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TUTGATHER PRACTICE PAPER

HONG KONG DIPLOMA OF SECONDARY EDUCATION EXAMINATION 2027

MATHEMATICS Extended Part Module M2
PAPER

Question-Answer Book

Candidate Number

TUTGATHER
PRACTICE PAPER · NOT AN OFFICIAL HKEAA PAPER

1 hour 5 minutes

This paper must be answered in English

Topic practice: Systems of Linear Equations

INSTRUCTIONS

(1) This paper consists of THREE sections, A(1), A(2) and B.

(2) Attempt ALL questions in this paper. Write your answers in the spaces provided in this Question-Answer Book. Do not write in the margins.

(3) Unless otherwise specified, all working must be clearly shown.

(4) Unless otherwise specified, numerical answers should be either exact or correct to 3 significant figures.

(5) The diagrams in this paper are not necessarily drawn to scale.

(6) Calculators and mathematical drawing instruments may be used.

(7) The marks for each question are shown in brackets.

(8) No extra time will be given after the 'Time is up' announcement.

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SECTION A(1) (16 marks)

1. Solve the system of linear equations **(3 marks)**

$$\begin{cases} 2x + y = 7 \\ x - 3y = -7 \end{cases}$$

for real numbers x and y.

2. Using Gaussian elimination, solve the system **(3 marks)**

$$\begin{cases} x + 2y - z = 3 \\ 2x + 3y + z = 1 \\ x - y + 2z = 6 \end{cases}$$

for real numbers x, y, z.

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3. Use Cramer's rule to solve the system **(4 marks)**

$$\begin{cases} 3x + 2y = 8 \\ 5x - 4y = -6 \end{cases}$$

for real numbers x and y.

4. Consider the system of linear equations in x, y, z **(6 marks)**

$$\begin{cases} x + y + z = 6 \\ 2x - y + z = 3 \\ x + 2y + kz = 9 \end{cases}$$

where k is a real constant.

(a) Find the value of k for which the system does **not** have a unique solution.

(b) For that value of k, determine whether the system has infinitely many solutions or no solution, and describe the solution set.

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SECTION A(2) (24 marks)

5. Consider the system **(7 marks)**

$$\begin{cases} x + 2y + 3z = 1 \\ 2x + 5y + (a + 5)z = 4 \\ x + 3y + (a^2 + 3)z = b \end{cases}$$

where a and b are real constants.

(a) Use Gaussian elimination to reduce the augmented matrix to row echelon form.

(b) Find the values of a and b for which the system has infinitely many solutions, and find those solutions.

(c) State the condition on a and b for the system to have no solution.

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6. (a) Using Cramer's rule, solve the system **(8 marks)**

$$\begin{cases} x + y + z = 2 \\ 2x - y + z = 1 \\ x + 2y - z = 5 \end{cases}$$

for real numbers x, y, z.

(b) Hence, or otherwise, solve the system

$$\begin{cases} x + y + z = 2 \\ 2x - y + z = 1 \\ x + 2y - z = 5 \\ 3x + 2y + 4z = c \end{cases}$$

for real numbers x, y, z, stating the value of c (if any) for which the fourth equation is consistent with the first three.

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7. A shop sells three types of gift box: small, medium and large. A small box costs \$20, a medium box \$35 and a large box \$50. On a certain day the shop sold 40 boxes in total and received \$1325. Let s, m and ℓ be the numbers of small, medium and large boxes sold. **(9 marks)**

(a) Write down a system of two linear equations in s, m, ℓ.

(b) Solve the system for s and m in terms of ℓ.

(c) Given that the number of large boxes sold is at least 5 and the number of small boxes sold is at least twice the number of large boxes, find all possible values of ℓ and the corresponding numbers of boxes sold.

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SECTION B (10 marks)

8. Consider the system of linear equations in x, y, z **(10 marks)**

$$\begin{cases} x + 2y + 3z = 1 \\ 2x + 5y + 8z = 3 \\ 3x + 8y + (\lambda + 8)z = \mu \end{cases}$$

where λ, μ are real constants.

(a) Use Gaussian elimination to reduce the augmented matrix to row echelon form, and express the last pivot in terms of λ.

(b) Find the values of λ and μ for which the system has (i) a unique solution, (ii) infinitely many solutions, (iii) no solution.

(c) For the case of infinitely many solutions, express the solution set in terms of a parameter t and verify your answer by substitution.

END OF PAPER

Answers written in the margins will not be marked.
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