



11th EUROPEAN UNION SCIENCE OLYMPIAD

Test 1

Answer sheet

Luxembourg, March 19th, 2013



Country:

Team:

Names and signatures:

TASK 1: DETERMINATION OF SiO₂ IN WATER

TASK 1.1: Preparing the calibration solutions (8 marks):

SiO₂ concentration of the given stock solution: _____ mg/L

Volume of stock solution used for the 50fold dilution in the 10 mL flask: _____ mL

SiO₂ concentrations of the calibration solutions (indicate 3 significant numbers):

	Solution B (mL)	Water (mL)	SiO ₂ Concentration [mg/L]
1	0	2	
2	0.1	1.9	
3	0.2	1.8	
4	0.4	1.6	
5	0.8	1.2	
6	1.6	0.4	

TASK 1.2: Establishing the calibration curve (17 marks):

1.2.1 Complete the following table:

	SiO ₂ Concentration [mg/L]	Absorbance reading at 800 nm
1		
2		
3		
4		
5		
6		
Unknown 1		
Unknown 2		
Unknown 3		

1.2.2 On a sheet of millimeter graph paper, draw a graph that represents the absorbance values of each calibration solution vs the concentration.

1.2.3 Calculate the slope of the obtained calibration curve and write the equation of the line.

- 1.2.4 Add the absorbance readings of the unknown samples on the graph.
- 1.2.5 Determine the SiO_2 concentration of the unknown samples both graphically and by calculation. Give the result with 3 significant figures.

	SiO_2 [mg/L] – graphically	SiO_2 [mg/L] - calculated
Unknown 1		
Unknown 2		
Unknown 3		

TASK 1.3: Error estimation (5 marks)

- 1.3.1 Indicate which of the following sentences are correct and incorrect.

	Correct	Wrong
The proposed experimental has been setup in a way to avoid systematic errors.		
A reduction of the random errors could be achieved by repeating the overall manipulation for the unknown samples and calculating the average of the obtained results.		
For this type of experiment, if samples fall within the non linear range of the calibration curves, a dilution of the samples would yield a more precise result for the SiO_2 concentration than the use of a non-linear fitted curve.		
The whole experiment could be carried out in glass cuvettes without an effect on the overall accuracy of the results.		
A one point calibration forced through the origin of the plot would yield the same precision as obtained with 6-point calibration proposed in the experimental setup.		

TASK 2: DIATOMS, LIFE IN A SILICA BOX

Task 2.1: Identification and dimensions of diatoms (4 marks)

Identify the species using the photographic identification key and measure the mean length of these four diatom species :

Diatom species	Mean length in μm
<i>Navicula cryptotenella</i> (NCTE)	
<i>Amphora pediculus</i> (APED)	
<i>Mayamaea permitis</i> (MPMI)	
<i>Nitzschia dissipata</i> (NDIS)	

Task 2.2 Determination of the degree of pollution of the rivers ‘Syre’ and ‘Gander’ (24 marks)

Identify the species present, fill in the name with the corresponding code name and the total number (A = abundance) of each species. Calculate ($S \cdot V \cdot A$) and ($V \cdot A$) of each species and the Sum (Σ). (S) & (V) values for each species may be found in table I.

River ‘Syre’						
Diatom species name	CODE name	(A) Number of valves	(S)	(V)	($S \cdot V \cdot A$)	($V \cdot A$)
Sum (Σ)			----	----		

Pollution of the river ‘Syre’ :

IPS (1 - 20)	
Degree of biological quality	

River ‘Gander’						
Diatom species name	CODE name	(A) Number of valves	(S)	(V)	(S*V*A)	(V*A)
Sum (Σ)			---	---		

Pollution of the river ‘Gander’ :

IPS (1 - 20)	
Degree of biological quality	

Question 2A: Diatoms & technology (1 marks)

Alfred Bernhard Nobel (1833- 1896) was a famous swedish chemist, engineer and inventor. He used his fortune to posthumously institute the well known Nobel Prizes.

He used diatomaceous earth (fossilized remains of diatoms), a siliceous sedimentary rock for his most famous invention. Which of the following inventions made him famous and rich?

Cracking of petrol	
Photovoltaik cells	
Dynamite	
Window glass	
Quartz oscillators in watches	

TASK 3: SiO₂ IN SOLAR CELL TECHNOLOGY

Question 3A (5 marks)

Which of the following factors will reduce the solar efficiency of a solar module?

For every item tick the boxes “Yes” or “No”.

Items	Yes	No
Reducing N		
Increasing the contact grid area		
Part of the incoming light being reflected		
Choosing a solar cell material with lower quantum yield		
Increasing the energy of the photons (assume a invariant quantum yield)		
Increasing the dirt on the glass layer		
Thicker layer of n-type semi-conductor		
Thicker layer of p-type semi-conductor		
Choosing a very high load resistance		
Choosing a very low load resistance		

Task 3.1: Open-circuit voltage U_{oc} and short-circuit current intensity I_{sc} (2 marks)

Light source number	
Cell number	
Open-circuit voltage U_{oc}	
Short-circuit current intensity I_{sc}	

Task 3.2: Current – voltage and power – voltage characteristics (14 marks)

I	U	P

Maximum power point	I_m	U_m	P_m

Question 3B (2 marks)

The efficiency of your solar cells (see formula 1) at the maximum power point is roughly equal to 8%. What is the incident light power per surface unit?

Incident light power per surface unit (W/m^2)	
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Task 3.3: Combination of solar cells (6 marks)

Series combination	Cell number	I (mA)	U
First cell		40	
Second cell		40	
Cells in series		40	

Parallel combination	Cell number	I	U (V)
First cell			0,40
Second cell			0,40
Cells in parallel			0,40

Question 3C (4 marks)

- How many cells should you connect in series?
- How many of these series circuits should you connect in parallel?

Number of cells in series	
Number of series circuits in parallel	