Chapter 12 Determinants and Systems of Linear Equations

EXERCISE 12A

(*) Out syl after HKDSE 2022

Level 1

1. Consider $\begin{vmatrix} 1 & 0 & 1 \\ 2 & -1 & 0 \\ 3 & 1 & 2 \end{vmatrix}$.
   - **(a)** Find M_{13}.
   - **(b)** Find A_{31}.
   - **(c)** Find A_{12}.

2. Consider $\begin{vmatrix} 9 & 0 & 3 \\ 8 & 8 & 1 \\ 9 & 9 & 7 \end{vmatrix}$.
   - **(a)** Find M_{23}.
   - **(b)** Find A_{32}.
   - **(c)** Find A_{21}.

3. Consider $\begin{vmatrix} 1 & -6 & 1 \\ 2 & 3 & -4 \\ 5 & -7 & 2 \end{vmatrix}$.
   - **(a)** Find M_{12}.
   - **(b)** Find A_{21}.
   - **(c)** Find A_{32}.

4. Find the value of $\begin{vmatrix} 4 & 5 & 6 \\ 2 & 0 & -1 \\ 1 & 2 & 1 \end{vmatrix}$ by the following methods.
   - **(a)** Expand along the 2nd column.
   - **(b)** Expand along the 2nd row.

Properties of determinants:

$$\begin{vmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{vmatrix} = \begin{vmatrix} a_1 & a_2 & a_3 \\ b_1 & b_2 & b_3 \\ c_1 & c_2 & c_3 \end{vmatrix}$$

$$\begin{vmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{vmatrix} = -\begin{vmatrix} c_1 & b_1 & a_1 \\ c_2 & b_2 & a_2 \\ c_3 & b_3 & a_3 \end{vmatrix}$$

$$\begin{vmatrix} a_1 & b_1 & 0 \\ a_2 & b_2 & 0 \\ a_3 & b_3 & 0 \end{vmatrix} = 0$$

$$\begin{vmatrix} a_1 & kb_1 & c_1 \\ a_2 & kb_2 & c_2 \\ a_3 & kb_3 & c_3 \end{vmatrix} = k\begin{vmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{vmatrix}$$

$$\begin{vmatrix} a_1 & b_1 & kb_1 \\ a_2 & b_2 & kb_2 \\ a_3 & b_3 & kb_3 \end{vmatrix} = 0$$

$$\begin{vmatrix} a_1+a_1' & b_1 & c_1 \\ a_2+a_2' & b_2 & c_2 \\ a_3+a_3' & b_3 & c_3 \end{vmatrix} = \begin{vmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{vmatrix} + \begin{vmatrix} a_1' & b_1 & c_1 \\ a_2' & b_2 & c_2 \\ a_3' & b_3 & c_3 \end{vmatrix}$$

$$\begin{vmatrix} a_1+kb_1 & b_1 & c_1 \\ a_2+kb_2 & b_2 & c_2 \\ a_3+kb_3 & b_3 & c_3 \end{vmatrix} = \begin{vmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{vmatrix}$$

$$\begin{vmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{vmatrix} = a_1\begin{vmatrix} b_2 & c_2 \\ b_3 & c_3 \end{vmatrix} - a_2\begin{vmatrix} b_1 & c_1 \\ b_3 & c_3 \end{vmatrix} + a_3\begin{vmatrix} b_1 & c_1 \\ b_2 & c_2 \end{vmatrix}$$

5. Find the value of $\begin{vmatrix} 2 & 1 & 0 \\ -1 & -1 & 2 \\ 1 & 1 & 3 \end{vmatrix}$ by the following methods.

(a) Expand along the 1st row.
(b) Expand along the 1st column.

