Cambridge International A Level

Cambridge International Examinations
Cambridge International Advanced Level

THINKING SKILLS | **9694/33**

Paper 3 Problem Analysis and Solution | **October/November 2016**

MARK SCHEME

Maximum Mark: 50

Published

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1 (a) Based on his prediction, how long would George need to answer every question in the competition? [1]

75 minutes (1 hour 15 minutes)

In each round he would require 1 + 2 + 3 + 4 + 5 = 15 minutes, so a total of 5 × 15 = 75 minutes would be needed for the whole competition.

(b) What is the largest number of questions George would expect to be able to answer and how should he allocate the time among the five rounds to achieve this? [2]

17

6,6,6,10,10 with up to two minutes added anywhere or
6,6,6,6,15 with or without one minute added or
3,6,6,10,15 or
3,6,10,10,10 with or without one minute added.

To achieve the maximum number of questions, George should make sure that he answers as many of the quicker questions as possible. He can answer 5 questions at 1 minute each, 5 at 2 minutes each and 5 at 3 minutes each, leaving 10 minutes which he could use either to answer two questions at 4 minutes or 1 question at 4 minutes and 1 question at 5 minutes.

Award 1 mark for the answer of 17.
Award 1 mark for a possible allocation of time to the rounds.
Ignore subsequent working.
FT if deducting time from a wrong answer to (a) (must be greater than 40).

(c) How much time should George now allocate to the different rounds and how many questions does he think he will he be able to answer overall? [2]

8 minutes for round 1, 6 minutes for each of two other rounds and 10 minutes in each of the remaining two rounds [1], allowing him to answer 19 questions [1].

There are now 7 questions that will take 1 minute each, 5 that will take 2 minutes and 5 that will take 3 minutes. George will then have a further 8 minutes for a 4 minute question in each of two rounds.

Award 1 mark for recognition that George can answer all the 3-minute questions.

(d) Assuming that all of the questions that he answers are answered correctly, what is the best score that George can expect to get? [2]

23 points

EITHER
5 + (3 + 3 + 4) + 8 = 23 points
5 + (3 + 3 + 4) + 4 questions
8 + (6 + 6 + 10) + 10 = 40 minutes

OR

5 + (3 + 3 + 2) + 10 = 23 points
5 + (3 + 3 + 2) + 5 questions
8 + (6 + 6 + 3) + 15 = 38 minutes [with 1 or 2 minutes available to any individual question]

Award 1 mark for 23 without working.
Award 1 mark for evidence of splitting the questions between rounds appropriately for 23 or sub-optimal 22 points.

(e) What is the smallest number of points that they could award for question 5? [3]

5 *(only credit with working)*

The contestant would need a total of 14 minutes to answer all of the questions in a round, so if all of the questions were answered in two rounds there would be 12 minutes left, which could be used for 6 questions in the other rounds. The total score would be 28, plus twice the score for a final question in a round.

If the contestant maximised the number of 2-minute questions then all 15 of those would be answered and there would be time for two more questions, one of which could be the final question of a round. The total score would be 32, plus the score for a final question in a round.

4 points for the final question in a round would mean that either strategy would lead to a score of 36, so 5 points would need to be allocated to ensure that all questions need to be attempted in two of the rounds (allowing a score of 38, beating 37).

$28 + 2p > 32 + p$ where p is the score in the 5th question

M1: expressions equivalent to either side of the inequality expressed above
M1: expressions equivalent to the other side of the inequality expressed above

SC2: $p = 4$ with working showing that this was derived from $34 < 28 + 2p$ (i.e. not appreciating that one Question 5 would be one of the 4 minute questions even if the contestant only tried one). Award SC1 if not treated as an inequality.

SC2: more than 4 marks because you should get (more than) twice the points if you are spending twice the time. Award SC1 if not treated as an inequality.

