

All IBO examination questions are published under the following Creative Commons license:



CC BY-NC-SA (Attribution-NonCommercial-ShareAlike) - https://creativecommons.org/licenses/by-nc-sa/4.0/

The exam papers can be used freely for educational purposes as long as IBO is credited and new creations are licensed under identical terms. No commercial use is allowed.

25th INTERNATIONAL BIOLOGY OLYMPIAD

5 - 13 July, 2014

INDONESIA



PRACTICAL TEST 1 CELL & MOLECULAR BIOLOGY ANSWER KEY

Total points: 64.5

Duration: 90 minutes

COUNTRY:	
STUDENT ID:	

Task (64.5 points)

Plasmid Identification and Telomere Analysis

Part A. Confirmation of plasmid sample X, Y, and Z by restriction analysis and DNA electrophoresis. (40 points)

Q 1.1. 8 points

For row 4 & 5 – 6 points; 1 series with two enzyme and 1 series EcoRI

For row 2 – 1 point if students fill 1 (µl) for every cell

For row 1 - 1 point for correct volume of water to add up to final volume of 10 µl

Na	Reagents	Series 1 (Volume in µL)			Series 2 (Volume in µL)		
NO.		Plasmid 1	Plasmid 2	Plasmid 3	Plasmid 1	Plasmid 2	Plasmid 3
		S1	S2	S 3	S4	S5	S6
1	Sterile water	<mark>7</mark>	<mark>7</mark>	<mark>7</mark>	<mark>6</mark>	<mark>6</mark>	<mark>6</mark>
2	10 X Restriction buffer solution	<mark>1</mark>	<mark>1</mark>	<mark>1</mark>	<mark>1</mark>	<mark>1</mark>	<mark>1</mark>
3	DNA Plasmid	1	1	1	1	1	1
4	EcoRI*	<mark>1</mark>	<mark>1</mark>	<mark>1</mark>	<mark>1</mark>	<mark>1</mark>	<mark>1</mark>
5	HindIII*	0	0	0	1	1	1
	Volume total	10	10	10	10	10	10

Table I. Design of Experiment for Plasmid Identification

 * If the enzyme is used in the reaction, add 1 μL enzyme

Or

		Series 1 (Volume in µL)			Series 2 (Volume in µL)		
No.	Reagents	Plasmid 1	Plasmid 2	Plasmid 3	Plasmid 1	Plasmid 2	Plasmid 3
		S1	S2	S3	S4	S5	S6
1	Sterile water	<mark>6</mark>	<mark>6</mark>	<mark>6</mark>	7	7	7
2	10 X Restriction buffer solution	1	1	1	1	1	1
3	DNA Plasmid	1	1	1	1	1	1

4	EcoRI*	1	1	1	1	<mark>1</mark>	1
5	HindIII*	1	1	1	0	0	0
	Volume total	10	10	10	10	10	10

Q1.2 Answers . (6 points - 1 points each lane)

enzymes	Series 1	Series 2
HindIII A		V
EcoR1	N	V



Q 1.3 DNA Electrophoresis Result of Plasmid Restriction Experiment (26 points):

1 point for each ladder (1x2)

4 points for each lane (4x 6) :

- 1 point for the presence of DNA and
- 3 points for correct sized band



1 point for each lane of ladder

3 points for each correct lane (or none)- partial digest , if the correct bands are thicker than the uncorrect one. Points are given based on the filled table 1 (error carried forward where applicable)

Code in problem sheet	Plasmid 1	Plasmid 2	Plasmid 3
Real size	3750	3786	3600
EcoRI restriction	3000 + 750	3786 (linearized)	3600 (linearized)
HindIII restriction	3750	3786 (linearized)	uncut
EcoRI + HindIII restriction	3000 + 750	2686 + 1100	2862 + 738

Part B. Cell reproduction and telomere analysis of *Paramaecium* (24.5 points)

Q 2.1. (1 points x 2 = 2 points)

Culture	Binary Fission	Conjugation
A	<mark>√</mark>	-
В	<mark>√</mark>	<mark>√</mark>

Q 2.2. (2.5 points)

	Cell Con	centration	Average cell	Log of Averag	
Day	Α	В	С	(cells/mL) N (Q2.2)	e cell concen tration
0	1	1	1	<mark>1</mark>	0.00
1	8	10	16	<mark>11</mark>	1.05
2	80	120	128	<mark>109</mark>	2.04
3	640	960	1024	<mark>875</mark>	2.94
4	5760	7680	10240	<mark>7893</mark>	3.90

