British Informatics Olympiad

CONFIDENTIAL before 26 December 2010

LIONHEAD STUDIOS

The 2011 British Informatics Olympiad Marking Scheme

Instructions for setting the 2011 British Informatics Olympiad

Students should each have a computer with their chosen programming language installed.

They should also each have a calculator, pen and paper, and an empty USB stick (or other storage device) on which to back up their work and save their solution programs.

If possible, please disable any network to prevent students from communicating.

Please allow the students a few minutes to carefully read the rubric; during this time they must not turn over the page and look at the questions. Please also encourage the students to read the questions first before attempting any answers.

The 3 hour time limit should start once you allow them to turn the page and begin the exam.

Marking instructions

For each competitor you should have a set of programs and a written paper. The programs for parts 1(a), 2(a) and 3(a) are to be tested by running them with data specified in this marks scheme – you do not need to look at their program code. The written answers can also be marked as specified here, without needing any specialist knowledge.

The program names used by competitors should be clearly marked on their papers. Failure to do this, or to compile programs where necessary, should not prevent programs being marked, but deduct [2] marks for every such program. Programs produced by the competitors to help in the written questions may be used in selecting the BIO 2011 finalists.

If a student gets a negative number of marks on any question, score that question as a 0.

Programs written for 1(a), 2(a) and 3(a) are to be 'black-box' tested: you should run the program, enter the given data and verify the solution. For each of these tests the data to be entered is given in **`bold text`**. The output format is flexible (there is no penalty for extra spaces etc.), but the solutions must be correct for marks to be scored. Input and output may appear in different windows.

Note that, if a program does not complete a test in 2 seconds of processing time, it should be interrupted and the rest of that test ignored. The other questions should be marked from the competitors' written answers.

All marks are given in square brackets by the test/answer they relate to. Answers not covered under the mark scheme should get no marks. In some cases details are given on how marks may be given for partial answers, as well as alternative answers which merit marks.

Accompanying this marks scheme are two forms to help you in grading the paper. The script cover sheet is designed to assist you with marking each student's answers and the marks submission sheet is to list the marks for all students.

Please **submit all your marks to us electronically** using the form at
http://www.olympiad.org.uk/2011/2011-submission-form.html

Marks that are received after **26 December 2010** will not be considered for the final.

Certificates will be sent out for all participating students whose marks are returned, including those who submitted no solutions or left early, and for marks that are received before 26 December 2010.

In addition to submitting the marks for all students electronically, please email the programs for all students who score over 50 marks; if this does not apply please email the material for your highest-scoring student. All programs and student scripts should be retained by you until at least 1 February as we may require them for moderation. After this date, you are free to return scripts to the students and distribute copies of the BIO 2011 exam paper.

Finally, thank you very much for participating in BIO 2011.

Question 1(a) [24 marks available]

For each test of the program for 1(a) you need to type two capital letters and a number, with a single space between the three items. The response should be a single capital letter.

There are no marks for incorrect answers, however students should not be penalised for outputting lower-case letters.

[1]	**A A 7**	M
[3]	**A M 1**	A
[2]	**A A 8**	U
[2]	**P Q 101**	S
[2]	**Y Y 1000**	U
[2]	**Z M 5005**	Z
[2]	**K V 10000**	C
[2]	**K Y 20000**	W
[2]	**B I 987654**	W

Additional marks are available for general program behaviour:

[2] Program inputs two letters and a number.
[2] For each a test single letter is output.
[2] Program terminates without crashing / hanging.

Question 1(b) [3 marks available]

[1]	R	(together with F to produce X)
[2]	Q	(together with Q to produce H)

Question 1(c) [3 marks available]

[3] K

Question 2(a) [24 marks available]

There are 6 multiple part tests used to check program 2(a). For each test you will first need to type in six integers separated by spaces. Marks are given within the tests, besides the expected output from the program; this will be four lines output, each containing two items.

(**Supplementary:** If a student gets only one item correct on a line, award half the marks for that line. When recording the total marks for this question *round up* to the nearest integer.)

