Pearson Edexcel AS Further Mathematics 8FM0

Decision 1 – 5 Linear Programming

Time allowed: 45 minutes

School: www.CasperYC.club

Name:

Teacher:

Question	Points	Score
1	14	
2	10	
3	11	
4	9	
Total:	44	

How I can achieve better:

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1. A baker makes lemon cakes and cherry cakes for a forthcoming fair.

   The baker must make at least 360 cakes in total.

   The cost of the ingredients for each lemon cake is 40p and the cost of the ingredients for each cherry cake is 20p. The baker has a total budget of £200 to spend on ingredients.

   The baker must make at least twice as many cherry cakes as lemon cakes and he must make at least 100 lemon cakes.

   The baker calculates that the time required to decorate each lemon cake is 1 minute and the time required to decorate each cherry cake is 3 minutes. The baker wants to minimise the total time needed to decorate all the required cakes.

   (a) Formulate this information as a linear programming problem.   [6]

   (b) Use a graphical method to determine the number of each type of cake the baker should   [7]
       make in order to minimise the total decoration time. You should make your method and
       working clear.

   (c) Using your solution to part (b), determine how much of the baker's budget for ingredients   [1]
       will be unspent.

                                                                          Total: 14

(Q1 continued . . .)

2. Ben is a wedding planner. He needs to order flowers for the weddings that are taking place next month. The three types of flower he needs to order are roses, hydrangeas and peonies. Based on his experience, Ben forms the following constraints on the number of each type of flower he will need to order.

- At least three–fifths of all the flowers must be roses.

- For every 2 hydrangeas there must be at most 3 peonies.

- The total number of flowers must be exactly 1000.

The cost of each rose is £1, the cost of each hydrangea is £5 and the cost of each peony is £4
Ben wants to minimise the cost of the flowers.

Let x represent the number of roses, let y represent the number of hydrangeas and let z represent the number of peonies that he will order.

(a) Formulate this as a linear programming problem in x and y only, stating the objective function and listing the constraints as simplified inequalities with integer coefficients. [7]

Ben decides to order the minimum number of roses that satisfy his constraints.

(b)   i. Calculate the number of each type of flower that he will order to minimise the cost of the flowers. [3]

  ii. Calculate the corresponding total cost of this order.

Total: 10

(Q2 continued ...)

3. The manager of a factory is planning the production schedule for the next three weeks for a range of cabinets. The following constraints apply to the production schedule.

   - The total number of cabinets produced in week 3 cannot be fewer than the total number produced in weeks 1 and 2.

   - At most twice as many cabinets must be produced in week 3 as in week 2.

   - The number of cabinets produced in weeks 2 and 3 must, in total, be at most 125.

The production cost for each cabinet produced in weeks $1, 2$ and 3 is $£250, £275$ and $£200$ respectively.

The factory manager decides to formulate a linear programming problem to find a production schedule that minimises the total cost of production.

The objective is to minimise $250x + 275y + 200z$.

(a) Explain what the variables x, y and z represent. [1]

(b) Write down the constraints of the linear programming problem in terms of x, y and z. [2]

Due to demand, exactly 150 cabinets must be produced during these three weeks. This reduces the constraints to

$$x + y \leq 75$$

$$x + 3y \geq 150$$

$$x \geq 25$$

$$y \geq 0$$

which are shown.
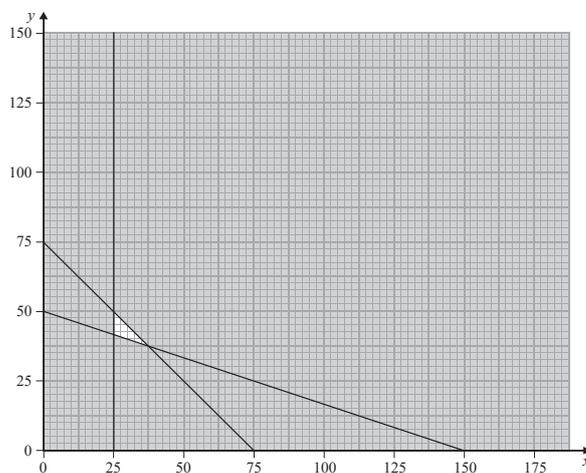
Given that the manager does not want any cabinets left unfinished at the end of a week,

(c)   i. use a graphical approach to solve the linear programming problem and hence determine [8]
the production schedule which minimises the cost of production. You should make your
method and working clear.

ii. Find the minimum total cost of the production schedule.