 $N = N_0 2^n$

Log N = log N_o + n log2 Log N - log N_o= n log2 n = (Log N - log N_o)/log 2 n = fission rate (per day) x = day

x = day;

N = average cell number

G= 1 day/fission rate →

Graph 8 points:

- Axis X and Y : 2 points (1 point for each axis)
- 5 points : 1 point for each value of log N
- 1 point for drawing the line





Q 2.3 (12 points)

No.	True	False
а	<mark>√</mark>	
b		N
с		<mark>√</mark>
d	<mark>√</mark>	
е		N
f	<mark>√</mark>	

PRACTICAL TEST 2

25th INTERNATIONAL BIOLOGY OLYMPIAD

5 – 13 July, 2014 **INDONESIA**



PRACTICAL TEST 2 PLANT ANATOMY AND PHYSIOLOGY **ANSWER KEY**

Total points: 96

Duration: 90 minutes

COUNTRY:	
STUDENT:	

The answers have to be given either with a tick ($\sqrt{}$) or with Arabic numbers. The numbers "1" and "7" can look very similar in handwriting. To make sure that those two numbers can be well distinguished by the IBO staff, please write them as you normally would into the following box.

Task 1: Determination of plant pigment (36 points)

TLC plate photograph (*4 points*).

		4	3	2	1
٠	Did the experiment (1 point)	all	Three	Two	Only one
	and TLCed both samples (1	parameters	parameters	parameters	parameter
	point)	are correct	are correct	are correct	is correct
•	Properly marked the scale on the TLC plate				
•	Solvent reached the top end of the plate				
•	4 pigment spots appear on the plate				

Q 1.1 (<u>12 points</u>)

m Table 1
)
;
I
а
b

Q. 1.2 (4 points)

True	False
	N
<mark>√</mark>	
N	
	N

Q 1.3 (10 points)

Group 1

Extract	ļ	٩	Total Chlorophyll (mg/L)	Chlorophyll a (mg/L)	Chlorophyll b (mg/L)
	649 (nm)	665 (nm)			
С	0.038 – 0.041	0.083 – 0.090	1.2663 - 1.369	0.91822 - 0.99684	0.3413 - 0.3648
D	0.111 – 0.117	0.273 – 0.281	3.8853 - 4.0541	3.10074 - 3.17578	0.7617 - 0.8549

Group 2

Extract	ļ	Ą	Total Chlorophyll (mg/L)	Chlorophyll a (mg/L)	Chlorophyll b (mg/L)
	649 (nm)	665 (nm)			
С	0.043 – 0.050	0.088 – 0.105	1.3968 - 1.6405	0.9579 -1.1505	0.4318 - 0.4815
D	0.100 – 0.111	0.245 – 0.263	2.6771 - 6.5043	2.7805 - 2.9637	0.6935 - 0.8387

Extract	ļ	Ą	Total Chlorophyll (mg/L)	Chlorophyll a (mg/L)	Chlorophyll b (mg/L)
	649 (nm)	665 (nm)			
С	0.033 – 0.052	0.073 – 0.096	1.1053 - 1.6256	0.81002 - 1.01568	0.2893 - 0.6024

IBO 2014 BALI, INDONESIA

PRACTICAL TEST 2 PLANT ANATOMY AND PHYSIOLOGY

0.127 0.282 3.0304 - 4.2002 2.97744 - 3.13100 0.031 - 1.10	D	0.111 – 0.127	0.264 – 0.282	3.8304 - 4.2602	2.97744 - 3.13188	0.831 - 1.1052
--	---	------------------	------------------	-----------------	-------------------	----------------

Group 4

	А		Total Chlorophyll	Chlorophyll a	Chlorophyll b
Extract	, F	4	(mg/L)	(mg/L)	(mg/L)
	649 (nm)	665 (nm)			
С	0.029 – 0.043	0.068 – 0.082	0.9948 - 1.3602	0.76456 - 0.87572	0.2246 - 0.478
D	0.123 – 0.131	0.291 – 0.296	4.2351 - 4.4256	3.27822 - 3.30064	0.9327 - 1.1006

Q 1.4 (2 points)

Group 1

Extract	Ratio of chlorophyll
C	2.2184 - 2.3894
D	3.5337 - 4.0094

Group 2

Extract	Ratio of chlorophyll
С	2.6904 - 2.7326
D	3.7148 - 4.0708

Extract	Ratio of chlorophyll
С	1.6860 - 2.7999
D	2.8338 - 3.5830

Group 4

Extract	Ratio of chlorophyll
С	1.8321 - 3.4041
D	2.9989 - 3.5148

Q 1.5 (4 points)

