

ИНДИВИДУАЛЬНЫЕ ТИПОВЫЕ ЗАДАНИЯ ПО ДИСЦИПЛИНЕ «АНАЛИТИЧЕСКАЯ ГЕОМЕТРИЯ»

1. Вычислить определитель:

а) по правилу треугольников;

б) разложением по какой-нибудь строке или столбцу.

$$1.1 \begin{vmatrix} -1 & 5 & 1 \\ -2 & 6 & 2 \\ 2 & 7 & 3 \end{vmatrix} \cdot 1.2 \begin{vmatrix} 1 & 2 & 2 \\ 2 & -1 & 3 \\ -1 & -3 & 4 \end{vmatrix} \cdot 1.3 \begin{vmatrix} 6 & 10 & 6 \\ 8 & 8 & 5 \\ 5 & 9 & 5 \end{vmatrix} \cdot 1.4 \begin{vmatrix} 7 & 9 & 7 \\ 6 & 8 & 6 \\ -7 & 9 & 7 \end{vmatrix} \cdot 1.5 \begin{vmatrix} 6 & 8 & -9 \\ 4 & 6 & -6 \\ -2 & -3 & 4 \end{vmatrix}.$$

$$1.6 \begin{vmatrix} 2 & -5 & 1 \\ -3 & 7 & -1 \\ 5 & -9 & 2 \end{vmatrix} \cdot 1.7 \begin{vmatrix} 9 & 3 & 6 \\ 8 & 2 & 7 \\ 5 & 3 & 2 \end{vmatrix} \cdot 1.8 \begin{vmatrix} 2 & 4 & 3 \\ 3 & 7 & 5 \\ 4 & 8 & 5 \end{vmatrix} \cdot 1.9 \begin{vmatrix} 3 & -5 & 2 \\ -3 & 4 & -5 \\ 8 & -8 & 5 \end{vmatrix} \cdot 1.10 \begin{vmatrix} 7 & 6 & 3 \\ 3 & 5 & 7 \\ 5 & 4 & 3 \end{vmatrix}.$$

$$1.11 \begin{vmatrix} 1 & 6 & 5 \\ 2 & 8 & 6 \\ 4 & 9 & 3 \end{vmatrix} \cdot 1.12 \begin{vmatrix} 3 & -3 & 6 \\ 2 & 1 & 3 \\ 1 & -1 & 2 \end{vmatrix} \cdot 1.13 \begin{vmatrix} 10 & 6 & 6 \\ 8 & 8 & 5 \\ 9 & 5 & 5 \end{vmatrix} \cdot 1.14 \begin{vmatrix} -6 & 8 & 6 \\ 6 & 8 & 6 \\ 7 & 9 & 7 \end{vmatrix} \cdot 1.15 \begin{vmatrix} 8 & 6 & -9 \\ 6 & 4 & -6 \\ -3 & -2 & 4 \end{vmatrix}.$$

$$1.16 \begin{vmatrix} 2 & -5 & 1 \\ 4 & 7 & -1 \\ 2 & -6 & 1 \end{vmatrix} \cdot 1.17 \begin{vmatrix} 6 & 9 & 3 \\ 7 & 8 & 2 \\ 5 & 8 & 4 \end{vmatrix} \cdot 1.18 \begin{vmatrix} 4 & 2 & 3 \\ 7 & 3 & 5 \\ 8 & 4 & 5 \end{vmatrix} \cdot 1.19 \begin{vmatrix} -5 & 3 & 2 \\ 4 & -3 & -5 \\ -8 & 8 & 5 \end{vmatrix} \cdot 1.20 \begin{vmatrix} 7 & 6 & 3 \\ 2 & 5 & 7 \\ 5 & 4 & 3 \end{vmatrix}.$$

$$1.21 \begin{vmatrix} 4 & 9 & 3 \\ 2 & 8 & 6 \\ 1 & 6 & 5 \end{vmatrix} \cdot 1.22 \begin{vmatrix} 6 & -3 & 3 \\ 3 & 1 & 2 \\ 2 & -1 & 1 \end{vmatrix} \cdot 1.23 \begin{vmatrix} 7 & 7 & 4 \\ 8 & 8 & 5 \\ 9 & 5 & 5 \end{vmatrix} \cdot 1.24 \begin{vmatrix} 6 & 8 & -8 \\ 6 & 8 & 8 \\ 7 & 9 & 9 \end{vmatrix} \cdot 1.25 \begin{vmatrix} -3 & 4 & 6 \\ -4 & 6 & 8 \\ 8 & -9 & 12 \end{vmatrix}.$$

$$1.26 \begin{vmatrix} 7 & 2 & 5 \\ 2 & 1 & 2 \\ 2 & 1 & 4 \end{vmatrix} \cdot 1.27 \begin{vmatrix} 5 & 8 & 4 \\ 7 & 8 & 2 \\ 2 & 5 & 3 \end{vmatrix} \cdot 1.28 \begin{vmatrix} 8 & 4 & 5 \\ 7 & 3 & 5 \\ 4 & 2 & 3 \end{vmatrix} \cdot 1.29 \begin{vmatrix} 7 & -5 & 5 \\ 4 & -3 & 3 \\ -5 & 3 & -4 \end{vmatrix} \cdot 1.30 \begin{vmatrix} 5 & 3 & 5 \\ 2 & 7 & 3 \\ 4 & 5 & 5 \end{vmatrix}.$$

2. Вычислить определитель.

$$2.1 \begin{vmatrix} -1 & 6 & 5 & 1 \\ -2 & 8 & 6 & 2 \\ 2 & 16 & 7 & 3 \\ -3 & 9 & 3 & 4 \end{vmatrix} \cdot 2.2 \begin{vmatrix} 1 & 2 & -1 & 2 \\ 2 & -1 & 1 & 3 \\ -1 & -3 & -2 & 4 \\ 3 & -4 & -3 & 6 \end{vmatrix} \cdot 2.3 \begin{vmatrix} -5 & 6 & 10 & 6 \\ -9 & 8 & 8 & 5 \\ -8 & 5 & 9 & 5 \\ -11 & 7 & 7 & 4 \end{vmatrix}.$$

$$2.4 \begin{vmatrix} 9 & 7 & 9 & 7 \\ 8 & 6 & 8 & 6 \\ -9 & -7 & 9 & 7 \\ -8 & -6 & 8 & 6 \end{vmatrix} \cdot 2.5 \begin{vmatrix} 6 & 8 & -9 & 12 \\ 4 & 6 & -6 & -9 \\ -3 & -4 & 6 & 8 \\ -2 & -3 & 4 & 6 \end{vmatrix} \cdot 2.6 \begin{vmatrix} 2 & -5 & 1 & 2 \\ -3 & 7 & -1 & 4 \\ 5 & -9 & 2 & 7 \\ 4 & -6 & 1 & 2 \end{vmatrix}.$$

$$\begin{array}{l} \mathbf{2.7} \begin{vmatrix} -3 & 9 & 3 & 6 \\ -5 & 8 & 2 & 7 \\ 4 & -5 & -3 & -2 \\ 7 & -8 & -4 & -5 \end{vmatrix} \cdot \mathbf{2.8} \begin{vmatrix} 2 & -5 & 4 & 3 \\ 3 & -4 & 7 & 5 \\ 4 & -9 & 8 & 5 \\ -3 & 2 & -5 & 3 \end{vmatrix} \cdot \mathbf{2.9} \begin{vmatrix} 3 & -5 & 2 & -4 \\ -3 & 4 & -5 & 3 \\ -5 & 7 & -7 & 5 \\ 8 & -8 & 5 & -6 \end{vmatrix} \cdot \end{array}$$

$$\begin{array}{l} \mathbf{2.10} \begin{vmatrix} 7 & 6 & 3 & 7 \\ 3 & 5 & 7 & 2 \\ 5 & 4 & 3 & 5 \\ 5 & 6 & 5 & 4 \end{vmatrix} \cdot \mathbf{2.11} \begin{vmatrix} 1 & 6 & 5 & -1 \\ 2 & 8 & 6 & -2 \\ 3 & 16 & 7 & 2 \\ 4 & 9 & 3 & -3 \end{vmatrix} \cdot \mathbf{2.12} \begin{vmatrix} 3 & -4 & -3 & 6 \\ 2 & -1 & 1 & 3 \\ -1 & -3 & -2 & 4 \\ 1 & 2 & -1 & 2 \end{vmatrix} \cdot \end{array}$$

$$\begin{array}{l} \mathbf{2.13} \begin{vmatrix} 10 & 6 & -5 & 6 \\ 8 & 8 & -9 & 5 \\ 9 & 5 & -8 & 5 \\ 7 & 7 & -11 & 4 \end{vmatrix} \cdot \mathbf{2.14} \begin{vmatrix} -8 & -6 & 8 & 6 \\ 8 & 6 & 8 & 6 \\ -9 & -7 & 9 & 7 \\ 9 & 7 & 9 & 7 \end{vmatrix} \cdot \mathbf{2.15} \begin{vmatrix} 8 & 6 & -9 & 12 \\ 6 & 4 & -6 & -9 \\ -4 & -3 & 6 & 8 \\ -3 & -2 & 4 & 6 \end{vmatrix} \cdot \end{array}$$

$$\begin{array}{l} \mathbf{2.16} \begin{vmatrix} 2 & -5 & 1 & 2 \\ 4 & 7 & -1 & -3 \\ 7 & -9 & 2 & 5 \\ 2 & -6 & 1 & 4 \end{vmatrix} \cdot \mathbf{2.17} \begin{vmatrix} 6 & 9 & 3 & -3 \\ 7 & 8 & 2 & -5 \\ -2 & -5 & -3 & 4 \\ -5 & -8 & -4 & 7 \end{vmatrix} \cdot \mathbf{2.18} \begin{vmatrix} 4 & -5 & 2 & 3 \\ 7 & -4 & 3 & 5 \\ 8 & -9 & 4 & 5 \\ -5 & 2 & -3 & 3 \end{vmatrix} \cdot \end{array}$$

$$\begin{array}{l} \mathbf{2.19} \begin{vmatrix} -5 & 3 & 2 & -4 \\ 4 & -3 & -5 & 3 \\ 7 & -5 & -7 & 5 \\ -8 & 8 & 5 & -6 \end{vmatrix} \cdot \mathbf{2.20} \begin{vmatrix} 7 & 6 & 3 & 7 \\ 2 & 5 & 7 & 3 \\ 5 & 4 & 3 & 5 \\ 4 & 6 & 5 & 5 \end{vmatrix} \cdot \mathbf{2.21} \begin{vmatrix} 4 & 9 & 3 & -3 \\ 2 & 8 & 6 & -2 \\ 3 & 16 & 7 & 2 \\ 1 & 6 & 5 & -1 \end{vmatrix} \cdot \end{array}$$

$$\begin{array}{l} \mathbf{2.22} \begin{vmatrix} 6 & -4 & -3 & 3 \\ 3 & -1 & 1 & 2 \\ 4 & -3 & -2 & -1 \\ 2 & 2 & -1 & 1 \end{vmatrix} \cdot \mathbf{2.23} \begin{vmatrix} 7 & 7 & -11 & 4 \\ 8 & 8 & -9 & 5 \\ 9 & 5 & -8 & 5 \\ 10 & 6 & -5 & 6 \end{vmatrix} \cdot \mathbf{2.24} \begin{vmatrix} 6 & -6 & 8 & -8 \\ 6 & 6 & 8 & 8 \\ 7 & -7 & 9 & -9 \\ 7 & 7 & 9 & 9 \end{vmatrix} \cdot \end{array}$$

$$\begin{array}{l} \mathbf{2.25} \begin{vmatrix} -3 & -2 & 4 & 6 \\ 6 & 4 & -6 & -9 \\ -4 & -3 & 6 & 8 \\ 8 & 6 & -9 & 12 \end{vmatrix} \cdot \mathbf{2.26} \begin{vmatrix} 7 & -9 & 2 & 5 \\ 4 & 7 & -1 & -3 \\ 2 & -5 & 1 & 2 \\ 2 & -6 & 1 & 4 \end{vmatrix} \cdot \mathbf{2.27} \begin{vmatrix} -5 & -8 & -4 & 7 \\ 7 & 8 & 2 & -5 \\ -2 & -5 & -3 & 4 \\ 6 & 9 & 3 & -3 \end{vmatrix} \cdot \end{array}$$

$$\begin{array}{l} \mathbf{2.28} \begin{vmatrix} 8 & -9 & 4 & 5 \\ 7 & -4 & 3 & 5 \\ 4 & -5 & 2 & 3 \\ -5 & 2 & -3 & 3 \end{vmatrix} \cdot \mathbf{2.29} \begin{vmatrix} 7 & -5 & -7 & 5 \\ 4 & -3 & -5 & 3 \\ -5 & 3 & 2 & -4 \\ -8 & 8 & 5 & -6 \end{vmatrix} \cdot \mathbf{2.30} \begin{vmatrix} 5 & 4 & 3 & 5 \\ 2 & 5 & 7 & 3 \\ 7 & 6 & 3 & 7 \\ 4 & 6 & 5 & 5 \end{vmatrix} \cdot \end{array}$$

3. Даны матрицы A, B . Найдите матрицы C, D .

$$3.1. A = \begin{pmatrix} -4 & 5 & 1 \\ 2 & -3 & 8 \end{pmatrix}, \quad B = \begin{pmatrix} -7 & 4 \\ 10 & -5 \\ 3 & 16 \end{pmatrix}, \quad C = B - 2A^T, \quad D = A \cdot B$$

$$3.2. A = \begin{pmatrix} 4 & 1 & 3 \\ 0 & -1 & 2 \\ 2 & 1 & -1 \end{pmatrix}, \quad B = \begin{pmatrix} 1 & -1 & 3 \\ 2 & 1 & 0 \\ 1 & 1 & -1 \end{pmatrix}, \quad C = (3A)^T - B, \quad D = A \cdot B$$

$$3.3. A = \begin{pmatrix} 5 & -2 \\ 4 & 3 \\ 0 & 2 \end{pmatrix}, \quad B = \begin{pmatrix} -4 & -1 & 5 \\ 2 & 3 & -1 \end{pmatrix}, \quad C = A + B^T, \quad D = A \cdot B$$

$$3.4. A = \begin{pmatrix} 2 & 3 & 5 \\ -1 & 2 & -4 \end{pmatrix}, \quad B = \begin{pmatrix} 1 & -2 & -1 \\ 4 & 3 & 2 \end{pmatrix}, \quad C = 2A + 3B, \quad D = A \cdot (B^T)$$

$$3.5. A = \begin{pmatrix} 3 & 0 \\ -2 & 1 \\ 1 & 3 \end{pmatrix}, \quad B = \begin{pmatrix} 4 & 1 \\ -3 & 1 \\ 2 & 1 \end{pmatrix}, \quad C = A^T - B^T, \quad D = A^T \cdot B$$

$$3.6. A = \begin{pmatrix} 2 & -4 \\ 3 & 7 \\ 6 & -1 \end{pmatrix}, \quad B = \begin{pmatrix} 4 & 0 & 1 \\ 6 & 1 & -3 \end{pmatrix}, \quad C = 2A - B^T, \quad D = A \cdot B$$

$$3.7. A = \begin{pmatrix} 3 & 1 & 0 \\ -2 & -1 & 4 \\ 7 & 2 & 1 \end{pmatrix}, \quad B = \begin{pmatrix} 0 & -1 & 3 \\ 2 & -1 & 4 \\ 4 & 6 & 2 \end{pmatrix}, \quad C = (2B)^T + A, \quad D = A \cdot B$$

$$3.8. A = \begin{pmatrix} 3 & -4 & 2 \\ 7 & 5 & 1 \end{pmatrix}, \quad B = \begin{pmatrix} -2 & 4 \\ 6 & 6 \\ -3 & 1 \end{pmatrix}, \quad C = A - B^T, \quad D = A \cdot B$$

$$3.9. A = \begin{pmatrix} 7 & -4 \\ 0 & -3 \\ 1 & 2 \end{pmatrix}, \quad B = \begin{pmatrix} -1 & 4 \\ -1 & 2 \\ 6 & 3 \end{pmatrix}, \quad C = 3B - 2A, \quad D = A^T \cdot B$$

$$3.10. A = \begin{pmatrix} 6 & 1 & -3 \\ 2 & -1 & 0 \end{pmatrix}, \quad B = \begin{pmatrix} 7 & 3 & 1 \\ -5 & 1 & 4 \end{pmatrix}, \quad C = A^T + B^T, \quad D = A \cdot (B^T)$$

$$3.11. A = \begin{pmatrix} -2 & 1 & -5 \\ 4 & 3 & -2 \end{pmatrix}, \quad B = \begin{pmatrix} 5 & 1 \\ 3 & 0 \\ -4 & -2 \end{pmatrix}, \quad C = 2B - A^T, \quad D = A \cdot B$$

$$3.12. A = \begin{pmatrix} -4 & 2 & -1 \\ -1 & 0 & -2 \\ 3 & 1 & 0 \end{pmatrix}, \quad B = \begin{pmatrix} 0 & -2 & 1 \\ 5 & 1 & 3 \\ 2 & 0 & -1 \end{pmatrix}, \quad C = (2A)^T - B, \quad D = A \cdot B$$

$$3.13. A = \begin{pmatrix} -4 & 3 \\ 2 & 1 \\ 0 & 1 \end{pmatrix}, \quad B = \begin{pmatrix} -7 & 1 & -2 \\ 1 & 3 & 2 \end{pmatrix}, \quad C = 3A + B^T, \quad D = A \cdot B$$

$$3.14. A = \begin{pmatrix} -2 & 3 & 4 \\ -1 & 2 & -5 \end{pmatrix}, \quad B = \begin{pmatrix} 7 & 1 & 0 \\ -3 & 2 & 1 \end{pmatrix}, \quad C = 2A - 3B, \quad D = A \cdot (B^T)$$

$$3.15. A = \begin{pmatrix} -2 & 1 \\ 5 & -7 \\ 4 & 3 \end{pmatrix}, \quad B = \begin{pmatrix} 7 & 1 \\ -2 & -1 \\ 3 & 0 \end{pmatrix}, \quad C = 2(A^T) - B^T, \quad D = A^T \cdot B$$

$$3.16. A = \begin{pmatrix} 4 & -3 & 2 \\ 1 & 0 & 3 \\ 9 & 7 & -3 \end{pmatrix}, \quad B = \begin{pmatrix} 6 & 1 & -2 \\ 4 & 3 & 2 \\ -8 & -3 & 2 \end{pmatrix}, \quad C = A + B^T, \quad D = A \cdot B$$

