THINKING SKILLS **9694/33**

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

2 hours

Additional Materials: Electronic Calculator

READ THESE INSTRUCTIONS FIRST

An answer booklet is provided inside this question paper. You should follow the instructions on the front cover of the answer booklet. If you need additional answer paper ask the invigilator for a continuation booklet.

Answer **all** the questions.

Show your working. Marks may be awarded for correct steps towards a solution, even if the final answer is not correct. Marks may be lost if working needed to support an answer is not shown.

Calculators should be used where appropriate.

The number of marks is given in brackets [ ] at the end of each question or part question.

This document consists of **7** printed pages, **1** blank page and **1** insert.

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International Examinations

[Turn over

1 George is planning to take part in a competition next week. The competition is in 5 rounds, each of 5 questions. In each round, contestants are asked questions one at a time and will only be asked the next question if they have correctly answered the current question. George predicts that it will take him 1 minute to answer the first question in each round, and then each other question within any round will take 1 minute longer than the previous one to answer.

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

Contestants only have a total of 40 minutes to answer questions; before the start of the competition they must decide how to allocate this time across the 5 rounds. George wants to make sure that he can answer as many questions as possible within the 40 minutes.

(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]

The topics for this year's competition have just been announced. The first round will be *Science* and George thinks that this is likely to be a good round for him. He thinks that he will be able to answer the first three questions in 1 minute each, with the last two questions taking 2 and 3 minutes respectively.

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

Each correct answer scores 1 point. However, this year the final round will be *General Knowledge* and the questions in that round will each score 2 points rather than 1.

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

The organisers of the competition have decided that they want to encourage more competitors to continue to the fifth questions of the rounds, so they are considering a different scoring system for next year's competition.

Instead of awarding double points for the *General Knowledge* round, they will award 2 points for each of the first four questions in a round, and then a higher number of points for the final question.

Based on the results of previous years they assume that a contestant takes 2 minutes for each of the first 3 questions in a round and 4 minutes for each of the other questions. Based on this assumption they wish to set the points for question 5 so that contestants would need to attempt the fifth question in more than one of the rounds if they were to achieve the best score possible.

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

2 The rate of reported crime in Einrossdorf is said to be exceptionally low, but no figures have been published to support this; so Edward, an investigative journalist, tries to get an estimate. He knows that each crime report is given a sequence number, starting from #1 every morning. He assumes, and it is true, that all reports made by townspeople are of real crimes and that the townspeople have all gone to bed by 10 pm. So each day he selects a random time between 11 pm and midnight, makes a false report, and is then given a sequence number.

His false reports are #6/Monday, #5/Tuesday and #6/Wednesday.

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

Unknown to him, or to each other, other journalists were doing exactly the same: each putting in one false report between 11 pm and midnight on the same days.

Kim obtained reference numbers #3/Monday, #6/Tuesday and #4/Wednesday.
Anthony obtained #2/Monday, #7/Tuesday and #8/Wednesday.

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

There might have been more journalists; unfortunately, we do not know and cannot tell.

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

(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]

(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]

(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]

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

3 Carla manages a local store and wants to work out how long the queues are likely to be at different times of the day.

There is only one queue for the checkouts and customers go to the next available checkout once they have reached the front of the queue. Carla assumes that it takes two and a half minutes to serve each customer.

The store opens at 09:00. Carla assumes that one customer joins the queue every 2 minutes, starting at 09:02:00. Therefore, customer 1 arrives at the checkouts at 09:02:00 and is served immediately; customer 2 arrives at 09:04:00 and starts a queue.

The number of customers in the queue for each 30-second period of the first 5 minutes are shown in the diagram below:

09:00:00		09:01:00		09:02:00		09:03:00		09:04:00		09:05:00

Queue	0	0	0	0	0	0	0	0	1	0
	No customers at checkouts				Customer 1 being served					

The first time that there is one customer in the queue waiting to be served is at 09:04:00.

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

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

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

A second member of staff begins work at the second checkout at 10:32:00.

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

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

Carla would like to change the time that the second member of staff starts work. The start time must be either on an hour or at half past an hour and Carla wishes this time to be as late as possible, whilst ensuring that there will be no queue at 14:00:00.

