The 2001 British Informatics Olympiad

Marking Scheme

CONFIDENTIAL before 18 March 2001

Instructions for setting the 2001 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.

The 3 hour time limit should start once you allow them to turn the page and begin the exam.

Please also encourage the students to read the questions first before attempting any answers.

If you are asked how many marks are available for 3(c), please answer that this is a bonus question, and the number of marks available for it is not fixed.

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 2001 finalists.

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. Note that, if a program does not complete a test in two minutes 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. If a script is to be submitted for moderation, this cover sheet should be sent with it. 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 marks submission form and any script that scores more than 60 marks. If none of your students scored over 60, please send us the best script from your school.

Finally, thank you very much for participating in BIO 2001!

Marks scheme

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

For each test of the program for 1(a) you need to type in two integers. The response should be a statement containing a single integer. There are no marks for incorrect answers.

[2]	**6**	**4**	5
[2]	**40**	**1**	40
[2]	**20**	**8**	1
[2]	**37**	**19**	27
[2]	**200**	**200**	149
[2]	**230**	**173**	230
[2]	**555**	**444**	31
[2]	**999**	**82**	9
[2]	**82**	**999**	49

Additional marks are available for general program behaviour.

[2] Program inputs numbers
[2] For each test, a statement containing one number is output
[2] Program terminates without crashing/hanging

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

The following numbers must be given in order.

[2] 5, 10, 3, 9, 4, 12, 8, 7, 11, 2, 6 and 1.

(Supplementary: If the answer is wrong but the final number is given as 1, or the first two numbers are given as 5 and 10, score [1]).

Question 1(c) **[4 marks available]**

[4] 64

(Supplementary: The answer 7 is worth [2] marks.)

Question 2(a) **[30 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 either be two 5 by 5 grids, or a single word.

When required, if only one of the two grids is correct half the marks should be given for that stage. Any other incorrect output, at any phase, gets [0] marks for that stage. If the program crashes/hangs part way through a test, or takes longer than two minutes, the rest of that test should be discarded.

Note: If the program terminates without crashing/hanging *at the end of all four tests*, an additional [2] marks should be awarded.

Test 1

DOG
BONE

[2]

```
D O G A B     Z Y X W V
C E F H I     U T S R P
J K L M N     M L K J I
P R S T U     H G F D C
V W X Y Z     A E N O B
```

E
KENNEL
[1] WLZKKT

E
CAT
[1] VUAF

D
NVSC
[2] BIRD

D
YJIFOS
[2] MOUSE

Q

Test 2

APRICOT
ORANGE

[2]

```
A P R I C     Z Y X W V
O T B D E     U T S P M
F G H J K     L K J I H
L M N S U     F D C B E
V W X Y Z     G N A R O
```

E
LEMON
[2] MFWERC

E
CUCUMBER
[1] EZEZNEZP

D
XSXCXC
[1] BANANA

D
MFWERC
[2] LEMON

Q

Test 3

ABRACADABRA
XYZZY

```
A B R C D     W V U T S
E F G H I     R P O N M
J K L M N     L K J I H
O P S T U     G F E D C
V W X Y Z     B A Z Y X
```

[2]

E
CORNUCOPIA
HUGTOGEFZP

[1]

E
LIBRARY
MHFWEWZB

[2]

D
ESFMAW
AMENDS

[2]

D
SDMHYVZH
PELICAN

[1]

Q

Test 4

(NB: Note the absence of the letter Q!)

ABCDEFGHIJKLMNOPRSTUVWXYZ
ZYXWVUTSRPONMLKJIHGFEDCBA

```
A B C D E     A B C D E
F G H I J     F G H I J
K L M N O     K L M N O
P R S T U     P R S T U
V W X Y Z     V W X Y Z
```

[2]

E
PLAYFAIR
KRVDAFTG

[1]

D
HDFSUB
CIPHER

[1]

Q

[2] Marks awarded if the program terminates without crashing/hanging *at the end of all four tests.*

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

[3] 9

(Supplementary: There is [1] mark for answering 10 or 8.)

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

[4] 3000 or 2999

Either of these two answers on their own are worth all the marks. In the event of an incorrect answer, there are marks for saying

[1] The columns can be cycled / rotated (giving x 25 equivalent pairs)
[1] The rows can be permuted/ arbitrarily exchanged (giving x 120 pairs)
[1] There are no equivalent pairs other than column cycles and row permutations

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Question 3(a) **[30 marks available]**

Test 1:

1
10
10

[3]

Test 2:

2
8 13
13

[3]

Test 3:

3
3 7 15
25

[3]

Test 4:

4
10 15 20 25
80

[3]

Test 5:

4
2 3 5 8
19

[3]

Test 6:

6
4 23 40 41 80 90
252

[3]

Test 7:

```
7
1 6 8 19 20 30 40
```

[3] 101

Test 8:

```
8
99 99 99 99 99 99 99 99
```

[3] 1287

Test 9

```
8
1 20 38 39 95 96 97 98
```

[3] 375

Test 10:

```
8
11 12 13 14 15 16 17 18
```

[3] 165

Question 3(b) [3 marks available]

There are two solutions to this problem, either of them is worth [3]. There are no other valid solutions.

