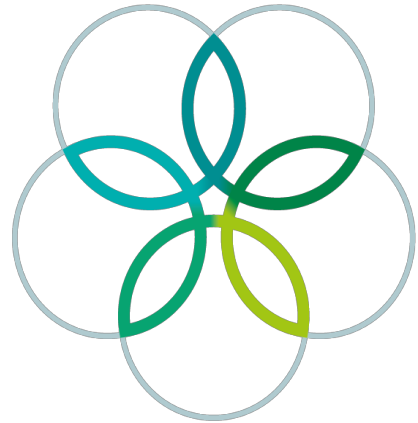
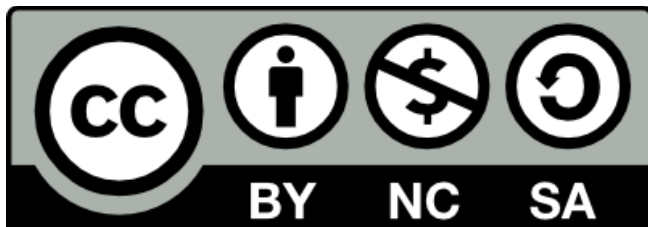


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IBO



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IBO 2019 - Practical Exam 1

- Sugar chromat., starch ident., micr. fuel cell



30th IBO
HUNGARY 2019

Q1.1.1 Max. 12 marks for TLC plate

CODE	Based on Bar Code
	• 8 marks spot width ○ 0.1-0.5 cm 2 points ○ 0.5-1 cm 1 point ○ >1cm - points • 2 marks eluent front, end point following the rules ○ 1.5 -0.5 cm 1 point ○ end point drawn – 1 point • 2 marks spot development ○ 2 points – spots present ○ 1 point faint spot ○ 0points no spots

Q.1.1.2 13 (1 for each correct distance, 2 for each R_f)

No error carry forward in R_f calculation

R_f>1 was not accepted → 0 marks

E (cm)		
17.1-17.7		
	d (cm)	R _f
(G)	2.3-2.7	0.13-0.15
(S)	5.6-6.7	0.32-0.39
(M)	2.9-3.5	0.16-0.2
(X)	2.1-2.5	0.12-0.14

Q.1.1.3 (5 marks for correct solution, 0 for incorrect)

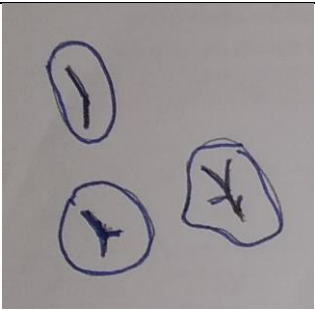
G	S	M
X		(X also acceptable, but only if selected together with G)

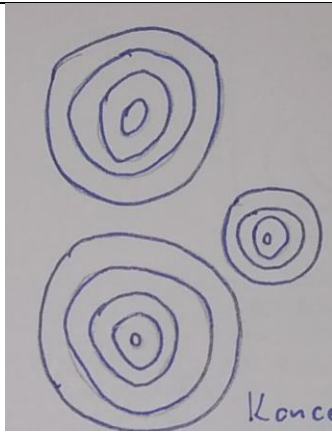
Q.1.2.1. (No marks awarded)

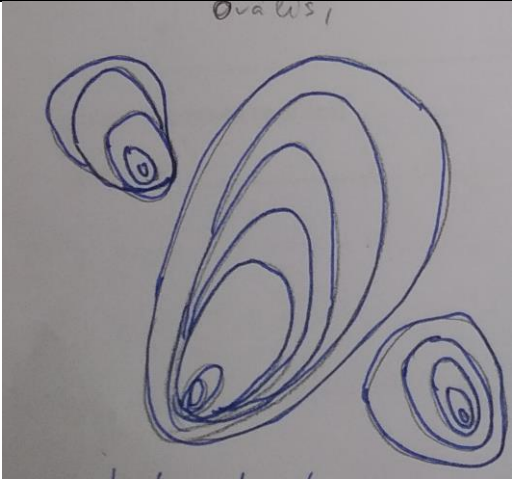
SIGNATURE: _____

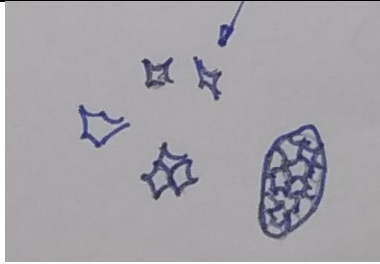
Q.1.2.2. Max. 16 (4 for each satisfactory drawing)

- At least two grains drawn → 1mark
- Shape → 1mark
- Pattern → 1 mark
- Relative size $C > B/A > D$ → 1 mark

A
 • Roundish • Central ridge

B
 • Round • Concentric

C
 • Oval, pointed • Eccentric

D
 • Angular and small • Concave, often many

Q.1.2.3. (4 marks)

A	
B	
C	X
D	

Q.1.2.4 (5 marks)

$8.4 \cdot 10^{-4}$	μg
---------------------	---------------

Q.1.2.5 (5 marks)

$3.11 \cdot 10^{13}$

Q.1.3.1. (15 marks for correctly assembled galvanic cell)

Signature: _____

Q.1.3.2. (5 marks for measurement within the range)

0.3-0.9	Volt
---------	------

NUMBER GIVEN to students is 433mV

Q.1.3.3. (1 mark / 0 marks if incorrect numbers of decimals are given)

0.02569 or 0.02568	Volt
--------------------	------

Q.1.3.4. (4 marks for 26,1 2 marks for 336)

261	mV
-----	----

Q.1.3.5.(2 marks for -172, 1 marks for -97)

-172	mV
------	----

Q.1.3.6. (5 marks for 0.0012, 2 marks for 0.012, 0 for other)

