

KINGDOM OF BAHRAIN

NATIONAL AUTHORITY for QUALIFICATIONS
and QUALITY ASSURANCE of EDUCATION
and TRAINING

Directorate of National Examinations

Grade 12 National Examinations

مملكة البحرين

الهيئة الوطنية للمؤهلات و ضمان جودة

التعليم و التدريب

إدارة الامتحانات الوطنية

الامتحانات الوطنية للصف الثاني عشر

March 2015

PROBLEM SOLVING

Paper 2 Problem Analysis and Solution

Duration: 2 hours

Write your answer on the answer booklet.

Additional materials: ruler, pencil, eraser,
calculator, answer booklet.

امتحان مارس 2015

حل المشكلات

الورقة 2 تحليل و حل المشكلات

مدة الامتحان: ساعتان

اكتب الإجابة في كراسة الإجابة.

الأدوات الإضافية: مسطرة، قلم رصاص، ممحاة،

آلة حاسبة، كراسة الإجابة.

Read these instructions first:

Follow the instructions on the answer booklet
provided.

Answer **all** questions.

The use of calculators is permitted.

The total number of marks for this paper is 50.

This document consists of **12** printed pages and **4** blank pages.

1 Study the information below and answer the questions that follow. You should show your working.

Rashid sells a variety of different mixes of muesli breakfast cereal in his shop, each one is made from a combination of oats, nuts and raisins. He creates all the mixes in 10 kg batches, then places them into containers. When customers wish to buy muesli, Rashid takes the amount they require from the appropriate container.

The nutritional values per 100 g of each of the three ingredients is as follows:

	Energy (kJ)	Protein (g)	Fat (g)
Oats	1600	16	6
Nuts	2400	22	50
Raisins	1200	2	0

Each container has two labels on it. One of them details the nutritional value of the mix per 100 g. The other one has a code on it that identifies the percentage of each of the ingredients that make up the mix in the order: oats, nuts, raisins.

The most popular mix has the code 601030, containing 60% oats, 10% nuts and 30% raisins (i.e. 6 kg of oats, 1 kg of nuts and 3 kg of raisins in a 10 kg batch).

(a) The energy content per 100 g of the 601030 mix is 1560 kJ.

(a1) What is the protein content per 100 g of the 601030 mix? [1]

(a2) What is the fat content per 100 g of the 601030 mix? [1]

Rashid has decided that:

- all the mixes must contain at least 50% oats, 10% nuts and 10% raisins.
- every 10 kg batch must contain a multiple of 1 kg of each ingredient.

(b) How many different mixes can Rashid create? [2]

(c) Without performing any calculations, state:

(c1) The code of the mix Rashid can create with the highest protein content per 100 g. [1]

(c2) The code of the mix Rashid can create with the lowest fat content per 100 g. [1]

(d) Rashid needs to make a new 10 kg batch of the bestselling 601030 mix, but only has 5 kg of oats in stock. He has decided to combine the 4 kg that is left in the 501040 container with the 3 kg that is left in the 701020 container and make the mix up to 10 kg of 601030 by adding the necessary amounts of each of the ingredients.

How much of each of the ingredients does Rashid need to add? [3]

(e) The label with the code has fallen off one of the containers. The other label details the nutritional values per 100 g of this mix as:

Energy	1720 kJ
Protein	15.8 g
Fat	14.2 g

What is the code for this mix? [3]

- (f) Rashid would like to create a mix that has nutritional content per 100g as follows:

Energy	1500 kJ	–	1700 kJ
Protein	14 g	–	16 g
Fat	11 g	–	13 g

He has discovered that he can do this if he allows multiples of 0.5 kg of each ingredient to make a 10 kg batch.

Show that it is possible to produce a mix that is within the range of Rashid's desired nutritional values, using multiples of 0.5 kg of each ingredient to make a 10 kg batch. It must still contain at least 50% oats, 10% nuts and 10% raisins.

With mentioning the nutritional values of this mix.

[3]

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2 Study the information below and answer the questions that follow. You should show your working.

Every year an Art Gallery supports a charity by auctioning a special limited edition of 4 prints donated by a leading artist, in a rather unusual way.

