CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Level

MARK SCHEME for the October/November 2012 series

9694 THINKING SKILLS

9694/33 Paper 3 (Problem Analysis and Solution), maximum raw mark 50

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

Cambridge will not enter into discussions about these mark schemes.

Cambridge is publishing the mark schemes for the October/November 2012 series for most IGCSE, GCE Advanced Level and Advanced Subsidiary Level components and some Ordinary Level components.

1 **(a) What will Maggie's and Nigel's scores be when they each play a game agains**

Nigel 15 points, Maggie 14 points.

1 mark for each correct score.

(b) In some games, one player may have scored enough points to ensure a win before all rounds have been completed. In which of the three games between Luke, Maggie and Nigel does this occur, and after which round? [2]

Luke versus Nigel. It is decided in the eleventh round.

1 mark for the correct players and 1 mark for the correct round.

(c) When Luke, Maggie and Nigel each play against Ophelia, which of the three scores the least and what is that score? [2]

Maggie loses 1 – 23 against Ophelia.
The following table shows the results, with the player on the left's score shown first.

	M	N	O
L	10 – 14	9 – 15	12 – 12
M		11 – 13	1 – 23
N			7 – 17

1 mark for Maggie, 1 mark for her score (1).
1 mark for one player's score for each of the three games calculated correctly.

(d) Pedro is going to play against Ophelia. Give a sequence of letters that he could play which would ensure that she scored nothing. [1]

C B A repeated

Ophelia	A	C	B	A	C	B	A	C	B	A	C	B
Pedro	C	B	A	C	B	A	C	B	A	C	B	A

(e) Quentin joins in and plays against Luke, Maggie and Nigel. Suggest a sequence of letters which would produce the maximum total score for Quentin over the games.

Quentin's options are shown in the table below, where * can be any letter.

Luke	B	A	B	A	C	A	C	A	A	A	C	A
Maggie	A	B	C	A	B	C	A	B	C	A	B	C
Nigel	A	B	A	B	B	B	C	A	C	A	B	C
Quentin	C/A	A	*	C/A	A/B	*	B/C	C/A	B/C	C	A/B	B/C

3 marks for a correct string of letters.
If 3 marks cannot be awarded, award 2 marks for a string of letters with one mistake.
1 mark for a string with two mistakes.