If the program crashes / hangs part way through a test, or takes longer than 2 seconds, the rest of that test should be discarded.

Test 1

1 3 5 7 2 4

[1] AC 3S
[1] 6 9C
[1] 5 KC
[1] 4 4H

Test 2

5 3 5 8 1 8

[1] 5C TD
[1] 4 5H
[1] 2 8C
[1] 3 QC

Test 3

8 7 2 5 9 9

[1] 8C 5D
[1] 7 8C
[1] 12 8C
[1] 1 9D

Test 4

2 9 3 6 6 3

[1] 2C TH
[1] 22 JC
[1] 19 JC
[1] 17 JC

Test 5

8 9 5 9 7 7

[1] 8C 8H
[1] 26 8C
[1] 27 8C
[1] 3 9C

Test 6

```
1 1 1 1 1 1
```

[1] `AC KD`
[1] `4 JC`
[1] `4 JC`
[1] `2 KD`

Question 2(b) [2 marks available]

The following 12 values should appear in order:

[2] 2C KC 3H KH 4S KS 2D KD 4C 2H 7H 5S

(**Supplementary:** A student who gets the first 8 values correct — i.e. from 2C to KD — but makes some other mistake, should be awarded [1] mark.)

Question 2(c) [4 marks available]

[1] 531434 (1 … 9)
[3] 998284 (1 … 10)

Question 2(d) [5 marks available]

[1] Yes

The following pieces of justification are worth marks:

[1] The first pile that is moved in the first game will only contain a single card.
[1] If a pile with a single card is moved onto another pile, that single card and the face card of the other pile will be adjacent when dealt for the second time.
[1] If a pile with top card A can be moved onto a pile with top card B, cards A and B match.
[1] Two adjacent piles can be combined if their top cards match.

Question 3(a) [24 marks available]

Each test for 3(a) consists of a single integer. The output will always be a single integer.

There are no marks for incorrect answers, and tests *must* terminate in 2 seconds to receive marks.

[1]	**`11`**	`159`
[2]	**`1`**	`5`
[2]	**`100`**	`9911`
[2]	**`160`**	`76543`
[2]	**`1234`**	`4995116`
[3]	**`8448`**	`141555969`
[3]	**`14659`**	`987654321`
[4]	**`12345678`**	`1398485825262179`
[5]	**`987654321`**	`13732787982132387379`

Question 3(b) [2 marks available]

[2] 384

Question 3(c) [3 marks available]

[3] 38

Question 3(d) [6 marks available]

[1] More 1001 digits that contain at least one 5.

The following pieces of justification are worth marks:

[1] Every 1001 digit upside-down number contains a 5 in the middle.
[1] Not every 1000 digit upside-down number contains a 5.
[1] Deleting the middle digit of a 1001 digit upside-down number makes a 1000 digit upside-down number. Adding a 5 in the middle of a 1000 digit upside-down number makes a 1001 digit upside-down number.
[1] The above deletions / additions are unique; i.e. each pair of 1000 and 1001 digit upside-down numbers are uniquely linked.
[1] There are the same number of 1000 digit upside-down numbers and 1001 digit upside-down numbers.

End of BIO 2011 marks scheme

British Informatics Olympiad

2011 British Informatics Olympiad
Script Cover Sheet

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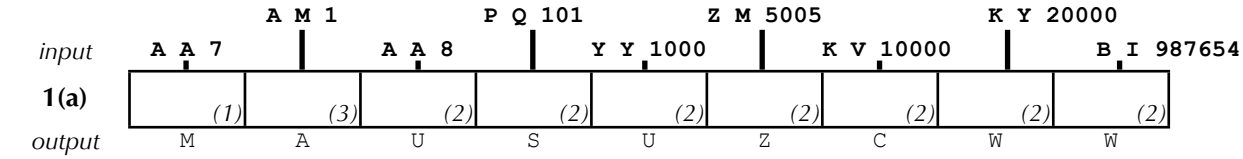
Please use this sheet, with reference to the marks scheme, to assist you with marking each student's script. As it summarises the solutions to many questions, **do not distribute or show this sheet to any contestant before 26 December 2010.**

