

## The 2024 British Informatics Olympiad Marking Scheme

### Instructions for setting the 2024 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 except where required to access the on-line help for their language.

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 2024 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  
<https://www.olympiad.org.uk/2024/24bio-results.html>

Marks that are received after **15 January 2024** will not be considered for the final.

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 2024 exam paper.

Finally, thank you very much for participating in BIO 2024.

**Question 1(a) [ 25 marks available ]**

For each test of the program for 1(a) you need to type in two numbers. The output should be a single digit. The output must be correct for the marks to be scored.

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

[1] 999 11	1
[1] 1 1	1
[1] 98765 1	9
[1] 1 5	5
[1] 1 50	3
[1] 1 500	0
[2] 1 123456	6
[2] 1 9988776655443322	6
[2] 123 1000	4
[2] 123 87654321	2
[2] 1122 3456543	7
[2] 345 9988776655443322	8
[2] 22334455667788 11	7
[2] 12345678912345 987654321987	9

Additional marks are available for general program behaviour:

- [1] Program inputs two numbers.
- [1] For each test a single digit is output.
- [1] All tests terminate without crashing / hanging.

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

[2] 12

**Question 1(c) [ 5 marks available ]**

- [2] Positions 223 – 227
- [3] Positions 1,677,777,779 – 1,677,777,787

**Question 2(a) [ 25 marks available ]**

There are 13 tests used to check 2(a). For each test you will need to type in a string consisting of *capital* letters and brackets, followed by an integer.

For each test you should see a single integer, which needs to be correct to score marks.

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

[1] E(OE) 3	350
[2] T 1	1
[2] O 123456	246911
[2] EE 1	8
[2] TOE 1000	354
[2] (TO)E 555	266
[2] T(OE) 2000	1430
[2] (EO)(OE) 5000	2559830
[2] E(OO)E 4433	2269458
[2] E(O(OE)) 5566	182375894
[2] T(OO(EO))T 987654	1108
[2] EEEEEEOEEEE 12345	103552892655
[2] EE(O(EEEE))O 12345678	424194248808595199

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

[2] 20

**Question 2(c) [ 5 marks available ]**

[5] 41

(Supplementary: The answer 44 scores [3] marks)

**Question 3(a) [ 25 marks available ]**

Each test for 3(a) consists of a single line containing a string of *capital* letters. For each test you should see a single integer output.

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

[1]	<b>BAB</b>	3
[2]	<b>A</b>	1
[2]	<b>GA</b>	38
[2]	<b>DEAD</b>	980
[2]	<b>R</b>	10843
[2]	<b>BIO</b>	579377
[2]	<b>DOG</b>	824034
[2]	<b>ALGAE</b>	346221
[2]	<b>NICE</b>	15671736
[2]	<b>ALGOL</b>	44097895090
[3]	<b>ZY</b>	1141042340074
[3]	<b>LIKELY</b>	444474391799316244

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

[2] ABABAB

**Question 3(c) [ 4 marks available ]**

[4] 954,658

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

[3] The largest difference in word length is 32.

[2] 1 pair of words have this difference.

# British Informatics Olympiad

## 2024 British Informatics Olympiad Script Cover Sheet

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 31 January 2024.**

Name of Student:

Age:

School Year:

1(a)

input	999	11	98765	1	1	50	1	500	123456	123	1000	345	9988776655443322	1122	3456543	123	87654321	22334455667788	11	12345678912345	987654321987	
1(a)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)
output	1	1	9	5	3	0	6	6	4	2	7	8	7	9								

TOTAL 1(a)  Inputs data?   
 Valid output?   
 Exits okay?  1(b)  Ans: 12  
 1(c)  Ans: 223-227  
 1,677,777,779-1,677,777,787

2(a)

input	E(OE) 3	T 1	O 123456	EE 1	TOE 1000	(EO)(OE) 2000	(TO)E 555	E(OO)E 4433	5000	EE(O(OE))T 987654	EE(O(OE))T 987654	12345
2(a)	(1)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)
output	350	1	246911	8	354	266	1430	2269458	1108	182375894	103552892655	424194248808595199

TOTAL 2(a)  2(b)  Ans: 20  
 2(c)  Ans: 41

Suppl: [3] for 44

3(a)

input	BAB	A	GA	DEAD	R	BIO	DOG	ALGAE	NICE	ALGOL	ZY	LIKELY
3(a)	(1)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(3)	(3)
output	3	1	38	980	10843	579377	824034	346221	15671736	44097895090	1141042340074	444474391799316244

TOTAL 3(a)  3(b)  Ans: ABABAB  
 3(c)  Ans: 954658  
 3(d)  Ans: 32, 1

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
<input type="text" value="(32)"/>	<input type="text" value="(32)"/>	<input type="text" value="(36)"/>

# British Informatics Olympiad

## 2024 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 <https://www.olympiad.org.uk/2024/24bio-results.html>

Please retain all student programs and scripts until 1 February.

Marks that are received after **15 January 2024** will not be considered for the final.

Please fill in details of the school/college and each pupil's name. 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	Marks for each section (maximum in brackets)										Total (100) †	PC/ Lang ‡	School Year §	Age	M/F
	1a (25)	1b (2)	1c (5)	2a (25)	2b (2)	2c (5)	3a (25)	3b (2)	3c (4)	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 13.0.1	Programming Language e.g. Visual C++
1				
2				
3				
4				