0.0012	mol/L
--------	-------

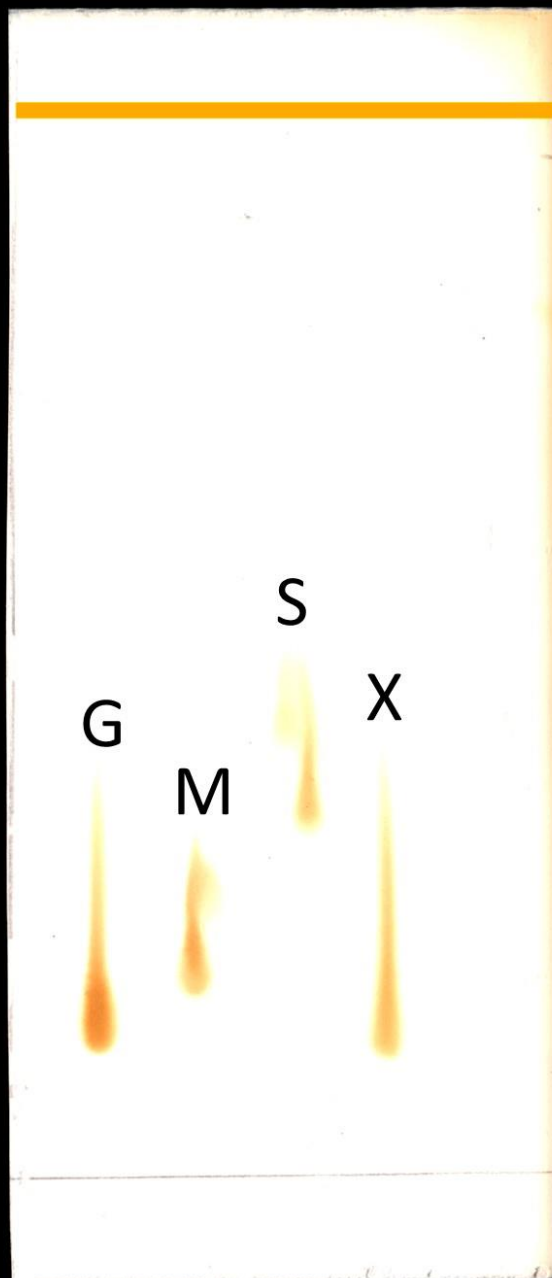
Q.1.3.7. (5 marks for -129; 2 marks for -143, 0 marks for other)

-129	mV
------	----

	A	B
Q.1.3.8	X	
Q.1.3.9		X
Q.1.3.10	X	

(1 mark per question)





IBO 2019 - Practical Exam 2

- Blood sugar measurement, molecular biology



30th IBO
HUNGARY 2019

Subtask 1. A Model of Home Blood Glucose Measurement

Part 1

total

15

Table 1 9points

D	V _s [μL]	V _{H₂O} [μL]	MC [mmol/L]
			accepted range
1:5	50	250	0 - 2.6 Not considered
1:2	100	200	0.4 - 3.8
1:1	150	150	1.6 - 5.3
2:1	200	100	3.1 - 6.9
1:0	300	0	4.8 - 10.4
when	exact	exact	in given range AND one decimal accuracy
points per cell	0.25	0.25	1.5
column total	1.25	1.25	7.5
table 1 total	10		

Table 2 6 points

T	0-5 °C	10-15 °C	RT	 °C	37 °C
MC [mmol/L]					
For all 4, accepted range	1.6 - 5.3 or if MC 1:1 out of range in Table 1 in correct range according to calibration curve (as MC 1:1 on regression line)				

- Points per cell: 1.5
- When in given range and 1 decimal

Part 2

total

34

Table 3 15 points

n	SC [mmol/L] (x)	MC [mmol/L] (y)	$(x - \bar{x})$	$(y - \bar{y})$	$(x - \bar{x})(y - \bar{y})$	$(x - \bar{x})^2$		$(y - \bar{y})^2$		
1	4.0	4.5	-5.63	-4.97	27,98	31,70		24,70		
2	6.0	6.4	-3.63	-3.07	11,14	13,18		9,42		
3	8.3	8.0	-1.33	-1.47	1,96	1,77		2,16		
4	9.9	9.6	0.27	0.13	0,04	0,07		0,02		
5	13.6	13.3	3.97	3.83	15,21	15,76		14,67		
6	16.0	15.0	6.37	5.53	35,23	40,58		30,58		
					$\Sigma((x - \bar{x})(y - \bar{y}))$	91,55	$\Sigma(x - \bar{x})^2$	103,05	$\Sigma(y - \bar{y})^2$	81,55
		total	4.5			1.5		1.5		1.5

$\bar{x} =$	9.63	$\bar{y} =$	9.47
per cell	1.5		
total	3		

$s_x =$	4.54
$s_y =$	4.04
$r =$	1.00
$b =$	0.89
$a =$	0.90
per cell	1.5
total	7.5

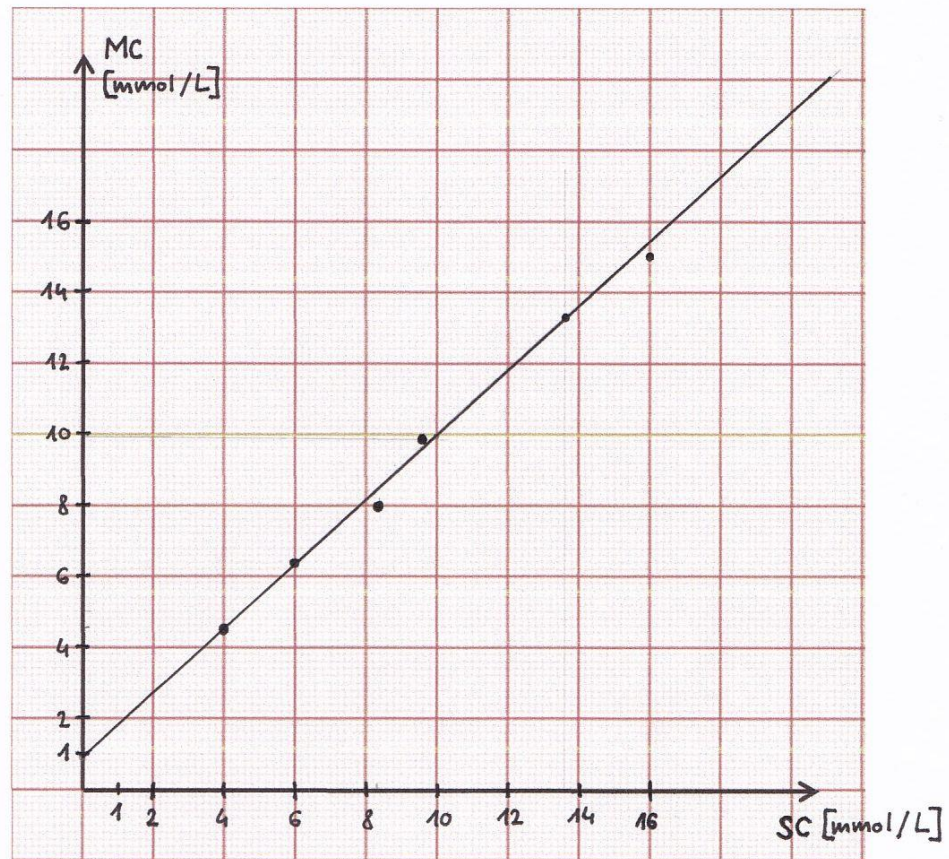
- All accepted at given value +/- 0.03

Penalties in case of "possibly right answers"

