3$

$e_2 = 2a_1 - 5a_2 - 4a_3$

$e_3 = -a_1 + 3a_2 + 2a_3$

$+ (4, 2, 4) = (6, 4, 0)$

$\varphi(e_1) = \varphi(a_3) = b_3 = (2, 1, 2)$

$\varphi(e_2) = \varphi(2a_1 - 5a_2 - 4a_3) = \cancel{2\varphi(a_1)}$

$= 2b_1 - 5b_2 - 4b_3 =$

$= (2, 2, 2) + (-5, -5, 5) + (-8, -4, -8) =$

$= (-11, -7, -1)$

$\varphi(e_3) = -b_1 + 3b_2 + 2b_3 = (-1, -1, -1) + (3, 3, -3) +$

(1451) змінюються i-й та j-й рядки та i-й та j-й стовпчики

(1436) e_1, e_2, e_3 - канонічний ортогональний базис

$\mathbb{R}^3 = \langle e_1 \rangle \dotplus \langle e_2, e_3 \rangle$

$\forall x \in \mathbb{R}^3 \quad x = y + r \quad , \quad y \in \langle e_1 \rangle, \ r \in \langle e_2, e_3 \rangle$

y - проекція x на $\langle e_1 \rangle \parallel \langle e_2, e_3 \rangle$

$\varphi(x) = y$

$\forall x_1 \in \mathbb{R}^3, x_2 \in \mathbb{R}^3, \forall \alpha, \beta \in \mathbb{R}$

$\exists! \ y_1, y_2 \in \langle e_1 \rangle$

$\exists! \ r_1, r_2 \in \langle e_2, e_3 \rangle :$

$x_1 = y_1 + r_1, \quad x_2 = y_2 + r_2$

$\varphi(\alpha x_1 + \beta x_2) = \varphi(\alpha(y_1 + r_1) + \beta(y_2 + r_2)) = \varphi((\alpha y_1 + \beta y_2) +$

$+ (\beta r_2 + \beta r_1)) = \alpha y_1 + \beta y_2 = \alpha \varphi(x_1) + \beta(\varphi)(x_2)$

$\Downarrow$

φ - лінійне

$\varphi(e_1) = e_1 = (1, 0, 0)$

$\varphi(e_2) = \Theta$

$\varphi(e_3) = \Theta_{\xi}$

$$\Rightarrow A_\varphi = \begin{pmatrix} 1 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{pmatrix}$$

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