Working which shows that it is preferable to choose 2 question 5s when p = 5:
12345/123/123/123/123 = ($5 \times 3 \times 2 + 4 \times 2$) 38 minutes & ($16 \times 2 + 5$) 37 points
12345/12345/123/123 = ($4 \times 3 \times 2 + 2 \times 2 \times 4$) 40 minutes & ($14 \times 2 + 10$) 38 points
[2 marks]
+ comparison with 4 (not possible) [1 mark]

2 (a) What does Edward think the total number of genuine reports of crime over the three days was? [1]

(6 – 1) + (5 – 1) + (6 – 1) = 5 + 4 + 5 = 14 *(Condone daily totals calculated)*

(b) What is the minimum (total) number of investigative journalists that could be working on this story? [1]

All numbers from the first journalist's onwards must be fake, so there must be at least 5 to get from 2 to 6 on Monday and 4 to 8 on Wednesday.

(c) What are the minimum and maximum of the total number of genuine crime reports over the three days? [2]

It is possible that there was no crime and it's all journalists, minimum is 0. [1 mark]
Maximum is (2 – 1) + (5 – 1) + (4 – 1) = 1 + 4 + 3 = 8. [1 mark]

(d) What are the minimum and maximum of the total number of genuine crime reports over the three days, if there are only the minimum number of journalists? [2]

Minimum is (6 – 5) + (7 – 5) + (8 – 5) = 1 + 2 + 3 (= 6). FT minimum 3, if 6 given in **(b)**
Maximum is still 8.

(e) Would knowing the name of the journalist who registered #7/Wednesday help with estimating the number of genuine crimes? Explain your answer briefly. [1]

No. We already knew that there was a false report at #7 – we know that #4 was a false report, so all those afterwards are journalists.

(f) Assuming that the number of journalists is the minimum possible, give the additional false report sequence numbers, and the day(s) on which they occur, which would each be sufficient to deduce the total number of genuine crime reports over the three days. [2]

#3/Tuesday *(FT #4/Tues if 4 given in **(b)**)*
#9/Tuesday *(FT #8/Tues if 4 given in **(b)**)*

SC1: #4&#8/Tuesday
SC1: #3&#4/Tuesday OR #8&#9/Tuesday

(g) What difference would it make if another journalist, Stella, announced that she had #7/Monday? [1]

The minimum possible number of journalists would be six. *(FT their (b)+1)*
OR
The minimum number of genuine crimes would be four.

3 (a) How long will customers 2 and 3 each have to wait to be served? [1]

Customer 2: 30 seconds
Customer 3: 60 seconds

(b) At what time will customer 5 have finished being served? [2]

It will take 12 minutes 30 seconds to serve 5 customers
09:02:00 + 12 minutes 30 seconds = 09:14:30

*2 marks for the correct time; 1 mark for the correct duration **soi**.*

(c) At what time will there first be two customers in the queue? [2]

Customer 2 waits for 30 seconds from 09:04:00 before being served.
Customer 3 waits for 60 seconds from 09:06:00 before being served.
Therefore customer 6 waits for 150 seconds from 09:12:00 and customer 7 joins the queue at 09:14:00 as the second customer in the queue.

Award 1 mark for a correct extraction of the information from their table
OR a correctly derived set of arrival times and service-starting times for the first 7 customers.

SC1: 09:12:00 for one arriving as other leaves, with FT for initial starting time.

(d) How many customers will be in the queue at 10:31:00? [2]

By 10:31:00, 45 customers will have joined the queue
By 10:31:00, 36 customers will have gone to be served at a checkout (35 will have been served). There will be 45 – 36 = 9 customers in the queue.

1 mark for 45/44.5 joined OR 36 (started serving) OR 35 (finished serving)

OR

The length of the queue increases by 1 customer every 10 minutes. [1 mark]
At 09:11 there was one customer in the queue, so there will be 9 customers at 10:31:00.

OR

The number of customers who have joined the queue is
(the number of minutes after 09:00:00) / 2
The number of customers who have been served is
(the number of minutes after 09:02:00) / 2.5

1 mark for either valid algebraic representation, or correct answer from FT of wrong start.