$$3.17. A = \begin{pmatrix} 3 & -1 \\ 6 & 8 \\ -2 & 3 \end{pmatrix}, \quad B = \begin{pmatrix} -2 & 1 & 0 \\ -7 & 1 & -2 \end{pmatrix}, \quad C = A - 2(B^T), \quad D = A \cdot B$$

$$3.18. A = \begin{pmatrix} 4 & 1 & -3 \\ 2 & 0 & 5 \\ 0 & -4 & 3 \end{pmatrix}, \quad B = \begin{pmatrix} -7 & 8 & 1 \\ 0 & 3 & 0 \\ -2 & 1 & 1 \end{pmatrix}, \quad C = 3A - B, \quad D = A \cdot B$$

$$3.19. A = \begin{pmatrix} -2 & 1 & 4 \\ -3 & 7 & 2 \end{pmatrix}, \quad B = \begin{pmatrix} 6 & 1 \\ -3 & 2 \\ 0 & -3 \end{pmatrix}, \quad C = 2A + B^T, \quad D = A \cdot B$$

$$3.20. A = \begin{pmatrix} 9 & -11 \\ 7 & -3 \\ 0 & -2 \end{pmatrix}, \quad B = \begin{pmatrix} 6 & -2 \\ 1 & -3 \\ 8 & -1 \end{pmatrix}, \quad C = A - 3B, \quad D = A^T \cdot B$$

$$3.21. A = \begin{pmatrix} -3 & 2 & 1 \\ -4 & 3 & 1 \end{pmatrix}, \quad B = \begin{pmatrix} 9 & -8 & 7 \\ -6 & 5 & -4 \end{pmatrix}, \quad C = A^T + 2(B^T), \quad D = A \cdot (B^T)$$

$$3.22. A = \begin{pmatrix} 3 & 4 & -2 \\ 1 & 0 & -3 \\ -7 & 5 & 1 \end{pmatrix}, \quad B = \begin{pmatrix} 6 & 1 & 2 \\ -3 & 1 & 4 \\ 2 & -1 & 3 \end{pmatrix}, \quad C = A - B, \quad D = A \cdot B$$

$$3.23. A = \begin{pmatrix} -4 & 0 & 5 \\ -6 & -2 & 1 \end{pmatrix}, \quad B = \begin{pmatrix} 6 & -1 \\ 3 & 2 \\ 4 & -3 \end{pmatrix}, \quad C = 3B - A^T, \quad D = A \cdot B$$

$$3.24. A = \begin{pmatrix} 7 & -3 & 1 \\ 0 & 2 & 1 \\ -4 & 5 & -3 \end{pmatrix}, \quad B = \begin{pmatrix} 6 & 1 & 3 \\ 4 & -2 & 1 \\ 0 & 1 & 2 \end{pmatrix}, \quad C = A + (2B)^T, \quad D = A \cdot B$$

$$3.25. A = \begin{pmatrix} -6 & 1 \\ 0 & -2 \\ 1 & 3 \end{pmatrix}, \quad B = \begin{pmatrix} 6 & 1 & -3 \\ -2 & 0 & 1 \end{pmatrix}, \quad C = 4A + B^T, \quad D = A \cdot B$$

$$3.26. A = \begin{pmatrix} -2 & 3 & 0 \\ -4 & -2 & -1 \end{pmatrix}, \quad B = \begin{pmatrix} 7 & -3 & 1 \\ -1 & 2 & 3 \end{pmatrix}, \quad C = 3A + 2B, \quad D = A \cdot (B^T)$$

$$3.27. A = \begin{pmatrix} -3 & 1 \\ 5 & -7 \\ 3 & -4 \end{pmatrix}, \quad B = \begin{pmatrix} 3 & 7 \\ -1 & -2 \\ 4 & 0 \end{pmatrix}, \quad C = A^T - 2(B^T), \quad D = A^T \cdot B$$

$$3.28. A = \begin{pmatrix} 3 & -4 & 0 \\ -2 & 0 & 1 \\ 6 & 7 & -5 \end{pmatrix}, \quad B = \begin{pmatrix} 1 & 2 & 3 \\ -1 & -2 & -3 \\ 3 & 1 & 0 \end{pmatrix}, \quad C = A^T + B, \quad D = A \cdot B$$

$$3.29. A = \begin{pmatrix} -3 & 6 \\ 7 & 1 \\ -2 & 3 \end{pmatrix}, \quad B = \begin{pmatrix} -2 & 1 & 4 \\ -3 & 2 & 1 \end{pmatrix}, \quad C = A^T - 3B, \quad D = A \cdot B$$

$$3.30. A = \begin{pmatrix} -4 & 0 & 2 \\ -6 & 1 & 0 \\ 0 & -3 & 1 \end{pmatrix}, \quad B = \begin{pmatrix} 6 & 1 & 3 \\ -2 & 1 & 0 \\ 1 & -4 & 2 \end{pmatrix}, \quad C = 2A + B, \quad D = A \cdot B$$

4. Вычислить ранг матрицы A.

$$4.1 \begin{pmatrix} 1 & 1 & 1 & 1 \\ 1 & 2 & 1 & 2 \\ 3 & 1 & 3 & 1 \\ 0 & 1 & 1 & 0 \end{pmatrix}.$$

$$4.2 \begin{pmatrix} 1 & 3 & 5 & -1 \\ 2 & -1 & -3 & 4 \\ 5 & 1 & -1 & 7 \\ 7 & 7 & 9 & 1 \end{pmatrix}.$$

$$4.3 \begin{pmatrix} 1 & 3 & 5 & 1 \\ 2 & 1 & 3 & 4 \\ 5 & 1 & 1 & 7 \\ 7 & 7 & 9 & 1 \end{pmatrix}.$$

$$4.4 \begin{pmatrix} 2 & 1 & 4 & 5 \\ 1 & 0 & 1 & 2 \\ 1 & 2 & 4 & 0 \end{pmatrix}.$$

$$4.5 \begin{pmatrix} 2 & -1 & 3 & -2 & 4 \\ 4 & -2 & 5 & 1 & 7 \\ 2 & -1 & 1 & 8 & 2 \end{pmatrix}.$$

$$4.6 \begin{pmatrix} 1 & 3 & -1 & 2 \\ 2 & -1 & 3 & 5 \\ 1 & 10 & -6 & 1 \end{pmatrix}.$$

$$4.7 \begin{pmatrix} 1 & -3 & -5 & 0 & -7 \\ 3 & -1 & 3 & 2 & 5 \\ 5 & -3 & 2 & 3 & 4 \\ 7 & -5 & 1 & 4 & 1 \end{pmatrix}.$$

$$4.8 \begin{pmatrix} 1 & 1 & -1 & 2 \\ 2 & -1 & 1 & 5 \\ 1 & 10 & -6 & 1 \end{pmatrix}.$$

$$4.9 \begin{pmatrix} 1 & 1 & 0 & 3 \\ 0 & -3 & 3 & -3 \\ -2 & 2 & -4 & -2 \end{pmatrix}.$$

$$4.10 \begin{pmatrix} 1 & 2 & 3 & 4 & 5 \\ 2 & 3 & 1 & -1 & -1 \\ 1 & 3 & 8 & 13 & 16 \\ -1 & 0 & 7 & 14 & 17 \end{pmatrix}, \quad 4.11 \begin{pmatrix} 2 & 1 & 3 & -2 & 4 \\ 4 & 2 & 5 & 2 & 7 \\ 2 & 1 & 1 & 8 & 2 \end{pmatrix}, \quad 4.12 \begin{pmatrix} 3 & 2 & -1 & -3 \\ 2 & -1 & 3 & 0 \\ 4 & 5 & -5 & -6 \end{pmatrix}.$$

$$4.13 \begin{pmatrix} 4 & 3 & -5 & 2 & 3 \\ 8 & 6 & -7 & 4 & 2 \\ 4 & 3 & -8 & 2 & 7 \\ 4 & 3 & 1 & 2 & -5 \end{pmatrix}, \quad 4.14 \begin{pmatrix} 1 & 7 & 17 & 3 \\ 0 & 4 & 10 & 1 \\ 3 & 1 & 1 & 4 \\ 2 & 2 & 4 & 3 \end{pmatrix}, \quad 4.15 \begin{pmatrix} 2 & 2 & 4 & 3 \\ 2 & 4 & 10 & 1 \\ 3 & 1 & 1 & 4 \\ 1 & 7 & 17 & 3 \end{pmatrix}.$$

$$4.16 \begin{pmatrix} 2 & -4 & 3 & -3 & 5 \\ 1 & -2 & 1 & 5 & 3 \\ 1 & -2 & 4 & -34 & 0 \end{pmatrix}, \quad 4.17 \begin{pmatrix} 1 & 2 & 3 & -1 \\ 2 & 3 & 1 & -1 \\ 3 & 1 & 4 & 2 \\ 1 & -4 & -7 & 5 \end{pmatrix}, \quad 4.18 \begin{pmatrix} 1 & 2 & -1 & 1 \\ 5 & 1 & 2 & 1 \\ 4 & -1 & 3 & 0 \\ 3 & -3 & 4 & -1 \end{pmatrix}.$$

$$4.19 \begin{pmatrix} 1 & 5 & -2 & 3 & 4 \\ 2 & -1 & 1 & 2 & 3 \\ 3 & 4 & -1 & 5 & -2 \\ 3 & -7 & 4 & 1 & -7 \end{pmatrix}, \quad 4.20 \begin{pmatrix} 1 & 2 & 3 & -2 \\ 2 & -3 & 1 & -4 \\ 1 & 9 & 8 & -2 \\ -1 & 12 & 7 & 2 \end{pmatrix}, \quad 4.21 \begin{pmatrix} 1 & 1 & 1 & -1 \\ 4 & 3 & -1 & 1 \\ 2 & 1 & -3 & 3 \\ 6 & 5 & 1 & -1 \end{pmatrix}.$$

$$4.22 \begin{pmatrix} 1 & 3 & 1 & -3 \\ 2 & 1 & 1 & 1 \\ 1 & 12 & 2 & -16 \end{pmatrix}, \quad 4.23 \begin{pmatrix} 1 & 1 & 1 & 1 \\ 1 & 2 & 1 & 1 \\ 1 & 1 & 3 & 1 \\ 1 & 2 & -1 & 1 \end{pmatrix}, \quad 4.24 \begin{pmatrix} 1 & 0 & 4 & -1 \\ 2 & 1 & 11 & 2 \\ 2 & -1 & 5 & -6 \end{pmatrix}.$$

$$4.25 \begin{pmatrix} 1 & 2 & 3 & 1 & -1 \\ 2 & 1 & 1 & 0 & -2 \\ 1 & 1 & -1 & 1 & 1 \\ 1 & -3 & 10 & -1 & 3 \end{pmatrix}, \quad 4.26 \begin{pmatrix} 1 & 3 & 0 & -1 \\ 2 & 1 & -3 & -1 \\ 3 & 2 & -4 & 3 \\ 0 & 3 & 2 & 4 \end{pmatrix}, \quad 4.27 \begin{pmatrix} 1 & 3 & 5 & 6 \\ 1 & 3 & 1 & 1 \\ 1 & 3 & 13 & 16 \\ 1 & 3 & 9 & 11 \end{pmatrix}.$$

$$4.28 \begin{pmatrix} 1 & 7 & 17 & -1 \\ 0 & 4 & 10 & 1 \\ 4 & 8 & 18 & 7 \end{pmatrix}, \quad 4.29 \begin{pmatrix} -1 & 5 & 4 & 2 \\ 2 & 1 & 0 & -3 \\ 6 & 1 & -1 & 4 \\ 0 & 3 & 4 & -2 \end{pmatrix}, \quad 4.30 \begin{pmatrix} 1 & 0 & 3 & 4 \\ 3 & 2 & 1 & 5 \\ 7 & -3 & 6 & 8 \\ 4 & 9 & 3 & 15 \end{pmatrix}.$$

5. Дана матрица A . Найти: $|A|$, A^{-1} , $A \cdot A^{-1}$.

$$5.1. A = \begin{pmatrix} -2 & 3 & 1 \\ 3 & 6 & 2 \\ 1 & 2 & 1 \end{pmatrix}, \quad 5.2. A = \begin{pmatrix} 2 & 2 & -1 \\ 2 & -1 & 2 \\ -1 & 2 & 2 \end{pmatrix}, \quad 5.3. A = \begin{pmatrix} 1 & -3 & -1 \\ -2 & 7 & 2 \\ 3 & 2 & -4 \end{pmatrix}.$$

$$\begin{array}{lll}
5.4. A = \begin{pmatrix} 2 & 1 & -1 \\ 3 & 1 & -2 \\ 1 & 0 & 1 \end{pmatrix}. & 5.5. A = \begin{pmatrix} 2 & 2 & 3 \\ 1 & -1 & 0 \\ -1 & 2 & 1 \end{pmatrix}. & 5.6. A = \begin{pmatrix} 1 & 2 & -3 \\ 0 & 1 & 2 \\ 1 & 0 & 4 \end{pmatrix}. \\
5.7. A = \begin{pmatrix} 4 & -8 & -5 \\ -4 & 7 & -1 \\ -3 & 5 & 1 \end{pmatrix}. & 5.8. A = \begin{pmatrix} 1 & 2 & 1 \\ 4 & 3 & -2 \\ -5 & -4 & -1 \end{pmatrix}. & 5.9. A = \begin{pmatrix} 1 & 1 & 1 \\ 2 & -3 & 1 \\ 4 & 1 & -5 \end{pmatrix}. \\
5.10. A = \begin{pmatrix} 2 & -1 & 0 \\ 5 & 3 & -6 \\ -1 & -2 & 3 \end{pmatrix}. & 5.11. A = \begin{pmatrix} 1 & 2 & 2 \\ 2 & 1 & -2 \\ 2 & -2 & 1 \end{pmatrix}. & 5.12. A = \begin{pmatrix} 2 & 1 & 1 \\ 0 & 2 & 1 \\ 3 & 1 & 2 \end{pmatrix}. \\
5.13. A = \begin{pmatrix} 1 & 2 & 0 \\ 4 & 5 & 1 \\ 3 & 1 & 1 \end{pmatrix}. & 5.14. A = \begin{pmatrix} 3 & -4 & 5 \\ 2 & -3 & 1 \\ 3 & -5 & -1 \end{pmatrix}. & 5.15. A = \begin{pmatrix} 4 & -8 & -5 \\ -4 & 7 & -1 \\ -3 & 5 & 1 \end{pmatrix}. \\
5.16. A = \begin{pmatrix} 2 & 7 & 3 \\ 3 & 9 & 4 \\ 1 & 5 & 3 \end{pmatrix}. & 5.17. A = \begin{pmatrix} 1 & 2 & 3 \\ 2 & 3 & 4 \\ 1 & 4 & 3 \end{pmatrix}. & 5.18. A = \begin{pmatrix} 3 & 2 & 1 \\ 1 & -2 & 1 \\ 2 & 2 & 3 \end{pmatrix}. \\
5.19. A = \begin{pmatrix} 1 & -2 & 3 \\ -3 & 7 & 2 \\ -1 & 2 & -4 \end{pmatrix}. & 5.20. A = \begin{pmatrix} 1 & 0 & 1 \\ 2 & 1 & 0 \\ -3 & 2 & 4 \end{pmatrix}. & 5.21. A = \begin{pmatrix} 1 & 0 & 1 \\ 3 & 1 & -2 \\ 2 & 1 & -1 \end{pmatrix}. \\
5.22. A = \begin{pmatrix} 5 & 3 & -6 \\ 2 & -1 & 0 \\ -1 & -2 & 3 \end{pmatrix}. & 5.23. A = \begin{pmatrix} 2 & 1 & -1 \\ 2 & -1 & 2 \\ 3 & 0 & 1 \end{pmatrix}. & 5.24. A = \begin{pmatrix} -4 & 4 & 3 \\ -8 & 7 & 5 \\ 5 & 1 & -1 \end{pmatrix}. \\
5.25. A = \begin{pmatrix} 2 & 1 & 3 \\ 1 & 0 & 1 \\ 1 & 2 & 2 \end{pmatrix}. & 5.26. A = \begin{pmatrix} 4 & 5 & 1 \\ 1 & 2 & 0 \\ 3 & 1 & 1 \end{pmatrix}. & 5.27. A = \begin{pmatrix} 2 & 3 & 1 \\ 7 & 9 & 5 \\ 3 & 4 & 3 \end{pmatrix}. \\
5.28. A = \begin{pmatrix} 1 & 2 & 1 \\ 2 & 3 & 4 \\ 3 & 4 & 3 \end{pmatrix}. & 5.29. A = \begin{pmatrix} 3 & 1 & 2 \\ 2 & -2 & 2 \\ 1 & 1 & 3 \end{pmatrix}. & 5.30. A = \begin{pmatrix} 3 & 2 & 3 \\ 4 & 3 & 5 \\ -5 & -1 & 1 \end{pmatrix}.
\end{array}$$

6. Решить матричное уравнение.