Bidders pay BD 250 each to the charity to take part and are instructed to submit four bids in a sealed envelope. Each bid must be a whole number of dinars from BD 20 to BD 99, and the four bids must total BD 250 exactly.

The owners of the highest four bids that were **not repeated** will win the four paintings. The winning bidders do not have to pay any further money for the prints.

The following table shows the bids submitted at last year's auction (2014):

Bidder number	Values of bids (BD)
1	89, 83, 54, 24
2	95, 89, 35, 31
3	97, 81, 44, 28
4	92, 66, 50, 42
5	99, 93, 35, 23
6	85, 73, 64, 28
7	95, 78, 54, 23
8	75, 71, 57, 47
9	94, 67, 50, 39
10	97, 84, 45, 24
11	76, 68, 62, 54
12	99, 80, 43, 28
13	87, 66, 51, 46
14	88, 71, 48, 43
15	94, 79, 48, 29
16	98, 78, 45, 29
17	92, 77, 56, 25
18	98, 70, 51, 31
19	87, 79, 53, 31
20	77, 69, 61, 43
21	93, 56, 52, 49
22	80, 69, 62, 39
23	81, 65, 55, 49
24	64, 63, 62, 61
25	84, 81, 47, 38
26	84, 72, 53, 41
27	89, 65, 58, 38
28	76, 67, 58, 49
29	88, 63, 53, 46
30	83, 72, 57, 38
31	87, 75, 52, 36
32	97, 70, 51, 42

The table below is a summary of the bids.

Value of bid (BD)	No of bids	Value of bid (BD)	No of bids	Value of bid (BD)	No of bids	Value of bid (BD)	No of bids
99	2	79	2	59	0	39	2
98	2	78	2	58	2	38	3
97	3	77	2	57	2	37	0
96	0	76	2	56	2	36	1
95	2	75	2	55	1	35	2
94	2	74	0	54	3	34	0
93	2	73	1	53	3	33	0
92	2	72	2	52	2	32	0
91	0	71	2	51	3	31	3
90	0	70	2	50	2	30	0
89	3	69	2	49	3	29	2
88	2	68	1	48	2	28	3
87	3	67	2	47	2	27	0
86	0	66	2	46	2	26	0
85	1	65	2	45	2	25	1
84	3	64	2	44	1	24	2
83	2	63	2	43	3	23	2
82	0	62	3	42	2	22	0
81	3	61	2	41	1	21	0
80	2	60	0	40	0	20	0

Since the gallery introduced this event in 2005, the winning bids and the total money raised for the charity have been as follows:

Year	Winning bids	Total money raised (BD)
2005	92, 78, 65, 52	7250
2006	84, 71, 69, 60	8500
2007	95, 83, 80, 68	7750
2008	90, 72, 56, 37	8250
2009	94, 81, 73, 59	7000
2010	92, 84, 77, 63	8750
2011	96, 91, 83, 67	7750
2012	86, 71, 54, 43	9250
2013	89, 75, 63, 46	7250
2014	85, 73, 68, 55	8000

- (a) How many bidders took part in the auction in 2011? [2]
- (b) At last year's auction, bidder 6 won two of the prints, having submitted both the highest and second highest winning bids (BD 85 and BD 73 respectively).

What were the bidder numbers of the bidders that won the other two prints? [2]

- (c) One sealed envelope was submitted after bidding had closed at last year's auction, and therefore could not be accepted. The four bids were BD 82, BD 63, BD 59 and BD 46.

Which of these bids (if any) would have been winning bids if they had been submitted in time? [2]

- (d) Majid and Sameera take part in the auction every year. Last year Majid included the digit 7 in each of his four bids, whilst the total of the two digits Sameera used in each of her four bids equaled 13.

(d1) What was Majid's bidder number? [1]

(d2) What was Sameera's bidder number? [1]

- (e) This year, Majid is going to choose four numbers with a constant difference between them, but will not make his highest bid less than BD 75, or his lowest bid less than BD 35. Sameera intends to make her four bids using 8 different digits, but does not want the difference between her highest and lowest bids to be more than BD 50.

(e1) Give **one** example of a set of four bids that Majid could make. [1]

(e2) Give **one** example of a set of four bids that Sameera could make. [2]

(e3) Is it possible that Majid and Sameera could make all four of their bids this year the same as each other? Explain your answer. [2]

- (f) Essa did not take part in last year's auction. Previously, he had made the same four bids every year from 2005 to 2013. In total he has won four prints, one from each year in 2008, 2009, 2011 and 2013.

