4.6 Decision: Linear Programming and Critical Path Depth: 1-hour Pack

EDEXCEL 9FM0 · Calculator allowed · about 60 minutes

Total Marks

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 A factory makes x units of product P and y units of product Q each week. The constraints are $4x + 3y \leq 62$, $2x + 4y \leq 56$, $x \geq 0$ and $y \geq 0$. The profit, in hundreds of pounds, is $P = 4x + 4y$, and the profit is to be maximised.

(a) Draw the feasible region and find the coordinates of each of its vertices. **(3)**

(b) Evaluate P at each vertex and hence find the maximum profit and the values of x and y which give it. **(3)**

(Total for Question 1 is 6 marks)

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2 A factory makes x units of product P and y units of product Q each week. The constraints are $2x + 3y \leq 44$, $x + 2y \leq 28$, $x \geq 0$ and $y \geq 0$. The profit, in hundreds of pounds, is $P = 3x + 3y$, and the profit is to be maximised.

(a) Draw the feasible region and find the coordinates of each of its vertices. **(3)**

(b) Evaluate P at each vertex and hence find the maximum profit and the values of x and y which give it. **(3)**

(Total for Question 2 is 6 marks)

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3 A bakery makes x batches of rolls and y batches of loaves each day. The constraints are $x + 3y \leq 32$, $x + y \leq 16$, $x \geq 0$ and $y \geq 0$. The profit, in hundreds of pounds, is $P = 5x + 6y$, and the profit is to be maximised.

(a) Draw the feasible region and find the coordinates of each of its vertices. **(3)**

(b) Evaluate P at each vertex and hence find the maximum profit and the values of x and y which give it. **(3)**

(Total for Question 3 is 6 marks)

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4 A factory makes x units of product P and y units of product Q each week. The constraints are $x + 4y \leq 30$, $2x + 2y \leq 30$, $x \geq 0$ and $y \geq 0$. The profit, in hundreds of pounds, is $P = 3x + 4y$, and the profit is to be maximised.

(a) Draw the feasible region and find the coordinates of each of its vertices. **(3)**

(b) Evaluate P at each vertex and hence find the maximum profit and the values of x and y which give it. **(3)**

(Total for Question 4 is 6 marks)

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5 A bakery makes x batches of rolls and y batches of loaves each day. The constraints are $4x + 4y \leq 76$, $2x + 4y \leq 54$, $x \geq 0$ and $y \geq 0$. The profit, in hundreds of pounds, is $P = 4x + y$, and the profit is to be maximised.

(a) Draw the feasible region and find the coordinates of each of its vertices. **(3)**

(b) Evaluate P at each vertex and hence find the maximum profit and the values of x and y which give it. **(3)**

(Total for Question 5 is 6 marks)

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6 A farmer plants x hectares of wheat and y hectares of barley. The constraints are $x + 3y \leq 30$, $3x + 2y \leq 48$, $x \geq 0$ and $y \geq 0$. The profit, in hundreds of pounds, is $P = 6x + y$, and the profit is to be maximised.

(a) Draw the feasible region and find the coordinates of each of its vertices. **(3)**

(b) Evaluate P at each vertex and hence find the maximum profit and the values of x and y which give it. **(3)**

(Total for Question 6 is 6 marks)

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7 A factory makes x units of product P and y units of product Q each week. The constraints are $3x + y \leq 12$, $2x + 4y \leq 18$, $x \geq 0$ and $y \geq 0$. The profit, in hundreds of pounds, is $P = 4x + 6y$, and the profit is to be maximised.

(a) Draw the feasible region and find the coordinates of each of its vertices. **(3)**

(b) Evaluate P at each vertex and hence find the maximum profit and the values of x and y which give it. **(3)**

(Total for Question 7 is 6 marks)

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Mark scheme · 4.6 Decision: Linear Programming and Critical Path Depth: 1-hour Pack

Question 1

(a) plots both constraint lines and shades the unwanted region **M1**

(a) finds the intercepts with the axes and the intersection of the two lines **M1**

(a) vertices: (0, 0), (0, 14), (8, 10), (31/2, 0) **A1**

(a) Answer: (0, 0), (0, 14), (8, 10), (31/2, 0)

(b) evaluates P at each vertex **M1**

(b) values: 0, 56, 72, 62 **A1**

(b) maximum P = 72 at (8, 10) **A1**

(b) Answer: P = 72 at (8, 10)

Question 2

(a) plots both constraint lines and shades the unwanted region **M1**

(a) finds the intercepts with the axes and the intersection of the two lines **M1**

(a) vertices: (0, 0), (0, 14), (4, 12), (22, 0) **A1**

(a) Answer: (0, 0), (0, 14), (4, 12), (22, 0)

(b) evaluates P at each vertex **M1**

(b) values: 0, 42, 48, 66 **A1**

(b) maximum P = 66 at (22, 0) **A1**

(b) Answer: P = 66 at (22, 0)

Question 3

(a) plots both constraint lines and shades the unwanted region **M1**

(a) finds the intercepts with the axes and the intersection of the two lines **M1**

(a) vertices: (0, 0), (0, 32/3), (8, 8), (16, 0) **A1**

(a) Answer: (0, 0), (0, 32/3), (8, 8), (16, 0)

(b) evaluates P at each vertex **M1**

(b) values: 0, 64, 88, 80 **A1**

(b) maximum P = 88 at (8, 8) **A1**

(b) Answer: P = 88 at (8, 8)

Question 4

(a) plots both constraint lines and shades the unwanted region **M1**

(a) finds the intercepts with the axes and the intersection of the two lines **M1**

(a) vertices: (0, 0), (0, 15/2), (10, 5), (15, 0) **A1**

(a) Answer: (0, 0), (0, 15/2), (10, 5), (15, 0)

(b) evaluates P at each vertex **M1**

(b) values: 0, 30, 50, 45 **A1**

(b) maximum P = 50 at (10, 5) **A1**

(b) Answer: P = 50 at (10, 5)

Question 5

(a) plots both constraint lines and shades the unwanted region **M1**

(a) finds the intercepts with the axes and the intersection of the two lines **M1**

(a) vertices: (0, 0), (0, 27/2), (11, 8), (19, 0) **A1**

(a) Answer: (0, 0), (0, 27/2), (11, 8), (19, 0)

(b) evaluates P at each vertex **M1**

(b) values: 0, 27/2, 52, 76 **A1**

(b) maximum P = 76 at (19, 0) **A1**

(b) Answer: P = 76 at (19, 0)

Question 6

(a) plots both constraint lines and shades the unwanted region **M1**

(a) finds the intercepts with the axes and the intersection of the two lines **M1**

(a) vertices: (0, 0), (0, 10), (12, 6), (16, 0) **A1**

(a) Answer: (0, 0), (0, 10), (12, 6), (16, 0)

(b) evaluates P at each vertex **M1**

(b) values: 0, 10, 78, 96 **A1**

(b) maximum P = 96 at (16, 0) **A1**

(b) Answer: P = 96 at (16, 0)

Question 7

(a) plots both constraint lines and shades the unwanted region **M1**

(a) finds the intercepts with the axes and the intersection of the two lines **M1**

(a) vertices: (0, 0), (0, 9/2), (3, 3), (4, 0) **A1**

(a) Answer: (0, 0), (0, 9/2), (3, 3), (4, 0)

(b) evaluates P at each vertex **M1**

(b) values: 0, 27, 30, 16 **A1**

(b) maximum P = 30 at (3, 3) **A1**

(b) Answer: P = 30 at (3, 3)

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