(e) At what time will there first be no customers in the queue, after the second checkout has opened? [3]

The customers get served at the following times:

Customer 36 at 10:29:30
Customer 37 at 10:32:00 Customer 38 at 10:32:00
Customer 39 at 10:34:30 Customer 40 at 10:34:30
Continuing …
Customer 45 at 10:42:00 Customer 46 at 10:42:00
Customer 53 at 10:52:00 Customer 54 at 10:52:00
Customer 55 at 10:54:30 Customer 56 at 10:54:30
Customer 57 at 10:57:00 Customer 58 at 10:57:00

Customer 58 joins the queue at 10:56:00 and is served at 10:57:00 so at 10:57:00 there will be no customers in the queue.

Award 1 mark for customer numbers arriving, and being served at appropriate starting times OR precise statement of how many are in the queue and how many at the tills at a particular time.
Award 1 mark for a clear attempt to establish a pattern (including continuation of the pattern for 10 minutes, or making a 10-minute jump down the list)
Award 1 mark a correct conclusion from a table which is appropriately structured (differences of 2 and 2.5).

(f) (i) What time should the second member of staff start work at the second checkout? Justify your answer. [2]

The customer coming to the checkouts at 14:00:00 would be customer 150.
With just one checkout open throughout, 120 customers could be served.
The extra checkout will allow for an additional 12 customers to be served every 30 minutes. [1 mark]
Three sets of half an hour will be needed, so the second member of staff should start working at 12:30:00

1 mark for correct answer not rounded up to half hour
OR for any method which shows explicit awareness of how the queue grows when there is one queue (e.g. 6 per hour) AND how it decreases when there are two queues (e.g. 9 per half hour).

(ii) What is the longest time that a customer would have to wait to be served if the second member of staff starts work at this time? [3]

The customer who has to wait the longest will be one of those served at around the time that the second checkout opens.
Customer 84 would be served at 12:29:30 having joined the queue at 11:48:00 – a wait of 41 minutes 30 seconds.
Customer 85 would be served at 12:30:00 having joined the queue at 11:50:00 – a wait of 40 minutes.
The longest wait is therefore 41 minutes 30 seconds.

1 mark for working which shows the appreciation that the longest wait must be around the time that the second checkout opens.
1 mark for appropriate working to find out how long that customer has been in the queue (e.g. conversion of 83/84/85th customer into time of arrival, allowing for one precision error).

SC1: attempting to find the waiting time of the person at the back of the queue when the second cashier arrives.
SC2: if this calculation is performed correctly.

4 (a) List the Provinces in which the Games have not yet taken place. [2]

Aym, Lyju and Rhamc

If 2 marks cannot be awarded, award 1 mark for all three plus no more than one other Province
OR for one or two of the above without any others.

(b) How much was received from this donor? [2]

$10 800

If 2 marks cannot be awarded, award 1 mark for sight of 12, 18 and 15 ***soi****.*

(c) In which years was the Gregor Trophy presented to the host Province? [3]

2002, 2006 and 2014 *(Accept XII, XIII and XV)*

If 3 marks cannot be awarded, award 1 mark for each correct year, provided no other years are given.

If other years are given, consider any of 1962, 1966, 1978 and 1982 *as a single year and award one mark for each correct year that exceeds the total of incorrect ones.*

(d) (i) In which Province will the XVI Games be held in 2018? Justify your answer. [2]

Aym *(with reason based on data, not just rules)*

For 2 marks to be awarded it must be stated that (in the three most recent Games) Aym has won 31 gold medals.

If 2 marks cannot be awarded, award 1 mark for correct calculation of the gold medals won by at least one of the three teams.

(ii) If all the eligible Provinces had applied to host the XVI Games, which one would have been successful? [3]

Bauerfry

If 3 marks cannot be awarded, award 1 mark for each of the following:

- Acknowledgement that Merbenvo, Rebotoc and Stugua were not eligible.
- Correct calculation of the gold medals won (in the three most recent Games) by Bauerfry (55) or Yarjuan (44) or Rhamc (35).

(e) In which year was Julian born? **[3]**

1961

If 3 marks cannot be awarded:

Award 1 mark for appreciation that his last Games was 24 years after his first Games,
Award 2 marks for appreciation that he must have represented Bauerfry.

SC1: An answer of 1949, visibly deriving from a reckoning that 7 games would be 28 years apart and so Julian represented Stugua.
Condone 1962 (or 1950 from SC1) if evidence that arrived at correctly but with oriental birthday measurement.