2 (a) What is the missing digit (#) in 4920 1641 01#4 1711 ? **[2]**

```
4 9 2 0   1 6 4 1   0 1 # 4   1 7 1 1
8+9+4+0 + 2+6+8+1 + 0+1+ +4 + 2+7+2+1 = 55.
8+9+4+0 + 2+6+8+1 + 0+1+5+4 + 2+7+2+1 = 60.
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To make multiple of 10, we must add 5.
As the missing digit is in an odd position, we need whatever turns into 5, namely 7.

2 marks for "7" (working essential).
1 mark for getting 5, or for 1 (by using transformation rather than inverse transformation).
1 mark for one consistently applied mistake [e.g. converting all the numbers according to the table: 8+9+4+0+2+3+8+2+0+2+8+2+5+2+2 = 57; so missing digit is 6.

(b) Which pair of digits will not be detected if they are switched? **[1]**

It is easiest to consider how much the odd digits are changed (mod 10):

0	1	2	3	4	5	6	7	8	9
0	2	4	6	8	1	3	5	7	9
+0	+1	+2	+3	+4	+6	+7	+8	+9	+0

The only adjacent digits that can be swapped over are 0 and 9.

(c) How many of these fourteen mistakes will be detected, if just one of them occurs when the sixteen-digit number of a card is read?

All of them (2 marks – working essential).

Either check them all:
13 30 14 40 15 50 16 60 17 70 18 80 19 90
23 60 24 80 25 10 26 30 27 50 28 70 29 90
5 6 6 8 7 1 8 3 9 5 0 7 1 9

Or observe that 12 and 20 would clash (2+2 4+0) so other 1x x0 would not.

1 mark for checking at least two of the pairs (e.g. 13 & 30, and 14 & 40)

(d) In how many of the sixteen positions could the check digit be located? (Assume nothing other than the information given.) [1]

Any position could be the necessary check digit because the mapping of the odd positions is invertible (accept 16).

(e) Four digits of a card number were blanked out "for security reasons".

4579 3991 #### 2607

How many possible valid card numbers could this represent? [2]

1 mark for appreciating that three digits could be anything, and then the fourth is fixed.
2 marks for 10 × 10 × 10 = 1000.
SC: 1 mark for 10 000

(f) A national identity register using sixteen-digit numbers for individuals was proposed, and it was suggested that the numbers should be allocated so that they could not be confused with a credit card number. Specify a simple way to achieve this (without restricting the range of available credit card numbers). [2]

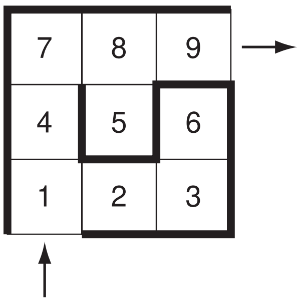
To guarantee no clashes, it suffices to have the remainder mod 10 as something fixed but non-zero: 2 Marks.

Any clear system that would distinguish the national identity card system from the credit card system but would restrict the available credit card numbers, e.g. "ID numbers start with 0", scores 1 mark.
OR 1 mark for recommending using the algorithm, and then altering the details of the check digit process which produces numbers which will work in some cases.

3 (a) **Show that the *complexity coefficient* of the following maze is 1.44 (roun… decimal places), and complete the path that the participant takes: 1, 2, 1, 4…**

1 mark for correct completion of the sequence: 1, 2, 1, 4, 5, 6, 3, 6, 5, 4, 7, 8, 9
1 mark for seeing the calculation: 13 ÷ 9 = 1.44

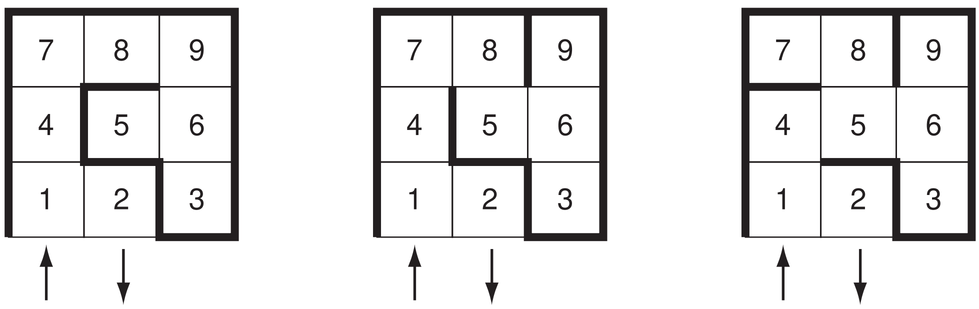
(b) **Draw a different maze involving a 3 × 3 grid of rooms, which also has a *complexity coefficient* of 1.44 and which has its entrance and exit in the same place as the maze above.** **[1]**



1 mark for a different maze with the same entrance and exit, which involves a longest path of 13.
Allow entrance and exit in the other walls of square 1 and 9, or entrance & exit reversed.

(c) (i) **The maximum *complexity coefficient* for a 3 × 3 maze is 1.78. Draw an example.** **[2]**

2 marks for an example which includes a longest path of 16; this requires each room to be visited to twice, except the end of the 'deadend pathway' and the exit. The exit and entrance must therefore be on adjacent squares. For example:



1 mark for a maze with complexity coefficient which is greater than 13/9, or a maze in which the entrance and exit are in adjacent rooms, but the interior walls are incomplete/confused.

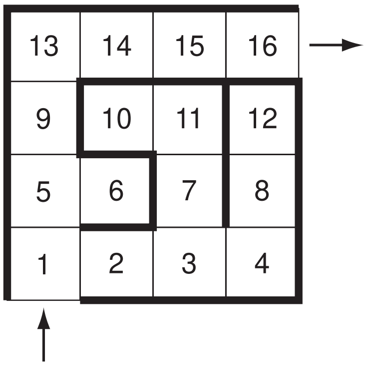
(ii) **Find the maximum *complexity coefficient* for a 5 × 5 maze.** **[2]**

Maximum complexity coefficient = ((23 × 2) + 2)/(5 × 5) = 48/25 = 1.92 [2 marks]

If 2 marks cannot be awarded, award 1 mark EITHER for seeing the number 48, OR for evidence that the candidate appreciates that all but one or two of the rooms in the maze must be visited (at least) twice OR a correctly drawn 5 × 5 maze (with adjacent entrance and exit) OR a correctly generalized case from their **(c)(i)**.

