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PROBLEM SOLVING	**حل المشكلات**
Paper 2 Problem Analysis and Solution	**الورقة 2 تحليل و حل المشكلات**

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1 (a1) What is the protein content per 100 g of the 601030 mix?   [1]
12.4 (g or %)
Award 1 mark.

(a2) What is the fat content per 100 g of the 601030 mix?   [1]
8.6 (g or %)
Award 1 mark.

(b) How many different mixes can Rashid create?   [2]
10
 Award 2 marks.

If 2 marks cannot be awarded, award 1 mark in sight of at least **six** of the mixes, which are:

    501040 or 50% oats, 10% nuts and 40% raisins
    502030 or 50% oats, 20% nuts and 30% raisins
    503020 or 50% oats, 30% nuts and 20% raisins
    504010 or 50% oats, 40% nuts and 10% raisins
    601030 or 60% oats, 10% nuts and 30% raisins
    602020 or 60% oats, 20% nuts and 20% raisins
    603010 or 60% oats, 30% nuts and 10% raisins
    701020 or 70% oats, 10% nuts and 20% raisins
    702010 or 70% oats, 20% nuts and 10% raisins
    801010 or 80% oats, 10% nuts and 10% raisins

(c1) The code of the mix Rashid can create with the highest protein content per 100 g.   [1]
504010 (accept 50% oats, 40% nuts and 10% raisins)
Award 1 mark.

(There needs to be the largest possible amount of nuts and the smallest possible amount of raisins)

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

501040 (accept 50% oats, 10% nuts and 40% raisins)
 Award 1 mark.

(There needs to be the smallest possible amount of nuts and the largest possible amount of raisins)

(d) **How much of each of the ingredients does Rashid need to add?[3]**

1.9 kg oats, 0.3 kg (300 g) nuts, 0.8 kg (800 g) raisins
Award 3 marks.

If 3 marks cannot be awarded, award 2 marks for evidence of understanding that the 4 kg of 501040 contains 2.0 kg oats, 0.4 kg nuts and 1.6 kg raisins **and** that the 3 kg of 701020 contains 2.1 kg oats, 0.3 kg nuts and 0.6 kg raisins. These 2 marks can be awarded for stating that the combination of the two mixes contains 4.1 kg oats, 0.7 kg nuts and 2.2 kg raisins.

If 2 marks cannot be awarded, award 1 mark for evidence of understanding that the 4 kg of 501040 contains 2.0 kg oats, 0.4 kg nuts and 1.6 kg raisins **or** that the 3 kg of 701020 contains 2.1 kg oats, 0.3 kg nuts and 0.6 kg raisins.

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(e) What is the code for this mix? [3]
702010 (accept 70% oats, 20% nuts and 10% raisins)
Award 3 marks.

If 3 marks cannot be awarded, award 2 marks for any **two** trials with correct nutritional values involving mixes that are made at present.

If 2 marks cannot be awarded, award 1 mark for any **one** trial with correct nutritional values involving mixes that are made at present.

<u>Energy (kJ), protein (g) and fat (g) per 100 g
of mixes made at present</u>

Code	Energy	Protein	Fat
501040	1520	11.0	8.0
502030	1640	13.0	13.0
503020	1760	15.0	18.0
504010	1880	17.0	23.0
601030	1560	12.4	8.6
602020	1680	14.4	13.6
603010	1800	16.4	18.6
701020	1600	13.8	9.2
702010	1720	15.8	14.2
801010	1640	15.2	9.8

(f) **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]**
Award 3 marks for any **one** of the three possibilities with the correct nutritional values detailed as follows:

- 651520 (accept 65% oats, 15% nuts and 20% raisins) – energy 1640 kJ, protein 14.1 g, fat 11.4 g.
- 701515 (accept 70% oats, 15% nuts and 15% raisins) – energy 1660 kJ, protein 14.8 g, fat 11.7 g.
- 751510 (accept 75% oats, 15% nuts and 10% raisins) – energy 1680 kJ, protein 15.5 g, fat 12.0 g.