True	False
√	
	<mark>√</mark>
√	
√	

Task 2: Determination of starch content in root extract (21 points)

Q 2.1 (1 point)

Starch	100
[ppm]	100
Starch	<mark>400</mark>
solution	
(µL)	
H2O (µL)	<mark>600</mark>

Q 2.2 (8 points)

Sample	Absorbance (580 nm)		
Starch 250 ppm (C4)	1.198 – 1.208 → 2		
	1.078(1.198 – 1.208) 1.329→ 1		
Starch 100 ppm (C6)	0.484 – 0.486 → 2		
	0.436(0.484 – 0.486) 0.535→ 1		

Sample C7	0.375 – 0.401 → 2
	0.338(0.375 – 0.401) 0.441→ 1
Sample C8	0.825 – 0.839 → 2
	0.743(0.825 – 0.839) 0.923 → 2

Group 2

Sample	Absorbance (580 nm)
Starch 250 ppm (C4)	1.204 - 1.235 → 2
	1.084(1.204 – 1.235) 1.358 → 1
Starch 100 ppm (C6)	0.485 – 0.494 → 2
	0.437(0.485 – 0.494) 0.543→ 1
Sample C7	0.406 - 0.428 → 2
	0.365(0.406 - 0.428) 0.471→ 1
Sample C8	0.843 – 0.863 → 2
	0.759(0.843 – 0.863) 0.949→ 1

Group 3

Sample	Absorbance (580 nm)
Starch 250 ppm (C4)	1.136 – 1.154 → 2
	1.022(1.136 – 1.154) 1.269 → 1
Starch 100 ppm (C6)	0.445 – 0.459 → 2
	0.401(0.445 – 0.459) 0.505 → 1
Sample C7	0.362 - 0.377 → 2
	0.326(0.362 – 0.377) 0.415 → 1
Sample C8	0.778 – 0.805 → 2
	0.700(0.778 – 0.805) 0.886 → 1

Sample	Absorbance (580 nm)
Starch 250 ppm	1.158 – 1.163 → 2
(C4)	1.042(1.158 – 1.163) 1.279 → 1

Starch 100 ppm	0.457 – 0.466 → 2
(C6)	0.411 (0.457 – 0.466) 0.513 → 1
Sample C7	0.382 - 0.396 → 2
	0.344 (0.382 – 0.396) 0.436 → 1
Sample C8	0.795 – 0.812 → 2
	0.716 (0.795 – 0.812) 0.893 → 1

Q 2.3 (4 points)

Q 2.3 (4 points)

a: 4.45 x10⁻³ – 0.01

Q 2.4 (4 points)

Group 1 (02):

<u>C7: 78 – 83 ;</u>

<u>C8: 171 – 174</u>

Group 2 (01):

<u>C7: 84 – 87 ;</u> C8: 174 – 175

Group 3 (03):

C7:	79 –	82;
C8:	171	- 175

Group 4 (04):

C7:	82	<mark>- 85 ;</mark>
C8:	171	- 175

Q 2.5 (4 points)



Task 3. Observation of structural adaptation in plants (39 Points)

Q 3.1 (6 points @ 0.5 point)

Tissue type	Presence		
Specimen	Х	Y	Z
Cortex			
a. sclerenchyma	+	+	-
Endodermis	+	+	+
Xylem			
a. primary xylem	+	+	+
b. secondary xylem	-	-	-

Q. 3.2 (9 points)

Specimen	Diagram (number)		
Х	<mark>4</mark>		
Y	<mark>2</mark>		
Z	<mark>6</mark>		

Q 3.3 (9 points)

Specimen	No aerenchyma	Lysigenous*	Schizogenous**	
Х	\checkmark			
Y		\checkmark		
Z				

* This type of intercellular space arises through dissolution of entire cells.

** This type of intercellular space arises through separation of cell walls from each other along more or less extended areas of their contact.

