6. Martin is making three types of cake for a picnic. The three types of cake are carrot cake, apple cake and chocolate cake. Along with other ingredients,

- each carrot cake contains 275 grams of flour, 300 grams of sugar and 5 eggs
- each apple cake contains 200 grams of flour, 400 grams of sugar and 2 eggs
- each chocolate cake contains 100 grams of flour, 400 grams of sugar and 3 eggs

If Martin makes only one type of cake then he has enough time to prepare 15 carrot cakes or 20 apple cakes or 30 chocolate cakes.

Martin has 5.5 kilograms of flour and 70 eggs available and he has promised the picnic organisers that he will make at least 18 cakes in total.

Martin plans to make a selection of these cakes and wants to minimise the total amount of sugar that he uses.

Let x be the number of carrot cakes made, y the number of apple cakes made and z the number of chocolate cakes made.

(a) Formulate this information as a linear programming problem. State the objective and list the constraints as simplified inequalities with integer coefficients.

(6)

A further constraint is that $y = 2z$

(b) Explain what this constraint means in the context of the question.

(1)

The constraint $y = 2z$ reduces the problem to the following

Minimise $P = 300x + 600y$

subject to $11x + 10y \leqslant 220$

$10x + 7y \leqslant 140$

$x + y \leqslant 15$

$2x + 3y \geqslant 36$

$x \geqslant 0,\ y \geqslant 0$

(c) Represent these constraints on Diagram 1 in the answer book. Hence determine, and label, the feasible region, R.

(4)

(d) Use the objective line method to find the optimal number of each type of cake that Martin should make, and the amount of sugar used.

(4)

(e) Determine how much flour and how many eggs Martin will have left over after making the optimal number of cakes.

(2)

(Total for Question 6 is 17 marks)

TOTAL FOR PAPER: 75 MARKS

END