Total: 11

4. Figure below shows the constraints of a linear programming problem in x and y, where R is the feasible region. Figure below also shows an objective line for the problem and the optimal vertex, which is labelled as V. [9]
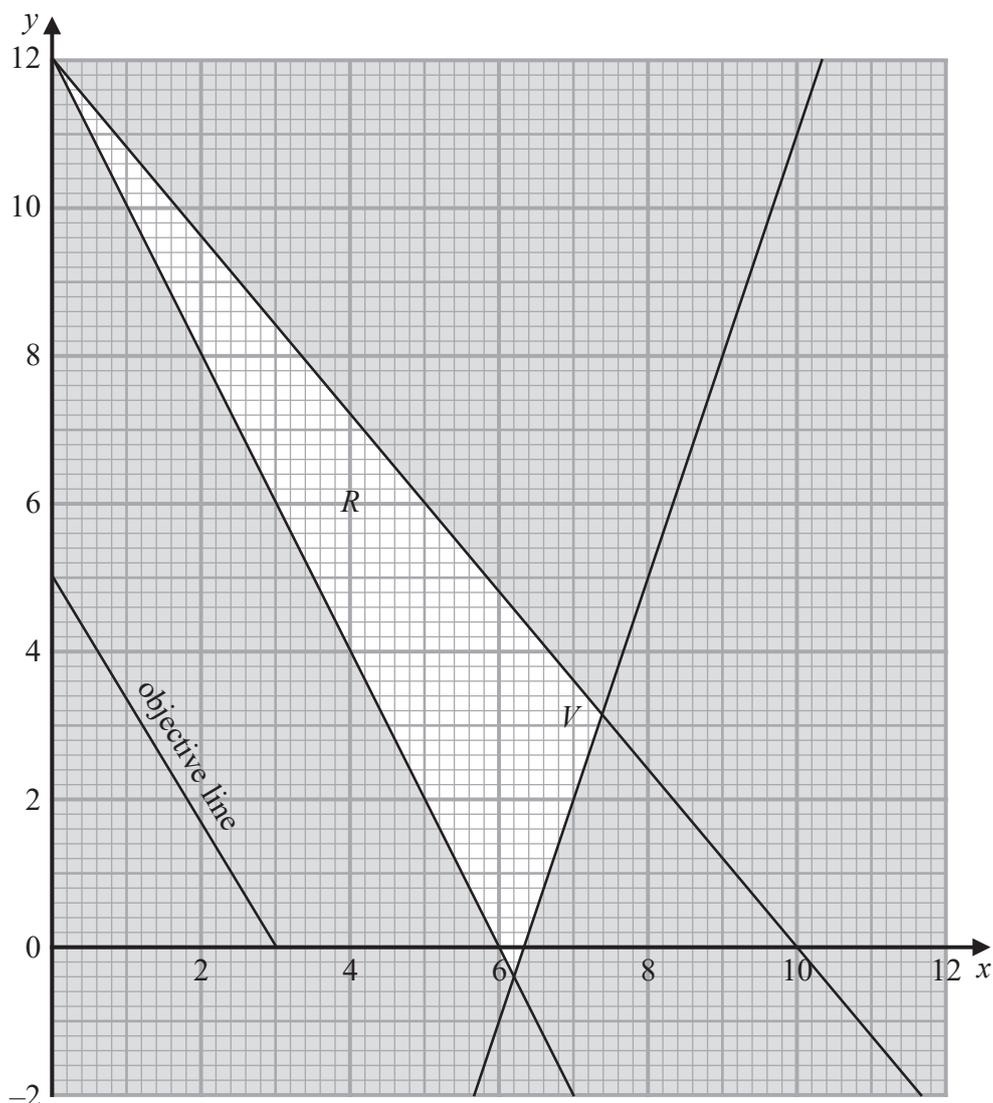
The value of the objective at V is 556. Express the linear programming problem in algebraic form. List the constraints as simplified inequalities with integer coefficients and determine the objective.

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(Q4 continued . . .)