NATIONAL SENIOR CERTIFICATE EXAMINATION
NOVEMBER 2009

MATHEMATICS: PAPER I

EXAMINATION NUMBER

Time: 3 hours 150 marks

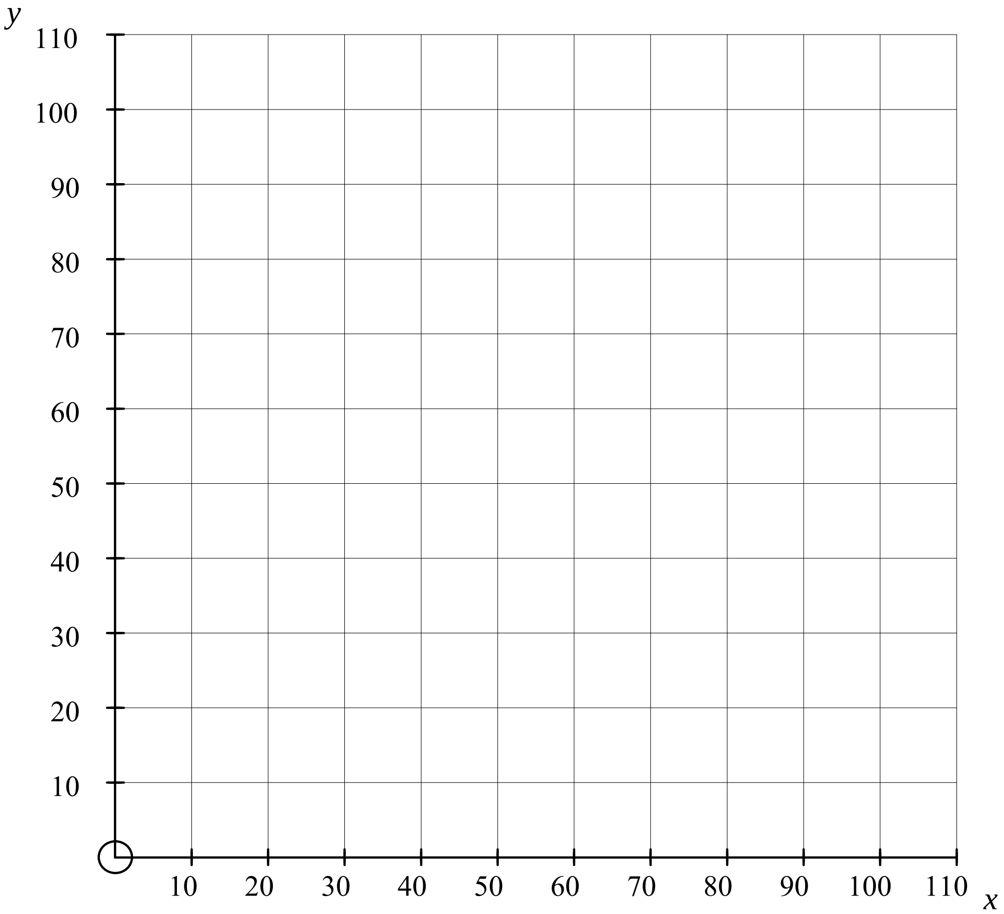
ANSWER BOOKLET

QUESTION 6

(a) The following constraints apply to a linear programming problem.

$x \geq 0, \quad y \geq 0, \quad x + y \geq 50, \quad x + y \leq 100, \quad y \leq x$

(1) Draw these constraints on the axes below and shade the feasible region.



(5)

(2) Which constraint does not influence the feasible region?

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____ (1)

(3) Give the maximum value of y that satisfies all the constraints.

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____ (1)

(4) Given the objective function $C = 2x + y$ determine the minimum value of C that satisfies all the constraints.