Name of Student: Age: School Year:

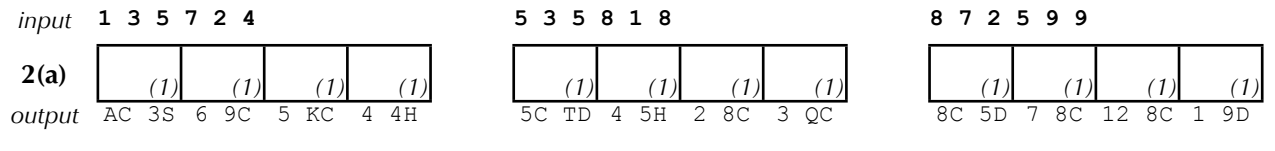


Inputs data? (2)
Valid output? (2)
Exits okay? (2)

1(b) *Ans: R + Q* (1+2)

1(c) *Ans: K* (3)

TOTAL 1(a) (24)

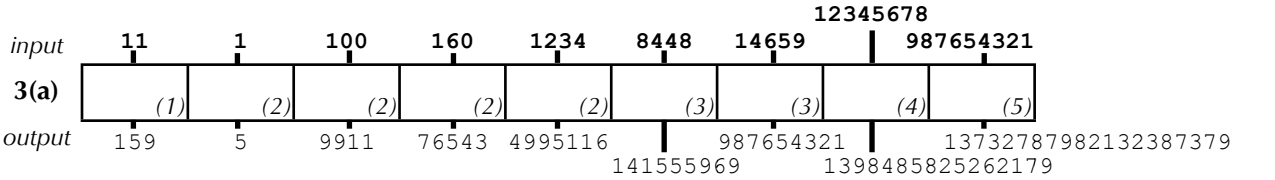


2(b) *(see marks scheme)* (2)

2(c) *Ans: 531434 and 998284* (1)+(3)

2(d) *(see marks scheme)* (5)

TOTAL 2(a) (24)



3(b) *Ans: 384* (2)

3(c) *Ans: 38* (3)

3(d) *(see marks scheme)* (6)

TOTAL 3(a) (24)

Deduct [2] marks for every part (a) program name that is not clearly marked on the script, or where the student has failed to compile the program for languages that require compiling.

Marked By:

TOTAL Q1	***TOTAL Q2***	***TOTAL Q3***
(30)	(35)	(35)

British Informatics Olympiad

2011 British Informatics Olympiad
Marks Submission Sheet

Please use BLOCK CAPITALS

LIONHEAD STUDIOS

This sheet is provided for your convenience and records.

Please **submit all your marks to us electronically** using the form at
http://www.olympiad.org.uk/2011/2011-submission-form.html

In addition, please email the source-code from your **highest-scoring student**, and all others who score **over 50 marks**.

Marks that are received after **26 December 2010** will not be considered for the final.

Please fill in details of the school/college and each pupil's name as they should appear on certificates. There is room for 10 entrants in the marks submission table, so duplicate this page if more space is required. It would also be very helpful for us to know what hardware, operating system and programming language(s) each entrant used; please list the different combinations you used in the computer summary table.

School / College: _____ Date exam taken: _____

Name of marker: _____ Date exam marked: _____

Name of Entrant (as it should appear on certificate)	Marks for each section (maximum in brackets)											Total (100) †	PC/ Lang ‡	School Year §	Age	M/F
	1a (24)	1b (3)	1c (3)	2a (24)	2b (2)	2c (4)	2d (5)	3a (24)	3b (2)	3c (3)	3d (6)					

† Write **N/S** (no submission) in this column if the student produced no answers.

‡ Give the number of the machine and language type in the computer / language type table below

§ Please indicate the type of enumeration used, e.g. year band / curriculum level: _____

Type Number	Hardware e.g. PC / Mac	Processor e.g. Pentium 4 (2 Ghz)	Operating System e.g. Mac OS X	Programming Language e.g. Visual C++
1				
2				
3				
4				