$$\begin{array}{ll}
6.1. \begin{pmatrix} 1 & 3 \\ 0 & 2 \end{pmatrix} \cdot X = \begin{pmatrix} 2 & 11 \\ 2 & 6 \end{pmatrix}. & 6.2. X \cdot \begin{pmatrix} 5 & 4 \\ 3 & 2 \end{pmatrix} = \begin{pmatrix} 8 & 6 \\ -1 & -2 \end{pmatrix}. \\
6.3. \begin{pmatrix} 3 & -2 \\ 5 & -4 \end{pmatrix} \cdot X = \begin{pmatrix} -1 & 2 \\ -5 & 6 \end{pmatrix}. & 6.4. X \cdot \begin{pmatrix} 2 & 1 \\ 4 & 3 \end{pmatrix} = \begin{pmatrix} 2 & 5 \\ 6 & 9 \end{pmatrix}. \\
6.5. \begin{pmatrix} 3 & 2 \\ -2 & -1 \end{pmatrix} \cdot X = \begin{pmatrix} -1 & 2 \\ -1 & 1 \end{pmatrix}. & 6.6. X \cdot \begin{pmatrix} 1 & -3 \\ -1 & 2 \end{pmatrix} = \begin{pmatrix} 7 & -4 \\ -6 & 2 \end{pmatrix}.
\end{array}$$

$$6.7. \begin{pmatrix} -3 & 1 \\ 2 & -1 \end{pmatrix} \cdot X = \begin{pmatrix} -8 & -5 \\ 5 & 3 \end{pmatrix}.$$

$$6.9. \begin{pmatrix} 3 & -2 \\ -1 & 1 \end{pmatrix} \cdot X = \begin{pmatrix} 4 & -5 \\ -2 & 3 \end{pmatrix}.$$

$$6.11. \begin{pmatrix} 2 & 3 \\ 1 & -3 \end{pmatrix} \cdot X = \begin{pmatrix} 0 & 9 \\ 3 & 0 \end{pmatrix}.$$

$$6.13. \begin{pmatrix} -1 & 0 \\ 2 & 3 \end{pmatrix} \cdot X = \begin{pmatrix} -3 & 2 \\ 3 & -1 \end{pmatrix}.$$

$$6.15. \begin{pmatrix} 5 & 4 \\ 3 & 2 \end{pmatrix} \cdot X = \begin{pmatrix} 8 & 6 \\ -1 & -2 \end{pmatrix}.$$

$$6.17. \begin{pmatrix} 2 & 1 \\ 4 & 3 \end{pmatrix} \cdot X = \begin{pmatrix} 2 & 5 \\ 6 & 9 \end{pmatrix}.$$

$$6.19. \begin{pmatrix} 1 & -3 \\ -1 & 2 \end{pmatrix} \cdot X = \begin{pmatrix} 7 & -4 \\ -6 & 2 \end{pmatrix}.$$

$$6.21. \begin{pmatrix} -3 & 2 \\ 2 & -1 \end{pmatrix} \cdot X = \begin{pmatrix} 3 & -9 \\ -2 & 5 \end{pmatrix}.$$

$$6.23. \begin{pmatrix} 1 & -2 \\ 1 & 3 \end{pmatrix} \cdot X = \begin{pmatrix} -1 & -8 \\ 4 & 7 \end{pmatrix}.$$

$$6.25. \begin{pmatrix} 5 & 1 \\ 3 & 1 \end{pmatrix} \cdot X = \begin{pmatrix} 7 & 1 \\ -2 & 0 \end{pmatrix}.$$

$$6.27. \begin{pmatrix} -2 & 4 \\ -3 & 5 \end{pmatrix} \cdot X = \begin{pmatrix} -3 & 7 \\ 6 & -10 \end{pmatrix}.$$

$$6.29. \begin{pmatrix} 5 & -1 \\ -1 & 1 \end{pmatrix} \cdot X = \begin{pmatrix} 6 & 3 \\ -2 & 1 \end{pmatrix}.$$

$$6.8. X \cdot \begin{pmatrix} -3 & 2 \\ 2 & -1 \end{pmatrix} = \begin{pmatrix} 3 & -9 \\ -2 & 5 \end{pmatrix}.$$

$$6.10. X \cdot \begin{pmatrix} 1 & -2 \\ 1 & 3 \end{pmatrix} = \begin{pmatrix} -1 & -8 \\ 4 & 7 \end{pmatrix}.$$

$$6.12. X \cdot \begin{pmatrix} -2 & 4 \\ -3 & 5 \end{pmatrix} = \begin{pmatrix} -3 & 7 \\ 6 & -10 \end{pmatrix}.$$

$$6.14. X \cdot \begin{pmatrix} 5 & -1 \\ -1 & 1 \end{pmatrix} = \begin{pmatrix} 6 & 3 \\ -2 & 1 \end{pmatrix}.$$

$$6.16. X \cdot \begin{pmatrix} 1 & 3 \\ 0 & 2 \end{pmatrix} = \begin{pmatrix} 2 & 11 \\ 2 & 6 \end{pmatrix}.$$

$$6.18. X \cdot \begin{pmatrix} 3 & -2 \\ 5 & -4 \end{pmatrix} = \begin{pmatrix} -1 & 2 \\ -5 & 6 \end{pmatrix}.$$

$$6.20. X \cdot \begin{pmatrix} 3 & 2 \\ -2 & -1 \end{pmatrix} = \begin{pmatrix} -1 & 2 \\ -1 & 1 \end{pmatrix}.$$

$$6.22. X \cdot \begin{pmatrix} -3 & 1 \\ 2 & -1 \end{pmatrix} = \begin{pmatrix} -8 & -5 \\ 5 & 3 \end{pmatrix}.$$

$$6.24. X \cdot \begin{pmatrix} 3 & -2 \\ -1 & 1 \end{pmatrix} = \begin{pmatrix} 4 & -5 \\ -2 & 3 \end{pmatrix}.$$

$$6.26. X \cdot \begin{pmatrix} 2 & 3 \\ 1 & -3 \end{pmatrix} = \begin{pmatrix} 0 & 9 \\ 3 & 0 \end{pmatrix}.$$

$$6.28. X \cdot \begin{pmatrix} 5 & 1 \\ 3 & 1 \end{pmatrix} = \begin{pmatrix} 7 & 1 \\ -2 & 0 \end{pmatrix}.$$

$$6.30. X \cdot \begin{pmatrix} -1 & 0 \\ 2 & 3 \end{pmatrix} = \begin{pmatrix} -3 & 2 \\ 3 & -1 \end{pmatrix}.$$

7. Решить систему линейных алгебраических уравнений тремя способами:

а) методом Крамера;

б) методом обратной матрицы;

в) методом Гаусса.

$$7.1 \begin{cases} 2x_1 - x_2 - x_3 = 4 \\ 3x_1 + 4x_2 - 2x_3 = 11 \\ 3x_1 - 2x_2 + 4x_3 = 11 \end{cases}$$

$$7.2 \begin{cases} x_1 + x_2 + 2x_3 = -1 \\ 2x_1 - x_2 + 2x_3 = -4 \\ 4x_1 + x_2 + 4x_3 = -2 \end{cases}$$

$$7.3 \begin{cases} 3x_1 + 2x_2 + x_3 = 5 \\ 2x_1 + 3x_2 + x_3 = 1 \\ 2x_1 + x_2 + 3x_3 = 11 \end{cases}$$

$$7.4 \begin{cases} x_1 + x_2 + 2x_3 = 2 \\ 3x_1 + 2x_2 + x_3 = 2 \\ -x_1 - x_2 + 4x_3 = 4 \end{cases}$$

$$7.5 \begin{cases} x_1 + 5x_2 - 4x_3 = -5 \\ 2x_1 - 3x_2 + x_3 = 2 \\ 4x_1 + x_2 - 3x_3 = -4 \end{cases}$$

$$7.6 \begin{cases} x_1 - 2x_2 + 4x_3 = 3 \\ 2x_1 - 4x_2 + 3x_3 = 1 \\ 3x_1 - x_2 + 5x_3 = 2 \end{cases}$$

$$\begin{array}{lll}
7.7 \left\{ \begin{array}{l} 2x_1 - x_2 + x_3 = 2 \\ 3x_1 + 2x_2 + 2x_3 = -2 \\ x_1 - 2x_2 + x_3 = 1 \end{array} \right. & 7.8 \left\{ \begin{array}{l} x_1 + 3x_2 + 4x_3 = 6 \\ 2x_1 - x_2 - x_3 = 1 \\ x_1 + 2x_2 + 3x_3 = 5 \end{array} \right. & 7.9 \left\{ \begin{array}{l} x_1 + x_2 + x_3 = 3 \\ 2x_1 + 3x_2 - x_3 = 0 \\ x_1 - x_2 + 3x_3 = 7 \end{array} \right. \\
7.10 \left\{ \begin{array}{l} 2x_1 - 4x_2 + 9x_3 = 28 \\ 7x_1 + 3x_2 - 6x_3 = -1 \\ 7x_1 + 9x_2 - 9x_3 = 5 \end{array} \right. & 7.11 \left\{ \begin{array}{l} x_1 + x_2 + x_3 = 3 \\ 2x_1 + x_2 - 2x_3 = 1 \\ x_1 + x_2 - 3x_3 = -1 \end{array} \right. & 7.12 \left\{ \begin{array}{l} 2x_1 + 2x_2 + 2x_3 = 6 \\ x_1 + 2x_2 + 3x_3 = 1 \\ x_1 + 3x_2 + 6x_3 = 2 \end{array} \right. \\
7.13 \left\{ \begin{array}{l} 2x_1 - 4x_2 + x_3 = 3 \\ x_1 - 5x_2 + 3x_3 = -1 \\ x_1 - x_2 + x_3 = 1 \end{array} \right. & 7.14 \left\{ \begin{array}{l} x_1 - x_2 + x_3 = 6 \\ 2x_1 + x_2 + x_3 = 3 \\ x_1 + x_2 + 2x_3 = 5 \end{array} \right. & 7.15 \left\{ \begin{array}{l} 2x_1 + x_2 + x_3 = 6 \\ x_1 - x_2 + x_3 = 5 \\ x_1 + x_2 + 2x_3 = 4 \end{array} \right. \\
7.16 \left\{ \begin{array}{l} x_1 + x_2 + x_3 = 1 \\ x_1 + 2x_2 + 3x_3 = 2 \\ x_1 + 3x_2 + 6x_3 = 1 \end{array} \right. & 7.17 \left\{ \begin{array}{l} x_1 - 2x_3 = 4 \\ 2x_2 + x_3 = 3 \\ x_1 - x_3 = 6 \end{array} \right. & 7.18 \left\{ \begin{array}{l} 2x_1 - x_2 + x_3 = 4 \\ -x_1 + 3x_2 - 2x_3 = -3 \\ 3x_1 + 2x_2 - x_3 = 3 \end{array} \right. \\
7.19 \left\{ \begin{array}{l} 3x_1 + x_2 - 2x_3 = -2 \\ x_1 + x_2 + x_3 = 0 \\ x_1 - 2x_2 + 3x_3 = -3 \end{array} \right. & 7.20 \left\{ \begin{array}{l} x_1 + 2x_2 - x_3 = 1 \\ -2x_1 - 3x_2 + 2x_3 = 0 \\ x_1 + 5x_2 + x_3 = -5 \end{array} \right. & 7.21 \left\{ \begin{array}{l} 2x_1 - 3x_2 + x_3 = -3 \\ x_1 - 5x_2 - 2x_3 = 6 \\ 2x_1 + x_2 - 3x_3 = 9 \end{array} \right. \\
7.22 \left\{ \begin{array}{l} 3x_1 + x_2 + x_3 = 4 \\ x_1 + 2x_2 + 2x_3 = 3 \\ x_1 + 4x_2 - x_3 = -2 \end{array} \right. & 7.23 \left\{ \begin{array}{l} 4x_1 - x_2 - x_3 = -3 \\ x_1 + 3x_2 + 3x_3 = -4 \\ -x_1 + 2x_2 - x_3 = 5 \end{array} \right. & 7.24 \left\{ \begin{array}{l} 2x_1 - x_2 = 5 \\ 5x_1 + 3x_2 - 6x_3 = -5 \\ -x_1 - 2x_2 + 3x_3 = 7 \end{array} \right. \\
7.25 \left\{ \begin{array}{l} 3x_1 - x_2 + x_3 = 12 \\ x_1 + 2x_2 - x_3 = 12 \\ 2x_1 - x_2 + 3x_3 = 9 \end{array} \right. & 7.26 \left\{ \begin{array}{l} x_1 + 3x_2 - 2x_3 = -4 \\ x_1 - x_2 + 4x_3 = 4 \\ 3x_1 + 2x_2 - x_3 = -9 \end{array} \right. & 7.27 \left\{ \begin{array}{l} 2x_1 + x_2 + x_3 = 6 \\ 2x_2 + x_3 = 13 \\ 3x_1 + x_2 + 2x_3 = 8 \end{array} \right. \\
7.28 \left\{ \begin{array}{l} 2x_1 - x_2 + 3x_3 = 8 \\ x_1 + x_2 - 2x_3 = 5 \\ 3x_1 - 2x_2 + x_3 = 7 \end{array} \right. & 7.29 \left\{ \begin{array}{l} x_1 + 3x_2 - x_3 = 4 \\ -x_1 + 2x_2 + 3x_3 = 12 \\ 2x_1 + x_2 - x_3 = 1 \end{array} \right. & 7.30 \left\{ \begin{array}{l} x_1 - 3x_2 + 2x_3 = -11 \\ 5x_1 - x_2 + x_3 = -17 \\ 2x_1 + x_2 + x_3 = 0 \end{array} \right.
\end{array}$$

8. Найти общее решение СЛАУ методом Гаусса.

$$\begin{array}{ll}
8.1 \left\{ \begin{array}{l} x_1 + 2x_2 - 2x_3 - 3x_4 = 4 \\ 2x_1 + 5x_2 - x_3 - 4x_4 = 9 \\ x_1 + 3x_2 + x_3 - x_4 = 5 \end{array} \right. & 8.2 \left\{ \begin{array}{l} x_1 - 4x_2 + 2x_3 + 3x_5 = 5 \\ 2x_1 - 7x_2 + 4x_3 + x_4 = 9 \\ x_1 - 3x_2 + 2x_3 + x_4 - 3x_5 = 4 \end{array} \right. \\
8.3 \left\{ \begin{array}{l} x_1 + 2x_2 - 3x_3 - 4x_4 = 1 \\ 3x_1 + 7x_2 - 2x_3 - 4x_4 = 4 \\ 2x_1 + 5x_2 + x_3 + 3x_4 = 3 \end{array} \right. & 8.4 \left\{ \begin{array}{l} x_1 - 5x_2 + 3x_3 + 4x_4 = 4 \\ 2x_1 - 9x_2 + 2x_3 + x_5 = 7 \\ x_1 - 4x_2 - x_3 - 4x_4 + x_5 = 3 \end{array} \right. \\
8.5 \left\{ \begin{array}{l} x_1 + 3x_2 - x_3 - 2x_4 = 1 \\ 2x_1 + 7x_2 - 4x_3 - 3x_4 = 3 \\ x_1 + 4x_2 - 3x_3 - x_4 = 2 \end{array} \right. & 8.6 \left\{ \begin{array}{l} x_1 + x_2 + 4x_3 + 2x_5 = 0 \\ 3x_1 + 4x_2 + x_3 + 3x_4 = 1 \\ 2x_1 + 3x_2 - 3x_3 + 3x_4 - 2x_5 = 1 \end{array} \right.
\end{array}$$

$$8.7 \begin{cases} x_1 - 2x_2 + 2x_3 + 3x_4 = 0 \\ 2x_1 - 3x_2 + x_3 + 4x_4 = 1 \\ 3x_1 - 5x_2 + 3x_3 + 7x_4 = 1 \end{cases}$$

$$8.9 \begin{cases} x_1 - 2x_2 + 2x_3 + 3x_4 = 0 \\ 3x_1 - 5x_2 + x_3 + 4x_4 = 1 \\ 2x_1 - 3x_2 - x_3 + x_4 = 1 \end{cases}$$

$$8.11 \begin{cases} x_1 - 3x_2 + x_3 + 2x_4 = 4 \\ 2x_1 - 5x_2 + 4x_3 + 3x_4 = 7 \\ x_1 - 2x_2 + 3x_3 + x_4 = 3 \end{cases}$$

$$8.13 \begin{cases} x_1 + 4x_2 - 2x_3 - 3x_4 = 2 \\ 2x_1 + 9x_2 - x_3 - 4x_4 = 5 \\ x_1 + 5x_2 + x_3 - x_4 = 3 \end{cases}$$

$$8.15 \begin{cases} x_1 - x_2 + 3x_3 + 4x_4 = 0 \\ 2x_1 - x_2 + 2x_3 + x_4 = 1 \\ 4x_1 - 3x_2 + 8x_3 + 9x_4 = 1 \end{cases}$$

$$8.17 \begin{cases} x_1 - 4x_2 + 2x_3 + 3x_4 = 5 \\ 2x_1 - 7x_2 + 4x_3 + x_4 = 9 \\ x_1 - 3x_2 + 2x_3 - 2x_4 = 4 \end{cases}$$

$$8.19 \begin{cases} x_1 - 5x_2 + 3x_3 + 4x_4 = 4 \\ 2x_1 - 9x_2 + 2x_3 + x_4 = 7 \\ x_1 - 4x_2 - x_3 - 3x_4 = 3 \end{cases}$$

$$8.21 \begin{cases} x_1 + x_2 + 4x_3 + 2x_4 = 0 \\ 3x_1 + 4x_2 + x_3 + 3x_4 = 1 \\ 2x_1 + 3x_2 - 3x_3 + x_4 = 1 \end{cases}$$

$$8.23 \begin{cases} x_1 - x_2 + 4x_3 + 3x_4 = 0 \\ 3x_1 - 2x_2 + x_3 + 2x_4 = 1 \\ 2x_1 - x_2 - 3x_3 - x_4 = 1 \end{cases}$$

$$8.25 \begin{cases} x_1 - 3x_2 + 4x_3 + 3x_4 = 2 \\ 3x_1 - 8x_2 + x_3 + 2x_4 = 5 \\ 2x_1 - 5x_2 - 3x_3 - x_4 = 3 \end{cases}$$

$$8.27 \begin{cases} x_1 - x_2 + 3x_3 + 4x_4 = 0 \\ 4x_1 - 3x_2 + x_3 + 2x_4 = 1 \\ 3x_1 - 2x_2 - 2x_3 - 2x_4 = 1 \end{cases}$$

$$8.8 \begin{cases} x_1 - x_2 + 4x_3 + 3x_4 = 0 \\ 3x_1 - 2x_2 + x_3 + 2x_5 = 1 \\ 2x_1 - x_2 - 3x_3 - 3x_4 + 2x_5 = 1 \end{cases}$$

$$8.10 \begin{cases} x_1 - 3x_2 + 4x_3 + 3x_5 = 2 \\ 3x_1 - 8x_2 + x_3 + 2x_4 = 5 \\ 2x_1 - 5x_2 - 3x_3 + 2x_4 - 3x_5 = 3 \end{cases}$$

$$8.12 \begin{cases} x_1 - x_2 + 3x_3 + 4x_4 = 0 \\ 4x_1 - 3x_2 + x_3 + 2x_5 = 1 \\ 3x_1 - 2x_2 - 2x_3 - 4x_4 + 2x_5 = 1 \end{cases}$$

$$8.14 \begin{cases} x_1 - 2x_2 + 3x_3 + 4x_5 = 1 \\ 4x_1 - 7x_2 + 2x_3 + x_4 = 3 \\ 3x_1 - 5x_2 - x_3 + x_4 - 4x_5 = 2 \end{cases}$$

$$8.16 \begin{cases} x_1 + x_2 - 3x_3 - 4x_4 = 1 \\ 4x_1 + 5x_2 - 2x_3 - x_5 = 3 \\ 3x_1 + 4x_2 + x_3 + 4x_4 - x_5 = 2 \end{cases}$$

$$8.18 \begin{cases} x_1 + 2x_2 - 2x_3 - 3x_5 = 4 \\ 2x_1 + 5x_2 - x_3 - 4x_4 = 9 \\ x_1 + 3x_2 + x_3 - 4x_4 + 3x_5 = 5 \end{cases}$$

$$8.20 \begin{cases} x_1 + 2x_2 - 3x_3 - 4x_4 = 1 \\ 3x_1 + 7x_2 - 2x_3 + x_5 = 4 \\ 2x_1 + 5x_2 + x_3 + 4x_4 + x_5 = 3 \end{cases}$$

$$8.22 \begin{cases} x_1 + 3x_2 - x_3 - 2x_5 = 1 \\ 2x_1 + 7x_2 - 4x_3 - 3x_4 = 3 \\ x_1 + 4x_2 - 3x_3 - 3x_4 + 2x_5 = 2 \end{cases}$$

$$8.24 \begin{cases} x_1 - 2x_2 + 2x_3 + 3x_4 = 0 \\ 2x_1 - 3x_2 + x_3 + 4x_5 = 1 \\ 3x_1 - 5x_2 + 3x_3 + 3x_4 + 4x_5 = 1 \end{cases}$$

$$8.26 \begin{cases} x_1 - 2x_2 + 2x_3 + 3x_5 = 0 \\ 3x_1 - 5x_2 + x_3 + 4x_4 = 1 \\ 2x_1 - 3x_2 - x_3 + 4x_4 - 3x_5 = 1 \end{cases}$$

$$8.28 \begin{cases} x_1 - 3x_2 + x_3 + 2x_4 = 4 \\ 2x_1 - 5x_2 + 4x_3 + 3x_5 = 7 \\ x_1 - 2x_2 + 3x_3 - 2x_4 + 3x_5 = 3 \end{cases}$$

$$8.29 \begin{cases} x_1 - 2x_2 + 3x_3 + 4x_4 = 1 \\ 4x_1 - 7x_2 + 2x_3 + x_4 = 3 \\ 3x_1 - 5x_2 - x_3 - 3x_4 = 2 \end{cases} \quad 8.30 \begin{cases} x_1 + 4x_2 - 2x_3 - 3x_5 = 2 \\ 2x_1 + 9x_2 - x_3 - 4x_4 = 5 \\ x_1 + 5x_2 + x_3 - 4x_4 + 3x_5 = 3 \end{cases}$$

