Student Code:

# 24th International Biology Olympiad

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Bern, Switzerland

BERN 2013 International Biology Olympiad

## Practical Exam 2

## Plant Physiology, Morphology and Ecology

## Answer Key

**Q 1**

| Well | A1 | A2 | A3 | A4 | A5 | A6 | A7 |
|---|---|---|---|---|---|---|---|
| [NADH] (µM) | 0 | 50 | 100 | 150 | 200 | 250 | 300 |
| 500 µM NADH (µl) | 0 | 20 | 40 | 60 | 80 | 100 | 120 |
| $H_2O$ (µl) | 200 | 180 | 160 | 140 | 120 | 100 | 80 |

3 points for Q1:

2 points if the correct concentrations for NADH are achieved. Deduction of 0.5 points for each dilution where the wrong concentration is achieved (0 points if more than 3 concentrations are wrong).

1 point if for every dilution of NADH the sum is 200 µl (0.5 if for one dilution the sum differs from 200 µl, 0 points if for more than one dilution the sum differs from 200 µl).

10.5 points for raw values given on the printout from the microplate reader (lines A1-A7) will be evaluated for precision of pipetting:

Measures will be repeated multiple times by the lab assistants with the same material as the students. The mean of these measurements will be used to set the references. During pretests we obtained the following values 0.113 (A1), 0.277 (A2), 0.436(A3), 0.593 (A4), 0.760 (A5), 0.921 (A6), 1.086 (A7), with standard deviations of approximately 0.025.

1.5 points for each value within the range "mean +/- 0.025". 1 point for values within the range "mean +/- 0.05". 0.5 points for values within the range "mean +/- 0.075": 0 points if values are out of this range.

**Q 2**

| Well | A2 | A3 | A4 | A5 | A6 | A7 |
|---|---|---|---|---|---|---|
| [NADH] (µM) | 50 | 100 | 150 | 200 | 250 | 300 |
| $\varepsilon_s$ ($\mu M^{-1}$) | | | | | | |

3 points for Q2:

0.5 points for each correct calculation (according to the measurements on the students printout). The first four digits after the decimal point must be correct to get the points.

Per cell, 0.1 points are deducted if there are not five digits (up to a maximal deduction of 0.5 points).

| Q 3 | $\bar{\varepsilon}_s$ ($\mu M^{-1}$) | |
|---|---|---|

1 point for Q3:

1 point for the correct calculation (according to the values in Q2). The first four digits after the decimal point must be correct to get the points.

0.1 points are deducted if there are not five digits.

Q 4

| sample | concentration in well (μM) | content in leafs (mmol/g) |
|---|---|---|
| WT light | | |
| WT dark | | |
| sex1 light | | |
| sex1 dark | | |
| pgm1 light | | |
| pgm1 dark | | |

15 points for raw values given on the printout from the microplate reader (lines B1-C7) will be evaluated:

Measures will be repeated multiple times by the lab assistants with the same material as the students. The mean of these measurements will be used to set the references.

0.5 point for each value within the range "mean +/- 25%". 0.25 points for values within the range "mean +/- 50%". 0 points if values are out of this range. The tolerance is much bigger than in Q2 as the stochastic variation of the measurements of plant extracts is higher than for solution of NADH.

The concentration in well will be calculated by the scientific assistants according to the values on the printout. During a pretest we obtained the following values:

| wt light | wt dark | sex1 light | sex1 dark | pgm1 light | pgm1 dark |
|---|---|---|---|---|---|
| 43.8 | 8.3 | 68.2 | 9.5 | 104.0 | 5.9 |

4 points when wt light < sex1 light < pgm1 light; 1 point if wt light < pgm 1 light < sex1 light; 1 point if sex1 light < wt light < pgm1 light.

4 points if all values of dark samples are < 50% of the smallest value of light sample. 1 point if all values of dark samples are smaller than the smallest value of light samples.

1 point if no value of dark samples exceeds the double of the value of another dark sample.

3 points for Q4 (concentration in well):

0.5 points for each correct calculation (according to the measurements on the students printout). All digits before the decimal point must be correct to get the points.

Per cell, 0.1 points will be deducted if there are not five digits (up to a maximal deduction of 0.5 points).

5 points for Q4 (content in leaves):

2 points if the correct factor (= 0.1) has been found to calculate the content in leaves from the concentration in well.

0.5 points for each correct calculation (according to the measurements on the students printout). All digits before the decimal point must be correct to get the points.

Per cell, 0.1 points will be deducted if there are not five digits (up to a maximal deduction of 0.5 points).

**Q 5**

| | true | false |
|---|---|---|
| Plants exposed to 10h of light prior to extraction contain more glucose than those exposed to 48h of complete darkness. | √ | |
| Leaves of dark incubated plants have used up all their carbon energy sources in the dark period. | | √ |
| During the day, starch synthesis in wild type plants reduces glucose levels below the level present during the night. | | √ |
| Both "pgm1 light" and "sex1 light" samples contain more glucose than "WT light" samples. | √ | |
| The "sex1 light" sample contains more glucose than the "pgm1 light" sample. | | √ |
| The difference in glucose concentrations between dark and light incubated plants is bigger in wildtype plants than in mutant plants. | | √ |
| sex1 plants are likely to grow faster than pgm1 plants. | | √ |
| Measuring samples without addition of G6PDH is needed to correct the effect of the background concentration of 6-P-Gluconolactone. | | √ |
| The concentration of NADH in plant leaves is proportional to the concentration of glucose. | | √ |

4.5 points in Q5: 0.5 points for each statement. Inherited errors from Q4 will be taken in account.