6. Find the value of $\begin{vmatrix} 7 & 2 \\ 3 & 8 \end{vmatrix}$.

7. Find the value of $\begin{vmatrix} -1 & 2 \\ 3 & -4 \end{vmatrix}$.

8. Find the value of $\begin{vmatrix} -11 & -2 \\ 9 & 3 \end{vmatrix}$.

Level 2

9. Find the value of $\begin{vmatrix} 1 & 0 & 1 \\ 0 & 1 & 2 \\ 3 & 4 & 1 \end{vmatrix}$.

10. Find the value of $\begin{vmatrix} 1 & -2 & 3 \\ -1 & 4 & 2 \\ 2 & 1 & -2 \end{vmatrix}$.

11. Find the value of $\begin{vmatrix} 3 & 1 & -2 \\ 4 & 5 & -6 \\ 2 & -2 & 3 \end{vmatrix}$.

12. Find the value of $\begin{vmatrix} 4 & 7 & 2 \\ 8 & -1 & -3 \\ 9 & -2 & 1 \end{vmatrix}$.

13. Find the value of $\begin{vmatrix} 2 & 0 & 1 \\ 1 & 4 & -2 \\ -5 & 0 & 3 \end{vmatrix}$ by cofactor expansion.

14. Find the value of $\begin{vmatrix} 7 & -2 & 2 \\ 5 & 8 & 0 \\ -1 & -4 & 6 \end{vmatrix}$ by cofactor expansion.

15. Find the value of $\begin{vmatrix} -1 & -1 & 5 \\ 2 & 2 & -10 \\ 4 & 0 & 3 \end{vmatrix}$ by cofactor expansion.

16. Find the value of $\begin{vmatrix} 2 & -1 & 3 \\ 4 & 5 & 7 \\ -2 & 1 & -3 \end{vmatrix}$ by cofactor expansion.

17. Find the value of $\begin{vmatrix} 2 & 1 & 3 \\ 3 & 1 & 4 \\ -1 & 1 & 5 \end{vmatrix}$ by cofactor expansion.

18. Find the value of $\begin{vmatrix} 7 & -2 & 4 \\ -5 & 2 & 1 \\ 2 & -6 & 3 \end{vmatrix}$ by cofactor expansion.

19. Solve the equation $\begin{vmatrix} x & 2 \\ 5 & 7 \end{vmatrix} = 4$.

20. Solve the equation $\begin{vmatrix} -3 & x \\ 5 & 6 \end{vmatrix} = 2$.

21. Solve the equation $\begin{vmatrix} x & 2x \\ 3 & 4 \end{vmatrix} = 14$.

22. Solve the equation $\begin{vmatrix} x & 2x \\ x & 6 \end{vmatrix} = -20$.

Level 3

23. Solve the equation $\begin{vmatrix} 2 & 1 & 0 \\ x & 2 & 1 \\ 1 & -1 & 3 \end{vmatrix} = 9.$

24. Solve the equation $\begin{vmatrix} 1 & 0 & 1 \\ -2 & -4 & 3 \\ x & 1 & 2x \end{vmatrix} = 11.$

25. Solve the equation $\begin{vmatrix} 2 & x & 1 \\ 0 & -5 & x \\ 1 & 1 & 2 \end{vmatrix} = -7.$

26. Solve the equation $\begin{vmatrix} x & 2 & x \\ -1 & x & 3 \\ x & 2 & 1 \end{vmatrix} = 0.$

27. Solve the equation $\begin{vmatrix} \sin\theta & \sin\theta \\ 2 & \sin\theta \end{vmatrix} = -1$, where $0° \le \theta \le 360°$.

EXERCISE 12B

Out Syl : Ex 12B (28-61)

Level 1

28. Find the value of each of the following determinants.

(a) $\begin{vmatrix} 7 & 7 \\ 8 & 8 \end{vmatrix}$

(b) $\begin{vmatrix} 3 & 6 & 9 \\ 7 & 6 & 5 \\ 6 & 12 & 18 \end{vmatrix}$

29. Find the value of each of the following determinants.

(a) $\begin{vmatrix} 9 & 1 & 8 \\ 1 & 0 & 1 \\ 9 & 1 & 8 \end{vmatrix}$

(b) $\begin{vmatrix} p & p-1 & 2p \\ q & q-1 & 2q \\ r & r-1 & 2r \end{vmatrix}$

Out Syl : Ex 12B (28-61)

30. Without evaluating the determinant, find the unknown in the following.

$$\begin{vmatrix} 3 & 7 \\ 2 & 1 \end{vmatrix} = \begin{vmatrix} 3 & 2 \\ 7 & x \end{vmatrix}$$

