

D1 – Linear Programming (1) Formulating Problems and Graphing. – www.m4ths.com

(1) Company Z is making 2 types of toy for a special order. They are making dogs and cats and plan to sell them with each dog sold making a £1 profit and each cat sold a £3 profit. It takes the company 4 minutes to make a dog and 3 minutes to make a cat. They have a total of 1 hour to make all of the cats and dogs in order to meet a deadline.

The toys then need to be packed into boxes after being made. It takes 1 minute to pack each dog and 2 minutes to pack each cat. The company only has 20 minutes to carry out all of the packaging.

The number of cats produced must be at least twice the number of dogs produced to meet the needs of the buyer.

(a) Fill in the blanks below to formulate this as a linear programming problem. (You do not have to find a solution to the problem):

Let _____ be the number of dogs and _____ be the number of cats produced. (These are the decision variables)

The objective function is _____

The 5 constraints are:

- (i) _____
- (ii) _____
- (iii) _____
- (iv) _____
- (v) _____ (optional)

(You can simplify these if you wish)

(b) Extension – Show this information on a graph and label the feasible region R.

(2) Ming is laying a path in her garden. The shortest length the path can be is 50m long. She can buy two types of slab. The smaller slabs are 1m long and the larger slabs are 5m long. Ming would like a pattern in the path such that for every large block there can be no more than 3 small blocks. Each small slab costs £2 and each large slab costs £5 and the slab shop only has 60 small slabs in stock. Ming wishes to minimise the cost of laying the path.

(a) Use this information to formulate this as a linear programming problem.

(b) Extension – Show this information on a graph and label the feasible region R.

(3) Tyrone and Levi decide to make 2 types of soft drink to sell to Mercedes who is having a party.

- *Drink 1* is made up of 20% sugar, 70% mango juice and 10% salt.
- *Drink 2* is made up of 30% sugar, 66% mango juice and 4% salt.

The cost of producing 1 litre of *Drink 1* is £3 and the cost of producing 1 litre of *Drink 2* is £2.

Tyrone and Levi want to minimise the cost of production.

Mercedes needs at least 40 litres of drink at her party. She also wants less than 25% of the total drink she buys to be sugar but at least 9% of the total drink she buys to be salt.

Mercedes also wants at least 2 litres of *Drink 1* for every 3 litres of *Drink 2* at the party.

Let the number of litres of *Drink 1* be x and the number of litres of *Drink 2* be y .

(a) Formulate a linear programming problem to represent the situation simplifying each of the constraints.

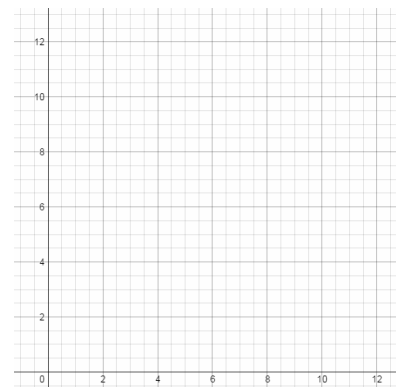
(b) Extension – Show this information on a graph and label the feasible region R.

(4) Graph the following constraints and label the feasible region R:

$$x + y \leq 12$$

$$y \geq x$$

$$x > 2$$



(5) Graph the following constraints and label the feasible region R:

$$2x + 3y \geq 30$$

$$2x > y$$

$$y \leq 8$$

