

The 2014 British Informatics Olympiad Marking Scheme

Instructions for setting the 2014 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 2014 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/2014/bio2014-score-registration.html>

Marks that are received after **31 December 2013** 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 31 December 2013.

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 student's programs unless requested. After this date, you are free to return scripts to the students and distribute copies of the BIO 2014 exam paper.

Finally, thank you very much for participating in BIO 2014.

Question 2(b) [2 marks available]

[2] 31

Question 2(c) [3 marks available]

[3] 18

Question 2(d) [5 marks available]

[1] No

The following pieces of justification are worth at most [4] marks.

[1] In the loop, whenever a line extends to a tile in any direction, it must be matched somewhere by the line extending over a tile in the opposite direction.

(This point can also be awarded if the justification is given in terms of specific directions, such as left/right.)

[1] Every loop covers an even number of tiles.

[1] Each player's score must be even as it consists of the sum of even numbers.

[1] The difference between two even numbers (the players' scores) must be even.

The following pieces of justification are worth at most [4] marks.

At most [2] marks from the following four points:

- [1] Two adjacent passwords either have the same length or the second password is one character longer than the first.
- [1] If the first password has fewer than 18 characters there are fewer than 36 characters in the combined passwords.
- [1] If the second password has more than 18 characters the total number of characters in the passwords is more than 36, so at least one character appears in both passwords.
- [1] Both passwords must contain 18 characters.

Question 3(a) [25 marks available]

Each test for 3(a) consists of an input integer and an alphanumeric output string. The case of the letters for the output can be ignored.

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

[1]	1	A
[2]	21	U
[2]	321	JP
[2]	4321	HPQ
[2]	54321	LNOV
[2]	654321	AHJSVW
[2]	7654321	EHJK025
[3]	87654321	CEILRU059
[4]	234234234	BEHJVPVX267
[5]	987654321	MNOPQTUX026

Question 3(b) [2 marks available]

The following five passwords must be in the exact order listed below:

[2] 14, BIO, NTU, ABCDE, BIO14

Question 3(c) [3 marks available]

[3] 68,719,476,735
Which can optionally be written as $2^{36}-1$.

Question 3(d) [5 marks available]

[1] 1 pair

At most [2] marks from the following three points:

- [1] As the passwords are ordered, the *first* password must contain the A.
- [1] If the first password contains an A and the second does not, the first password can only be the last password (of that length) beginning with an A.
- [1] ATUVWXYZ0123456789 and BCDEFGHIJKLMNOPQRS fulfill the criteria.

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/2014/bio2014-score-registration.html>

Please retain all student programs and scripts until 1 February.

Marks that are received after **31 December 2013** 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 (25)	1b (2)	1c (3)	2a (25)	2b (2)	2c (3)	2c (5)	3a (25)	3b (2)	3c (3)	3d (5)						

† 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 10.9	Programming Language e.g. Visual C++
1				
2				
3				
4				