**CAMBRIDGE INTERNATIONAL EXAMINATIONS**
GCE Advanced Level

# MARK SCHEME for the May/June 2013 series

## 9694 THINKING SKILLS

**9694/32**    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.

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**CAMBRIDGE**
International Examinations

**1 (a)** **Suggest two places where a player could be positioned in order to hit a target at (0, 4) by rebounding off the mirror.** **[1]**

Any two of the following positions: (2, 0), (1, 0), (0, 0), (2, 1), (3, 1).

**(b)** **Which position allows a player to hit targets in the greatest number of possible positions, having rebounded the laser beam off the mirror?** **[1]**

At (3, 1) he can rebound at anything above $y = 1$, except three positions in the top right hand corner. 11 positions.

**(c)** **What is the greatest score that he can achieve? State how many points he scores for each target.** **[3]**

He can shoot targets at (0, 3) and (0, 2) with two rebounds. He can shoot targets at (0, 1) and (0, 0) with one rebound. He can only shoot the target at (0, 4) directly. This would give a total of <u>3 + 3 + 2 + 2 + 1 = 11 points.</u>

| Target | 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|
| Score | 2 | 2 | 3 | 3 | 1 |

2 marks for correctly identifying 4 of the targets' scores correctly.
If 2 marks cannot be awarded, award 1 mark for 2 or 3 scores calculated correctly.

**(d)** **The player is positioned at (3, 3). At what positions along the top wall can he hit targets by rebounding off one or more mirrors?** **[2]**

(1, 4) and (4, 4)

Award only 1 mark if an extra point included (to either/both of the correct points).

**(e)** **The player is originally positioned at (2, 1), and can destroy a target at (0, 1) by rebounding off the top mirror, scoring two points. Explain precisely how the player can destroy the target and score more points overall.** **[2]**

By moving 1 unit up to (2, 2), the player can then shoot to strike the mirror on the bottom wall at (3⅓, 0).

1 mark for (2, 2), and 1 mark for a correct ordering of mirrors offered (bottom wall, right-hand wall, top wall).

**(f)** **In what position is a player capable of shooting himself using all three mirrors?** **[1]**

(0, 3)

**2 (a)** The median time on Friday at 22:30 was 78 km/h.  During this minute, just one truck and two cars were recorded.  Suggest the speeds at which the three vehicles could have been travelling. **[1]**

Truck 60, Cars 78 and {78 or 79 or 80}

**(b)** Which one of the five points at 0 km/h is most plausibly due to an accident?  Explain your answer. **[2]**

(Thursday) at 12:00

Highly unlikely to be no traffic at this time of day (whereas for the other four points this seems likely)
Heavy traffic at 12:30 is consistent with a recent accident.

**(c)** For some values of the median, one can be certain that the traffic was not flowing freely.  What are these possible values for the median? **[2]**

All values below 65 (1 mark) except 60 (1 mark).

**(d)** Between 01:00 and 05:00 on the three days, how many cases (if any) could there be where just one truck and one car passed the camera during the minute?  How can you tell? **[2]**

No cases where there is one truck (60) and one car (70–80), as this would give a median of between 65 and 70 (inclusive).

1 mark for correct answer and 1 mark for reason.

**(e) At 14:00 on each day the median is 72 km/h. What are the maximum and minimum possible values of the mean speed of traffic at 14:00?** [3]

As the median is 72 the traffic is flowing freely, and not more than half of the speeds are 60. So mean must be <u>at least 66</u>.

No vehicles exceed 80, and with half not exceeding 72, the mean <u>cannot be more than</u> the mid point of the median and 80, namely <u>76</u>.

If 2 marks can not be awarded, award 1 mark for either max or min for an appropriate set of three, e.g. (60 + 72 + 72) ÷ 3 = 68 or (72 + 72 + 80) ÷ 3 = 74.67.

**3**
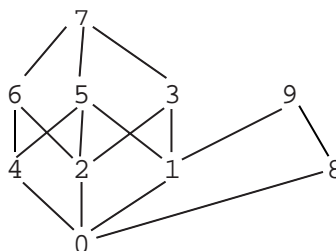


**(a) Which of the ten possible digits could never be changed to any other?** [2]

<u>7</u> and <u>9</u>

1 mark for each. No marks if other digits included.

**(b) (i) Give an example of a 5-digit ticket number where the digits in two positions can be altered to give another valid ticket (i.e. with a valid time and sum). Show both the original and amended ticket numbers.** [3]

Numeric values can never decrease, so we are looking for two changes where the sum of the change is 10.

e.g. 10:30 would be presented as the 5 digits 10306 and that can be changed to 12:38 as this would be 12386.