Q 6

| Plant | light orange | dark brown | intense black |
|---|---|---|---|
| A | √ | | |
| B | √ | | |
| C | | | √ |
| D | | √ | |

| Plant | light orange | dark brown | intense black |
|---|---|---|---|
| E | | | √ |
| F | √ | | |
| G | √ | | |
| H | | | √ |

4 points in Q6: 0.5 points per plant

Q 7

| | Growth condition: 12 h in light | Growth condition: 12 h in darkness |
|---|---|---|
| Group I | | |
| Group II | | |

1 point in Q7: 0.5 points per correct growth condition.

Q 8

| Group | Plant | Mutant: WT | Mutant: sex1 | Mutant: pgm1 |
|---|---|---|---|---|
| I | A | | | √ |
| | B | | | √ |
| | C | | √ | |
| | D | √ | | |
| II | E | | √ | |
| | F | √ | | |
| | G | | | √ |
| | H | | √ | |

4 points in Q8: 0.5 points per correct mutant type. It will not be possible to correct for inherited errors from Q6 because it will not be possible in many cases to reconstruct what exactly students did when they are confusing the plants.

**Q 9**

| | V | W | X | Y | Z |
|---|---|---|---|---|---|
| Inflorescence type 1 | √ | | √ | | |
| Inflorescence type 2 | | | | √ | |
| Inflorescence type 3 | | | | | √ |
| Inflorescence type 4 | | | | | |
| Inflorescence type 5 | | | | | |
| Inflorescence type 6 | | | | | |
| Inflorescence type 7 | | √ | | | |

2.5 points in Q9: 0.5 point per plant

**Q 10**

| | V | W | X | Y | Z |
|---|---|---|---|---|---|
| number of sepals | 5 | >10 | | (3)/4/(5) | 5 |
| number of petals / tepals | 5 | 5 | 6 | 4 | (4)/5 |
| number of stamens | 5 | 5 | 6 | | 4 |
| number of styles (count branched styles only once) | 1 | 1 | 1 | 1 | 1 |
| number of distinct ovaries | 4 | 1 | 1 | 1 | 4 |

11.5 points in Q10: 0.5 points per plant and floral part. Sepals of pant Y: two sepals are almost entirely fused and can easily be taken as one. A bract almost looks as a sepal and can easily be mistaken; therefore all values between 3 and 5 are accepted. Petal of Z: Two petals are completely fused and will be considered as one by most of the students, therefore both numbers 4 and 5 are accepted.

Q 11

| | | V | W | X | Y | Z |
|---|---|---|---|---|---|---|
| **Sepals** | Free (fused part <10%), | √ | √ | | | |
| | Partially fused (fused part 10-90%) | | | | | √ |
| | Completely fused (fused part >90%) | | | | | |
| **Petals / tepals** | Free (fused part <10%) | | | √ | | |
| | Partially fused (fused part 10-90%) | √ | | | √ | √ |
| | Completely fused (fused part >90%) | | √ | | | |
| **Stamens** | Free | | | √ | (√) | |
| | Partially fused to other stamens at the base or the top (fused part <10-90%) | | | | | |
| | Partially fused with petals / tepals (fused part 10-90%), | √ | | | √ | √ |
| | Partially fused to other stamens AND with petals / tepals (fused part 10-90%) | | √ | | | |

7 points in Q11: 0.5 point per plant and floral part. sepals of Y: two sepals are free, two sepals are completely fused, but it is difficult to estimate if more or less than 90%, therefore this observation is omitted. Stamen of Y: Sepals are partially fuses to petals, but it is difficult to estimate if more or less than 10%, therefore two answers are accepted.

Q 12

| | V | W | X | Y | Z |
|---|---|---|---|---|---|
| A (inferior) | | √ | √ | | |
| B (half-inferior) | | | | | |
| C (superior) | √ | | | √ | √ |

2.5 points in Q12: 0.5 point per plant

Q 13

| | V | W | X | Y | Z |
|---|---|---|---|---|---|
| A (radial) | √ | | √ | √ | |
| B (bilateral) | | √ | | | √ |
| C (asymmetrical) | (√) | | | | |

2.5 points in Q13: 0.5 point per plant

**Q 14**

| | V | W | X | Y | Z |
|---|---|---|---|---|---|
| Floral shape 1 | | √ | | | |
| Floral shape 2 | √ | | √ | | |
| Floral shape 3 | | | | | √ |
| Floral shape 4 | | | | √ | |

5 points in Q14: 1 point per correct floral shape

**Q 15**

| | V | W | X | Y | Z |
|---|---|---|---|---|---|
| Pollinator 1 | | | | √ | |
| Pollinator 2 | √ | √ | √ | √ | √ |
| Pollinator 3 | | | | | |
| Pollinator 4 | √ | √ | | | |
| Pollinator 5 | | √ | | | |

5 points in Q15: 1 point if the pollinator chosen is one of the possible correct ones.

## End of the Practical Exam