31. Without evaluating the determinant, find the unknown in the following.

$$\begin{vmatrix} -1 & 8 \\ 8 & -2 \end{vmatrix} = -\begin{vmatrix} -1 & x \\ 8 & 2 \end{vmatrix}$$

32. Without evaluating the determinant, find the unknown in the following.

$$\begin{vmatrix} 4 & 6 \\ 8 & 7 \end{vmatrix} = -\begin{vmatrix} 6 & 4 \\ -7 & x \end{vmatrix}$$

33. Without evaluating the determinant, find the unknown in the following.

$$\begin{vmatrix} 1 & 3 \\ 2 & 4 \end{vmatrix} = x\begin{vmatrix} 4 & 6 \\ 8 & 8 \end{vmatrix}$$

34. Without evaluating the determinant, find the unknown in the following.

$$\begin{vmatrix} 1 & 2 & 1 \\ 1 & 4 & 4 \\ 1 & 6 & 9 \end{vmatrix} = x\begin{vmatrix} 1 & 1 & 1 \\ 1 & 4 & 2 \\ 1 & 9 & 3 \end{vmatrix}$$

35. Without evaluating the determinant, find the unknown in the following.

$$\begin{vmatrix} 3 & 1 & 9 \\ 3 & 5 & 1 \\ 4 & 7 & 8 \end{vmatrix} = \begin{vmatrix} 3 & -5 & 9 \\ 3 & -1 & 1 \\ 4 & x & 8 \end{vmatrix}$$

36. Without evaluating the determinant, find the unknown in the following.

$$\begin{vmatrix} 1 & 0 & 1 \\ 2 & -3 & -4 \\ 1 & 1 & 2 \end{vmatrix} = \begin{vmatrix} 1 & 2 & 3 \\ 0 & -1 & x \\ 1 & -4 & 6 \end{vmatrix}$$

37. Without evaluating the determinant, find the unknown in the following.

$$\begin{vmatrix} 2 & 3 & 5 \\ 4 & 4 & 2 \\ 4 & 3 & 3 \end{vmatrix} = -2\begin{vmatrix} 2 & 4 & 2 \\ 3 & 3 & y \\ 5 & 3 & 1 \end{vmatrix}$$

Level 2

38. Simplify $\begin{vmatrix} 3 & 1 & -2 \\ 0 & -1 & 2 \\ 1 & 4 & 2 \end{vmatrix}$, and evaluate the determinant by expanding it along the 1st column.

39. Simplify $\begin{vmatrix} -4 & 1 & -5 \\ 2 & 0 & 1 \\ 3 & 2 & 6 \end{vmatrix}$, and evaluate the determinant by expanding it along the 2nd row.

40. Simplify $\begin{vmatrix} 2 & 6 & 5 \\ -4 & -1 & 2 \\ 1 & 3 & 2 \end{vmatrix}$, and evaluate the determinant by expanding it along the 1st row.

41. Simplify $\begin{vmatrix} 6 & -1 & 2 \\ 12 & 4 & 5 \\ 9 & -5 & 3 \end{vmatrix}$, and evaluate the determinant by expanding it along the 3rd column.

42. If $\begin{vmatrix} p & q \\ r & s \end{vmatrix} = 3$, find the value of $\begin{vmatrix} p+r & r \\ q+s & s \end{vmatrix}$.

43. If $\begin{vmatrix} p & q \\ r & s \end{vmatrix} = 2$, find the value of $\begin{vmatrix} 3r+3s & 2s \\ 3p+3q & 2q \end{vmatrix}$.

44. If $\begin{vmatrix} a & b & c \\ p & q & r \\ x & y & z \end{vmatrix} = 5$, find the value of $\begin{vmatrix} p & q & r \\ a+2p & b+2q & c+2r \\ 3x-a & 3y-b & 3z-r \end{vmatrix}$.

Out Syl : Ex 12B (28-61)

45. If $\begin{vmatrix} a & b & c \\ p & q & r \\ x & y & z \end{vmatrix} = 7$, find the value of $\begin{vmatrix} 2a & 2c & 2b \\ p & r & q \\ x+a+p & z+c+r & y+b+q \end{vmatrix}$.