- 1 decimal format, correct rounding: 0.5x(point per cell)
- >2 decimals format: 0.5x(point per cell)
- no decimals → no point
- missing negative sign → no point

Graph 1 8 points

Graph 1



Points:

	per axis	total
scaling shown AND right	0.5 p	1 p
labeling according to instructions with abbreviations (MC,SC)	0.5 p	1 p
other label	0 p	0 p
unit shown AND right	0.5 p	1 p
	per data point	total
dot center within ± 0.4 mmol/L (± 1 mm) of „should“	0.5 p	3 p
- dots of > 2 mm diameter - x instead of dots at right spot	0 p 0.3 p	0 p 1.8 p
regression line	2 p	
y intercept at 0.9 ± 0.4 mmol/L (± 1 mm) AND $X(10 \text{ mmol/L}) \rightarrow y=9.9 \pm 0.4 \text{ mmol/L}$	2 p	
correct regression line, wrong a and b	2 p	
Table total	8 p	
x and y axis switched	0.5 x (total earned) p	

Table 4 3+4 points

S	L15	R30	D		D ²	
1	5,4	6,7	-1,30		1,69	
2	4,2	5,2	-1,00		1,00	
3	6,0	6,8	-0,80		0,64	
4	4,4	6,2	-1,80		3,24	
5	5,7	9,4	-3,70		13,69	
6	4,6	5,5	-0,90		0,81	
7	5,1	8,7	-3,60		12,96	
8	5,9	8,6	-2,70		7,29	
9	3,7	2,6	1,10		1,21	
10	4,4	4,4	0,00		0,00	
11	4,8	7,0	-2,20		4,84	
12	5,6	8,9	-3,30		10,89	
13	3,9	5,7	-1,80		3,24	
14	4,3	6,4	-2,10		4,41	
15	4,5	5,4	-0,90		0,81	
			ΣD	-25.00	ΣD ²	66.72
			(ΣD) ²	625.00		
			per cell	total		
			exact number, 2 decimals		1 p	3 p
<2 decimals, correctly rounded			0.5 p	1.5 p		
>2 decimals			0 p	0 p		

$t_{\text{stat}} = (-) 4.83 \pm 0.03$ 2 points

$\Sigma D / \Sigma D^2 / (\Sigma D)^2$ incorrect, t_{stat} calculated right	1 point
--	---------

$t_{\text{crit}} = (-) 4.14$ exact.....2 points

Table 5 4 points

	T	F	
2.1.8	X		2 points
2.1.9		X	2 points

Subtask 2. Molecular biology

Q2.2.1

	A	B	C	D	E	F
1.			X			
2.				X		
3.	X					
4.					X	
5.		X				

10 points

Every correct row is 2 points

Q2.2.2

A	2
B	2
C	950
D	300

12 points

Every correct item 3 points

Q2.2.3

A	B	C	D
		X	

1 point

Q2.2.4

START: _____ END: _____ TIME: 17-25 minutes – 3 points
15-17 & 25-30 – 1 point

Q2.2.5

<15 & >30 – 0 point

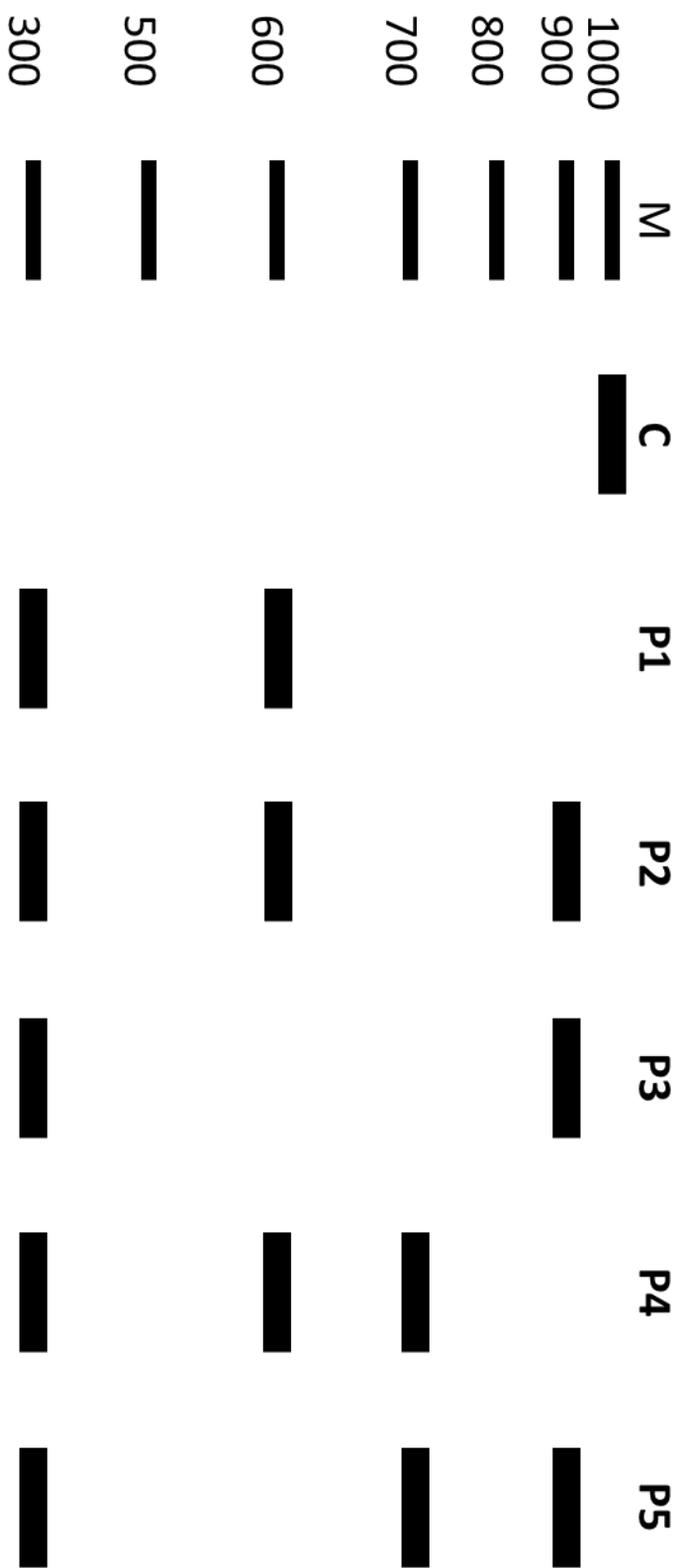
CODE: 14 points altogether
4x2 points for every lane being loaded correctly (band intensity)
3x2 points for every sample (not including the marker) in the correct position