Method 1:

A & B cross	->	
	<-	A crosses
C & D cross	->	
	<-	B crosses
A & B cross	->	

Method 2:

A & B cross	->	
	<-	B crosses
C & D cross	->	
	<-	A crosses
A & B cross	->	

Question 3(c) [bonus]

The student's answer to this question will be considered when selecting the finalists. Please indicate on the script cover sheet if the student has attempted the question.

End of BIO 2001 marks scheme

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Script cover sheet

British Informatics Olympiad

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 18 March 2001.**

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

									inputs numbers?	*outputs number?*	*exits ok?*	***total for 1(a)***
input:	6 4	40 1	20 8	37 19	200 200	230 173	555 444	999 82	82 999				
1(a)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(24)
output:	5	40	1	27	149	230	31	9	49				

1(b) (2) *answer*: 5, 10, 3, 9, 4, 12, 8, 7, 11, 2, 6, 1
see marks scheme for partial marks

1(c) (4) *answer*: 64
see marks scheme for partial marks

Test 1

input:	DOG BONE	E KENNEL	E CAT	D NVSC	D YJIFOS	Q
2(a)	(2)	(1)	(1)	(2)	(2)	
output:	DOGAB ZYXWV CEFHI UTSRP JKLMN MLKJI PRSTU HGFDC VWXYZ AENOB	WLZKKT	VUAF	BIRD	MOUSE	

Test 2

input:	APRICOT ORANGE	E LEMON	E CUCUMBER	D XSXCXC	D MFWERC	Q
2(a)	(2)	(2)	(1)	(1)	(2)	
output:	APRIC ZYXWV OTBDE UTSPM FGHJK LKJIH LMNSU FDCBE VWXYZ GNARO	MFWERC	EZEZNEZP	BANANA	LEMON	

Test 3

input:	ABRACADABRA XYZZY	E CORNUCOPIA	E LIBRARY	D ESFMAW	D SDMHYVZH	Q
2(a)	(2)	(1)	(2)	(2)	(1)	
output:	ABRCD WVUTS EFGHI RPONM JKLMN LKJIH OPSTU GFEDC VWXYZ BAZYX	HUGTOGEFZP	MHFWEWZB	AMENDS	PELICAN	

Test 4

input:	ABC…OPRS…XYZ ZYX..RPON…CBA	E PLAYFIAR	D HDFSUB	Q
	(2)	(1)	(1)	
:	ABCDE ABCDE FGHIJ FGHIJ KLMNO KLMNO PRSTU PRSTU VWXYZ VWXYZ	KRVDAFTG	CIPHER	

	exits ok?	***total for 2(a)***
2(a)	(2)	(30)

2(b) (3) *answer* 9

2(c) (4) 3000 or 2999

see marks scheme for partial marks for 2(b), 2(c)

please see the marks scheme for the input format for 3(a).

											total for 3(a)
input	1 10	2 8 13	3 3 7 15	4 10 15 20 25	4 2 3 5 8	6 4 23 40 41 80 90	7 1 6 8 19 20 30 40	8 99 99 99 99 99 99 99 99	8 1 20 38 39 95 96 97 98	8 11 12 13 14 15 16 17 18	
	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(30)
output	10	13	25	80	19	252	101	1287	375	165	

(3)
see marks scheme

please tick if student has attempted 3(c)

Total question 1	**Total question 2**	**Total question 3**
(30)	(37)	(33)

Deduct [2] marks for every part (a) program name that is not clearly marked on paper

Please use the back of this sheet for any further comments

Marked by

Total mark for BIO 2001 (100)

Send to: Fieke Dekkers, 33 Sutherland Place, London W2 5BZ Fax: 0870 130 8498

The 2001 British Informatics Olympiad

Marks submission sheet

British Informatics Olympiad

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.

Make a copy of the completed forms before sending them, and enclose cover sheets, scripts, printouts and disks (labelled with type e.g. PC 1.4MB) from your **highest-scoring student**, and all others who score **over 60 marks**.

School/College: _____ Date exam taken: _____

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

Marks submission table.

BIO 2001 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*
	1a (24)	1b (2)	1c (4)	2a (30)	2b (3)	2c (4)	3a (30)	3b (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 use National Curriculum year bands: year 11 (age 15-16, 5th form, GCSE year), 12 for lower VIth, 13 for upper VIth, etc.

Computer summary table.

Type number	Hardware *e.g. PC/Mac/Arc*	Processor *e.g. P150*	Operating system *e.g. Win95*	Programming language(s) *e.g. Turbo Pascal*
1				
2				
3				
4				

Send to: Fieke Dekkers
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