

## The 2018 British Informatics Olympiad Marking Scheme

### Instructions for setting the 2018 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 2018 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/2018/mark-transcript-2018.html>

Marks that are received after **15 January 2018** 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 2018.

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 2018 exam paper.

Finally, thank you very much for participating in BIO 2018.

**Question 1(a) [ 26 marks available ]**

For each test of the program for 1(a) you need to type in two integers. The output should be a single number. It is the value, rather than the format, of the output that is important; e.g. 170 and 170.00 are the same number.

[1]	<b>10 50</b>	116.55
[1]	<b>0 0</b>	100
[1]	<b>0 70</b>	100
[1]	<b>49 0</b>	492.17
[1]	<b>70 100</b>	170
[2]	<b>21 21</b>	143.46
[2]	<b>31 31</b>	180.80
[2]	<b>24 30</b>	152.22
[2]	<b>76 79</b>	214.48
[2]	<b>98 69</b>	317.74
[2]	<b>61 52</b>	287.57
[2]	<b>36 37</b>	207.22
[2]	<b>61 38</b>	6755.51
[2]	<b>85 46</b>	34606.34

Additional marks are available for general program behaviour:

- [1] Program inputs two integers.
- [1] For each a test a single value is output.
- [1] Program terminates without crashing / hanging.

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

[2] 5

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

- [3] Interest = 96%
- Repayment = 49%

**Question 2(a) [ 24 marks available ]**

There are 9 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.

For each test you should see as output a word of 6 letters, followed by a word with the same number of letters as the input word.

The two output words are scored independently. The first mark shown by each test is for the first word and the second mark for the second word. A word must be correct in every letter to score the marks.

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

[1]	<b>5 ABCD</b>	EJOTYD
[1]		EOYK
[1]	<b>1 A</b>	ABCDEF
[1]		A
[1]	<b>2 Z</b>	BDFHJL
[1]		U
[1]	<b>3 AZ</b>	CFILOR
[2]		CC
[1]	<b>4 BIO</b>	DHLPTX
[2]		HRO
[2]	<b>10 MZNOYW</b>	JTDOZL
[1]		IJUVDI
[2]	<b>27 ABCDEF</b>	ACFJOU
[1]		AFODYG
[2]	<b>31 ELEPHANT</b>	EKRZJV
[1]		JPIOLVWE
[2]	<b>999999 MOON</b>	MKAFSR
[1]		YDVV

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

[3] LKBXIY

**Question 2(c) [ 4 marks available ]**

[2] No

At most [2] marks, taken from the following arguments. Both marks must be from the same argument; note that the last argument on its own is only worth [1] mark.

- [1] The  $i^{\text{th}}$  letter to be encrypted will take place after  $i-1$  rotations of the dial.  
 [1] The  $i^{\text{th}}$  letter of the alphabet will be encrypted to the  $i+i-1^{\text{th}}$  letter on the second dial.  
 [1] The  $i^{\text{th}}$  encrypted letter will always match the  $i+13^{\text{th}}$  encrypted letter. [The student can either give a specific  $i$  in the range 1 to 13, or express the range.]

*or*

- [2] The word is always encrypted as the following positions from the second dial:  
 1, 3, 5, 7, 9, 11, 13, 15, 17, 19, 21, 23, 25,  
 1, 3, 5, 7, 9, 11, 13, 15, 17, 19, 21, 23, 25.

*or*

- [1] Any explicit example of an encryption of the word, for any second dial.  
 [The most likely example, from the ordered second dial, would be  
 ACEGIKMOQSUSWYACEGIKMOQSUSWY]  
 [1] Any re-mapping of the letters on the second dial would just result in the corresponding re-mapping of this encrypted word.

*or*

- [1] The word will always be encrypted as 13 letters which are then repeated.

**Question 2(d) [ 4 marks available ]**

[4] 1260

**Question 3(a) [ 24 marks available ]**

Each test for 3(a) consists of a single digit  $d$ , followed by a  $d$  digit number. 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]	<b>6</b> <b>461235</b>	6
[2]	<b>6</b> <b>412365</b>	3
[2]	<b>9</b> <b>123456789</b>	0
[2]	<b>1</b> <b>1</b>	0
[2]	<b>3</b> <b>132</b>	1
[2]	<b>5</b> <b>41235</b>	3
[2]	<b>6</b> <b>254631</b>	5
[2]	<b>7</b> <b>2756413</b>	9
[2]	<b>7</b> <b>7521436</b>	10
[2]	<b>8</b> <b>51438672</b>	8
[2]	<b>8</b> <b>51432687</b>	13
[3]	<b>9</b> <b>547389126</b>	19

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

- [2] 7  
 [2] 16

**Question 3(c) [ 6 marks available ]**

- [2] 26  
 [4] 2620

# British Informatics Olympiad

## 2018 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 15 January 2018.**

Name of Student:

Age:

School Year:

input	10 50	0 0	0 70	49 0	70 100	21 21	24 30	76 79	98 69	61 52	36 37	61 38	85 46	
1(a)	(1)	(1)	(1)	(1)	(1)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	
output	116.55	100	100	492.17	170	143.46	180.80	152.22	214.48	317.74	287.57	207.22	6755.51	34606.34

Inputs data?  (1)

Valid output?  (1)

Exits okay?  (1)

**TOTAL 1(a)**  (26)

1(b)

Ans: 5

 (2)

1(c)

Ans: 96, 49

 (3)

input	5 ABCD	1 A	2 Z	3 AZ	4 BIO	10 MZNOYW	27 ABCDEF	31 ELEPHANT	99999 MOON
2(a)	(1+1)	(1+1)	(1+1)	(1+2)	(1+2)	(2+1)	(2+1)	(2+1)	(2+1)
output	EJOTYD EOYK	ABCDEF A	BDFHJL U	CFILOR CC	DHLPTX HRO	JTDOZL IJUVDT	ACFJOU AFODYG	EKRZJV JPIOLVWE	MKAFSR YDVV

**TOTAL 2(a)**  (24)

2(b)

Ans: LKBXIY

 (3)

2(c)

(see marks scheme)

 (4)

2(d)

Ans: 1260

 (4)

input	6 461235	6 412365	9 123456789	1 1	3 132	5 41235	7 2756413	8 51438672	9 547389126			
3(a)	(1)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(3)		
output	6	3	0	0	1	3	5	9	10	8	13	19

**TOTAL 3(a)**  (24)

3(b)

Ans: 7, 16

 (2+2)

3(c)

Ans: 26, 2620

 (2+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:

<b>TOTAL Q1</b>	<b>TOTAL Q2</b>	<b>TOTAL Q3</b>
<input type="text"/> (31)	<input type="text"/> (35)	<input type="text"/> (34)

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/2018/mark-transcript-2018.html>

Please retain all student programs and scripts until 1 February.

Marks that are received after **15 January 2018** 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									Total (100) †	PC/ Lang ‡	School Year §	Age	M/F
	1a (26)	1b (2)	1c (3)	2a (24)	2b (3)	2c (4)	2d (4)	3a (24)	3b (4)					

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