What were the four bids that Essa made every year? [2]

3 Study the information below and answer the questions that follow. You should show your working.

Adel took part in a Skateboard Stunt competition yesterday and finished in third place.

There was a qualifying round during the afternoon, followed by the Final last night.

In the qualifying round, competitors had to perform one stunt chosen from a list compiled by the organisers. Each of the stunts had a difficulty rating of 1, 2, 3 or 4.

Every performance was given a whole number mark from 0 to 10 by each of the five judges and then a competitor's score for his stunt was calculated as follows:

- Discard the highest and lowest of the five judges' marks
- Multiply the sum of the other three marks by the difficulty rating

The competition attracted 36 skateboarders, each paying an entry fee of BD 6. Competitors who were disappointed with their score had the option to add a further BD 4 to their entry fee and have a second attempt, performing a different stunt. The score for a second attempt was calculated as follows:

- Discard the highest and lowest of the five judges' marks
- Multiply the sum of the other three marks by the difficulty rating
- Subtract 5 points

The six competitors with the highest scores qualified to take part in the Final. Of the 11 competitors who paid for a second attempt, Adel was the only one who qualified for the Final.

In the Final, the six qualifiers performed three stunts each, with all their scores calculated in the same way as their first attempt in the qualifying round. When all the stunts had been performed, each competitor's two highest scores from the Final were added together to give a grand total.

The prize fund was made up of 75% of the total amount of entry fees received, shared out as follows:

- first place - 60% of the prize fund
- second place - 25% of the prize fund
- third place - 15% of the prize fund

- (a) What is the maximum score that could have been achieved for the performance of a stunt? [1]
- (b) Adel's first attempt in the qualifying round was a stunt with a difficulty rating of 3. His performance received marks of 8, 7, 8, 6 and 7 from the five judges. For his second attempt he decided to risk performing a stunt with a difficulty rating of 4, and received marks of 7, 7, 9, 7 and 8.
- (b1) What was Adel's score for his first attempt? [1]
- (b2) What was Adel's score for his second attempt? [1]
- (c) The standard of the competition proved to be very high. No competitor was given a mark lower than a 6 by any of the judges throughout the competition. Hamad, like Adel, performed a stunt with a difficulty rating of 3 in the qualifying round, and then decided to risk a stunt with a difficulty rating of 4 for his second attempt. Unlike Adel, however, his calculated scores for both stunts were exactly the same.
- Give **one** example of a score that Hamad may have achieved for both of his stunts. [2]
- (d) How much prize money did Adel receive? [3]
- (e) Tickets to watch the event cost BD 5 for each round. However, there was a discount for buying a ticket for both rounds. The total income from ticket sales was BD 1789; 182 tickets were sold for the qualifying round and 207 tickets were sold for the Final.
- What further piece of information would be sufficient to be able to deduce how many people bought a ticket for both rounds? [1]

(f) Hassan claimed that his best score in last year's competition was 93, but Adel pointed out that it is impossible to achieve a score of 93 for a stunt under the current scoring system, regardless of whether the stunt was a first or second attempt.

(f1) What is the lowest score that it is impossible to achieve for a stunt under the current scoring system? [2]

(f2) Give **two** other scores less than 93 that it is impossible to achieve for a stunt under the current system. [2]

(g) Adel was the last to perform his third stunt in the final. The competitors' scores just before he performed were as follows:

Name	Score for		
	first stunt	second stunt	third stunt
Salman	80	92	88
Saad	81	104	76
Ibrahem	78	96	92
Hassan	88	78	80
Zayed	75	81	100
Adel	84	87	

Adel received the same mark from each of the five judges for his third stunt, and finished the competition in third place.

(g1) Explain why the difficulty rating of Adel's first stunt in the Final cannot be deduced from the information given above. [1]

(g2) How many of the five judges gave Adel 10 marks for his second stunt? Explain your answer. [2]

(g3) Ibrahem finished the competition in first place. How many points behind Ibrahem's grand total was Adel's grand total? Explain how you developed your answer. [4]

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