HIGHER

2.1 Linear Programming: 30-minute Pack

EDEXCEL 4MA1 · Calculator allowed · about 30 minutes

Total Marks

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 A shop makes x small boxes and y large boxes each day. The following conditions apply: (a) there must be no more small boxes than large boxes; (b) each of the small boxes takes 10 minutes and each of the large boxes takes 30 minutes, and the total time available is 6 hours; (c) no more than 24 large boxes are made.
Write down an inequality for each condition, using x and y.

(Total for Question 1 is 3 marks)

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2 The region R satisfies all of the inequalities $x + y \leq 50$, $y \leq 25$ and $x + y \geq 8$, with $x \geq 0$ and $y \geq 0$.
The points P(8, 11), Q(4, 7), R(15, 12), S(7, 29) are tested.
Which of the points lie inside R?

(Total for Question 2 is 3 marks)

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3 Find the minimum value of $C = 4x + 3y$, where x and y satisfy $3x + 2y \geq 24$, $x + 2y \geq 12$, $x \geq 0$ and $y \geq 0$.

(Total for Question 3 is 5 marks)

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4 A shop makes x cakes and y pastries each day. The following conditions apply: (a) the total number of items made is at most 24; (b) at least 7 cakes are made; (c) at least 8 items are made altogether; (d) there must be no more than 4 times as many pastries as cakes.
Write down an inequality for each condition, using x and y.

(Total for Question 4 is 4 marks)

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5 The region R satisfies all of the inequalities $x + y \geq 12$, $x \geq 7$ and $y \leq 4x$, with $x \geq 0$ and $y \geq 0$.
The points P(9, 10), Q(3, 19), R(16, 4), S(15, 25) are tested.
Which of the points lie inside R?

(Total for Question 5 is 3 marks)

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6 Find the maximum value of $P = 5x + 8y$, where x and y satisfy $3x + y \leq 12$, $x + y \leq 8$, $x \geq 0$ and $y \geq 0$.

(Total for Question 6 is 5 marks)

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Mark scheme · 2.1 Linear Programming: 30-minute Pack

Question 1

(a) $x \leq y$	**B1**
(b) $10x + 30y \leq 360$	**B1**
(c) $y \leq 24$	**B1**

Answer: (a) $x \leq y$; (b) $10x + 30y \leq 360$; (c) $y \leq 24$

Question 2

substitutes each point into each of the three inequalities	**M1**
correct decision for each point (at least three correct)	**A1**
inside R: P, Q, R; the other points break at least one inequality	**A1**

Answer: P, Q, R

Question 3

solves $3x + 2y \geq 24$ and $x + 2y \geq 12$ simultaneously to find the corner where the lines cross	**M1**
corner at (6, 3)	**A1**
finds the other corners of the region on the axes	**M1**
evaluates C at each corner: (0, 12) gives 36; (6, 3) gives 33; (12, 0) gives 48	**M1**
minimum C = 33 at (6, 3)	**A1**

Answer: Minimum C = 33 at (6, 3)

Question 4

(a) $x + y \leq 24$	**B1**
(b) $x \geq 7$	**B1**
(c) $x + y \geq 8$	**B1**
(d) $y \leq 4x$	**B1**

Answer: (a) $x + y \leq 24$; (b) $x \geq 7$; (c) $x + y \geq 8$; (d) $y \leq 4x$

Question 5

substitutes each point into each of the three inequalities	**M1**
correct decision for each point (at least three correct)	**A1**
inside R: P, R, S; the other points break at least one inequality	**A1**

Answer: P, R, S

Question 6

solves $3x + y \leq 12$ and $x + y \leq 8$ simultaneously to find the corner where the lines cross	**M1**
corner at (2, 6)	**A1**
finds the other corners of the region on the axes	**M1**
evaluates P at each corner: (0, 0) gives 0; (0, 8) gives 64; (2, 6) gives 58; (4, 0) gives 20	**M1**
maximum P = 64 at (0, 8)	**A1**

Answer: Maximum P = 64 at (0, 8)

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