



The 2007 British Informatics Olympiad Marking Scheme

Instructions for setting the 2007 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 a blank floppy disk (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 2007 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 is a script cover sheet to help you in marking each student’s answers.

Please **submit all your marks to us electronically** using the form at
<http://www.olympiad.org.uk/2007/2007-mark-submission.html>

Marks that are received after **13 March** 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 after the 13 March deadline but before 1 April 2007.

In addition to submitting the marks for all students electronically, please email the programs for all students who score over 50 marks to bio@olympiad.org.uk; 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 30 March 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 2007 exam paper.

Finally, thank you very much for participating in BIO 2007.

Question 1(a) [24 marks available]

For each test of the program for 1(a) you need to type in five integers. Students' programs will *probably* expect the numbers to be on the same line; you may enter words separated by a new-line or comma if required by a student's program. The correct response is given to the right of each pair. There are no marks for incorrect answers.

- [1] 3 3 3 2 10 6
 [2] 3 4 7 9 10 0
 [2] 7 9 2 2 10 1
 [2] 2 7 9 10 2 1
 [2] 2 2 3 3 4 2
 [2] 7 6 6 6 10 3
 [2] 1 6 2 4 9 2
 [2] 1 8 2 3 9 1
 [2] 2 2 7 8 2 4
 [2] 5 5 10 5 5 14

Additional marks are available for general program behaviour:

- [2] Program inputs five numbers
 [1] For each test a single number is output
 [2] Program terminates without crashing / hanging

Question 1(b) [2 marks available]

There are eight possible answers and only a single answer is required. Award [2] marks for any of the following sets of five numbers, where the numbers in the set can appear in any order:

- 1 2 7 9 10
or
 1 2 8 9 10
or
 1 3 6 7 10
or
 1 3 7 9 10
or
 1 3 8 9 10
or
 2 4 6 8 10
or
 3 4 6 7 10
or
 3 4 7 9 10

Question 1(c) [4 marks available]

- [4] 28

(Supplementary: 29 is worth [3] marks.)

Question 2(a) [24 marks available]

There are seven multiple part tests used to check program 2(a). Marks are given within the tests, besides the expected output from the program; this will be a 9 character string consisting of four Xs, four Os and an E, or a single line of text.

Incorrect output at any stage gets no marks for that stage. In a 9 character string every character must be correct.

If the program crashes / hangs (appears to get stuck) part way through a test the rest of that test should be discarded.

Test 1

XXEXOOOXO

n

- [1] XXEXOOOXO

- [1] Player 2 wins

Test 2

EOOOOXXXX

n

- [1] EOEOOXXXX

r

- [1] OXOEXXXXO

- [1] Player 1 wins

Test 3

OEXXOOOXX

n

- [1] EOXXOOOXX

n

- [1] XOEXOOOXX

n

- [1] XEOXOOOXX

n

- [1] XXOXOOOXXE

- [1] Player 2 wins

Test 4

EXXXEOOOO

n

- [1] OXXXXE000

n

- [1] OXXXEX000

r

- [2] Draw

Test 5

- XEOXXXOOO**
n
 [2] XOOXXXOOE
r
 [1] OXOXXXOEO
 [1] Player 1 wins

Test 6

- OOEXOOXXX**
r
 [2] XOXOOOXEX
 [1] Player 2 wins

Test 7

- EXOXXXOOO**
r
 [3] Draw

Question 2(b) [3 marks available]

To score the first [2] marks both of the following board layouts must be given, but *no* additional ones:

- [2] XOEXXXXOOO
 XOOXXXOOE

(Supplementary: If the student gives both layouts plus any additional layouts, or lists one of these layouts and no others, award [1] mark.)

- [1] The strategy gives XOOXXXOOE

Question 2(c) [3 marks available]

- [1] No
 [1] If a player has a marker in the putahi (central position) that player will be able to move.

In addition, up to [1] mark can be gained from either of the following points:

- [1] If neither player has a marker in the putahi both players must have a marker adjacent to a marker of the opposing player and be able to move.
 [1] All the losing positions have a marker in the putahi.

Question 2(d) [5 marks available]

- [5] 46

(Supplementary: If the student has the total incorrect there are up to [4] marks for calculating the following: [2] for identifying 8 different layouts when the putahi is empty; [2] for identifying 19 different layouts when the putahi contains one of the first (or second) player's markers)

Question 3(a) [25 marks available]

Each test for 3(a) consists of a three letter string (capital letters from A, B, C, D and E), followed by two numbers on a separate line. The output should consist of five integers, all of which need to be correct for the test to score marks.

Tests must complete in **2 seconds** to score marks.