46. Prove that $\begin{vmatrix} a+1 & b & c \\ a & b+1 & c \\ a & b & c+1 \end{vmatrix} = a+b+c+1.$

47. Prove that $\begin{vmatrix} x^4 & x^2 & 1 \\ y^4 & y^2 & 1 \\ z^4 & z^2 & 1 \end{vmatrix} = (y^2-x^2)(z^2-x^2)(y^2-z^2).$

48. Prove that $\begin{vmatrix} 1 & x & x^3 \\ 1 & y & y^3 \\ 1 & z & z^3 \end{vmatrix} = (x-y)(y-z)(z-x)(x+y+z).$

49. Prove that $\begin{vmatrix} k^7 & k^3 & 1 \\ k^5 & k^2 & 1 \\ k^3 & k & 1 \end{vmatrix} = k^5(k-1)^3(k+1).$

50. Prove that $\begin{vmatrix} x & x & x \\ \sin^2 x & \sin^2 y & \sin^2 z \\ \cos^2 x & \cos^2 y & \cos^2 z \end{vmatrix} = 0.$

51. Prove that $\begin{vmatrix} \sin\theta & \sin\theta+\cos\theta & 1 \\ -\cos\theta & \sin^2\theta\cos^2\theta & \tan\theta \\ \sin\theta & \sin\theta & 1 \end{vmatrix} = 1.$

52.(a) Prove that $\begin{vmatrix} x+1 & 1 & 1 \\ 1 & y+1 & 1 \\ 1 & 1 & z+1 \end{vmatrix} = xy+yz+zx+xyz.$

(b) Hence find the value of $\begin{vmatrix} 4 & 1 & 1 \\ 1 & 5 & 1 \\ 1 & 1 & 6 \end{vmatrix}$.

53. **(a)** Prove that $\begin{vmatrix} 1 & a & bc \\ 1 & b & ac \\ 1 & c & ab \end{vmatrix} = (a-b)(b-c)(c-a)$.

(b) Hence find the value of $\begin{vmatrix} 1 & 2 & 12 \\ 1 & 3 & 8 \\ 1 & 4 & 6 \end{vmatrix}$.

54. Factorize $\begin{vmatrix} x+y & y & z \\ y+z & z & x \\ z+x & x & y \end{vmatrix}$.

55. Factorize $\begin{vmatrix} n & n & m \\ n & m & n \\ m & n & n \end{vmatrix}$.

56. Factorize $\begin{vmatrix} m+n & n & m \\ m & m+n & n \\ n & m & m+n \end{vmatrix}$.

57. **(a)** Prove that $\begin{vmatrix} x & x^2 & yz \\ y & y^2 & xz \\ z & z^2 & xy \end{vmatrix} = (x-y)(y-z)(z-x)(xy+yz+xz)$.

(b) Hence find the value of $\begin{vmatrix} 2 & 1 & 6 \\ 4 & 4 & 3 \\ 6 & 9 & 2 \end{vmatrix}$.

58. **(a)** Factorize $\begin{vmatrix} 1 & 1 & 1 \\ yz & xz & xy \\ x^2 & y^2 & z^2 \end{vmatrix}$.

(b) Hence find the value of $\begin{vmatrix} 1 & 30 & 16 \\ 1 & 24 & 25 \\ 1 & 20 & 36 \end{vmatrix}$.

Out Syl : Ex 12B (28-61)

59. Given that $x_1, x_2, x_3, x_4, x_5, x_6, x_7, x_8, x_9$ form a geometric sequence, find the value of
$\begin{vmatrix} x_1 & x_2 & x_3 \\ x_4 & x_5 & x_6 \\ x_7 & x_8 & x_9 \end{vmatrix}$.

60. Given that $x_1, x_2, x_3, x_4, x_5, x_6, x_7, x_8, x_9$ form a geometric sequence, find the value of
$\begin{vmatrix} x_1 & x_4 & x_7 \\ x_2 & x_5 & x_8 \\ x_3 & x_6 & x_9 \end{vmatrix}$.

61. Given that $F_1, F_2, F_3, \cdots$ is the Fibonacci sequence (i.e. $F_1 = F_2 = 1$, $F_n = F_{n-2} + F_{n-1}$, where $n > 2$), find the value of $\begin{vmatrix} F_{11} & F_{14} & F_{17} \\ F_{12} & F_{15} & F_{18} \\ F_{13} & F_{16} & F_{19} \end{vmatrix}$.

