The 2019 British Informatics Olympiad Marking Scheme

Instructions for setting the 2019 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. Students should not use the internet during the contest.

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 2019 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 1 second 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/2019/mark-2019-registration.html
>
> Marks that are received after **13 January 2019** 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 1 February 2019.

All programs and student scripts should be retained by you until at least 1 February as we may require them for moderation; you do *not* need to send us students' programs unless requested. After this date, you are free to return scripts to the students and distribute copies of the BIO 2019 exam paper.

Finally, thank you very much for participating in BIO 2019.

VERSION 1

Question 1(a)   [25 marks available]

For each test of the program for 1(a) you need to type in a single integer. The output should be a single number which is required to match exactly.

Tests *must* terminate in 1 second to receive marks.

[1]	**5**	6
[1]	**9**	11
[1]	**33**	44
[1]	**84**	88
[1]	**45653**	45654
[1]	**36460000**	36466463
[1]	**24355343**	24366342
[1]	**123450000**	123454321
[1]	**234567890**	234575432
[1]	**678999876**	679000976
[1]	**99999999999999** (14 9s)	100000000000001 (13 0s)
[1]	**999999999999999** (15 9s)	1000000000000001 (14 0s)
[2]	**123456789000000000** (9 0s)	123456789987654321
[2]	**987654321123456789**	987654322223456789
[2]	**1234567890000000000** (10 0s)	1234567890987654321
[2]	**9876543210123456789**	9876543211123456789
[2]	**9876543219123456789**	9876543220223456789

Additional marks are available for general program behaviour:

[1] Program inputs one integer.
[1] For each a test a single integer is output.
[1] First 7 tests (up to 24355343) terminate without without crashing / hanging.

Question 1(b)   [2 marks available]

[2] 11,000,000,000

Question 1(c)   [4 marks available]

[4] 9030

Question 2(a)   [24 marks available]

There are 12 tests used to check program 2(a). For each test you will need to type in an integer followed by a word consisting of *uppercase* letters, followed by another integer.

For each test you should see a co-ordinate output. The X- and Y- co-ordinate must both be correct to score marks. Other formatting (e.g. brackets and a comma) are optional.

Tests *must* terminate in 1 second to receive marks.

[2]	**8 FL 2**	-1 1
[2]	**100 FLF 591**	9 -6
[2]	**39 LLLRFFF 50**	1 -1
[2]	**100 LLRR 5000**	-2500 0
[2]	**10 LLRFLR 5000**	-3 -3
[2]	**1 F 1000**	0 1000
[2]	**100 L 1000**	-4 -12
[2]	**39 LRFRRF 5000**	0 -1
[2]	**1 L 999**	0 -1
[2]	**9 LLR 5000**	0 -2
[2]	**100 R 1000**	0 -12
[2]	**10 FFRFRFFRRR 100**	1 1

Question 2(b)   [2 marks available]

[2]

		3	4	5
	1	2		6
	↓			7

Question 2(c)   [3 marks available]

[3] 440

Question 2(d)   [5 marks available]

[5] 1007

Question 3(a)   [24 marks available]

Each test for 3(a) consists of an integer followed by a word consisting of *uppercase* letters. The output is always a single integer.

There are no marks for incorrect answers, and tests *must* terminate in 1 second to receive marks.

[1]	**1 A**	1
[1]	**2 AB**	1
[1]	**2 BA**	1
[1]	**4 C**	5
[1]	**4 AB**	0
[1]	**6 FED**	5
[1]	**8 HGFEDCBA**	1
[1]	**8 H**	429
[1]	**8 FED**	28
[1]	**8 FEH**	42
[1]	**12 LKJI**	1430
[1]	**13 MH**	13260
[2]	**14 N**	742900
[2]	**16 KHF**	5508
[2]	**16 FEDCBA**	1
[2]	**18 FRN**	0
[2]	**18 QPON**	2674440
[2]	**18 R**	129644790

Question 3(b)   [2 marks available]

[2] BOI, IBO, IOB, OBI, OIB

(**Supplementary:** If there are only 4 of these values given, score [1] mark. Do not score *any* marks if BIO is given.)

