Cambridge International A Level

Cambridge International Examinations
Cambridge International Advanced Level

THINKING SKILLS **9694/31**

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

1 Peter's Pizzas sell pizzas in three sizes: Small, Medium and Large. The types of pizza are grouped into three categories: Basic, Standard and Luxury. The cost of making each type of pizza is shown in the table below.

	Basic	Standard	Luxury
Small	\$0.60	\$0.80	\$1.20
Medium	\$0.90	\$1.20	\$1.80
Large	\$1.60	\$2.50	\$3.00

In order to set his prices, Peter assumes that it will cost him \$1.50 to make any delivery, regardless of the number of pizzas to be delivered.

He does not want to make a separate charge for delivery of pizzas and wishes to set the prices so that he will make a profit of at least 20% overall on any delivery.

He has therefore worked out that the lowest price he could charge for a Small Basic pizza is \$2.52 and the lowest price he could charge for a Large Luxury pizza is \$5.40.

(a) What is the lowest price that Peter could charge for a Medium Luxury pizza? [1]

Peter also wishes to offer special deals when buying more than one pizza. He wishes to make two offers: a percentage discount on the sale of 3 pizzas or more; and an offer in which, for any order of 2 or more pizzas, the cheapest pizza is reduced to half price. In either case he still wishes to make a profit of at least 20% overall on any delivery.

(b) If the prices are still set as before, what is the greatest percentage discount (to the nearest 1%) that Peter can offer on orders of 3 pizzas? [3]

(c) What price should Peter now charge for each Large Basic pizza so that he will still make a 20% profit on a delivery of 2 such pizzas if the second one is half price? [2]

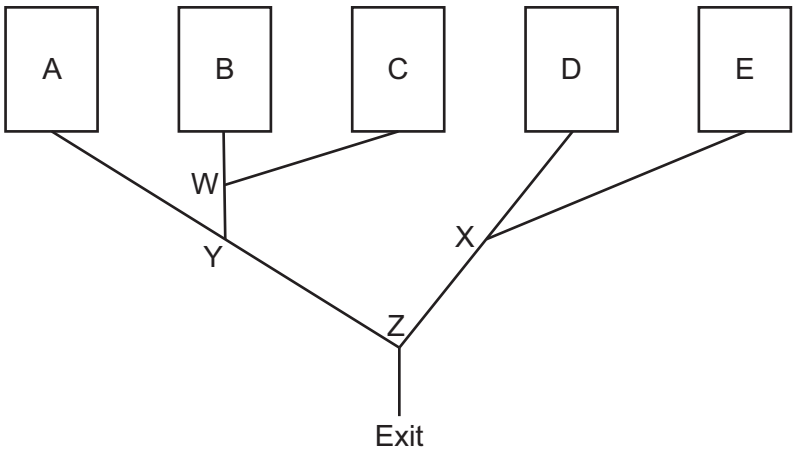
Peter decided to set the discount at 10% for an order of 3 pizzas or more.
He also decided to set the price of a Large Standard pizza at \$5.20.

(d) If a customer placed an order for two Large Standard pizzas and one other, cheaper, pizza, what price would the other pizza have to be so that the two offers resulted in the same overall cost for the order? [2]

Unfortunately, Peter forgot to specify that only one offer could be used for any order. He received an order for 3 Large Standard pizzas, and the customer claimed that one of the pizzas should be half price and that there should also be a 10% discount on the order.

(e) If Peter does apply both offers to this order, what will be his overall profit? [2]

2 There are five identical car parks at the Nambassa festival, each taking hundreds of cars, but there is only one exit, where each car has to stop to hand in a badge. Since everyone tries to leave at the same time there are queues.



At each junction cars will merge alternately: one from one branch and then one from the other. Assume that car parks all start with the same number of cars, and ignore the small number of cars on the tracks.

It takes one hour for everyone to leave.

(a) (i) The first car to exit came from car park C and the second from car park D. From which car parks did the next seven cars come from? List them in order. [2]

(ii) Which car parks empty long before the others? [1]

Peter wanted to rearrange the tracks so that the total time to clear all the car parks is reduced.

(b) Explain why this will not be possible. [1]

Terry is concerned that people using some car parks will complain that some other car parks emptied long before theirs did. To avoid this, he is considering arranging for cars to merge 2 to 1, instead of alternately, at some of the junctions. By doing this he hopes to make the earliest emptying of any car park as late as possible.

(c) Determine which junction(s) should be 2 to 1, and which branch is which, to achieve Terry's aim. Explain your reasoning for junction Z. [3]

Lorraine suggested that it might be better if the track from C were moved over to join the one from D. Peter pointed out that, although he was not sure whether she meant before or after junction X, it would not make any difference because it would simply be equivalent to relabelling the car parks.