Q2.2.6

	A	B	C	D
P1		X		
P2		X	X	
P3			X	
P4	X	X		
P5	X		X	

10 points

2 points for every correct row



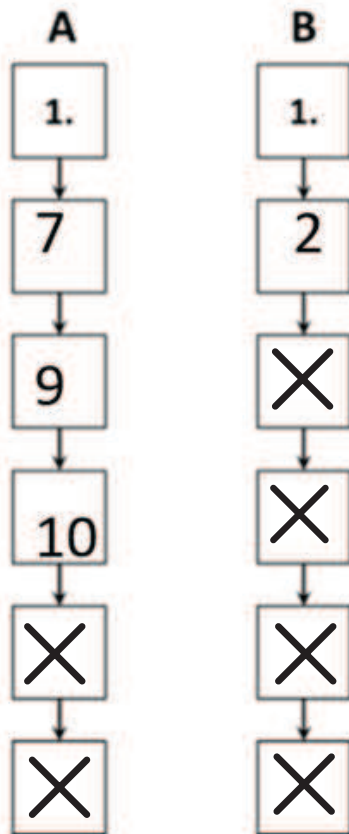
IBO 2019 - Practical Exam 3

- Plant & animal anatomy, ecology



30th IBO
HUNGARY 2019

Q3.1.1



Q3.1.2

	A	B
I.		X
II.		
III.		
IV.		
V.		
VI.		
VII.		
VIII.		
IX.	X	
X.		
XI.		
XII.		

Q3.2.1

		<i>Festuca</i>		
		+	-	
<i>Stipa</i>	+	$a = 2$	$b = 20$	$a+b = 22$
	-	$c = 5$	$d = 13$	$c+d = 18$
		$a+c = 7$	$b+d = 33$	$n = 40$

		<i>Festuca</i>		
		+	-	
<i>Cynodon</i>	+	$a = 0$	$b = 4$	$a+b = 4$
	-	$c = 7$	$d = 29$	$c+d = 36$
		$a+c = 7$	$b+d = 33$	$n = 40$

		<i>Stipa</i>		
		+	-	
<i>Cynodon</i>	+	$a = 3$	$b = 1$	$a+b = 4$
	-	$c = 19$	$d = 17$	$c+d = 36$
		$a+c = 22$	$b+d = 18$	$n = 40$

Q3.2.2

df	1
------	----------

Q3.2.3 & Q3.2.4

	χ^2	p
<i>Festuca</i> & <i>Stipa</i>	90.11	D
<i>Festuca</i> & <i>Cynodon</i>	61.01	D
<i>Cynodon</i> & <i>Stipa</i>	22.63	D

Q3.2.5

	A	B	C
1.			X
2.			X
3.	X		

Q3.3.1

	A	B	C	D
T	X	X		
F			X	X

Q3.3.2

	A	B	C	D
T	X	X	X	X
F				

Q3.3.3

	A	B	C
T	X	X	
F			X

Q3.3.4

	A	B	C	D
T	X		X	
F		X		X

Q3.3.5

CODE	
------	--

Q3.3.6

	A	B	C	D	E
T			X		X
F	X	X		X	

Q.3.3.7

	A	B	C	D
Q3.3.7.1		X		
Q3.3.7.2			X	

Q.3.3.8

	A	B	C	D
Q3.3.8	X			

Q3.3.9

CODE	
------	--

	A	B	C	D
Q.3.3.10			X	

	A	B	C	D	E
Q.3.3.11				X	

	A	B	C	D	E
Q.3.3.12		X			

Q3.3.13

CODE	
------	--

	A	B	C	D	E
Q.3.3.14	X				

IBO 2019 - Practical Exam 4

- Bioinformatics & biotechnology



30th IBO
HUNGARY 2019

Q4.1.1

1	X	5		9		13	
2		6		10		14	
3	X	7	X	11	X	15	X
4	X	8		12		16	

3

(-1 for each
incorrectly filled
cell)

Q4.1.2a

315

1

(1/0)

Q4.1.2b

A

1

(1/0)

Q4.1.2c

447

196

2

(2/1/0)

Q4.1.2d

4

11

15

3

(3/2/1/0)

Q4.1.2e

452

-

453

2

(2/1/0)

Q4.1.2f

452

453

495

577

578

5

(5/4/3/2/1/0)

Q4.1.3a

$3N+6$ ~~or~~ $3N+3$

2

(2/1/0)

Q4.1.3b

40

1

(1/0)

Q4.1.3c

151

193

2

(2/1/0)

Q4.1.3d

165

1

(1/0)

Q4.1.3e

193

(1/0)

1

Q4.1.4a

9

2

(2/0)

Q4.1.4b

10

13

4

(4/2/0)

Q4.1.4c

4

15

4

(4/2/0)

Q4.1.4d

	A	B	
I		X	
II.	X		
III.		X	

2

2

2

(6/4/2/0)

Q4.1.4e

	A	B	C
51			X
144			X
312	X		
447		X	
531			X

2

2

2

2

2

(10/8/6/4/2/0)

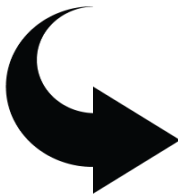
Q4.2.1

CODE	
------	--

32

(computer generated mark)

Signature



Q4.2.2

No.	A	B	C	D	E
23			X		
17					X
9				X	
25					X
3	X				
11		X			

3
3
3
3
3
3

(18/15/12/9/6/3/0)