Q 3.4 (9 points)

Organ	Monocotyledonous		Dicotyledonous			
Organ	Root	Stem	Leaf	Root	Stem	Leaf
Х	N					
Y	N					
Z				V		

Q 3.5 (6 points)

Specimen	Control	Flooding
Х	∕	
Y		N
Z		<mark>√</mark>

End of the Practical Exam

25th INTERNATIONAL BIOLOGY OLYMPIAD

5th – 13th July, 2014 INDONESIA



PRACTICAL TEST 3 ANIMAL ANATOMY, PHYSIOLOGY AND SYSTEMATICS ANSWER SHEET

Total points: 93.5

Duration: 90 minutes

COUNTRY:	
STUDENT:	

Task (93.5 points)

Acute Response of Fish Larvae to Rapid Changes in Salinity to Salt Concentration, Calculation of LC₅₀, and Classification of Prawns

Part A. Acute Response of Fish Larvae to Rapid Changes in Salinity (12 points)

Q 1.1 and Q.1.2 (6 + 2 points)



Q 1.3. (2 points)

Mark the appropriate answer with a tick " \checkmark "

Α	В	С	D
			~

Q 1.4. (2 points)

Mark the appropriate answer with a tick "✓"

Α	В	С	D
			~

25th INTERNATIONAL BIOLOGY OLYMPIAD

5 – 13 July 2014 INDONESIA



PRACTICAL TEST 4 ECOLOGY AND ETHOLOGY

ANSWER KEY (Rev. 09-07-14)

Total points: 100

Duration: 90 minutes

COUNTRY:	
STUDENT:	

The answers have to be given either with a tick ($\sqrt{}$) or with Arabic numbers. The numbers "1" and "7" can look very similar in handwriting. To make sure that those two numbers can be well distinguished by the IBO staff, please write them as you normally would into the following box.

Biogeography and Biodiversity

TASK 1. ISLAND BIOGEOGRAPHY

Question 1.1 (5 points: 5 x 1) (straightforward – no partial points) values slightly outside the range were still accepted.

No.	Island	Distance from mainland (km) (accepted range in parentheses)
1.	Ternate	<u> 12.8 (12.4 – 13.2)</u>
2.	Tidore	9.7 (9.3 — 10.1)
3.	Mare	13.0 (12.6 — 13.4)
4.	Moti	14.1 (13.7 — 14.5)
5.	Makian	17.8 (17.4 — 18.2)

Grading Rule:

- Measurements within range are accepted for 1 point each, no partial points.
- *Range determined as mean of 20 measurements that have been made during our simulation, +/- standard deviation which reached 0.35. Therefore, the accepted range was determined as mean +/- 0.40.

Question 1.2 (10 points: 10 x 1) (straightforward)



Number of Species in Equilibrium

Question 1.3 (2 points: 2 x 1) (straightforward)

Place a tick ($\sqrt{}$) mark in the box of your selected correct answer.

А	В	С	D	E
<mark>×</mark>	N			

TASK 2. PRIMARY SUCCESSION AFTER VOLCANIC ERUPTION Part A : Succession and Plant Community Structure

Question 2.1 (3 points) (straightforward-no partial points)

Place a tick ($\sqrt{}$) mark in the box of your selected correct answer

А	В	С	D	E
			N	

Question 2.2 (5 points; 10 x 0.5) (straightforward-no partial points)

Fill in your calculated similarity indices in the boxes provided.

Year	1934	1949	1963	1979	1991
1949	<mark>0.60</mark>				
1963	<mark>0.52</mark>	<mark>0.32</mark>			
1979	<mark>0.48</mark>	<mark>0.29</mark>	<mark>0.94</mark>		
1991	<mark>0.52</mark>	<mark>0.26</mark>	<mark>0.89</mark>	<mark>0.95</mark>	

Question 2.3 (2 points) (straightforward-no partial points)

Place a tick ($\sqrt{}$) mark in the box of your selected correct answer.

А	В	С	D	E
				N

Question 2.4 (4 points: 4 x 1)

Place a tick ($\sqrt{}$) mark in the box of your selected correct answer. (straightforward–no partial points)

Statement	True	False
А		<mark>√</mark>
В		<mark>√</mark>
С	<mark>√</mark>	
D		<mark>√</mark>

Question 2.5 (6 points)



Grading Rule

- Correct format of graph using correct data from table (two separate graphs for coastal and inland plants will also be accepted) (5 points)
- correct axes and labels (1 point)

Question 2.6 (2 points: 2 x 1) (straightforward–no partial points)

Place a tick ($\sqrt{}$) mark in the box of your selected correct answer.