9. Найти общее решение однородной СЛАУ, построить фундаментальную систему решений (ФСР) и записать общее решение однородной СЛАУ через её ФСР.

$$9.1 \begin{cases} x_1 + 11x_2 + 34x_4 - 5x_5 = 0 \\ 3x_1 + x_2 - 4x_3 + 2x_4 + x_5 = 0 \\ 2x_1 - 2x_2 - 3x_3 - 7x_4 + 2x_5 = 0 \end{cases} \quad 9.2 \begin{cases} x_1 - 3x_2 + x_3 - x_4 - x_5 = 0 \\ 7x_1 + 2x_2 - x_3 - 2x_4 + 2x_5 = 0 \\ 2x_1 + 3x_2 + 2x_3 + x_4 + x_5 = 0 \end{cases}$$

$$9.3 \begin{cases} x_1 + x_2 + 10x_3 + x_4 - x_5 = 0 \\ 5x_1 - x_2 + 8x_3 - 2x_4 + 2x_5 = 0 \\ 3x_1 - 3x_2 - 12x_3 - 4x_4 + 4x_5 = 0 \end{cases} \quad 9.4 \begin{cases} 2x_1 - 3x_2 + 7x_3 - x_4 - 4x_5 = 0 \\ 6x_1 - 9x_2 + 21x_3 - 3x_4 - 12x_5 = 0 \\ -4x_1 + 6x_2 - 14x_3 + 2x_4 + 8x_5 = 0 \end{cases}$$

$$9.5 \begin{cases} x_1 + 10x_2 - 3x_3 - 2x_4 - x_5 = 0 \\ 2x_1 - x_2 + 2x_3 - x_4 + x_5 = 0 \\ 4x_1 + 19x_2 - 4x_3 - 5x_4 - x_5 = 0 \end{cases} \quad 9.6 \begin{cases} x_1 + 4x_2 + 2x_3 + 2x_4 - 5x_5 = 0 \\ 5x_1 - 2x_2 + 9x_3 - 4x_4 - x_5 = 0 \\ 6x_1 + 2x_2 + 11x_3 - 2x_4 - 6x_5 = 0 \end{cases}$$

$$9.7 \begin{cases} x_1 + x_2 + x_3 - x_4 + 2x_5 = 0 \\ 12x_1 - x_2 + 7x_3 + 11x_4 - x_5 = 0 \\ 24x_1 - 2x_2 + 14x_3 + 22x_4 - 2x_5 = 0 \end{cases} \quad 9.8 \begin{cases} x_1 + 2x_2 + x_3 + 4x_4 + x_5 = 0 \\ 2x_1 + x_2 + 3x_3 + x_4 - 5x_5 = 0 \\ x_1 + 3x_2 - x_3 + 6x_4 - x_5 = 0 \end{cases}$$

$$9.9 \begin{cases} x_1 + 6x_2 - x_3 + x_4 + 2x_5 = 0 \\ 2x_1 + 3x_2 + 3x_3 - 3x_4 - x_5 = 0 \\ x_1 + 16x_2 - 6x_3 + 6x_4 + 7x_5 = 0 \end{cases} \quad 9.10 \begin{cases} x_1 + 2x_2 - x_3 + x_4 - x_5 = 0 \\ x_1 + x_2 + 2x_3 - x_4 + x_5 = 0 \\ 2x_1 + 3x_2 + x_3 = 0 \end{cases}$$

$$9.11 \begin{cases} 3x_1 - 3x_2 - 2x_3 + x_4 - 3x_5 = 0 \\ 8x_1 + x_2 + x_3 - x_4 + 2x_5 = 0 \\ 5x_1 + 4x_2 + 3x_3 - 2x_4 + 5x_5 = 0 \end{cases} \quad 9.12 \begin{cases} x_1 + 3x_2 - x_3 + 12x_4 - x_5 = 0 \\ 2x_1 - 2x_2 + x_3 - 10x_4 + x_5 = 0 \\ 3x_1 + x_2 + 2x_4 = 0 \end{cases}$$

$$9.13 \begin{cases} x_1 - 2x_2 + x_3 - 3x_4 + 7x_5 = 0 \\ 7x_1 - 14x_2 + 3x_3 - x_4 + x_5 = 0 \\ 5x_1 - 10x_2 + x_3 + 5x_4 - 13x_5 = 0 \end{cases} \quad 9.14 \begin{cases} x_1 + 2x_2 + 3x_3 + x_4 - x_5 = 0 \\ 2x_1 - 2x_2 - 6x_3 - 4x_4 + x_5 = 0 \\ 3x_1 - 2x_2 + 3x_3 + 3x_4 - x_5 = 0 \end{cases}$$

$$9.15 \begin{cases} x_1 + x_2 + x_3 - x_4 - x_5 = 0 \\ 2x_1 + x_2 - 2x_3 - x_4 - 2x_5 = 0 \\ x_1 + 2x_2 + 5x_3 - 2x_4 - x_5 = 0 \end{cases} \quad 9.16 \begin{cases} x_1 - 3x_2 + 4x_3 - 2x_4 + 5x_5 = 0 \\ 2x_1 + 2x_2 - 2x_3 + x_4 - 3x_5 = 0 \\ 3x_1 - x_2 + 2x_3 - x_4 + 2x_5 = 0 \end{cases}$$

$$9.17 \begin{cases} x_1 + 2x_2 - 3x_3 + 10x_4 - x_5 = 0 \\ -x_1 - 2x_2 + 3x_3 + 10x_4 + x_5 = 0 \\ x_1 + 6x_2 - 9x_3 + 30x_4 - 3x_5 = 0 \end{cases} \quad 9.18 \begin{cases} x_1 - 2x_2 + 3x_3 - 5x_4 - 7x_5 = 0 \\ 2x_1 + x_2 - x_3 + 7x_4 + 5x_5 = 0 \\ 3x_1 - x_2 + 2x_3 + 2x_4 - 2x_5 = 0 \end{cases}$$

$$\begin{array}{ll}
9.19 \left\{ \begin{array}{l} x_1 + 11x_2 + 34x_4 - 5x_5 = 0 \\ 2x_1 - 2x_2 - 3x_3 - 7x_4 + 2x_5 = 0 \\ x_1 - 5x_2 - 2x_3 - 16x_4 + 3x_5 = 0 \end{array} \right. & 9.20 \left\{ \begin{array}{l} x_1 + 11x_2 - 12x_3 - 5x_5 = 0 \\ 3x_1 + x_2 - 8x_3 + 2x_4 + x_5 = 0 \\ x_1 - 5x_2 + 2x_3 + x_4 + 3x_5 = 0 \end{array} \right. \\
9.21 \left\{ \begin{array}{l} x_1 + 3x_2 - 5x_3 + 9x_4 - x_5 = 0 \\ 2x_1 + 7x_2 - 3x_3 - 7x_4 + 2x_5 = 0 \\ x_1 + 4x_2 + 2x_3 - 16x_4 + 3x_5 = 0 \end{array} \right. & 9.22 \left\{ \begin{array}{l} 3x_1 + x_2 - 3x_3 + 3x_4 + 5x_5 = 0 \\ 5x_1 + 2x_2 - x_3 + 3x_4 + 4x_5 = 0 \\ 6x_1 + 3x_2 - 2x_3 + 4x_4 + 5x_5 = 0 \end{array} \right. \\
9.23 \left\{ \begin{array}{l} x_1 + x_2 + x_3 - 7x_5 = 0 \\ 3x_1 + 2x_2 - 2x_3 - x_4 + 4x_5 = 0 \\ 7x_1 + 5x_2 - 3x_3 - 2x_4 + x_5 = 0 \end{array} \right. & 9.24 \left\{ \begin{array}{l} x_1 + x_2 - x_3 - 2x_4 - 3x_5 = 0 \\ 6x_1 + 3x_2 - 2x_3 + 4x_4 + 7x_5 = 0 \\ 7x_1 + 4x_2 - 3x_3 + 2x_4 + 4x_5 = 0 \end{array} \right. \\
9.25 \left\{ \begin{array}{l} x_1 - x_2 + x_3 - 2x_4 + x_5 = 0 \\ x_1 + x_2 - 2x_3 - x_4 + 2x_5 = 0 \\ x_1 - 3x_2 + 4x_3 - 3x_4 = 0 \end{array} \right. & 9.26 \left\{ \begin{array}{l} x_1 + x_2 + 3x_3 - 2x_4 + 3x_5 = 0 \\ 2x_1 + 2x_2 + 5x_3 - x_4 + 3x_5 = 0 \\ x_1 + x_2 + 4x_3 - 5x_4 + 6x_5 = 0 \end{array} \right. \\
9.27 \left\{ \begin{array}{l} x_1 + 2x_2 + 3x_3 - 2x_4 + x_5 = 0 \\ x_1 + 2x_2 + 7x_3 - 4x_4 + x_5 = 0 \\ x_1 + 2x_2 + 11x_3 - 6x_4 + x_5 = 0 \end{array} \right. & 9.28 \left\{ \begin{array}{l} 2x_1 + x_2 + x_3 + x_4 + x_5 = 0 \\ 6x_1 + 3x_2 + 2x_3 + 3x_4 + 4x_5 = 0 \\ 4x_1 + 2x_2 + x_3 + 2x_4 + 3x_5 = 0 \end{array} \right. \\
9.29 \left\{ \begin{array}{l} 3x_1 + 2x_2 + 4x_3 + x_4 + 2x_5 = 0 \\ 3x_1 + 2x_2 - 2x_3 + x_4 = 0 \\ 3x_1 + 2x_2 + 16x_3 + x_4 + 6x_5 = 0 \end{array} \right. & 9.30 \left\{ \begin{array}{l} x_1 + x_2 + x_3 + 2x_4 + x_5 = 0 \\ x_1 - 2x_2 - 3x_3 + x_4 - x_5 = 0 \\ 2x_1 - x_2 - 2x_3 + 3x_4 = 0 \end{array} \right.
\end{array}$$

10. Представить вектор $\vec{d}$ в виде линейной комбинации векторов $\vec{a}, \vec{b}, \vec{c}$.

10.1 $\vec{a} = (1, 2, -1), \vec{b} = (-2, 0, 3), \vec{c} = (-1, 1, -1), \vec{d} = (-2, 3, 1).$

10.2 $\vec{a} = (2, 1, 0), \vec{b} = (1, 0, 1), \vec{c} = (4, 2, 1), \vec{d} = (3, 1, 3).$

10.3 $\vec{a} = (5, 1, 0), \vec{b} = (2, -1, 3), \vec{c} = (1, 0, -1), \vec{d} = (13, 2, 7).$

10.4 $\vec{a} = (4, 1, 1), \vec{b} = (2, 0, -3), \vec{c} = (-1, 2, 1), \vec{d} = (-9, 5, 5).$

10.5 $\vec{a} = (1, 0, 2), \vec{b} = (0, 1, 1), \vec{c} = (2, -1, 4), \vec{d} = (3, -3, 4).$

10.6 $\vec{a} = (0, 1, 3), \vec{b} = (1, 2, -1), \vec{c} = (2, 0, -1), \vec{d} = (3, 1, 8).$

10.7 $\vec{a} = (1, 4, 1), \vec{b} = (-3, 2, 0), \vec{c} = (1, -1, 2), \vec{d} = (-9, -8, -3).$

10.8 $\vec{a} = (3, 1, 0), \vec{b} = (-1, 2, 1), \vec{c} = (-1, 0, 2), \vec{d} = (3, 3, -1).$

10.9 $\vec{a} = (1, 0, 5), \vec{b} = (-1, 3, 2), \vec{c} = (0, -1, 1), \vec{d} = (5, 15, 0).$

10.10 $\vec{a} = (-1, 2, 1), \vec{b} = (2, 0, 3), \vec{c} = (1, 1, -1), \vec{d} = (-1, 7, -4).$

10.11 $\vec{a} = (0, 5, 1), \vec{b} = (3, 2, -1), \vec{c} = (-1, 1, 0), \vec{d} = (-15, 5, 6).$

10.12 $\vec{a} = (2, 1, 0), \vec{b} = (1, -1, 0), \vec{c} = (-3, 2, 5), \vec{d} = (23, -14, 30).$

10.13 $\vec{a} = (0, 3, 1), \vec{b} = (1, -1, 2), \vec{c} = (2, -1, 0), \vec{d} = (-1, 7, 0).$

10.14 $\vec{a} = (1, 1, 4), \vec{b} = (-3, 0, 2), \vec{c} = (1, 2, -1), \vec{d} = (-13, 2, 18).$

- 10.15 $\bar{a} = (0, -1, 2), \bar{b} = (3, 1, -1), \bar{c} = (4, 0, 1), \bar{d} = (0, -8, 9).$
 10.16 $\bar{a} = (3, 2, 0), \bar{b} = (1, -1, 2), \bar{c} = (-1, 1, 1), \bar{d} = (11, -1, 4).$
 10.17 $\bar{a} = (2, 1, 0), \bar{b} = (1, 0, 1), \bar{c} = (4, 2, 1), \bar{d} = (3, 1, 3).$
 10.18 $\bar{a} = (1, 0, 1), \bar{b} = (0, -2, 1), \bar{c} = (1, 3, 0), \bar{d} = (8, 9, 4).$
 10.19 $\bar{a} = (1, 1, 4), \bar{b} = (0, -3, 2), \bar{c} = (2, 1, -1), \bar{d} = (6, 5, -14).$
 10.20 $\bar{a} = (1, -2, 0), \bar{b} = (-1, 1, 3), \bar{c} = (1, 0, 4), \bar{d} = (6, -1, 7).$
 10.21 $\bar{a} = (1, 1, 0), \bar{b} = (0, 1, -2), \bar{c} = (1, 0, 3), \bar{d} = (2, -1, 11).$
 10.22 $\bar{a} = (0, 1, -2), \bar{b} = (3, -1, 1), \bar{c} = (4, 1, 0), \bar{d} = (-5, 9, -13).$
 10.23 $\bar{a} = (1, 2, -1), \bar{b} = (3, 0, 2), \bar{c} = (-1, 1, 1), \bar{d} = (8, 1, 12).$
 10.24 $\bar{a} = (1, 2, -1), \bar{b} = (-2, 0, 3), \bar{c} = (-1, 1, -1), \bar{d} = (-2, 3, 1).$
 10.25 $\bar{a} = (1, 2, -1), \bar{b} = (-2, 0, 3), \bar{c} = (-1, 1, -1), \bar{d} = (-2, 3, 1).$
 10.26 $\bar{a} = (1, 2, -1), \bar{b} = (-2, 0, 3), \bar{c} = (-1, 1, -1), \bar{d} = (-2, 3, 1).$
 10.27 $\bar{a} = (1, 2, -1), \bar{b} = (-2, 0, 3), \bar{c} = (-1, 1, -1), \bar{d} = (-2, 3, 1).$
 10.28 $\bar{a} = (1, 2, -1), \bar{b} = (-2, 0, 3), \bar{c} = (-1, 1, -1), \bar{d} = (-2, 3, 1).$
 10.29 $\bar{a} = (1, 2, -1), \bar{b} = (-2, 0, 3), \bar{c} = (-1, 1, -1), \bar{d} = (-2, 3, 1).$
 10.30 $\bar{a} = (1, 2, -1), \bar{b} = (-2, 0, 3), \bar{c} = (-1, 1, -1), \bar{d} = (-2, 3, 1).$

11. Даны векторы $\bar{a}, \bar{b}, \bar{c}, \bar{d}$. Векторы $\bar{a}, \bar{b}, \bar{c}$ образуют базис R^3 . Найти координаты вектора $\bar{d}$ в этом базисе.