1 mark for two characters changing by adding one or more holes in each (any two of the five).
1 mark for the sum of changes being a multiple of 10.
1 mark for both being valid times and at least one valid check-digit (so nothing like 34:13 13:78 or 27:22).

**(ii) What is the greatest time that can be fraudulently gained with only two extra holes punched?** [2]

2 in tens of hours clearly optimal, but then can't have 8 in hours or tens of minutes.

<u>20 hours and 8 minutes</u>.

1 mark for 20 hours.

**(c)** There are cases where a ticket with a time of the form 0*w*:0*x* can be amended to a valid ticket with a later time of 0*y*:0*z*, without changing the check-digit. How many such cases are there? **[3]**

The possible increases (from the numbers in brackets) are:
+9 (0)          +1 (**0, 2, 4, 6, 8**)
+8 (**0, 1**)       +2 (**0, 1, 4, 5**)
+7 (0)          +3 (0, 4)
+6 (0, 1)       +4 (**0, 1, 2, 3**)
+5 (0, 2)       +5 (0, 2)

From the rows of the table we get
$2 \times (1 \times 5 + 2 \times 4 + 1 \times 2 + 2 \times 4) + 2 \times 2 = \underline{50}$

If 3 marks not given, then
1 mark for producing table of possible changes for a digit.
1 mark for correctly combining pairs of digits.
1 mark for considering all possiblilities.

Award 1 mark for a systematic listing of changed times (e.g. the 9 cases beginning 00:00), or more than 10 cases listed (regardless of system).
SC: 2 marks for considering all the 00:0*x* cases (9 + 14 + 14 = 37).

**(d) (i)** Suggest a variant of the five-position code which does not give any opportunity for fraud, but always produces fewer chads than the one suggested by Bill. **[1]**

Simplest scheme is <u>inverting the code</u> by punching only 2 holes per digit in the places where they aren't, and leaving gaps where they are.

**(ii)** How many fewer chads than Bill's suggested system would your variant produce for a ticket valid to 14:26? **[1]**

Each digit has 2 holes instead of 3, so <u>4 chads are saved</u>.
FT from **(d)(i)**

**(e) (i)** Identify the two positions which would not be needed. **[1]**

The first and last position are constant for the 10-hours digit (0, 1, or 2). <u>1st and 5th</u>

**(ii)** Swapping the codes for two digits would allow a further position to be removed. Which two codes could be swapped, and which position would no longer be needed? **[2]**

| 0 | ●●●○○ | 5 | ●○●○● |
|---|-------|---|-------|
| 1 | ●●○●○ | 6 | ○●●○● |
| 2 | ●○●●○ | 7 | ○●●●○ |
| 3 | ●○○●● | 8 | ○●○●● |
| 4 | ●●○○● | 9 | ○○●●● |

The codes for <u>3</u> and <u>7</u>.

The <u>first position for the third digit</u> would no longer be needed.

**4 (a) Which team will the Kraits play in their next**

    **(i) home match?** **[1]**

    Answer: Taipans (week 15)

    **(ii) away match?** **[1]**

    Answer: Mambas (week 13)

**(b) Which is the only team so far this season to have**

    **(i) beaten the Taipans?** **[1]**

    Answer: Mambas

    **(ii) lost to the Cottomouths?** **[1]**

    Answer: Asps

    **(iii) scored at least one goal in every match?** **[1]**

    Answer: Taipans

**(c)** For each of the last 5 weeks of the season (weeks 14–18), state which team has no fixture. **[3]**

Answer:      (Week 14): Copperheads
                 (Week 15): Mambas
                 (Week 16): Cobras
                 (Week 17): Taipans
                 (Week 18): Cottonmouths

Award 3 marks for all 5 correct.
Award 2 marks for 3 or 4 correct.
Award 1 mark for 1 or 2 correct.

**(d)** Work out, and supply, all the missing information, and state what position the Vipers are in the league. **[4]**

Answer:
| Played | 9 | |
|--------|---|---|
| Won | 3 | |
| Drawn | 1 | |
| Lost | 5 | Award 1 mark |
| | | |
| Goals for | 12 | |
| Goals against | 15 | Award 1 mark |
| | | |
| Points | 15 [(3 × 3) + (1 × 1) + 5] | Award 1 mark (FT) |
| | | |
| Position | Sixth | Award 1 mark |

**(e)** If the original proposal had been adopted, which teams would now be first, second and third, and with how many points? **[3]**

Answer:      1st Mambas with 25 points
                2nd Taipans with 24 points
                3rd Kraits with 22 points

Award 3 marks, provided there is evidence that the Copperheads would drop to fewer than 22 points.

If 3 marks cannot be awarded, award 1 mark each (maximum of 2 marks) for giving the correct number of points for the Mambas (25), Taipans (24), Kraits (22) or Copperheads (21).