Cambridge International A Level

Cambridge International Examinations
Cambridge International Advanced Level

THINKING SKILLS **9694/33**

Paper 3 Problem Analysis and Solution **May/June 2017**

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.

DC (NH) 145230

CAMBRIDGE International Examinations

[Turn over

1 In a nursery, the children must be properly supervised throughout the day. In any room which has children in it there must be 1 adult present for every 4 children, plus 1 additional adult. So 5 children would require 3 adults to be present in the room.

Sandra's nursery has 1 large room and 4 identical small rooms. The large room holds a maximum of 10 children and the small rooms each hold a maximum of 7 children.

(a) If the nursery employs 6 adults, what is the largest number of children that could be supervised? [2]

There are currently 18 children enrolled at the nursery.

(b) What is the smallest number of adults that would be needed to supervise all 18 children? [2]

5 more children join the nursery.

(c) What is the smallest number of adults that are needed to supervise all 23 children? [1]

Sandra decides to combine some of the rooms, in order to reduce the number of adults she needs to employ. After consultation with the builder, she has three options. Her budget will allow for only one of these to be undertaken:

1) Combine the large room and one of the small rooms to make a room with a capacity of 17 children
2) Combine two of the small rooms to make a room with a capacity of 14 children
3) Combine three of the small rooms to make a room with a capacity of 21 children

(d) For each of these options, find the minimum number of adults required to supervise all 23 children. [3]

Sandra expects that more children will join the nursery in the future.

(e) Explain which of the three options she should choose. [2]

2 Economists study the inequalities in the distribution of wealth in different countries in the following way:

- They consider who owns the wealth of the country, and place the owners of the wealth in order (from least wealthy to most wealthy).
- The amounts of wealth owned by different groups (for example, the top 10% in this list of wealth-owners, or the bottom 1%) are then compared, and used to support claims about how fairly the wealth is distributed.

A student of economics studies these measures of inequality by creating a simple model.

She defines a situation in which there are 100 people in a community, and $1000 of total wealth shared between them. None of this wealth is 'unowned' (i.e., the total wealth of all the people in the community adds up to $1000), but not everyone necessarily has some of it. The wealth is divided up into $1 units, and cannot be divided into smaller units.

Any number of people could have the same amount of wealth. In these circumstances, when they are put in order of wealth, which particular person is considered 'more wealthy' than another is arbitrary and does not matter.

(a) If everyone in the community owns at least $1, what is the most that the wealthiest person in the community could own? [1]

(b) If the least wealthy 10 people in the community own $50 in total,

(i) what is the most that the least wealthy person (or people) could own? [1]

(ii) explain why the wealthiest of these 10 people could not own $50. [2]

(iii) what is the most that the 10 most wealthy members of the community could own in total? [1]

(c) One economist claims that the wealthiest 10% of the population in Europe owned 60% of the wealth in 2010.

Use the student's model to calculate what is the most that the least wealthy 10% could own. [3]

One measure of the inequality of wealth in a country is calculated as *A* minus *B*, where *A* is the percentage of wealth owned by wealthiest 10% of the population, and *B* is the percentage of wealth owned by least wealthy 10% of the population.

(d) If a country had a measure of 50 on this scale, what would be the maximum value of *B*? Justify your answer. [2]

3 Richard owns a company which produces a range of different chocolates. He owns a shop where he sells standard boxes of the chocolates. He also has a website through which customers can order boxes containing whatever assortment of chocolates they want.

The standard boxes of chocolates come in three sizes: small, medium and large. Richard packs these boxes in the back room, and has a full-time salesperson working in the shop. Every morning Richard checks how many of each type of box he has in stock. He then plans how many of each type to pack during that day. As medium boxes are more popular, his aim is to have in stock equal numbers of small and large boxes and twice this number of medium boxes. He packs boxes such that, if no boxes were sold during the day, he would have boxes in this ratio at the end of the day. He starts work at 09:00 and spends 8 hours packing chocolates each day.

It takes Richard 4 minutes to pack a small box of chocolates, 8 minutes to pack a medium box and 10 minutes to pack a large box. If a box of chocolates is ordered on the website it takes Richard 3 minutes, plus 30 seconds for every chocolate to pack the box. The maximum number of chocolates that can be packed into a box for an order through the website is 48.

The table shows the website orders and the numbers of boxes in the shop last week.

Day	*Website orders*	*Stock in shop at 09:00*		
		Small	*Medium*	*Large*
Monday	1 box of 24 chocolates 1 box of 32 chocolates	17	23	14
Tuesday	None	15	20	11
Wednesday	1 box of 36 chocolates	12	18	8
Thursday	None	4	10	5
Friday	None	6	12	7

(a) How long did it take for Richard to pack the boxes for the website orders on Monday? [2]

(b) To deliver an order from the website on the next day, Richard needs to have it packed by 11:00. What is the largest number of chocolates that Richard would be able to have delivered on the next day? [3]

(c) How many of each type of box did Richard pack on Tuesday? [3]

Richard has decided to hire a part-time assistant to help him to pack the chocolates. On any day that the assistant works, she will work for a whole number of hours. Richard expects that it will take the assistant 7 minutes to pack a small box, 9 minutes to pack a medium box and 15 minutes to pack a large box. Neither Richard nor the assistant will start to pack a box if there is not time to complete it during the same day. Richard will continue to complete the website orders himself.