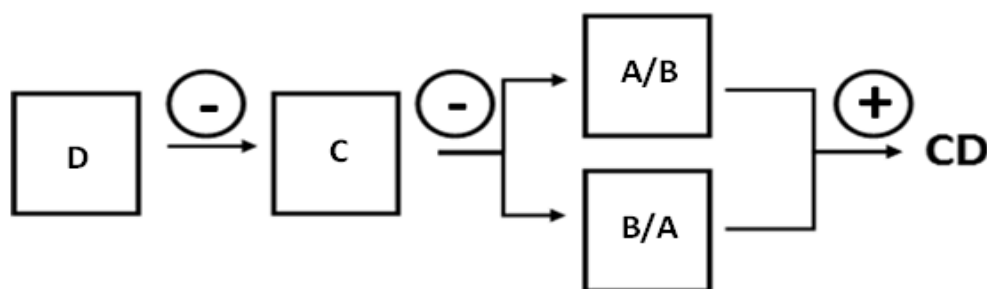
IBO 2019 - Theoretical Exam 1



30th IBO
HUNGARY 2019

Q.1

Q.1.1 & Q.1.2



1D 1
2C 1
3A/B 1
4A/B 1
1- 1
2- 1
3+ 1

Q.2

	Q.2.1	Q.2.2	Q.2.3	Q.2.4	Q.2.5	Q.2.6
T		X			X	X
F	X		X	X		

1 each

3

3

Q.3

	A	B	C
Q.3.1			X
Q.3.2	X		
Q.3.3			X
Q.3.4	X		
Q.3.5	X		
Q.3.6			X

1
1
1
1
1
1

	Q.3.7	Q.3.8	Q.3.9	Q.3.10	Q.3.11
T	X	X			
F			X	X	X

1 each

2

3

Q.4

	A	B	C
Q.4.1		X	
Q.4.2			X
Q.4.3	X		
Q.4.4			X
Q.4.5		X	

1
1
1
1
1

Q.5

Q.5.1	11	ml O ₂ *min ⁻¹ *kg ⁻¹
Q.5.2	0.125	ml*min ⁻¹

3

3

	Q.5.3	Q.5.4	Q.5.5	Q.5.6	Q.5.7	Q.5.8	Q.5.9
T		X		X	X		X
F	X		X			X	

1 each

4

3

Q.6

Q.6.1	50	2
-------	----	---

	5'-3'	3'-5'	
Q.6.2	X		1

Q.6.3	1.25	3
-------	------	---

Q.6.4	L	2
-------	---	---

	A	B	C	D	
Q.6.5				X	2

Q.7

	A	B	C	D	
Q.7.1		X			2

	A	B	C	D	E	F	G	
Q.7.2			X					2

Q.7.3	M1	M2	M3	M4	M5	M6	1 each
A		X					1
B	X		X	X	X	X	5

Q.7.4	2 OR 3	2
-------	--------	---

Q.7.5	M1	M2	M3	M4	M5	M6	1 each
M1				X			1
M2							
M3					X	X	2
M4							
M5						X	1
M6							-1 each wrong

Q.8

	1	2	3	4	5	6	7	8	1 each
Q.8.1	X	O	O	O	O	O	X	O	2
Q.8.2	O	O	O	X	O	X	O	O	2
Q.8.3	O	X	X	O	X	O	O	X	2

1 mistake = 1, more mistakes/line = 0

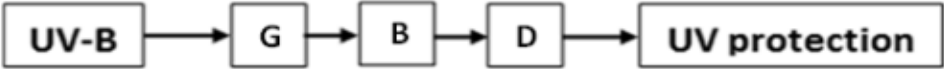
Q.8.4	4	2
-------	---	---

Q.8.5		

Q.9

Q.9.1	920	μg/ml	3	
Q.9.2	2.17	μl	3	
Q.9.3	9		2	

Q.9.4



G	2
B	2
D	2

Q.10

	A	B	C	I.	II.	0	
Q.10.1						X	1
Q.10.2				X			1
Q.10.3	X						1
Q.10.4						X	1
Q.10.5		X					1
Q.10.6			X				1
Q.10.7					X		1
Q.10.8						X	1

Q.11

	A	B	C	D	E	F	
Q.11.1			X				1
Q.11.2	X						1
Q.11.3				X			1
Q.11.4		X					1
Q.11.5					X		1

Q.12

Q.12.1	55	L	3
Q.12.2	0.01	mg/ml	3

	Q.12.3	Q.12.4	Q.12.5	Q.12.6	
T		X	X		1 each
F	X			X	2

Q.13

	Q.13.1
T	X
F	

1 each
1

	A	B	C	D
Q.13.2		X		
Q.13.3	X			
Q.13.4			X	
Q.13.5				X

1 each

1
1
1
1

Q.13.6	400
--------	-----

mg/min

3

Q.14

	A	B	C	D	E	P	Q
Q.14.1							X
Q.14.2							X
Q.14.3					X		
Q.14.4							X
Q.14.5				X			

1
1
1
1
1

Q.15

	Type I	Type II	Type III	Type IV
Q.15.1		X		
Q.15.2				X
Q.15.3	X			
Q.15.4			X	
Q.15.5				X
Q.15.6	X			