DEC
2 10
 [1] 0 0 3 3 4

BDA
1 5
 [1] 1 2 1 1 0

ABA
5 29
 [2] 11 18 0 0 0

EEE
10 3072
 [2] 0 0 0 0 3072

CDD
12 12001
 [2] 0 0 6000 6001 0

CDC
12 12001
 [2] 0 0 6001 6000 0

ACE
15 987
 [2] 377 610 0 0 0

ACE
15 17371
 [2] 377 610 8192 8192 0

ACE
15 66523
 [2] 377 610 16384 16384 32768

DAE
29 1
 [1] 0 0 0 1 0

EEE
29 100000000 (nine 0s)
 [2] 0 0 0 0 100000000 (nine 0s)

BAB
29 1664080
 [2] 635622 1028458 0 0 0

BED
29 100000000 (nine 0s)
 [4] 514229 832040 230891410 230891409 536870912

Question 3(b) [2 marks available]

[1] 256 (starting with the string C)
 [1] 34 (starting with the string A)

Question 3(c) [5 marks available]

[1] No
 [1] Every C must have come from a C or D at the previous step.
 [1] After each step, each C is transformed into a C followed by a D. Similarly, each D is transformed into a C preceded by a D.
 [1] Every C will be followed or preceded by a D.
 [1] If there are two adjacent Cs the first must be preceded by a D and the second must be followed by a D.

Question 3(d) [3 marks available]

Either of the following pairs of rules is sufficient, where A and B can be any two letters so long as they are different, and X can be either of the two previous letters or a different letter.

[3] A should be changed to XX
 B should be changed to X

or

A should be changed to X
 B should be changed to XX

End of BIO 2007 marks scheme

British Informatics Olympiad

2007 British Informatics Olympiad Script Cover Sheet



Use this sheet, with reference to the marks scheme, to assist you with marking each student's script.
Please do not distribute or show this sheet to any contestant before 2 April 2007.

Name of Student: _____ M/F: _____ Age: _____ School Year: _____
Programming Language: _____ Processor: _____ Operating System: _____

input	3 3 3 2 10	7 9 2 2 10	2 2 3 3 4	1 6 2 4 9	2 2 7 8 2
	3 4 7 9 10	2 7 9 10 2	7 6 6 6 10	1 8 2 3 9	5 5 10 5 5
1(a)	(1)	(2)	(2)	(2)	(2)
output	6	0	1	1	2
					3
					2
					1
					4
					14

Inputs 5 numbers?	(2)	1(b)	(2)	1(c)	(4)	TOTAL	(24)
Outputs a number?	(1)	(see marks scheme)		Ans: 28		1(a)	
Exits okay?	(2)			(Supl. 29 scores 1)			

Merged input & output	OEXXXXXX n EOXXXXXX n EXXXXXXX n XXEXXXXO n XXEXXXXO n	EOXXXXXX n OEXXXXXX r OXOEXXXX r	XOXXXXXX n XEXXXXXX n XXOXOXXE r	EXXXXXXX n OXXXXE n OXXXXE r	XEXXXXXX n XOXXXXXX r	OOEXXXXX r	EXOXOXXO r
2(a)	(1)+(1)	(1)+	(1)+(1)+	(1)+	(2)+	(2)+(1)	(3)
		(1)+(1)	(1)+(1)+(1)	(1)+(2)	(1)+(1)		

2(b)	(2)+(1)	2(c)	(3)	2(d)	(5)	TOTAL	(24)
XOXXXXXX XOXXXXXX		(see marks scheme)		46 (Supl. see scheme)		2(a)	
Strategy: XOXOXXOE							

input	DEC 2 10	BDA 1 5	ABA 5 29	EEE 10 3072	CDD 12 12001	CDC 12 12001	ACE 15 987	ACE 15 66523	DAE 29 1	EEE 29	BED 29
	1000000000	1000000000									
3(a)	(1)	(1)	(2)	(2)	(2)	(2)	(2)	(2)	(1)	(2)	(4)
output			0 0 0 0 3072	0 0 6001 6000 0	377 610 0 0 0	377 610 8192 8192 0	377 610 16384 16384 32768	0 0 0 1 0	0 0 0 0 1000000000	635622 1028458 0 0 0	514229 832040 230891410 230891409 536870912

3(b)	(1)+(1)	3(c)	(5)	3(d)	(3)	TOTAL	(25)
Ans: 256 and 34		(see marks scheme)		(see marks scheme)		3(a)	

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.

Tests must complete in 2 seconds to score marks.

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

Marked by: _____

TOTAL BIO 2007	(100)
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