(d) If the assistant works for 3 hours during one day and there are no website orders, what is the largest number of boxes that can be packed in the ratio 1 : 2 : 1 (small : medium : large)? [3]

On Monday morning this week there were only 6 small, 5 medium and 4 large boxes in stock.

(e) Richard assumes that the sales of chocolates last week were typical. He wants to use this information to decide how many hours he should employ the assistant for each week.

What is the smallest number of hours that he could employ her for each week, so that the stock of boxes of chocolates at the end of each week remains constant? [4]

[Question 4 begins on the next page]

4 The theme park Pirate World is open every day from 10:00 to 18:30.
Admission prices each day are as follows:

Adults (ages 16–59)	$40
Juniors (under 16)	$25
Seniors (60+)	$25
Group of 1 Adult + up to 3 Juniors	$75
Group of 2 Adults + up to 4 Juniors	$120
Group of 4 or more Adults	$30 per person

Upon entry each person receives a treasure chest containing 30 doubloons, to pay for rides. Further doubloons can be bought during the day at Blackbeard's Booth, as follows:

10 doubloons	$12
20 doubloons	$18
50 doubloons	$40

Pirate World has six premium rides, known collectively as the Swashbuckler Rides. They are:

Avast	(72 seats)
Broadside	(72 seats)
Plunder	(72 seats)
Mutiny	(64 seats)
Keelhaul	(60 seats)
Scuppered	(60 seats)

The Swashbuckler Rides have a strict timetable, starting runs every 10 minutes from 10:25 to 18:05. They are very popular and there are frequently large queues for each of them. The normal cost of each of the Swashbuckler Rides is 6 doubloons per run.

Queuing can be avoided by purchasing Black Spot tokens at Blackbeard's Booth. Each token costs 10 doubloons and is for a specific ride at a specific time, guaranteeing a seat on that run without having to queue. Black Spot tokens can only be bought for the runs that begin at quarter to and quarter past each hour. The number of tokens offered for sale for each run is limited to half the number of seats on the ride.

Nobody is allowed to ride any of the Swashbuckler Rides again without rejoining the queue, unless they have a Black Spot token.

The other rides at Pirate World are:

Ride	Seats	Cost per run
Davy Jones's Locker	48	4 doubloons
Spanish Main	48	4 doubloons
Cutlass	40	4 doubloons
Shiver Me Timbers	40	4 doubloons
Crow's Nest	36	3 doubloons
Jolly Roger	48	3 doubloons
Marooned	40	3 doubloons
Seven Seas	40	3 doubloons
Yo-Ho-Ho	36	2 doubloons
Sea Legs	32	2 doubloons
Bucko	36	1 doubloon
Weigh Anchor	32	1 doubloon

These rides do not operate to a timetable and there are no Black Spot tokens available for any of them.

In addition, there are two free shows at the Yardarm Theatre:

Ahoy There Me Hearties is performed daily at 10:30, 13:00 and 15:30.
Batten Down The Hatches is performed daily at 11:45, 14:15 and 16:45.

Both shows last for 35 minutes.

There is also a free Treasure Hunt that takes place at 15:00 each day and lasts for 50 minutes.

(a) What is the maximum number of people that could ride on Scuppered in one day? [2]

(b) At 10:00 each morning, what is the total number of Black Spot tokens on sale for the day's Swashbuckler Rides? [2]

(c) What is the minimum possible total cost of admission to Pirate World for a party consisting of 15 Adults and 9 Juniors? [2]

Will and Elizabeth went to Pirate World yesterday. They headed first for Broadside and joined the queue whilst the 10:55 run was in progress. Eventually they were the last two people to be allowed onto the 11:45 run. All the available Black Spot tokens for runs of Broadside before midday had been sold.

(d) How many people were ahead of Will and Elizabeth in the queue for Broadside when they first joined it? [2]

After Broadside, they realized that if they were to achieve their aim of experiencing all of the rides in the park, they would have to buy Black Spot tokens for the other five Swashbuckler Rides. They did manage one run on every ride, and even had a second run on Cutlass, Jolly Roger and Marooned before time and their doubloons ran out.

(e) How much did the couple pay for the doubloons they bought at Blackbeard's Booth, assuming they bought them as economically as possible? [2]

It is 12:20, and Ruth, Kate, Samuel, Frederic and Edith have just entered Pirate World. They intend to ride together on all six of the Swashbuckler Rides. They also intend to watch one of the shows together and take part in the Treasure Hunt. They have decided to buy Black Spot tokens for all of the Swashbuckler Rides.

A display outside Blackbeard's Booth shows how many Black Spot tokens are still available for the rest of the day, as follows:

	12:45	13:15	13:45	14:15	14:45	15:15	15:45	16:15	16:45	17:15	17:45
Avast	3	4	4	2	5	7	6	8	6	7	8
Broadside	0	3	0	4	6	7	8	6	4	6	3
Plunder	1	0	2	0	4	4	3	4	3	7	4
Mutiny	0	6	3	2	3	3	6	4	4	8	4
Keelhaul	3	6	0	4	6	8	7	6	4	5	7
Scuppered	2	4	5	5	3	5	4	7	5	6	6

Kate has pointed out that the only run of Plunder that still has enough tokens available is the 17:15 run.

(f) Which runs of the other five Swashbuckler Rides must they buy Black Spot tokens for in order to fulfil their intentions? [5]

BLANK PAGE