1
1
1
1
1
1

Q.16

	Q.16.1	Q.16.2
T		X
F	X	

1
1

Q.16.3	0.25
Q.16.4	10000

ms

3

3

Q.17

	0 h	4 h	8 h	12 h	16 h
Q.17.1				X	
Q.17.2	X				
Q.17.3		X*	X*		

2

2

2

*ONE AND ONLY ONE

*EGY ÉS CSAK EGY

	A	B	C	D	E	F
Q.17.4			X			

2

Q.18

	T3	T4	TSH	TRH
Q.18.1			X	X
Q.18.2	X	X		
Q.18.3	X	X		
Q.18.4	X	X	X	
Q.18.5	X	X	X	X

per completely correct line

2

2

2

2

2

Q.19

	A	B	C
Q.19.1			X
Q.19.2	X		
Q.19.3		X	
Q.19.4			X
Q.19.5	X		

1

1

1

1

1

Q.20

Q.20.1	G	G	G	A	T	C
--------	---	---	---	---	---	---

for completely correct

3

Q.20.2	A	R
GNC		X
GLK	X	

1

1

Q.20.3

GNC	G	C	G	A	T	C			1
	C	C	G	A	T	C			1
GLK	R	G	A	T	T	C	C		1
	G	A	T	T	C	C			1

Q.21

Q.21.1

"A"	110	3
"B"	104	3

	A	B	C	D	E	F	
Q.21.2				X			1
Q.21.3	X						1
Q.21.4	X				X		1
Q.21.5				X			1
Q.21.6	X		X				1
Q.21.7				X			1

Q.21.8	A	>	B	1
--------	---	---	---	---

Q.22

	A	B	C	D	E	
Q.22.1					X	2

Q.22.2	A	>	B	1
--------	---	---	---	---

	A	B	C	D	E	
Q.22.3		X				2

Q.22.4	122	m	2	Q.22.6	130	m	2
Q.22.5	122	m	2	Q.22.7	125	m	2

	A	B	C	D	1 each, -1 per incorrect X, min 0
Q.22.8	X	X			2

Q.23

	A	B	C	D	E	F	G	
Q.23.1						X	X	2
Q.23.2		X		X				2

1 each, -1 per incorrect X, min 0

Q.23.3	20-30	μm	3
Q.23.4	50-60	μm	3

Q.24

	Q.24.1	Q.24.2	Q.24.3	Q.24.4	1 each
T					
F	X	X	X	X	4

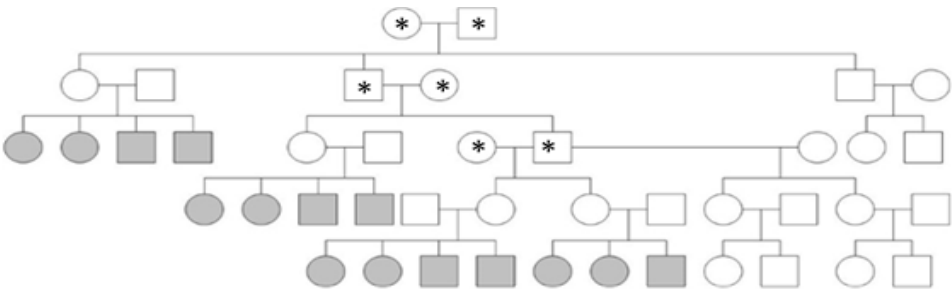
Q.25

	Q.25.1	Q.25.2	Q.25.3	Q.25.4	Q.25.5	Q.25.6	Q.25.7	Q.25.8	1 each
T		X							
F	X		X	X	X		X	X	6

Q.26

	A	B	C	D	E	F	2
Q.26.1						X	

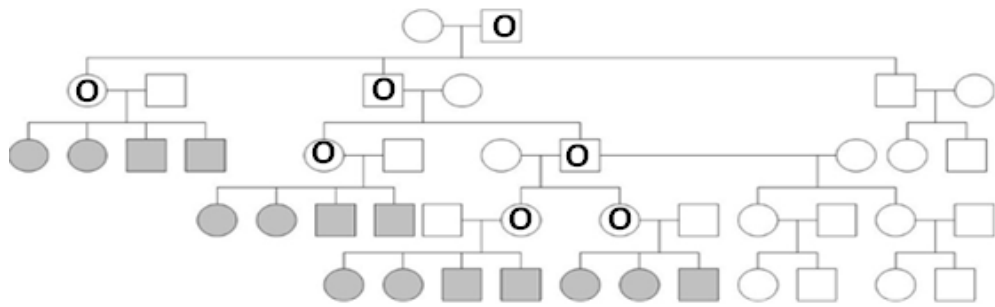
Q.26.2



3

both: -1 per incorrect, min 0

Q.26.3



3

Q.27

Q.27.1	BR/BR	BR/Br	BR/bR	BR/br	Br/Br	Br/bR	Br/br	bR/bR	bR/br	2
Lily				X						
Jacob							X			2

Q.27.2	50%	2	Q.27.4	50%	2
Q.27.3	25%	2	Q.27.5	10%	2

Q.28

Q.28	16	3
------	----	---

Q.29

Q.29.1	1 or 2 or 3	2
--------	-------------	---

Q.29.2

Q.29.3

T	T	A/G*
---	---	------

*One of the two

*A kettőből az egyik

2

codon

1

circle

Q.30

Q30.1	B, E, K	B, H, L	X	X	1	1
Q30.2	A, F, K	A, E, K	A, H, K	A, G, K	1	1
Q30.3	A, E, K	A, D, K	A, H, K	A, G, K	1	1

*cells are interchangeable within rows

1 per fully correct box

Q.31

	Q.31.1	Q.31.2	Q.31.3	Q.31.4	Q.31.5
T	X	X	X	X	X
F					

1 each

5

0

Q.32

	Q.32.1	Q.32.2	Q.32.3	Q.32.4	Q.32.5
T	X			X	
F		X	X		X

1 each

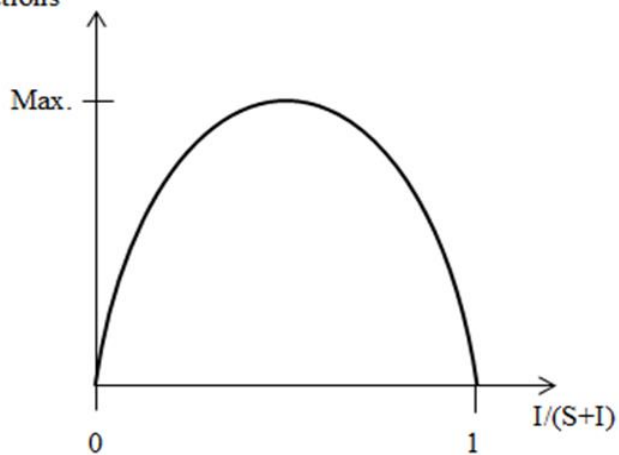
2

3

Q.32.6

Number of new infections

3



	Q.32.7	Q.32.8	Q.32.9	Q.32.10	Q.32.11	1 each
T	X		X		X	3
F		X		X		2

Q.33

	A	B	C	D	
Q.33.1	X				2
Q.33.2		X			2
Q.33.3				X	2
Q.33.4				X	2
Q.33.5	X				2
Q.33.6			X		2

Q.34

	I.	II.	III.	IV.	V.	VI.	VII.	
A	X							1
B							X	1
C		X						1
D				X				1
E			X					1
F	X							1
G						X		1
H						X		1
I					X			1
J			X					1

Q.35

	Q.35.1	Q.35.2	Q.35.3	Q.35.4	1 each
T	X				1
F		X	X	X	3

Q.36

	A	B	C	D	E	
Q.36.1				X		2

Q.36.2	A	B	C	D	E	F	Q	
<i>Anthyllis</i>	X							1
<i>Arachis</i>							X	1
<i>Astragalus</i>							X	1
<i>Cajanus</i>					X			1
<i>Cercis</i>						X		1
<i>Cicer</i>				X				1
<i>Glycine</i>					X			1
<i>Lathyrus</i>							X	1
<i>Leucaena</i>						X		1
<i>Lotus</i>	X							1
<i>Ononis</i>		X						1
<i>Parasponia</i>						X		1
<i>Trifolium</i>							X	1
<i>Trigonella</i>							X	1
<i>Vicia</i>			X					1
<i>Vigna</i>					X			1

Q.37

	Q.37.1	Q.37.2	Q.37.3	Q.37.4	Q.37.5	Q.37.6	Q.37.7	Q.37.8	1 each
T		X		X		X	X	X	5
F	X		X		X				3

Q.38

Q.38.1	A	R	Q	
Ne			X	1
Nb		X		1
Fe	X			1
Fb	X			1
S	X			1

	336	200	136
	Q (a)	336	
Cell biology	1	7	
Cell biology	2	6	
Cell biology	3	11	
Cell biology	4	5	
Cell biology	5	13	
Cell biology	6	10	
Cell biology	7	16	
Molbio	8	8	
Molbio	9	14	
Physiology	10	8	
Physiology	11	5	
Physiology	12	10	
Physiology	13	8	
Physiology	14	5	
Physiology	15	6	
Physiology	16	8	
Physiology	17	8	
Physiology	18	10	
Physiology	19	5	
Plants	20	9	
Plants	21	13	
Plants	22	15	
Plants	23	10	
Plants	24	4	
Genetics	25	7	
Genetics	26	8	
Genetics	27	12	
Genetics	28	3	
Genetics	29	5	
Genetics	30	12	
Ecology	31	5	
Ecology	32	13	
Ecology	33	12	
Biosystematics	34	10	
Biosystematics	35	4	
Biosystematics	36	18	
Ethology	37	8	
Ethology	38	5	

total	
336	
68	Cell biology
22	Molbio
73	Physiology
51	Plants
47	Genetics & Evolution
30	Ecology
32	Biosystematics
13	Ethology