EXERCISE 12C

Level 1

62. Solve the system of linear equations $\begin{cases} 2x + y = 4 \\ 3x - 2y = -1 \end{cases}$ by Cramer's rule.

63. Solve the system of linear equations $\begin{cases} 3x - 5y = 1 \\ 4x - 3y = 5 \end{cases}$ by Cramer's rule.

64. Solve the system of linear equations $\begin{cases} -7x + 5y = 12 \\ 2x - 3y = -5 \end{cases}$ by Cramer's rule.

65. Solve the system of linear equations $\begin{cases} 2x - 5y = -19 \\ -7x + 2y = 20 \end{cases}$ by Cramer's rule.

66. Solve the system of linear equations $\begin{cases} 9x + 5y = -46 \\ 7x - 2y = -24 \end{cases}$ by Cramer's rule.

67. Solve the system of linear equations $\begin{cases} x - y + 2z = -2 \\ 4x - y + 2z = 1 \end{cases}$ by Cramer's rule.

68. Solve the system of linear equations $\begin{cases} 2x - 3y + z = 7 \\ 4x + 5y - z = -3 \\ x + y - z = -2 \end{cases}$ by Cramer's rule.

69. Solve the system of linear equations $\begin{cases} 2x - 5y + z = 7 \\ -x + 4y + 2z = 7 \\ 3x - 11y - z = -4 \end{cases}$ by Cramer's rule.

70. Solve the system of linear equations $\begin{cases} 2x - 3y + 4z = 15 \\ -x + 2y + 3z = 2 \\ 4x + 2y + 5z = 16 \end{cases}$ by Cramer's rule.

71. Solve the system of linear equations $\begin{cases} 11x + 7y + 5z = -8 \\ -4x - 9y - 8z = -21 \\ 9x - 4y + 2z = 8 \end{cases}$ by Cramer's rule.

Level 2

72. Determine whether the system of equations $\begin{cases} x - 2y = 1 \\ 2x - 4y = 3 \end{cases}$ has solutions. If it does, solve the system of equations.

73. Determine whether the system of equations $\begin{cases} x + 3y = 2 \\ 3x + 9y = 5 \end{cases}$ has solutions. If it does, solve the system of equations.

74. Determine whether the system of equations $\begin{cases} 4x - 3y = -2 \\ 2x + y = 4 \end{cases}$ has solutions. If it does, solve the system of equations.

75. Determine whether the system of equations $\begin{cases} 3x + 2y = 2 \\ 7x - 3y = -26 \end{cases}$ has solutions. If it does, solve the system of equations.

76. Determine whether the system of equations $\begin{cases} x - y = 2 \\ 3x - 3y = 6 \end{cases}$ has solutions. If it does, solve the system of equations.

77. Determine whether the system of equations $\begin{cases} x + 5y = -8 \\ -4x - 20y = 32 \end{cases}$ has solutions. If it does, solve the system of equations.

78. Determine whether the system of equations $\begin{cases} x - y + z = 1 \\ 2x - 2y + 3z = 3 \\ 4x - 4y + 4z = 3 \end{cases}$ has solutions. If it does, solve the system of equations.

79. Determine whether the system of equations $\begin{cases} 3x + y - 2z = 4 \\ 6x + y - 2z = 5 \\ 6x + 2y - 4z = 7 \end{cases}$ has solutions. If it does, solve the system of equations.

80. Determine whether the system of equations $\begin{cases} 2x - y + z = 1 \\ 3x - 2y - z = -2 \\ x + y - z = 2 \end{cases}$ has solutions. If it does, solve the system of equations.

81. Determine whether the system of equations $\begin{cases} x - y + z = 2 \\ 2x + y + 4z = -3 \\ x - 4y - 6z = 4 \end{cases}$ has solutions. If it does, solve the system of equations.

82. Determine whether the system of equations $\begin{cases} x - y - z = -2 \\ 3x + y + 5z = 14 \\ 3x - y + z = 4 \end{cases}$ has solutions. If it does, solve the system of equations.