- 11.1. $\bar{a} = (1, -1, -1), \bar{b} = (0, 1, 1), \bar{c} = (-1, 0, 1), \bar{d} = (-3, 3, 5).$
 11.2. $\bar{a} = (1, 1, 0), \bar{b} = (-1, 0, -1), \bar{c} = (1, 1, 1), \bar{d} = (0, 2, -1).$
 11.3. $\bar{a} = (2, -3, 1), \bar{b} = (3, -3, 1), \bar{c} = (2, -1, 2), \bar{d} = (6, -8, 1).$
 11.4. $\bar{a} = (1, 1, 0), \bar{b} = (1, 0, 1), \bar{c} = (1, 1, 1), \bar{d} = (2, 3, 1).$
 11.5. $\bar{a} = (2, 1, 3), \bar{b} = (4, 2, 1), \bar{c} = (3, 4, 5), \bar{d} = (1, 3, 2).$
 11.6. $\bar{a} = (2, 3, 1), \bar{b} = (-1, 2, -2), \bar{c} = (1, 2, 1), \bar{d} = (2, -2, 1).$
 11.7. $\bar{a} = (1, 2, 1), \bar{b} = (2, -1, 3), \bar{c} = (3, -1, 4), \bar{d} = (5, 1, 6).$
 11.8. $\bar{a} = (-1, 0, 2), \bar{b} = (-2, 2, 1), \bar{c} = (1, -3, 2), \bar{d} = (1, 4, -6).$
 11.9. $\bar{a} = (1, -1, 0), \bar{b} = (0, 1, -1), \bar{c} = (0, 0, 1), \bar{d} = (2, -1, 0).$
 11.10. $\bar{a} = (3, 3, -1), \bar{b} = (3, 1, 0), \bar{c} = (-1, 2, 1), \bar{d} = (-1, 0, 2).$
 11.11. $\bar{a} = (0, 1, 2), \bar{b} = (1, 0, 1), \bar{c} = (-1, 2, 4), \bar{d} = (-2, 4, 7).$
 11.12. $\bar{a} = (1, 3, 0), \bar{b} = (2, -1, 1), \bar{c} = (0, -1, 2), \bar{d} = (6, 12, -1).$
 11.13. $\bar{a} = (2, 1, -1), \bar{b} = (0, 3, 2), \bar{c} = (1, -1, 1), \bar{d} = (1, -4, 4).$
 11.14. $\bar{a} = (4, 1, 1), \bar{b} = (2, 0, -3), \bar{c} = (-1, 2, 1), \bar{d} = (-9, 5, 5).$
 11.15. $\bar{a} = (-2, 0, 1), \bar{b} = (1, 3, -1), \bar{c} = (0, 4, 1), \bar{d} = (-5, -5, 5).$
 11.16. $\bar{a} = (5, 1, 0), \bar{b} = (2, -1, 3), \bar{c} = (1, 0, -1), \bar{d} = (13, 2, 7).$
 11.17. $\bar{a} = (0, 1, 1), \bar{b} = (-2, 0, 1), \bar{c} = (3, 1, 0), \bar{d} = (-19, -1, 7).$
 11.18. $\bar{a} = (1, 0, 2), \bar{b} = (0, 1, 1), \bar{c} = (2, -1, 4), \bar{d} = (3, -3, 4).$

- 11.19. $\bar{a} = (3, 1, 0)$, $\bar{b} = (-1, 2, 1)$, $\bar{c} = (-1, 0, 2)$, $\bar{d} = (3, 3, -1)$.
 11.20. $\bar{a} = (-1, 2, 1)$, $\bar{b} = (2, 0, 3)$, $\bar{c} = (1, 1, -1)$, $\bar{d} = (-1, 7, -4)$.
 11.21. $\bar{a} = (1, 1, 4)$, $\bar{b} = (0, -3, 2)$, $\bar{c} = (2, 1, -1)$, $\bar{d} = (6, 5, -14)$.
 11.22. $\bar{a} = (1, -2, 0)$, $\bar{b} = (-1, 1, 3)$, $\bar{c} = (1, 0, 4)$, $\bar{d} = (6, -1, 7)$.
 11.23. $\bar{a} = (2, 0, 1)$, $\bar{b} = (1, 1, 0)$, $\bar{c} = (4, 1, 2)$, $\bar{d} = (8, 0, 5)$.
 11.24. $\bar{a} = (0, 1, 3)$, $\bar{b} = (1, 2, -1)$, $\bar{c} = (2, 0, -1)$, $\bar{d} = (3, 1, 8)$.
 11.25. $\bar{a} = (1, 0, 5)$, $\bar{b} = (-1, 3, 2)$, $\bar{c} = (0, -1, 1)$, $\bar{d} = (5, 15, 0)$.
 11.26. $\bar{a} = (1, 1, 0)$, $\bar{b} = (0, 1, -2)$, $\bar{c} = (1, 0, 3)$, $\bar{d} = (2, -1, 11)$.
 11.27. $\bar{a} = (1, 0, 2)$, $\bar{b} = (-1, 0, 1)$, $\bar{c} = (2, 5, -3)$, $\bar{d} = (11, 5, -3)$.
 11.28. $\bar{a} = (1, 2, -1)$, $\bar{b} = (3, 0, 2)$, $\bar{c} = (-1, 1, 1)$, $\bar{d} = (8, 1, 12)$.
 11.29. $\bar{a} = (1, 0, 1)$, $\bar{b} = (0, -2, 1)$, $\bar{c} = (1, 3, 0)$, $\bar{d} = (8, 9, 4)$.
 11.30. $\bar{a} = (2, 1, 0)$, $\bar{b} = (1, 0, 1)$, $\bar{c} = (4, 2, 1)$, $\bar{d} = (3, 1, 3)$.

12. Даны векторы $\bar{a}, \bar{b}, \bar{c}, \bar{d}$. Требуется:

а) вычислить скалярное произведение векторов $\bar{m} \cdot \bar{n}$, если $\bar{m} = \bar{a} + 2\bar{b}$, $\bar{n} = 3\bar{c} - \bar{d}$ и установить ортогональность векторов $\bar{m}$ и $\bar{n}$;

б) найти векторное произведение векторов $\bar{a} \times \bar{b}$ и установить коллинеарность векторов $\bar{a}$ и $\bar{b}$.

- 12.1. $\bar{a} = (1, -1, -1)$, $\bar{b} = (0, 1, 1)$, $\bar{c} = (-1, 0, 1)$, $\bar{d} = (-3, 3, 5)$.
 12.2. $\bar{a} = (1, 1, 0)$, $\bar{b} = (-1, 0, -1)$, $\bar{c} = (1, 1, 1)$, $\bar{d} = (0, 2, -1)$.
 12.3. $\bar{a} = (2, -3, 1)$, $\bar{b} = (3, -3, 1)$, $\bar{c} = (2, -1, 2)$, $\bar{d} = (6, -8, 1)$.
 12.4. $\bar{a} = (1, 1, 0)$, $\bar{b} = (1, 0, 1)$, $\bar{c} = (1, 1, 1)$, $\bar{d} = (2, 3, 1)$.
 12.5. $\bar{a} = (2, 1, 3)$, $\bar{b} = (4, 2, 1)$, $\bar{c} = (3, 4, 5)$, $\bar{d} = (1, 3, 2)$.
 12.6. $\bar{a} = (2, 3, 1)$, $\bar{b} = (-1, 2, -2)$, $\bar{c} = (1, 2, 1)$, $\bar{d} = (2, -2, 1)$.
 12.7. $\bar{a} = (1, 2, 1)$, $\bar{b} = (2, -1, 3)$, $\bar{c} = (3, -1, 4)$, $\bar{d} = (5, 1, 6)$.
 12.8. $\bar{a} = (-1, 0, 2)$, $\bar{b} = (-2, 2, 1)$, $\bar{c} = (1, -3, 2)$, $\bar{d} = (1, 4, -6)$.
 12.9. $\bar{a} = (1, -1, 0)$, $\bar{b} = (0, 1, -1)$, $\bar{c} = (0, 0, 1)$, $\bar{d} = (2, -1, 0)$.
 12.10. $\bar{a} = (3, 3, -1)$, $\bar{b} = (3, 1, 0)$, $\bar{c} = (-1, 2, 1)$, $\bar{d} = (-1, 0, 2)$.
 12.11. $\bar{a} = (0, 1, 2)$, $\bar{b} = (1, 0, 1)$, $\bar{c} = (-1, 2, 4)$, $\bar{d} = (-2, 4, 7)$.
 12.12. $\bar{a} = (1, 3, 0)$, $\bar{b} = (2, -1, 1)$, $\bar{c} = (0, -1, 2)$, $\bar{d} = (6, 12, -1)$.
 12.13. $\bar{a} = (2, 1, -1)$, $\bar{b} = (0, 3, 2)$, $\bar{c} = (1, -1, 1)$, $\bar{d} = (1, -4, 4)$.
 12.14. $\bar{a} = (4, 1, 1)$, $\bar{b} = (2, 0, -3)$, $\bar{c} = (-1, 2, 1)$, $\bar{d} = (-9, 5, 5)$.
 12.15. $\bar{a} = (-2, 0, 1)$, $\bar{b} = (1, 3, -1)$, $\bar{c} = (0, 4, 1)$, $\bar{d} = (-5, -5, 5)$.
 12.16. $\bar{a} = (5, 1, 0)$, $\bar{b} = (2, -1, 3)$, $\bar{c} = (1, 0, -1)$, $\bar{d} = (13, 2, 7)$.
 12.17. $\bar{a} = (0, 1, 1)$, $\bar{b} = (-2, 0, 1)$, $\bar{c} = (3, 1, 0)$, $\bar{d} = (-19, -1, 7)$.
 12.18. $\bar{a} = (1, 0, 2)$, $\bar{b} = (0, 1, 1)$, $\bar{c} = (2, -1, 4)$, $\bar{d} = (3, -3, 4)$.
 12.19. $\bar{a} = (3, 1, 0)$, $\bar{b} = (-1, 2, 1)$, $\bar{c} = (-1, 0, 2)$, $\bar{d} = (3, 3, -1)$.
 12.20. $\bar{a} = (-1, 2, 1)$, $\bar{b} = (2, 0, 3)$, $\bar{c} = (1, 1, -1)$, $\bar{d} = (-1, 7, -4)$.
 12.21. $\bar{a} = (1, 1, 4)$, $\bar{b} = (0, -3, 2)$, $\bar{c} = (2, 1, -1)$, $\bar{d} = (6, 5, -14)$.
 12.22. $\bar{a} = (1, -2, 0)$, $\bar{b} = (-1, 1, 3)$, $\bar{c} = (1, 0, 4)$, $\bar{d} = (6, -1, 7)$.

$$12.23. \bar{a} = (2, 0, 1), \bar{b} = (1, 1, 0), \bar{c} = (4, 1, 2), \bar{d} = (8, 0, 5).$$

$$12.24. \bar{a} = (0, 1, 3), \bar{b} = (1, 2, -1), \bar{c} = (2, 0, -1), \bar{d} = (3, 1, 8).$$

$$12.25. \bar{a} = (1, 0, 5), \bar{b} = (-1, 3, 2), \bar{c} = (0, -1, 1), \bar{d} = (5, 15, 0).$$

$$12.26. \bar{a} = (1, 1, 0), \bar{b} = (0, 1, -2), \bar{c} = (1, 0, 3), \bar{d} = (2, -1, 11).$$

$$12.27. \bar{a} = (1, 0, 2), \bar{b} = (-1, 0, 1), \bar{c} = (2, 5, -3), \bar{d} = (11, 5, -3).$$

$$12.28. \bar{a} = (1, 2, -1), \bar{b} = (3, 0, 2), \bar{c} = (-1, 1, 1), \bar{d} = (8, 1, 12).$$

$$12.29. \bar{a} = (1, 0, 1), \bar{b} = (0, -2, 1), \bar{c} = (1, 3, 0), \bar{d} = (8, 9, 4).$$

$$12.30. \bar{a} = (2, 1, 0), \bar{b} = (1, 0, 1), \bar{c} = (4, 2, 1), \bar{d} = (3, 1, 3).$$

13. Вычислить площадь параллелограмма, построенного на векторах $\bar{a}$ и $\bar{b}$.

$$13.1 \quad \bar{a} = \bar{p} + 2\bar{q}, \bar{b} = 3\bar{p} - \bar{q}, \quad |\bar{p}| = 1, \quad |\bar{q}| = 2, \quad (\bar{p}, \bar{q}) = \pi/6$$

$$13.2 \quad \bar{a} = 3\bar{p} + \bar{q}, \bar{b} = \bar{p} - 2\bar{q}, \quad |\bar{p}| = 4, \quad |\bar{q}| = 1, \quad (\bar{p}, \bar{q}) = \pi/4$$

$$13.3 \quad \bar{a} = \bar{p} - 3\bar{q}, \bar{b} = \bar{p} + 2\bar{q}, \quad |\bar{p}| = 1/5, \quad |\bar{q}| = 1, \quad (\bar{p}, \bar{q}) = \pi/2$$

$$13.4 \quad \bar{a} = 3\bar{p} - 2\bar{q}, \bar{b} = \bar{p} + 5\bar{q}, \quad |\bar{p}| = 4, \quad |\bar{q}| = 1/2, \quad (\bar{p}, \bar{q}) = 5\pi/6$$

$$13.5 \quad \bar{a} = \bar{p} - 2\bar{q}, \bar{b} = 2\bar{p} + \bar{q}, \quad |\bar{p}| = 2, \quad |\bar{q}| = 3, \quad (\bar{p}, \bar{q}) = 3\pi/4$$

$$13.6 \quad \bar{a} = \bar{p} + 3\bar{q}, \bar{b} = \bar{p} - 2\bar{q}, \quad |\bar{p}| = 2, \quad |\bar{q}| = 3, \quad (\bar{p}, \bar{q}) = \pi/3$$

$$13.7 \quad \bar{a} = 2\bar{p} - \bar{q}, \bar{b} = \bar{p} + 3\bar{q}, \quad |\bar{p}| = 3, \quad |\bar{q}| = 2, \quad (\bar{p}, \bar{q}) = \pi/2$$

$$13.8 \quad \bar{a} = 4\bar{p} + \bar{q}, \bar{b} = \bar{p} - \bar{q}, \quad |\bar{p}| = 7, \quad |\bar{q}| = 2, \quad (\bar{p}, \bar{q}) = \pi/4$$

$$13.9 \quad \bar{a} = \bar{p} - 4\bar{q}, \bar{b} = 3\bar{p} + \bar{q}, \quad |\bar{p}| = 1, \quad |\bar{q}| = 2, \quad (\bar{p}, \bar{q}) = \pi/6$$

$$13.10 \quad \bar{a} = \bar{p} + 4\bar{q}, \bar{b} = 2\bar{p} - \bar{q}, \quad |\bar{p}| = 7, \quad |\bar{q}| = 2, \quad (\bar{p}, \bar{q}) = \pi/3$$

$$13.11 \quad \bar{a} = 3\bar{p} + 2\bar{q}, \bar{b} = \bar{p} - \bar{q}, \quad |\bar{p}| = 10, \quad |\bar{q}| = 1, \quad (\bar{p}, \bar{q}) = \pi/2$$

$$13.12 \quad \bar{a} = 4\bar{p} - \bar{q}, \bar{b} = \bar{p} + 2\bar{q}, \quad |\bar{p}| = 5, \quad |\bar{q}| = 4, \quad (\bar{p}, \bar{q}) = \pi/4$$

$$13.13 \quad \bar{a} = 2\bar{p} + 3\bar{q}, \bar{b} = \bar{p} - 2\bar{q}, \quad |\bar{p}| = 6, \quad |\bar{q}| = 7, \quad (\bar{p}, \bar{q}) = \pi/3$$

$$13.14 \quad \bar{a} = 3\bar{p} - \bar{q}, \bar{b} = \bar{p} + 2\bar{q}, \quad |\bar{p}| = 3, \quad |\bar{q}| = 4, \quad (\bar{p}, \bar{q}) = \pi/3$$

$$13.15 \quad \bar{a} = 2\bar{p} + 3\bar{q}, \bar{b} = \bar{p} - 2\bar{q}, \quad |\bar{p}| = 2, \quad |\bar{q}| = 3, \quad (\bar{p}, \bar{q}) = \pi/4$$

$$13.16 \quad \bar{a} = 2\bar{p} - 3\bar{q}, \bar{b} = 3\bar{p} + \bar{q}, \quad |\bar{p}| = 4, \quad |\bar{q}| = 1, \quad (\bar{p}, \bar{q}) = \pi/6$$

$$13.17 \quad \bar{a} = 5\bar{p} + \bar{q}, \bar{b} = \bar{p} - 3\bar{q}, \quad |\bar{p}| = 1, \quad |\bar{q}| = 2, \quad (\bar{p}, \bar{q}) = \pi/3$$

$$13.18 \quad \bar{a} = 7\bar{p} - 2\bar{q}, \bar{b} = \bar{p} + 3\bar{q}, \quad |\bar{p}| = 1/2, \quad |\bar{q}| = 2, \quad (\bar{p}, \bar{q}) = \pi/2$$

$$13.19 \quad \bar{a} = 6\bar{p} - \bar{q}, \bar{b} = \bar{p} + \bar{q}, \quad |\bar{p}| = 3, \quad |\bar{q}| = 4, \quad (\bar{p}, \bar{q}) = \pi/4$$

$$13.20 \quad \bar{a} = 10\bar{p} + \bar{q}, \bar{b} = 3\bar{p} - 2\bar{q}, \quad |\bar{p}| = 4, \quad |\bar{q}| = 1, \quad (\bar{p}, \bar{q}) = \pi/6$$

$$13.21 \quad \bar{a} = 6\bar{p} - \bar{q}, \bar{b} = \bar{p} + 2\bar{q}, \quad |\bar{p}| = 8, \quad |\bar{q}| = 1/2, \quad (\bar{p}, \bar{q}) = \pi/3$$

$$13.22 \quad \bar{a} = 3\bar{p} + 4\bar{q}, \bar{b} = -\bar{p} + \bar{q}, \quad |\bar{p}| = 5/2, \quad |\bar{q}| = 2, \quad (\bar{p}, \bar{q}) = \pi/2$$

$$13.23 \quad \bar{a} = 7\bar{p} + \bar{q}, \bar{b} = \bar{p} - 3\bar{q}, \quad |\bar{p}| = 3, \quad |\bar{q}| = 1, \quad (\bar{p}, \bar{q}) = 3\pi/4$$

- 13.24 $\bar{a} = \bar{p} + 3\bar{q}$, $\bar{b} = 3\bar{p} - \bar{q}$, $|\bar{p}| = 3$, $|\bar{q}| = 5$, $(\bar{p}, \bar{q}) = 2\pi/3$
- 13.25 $\bar{a} = 3\bar{p} + \bar{q}$, $\bar{b} = \bar{p} - 3\bar{q}$, $|\bar{p}| = 7$, $|\bar{q}| = 2$, $(\bar{p}, \bar{q}) = \pi/4$
- 13.26 $\bar{a} = 5\bar{p} - \bar{q}$, $\bar{b} = \bar{p} + \bar{q}$, $|\bar{p}| = 5$, $|\bar{q}| = 3$, $(\bar{p}, \bar{q}) = 5\pi/6$
- 13.27 $\bar{a} = 3\bar{p} - 4\bar{q}$, $\bar{b} = \bar{p} + 3\bar{q}$, $|\bar{p}| = 2$, $|\bar{q}| = 3$, $(\bar{p}, \bar{q}) = \pi/4$
- 13.28 $\bar{a} = 6\bar{p} - \bar{q}$, $\bar{b} = \bar{p} + 5\bar{q}$, $|\bar{p}| = 1/2$, $|\bar{q}| = 4$, $(\bar{p}, \bar{q}) = 5\pi/6$
- 13.29 $\bar{a} = 2\bar{p} + 3\bar{q}$, $\bar{b} = \bar{p} - 2\bar{q}$, $|\bar{p}| = 2$, $|\bar{q}| = 1$, $(\bar{p}, \bar{q}) = \pi/3$
- 13.30 $\bar{a} = 2\bar{p} - 3\bar{q}$, $\bar{b} = 5\bar{p} + \bar{q}$, $|\bar{p}| = 2$, $|\bar{q}| = 3$, $(\bar{p}, \bar{q}) = \pi/2$

14. Коллинеарны ли векторы $\bar{c}$ и $\bar{d}$, построенные по векторам $\bar{a}$ и $\bar{b}$?