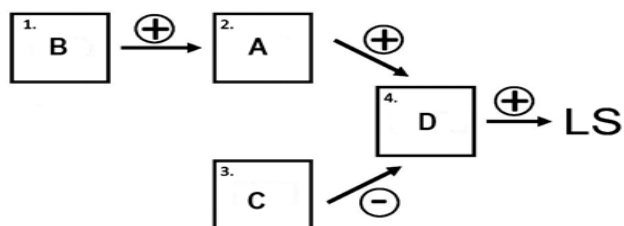
reference		
1	1	TF
1	1	matching/allocation (e.g. curves to letters)
1	1	ABC
2	2	choice of at least 4
2	2	counting, data reading
2	2	calculation with provided formula or interrelated calculations
3	3	calculation

IBO 2019 - Theoretical Exam 2



30th IBO
HUNGARY 2019

Q.1



1B	1
2A	1
3C	1
4D	1
+	1
+	1
+	1
-	1

Q.2

	Q.2.1	Q.2.2	Q.2.3	Q.2.4	1 each
T		X			1
F	X		X	X	3

Q.3

	A	B	C	D	E	F	G	H	I	
Q3.1							X			2
Q3.2			X							2
Q3.3							X			2
Q3.4			X							2

Q.4

	Q.4.1	Q.4.2	Q.4.3	1 each
T			X	1
F	X	X		2

Q.4.4	H1	H3	N1	N2	
1	X	O	O	O	2
2	X	X	X	X	2 XXOX or OXXX or XXXX
3	X	O	O	X	2

	Q.4.5	Q.4.6	1 each
T		X	1
F	X		1

Q.5

	Q.5.1	Q.5.2	1 each
T	X	X	2
F			0

	A	B	C	D	
Q.5.3		X			2
Q.5.4				X	2

Q.6

Q.6.1	A	B	C	
I.		x		1
II.			x	1
III.	x			1

Q.6.2	1500 bp	bp	3
Q.6.3	150 pb/sec	bp/sec	3
Q.6.4	15 min	min	3

Q.7

	A	B	C	D	
Q.7.1				x	2

Q.7.2	A	B	C	D	E	F	G
GG	x				x		
AG			x				x
AA		x		x		x	
	1	1	1	1	1	1	1

	A	B	C	
Q.7.3		x		1

Q.7.4	1/16 <u>or</u> 0.0625	3
-------	-----------------------	---

Q.8

Q.8.1	500 mL	2
Q.8.2	9 breaths/min	2
Q.8.3	250 mL/min	3

	A	B	C	
Q.8.4	x			1

Q.8.5	700 mL	3
Q.8.6	900 mL	3

Q.9

	A	B	C	
Q.9.1			x	1
Q.9.2			x	1
Q.9.3		x		1
Q.9.4			x	1
Q.9.5	x			1

Q.10

Q.10.1	A	<	B	1
Q.10.2	A	>	B	1
Q.10.3	A	<	B	1
Q.10.4	A	>	B	1
Q.10.5	A	=	B	1

Q.11

Q.11.1	42.0 m sec-1	3
--------	--------------	---

	A	B	C	D	E	F	G	H	I	
Q.11.2		X			X					2
Q.11.3				X						2
Q.11.4						X				2
Q.11.5								X		2

Q.12

	A	B	C	
Q.12.1	x			1
Q.12.2			x	1
Q.12.3			x	1

Q.12.4	10 000	3
--------	--------	---

Q.13

Q.13.1	7	3
--------	---	---

	A	B	C	D	
Q.13.2	x				1
Q.13.3		x			1
Q.13.4				x	1
Q.13.5			x		1
Q.13.6	x				1

Q.14

Q.14.1	A	B	C	
1		x		1
2	x			1
3			x	1

	Q.14.2	Q.14.3	Q.14.4	Q.14.5	1 each
T			x		1
F	x	x		x	3

Q.15

Q.15.1	4 000 Hz <u>or</u> 4 kHz	1
--------	--------------------------	---

	A	B	C	D	
Q.15.2	x				1
Q.15.3		x			1
Q.15.4				x	1
Q.15.5			x		1

Q.16

	A	B	C	D	
Q.16.1				x	1
Q.16.2				x	1
Q.16.3			x		1
Q.16.4	x				1

Q.17

Q.17.1	0.18 [0.16-0.20]	2
Q.17.2	0.17 [0.15-0.19]	2
Q.17.3	0.11 [0.10-0.12]	2
Q.17.4	0.13 [0.12-0.14]	2

Q.17.5	A	B	
1		x	1
2	x		1

	A	B	
Q.17.6	x		1

Q.18

Q.18.1	A	B	C	D	E	F
1.i		x				
1.iv					x	

2
2

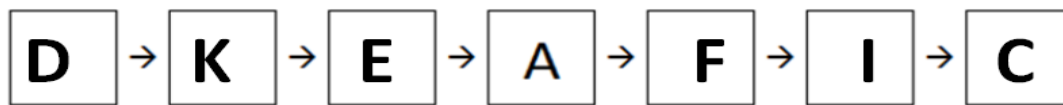
Q.18.2	GLK	>	GNC	1
--------	-----	---	-----	---

	A	B	C	D
Q.18.3		x		

2

Q.19

Q.19.1



1 1 1

1 1 1

Q.19.2	PSAE-2	PSAF	PSBY	CHLM	LHCA2	LHCB3	rbcL	psaC	psbA
GNC	X	X	X	X	X	X		X	X
GLK	X	X	X	X	X	X		X	X

entire line

2
2

1 mistake = 1

Q.20

Q.20.1



1 1 1 1

1

Q.21

Q.21.1	A	B	C	D	E	F	G	H
Gene 1		X						
Gene 2 and 3								X
Gene 4 and 5							X	
Gene 6 and 7			X					
Gene 10				X				
Gene 11, 12, 13						X		

1
1
1
1
1
1

Q.22

Q.22.1.1	A	<	B	1
Q.22.1.2	A	=	B	1

Q.22.2	A	B	C	D	
I.				X	1
II.			X		1
III.		X			1
IV.	X				1

Q.23

	A	B	C	D	E	F	
Q.23.1			x				1
Q.23.2						x	1
Q.23.3	x						1
Q.23.4				x			1

Q.24

	A	B	C	D	E	
Q.24.1					x	2

Q.24.2

VNTR	Rupert				per correct line
A	3+7	3+8	-	-	1
B	4	5	-	-	1
C	9+11	9+18	10+11	10+18	1
D	7+7	7+19	7+21	19+21	1
E	6+6	6+9	6+10	9+10	1