Statement	True	False
A		<mark>√</mark>
В	√	

Part B : Dispersal Biology of Ficus

Question 2.7. (15 points) Answer data may vary slightly among participants)

Fruit Serial		Fruit Diameter (mm)	
Number	Ficus hispida	Ficus septica	Ficus variegata
1	<mark>32.12</mark>		
2			<mark>22.54</mark>
3		21.22	
4			<mark>20.42</mark>
5		20.56	
6		<mark>18.74</mark>	
7			<mark>21.45</mark>
8		<mark>19.63</mark>	
9	<mark>28.34</mark>		
10			<mark>24.21</mark>
11		23.22	
12	<mark>30.46</mark>		
13		<mark>21.43</mark>	
14			<mark>21.55</mark>
15	<mark>29.12</mark>		
16		<mark>24.24</mark>	
17	<mark>27.50</mark>		
18		<mark>20.45</mark>	
19			<mark>24.54</mark>
20			<mark>22.11</mark>
21		<mark>18.12</mark>	
22			
23	<mark>25.12</mark>		
24			<mark>23.50</mark>
25	<mark>26.42</mark>		
26			20.22
27		<mark>22.86</mark>	
28	<mark>31.22</mark>		
29			<mark>23.42</mark>
30		<mark>17.15</mark>	
Mean	<mark>28.79</mark>	<mark>21.05</mark>	<mark>22.28</mark>
Std. Dev.	<mark>2.42</mark>	<mark>2.21</mark>	<mark>1.51</mark>

*Measurements should be with two decimal places.

Grading Rule

- Each measurement = 0.25 point (total 7.5 points).
- Mean and standard deviation = 2.5 points for each species.
- Measurements will be compared to our own record of measurements.

Question 2.8. (8 points) (Example)



Grading Rule:

- Correct format of bar graph (4 points)
- Graph based on correct values from Question 2.7 (2 points)
- Standard deviation given correctly (1 point)
- Vertical axis given correct label and units (1 point)

Question 2.9 (4 points: 4 x 1)

Place a tick ($\sqrt{}$) mark in the box of your selected correct answer: (straightforward – no partial points)

Statement	True	False
А	N	
В	N	
С	N	
D		<mark>√</mark>

Question 2.10 (3 points: 3 x 1) (straightforward – no partial points)

Place a tick ($\sqrt{}$) mark in the box of your selected correct answer:

Statement	True	False
А	<mark>√</mark>	
В		<mark>√</mark>
С	<mark>√</mark>	

TASK 3. SPECIATION IN SONGBIRDS

Question 3.1 (1 point: 2 x 0.5) (straightforward – no partial points)

Place a tick ($\sqrt{}$) mark in the box of your selected correct answer.

A B C D E N

Question 3.2 (18 points: 9 x 2) (straightforward-no partial points)

Songbird Number	Syllable Repertoire	Acceptable Range for Answers
1	<mark>11</mark>	<mark>9 – 13</mark>
2	<mark>19</mark>	<mark>17 – 21</mark>
3	<mark>30</mark>	<mark>28 – 32</mark>
4	<mark>20</mark>	<mark>18 – 22</mark>
5	<mark>29</mark>	<mark>27 – 31</mark>
6	<mark>11</mark>	<mark>9 – 13</mark>
7	<mark>32</mark>	<mark>30 –34</mark>
8	<mark>12</mark>	<mark>10 – 14</mark>
9	<mark>24</mark>	<mark>22 – 26</mark>

Question 3.3 (3 points: 3 x 1)

Group	Songbird Number
	<mark>1, 6, 8</mark>
	<mark>2, 4, 9</mark>
	<mark>3, 5, 7</mark>

Grading Rule:

- Grading within a group will only be based on the first three numbers (in the case where students enter more than three songbird numbers in a group).
- Full point (1) given if all three numbers are correct.
- Partial point (0.5) given if two numbers are correct.
- No points (0) given if only one number or none is correct.

Note: Students were given full points if they tick the two correct anwers, and were not penalized if they additionally ticked one other answer which is incorrect.

Question 3.4 (8 points: 2 x 4)

Note: statistical calculations were graded very leniently. Two formulas for variance (divided by "n" as in the formula given, or divided by "n-1") were accepted. Since it was not specified in the question, both one- tailed and two-tailed tests were accepted as correct. t-values may vary according to the acceptable range for answers (number of different syllables).		Group	Group
		11	<mark>30</mark>
		11	<mark>29</mark>
		12	32
	Mean within group	<mark>11.33</mark>	<mark>30.33</mark>
	Variance within group	<mark>0.11_</mark> 0.22	0.78 1.56

Calculated t-value	<mark>20.152</mark>	
Table t-value	<mark>2.132 (one-tailed) or</mark> 2.776 (for two-tailed test)	

Grading Rule:

- 1 point each for mean and variance for two groups.
- 2 points each for calculated t-value and table t-value.

Question 3.5 (1 point) (straightforward – no partial points)

Place a tick ($\sqrt{}$) mark in the box of your selected correct answer.

А	В
	N