British Informatics Olympiad

The 2004 British Informatics Olympiad Marking Scheme

CONFIDENTIAL before 28 March 2004

LIONHEAD STUDIOS

Instructions for setting the 2004 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 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 2004 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 **10 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. The script cover sheet is designed to assist you with marking each student's answers. Use the marks submission sheet to list the marks for all your students, including those who submitted no solutions or left early. This information helps us to assess the level of the exam and allows us to send out certificates for every student who takes part.

Please send us the mark submission sheet and **all** cover sheets. For any student who scores 50 or more marks, please send us their written answers by mail, and email their programs. If none of your students score 50 or higher, please send us the material from your highest scoring student.

To help us send you certificates promptly, please submit all your marks to us electronically, in addition to mailing the marks submission sheet, using the on-line form at *http://www.rixcam.com/forms/bio-marks-2004.html*. The closing deadline for the return of marks, for students to be considered for the final, is **12 March**.

Finally, thank you very much for participating in BIO 2004!

Marks scheme

Question 1 (a) **[24 marks available]**

For each test of the program for 1(a) you need to type in 5 numbers. The response should be a date (day month year) in numeric form. If the date is consistently given in the wrong order (eg. month day year) deduct [4] marks, but otherwise treat the answers as if given in the correct order.

[2]	**13 20 9 2 9**	22 3 2001
[2]	**13 20 7 16 3**	1 1 2000
[2]	**13 20 7 16 12**	10 1 2000
[2]	**13 20 7 18 3**	10 2 2000
[2]	**13 20 8 11 8**	22 9 2000
[2]	**13 20 16 3 4**	29 2 2008
[2]	**13 20 14 6 9**	15 5 2006
[2]	**14 1 1 1 1**	21 12 2012
[2]	**14 1 14 14 14**	14 7 2026

Additional marks are available for general program behaviour:

[2]	Program inputs numbers
[2]	For each test, a date is output
[2]	Program terminates without crashing/hanging

Question 1 (b) **[2 marks available]**

The two answers to this question are the Mayan dates (each of 5 digits).

[1]	1 February 2000 is 13 20 7 17 14
[1]	1 January 2001 is 13 20 8 16 9

Question 1(c) **[3 marks available]**

[1]	2,880,000
[2]	Thursday

Question 2(a) **[26 marks available]**

There are four 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 6 by 7 grid of characters and, in some cases, a single line of text.

Incorrect output at any stage gets no marks for that stage. For an output grid every character must be correct. (**Supplementary:** An output grid that is reflected, but otherwise correct, scores [1] mark.)

If the program crashes / hangs part way through a test, or takes longer than 10 seconds, the rest of that test should be discarded.

Test 1

```
6
1 7 2 6 3 5

-------
-------
-------
-------
-------
-------
***-ooo

n

-------
-------
-------
-------
-------
-------
****ooo

Player 1 wins
```

[2]

[2]

[1]

2(a) continued on next page…

2(a)…

Test 2

```
8
3 3 3 4 4 4 4 2
```

```
-------
-------
---*---
--*o---
--o*---
-o*o---
```

[2]

```
n
```

```
-------
-------
---*---
--*o---
--o*---
*o*o---
```

[2]

```
n
```

```
-------
-------
---*---
--*o---
-oo*---
*o*o---
```

[2]

```
r
```

```
*------
o------
**o*---
oo*o---
*oo*---
*o*o*--
```

[2]

[1]

```
Player 1 wins
```

Test 3

```
5
3 4 3 4 3
```

```
-------
-------
-------
--*----
--*o---
--*o---
```

[2]

```
n
```

```
-------
-------
--o----
--*----
--*o---
--*o---
```

[2]

```
r
```

```
oo*o*o-
***oo*-
ooo**o-
***oo*-
oo*oooo
***o***
```

[2]

[1]

```
Player 2 wins
```

Test 4

```
1
7
```

```
-------
-------
-------
-------
-------
------*
```

[2]

```
r
```

```
**oo*oo
oo**o**
**oo*oo
oo**o**
**o***o
ooo*oo*
```

[2]

[1]

```
Draw
```

Question 2(b) **[2 marks available]**

[2]
```
oo**oo-
**oo**-
oo**oo-
**oo**-
oo*oooo
***o***
```

There are no marks for giving a reflection of the solution.

Question 2(c) **[6 marks available]**

[1] The maximum number of moves is 41
[1] The minimum number of moves is 15

In addition, up to [4] marks can be gained from the following points:

[1] (Since play alternates) odd moves are made by player 1 and even moves are made by player 2.
[1] (Since play alternates) if player 1 has just moved, they will have one more piece on the board than player 2.
[1] The winning move must have been made by player 1.
[1] Since, in all winning positions on this board, there are at least 8 pieces belonging to player 1, there must be at least 7 pieces belonging to player 2.
[1] Any example of a winning sequence with 15 pieces.

Marks should be awarded for these justification points, even if the numeric answers are incorrect.

Question 2(d) **[3 marks available]**

[3] 60691

Question 3(a) **[26 marks available]**

There are thirteen tests used to check program 3(a). In each case the output should consist of a single integer.

(**Supplementary:** In several cases, an alternative answer is given *in brackets and italics*. Each of these answers is worth [1] mark).

[1]	**dog**	4	
[2]	**e**	1	
[2]	**et**	1	
[2]	**ea**	2	*(4)*
[2]	**eeeee**	1	*(15)*
[2]	**ss**	3	*(29)*
[2]	**oo**	1	*(24)*
[2]	**morse**	99	*(1268)*
[2]	**cyclops**	12	*(11798568)*
[2]	**wireless**	8092	*(283953)*
[2]	**olympiad**	1255	*(3074351)*
[2]	**invisible**	27876	*(3919944)*
[3]	**typewriter**	91674	*(1950220)*

Question 3(b) **[5 marks available]**

[2] 13 (for `-----`)
[3] 170 (for `-.......-`)

Question 3(c) **[3 marks available]**

[3] 124

(**Supplementary:** Award [1] mark for 130.)

