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CAMBRIDGE INTERNATIONAL MATHEMATICS

0607/51

Paper 5 Investigation (Core)

May/June 2022

1 hour 10 minutes

You must answer on the question paper.

No additional materials are needed.

INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You should use a graphic display calculator where appropriate.
- You may use tracing paper.
- You must show all necessary working clearly, including sketches, to gain full marks for correct methods.
- In this paper you will be awarded marks for providing full reasons, examples and steps in your working to communicate your mathematics clearly and precisely.

INFORMATION

- The total mark for this paper is 36.
- The number of marks for each question or part question is shown in brackets [].

This document has **8** pages.



Answer **all** the questions.

INVESTIGATION

STORAGE BINS

This investigation looks at different methods to store items in storage bins.

Amara wants to use the smallest number of storage bins possible.
Each bin can hold a maximum total mass.

1 Amara uses this method.

Method 1 Put each item in the first bin that can hold its mass.

Example

These are the masses, in kg, of four items.

6 7 4 2

The maximum total mass that each bin can hold is **10 kg**.
The tables show how Amara puts these items into bins.

Amara puts the first item in bin 1.
4 kg of storage is unused in this bin.

Bin	Mass of items in bin	Unused mass in bin			
1	6	4			
2					
3					

The second item will not go in bin 1
because it is more than 4 kg.
Amara puts the second item in bin 2.

Bin	Mass of items in bin	Unused mass in bin			
1	6	4			
2	7	3			
3					

The third item is 4 kg.
Amara puts this in bin 1.
Bin 1 is now full.

Bin	Mass of items in bin	Unused mass in bin			
1	6, 4	4	0		
2	7, 2	3	1		
3					

The fourth item will go in bin 2.
Bin 3 is not used.

Amara needs two bins which can hold a total of 20 kg.
1 kg out of the total of 20 kg of storage is unused.

- (a) These are the masses, in kg, of ten items.

38 6 21 50 32 7 15 9 27 25

The maximum total mass that each bin can hold is **60 kg**.
Amara uses Method 1 to put these ten items into bins.
The table shows how she puts the first 6 items into bins.

Bin	Mass of items in bin	Unused mass in bin				
1	38, 6, 7	22	16	9		
2	21, 32	39	7			
3	50	10				
4						
5						

- (i) Complete Amara's table to show that she needs 5 bins. [4]
- (ii) Work out the total unused mass in the 5 bins.

..... [2]

- (b) These are the masses, in kg, of six items.

8 16 13 10 5 3

The maximum total mass that each bin can hold is **20 kg**.

Bin	Mass of items in bin	Unused mass in bin				
1	8	12				
2						
3						
4						
5						

Use Method 1 to complete the table for all six items.
The first item has been put in for you.
You may not need all the bins.

[2]

- 2 Amara wants to see if she can use fewer bins.
She puts her items in order of mass before she puts them in bins.
She uses this method.

Method 2 Put the masses in order, largest first.
Then use **Method 1**.

These are the masses, in kg, of the ten items from **Question 1(a)**.

38 6 21 50 32 7 15 9 27 25

- (a) Write these ten masses in order, largest first.

.....,,,,,,,,, [1]

- (b) The maximum total mass that each bin can hold is **60 kg**.

Complete the table using Method 2.

Bin	Mass of items in bin	Unused mass in bin				
1						
2						
3						
4						
5						

[3]

- (c) Work out the difference in the total unused mass when using Method 1 and Method 2.
Use your answers from **Question 1(a)(ii)** and **Question 2(b)**.

..... [2]

3 A *best solution* uses the smallest possible number of bins.

- (a) (i) A set of items with a total mass of 270 kg is put into 4 bins.
The maximum total mass that each bin can hold is 80 kg.

Show that this is a best solution.

[2]

- (ii) Show that the solution in **Question 1(b)** is a best solution.

[2]

- (b) Amara knows that for a particular set of items a best solution is 6 bins.
The maximum total mass that each bin can hold is 5 kg.
The total mass of the items is 27.5 kg.

Work out the amount of unused storage for a best solution for these items.

..... [2]

4 Amara tries another way to improve Method 1.

Method 3 Look for items that combine to make as many full bins as possible and place these first.
For the remaining items, use **Method 2**.

(a) These are the masses, in kg, of eight items.

21 10 30 19 13 7 28 4

The maximum total mass that each bin can hold is **40 kg**.

Does Method 3 give a best solution for these items?
Show how you decide.

Bin	Mass of items in bin	Unused mass in bin				
1						
2						
3						
4						
5						

[6]

- (b) Amara puts nine items into bins using Method 3.
The maximum total mass that each bin can hold is **40 kg**.

Bin	Mass of items in bin	Unused mass in bin				
1	18, 22	0				
2	32, 5, 3	0				
3	32	8				
4	19, 15	21	6			
5	12	28				

Amara only wants to use 4 bins.

She removes the last item she packed and divides it into two smaller items with the same total mass.

She puts each of these two items into a bin that can hold its mass.

Work out how much the percentage of unused storage changes when Amara uses 4 bins instead of 5 bins.

..... [5]

Question 5 is printed on the next page.

5 These are the masses, in kg, of eight items.

31 10 39 20 29 47 50 12

The maximum total mass that each bin can hold is **60 kg**.
Each bin Amara uses costs \$13.50 .

Use Method 2 or Method 3 to put these items into bins to give a best solution.
Find the cost of this solution.

Bin	Mass of items in bin	Unused mass in bin				
1						
2						
3						
4						
5						

\$ [5]

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