THINKING SKILLS **9694/32**

Paper 3 Problem Analysis and Solution **May/June 2015**

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.

IB15 06_9694_32/3RP
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International Examinations

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1 The activity boards at CONFEST offer various 60-minute workshops in three locations: the smallest, *Unity*; medium-sized *Bliss*; and the largest, *The Stage*. This is the timetable for Wednesday which was displayed at the information tent at 8 am:

Time	Unity	Bliss	The Stage
10 am		Meditation	Hatha Yoga
11 am			Macrobiotic Food
12 noon	Vinyasa Yoga		Cuddles
1 pm		Carpathian Water Buffalo	Origami
2 pm	Body Painting		Healing
3 pm	Tree Hugging		Privacy Rights in International Law
4 pm	Ashtanga Yoga	Fire Twirling	Massage
5 pm	Sunflowers	Mud Bath	
6 pm	Recycling	Tea Ceremony	Spontaneous Choir
7 pm		Chanting	
8 pm	Iyengar Yoga		Silent Disco

It is possible to move events to later in the day (at the risk of some people not being able to go to another workshop at that time) and it is possible to move an event to a larger venue if it is free. Starting earlier is not possible as those planning to attend would not know of the change.

Amethyst is considering offering a small workshop on flower arranging, which could be held at any of the locations, but she does not want to miss the Macrobiotic Food session or any form of Yoga.

(a) What is the earliest she could offer a workshop, and where would it be? [1]

In fact, she realises that many people will not know it is on, so offers it later in the week instead.

At 9.30 am on Wednesday there was concern that flooding might make Unity unusable for the whole day, and the committee looked at moving and/or postponing workshops. It would not be possible to add another session at 9 pm.

(b) (i) How many workshops would have to be moved to a later date? [1]

(ii) Suggest a revised timetable with the fewest workshops changed as possible, and the fewest times changed. [2]

There was no flood, but too many people came at 1 pm for the talk on Carpathian Water Buffalo. The tent at Bliss can accommodate no more than 40 people, including the organiser. The next two periods in Bliss were still vacant.

Of the 54 people who came for the talk on Carpathian Water Buffalo:

> 12 said they intended to go to Body Painting;
> 30 said they intended to go to Healing;
> 21 said they intended to go to Tree Hugging;
> 11 said they intended to go to Privacy Rights in International Law.

At least one of the 54, the organiser, Michel, didn't want to go to another session, and arranged to hold his talk on water buffalo twice so that everybody could attend.

(c) Which two of 1 pm, 2 pm and 3 pm did he choose? Explain your answer.   [2]
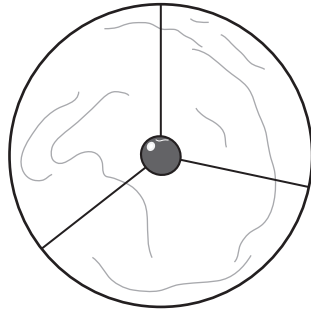
Some of those who had attended Origami found that they could now also attend Carpathian Water Buffalo, because they were not intending to go to workshops offered at 2 pm or 3 pm.

(d) Assuming that everyone who came to Bliss at 1 pm did attend one of the two sessions, what are the maximum and minimum numbers of other people that could attend the second session?   [3]

The fire marshals declared at 3 pm that it is not safe to do the Fire Twirling in a venue as small as Bliss, so the workshop must be moved.

(e) What is a two-move re-arrangement that will still allow Alys to attend the workshops on Sunflowers, Chanting and Fire Twirling?   [1]

2 Three sisters have devised a method to share a cake between them. Although none of the three is very good at cutting 120° slices, they are all good at identifying a fair portion. Assume that all portions are a whole number of degrees.

Their method involves allowing one of them to propose a cut, by marking lines on the icing on the top of the cake. The cake is then passed to the next sister who will improve upon the proposed division, if she can, by smoothing out one of the lines and re-marking it herself. The third sister then does the same.

Their method for improving upon a division involves moving the line between the largest and smallest portions so as to even out those portions. Where the largest and smallest portions add up to an odd number of degrees, one of the resulting portions is 1° bigger than the other. For example, portions of 110° and 136° would be adjusted to become two portions of 123° each, and portions of 110° and 137° would become portions of 123° and 124°.

The first sister's division never includes portions bigger than 165° or smaller than 75°. The sisters never attempt to improve a division where the difference between the largest and smallest portions is 10° or less.

(a) The first sister marked a cake into portions of 102°, 128° and 130°, and each of the other two sisters made an improvement upon the division.

What sizes were the portions after each sister had made her improvement? [2]

(b) The first sister marked a second cake into portions, which was then improved by the second sister, giving portions of 104°, 128° and 128°.

Give an example of what the first division might have been. [1]

Once the final portions are arrived at, the sisters are happy if all three portions are between 115° and 125° (inclusive). If not, they will eat the cake but will have an argument.

(c) A third cake had final portions which resulted in an argument. Give an example of a first division that would have led to this situation. [2]

(d) On a fourth cake, the first sister made a division which the others were unable to improve upon, but which resulted in an argument. Give two possibilities for the first division. [2]

(e) The first sister wants to make a division that would result in one of the final portions being as large as possible. Give an example of a first division that would achieve this. [3]

3 Roger's cleaning company calculates its prices for cleaning buildings in the following way:

- There is a fixed charge of $20.
- $0.50 is charged for every square metre of floor area in the building.
- An additional $10 is charged for every room in the building.