83. Determine whether the system of equations $\begin{cases} x + y - z = -2 \\ 2x + y - 4z = -9 \\ 2x - y - 8z = -19 \end{cases}$ has solutions. If it does, solve the system of equations.

84. Find the range of values of k such that the following system of equations has a unique solution.

$\begin{cases} 2x - 3y = 4 \\ ky + z = 5 \\ x - y + z = 3 \end{cases}$, where k is a real number.

85. Find the range of values of k such that the following system of equations has a unique solution.

$$\begin{cases} x - y + z = 2 \\ 2x - y - kz = 1 \\ 3x + 2y + 5z = -3 \end{cases}$$, where k is a real number.

86. Consider the system of equations (*) $\begin{cases} x - y + z = 2 \\ x + ky + z = 1 \\ 2x - y + 3z = 4 \end{cases}$, where k is a real number.

(a) Find the value of k such that the system (*) has no unique solution.

(b) For the value of k obtained in (**a**), determine whether the system (*) has solutions.

87. Consider the system of equations (*) $\begin{cases} x + z = 1 \\ y - kz = 2 \\ x - y + z = 3 \end{cases}$, where k is a real number.

(a) Find the value of k such that the system (*) has no unique solution.

(b) For the value of k obtained in (**a**), determine whether the system (*) has solutions.

88. Consider the system of equations (*) $\begin{cases} ax + by = 1 \\ ax + (b + c)y + az = 1 \\ (a + c)x + by + bz = 1 \end{cases}$, prove that (*) has a unique solution when all a, b and c are not equal to zero.

89. If the system of equations $\begin{cases} x + y - 2z = p \\ x + y - 8z = p \\ 2x + 2y + 6z = p^2 \end{cases}$ has solutions, where p is a non-zero real number, find the value of p and solve the system of equations.

90. **(a)** Solve the equation $\begin{vmatrix} x & 1 & 1 \\ 1 & x & 1 \\ 1 & 1 & x \end{vmatrix} = 0$.

(b) Consider the system of equations (*) $\begin{cases} kx + y + z = 1 \\ x + ky + z = k \\ x + y + kz = k^2 \end{cases}$, where k is a real number.

(i) Find the range of values of k such that (*) has a unique solution.

(ii) Suppose that $k = -2$. Solve (*).

91. Consider the system of equations (*) $\begin{cases}(k-1)x+y+z=1\\ x+(k-1)y+z=k\\ x+y+(k-1)z=k^2\end{cases}$, where k is a real number.

(a) Find the range of values of k such that (*) has a unique solution.

(b) Solve (*) when it has a unique solution.

(c) Suppose that $k=2$. Solve (*).

92. Consider the system of equations (*) $\begin{cases}kx-2y+z=0\\ -x+ky+z=-k\\ k^2x+(k-2)y-z=k\end{cases}$, where k is a real number.

(a) Find the range of values of k such that (*) has a unique solution.

(b) Suppose that $k=1$. Solve (*).

(c) Suppose (x, y, z) satisfies $\begin{cases}x-2y+z=0\\ -x+y+z=-1\\ x-y-z=1\end{cases}$. Find the least value of $2x^2+y^2+3z^2$ and the corresponding values of x, y, z.

93. (a) Prove that if the system of equations (*) $\begin{cases}ax+by+c=0\\ dx+ey+f=0\\ gx+hy+i=0\end{cases}$ is consistent, then $\Delta=\begin{vmatrix}a & d & g\\ b & e & h\\ c & f & i\end{vmatrix}=0$.

(b) If $\Delta=0$, is the system (*) consistent for sure?

94. (a) Consider the system of equations $\begin{cases}ax+by+cz=0\\ dx+ey+fz=0\end{cases}$, where $ae-bd\neq 0$.

Prove that $x:y:z=\begin{vmatrix}c & b\\ f & e\end{vmatrix}:\begin{vmatrix}a & c\\ d & f\end{vmatrix}:\begin{vmatrix}b & a\\ e & d\end{vmatrix}$.

(b) Hence solve the system of equations $\begin{cases}2x-y+z=0\\ x-2y-4z=0\\ x^3-y^3-3z^3=-128\end{cases}$.