If 3 marks cannot be awarded, award 2 marks for either of the following:

- the code (or composition) of **one** of the mixes without the correct nutritional values.
- any **two** trials with correct nutritional values involving mixes from the table below.

If 2 marks cannot be awarded, award 1 mark for any **one** trial with correct nutritional values involving mixes from the table below.

Energy (kJ), protein (g) and fat (g) per 100 g of new mixes

Code	Energy	Protein	Fat
501535	1580	12.0	10.5
502525	1700	14.0	15.5
503515	1820	16.0	20.5
551035	1540	11.7	8.3
551530	1600	12.7	10.8
552025	1660	13.7	13.3
552520	1720	14.7	15.8
553015	1780	15.7	18.3
553510	1840	16.7	20.8
601525	1620	13.4	11.1
602515	1740	15.4	16.1
651025	1580	13.1	8.9
651520	1640	14.1	11.4
652015	1700	15.1	13.9
652510	1760	16.1	16.4
701515	1660	14.8	11.7
751015	1620	14.5	9.5
751510	1680	15.5	12.0

2 **(a)** **How many bidders took part in the auction in 2011?** **[2]**
31 (BD 7750 ÷ BD 250)
Award 2 marks.

If 2 marks cannot be awarded, award 1 mark for extraction of (BD) 7750.

(b) **What were the bidder numbers of the bidders that won the other two prints?** **[2]**
(bidder) 11
Award 1 mark.

(bidder) 23
Award 1 mark.

Answers may be given in either order. Award a maximum of 1 mark if more than two bidder numbers are given.

(c) **Which of these bids (if any) would have been winning bids if they had been submitted in time?** **[2]**
(BD) 82 (only)
Award 2 marks.

If 2 marks cannot be awarded, award 1 mark for either of the following:
• (BD) 82 and (BD) 59.
• (BD) 59 (only).
(There is no other bid of BD 59 and it is higher than the winning bid of BD 55, but if these bids had been submitted in time, the four winning bids would have been BD 85, BD 82, BD 73 and BD 68.)

(d1) **What was Majid's bidder number?** **[1]**
(bidder) 8
Award 1 mark.

(d2) **What was Sameera's bidder number?** **[1]**
(bidder) 28
Award 1 mark.

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(e1)   Give one example of a set of four bids that Majid could make. [1]
Award 1 mark for any one of the 5 possible sets.

BD 76   BD 67   BD 58   BD 49
BD 79   BD 68   BD 57   BD 46
BD 82   BD 69   BD 56   BD 43
BD 85   BD 70   BD 55   BD 40
BD 88   BD 71   BD 54   BD 37

(e2)   Give one example of a set of four bids that Sameera could make.   [2]
Award 2 marks for any one of the 72 possible sets.

The bids should be of the form:
BD 9*, BD 6*, BD 5*, BD 4*, where * is replaced by 0, 1, 2, 7
or
BD 8*, BD 7*, BD 5*, BD 4*, where * is replaced by 0, 1, 3, 6
or
BD 8*, BD 7*, BD 6*, BD 3*, where * is replaced by 0, 1, 4, 5
or
BD 8*, BD 6*, BD 5*, BD 4*, where * is replaced by 1, 3, 7, 9

Each (*) must be replaced by a different digit and the highest and lowest bids must have a difference of less than 50 and adds up to BD250.

Examples include:
BD 92   BD 61   BD 50   BD 47
BD 86   BD 70   BD 53   BD 41
BD 84   BD 71   BD 60   BD 35
BD 89   BD 67   BD 53   BD 41

If 2 marks cannot be awarded, award 1 mark for a set (with 8 different digits) that adds up to BD 250, but has a range that is greater than BD 50 (including a set with a bid of less than BD 20).

Examples of 1 mark answers include:
BD 97   BD 80   BD 41   BD 32
BD 93   BD 82   BD 60   BD 15

(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]
No – Each of Majid's possible sets of bids contain at least one repeated digit.
Award 2 marks only if all 5 sets of Majid's bids have been identified and the explanation has been given. The set identified in (e1) does not need to be repeated here.