(d) Consider rectangular (including square) mazes made up from no more than What is the lowest *simplicity coefficient* for such mazes? Give an example of with this *simplicity coefficient*.

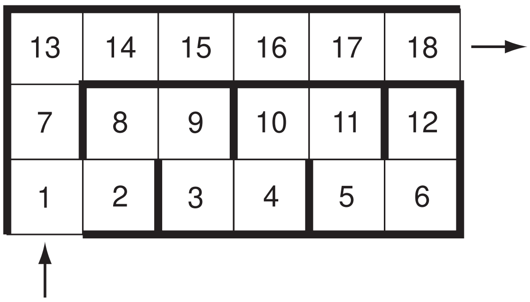
Simplicity coefficient of any 4 × 4 maze with a shortest path of 7 is <u>7/16 = 0.4375</u>. This minimises (L + W – 1) ÷ (LW). An example of such a maze is given below:



Award 1 mark for an example of a rectangular maze (of any dimensions permissible given the size) which includes a 'shortest path' (e.g. a corridor around the outside – or of the same length, but down the middle).
Award 1 mark for the 4 × 4 case, or appropriate variants, as shown above.
Award 1 mark for an appropriately calculated simplicity coefficient that is not equal to 1.

(e) (i) For a maze made up from no more than 18 rooms, what is the maximum difference between the longest and shortest paths? Draw an example. [2]

Maximum difference = <u>20</u>, achievable in a 6 × 3 maze, as shown below.
Longest path for a maze = 28; shortest path for this maze = 8.



2 marks for the answer (20) and an appropriate maze.
If 2 marks cannot be awarded, award 1 mark for an appropriate maze with no clear calculation of the difference, or a maze and difference correctly calculated for the 4 × 4 solution (whose difference is 25 – 7 = 18), or a different rectangular maze (not 3 × 6 or 4 × 4), or "28 – 8 = 20" seen with an incomplete/empty maze.

(ii) For a 16 × 21 maze, what is the maximum difference between the longest and shortest paths? You are not required to draw an example.

Maximum difference = 2 × (15 × 20) = <u>600</u> [3 marks]

If 3 marks cannot be awarded, award 1 mark for the number 36 [the shortest path] and 1 mark for an attempt to calculate length of the longest path in the 15 × 20 subsection of the maze.
Alternatively, 2 marks for 300 OR any number between 598 to 602 seen.

4 (a) (i) In which row are the two seats that have just been sold? [1]

Answer: (Row) L

(ii) How many $15 tickets have been sold so far for tomorrow afternoon's performance? [1]

Answer: 162

(iii) How many $12 tickets have now been sold for tomorrow afternoon's performance? [1]

Answer: 376 + 2 = 378

(b) (i) What was the income from total ticket sales for Tuesday's performance? [1]

Answer: $4806

(ii) How many $12 tickets were sold for Wednesday's performance? [2]

Answer: 309

If 2 marks cannot be awarded, award 1 mark for subtracting $1725 (115 × $15) from $5433 or an answer of ($)3708.

(c) (i) If no more tickets are sold for tomorrow afternoon's performance, what will be the total cost of hiring the theatre this week? [3]

Answer: $16 014

Accept a correctly calculated answer that carries forward one or more incorrect answers from **(a)** and **(b)**. Strict follow-through marks awarded.

If 3 marks cannot be awarded, award 1 mark each for inclusion of the following (maximum 2 marks):

- $9000 for 6 days' hire.
- 660 tickets sold for Friday and Saturday nights.
- 540/(162 + 378) tickets sold for Saturday afternoon.
- Calculated total number of tickets sold multiplied by $2.

(ii) What is the minimum profit the Society will make from this week's p[...] when the other costs are $4360?

Answer: $23 647

This is $20 135 (Monday – Thursday)
+ $8460 (Friday)
+ $8460 (Saturday night)
+ $6966 (Saturday afternoon)
– $16 014 (theatre hire)
– $4360 (other expenses)

Accept a correctly calculated amount that carries forward one or more incorrect answers from **(a)**, **(b)** and **(c)**.

If 3 marks cannot be awarded, award 2 marks for (total ticket sales of) $44 021.

OR

Award 1 mark for evidence of each of the following (maximum 2 marks):

- $20 135 ticket sales Monday to Thursday (e.g. $3440 + $4806 + $5433 + $6456 seen within calculation).
- $8460 ticket sales Friday and/or Saturday night (e.g. $8460 or $16 920 seen within calculation).
- $6966 ticket sales Saturday afternoon (e.g. $6966 seen within calculation) – or their FT ticket sales.

(Where appropriate, accept amounts correctly calculated using carried forward figures.)

(d) What price did the Programme Committee set? [3]

Answer: $1.80

Total sales so far = $1452, so profit is $252 at present, $2218 short of the target.

Number of programmes sold so far = 484 (1452/3), so there are 2516 left, of which the aim is to sell 1258.

For 3 marks to be awarded, appropriate working must be sighted, as well as the answer $1.80.
If 3 marks cannot be awarded, award 2 marks for evidence of $2218/1258 or an answer of $1.76 or $1.80.

OR

Award 1 mark for evidence of each of the following:

- (They aim to raise another) $2218
- (They aim to sell a further) 1258 programmes (or 2516 programmes)