Q.25

Q25.1	3	3
-------	---	---

Q.26

	1	2	3	4	5
Q.26	A	A	A <u>or</u> G	T	A

3
1 mistake: 2, 2 mistakes: 1

Q.27

	A	B	C	D	E	
Q.27.1				x		2
Q.27.2		x				2

Q.27.3	18%
--------	-----

3 carry forward not possible to account for

Q.28

	A	B	C
Q.28.1	x		

1

	a b ⁺ c	a b c ⁺	a ⁺ b ⁺ c ⁺	a ⁺ b ⁺ c	a b ⁺ c ⁺	a ⁺ b c ⁺	a ⁺ b c	a b c
Q.28.2	o	o	x	o	o	o	o	x

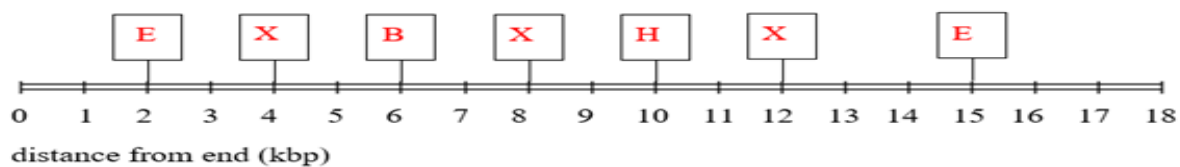
2

1 mistake= 1, 2 mistakes: 0

Q.28.3	29 cM
--------	-------

3

Q.29



1 1 1 1 1 1 1

Q.30

<i>Dr</i> ♀, + ♂	F	>	M	1
+ ♀, + ♂	F	=	M	1
<i>Dr</i> ♀, <i>Dr</i> ♂	F	>	M	1

Q.31

	Q.31.1	Q.31.2	Q.31.3	Q.31.4	Q.31.5	1 each
T		x		x		2
F	x		x		x	3

Q.32

Q.32.1	A	B
	α <u>or</u> alpha	0
	m	0
	X	X

2

2

per mistake -1, minimum 0

	A	B	C	D	E
Q.32.2	X				

2

Q.33

	Q.33.1	Q.33.2	Q.33.3	Q.33.4
T		x		
F	x		x	x

1 each
1
3

	Q.33.5	Q.33.6	Q.33.7
T			
F	x	x	x

1 each
0
3

Q.34

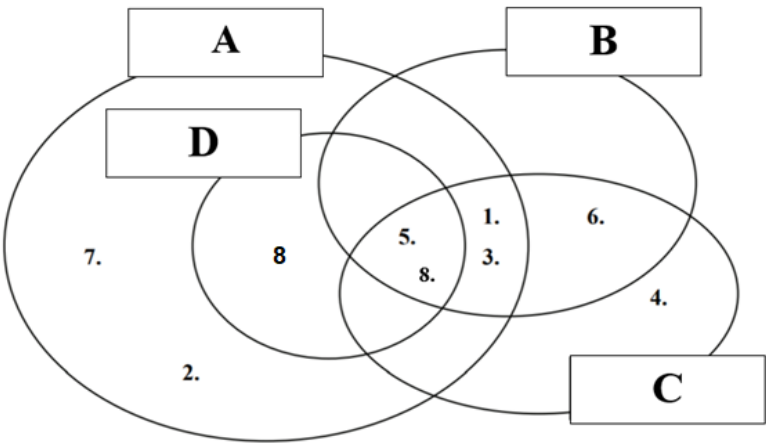
	Q.33.1	Q.33.2	Q.33.3	Q.33.4
T		x		
F	x		x	x

1 each
1
3

	Q.33.5	Q.33.6	Q.33.7
T		x	x
F	x		

1 each
2
1

Q.35



1 1 1 1 1 1 1 1

Q.36

	A	B	C	D	E
Q.36.1				X	

2

Q.36.2	I.	II.	III.	IV.	V.	VI.	VII.	VIII.
A			x					
B				x				
C								
D								
E					x			
F	x							
G								x
H							x	
I								
K						x		
L		x						

1
1
1
1
1
1
1
1
1
1
1**Q.37**

	Q.37.1	Q.37.2	Q.37.3	Q.37.4
T	x	x		
F			x	x

1 each
2
2**Q.38**

	Q.38.1	Q.38.2	Q.38.3	Q.38.4
T		x	x	
F	x			x

1 each
2
2

Q.38.5	A	B
NS		X
NY	X	
SC		

1 1

	268	160	108
	Q (m)	268	
Cell biology	1	8	
Cell biology	2	4	
Cell biology	3	8	
Molbio	4	11	
Molbio	5	6	
Molbio	6	12	
Molbio	7	13	
Physiology	8	14	
Physiology	9	5	
Physiology	10	5	
Physiology	11	11	
Physiology	12	6	
Physiology	13	8	
Physiology	14	7	
Physiology	15	5	
Physiology	16	4	
Plants	17	11	
Plants	18	7	
Plants	19	10	
Plants	20	5	
Plants	21	6	
Plants	22	6	
Genetics	23	4	
Genetics	24	7	
Genetics	25	3	
Genetics	26	3	
Genetics	27	7	
Genetics	28	6	
Genetics	29	7	
Genetics	30	3	
Ecology	31	5	
Ecology	32	6	
Ecology	33	7	
Ecology	34	7	
Biosystematics	35	8	
Biosystematics	36	13	
Ethology	37	4	
Evolution	38	6	

IBO 2019 - Theoretical Exams - Overview



30th IBO
HUNGARY 2019

100% rules	100%	total	morning afternoon		
		604	336	268	
20%	25%	88	68	20	Cell biology
		64	22	42	Molbio
25%	23%	138	73	65	Physiology
15%	16%	96	51	45	Plants
20%	15%	93	47	46	Genetics & Evo
10%	9%	55	30	25	Ecology
5%	9%	53	32	21	Biosystematics
5%	3%	17	13	4	Ethology

reference		
1	1	TF
1	1	matching/allocation (e.g. curves to letters)
1	1	ABC
2	2	choice of at least 4
2	2	counting, data reading
2	2	calculation with provided formula or interrelated calculations
3	3	calculation

to be changed if needed		
	x	
1	1	TF
1	1	matching / allocation (e.g. curves to letters)
1	1	ABC
2	2	choice of at least 4
2	2	counting, data reading
2	2	calculation with provided formula or interrelated calculations
3	3	complex calculation
	no	bonus for concept (all answers correct)