Question 3(c)   [4 marks available]

[1] Both original block-chains are in reverse alphabetical order.

[1] If the combination of the two block-chain is not a block-chain / contains three letters in alphabetical order, there must have been two letters in alphabetical order in one of the original block-chains as neither original block-chain can contain three letters in alphabetical order.

[1] Neither original block-chain can have two letters in alphabetical order, otherwise those two letters plus any letter from the other block-chain will give three letters in alphabetical order.

[1] If both block-chains are in reverse alphabetical order, if a pair of letters appears in alphabetical order in the combination one letter must have come from each block-chain.

Question 3(d)   [5 marks available]

[1] ASRQPONMLKJIHGFEDCB

[4] RPSMJQHOFEDNLKICGBA

British Informatics Olympiad

2019 British Informatics Olympiad
Script Cover Sheet

VERSION 1

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 11 January 2019.**

Name of Student: Age: School Year:

1(a)

input	output	marks
5	6	(1)
9	11	(1)
33	44	(1)
84	88	(1)
45653	45654	(1)
36460000	36466463	(1)
24355343	24366342	(1)
123450000	123454321	(1)
234567890	234575432	(1)
678999876	679000976	(1)
99999999999999	100000000000001	(1)

input	output	marks
999999999999999	1000000000000001	(1)
123456789000000000	123456789987654321	(2)
987654321123456789	987654322223456789	(2)
1234567890000000000	1234567890987654321	(2)
9876543210123456789	9876543211123456789	(2)
9876543219123456789	9876543220223456789	(2)

1(b) Ans: 11,000,000,000   (2)

1(c) Ans: 9030   (4)

Inputs data? (1)
Valid output? (1)
Exits okay? (1)

TOTAL 1(a) (25)

2(a)

input	output	marks
8 FL 2	-1 1	(2)
100 FLF 591	9 -6	(2)
39 LLLRFFF 50	1 -1	(2)
100 LLRR 5000	-2500 0	(2)
10 LLRFLR 5000	-3 -3	(2)
1 F 1000	0 1000	(2)
39 LRFRRF 5000	-4 -12	(2)
100 L 1000	0 -1	(2)
1 L 999	0 -1	(2)
9 LLR 5000	0 -2	(2)
10 FFRFRFFRRR 100	0 -12	(2)
100 R 1000	1 1	(2)

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

2(c) Ans: 440 (3)

2(d) Ans: 1007 (5)

TOTAL 2(a) (24)

3(a)

input	output	marks
1 A	1	(1)
2 AB	1	(1)
2 BA	1	(1)
4 C	5	(1)
4 AB	0	(1)
6 FED	5	(1)
8 H	1	(1)
8 HGFEDCBA	429	(1)
8 FED	28	(1)
8 FEH	42	(1)
12 LKJI	1430	(1)
13 MH	13260	(1)

input	output	marks
14 N	742900	(2)
16 KHF	5508	(2)
16 FEDCBA	1	(2)
18 FRN	0	(2)
18 QPON	2674440	(2)
18 R	129644790	(2)

TOTAL 3(a) (24)

3(b) Ans: BOI, IBO, IOB, OBI, OIB (2)

3(c) (see marks scheme) (4)

3(d) (see marks scheme) (1+4)

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
(31)	(34)	(35)

British Informatics Olympiad

2019 British Informatics Olympiad
Marks Submission Sheet

Please use BLOCK CAPITALS

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/2019/mark-2019-registration.html

Please retain all student programs and scripts until 1 February.

Marks that are received after **13 January 2019** 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)	1a (25)	1b (2)	1c (4)	2a (24)	2b (2)	2c (3)	2d (5)	3a (24)	3b (2)	3b (4)	3c (5)	Total (100) †	PC/ Lang ‡	School Year §	Age	M/F

†   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. Intel Core i7 (2.6 Ghz)	Operating System e.g. Mac OS X 10.14	Programming Language e.g. Visual C++
1				
2				
3				
4				