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TUTGATHER PRACTICE PAPER

HONG KONG DIPLOMA OF SECONDARY EDUCATION EXAMINATION 2027

Candidate Number

MATHEMATICS Compulsory Part
PAPER 1

Question-Answer Book

TUTGATHER
PRACTICE PAPER · NOT AN OFFICIAL HKEAA PAPER

1 hour 5 minutes

This paper must be answered in English

Topic practice: Inequalities and Linear Programming

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 compound inequality $3x - 5 < 2x + 1 \leq 4x - 7$ and represent the solution on a number line. **(3 marks)**

2. Solve the quadratic inequality $2x^2 - 5x - 3 \leq 0$. **(3 marks)**

3. A factory produces two types of chairs, A and B. Each type A chair requires 2 hours of carpentry and 1 hour of painting. Each type B chair requires 1 hour of carpentry and 3 hours of painting. The factory has at most 40 hours of carpentry and at most 45 hours of painting available each day. Let x and y be the numbers of type A and type B chairs produced daily. Write down the system of inequalities that models the constraints, including the non-negativity conditions. **(4 marks)**

Answers written in the margins will not be marked.
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4. Consider the feasible region defined by **(6 marks)**

$$\begin{cases} x + y \leq 6, \\ x + 2y \leq 8, \\ x \geq 0, \\ y \geq 0. \end{cases}$$

(a) Find the coordinates of all vertices of the feasible region.

(b) Hence find the maximum and minimum values of $P = 3x + 2y$ over the region.

Answers written in the margins will not be marked.

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SECTION A(2) (24 marks)

5. Consider the compound inequality **(7 marks)**

$$\frac{2x-1}{3} < x+2 \quad \text{and} \quad 5-2x \leq 3x+15.$$

(a) Solve the compound inequality.

(b) Find the number of positive integers that satisfy the compound inequality.

(c) Find the greatest integer n such that $x = n$ satisfies the compound inequality.

Answers written in the margins will not be marked.

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6. Consider the quadratic inequality $x^2 - (k + 2)x + 2k < 0$, where k is a real constant. **(8 marks)**

(a) Factorise $x^2 - (k + 2)x + 2k$.

(b) Solve the inequality for x in terms of k, considering all possible cases for k.

(c) Find the values of k for which the inequality has exactly one integer solution.

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7. A company produces two products, X and Y. Each unit of X requires 2 hours of machine time and 3 hours of labour. Each unit of Y requires 4 hours of machine time and 1 hour of labour. The company has at most 80 hours of machine time and at most 60 hours of labour available per week. The profit is \$30 per unit of X and \$20 per unit of Y. Let x and y be the weekly production quantities of X and Y respectively. **(9 marks)**

(a) Write down the system of inequalities representing the constraints.

(b) Graph the feasible region and find the coordinates of its vertices.

(c) How many units of each product should be produced to maximise profit? What is the maximum profit?

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SECTION B (10 marks)

8. A linear programming problem has feasible region R defined by **(10 marks)**

$$\begin{cases} x + y \geq 2, \\ x + 2y \leq 8, \\ 2x + y \leq 8, \\ x \geq 0, \\ y \geq 0. \end{cases}$$

Let $P = ax + by$, where a and b are positive constants.

(a) Find the coordinates of all vertices of R.

(b) It is given that the maximum value of P over R occurs at the vertex $(2, 2)$. Find the range of possible values of the ratio a/b.

(c) If the maximum value of P is 10 and occurs at $(2, 2)$, find a and b.

END OF PAPER

Answers written in the margins will not be marked.

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