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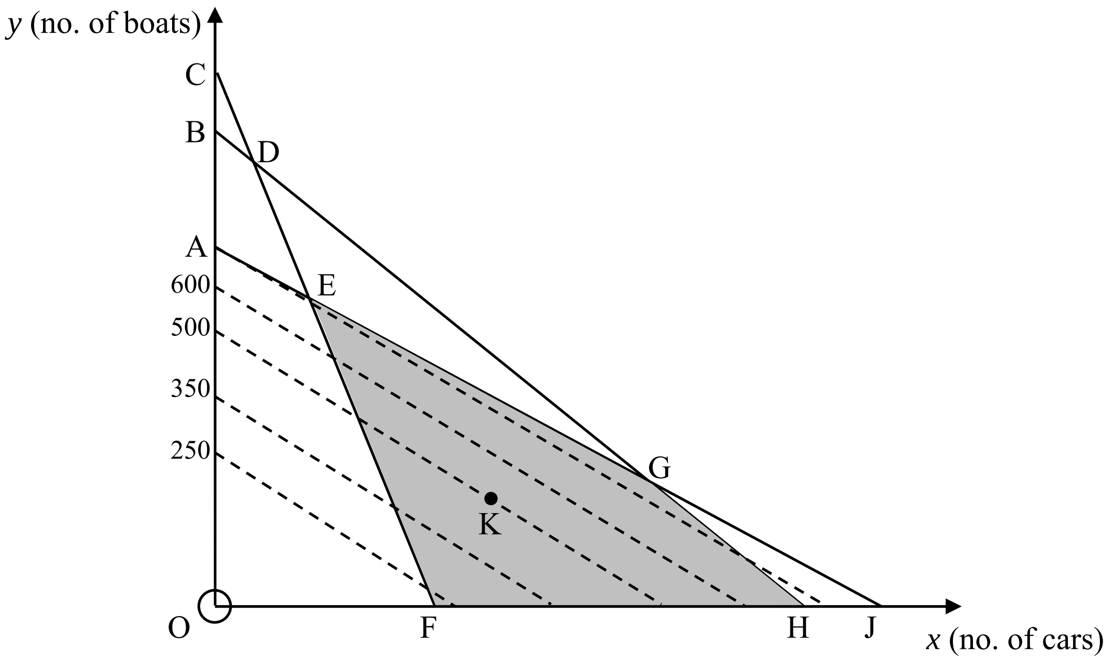
____ (3)

(b) A linear programming technique has been applied to a situation where the variables are the number of cars (x) and the number of boats (y) produced by a toy manufacturer. The shaded area below is the feasible region:



Assume that all points A to K have integer coordinates.

Suppose that c_1 is the profit made on each car and c_2 is the profit made on each boat. Hence the values c_1 and c_2 can be assumed to be positive constants.

The profit function is $P = c_1 x + c_2 y$
and is represented on the graph above by dotted lines.

(1) Write down the profit obtained at the point K in terms of c_2.

(1)

(2) Identify the point in the feasible region that yields the maximum profit.

(1)

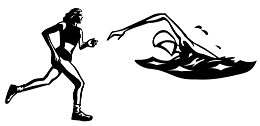
(3) As a result of an improved manufacturing process, the profit made on each car increases to become c_3, whereas the profit on each boat remains constant, such that the profit function is now $P = c_3 x + c_2 y$.

Determine which labelled point(s) in the feasible region are now likely to maximise the profit.

(3)

15 marks

QUESTION 7



Alex decides to include both swimming and running in her exercise plan.
On day 1, Alex swims 100 m and runs 500 m.
Each day she will increase the distance she swims by 50 m and the distance she runs will increase by 3,5% of the distance she ran on the previous day.

(a) Determine, in terms of n, the distance that Alex

(1) swims on the n^{th} day of her exercise plan.

(2) runs on the n^{th} day of her exercise plan.