End of BIO 2004 marks scheme

British Informatics Olympiad

2004 British Informatics Olympiad
Script Cover Sheet

LIONHEAD STUDIOS

Please use this sheet, with reference to the marks scheme, to assist you with marking each student's script. This cover sheet should accompany all scripts submitted to the BIO organisers. As it summarises the solutions to many questions, **do not distribute or show this sheet to any contestant before 28 March 2004.**

Name of student: _____ Age: _____ Year in school: _____

1(a)

Input:	**13 20 9 2 9**	**13 20 7 16 3**	**13 20 7 16 12**	**13 20 7 18 3**	**13 20 8 11 8**	**13 20 16 3 4**	**13 20 14 6 9**	**14 1 1 1 1**	**14 1 14 14 14**
	[2]	[2]	[2]	[2]	[2]	[2]	[2]	[2]	[2]
Output:	22 3 2001	1 1 2000	10 1 2000	10 2 2000	22 9 2000	29 2 2008	15 5 2006	21 12 2012	14 7 2026

1(a)

Inputs numbers?	*Outputs a date?*	*Exits OK?*
[2]	[2]	[2]

1(b) *Two correct dates:*
[1] 13 20 7 17 14
[1] 13 20 8 16 9

1(c)
[1] 2,880,000
[2] Thursday

Totals for Q1

1(a)	[24]
1(b)	[2]
1(c)	[3]

Test 1:

Input: **6** **n** **1 7 2 6 3 5**

2(a)

[2]	[2]	[1]

Output:

```
-------  -------
-------  -------
-------  -------   Player
-------  -------   1 wins
-------  -------
***-ooo  ****ooo
```

Test 2:

8 **n** **n** **r** **3 3 3 4 4 4 4 2**

[2]	[2]	[2]	[2]	[1]

Output:

```
-------  -------  -------  *------
-------  -------  -------  o------
---*---  ---*---  ---*---  **o*---   Player
--*o---  --*o---  --*o---  oo*o---   1 wins
--o*---  --o*---  -oo*---  *oo*---
-o*o---  *o*o---  *o*o---  *o*o*--
```

2(b)

```
oo**oo-
**oo**-
oo**oo-
**oo**-
oo*oooo
***o***
```

[2]

*See mark scheme for **2(c)***

2(d) 60691 [3]

Test 3:

Input: **5** **n** **r** **3 4 3 4 3**

2(a)

[2]	[2]	[2]	[1]

Output:

```
-------  -------  oo*o*o-  Player
-------  -------  ***oo*-  2 wins
-------  --o----  ooo**o-
--*----  --*----  ***oo*-
--*o---  --*o---  oo*oooo
--*o---  --*o---  ***o***
```

Test 4:

1 **r** **7**

[2]	[2]	[1]

```
-------  **oo*oo  Draw
-------  oo**o**
-------  **oo*oo
-------  oo**o**
-------  **o***o
------*  ooo*oo*
```

Q2 Totals

2(a)	[26]
2(b)	[2]
2(c)	[6]
2(d)	[3]

Input:	**3(a)**	*Output:*
dog	[1]	4
e	[2]	1
et	[2]	1
ea	[2]	2

Input:	**3(a)**	*Output:*
eeeee	[2]	1
ss	[2]	3
oo	[2]	1
morse	[2]	99

Input:	**3(a)**	*Output:*
cyclops	[2]	12
wireless	[2]	8092
olympiad	[2]	1255
invisible	[2]	27876

Input:	**3(a)**	*Output:*
typewriter	[3]	91674

See mark scheme for alternative solutions for 3(a) and 3(c)

3(b) [2] 13 and [3] 170

3(c) [3] 124

Totals for Q3

3(a)	[26]
3(b)	[5]
3(c)	[3]

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.*

Total question 1	**Total question 2**	**Total question 3**
(29)	(37)	(34)

Please use the back of this sheet for any further comments

Marked by

Total mark for BIO 2004 (100)

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British Informatics Olympiad

2004 British Informatics Olympiad
Marks Submission Sheet

Please fill in details of the school/college and each pupil's name as they should appear on certificates. There is room for 8 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.
Please submit all your marks to us electronically, using the on-line form at *http://www.rixcam.com/forms/bio-marks-2004.html*. In addition, please send us copies of the completed marks submission forms and all cover sheets by post, along with the scripts from your **highest-scoring student**, and all others who score **over 50 marks**. Please email the source-code for any students whose scripts you return.

School/College: _____ Date exam taken: _____

Name of marker: _____ Date exam marked: _____
(in BLOCK CAPITALS)

Marks submission table.

BIO *2004* Name of entrant (this will appear on certificate – please print clearly)	Marks for each section (maximum in brackets)										Total mark (100) *note 1*	PC/ Lang type *note 2*	Age in years	Year in school *note 3*	Gender
	1a (24)	1b (2)	1c (3)	2a (26)	2b (2)	2c (6)	2d (3)	3a (26)	3b (5)	3c (3)					

Note 1 Write N/S (no submission) in this column if the student produced no answers.
Note 2 Give the number of the machine and language type in the computer/language type table below.
Note 3 Please indicate the type of enumeration used, eg. year band / curriculum level: _____

Computer summary table.

Type number	Hardware *e.g. PC/Mac/Arc*	Processor *e.g. Pentium 4 (2 Ghz)*	Operating system *e.g. Mac OS X*	Programming language(s) *e.g. Visual C++*
1				
2				
3				
4				

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