In this question assume that all rooms in buildings have a floor area that is a whole number of square metres.

(a) What would be the price for Roger's company to clean a building containing 5 rooms and having a total floor area of 50 square metres? [2]

Trevor is planning to set up a cleaning company, but only wants to calculate his prices based on the floor area to be cleaned. He will not have a fixed charge or add any extra to the price for the number of rooms.

(b) What should he charge per square metre of floor area to match the price of Roger's company for a building containing 5 rooms and having a total floor area of 50 square metres? [1]

Trevor has decided to set his charge at $1.50 per square metre to be cleaned.

(c) If a building has 6 rooms and would cost the same to clean with either company, what is the total floor area? [3]

Trevor also intends to offer an 'Express' service in which he will have 3 cleaners clean the building, rather than just 1. He wants to set the price for this service so that he earns twice what he would from the standard service, after paying his cleaners. Trevor pays each cleaner $0.90 per square metre to be cleaned.

(d) How much should Trevor charge per square metre of floor area for the 'Express' service? [3]

As soon as Trevor announced his prices, Roger's company reduced their prices by making the extra charge per room just $5. One of the bookings that Trevor had received was cancelled because Trevor's price at the standard rate had been cheaper, but was now $15 more expensive than Roger's price.

(e) (i) What is the minimum number of rooms that could be in such a building? [1]

(ii) What is the floor area of a building with this minimum number of rooms? [2]

Trevor decided that he would offer to clean the smallest room in any building with more than 3 rooms for free. This meant that Trevor's price for the job that he lost was now cheaper again.

(f) What is the maximum number of rooms that there could be in this building? Justify your answer. [3]

4 Every year the winners of the four regional heats compete in the final of the National Quiz Challenge for the Wenwich Cup. The winner of the Cup is also presented with $500, and the runner-up receives $200.

There are 7 rounds in the final, each one consisting of 20 multiple-choice questions. Rounds 3 and 6 are General Knowledge rounds, whilst in each of the others the contestants are given a choice of three categories from which they must select one. No contestant may select the same category twice.

In all 7 rounds, a correct answer scores 5 points, and 3 points are deducted for an incorrect answer. Each contestant is allowed to pass (choose not to answer) 3 questions per round without penalty, but 2 points are deducted for all further passes.

Each contestant has the option to Double Dare **one** of the Category rounds. The intention to Double Dare must be declared when announcing the choice of category. In a Double Dare round, that contestant scores 10 points for every correct answer, but has 20 points deducted for every incorrect answer and every pass. Contestants may not Double Dare a General Knowledge round.

If two contestants finish with the same number of points, the contestant with the greater number of correct answers beats the other.

This year's finalists are Eamonn, Norma, Sophie and Wesley, and the final is currently in progress. Round 6 has been completed, and the categories for Round 7 have just been revealed as Literature, People and Science.

The categories for the previous rounds were:

    Round 1 – History, Music and Sport

    Round 2 – Geography, Literature and Science

    Round 4 – History, Music and People

    Round 5 – Current Affairs, Geography and Sport

The contestants' choices were as follows:

	Round 1	Round 2	Round 4	Round 5
Eamonn	Music	Literature	People	Current Affairs
Norma	Music	Science	People	Geography
Sophie	History	Science	Music	Geography
Wesley	Sport	Geography	People	Current Affairs

After 6 Rounds:

    Wesley is in first place with 478 points and has given 99 correct answers;
    Norma is in second place with 432 points and has given 93 correct answers;
    Eamonn is in third place with 420 points and has given 92 correct answers;
    Sophie is in fourth place with 381 points and has given 93 correct answers.

Their performances, round by round, are detailed below:

	Round 1		Round 2		Round 3		Round 4		Round 5		Round 6	
	Pts	Correct	Pts	Correct	Pts	Correct	Pts	Correct	Pts	Correct	Pts	Correct
Eamonn	62	14	80	16	74	16	70	15	74	16	60	15
Norma	71	16	74	16	69	15	63	14	77	16	78	16
Sophie	71	15	64	14	82	17	20	14	76	17	68	16
Wesley	70	15	85	17	77	16	80	16	82	17	84	18

(a) How many correct answers altogether have been given to Geography questions? [2]

(b) Norma gave one more correct answer in Round 1 than Sophie, yet they both scored 71 points.

    (i) How many incorrect answers and how many passes did Norma have in Round 1? [1]

    (ii) How many incorrect answers and how many passes did Sophie have in Round 1? [1]

Norma is the only contestant not to have Double Dared so far.

(c) What category did Wesley Double Dare? [2]

(d) Sophie's decision to Double Dare Music in Round 4 proved costly.

If she had not Double Dared but had given the same number of correct answers,

    (i) what is the minimum number of points she could have scored in Round 4? [1]

    (ii) what is the maximum number of points she could have scored in Round 4? [1]

(e) It is not compulsory to Double Dare, and Norma is considering whether or not to Double Dare Round 7.

    (i) What category must Norma select for Round 7? [1]

    (ii) If she decides to Double Dare, what is the minimum number of correct answers she needs to guarantee that she will win the Cup? [2]

    (iii) If she decides not to Double Dare, how many correct answers from Wesley would guarantee that he will win the Cup, even if he answers all of his other questions incorrectly? [2]

    (iv) Should Norma Double Dare Round 7, or not? Explain the reasoning behind your opinion. [2]

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