- 14.1 $\bar{a} = (1, -2, 3)$, $\bar{b} = (3, 0, -1)$, $\bar{c} = 2\bar{a} + 4\bar{b}$, $\bar{d} = -\bar{a} + 3\bar{b}$
- 14.2 $\bar{a} = (1, 0, 1)$, $\bar{b} = (-2, 3, 5)$, $\bar{c} = \bar{a} + 2\bar{b}$, $\bar{d} = 3\bar{a} - \bar{b}$
- 14.3 $\bar{a} = (-2, 4, 1)$, $\bar{b} = (1, -2, 7)$, $\bar{c} = 5\bar{a} + 3\bar{b}$, $\bar{d} = 2\bar{a} - 3\bar{b}$
- 14.4 $\bar{a} = (1, 2, -3)$, $\bar{b} = (2, -1, -1)$, $\bar{c} = 4\bar{a} + 3\bar{b}$, $\bar{d} = 8\bar{a} - \bar{b}$
- 14.5 $\bar{a} = (3, 5, 4)$, $\bar{b} = (5, 9, 7)$, $\bar{c} = -2\bar{a} + \bar{b}$, $\bar{d} = 3\bar{a} - 2\bar{b}$
- 14.6 $\bar{a} = (1, 4, -2)$, $\bar{b} = (1, 1, -1)$, $\bar{c} = \bar{a} + \bar{b}$, $\bar{d} = 4\bar{a} + 2\bar{b}$
- 14.7 $\bar{a} = (1, -2, 5)$, $\bar{b} = (3, -1, 0)$, $\bar{c} = 4\bar{a} - 2\bar{b}$, $\bar{d} = -2\bar{a} + \bar{b}$
- 14.8 $\bar{a} = (3, 4, -1)$, $\bar{b} = (2, -1, 1)$, $\bar{c} = 6\bar{a} - 3\bar{b}$, $\bar{d} = -2\bar{a} + \bar{b}$
- 14.9 $\bar{a} = (-2, -3, -2)$, $\bar{b} = (1, 0, 5)$, $\bar{c} = 3\bar{a} + 9\bar{b}$, $\bar{d} = -\bar{a} - 3\bar{b}$
- 14.10 $\bar{a} = (-1, 4, 2)$, $\bar{b} = (3, -2, 6)$, $\bar{c} = 2\bar{a} - \bar{b}$, $\bar{d} = -6\bar{a} + 3\bar{b}$
- 14.11 $\bar{a} = (5, 0, -1)$, $\bar{b} = (7, 2, 3)$, $\bar{c} = 2\bar{a} - \bar{b}$, $\bar{d} = -6\bar{a} + 3\bar{b}$
- 14.12 $\bar{a} = (0, 3, -2)$, $\bar{b} = (1, -2, 1)$, $\bar{c} = 5\bar{a} - 2\bar{b}$, $\bar{d} = 3\bar{a} + 5\bar{b}$
- 14.13 $\bar{a} = (-2, 7, -1)$, $\bar{b} = (-3, 5, 2)$, $\bar{c} = 2\bar{a} + 3\bar{b}$, $\bar{d} = 3\bar{a} + 2\bar{b}$
- 14.14 $\bar{a} = (3, 7, 0)$, $\bar{b} = (1, -3, 4)$, $\bar{c} = 4\bar{a} - 2\bar{b}$, $\bar{d} = -2\bar{a} + \bar{b}$
- 14.15 $\bar{a} = (-1, 2, -1)$, $\bar{b} = (2, -7, 1)$, $\bar{c} = 6\bar{a} - 2\bar{b}$, $\bar{d} = -3\bar{a} + \bar{b}$
- 14.16 $\bar{a} = (7, 9, -2)$, $\bar{b} = (5, 4, 3)$, $\bar{c} = 4\bar{a} - \bar{b}$, $\bar{d} = -\bar{a} + 4\bar{b}$
- 14.17 $\bar{a} = (5, 0, -2)$, $\bar{b} = (6, 4, 3)$, $\bar{c} = 5\bar{a} - 3\bar{b}$, $\bar{d} = -10\bar{a} + 6\bar{b}$
- 14.18 $\bar{a} = (8, 3, -1)$, $\bar{b} = (4, 1, 3)$, $\bar{c} = 2\bar{a} - \bar{b}$, $\bar{d} = -4\bar{a} + 2\bar{b}$
- 14.19 $\bar{a} = (3, -1, 6)$, $\bar{b} = (5, 7, 10)$, $\bar{c} = 4\bar{a} - 2\bar{b}$, $\bar{d} = -2\bar{a} + \bar{b}$
- 14.20 $\bar{a} = (1, -2, 4)$, $\bar{b} = (7, 3, 5)$, $\bar{c} = 6\bar{a} - 3\bar{b}$, $\bar{d} = -2\bar{a} + \bar{b}$
- 14.21 $\bar{a} = (3, 7, 0)$, $\bar{b} = (4, 6, -1)$, $\bar{c} = 3\bar{a} + 2\bar{b}$, $\bar{d} = 5\bar{a} - 7\bar{b}$
- 14.22 $\bar{a} = (2, -1, 4)$, $\bar{b} = (3, -7, -6)$, $\bar{c} = 2\bar{a} - 3\bar{b}$, $\bar{d} = 3\bar{a} - 2\bar{b}$
- 14.23 $\bar{a} = (5, -1, -2)$, $\bar{b} = (6, 0, 7)$, $\bar{c} = 3\bar{a} - 2\bar{b}$, $\bar{d} = -6\bar{a} + 4\bar{b}$
- 14.24 $\bar{a} = (-9, 5, 3)$, $\bar{b} = (7, 1, -2)$, $\bar{c} = 2\bar{a} - \bar{b}$, $\bar{d} = 3\bar{a} + 5\bar{b}$
- 14.25 $\bar{a} = (4, 2, 9)$, $\bar{b} = (0, -1, 3)$, $\bar{c} = -3\bar{a} + 4\bar{b}$, $\bar{d} = 4\bar{a} - 3\bar{b}$
- 14.26 $\bar{a} = (2, -1, 6)$, $\bar{b} = (-1, 3, 8)$, $\bar{c} = 5\bar{a} - 2\bar{b}$, $\bar{d} = 2\bar{a} - 5\bar{b}$
- 14.27 $\bar{a} = (5, 0, 8)$, $\bar{b} = (-3, 1, 7)$, $\bar{c} = 3\bar{a} - 4\bar{b}$, $\bar{d} = -9\bar{a} + 12\bar{b}$
- 14.28 $\bar{a} = (-1, 3, 4)$, $\bar{b} = (2, -1, 0)$, $\bar{c} = 6\bar{a} - 2\bar{b}$, $\bar{d} = -3\bar{a} + \bar{b}$
- 14.29 $\bar{a} = (4, 2, -7)$, $\bar{b} = (5, 0, -3)$, $\bar{c} = \bar{a} - 3\bar{b}$, $\bar{d} = -2\bar{a} + 6\bar{b}$

14.30 $\bar{a} = (2, 0, -5)$, $\bar{b} = (1, -3, 4)$, $\bar{c} = 2\bar{a} - 5\bar{b}$, $\bar{d} = 5\bar{a} - 2\bar{b}$

15. Компланарны ли векторы $\bar{a}, \bar{b}, \bar{c}$?

15.1 $\bar{a} = (2, 3, 1)$, $\bar{b} = (-1, 0, -1)$, $\bar{c} = (2, 2, 2)$

15.3 $\bar{a} = (1, 5, 2)$, $\bar{b} = (-1, 1, -1)$, $\bar{c} = (1, 1, 1)$

15.5 $\bar{a} = (3, 3, 1)$, $\bar{b} = (1, -2, 1)$, $\bar{c} = (1, 1, 1)$

15.7 $\bar{a} = (4, 3, 1)$, $\bar{b} = (1, -2, 1)$, $\bar{c} = (2, 2, 2)$

15.9 $\bar{a} = (3, 2, 1)$, $\bar{b} = (1, -3, -7)$, $\bar{c} = (1, 2, 3)$

15.11 $\bar{a} = (1, -2, 6)$, $\bar{b} = (1, 0, 1)$, $\bar{c} = (2, -6, 17)$

15.13 $\bar{a} = (7, 3, 4)$, $\bar{b} = (-1, -2, -1)$, $\bar{c} = (4, 2, 4)$

15.15 $\bar{a} = (5, 3, 4)$, $\bar{b} = (-1, 0, -1)$, $\bar{c} = (4, 2, 4)$

15.17 $\bar{a} = (-2, -4, -3)$, $\bar{b} = (4, 3, 1)$, $\bar{c} = (6, 7, 4)$

15.19 $\bar{a} = (4, 2, 2)$, $\bar{b} = (-3, -3, -3)$, $\bar{c} = (2, 1, 2)$

15.21 $\bar{a} = (5, 3, 4)$, $\bar{b} = (4, 3, 3)$, $\bar{c} = (9, 5, 8)$

15.23 $\bar{a} = (3, 4, 2)$, $\bar{b} = (1, 1, 0)$, $\bar{c} = (8, 11, 6)$

15.25 $\bar{a} = (3, 0, 3)$, $\bar{b} = (8, 1, 6)$, $\bar{c} = (1, 1, -1)$

15.27 $\bar{a} = (6, 3, 4)$, $\bar{b} = (-1, -2, -1)$, $\bar{c} = (2, 1, 2)$

15.29 $\bar{a} = (-3, 3, 3)$, $\bar{b} = (-4, 7, 6)$, $\bar{c} = (3, 0, -1)$

15.2 $\bar{a} = (3, 2, 1)$, $\bar{b} = (2, 3, 4)$, $\bar{c} = (3, 1, -1)$

15.4 $\bar{a} = (1, -1, -3)$, $\bar{b} = (3, 2, 1)$, $\bar{c} = (2, 3, 4)$

15.6 $\bar{a} = (3, 1, -1)$, $\bar{b} = (-2, -1, 0)$, $\bar{c} = (5, 2, -1)$

15.8 $\bar{a} = (4, 3, 1)$, $\bar{b} = (6, 7, 4)$, $\bar{c} = (2, 0, -1)$

15.10 $\bar{a} = (3, 7, 2)$, $\bar{b} = (-2, 0, -1)$, $\bar{c} = (2, 2, 1)$

15.12 $\bar{a} = (6, 3, 4)$, $\bar{b} = (-1, -2, -1)$, $\bar{c} = (2, 1, 2)$

15.14 $\bar{a} = (2, 3, 2)$, $\bar{b} = (4, 7, 5)$, $\bar{c} = (2, 0, -1)$

15.16 $\bar{a} = (3, 10, 5)$, $\bar{b} = (-2, -2, -3)$, $\bar{c} = (2, 4, 3)$

15.18 $\bar{a} = (3, 1, -1)$, $\bar{b} = (1, 0, -1)$, $\bar{c} = (8, 3, -2)$

15.20 $\bar{a} = (4, 1, 2)$, $\bar{b} = (9, 2, 5)$, $\bar{c} = (1, 1, -1)$

15.22 $\bar{a} = (4, -1, -6)$, $\bar{b} = (1, -3, -7)$, $\bar{c} = (2, -1, -4)$

15.24 $\bar{a} = (3, 1, 0)$, $\bar{b} = (-5, -4, -5)$, $\bar{c} = (4, 2, 4)$

15.26 $\bar{a} = (1, -1, 4)$, $\bar{b} = (1, 0, 3)$, $\bar{c} = (1, -3, 8)$

15.28 $\bar{a} = (4, 1, 1)$, $\bar{b} = (-9, -4, -9)$, $\bar{c} = (6, 2, 6)$

15.30 $\bar{a} = (-7, 10, -5)$, $\bar{b} = (0, -2, -1)$, $\bar{c} = (-2, 4, -1)$

16. Даны вершины треугольника ABC. Требуется найти:

а) длину стороны AB;

б) уравнение стороны AB;

в) длину h высоты CD;

г) площадь S треугольника ABC. Сделать чертёж.

16.1 $A(2, -5)$, $B(-3, -4)$, $C(-4, 2)$

16.2 $A(4, -5)$, $B(2, 2)$, $C(7, 4)$

16.3 $A(3, 2)$, $B(-5, 4)$, $C(-1, -6)$

16.4 $A(-3, -4)$, $B(-6, 7)$, $C(-1, 1)$

16.5 $A(-3, -5)$, $B(4, 3)$, $C(-2, 4)$

16.6 $A(2, 1)$, $B(-7, 3)$, $C(-4, -3)$

16.7 $A(-4, 5)$, $B(3, -3)$, $C(5, 2)$

16.8 $A(3, -4)$, $B(2, 1)$, $C(1, 7)$

16.9 $A(-4, -5)$, $B(-2, 2)$, $C(-7, 4)$

16.10 $A(3, 4)$, $B(6, 7)$, $C(1, 1)$

16.11 $A(-2, -1)$, $B(7, 3)$, $C(4, -3)$

16.12 $A(6, -4)$, $B(-3, -7)$, $C(-1, 2)$

16.13 $A(3, 2)$, $B(2, -5)$, $C(-6, -1)$

16.14 $A(-6, -4)$, $B(3, -7)$, $C(1, 2)$

16.15 $A(-3, 2)$, $B(-2, -5)$, $C(6, -1)$

16.16 $A(2, 5)$, $B(-3, 4)$, $C(-4, -2)$

16.17 $A(3, -2)$, $B(-5, -4)$, $C(-1, 6)$

16.18 $A(-3, 5)$, $B(4, -3)$, $C(-2, -4)$

16.19 $A(-4, -5)$, $B(3, 3)$, $C(5, -2)$

16.20 $A(3, 4)$, $B(2, -1)$, $C(1, -7)$

16.21 $A(-6, 5)$, $B(6, 0)$, $C(9, 4)$

16.22 $A(3, -3)$, $B(-1, -6)$, $C(-6, 6)$

16.23 $A(-8, 4)$, $B(4, -1)$, $C(7, 3)$

16.24 $A(-14, 6)$, $B(-2, 1)$, $C(1, 5)$

16.25 $A(7, -4)$, $B(3, -7)$, $C(-2, 5)$

16.26 $A(-9, 2)$, $B(3, -3)$, $C(6, 1)$

16.27 $A(6, 0)$, $B(2, -3)$, $C(-3, 9)$

16.28 $A(5, -1)$, $B(1, -4)$, $C(-4, 8)$

16.29 $A(-7, 3)$, $B(5, -2)$, $C(8, 2)$

16.30 $A(4, 1)$, $B(0, -2)$, $C(-5, 10)$

17. Даны вершины треугольника ABC. Требуется найти:

а) уравнение медианы BE, проведённой из вершины B;

б) уравнение высоты CD, проведённой из вершины C.

$$17.1 \quad A(4, 1), \quad B(0, -2), \quad C(-5, 10).$$

$$17.3 \quad A(5, -1), \quad B(1, -4), \quad C(-4, 8)$$

$$17.5 \quad A(-9, 2), \quad B(3, -3), \quad C(6, 1)$$

$$17.7 \quad A(-14, 6), \quad B(-2, 1), \quad C(1, 5)$$

$$17.9 \quad A(3, -3), \quad B(-1, -6), \quad C(-6, 6)$$

$$17.11 \quad A(3, 4), \quad B(2, -1), \quad C(1, -7)$$

$$17.13 \quad A(-3, 5), \quad B(4, -3), \quad C(-2, -4)$$

$$17.15 \quad A(2, 5), \quad B(-3, 4), \quad C(-4, -2)$$

$$17.17 \quad A(-6, -4), \quad B(3, -7), \quad C(1, 2)$$

$$17.19 \quad A(6, -4), \quad B(-3, -7), \quad C(-1, 2)$$

$$17.21 \quad A(3, 4), \quad B(6, 7), \quad C(1, 1)$$

$$17.23 \quad A(3, -4), \quad B(2, 1), \quad C(1, 7)$$

$$17.25 \quad A(2, 1), \quad B(-7, 3), \quad C(-4, -3)$$

$$17.27 \quad A(-3, -4), \quad B(-6, 7), \quad C(-1, 1)$$

$$17.29 \quad A(4, -5), \quad B(2, 2), \quad C(7, 4)$$

$$17.2 \quad A(-7, 3), \quad B(5, -2), \quad C(8, 2).$$

$$17.4 \quad A(6, 0), \quad B(2, -3), \quad C(-3, 9)$$

$$17.6 \quad A(7, -4), \quad B(3, -7), \quad C(-2, 5)$$

$$17.8 \quad A(-8, 4), \quad B(4, -1), \quad C(7, 3)$$

$$17.10 \quad A(-6, 5), \quad B(6, 0), \quad C(9, 4)$$

$$17.12 \quad A(-4, -5), \quad B(3, 3), \quad C(5, -2)$$

$$17.14 \quad A(3, -2), \quad B(-5, -4), \quad C(-1, 6)$$

$$17.16 \quad A(-3, 2), \quad B(-2, -5), \quad C(6, -1)$$

$$17.18 \quad A(3, 2), \quad B(2, -5), \quad C(-6, -1)$$

$$17.20 \quad A(-2, -1), \quad B(7, 3), \quad C(4, -3)$$

$$17.22 \quad A(-4, -5), \quad B(-2, 2), \quad C(-7, 4)$$

$$17.24 \quad A(-4, 5), \quad B(3, -3), \quad C(5, 2)$$

$$17.26 \quad A(-3, -5), \quad B(4, 3), \quad C(-2, 4)$$

$$17.28 \quad A(3, 2), \quad B(-5, 4), \quad C(-1, -6)$$

$$17.30 \quad A(2, -5), \quad B(-3, -4), \quad C(-4, 2)$$

18. Даны вершины пирамиды $ABCD$. Требуется найти:

а) длины ребер AB и AC ; б) косинус угла между ребрами AB и AC ;

в) площадь грани ABC ; г) объем пирамиды $ABCD$.

$$18.1 \quad A(-1, 2, 1), B(-2, 2, 5), C(-3, 3, 1), D(-1, 4, 3)$$

$$18.2 \quad A(1, 1, 2), B(0, 1, 6), C(-1, 2, 2), D(1, 3, 4)$$

$$18.3 \quad A(-2, 1, -1), B(-3, 1, 3), C(-4, 2, -1), D(-2, 3, 1)$$

$$18.4 \quad A(-1, -2, 1), B(-2, -2, 5), C(-3, -1, 1), D(-1, 0, 3)$$

$$18.5 \quad A(2, -1, 1), B(1, -1, 5), C(0, 0, 1), D(2, 1, 3)$$

$$18.6 \quad A(-1, 1, -2), B(-2, 1, 2), C(-3, 2, -2), D(-1, 3, 0)$$

$$18.7 \quad A(1, 2, 1), B(0, 2, 5), C(-1, 3, 1), D(1, 4, 3)$$

$$18.8 \quad A(1, 3, 6), B(2, 2, 1), C(-1, 0, 1), D(-4, 6, -3)$$

$$18.9 \quad A(2, 0, 3), B(1, 0, 7), C(0, 1, 3), D(2, 2, 5)$$

$$18.10 \quad A(2, 3, 2), B(1, 3, 6), C(0, 4, 2), D(2, 5, 4)$$

$$18.11 \quad A(1, 3, 6), B(2, 2, 1), C(-1, 0, 1), D(-4, 6, -3)$$

$$18.12 \quad A(-4, 2, 6), B(2, -3, 0), C(-10, 5, 8), D(-5, 2, -4)$$

$$18.13 \quad A(7, 2, 4), B(7, -1, -2), C(3, 3, 1), D(-4, 2, 1)$$

$$18.14 \quad A(2, 1, 4), B(-1, 5, -2), C(-7, -3, 2), D(-6, -3, 6)$$

$$18.15 \quad A(-1, -5, 2), B(-6, 0, -3), C(3, 6, -3), D(-10, 6, 7)$$

$$18.16 \quad A(0, -1, -1), B(-2, 3, 5), C(1, -5, -9), D(-1, -6, 3)$$

$$18.17 \quad A(5, 2, 0), B(2, 5, 0), C(1, 2, 4), D(-1, 1, 1)$$

$$18.18 \quad A(2, -1, -2), B(1, 2, 1), C(5, 0, -6), D(-10, 9, -7)$$

$$18.19 \quad A(-2, 0, -4), B(-1, 7, 1), C(4, -8, -4), D(1, -4, 6)$$

$$18.20 \quad A(1, 2, 0), B(3, 0, -3), C(5, 2, 6), D(8, 4, -9)$$

$$18.21 \quad A(14, 4, 5), B(-5, -3, 2), C(-2, -6, -3), D(-2, 2, -1)$$

$$18.22 \quad A(2, -1, 2), B(1, 2, -1), C(3, 2, 1), D(-4, 2, 5)$$

$$18.23 \quad A(1, 1, 2), B(-1, 1, 3), C(2, -2, 4), D(-1, 0, -2)$$

$$18.24 \quad A(2, 3, 1), B(4, 1, -2), C(6, 3, 7), D(7, 5, -3)$$

$$18.25 \quad A(1, 1, -1), B(2, 3, 1), C(3, 2, 1), D(5, 9, -8)$$

$$18.26 \quad A(1, 2, 0), B(1, -1, 2), C(0, 1, -1), D(-3, 0, 1)$$

$$18.27 \quad A(1, 0, 2), B(1, 2, -1), C(2, -2, 1), D(2, 1, 0)$$

$$18.28 \quad A(1, 2, -3), B(1, 0, 1), C(-2, -1, 6), D(0, -5, -4)$$

$$18.29 \quad A(3, 10, -1), B(-2, 3, -5), C(-6, 0, -3), D(1, -1, 2)$$

$$18.30 \quad A(0, -3, 1), B(-4, 1, 2), C(2, -1, 5), D(3, 1, -4)$$

19. Даны вершины пирамиды $ABCD$. Требуется:

а) написать уравнение плоскости P , проходящей через точку A перпендикулярно $\overrightarrow{BC}$;

б) написать уравнение плоскости P_1 грани ABC ;

в) найти расстояние от точки D до плоскости P_1 ;

г) найти угол между плоскостями P и P_1 .

- 19.1** $A(0, -3, 1), B(-4, 1, 2), C(2, -1, 5), D(3, 1, -4)$ **19.2** $A(3, 10, -1), B(-2, 3, -5), C(-6, 0, -3), D(1, -1, 2)$
19.3 $A(1, 2, -3), B(1, 0, 1), C(-2, -1, 6), D(0, -5, -4)$ **19.4** $A(1, 0, 2), B(1, 2, -1), C(2, -2, 1), D(2, 1, 0)$
19.5 $A(1, 2, 0), B(1, -1, 2), C(0, 1, -1), D(-3, 0, 1)$ **19.6** $A(1, 1, -1), B(2, 3, 1), C(3, 2, 1), D(5, 9, -8)$
19.7 $A(2, 3, 1), B(4, 1, -2), C(6, 3, 7), D(7, 5, -3)$ **19.8** $A(1, 1, 2), B(-1, 1, 3), C(2, -2, 4), D(-1, 0, -2)$
19.9 $A(2, -1, 2), B(1, 2, -1), C(3, 2, 1), D(-4, 2, 5)$ **19.10** $A(14, 4, 5), B(-5, -3, 2), C(-2, -6, -3), D(-2, 2, -1)$
19.11 $A(1, 2, 0), B(3, 0, -3), C(5, 2, 6), D(8, 4, -9)$ **19.12** $A(-2, 0, -4), B(-1, 7, 1), C(4, -8, -4), D(1, -4, 6)$
19.13 $A(2, -1, -2), B(1, 2, 1), C(5, 0, -6), D(-10, 9, -7)$ **19.14** $A(5, 2, 0), B(2, 5, 0), C(1, 2, 4), D(-1, 1, 1)$
19.15 $A(0, -1, -1), B(-2, 3, 5), C(1, -5, -9), D(-1, -6, 3)$ **19.16** $A(-1, -5, 2), B(-6, 0, -3), C(3, 6, -3), D(-10, 6, 7)$
19.17 $A(2, 1, 4), B(-1, 5, -2), C(-7, -3, 2), D(-6, -3, 6)$ **19.18** $A(7, 2, 4), B(7, -1, -2), C(3, 3, 1), D(-4, 2, 1)$
19.19 $A(2, 0, 3), B(1, 0, 7), C(0, 1, 3), D(2, 2, 5)$ **19.20** $A(-4, 2, 6), B(2, -3, 0), C(-10, 5, 8), D(-5, 2, -4)$
19.21 $A(2, 3, 2), B(1, 3, 6), C(0, 4, 2), D(2, 5, 4)$ **19.22** $A(1, 3, 6), B(2, 2, 1), C(-1, 0, 1), D(-4, 6, -3)$
19.23 $A(1, 2, 1), B(0, 2, 5), C(-1, 3, 1), D(1, 4, 3)$ **19.24** $A(1, 3, 6), B(2, 2, 1), C(-1, 0, 1), D(-4, 6, -3)$
19.25 $A(2, -1, 1), B(1, -1, 5), C(0, 0, 1), D(2, 1, 3)$ **19.26** $A(-1, -2, 1), B(-2, -2, 5), C(-3, -1, 1), D(-1, 0, 3)$
19.27 $A(1, 1, 2), B(0, 1, 6), C(-1, 2, 2), D(1, 3, 4)$ **19.28** $A(-2, 1, -1), B(-3, 1, 3), C(-4, 2, -1), D(-2, 3, 1)$
19.29 $A(-1, 2, 1), B(-2, 2, 5), C(-3, 3, 1), D(-1, 4, 3)$ **19.30** $A(-1, 1, -2), B(-2, 1, 2), C(-3, 2, -2), D(-1, 3, 0)$

20. Даны прямая $L: \frac{x-x_0}{l} = \frac{y-y_0}{m} = \frac{z-z_0}{n}$ **и плоскость** $P: Ax + By + Cz + D = 0$. **Найти точку**

M^* пересечения прямой L и плоскости P .

- 20.1** $L: \frac{x-2}{-1} = \frac{y-3}{-1} = \frac{z+1}{4}, \quad P: x + 2y + 3z - 14 = 0$
20.2 $L: \frac{x+1}{3} = \frac{y-3}{-4} = \frac{z+1}{5}, \quad P: x + 2y - 5z + 20 = 0$
20.3 $L: \frac{x-1}{-1} = \frac{y+5}{4} = \frac{z-1}{2}, \quad P: x - 3y + 7z - 24 = 0$
20.4 $L: \frac{x-1}{1} = \frac{y}{0} = \frac{z+3}{2}, \quad P: 2x - y + 4z = 0$
20.5 $L: \frac{x-5}{1} = \frac{y-3}{-1} = \frac{z-2}{0}, \quad P: 3x + y - 5z - 12 = 0$
20.6 $L: \frac{x+1}{-3} = \frac{y+2}{2} = \frac{z-3}{-2}, \quad P: x + 3y - 5z + 9 = 0$
20.7 $L: \frac{x-1}{-2} = \frac{y-2}{1} = \frac{z+1}{-1}, \quad P: x - 2y + 5z + 17 = 0$
20.8 $L: \frac{x-1}{2} = \frac{y-2}{0} = \frac{z-4}{1}, \quad P: x - 2y + 4z - 19 = 0$
20.9 $L: \frac{x+2}{-1} = \frac{y-1}{1} = \frac{z+4}{-1}, \quad P: 2x - y + 3z + 23 = 0$
20.10 $L: \frac{x+2}{1} = \frac{y-2}{0} = \frac{z+3}{0}, \quad P: 2x - 3y - 5z - 7 = 0$
20.11 $L: \frac{x-1}{2} = \frac{y-1}{-1} = \frac{z+2}{3}, \quad P: 4x + 2y - z - 11 = 0$
20.12 $L: \frac{x-1}{1} = \frac{y+1}{0} = \frac{z-1}{-1}, \quad P: 3x - 2y - 4z - 8 = 0$
20.13 $L: \frac{x+2}{-1} = \frac{y-1}{1} = \frac{z+3}{2}, \quad P: x + 2y - z - 2 = 0$

- 20.14 $L: \frac{x+3}{1} = \frac{y-2}{-5} = \frac{z+2}{3},$ $P: 5x - y + 4z + 3 = 0$
- 20.15 $L: \frac{x-2}{2} = \frac{y-2}{-1} = \frac{z-4}{3},$ $P: x + 3y + 5z - 42 = 0$
- 20.16 $L: \frac{x-3}{-1} = \frac{y-4}{5} = \frac{z-4}{2},$ $P: 7x + y + 4z - 47 = 0$
- 20.17 $L: \frac{x+3}{2} = \frac{y-1}{3} = \frac{z-1}{5},$ $P: 2x + 3y + 7z - 52 = 0$
- 20.18 $L: \frac{x-3}{2} = \frac{y+1}{3} = \frac{z+3}{2},$ $P: 3x + 4y + 7z - 16 = 0$
- 20.19 $L: \frac{x-5}{-2} = \frac{y-2}{0} = \frac{z+4}{-1},$ $P: 2x - 5y + 4z + 24 = 0$
- 20.20 $L: \frac{x-1}{8} = \frac{y-8}{-5} = \frac{z+5}{12},$ $P: x - 2y - 3z + 18 = 0$
- 20.21 $L: \frac{x-3}{1} = \frac{y-1}{-1} = \frac{z+5}{0},$ $P: x + 7y + 3z + 11 = 0$
- 20.22 $L: \frac{x-5}{-1} = \frac{y+3}{5} = \frac{z-1}{2},$ $P: 3x + 7y - 5z - 11 = 0$
- 20.23 $L: \frac{x-1}{7} = \frac{y-2}{1} = \frac{z-6}{-1},$ $P: 4x + y - 6z - 5 = 0$
- 20.24 $L: \frac{x-3}{1} = \frac{y+2}{-1} = \frac{z-8}{0},$ $P: 5x + 9y + 4z - 25 = 0$
- 20.25 $L: \frac{x+1}{-2} = \frac{y}{0} = \frac{z+1}{3},$ $P: x + 4y + 13z - 23 = 0$
- 20.26 $L: \frac{x-1}{6} = \frac{y-3}{1} = \frac{z+5}{3},$ $P: 3x - 2y + 5z - 3 = 0$
- 20.27 $L: \frac{x-2}{4} = \frac{y-1}{-3} = \frac{z+3}{-2},$ $P: 3x - y + 4z = 0$
- 20.28 $L: \frac{x-1}{2} = \frac{y+2}{-5} = \frac{z-3}{-2},$ $P: x + 2y - 5z + 16 = 0$
- 20.29 $L: \frac{x-1}{1} = \frac{y-3}{0} = \frac{z+2}{-2},$ $P: 3x - 7y - 2z + 7 = 0$
- 20.30 $L: \frac{x+3}{0} = \frac{y-2}{-3} = \frac{z+5}{11},$ $P: 5x + 7y + 9z - 32 = 0$

21. Даны прямая $L: \frac{x-x_0}{l} = \frac{y-y_0}{m} = \frac{z-z_0}{n}$ и плоскость $P: Ax + By + Cz + D = 0$. Требуется:

а) написать уравнение плоскости P_1 , проходящей через точку $M_0(x_0, y_0, z_0) \in L$ перпендикулярно прямой L ;

б) найти угол между плоскостями P и P_1 .

- 21.1 $L: \frac{x-2}{-1} = \frac{y-3}{-1} = \frac{z+1}{4},$ $P: x + 2y + 3z - 14 = 0$
- 21.2 $L: \frac{x+1}{3} = \frac{y-3}{-4} = \frac{z+1}{5},$ $P: x + 2y - 5z + 20 = 0$
- 21.3 $L: \frac{x-1}{-1} = \frac{y+5}{4} = \frac{z-1}{2},$ $P: x - 3y + 7z - 24 = 0$
- 21.4 $L: \frac{x-1}{1} = \frac{y}{0} = \frac{z+3}{2},$ $P: 2x - y + 4z = 0$

21.5	$L: \frac{x-5}{1} = \frac{y-3}{-1} = \frac{z-2}{0},$	$P: 3x + y - 5z - 12 = 0$
21.6	$L: \frac{x+1}{-3} = \frac{y+2}{2} = \frac{z-3}{-2},$	$P: x + 3y - 5z + 9 = 0$
21.7	$L: \frac{x-1}{-2} = \frac{y-2}{1} = \frac{z+1}{-1},$	$P: x - 2y + 5z + 17 = 0$
21.8	$L: \frac{x-1}{2} = \frac{y-2}{0} = \frac{z-4}{1},$	$P: x - 2y + 4z - 19 = 0$
21.9	$L: \frac{x+2}{-1} = \frac{y-1}{1} = \frac{z+4}{-1},$	$P: 2x - y + 3z + 23 = 0$
21.10	$L: \frac{x+2}{1} = \frac{y-2}{0} = \frac{z+3}{0},$	$P: 2x - 3y - 5z - 7 = 0$
21.11	$L: \frac{x-1}{2} = \frac{y-1}{-1} = \frac{z+2}{3},$	$P: 4x + 2y - z - 11 = 0$
21.12	$L: \frac{x-1}{1} = \frac{y+1}{0} = \frac{z-1}{-1},$	$P: 3x - 2y - 4z - 8 = 0$
21.13	$L: \frac{x+2}{-1} = \frac{y-1}{1} = \frac{z+3}{2},$	$P: x + 2y - z - 2 = 0$
21.14	$L: \frac{x+3}{1} = \frac{y-2}{-5} = \frac{z+2}{3},$	$P: 5x - y + 4z + 3 = 0$
21.15	$L: \frac{x-2}{2} = \frac{y-2}{-1} = \frac{z-4}{3},$	$P: x + 3y + 5z - 42 = 0$
21.16	$L: \frac{x-3}{-1} = \frac{y-4}{5} = \frac{z-4}{2},$	$P: 7x + y + 4z - 47 = 0$
21.17	$L: \frac{x+3}{2} = \frac{y-1}{3} = \frac{z-1}{5},$	$P: 2x + 3y + 7z - 52 = 0$
21.18	$L: \frac{x-3}{2} = \frac{y+1}{3} = \frac{z+3}{2},$	$P: 3x + 4y + 7z - 16 = 0$
21.19	$L: \frac{x-5}{-2} = \frac{y-2}{0} = \frac{z+4}{-1},$	$P: 2x - 5y + 4z + 24 = 0$
21.20	$L: \frac{x-1}{8} = \frac{y-8}{-5} = \frac{z+5}{12},$	$P: x - 2y - 3z + 18 = 0$
21.21	$L: \frac{x-3}{1} = \frac{y-1}{-1} = \frac{z+5}{0},$	$P: x + 7y + 3z + 11 = 0$
21.22	$L: \frac{x-5}{-1} = \frac{y+3}{5} = \frac{z-1}{2},$	$P: 3x + 7y - 5z - 11 = 0$
21.23	$L: \frac{x-1}{7} = \frac{y-2}{1} = \frac{z-6}{-1},$	$P: 4x + y - 6z - 5 = 0$
21.24	$L: \frac{x-3}{1} = \frac{y+2}{-1} = \frac{z-8}{0},$	$P: 5x + 9y + 4z - 25 = 0$
21.25	$L: \frac{x+1}{-2} = \frac{y}{0} = \frac{z+1}{3},$	$P: x + 4y + 13z - 23 = 0$
21.26	$L: \frac{x-1}{6} = \frac{y-3}{1} = \frac{z+5}{3},$	$P: 3x - 2y + 5z - 3 = 0$
21.27	$L: \frac{x-2}{4} = \frac{y-1}{-3} = \frac{z+3}{-2},$	$P: 3x - y + 4z = 0$
21.28	$L: \frac{x-1}{2} = \frac{y+2}{-5} = \frac{z-3}{-2},$	$P: x + 2y - 5z + 16 = 0$

$$21.29 \quad L: \frac{x-1}{1} = \frac{y-3}{0} = \frac{z+2}{-2}, \quad P: 3x - 7y - 2z + 7 = 0$$

$$21.30 \quad L: \frac{x+3}{0} = \frac{y-2}{-3} = \frac{z+5}{11}, \quad P: 5x + 7y + 9z - 32 = 0$$