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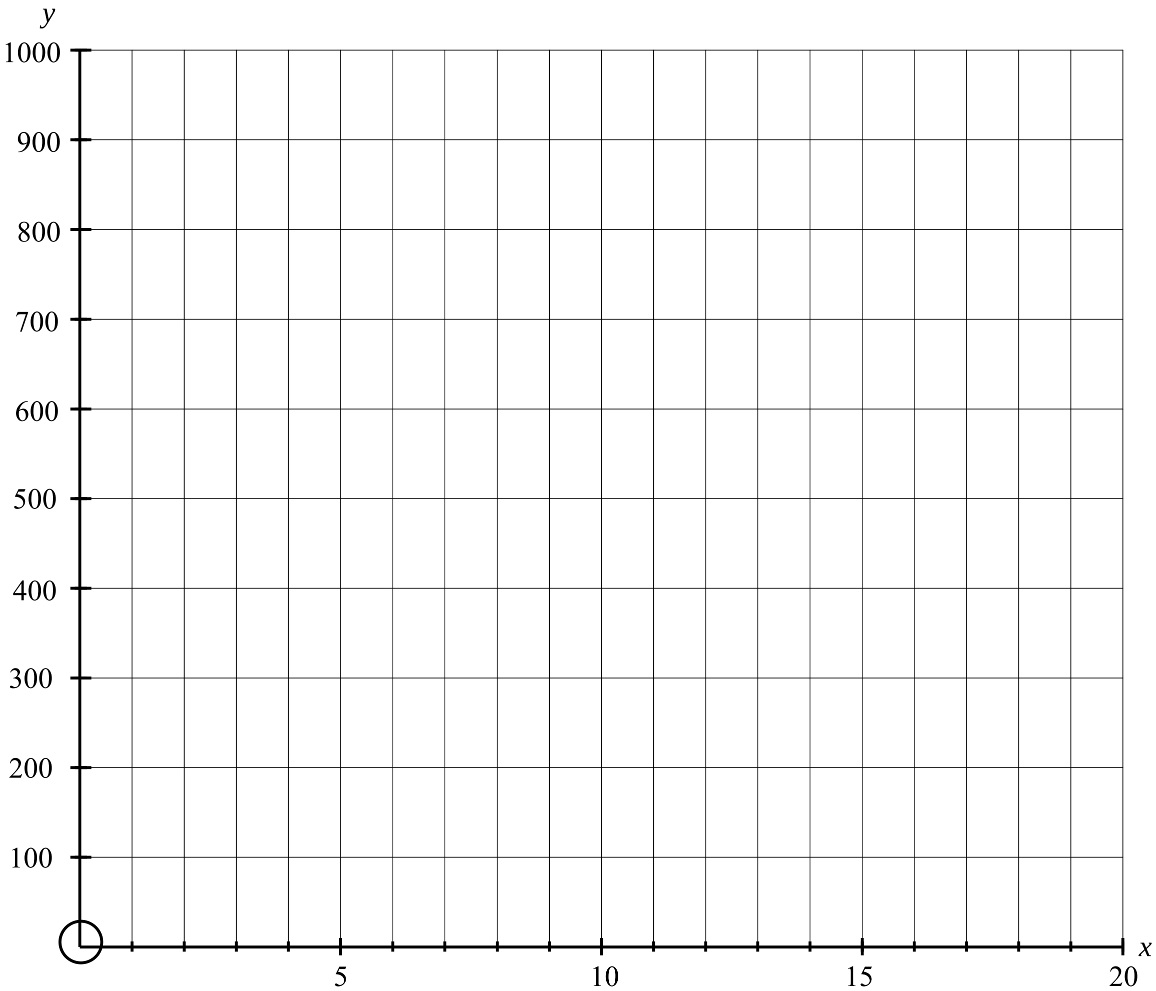
____ (6)

(b) On the set of axes provided, plot points for each of the exercise types. You may join the points to illustrate the trend.



(5)

(c) **Use your graphs** to determine the first day on which the distance Alex swims will be greater than the distance she runs.

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____ (1)

12 marks