(d) (i) Draw a different layout for the tracks, with no more than two tracks merging at any junction, which is **not** equivalent to relabelling the car parks. [1]

(ii) How long would it take before one of the car parks becomes empty in your new layout, if cars merge alternately at all junctions? [2]

3 A group of 20 volunteers is organising a charity *pieathlon* event near their village, and are considering how many visitors they can accommodate. They plan to hold a 'fun run' and to have a café selling tea and pies.

The event will be from 11:00 to 16:00. The café will be open throughout the event and the fun run will take place from 12:00 to 14:00.

The volunteers need to decide how to divide up their time among the following tasks:

- Serving in the café: 1 volunteer is needed to serve every 20 visitors in the café at any time.
- Directing the fun run: 1 volunteer is needed, for starting the race, awarding prizes, etc.
- Marshalling the fun run: 6 volunteers are needed to direct the runners along the route.
- Providing First Aid cover: 1 volunteer is needed for every 50 runners during the race.

All of the volunteers are capable of fulfilling any of the tasks, but can only be doing one of the four tasks at any particular time.

Those volunteers involved in the fun run will be fully occupied with it from 12:00 to 14:00.

(a) (i) If all 20 volunteers were occupied with the fun run, what would be the maximum number of runners that could take part? [2]

(ii) If this maximum number of runners all wanted a cup of tea in the café immediately after the race, how many **more** volunteers would be needed? [1]

The 20 volunteers assume that each of the runners will bring just one supporter with them, who will watch the race from the café.

(b) What is the maximum number of runners that can take part in the race? [3]

The organisers expect that the runners will join their supporters in the café at 14:00, and all these visitors will stay in the café until 16:00.

(c) Will the addition of the volunteers involved in the race be sufficient to serve all the visitors in the café after the race? [2]

The organisers decide that there must be at least one volunteer serving in the café throughout the event (from 11:00 to 16:00). They assume that no more than one volunteer will be needed from 11:00 to 12:00.

(d) (i) What is the minimum total number of hours of volunteering time that could be needed for the event, assuming that at least one runner takes part in the fun run? [1]

(ii) What is the total number of hours of volunteering time that will be needed for the event, assuming that the organisers allow as many runners to come as possible? [3]

The volunteers want to make sure that every one of them contributes 5 hours of their time to the event. Anyone who will spend less than 5 hours on tasks during the day must spend the remainder baking pies the day before. Each pie takes 1 hour of volunteering time to make. They assume that the maximum number of runners possible will take part in the event.

(e) What is the smallest number of equal slices that each pie should be divided into so that the runners and supporters could each get one slice? [3]

[Question 4 begins on the next page]

4 The televised final of *Bandwidth*, in which seven new rock bands competed to win a recording contract, took place last night.

There were five judges: Aleem, Tony, Marais, Roshan and Michael. They awarded points after all seven bands had performed, and the band with the most points won the contest.

Each judge was given the following instructions before the event began:

1 You must award a total of exactly 30 points.

2 You must award points to at least three of the bands.

3 You cannot award the same number of points to two or more bands.

4 There must be a difference of at least 3 points between your first-placed and second-placed bands.

5 There must be a difference of at least 2 points between your second-placed and third-placed bands.

At the afternoon rehearsal, five members of the production team pretended to be the judges and awarded points as follows:

Band	*Points awarded by:*					*Total*
	Jim	Jake	Jane	Joe	Jill	
The Elbees	2	0	12	14	2	30
DRS	0	15	0	3	7	25
Ashwin	0	2	8	0	0	10
The Urn	14	4	3	0	12	33
Riverside	9	0	0	10	4	23
Captain Cook	0	9	0	3	0	12
Broadsword	6	0	7	0	5	18

They only awarded points at the rehearsal in order to test the scoreboard.

(a) Name the three judges who awarded sets of points at the rehearsal that would **not** have been allowed at the contest itself, and give the number of the instruction that each one has violated. [3]

In the questions that follow, consider only sets of points that are allowed, e.g. 17, 9, 4.

(b) What is the greatest number of points that a judge could award to one band? [1]

(c) **(i)** Explain why a judge could **not** award points to all seven bands. [2]

(ii) List all the sets of points that a judge could award to six of the bands. [3]

This is how the scoreboard appeared after four of the five judges had awarded their points last night.

Band	*Points awarded by:*					*Total*
	Aleem	Tony	Marais	Roshan	Michael	
The Elbees	0	6	0	12		18
DRS	0	0	0	0		0
Ashwin	10	0	7	0		17
The Urn	0	15	0	0		15
Riverside	18	0	4	0		22
Captain Cook	2	9	16	1		28
Broadsword	0	0	3	17		20

When Michael awarded his points, the scoreboard operator mistakenly entered the points that Jill had awarded at the afternoon rehearsal.

(d) According to the incorrect scoreboard, which band appeared to have won the contest? [1]

In fact, Michael only awarded points to three bands. When the mistake was rectified, zero was the only number that appeared more than once on the scoreboard (including the final totals).

(e) (i) Which three bands did Michael award points to? [1]

(ii) Deduce the final totals of all seven bands. [4]

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