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

   (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]

[Question 4 begins on the next page]

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4 Teams representing the twelve Provinces of Ercaland compete against each other every four years in the Ercalympic Games.

The Games were first held in 1958, and most recently in 2014.

Year	Games designation	Host city	Province
1958	I	Lipanj	Unje
1962	II	Enero	Yarjuan
1966	III	Okosita	Stugua
1970	IV	Duben	Prali
1974	V	Kasim	Merbenvo
1978	VI	Vasaris	Bauerfry
1982	VII	Sausis	Yarjuan
1986	VIII	Rujan	Presbetem
1990	IX	Aralik	Drembeec
1994	X	Gusht	Stugua
1998	XI	Enero	Yarjuan
2002	XII	Frar	Bauerfry
2006	XIII	Kasim	Merbenvo
2010	XIV	Tetor	Rebotoc
2014	XV	Kolovoz	Stugua

Stugua are the current holders of the Gregor Trophy. This trophy was introduced in 1990 and is presented to the highest-ranked team in the medals table. This is the 2014 medals table.

Rank	Province	Gold	Silver	Bronze
1	Stugua	32	21	26
2	Rebotoc	27	23	17
3	Merbenvo	20	26	18
4	Bauerfry	17	22	15
5	Yarjuan	13	11	17
6	Presbetem	12	18	15
7	Rhamc	12	10	14
8	Aym	12	10	10
9	Drembeec	10	7	12
10	Unje	6	11	5
11	Lyju	6	6	9
12	Prali	3	5	12

The teams are ranked by the number of gold medals won. If two or more teams have the same number of gold medals, the number of silver medals is taken into consideration, then, if necessary, the number of bronze medals.

The following table records all the gold medals won in the Games up to 2010.

	Number of gold medals won at:													
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV
Aym	8	3	5	4	6	5	2	7	9	10	11	8	9	10
Bauerfry	26	20	14	18	19	23	16	19	23	21	24	30	22	16
Drembeec	6	9	11	11	7	11	8	6	15	7	6	12	9	7
Lyju	5	4	7	5	6	2	5	8	5	6	5	3	3	4
Merbenvo	12	17	11	28	23	20	16	15	22	25	23	19	28	31
Prali	9	7	15	17	10	6	5	4	1	5	4	7	4	5
Presbetem	3	7	5	6	7	11	12	17	10	12	7	9	5	8
Rebotoc	8	12	6	10	11	15	17	15	14	22	31	25	24	30
Rhamc	2	5	4	5	4	7	3	7	5	7	8	10	12	11
Stugua	21	17	33	20	16	18	22	27	25	18	17	18	20	23
Unje	19	11	9	7	10	12	12	10	8	6	8	7	10	11
Yarjuan	17	24	16	13	25	18	30	21	19	17	19	15	17	14

A Province wishing to host the Games must submit a formal application at the opening ceremony of the previous Games. The current host Province and the last two hosts may not apply. At the closing ceremony, the applicant Province with the most gold medals won in total at the three most recent Games is announced as the host of the next Games. This procedure was introduced at the XI Games in 1998. Previously, the host Province had been selected by a committee.

At the opening ceremony in 1998, Yarjuan, Stugua and Drembeec were not eligible to apply. Bauerfry and Rebotoc were the only Provinces who applied to host the XII Games in 2002. At the closing ceremony it was announced that Bauerfry had been successful, with a total of 68 gold medals in the three most recent games, just one ahead of Rebotoc's 67.

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

(b) In 2013 the Presbetem Games Committee launched an appeal to raise money to improve training facilities. One donor promised $500 for every gold medal, $200 for every silver medal and $80 for every bronze medal won by Presbetem in 2014.

How much was received from this donor? [2]

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

At the opening ceremony of the XV Games in 2014, Aym, Drembeec and Unje applied to host the next Games.

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

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

Julian Perido is the only person to have competed in seven Games. His first Games, during which he celebrated his 17th birthday, and his last Games, during which he celebrated his 41st birthday, were both held in his home Province.

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

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