22. Построить линии на плоскости по заданным уравнениям и назвать их.

$$22.1 \text{ а) } x + 2y + 6 = 0 \quad \text{б) } (x-2)^2 + (y-3)^2 = 9 \quad \text{в) } \frac{x^2}{25} + \frac{y^2}{9} = 1 \quad \text{г) } \frac{x^2}{49} - \frac{y^2}{25} = 1 \quad \text{д) } y^2 = 9x$$

$$22.2 \text{ а) } y + 4 = 0 \quad \text{б) } (x+3)^2 + (y-5)^2 = 4 \quad \text{в) } \frac{x^2}{49} + \frac{y^2}{4} = 1 \quad \text{г) } \frac{x^2}{25} - \frac{y^2}{16} = 1 \quad \text{д) } y^2 = -4x$$

$$22.3 \text{ а) } 3x - 2y + 12 = 0 \quad \text{б) } (x-3)^2 + (y-2)^2 = 9 \quad \text{в) } \frac{x^2}{9} + \frac{y^2}{25} = 1 \quad \text{г) } \frac{x^2}{49} - \frac{y^2}{25} = -1 \quad \text{д) } x^2 = 2y$$

$$22.4 \text{ а) } y = 4x - 2 \quad \text{б) } (x+5)^2 + (y-1)^2 = 1 \quad \text{в) } \frac{x^2}{16} + \frac{y^2}{36} = 1 \quad \text{г) } \frac{x^2}{25} - \frac{y^2}{4} = -1 \quad \text{д) } y^2 = 7x$$

$$22.5 \text{ а) } 5x + 2y + 20 = 0 \quad \text{б) } (x-5)^2 + (y+3)^2 = 4 \quad \text{в) } \frac{x^2}{4} + \frac{y^2}{49} = 1 \quad \text{г) } \frac{x^2}{16} - \frac{y^2}{9} = 1 \quad \text{д) } y^2 = -2x$$

$$22.6 \text{ а) } y = 2x + 5 \quad \text{б) } (x+1)^2 + (y-2)^2 = 16 \quad \text{в) } \frac{x^2}{36} + \frac{y^2}{25} = 1 \quad \text{г) } \frac{x^2}{25} - \frac{y^2}{16} = -1 \quad \text{д) } y^2 = 5x$$

$$22.7 \text{ а) } x + 2 = 0 \quad \text{б) } (x-1)^2 + (y+2)^2 = 36 \quad \text{в) } \frac{x^2}{4} + \frac{y^2}{9} = 1 \quad \text{г) } \frac{x^2}{16} - \frac{y^2}{4} = -1 \quad \text{д) } x^2 = -7y$$

$$22.8 \text{ а) } 2y - 6 = 0 \quad \text{б) } (x-3)^2 + (y+4)^2 = 25 \quad \text{в) } \frac{x^2}{25} + \frac{y^2}{16} = 1 \quad \text{г) } \frac{x^2}{64} - \frac{y^2}{25} = 1 \quad \text{д) } y^2 = 16x$$

$$22.9 \text{ а) } -\frac{x}{4} + \frac{y}{2} = 1 \quad \text{б) } (x+1)^2 + (y+1)^2 = 16 \quad \text{в) } \frac{x^2}{25} + \frac{y^2}{36} = 1 \quad \text{г) } \frac{x^2}{16} - \frac{y^2}{9} = -1 \quad \text{д) } y^2 = -6x$$

$$22.10 \text{ а) } 2x - 4 = 0 \quad \text{б) } (x+3)^2 + (y+3)^2 = 4 \quad \text{в) } \frac{x^2}{49} + \frac{y^2}{25} = 1 \quad \text{г) } \frac{x^2}{36} - \frac{y^2}{9} = 1 \quad \text{д) } y^2 = 3x$$

$$22.11 \text{ а) } 2x - y + 1 = 0 \quad \text{б) } (x+1)^2 + (y-5)^2 = 4 \quad \text{в) } \frac{x^2}{9} + \frac{y^2}{16} = 1 \quad \text{г) } \frac{x^2}{49} - \frac{y^2}{9} = -1 \quad \text{д) } x^2 = 3y$$

$$22.12 \text{ а) } 4x + 2y + 8 = 0 \quad \text{б) } (x-1)^2 + (y+1)^2 = 1 \quad \text{в) } \frac{x^2}{16} + \frac{y^2}{4} = 1 \quad \text{г) } \frac{x^2}{9} - \frac{y^2}{4} = 1 \quad \text{д) } y^2 = 4x$$

$$22.13 \text{ а) } 2x - 4y + 8 = 0 \quad \text{б) } (x+4)^2 + (y-3)^2 = 25 \quad \text{в) } \frac{x^2}{16} + \frac{y^2}{25} = 1 \quad \text{г) } \frac{x^2}{64} - \frac{y^2}{25} = -1 \quad \text{д) } y^2 = -x$$

$$22.14 \text{ а) } y = -3x + 7 \quad \text{б) } (x+2)^2 + (y-1)^2 = 36 \quad \text{в) } \frac{x^2}{9} + \frac{y^2}{4} = 1 \quad \text{г) } \frac{x^2}{16} - \frac{y^2}{4} = 1 \quad \text{д) } x^2 = -2y$$

$$22.15 \text{ а) } \frac{x}{3} - \frac{y}{4} = 1 \quad \text{б) } (x-3)^2 + (y-3)^2 = 4 \quad \text{в) } \frac{x^2}{25} + \frac{y^2}{49} = 1 \quad \text{г) } \frac{x^2}{36} - \frac{y^2}{9} = -1 \quad \text{д) } y^2 = -8x$$

$$22.16 \text{ а) } 3x + 2y + 6 = 0 \quad \text{б) } (x-4)^2 + (y+2)^2 = 49 \quad \text{в) } \frac{x^2}{49} + \frac{y^2}{36} = 1 \quad \text{г) } \frac{x^2}{25} - \frac{y^2}{9} = 1 \quad \text{д) } y^2 = 6x$$

$$22.17 \text{ а) } x + 3 = 0 \quad \text{б) } (x+1)^2 + (y-1)^2 = 1 \quad \text{в) } \frac{x^2}{4} + \frac{y^2}{16} = 1 \quad \text{г) } \frac{x^2}{9} - \frac{y^2}{4} = -1 \quad \text{д) } x^2 = 9y$$

$$22.18 \text{ а) } 2y + 6 = 0 \quad \text{б) } (x+4)^2 + (y-4)^2 = 9 \quad \text{в) } \frac{x^2}{36} + \frac{y^2}{9} = 1 \quad \text{г) } \frac{x^2}{36} - \frac{y^2}{16} = 1 \quad \text{д) } y^2 = x$$

$$22.19 \text{ а) } 2x - 5y - 10 = 0 \quad \text{б) } (x+2)^2 + (y-4)^2 = 49 \quad \text{в) } \frac{x^2}{36} + \frac{y^2}{49} = 1 \quad \text{г) } \frac{x^2}{25} - \frac{y^2}{9} = -1 \quad \text{д) } x^2 = 5y$$

- 22.20 а) $5x - 2y + 10 = 0$ б) $(x - 5)^2 + (y + 1)^2 = 4$ в) $\frac{x^2}{16} + \frac{y^2}{9} = 1$ г) $\frac{x^2}{49} - \frac{y^2}{9} = 1$ д) $y^2 = 8x$
- 22.21 а) $\frac{x}{2} + \frac{y}{3} = 1$ б) $(x - 4)^2 + (y + 4)^2 = 9$ в) $\frac{x^2}{9} + \frac{y^2}{36} = 1$ г) $\frac{x^2}{36} - \frac{y^2}{16} = -1$ д) $x^2 = 16y$
- 22.22 а) $2x - 4y - 8 = 0$ б) $(x + 5)^2 + (y - 6)^2 = 16$ в) $\frac{x^2}{25} + \frac{y^2}{4} = 1$ г) $\frac{x^2}{36} - \frac{y^2}{25} = 1$ д) $y^2 = -9x$
- 22.23 а) $2x - 3y + 6 = 0$ б) $(x - 6)^2 + (y + 5)^2 = 16$ в) $\frac{x^2}{4} + \frac{y^2}{25} = 1$ г) $\frac{x^2}{36} - \frac{y^2}{25} = -1$ д) $x^2 = 4y$
- 22.24 а) $\frac{x}{2} - \frac{y}{5} = 1$ б) $(x - 1)^2 + (y + 5)^2 = 1$ в) $\frac{x^2}{36} + \frac{y^2}{16} = 1$ г) $\frac{x^2}{25} - \frac{y^2}{4} = 1$ д) $y^2 = -7x$
- 22.25 а) $3x + y - 3 = 0$ б) $(x + 1)^2 + (y - 3)^2 = 25$ в) $\frac{x^2}{49} + \frac{y^2}{9} = 1$ г) $\frac{x^2}{49} - \frac{y^2}{16} = 1$ д) $x^2 = 6y$
- 22.26 а) $x - 2y + 1 = 0$ б) $(x - 3)^2 + (y + 1)^2 = 25$ в) $\frac{x^2}{9} + \frac{y^2}{49} = 1$ г) $\frac{x^2}{49} - \frac{y^2}{9} = -1$ д) $y^2 = -5x$
- 22.27 а) $-\frac{x}{3} - \frac{y}{3} = 1$ б) $(x - 3)^2 + (y - 2)^2 = 36$ в) $\frac{x^2}{64} + \frac{y^2}{25} = 1$ г) $\frac{x^2}{36} - \frac{y^2}{4} = 1$ д) $x^2 = y$
- 22.28 а) $2x + y + 3 = 0$ б) $(x - 2)^2 + (y - 3)^2 = 36$ в) $\frac{x^2}{16} + \frac{y^2}{49} = 1$ г) $\frac{x^2}{36} - \frac{y^2}{4} = -1$ д) $y^2 = -16x$
- 22.29 а) $x - 2y + 4 = 0$ б) $(x + 2)^2 + (y + 4)^2 = 49$ в) $\frac{x^2}{49} + \frac{y^2}{16} = 1$ г) $\frac{x^2}{64} - \frac{y^2}{36} = 1$ д) $x^2 = 8y$
- 22.30 а) $2x - y + 4 = 0$ б) $(x + 4)^2 + (y + 2)^2 = 49$ в) $\frac{x^2}{25} + \frac{y^2}{64} = 1$ г) $\frac{x^2}{64} - \frac{y^2}{36} = -1$ д) $y^2 = 2x$

23. Уравнение определяет невырожденную действительную алгебраическую кривую второго порядка. Назвать кривую 2-ого порядка и построить её.

- 23.1 $x^2 + y^2 - 4x + 6y - 3 = 0$ 23.2 $5x^2 + 9y^2 - 30x + 18y + 9 = 0$
- 23.3 $16x^2 - 9y^2 - 64x - 54y - 161 = 0$ 23.4 $x^2 - 4x - y - 5 = 0$
- 23.5 $x^2 + y^2 - 4y + 3 = 0$ 23.6 $9x^2 - 16y^2 + 90x + 32y - 367 = 0$
- 23.7 $16x^2 + 25y^2 + 32x - 100y - 284 = 0$ 23.8 $x + y^2 - 2y + 3 = 0$
- 23.9 $x^2 + y^2 - 6x + 5 = 0$ 23.10 $4x^2 + 3y^2 - 8x + 12y - 32 = 0$
- 23.11 $16x^2 - 9y^2 - 64x - 18y - 89 = 0$ 23.12 $x^2 + 2y^2 - 4x + 4y + 2 = 0$
- 23.13 $x^2 + y^2 + 10x - 4y + 13 = 0$ 23.14 $x^2 + y^2 - 8x + 6y = 0$
- 23.15 $x^2 + 4x + y + 3 = 0$ 23.16 $x + 2y^2 + 4y + 1 = 0$
- 23.17 $4x^2 - 5y^2 + 20x + 30y + 10 = 0$ 23.18 $x^2 - y^2 - 4x + 6y - 9 = 0$
- 23.19 $y^2 - 4y - 4x - 8 = 0$ 23.20 $x^2 + y^2 - 4x - 4y - 12 = 0$
- 23.21 $9x^2 + 4y^2 - 18x + 16y - 11 = 0$ 23.22 $4x^2 - 9y^2 - 8x - 18y - 41 = 0$
- 23.23 $x^2 - 2x + y - 3 = 0$ 23.24 $x^2 + y^2 + 6x - 10y + 30 = 0$
- 23.25 $4x^2 + y^2 + 24x - 4y + 36 = 0$ 23.26 $9x^2 - 16y^2 - 3y - 160 = 0$
- 23.27 $y^2 + x - 4y + 6 = 0$ 23.28 $x^2 + y^2 + 2x - 4y + 11 = 0$
- 23.29 $2x^2 + y^2 + 4x - 2 = 0$ 23.30 $4x^2 - 9y^2 - 16x + 54y - 29 = 0$

24. Даны комплексные числа z_1, z_2 . Выполнить над комплексными числами следующие действия: $\overline{z_1 + z_2}$, z_2^2 , $z_1 z_2$, z_1 / z_2 .

24.1 $z_1 = 5 + 10i$, $z_2 = 2 - i$

24.2 $z_1 = 1 - 5i$, $z_2 = 2 + 3i$

24.3 $z_1 = -8 + 4i$, $z_2 = 3 + i$

24.4 $z_1 = 4 - 16i$, $z_2 = 5 - 3i$

24.5 $z_1 = 2 - 4i$, $z_2 = 3 - i$

24.6 $z_1 = 15 + 10i$, $z_2 = 2 - 3i$

24.7 $z_1 = 18 + 12i$, $z_2 = 5 - i$

24.8 $z_1 = -5 + i$, $z_2 = 3 + 2i$

24.9 $z_1 = 6 - 3i$, $z_2 = 1 + 2i$

24.10 $z_1 = 6 + 2i$, $z_2 = -1 + 3i$

24.11 $z_1 = 8 + 3i$, $z_2 = 8 + 6i$

24.12 $z_1 = 2 - 5i$, $z_2 = 6 - 8i$

24.13 $z_1 = 3 + 7i$, $z_2 = -8 + 6i$

24.14 $z_1 = 4 - i$, $z_2 = 5 + 3i$

24.15 $z_1 = 2 + 3i$, $z_2 = 3 - 2i$

24.16 $z_1 = 5 + 4i$, $z_2 = 2 + 3i$

24.17 $z_1 = 8 + 2i$, $z_2 = 2 - i$

24.18 $z_1 = 4 - 3i$, $z_2 = 3 + 4i$

24.19 $z_1 = 1 + 2i$, $z_2 = 6 + i$

24.20 $z_1 = 3 + 5i$, $z_2 = 5 + 2i$

24.21 $z_1 = 3 + 4i$, $z_2 = 5 + i$

24.22 $z_1 = 2 + 4i$, $z_2 = 7 - i$

24.23 $z_1 = 4 + i$, $z_2 = 2 + 5i$

24.24 $z_1 = 9 - 2i$, $z_2 = 1 + 7i$

24.25 $z_1 = 8 + 5i$, $z_2 = 2 - 2i$

24.26 $z_1 = 1 + 3i$, $z_2 = 3 + 5i$

24.27 $z_1 = 4 + 3i$, $z_2 = 3 - 5i$

24.28 $z_1 = 1 + 4i$, $z_2 = 5 - 4i$

24.29 $z_1 = 2 - 6i$, $z_2 = 5 + 4i$

24.30 $z_1 = 7 + 2i$, $z_2 = 4 - 2i$

25. Дано алгебраическое уравнение $a_0 z^n + a_1 z^{n-1} + \dots + a_{n-1} z + a_n = 0$. Найти все корни алгебраического уравнения на множестве комплексных чисел.

25.1 $z^2 + 2z + 5 = 0$

25.2 $z^2 + 9 = 0$

25.3 $4z^2 - 2z + 1 = 0$

25.4 $z^2 - z + 1 = 0$

25.5 $z^3 - 8 = 0$

25.6 $z^2 + 4z + 13 = 0$

25.7 $z^2 - 2z + 10 = 0$

25.8 $z^3 + 16z = 0$

25.9 $z^2 + 6z + 13 = 0$

25.10 $z^2 - 6z + 25 = 0$

25.11 $z^3 + 27 = 0$

25.12 $z^2 + 16 = 0$

25.13 $z^2 + 4z + 5 = 0$

25.14 $z^2 + 2z + 2 = 0$

25.15 $z^2 - 8z + 20 = 0$

25.16 $z^2 + 2z + 10 = 0$

25.17 $z^3 + 25z = 0$

25.18 $z^2 + 8z + 20 = 0$

25.19 $z^2 - 4z + 5 = 0$

25.20 $z^2 - 8z + 17 = 0$

25.21 $z^3 + 9z = 0$

25.22 $z^2 - 2z + 2 = 0$

25.23 $z^2 + 4 = 0$

25.24 $z^2 + 6z + 25 = 0$

25.25 $z^3 + 8 = 0$

25.26 $z^2 - 2z + 5 = 0$

25.27 $z^3 + 4z = 0$

25.28 $z^2 - 2z + 29 = 0$

25.29 $z^2 + 25 = 0$

25.30 $z^3 - 27 = 0$