As a special case award 2 marks for the answer "Yes" if that answer is justified by referring to an incorrect set given in (e1) that does contain 8 different digits (and adds up to BD 250).

If 2 marks cannot be awarded, award 1 mark for either of the following:
- all 5 sets of Majid's bids have been identified.
- at least one more set of Majid's bids has been identified and the explanation has been given.

(f) What were the four bids that Essa made every year? [2]
BD 81 (2009 winner), BD 67 (2011 winner), BD 56 (2008 winner) and BD 46 (2013 winner)
Award 2 marks.

If 2 marks cannot be awarded, award 1 mark for BD 91, BD 63, BD 59 and BD 37. (If these had been his bids, he would have won a print in 2010 as well.)

3 **(a)** **What is the maximum score that could have been achieved for the performance of a stunt?** **[1]**
120 ((10 + 10 + 10) × 4)
Award 1 mark.

(b1) **What was Adel's score for his first attempt?** **[1]**
66 ((8 + 7 + 7) × 3)
Award 1 mark.

(b2) **What was Adel's score for his second attempt?** **[1]**
83 ((8 + 7 + 7) × 4 – 5)
Award 1 mark.

(c) **Give one example of a score that Hamad may have achieved for both of his stunts.** **[2]**
75
(The score must be a multiple of 3 that is 5 less than a multiple of 4. It must also be less than Adel's score (because Adel was the only finalist who had a second attempt in the qualifying round) and at least 54 (because nobody had an individual mark lower than a 6).)
Award 2 marks for either answer, provided that it is less than the answer given to (b2).

Accept 87 for 2 marks, but only if the answer given to (b2) is greater than 87.

If 2 marks cannot be awarded, award 1 mark for either of the following:

- any other multiple of 3, lower than 90, that is 5 less than a multiple of 4 (3, 15, 27, 39, 51, 63 or 87).
- evidence of understanding that nobody could have scored less than 54 (6 × 3 × 3) (for a stunt with a difficulty rating of 3).

(d) How much prize money did Adel receive? **[3]**

BD 29.250 (15% of 75% of BD 260)
Award 3 marks.

If 3 marks cannot be awarded, award 2 marks for total entry fees of BD 260 or prize fund of BD 195.

If 2 marks cannot be awarded, award 1 mark for either of the following:
- sight of 36 × BD 6 + 11 × BD 4
- an answer of BD 24.300 (the answer if the 11 × BD 4 is left out)

(e) What further piece of information would be sufficient to be able to deduce how many people bought a ticket for both rounds?

[1]

(It would be necessary to know) how much the discount was.
Award 1 mark.

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

62
Award 2 marks.

If 2 marks cannot be awarded, award 1 mark for any other score less than 90 that could not have been achieved (65, 74, 77, 86 or 89).

(f2) **Give two other scores less than 93 that it is impossible to achieve for a stunt under the current scoring system.** **[2]**
The scores less than 93 that are impossible to achieve are:
62, 65, 74, 77, 86, 89

If an answer was given to (f1) then the answers given here must be greater than the answer to (f1) to be considered correct.

Award 2 marks for two correct answers and no incorrect answers.

If 2 marks cannot be awarded, award 1 mark if at least one correct answer is given and no more than three incorrect answers are given.

(g1) **Explain why the difficulty rating of Adel's first stunt in the Final cannot be deduced from the information given above.** **[1]**
84 is a multiple of both 3 and 4.
Award 1 mark.

(g2) **How many of the five judges gave Adel 10 marks for his second stunt? Explain your answer.** **[2]**
Award 1 mark **for each** of the following:
- 3 × (10 + 10 + 9) = 87 (the only possible way of scoring 87 in the Final)
- (so) 3 (judges gave him 10 marks, because a score of 10 must have been discarded)

(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]**
Award 1 mark **for each** of the following:
- Ibrahem's grand total was 188, Saad's was 185 and Zayed's was 181.
- (So) Adel scored 95, 96 or 97 (for his third stunt) (to get a grand total of 182, 183 or 184).
- (Of these) only 96 ((8 + 8 + 8) × 4) is possible.
- (So Adel was) 5 points (188 – 183) (behind Ibrahem).

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