3rd April 2014 – Task B

All about Salt Water

- Answer sheet -

Country and Team No. _____

Name _____**Signature**_____

Name _____**Signature**_____

Name _____**Signature**_____

TASK B1 - BIOLOGY

Task B.1.1 Optical Density (OD$_{750}$) measurements

7Marks

Measure optical density of the samples in the spectrophotometer and insert values for the 3 regions in Table 1.

Culture time (Days)	Sample	OD$_{750}$ Region A	Sample	OD$_{750}$ Region B	Sample	OD$_{750}$ Region C
0	1					
3	2		6		10	
6	3		7		11	
9	4		8		12	
12	5		9		13	

TABLE 1: OPTICAL DENSITY (OD$_{750}$) MEASUREMENTS

OD$_{750}$ of the unknown sample (sample 14)

Task B.1.2

Draw a graph of Optical Densities (OD$_{750}$) vs. Time (Days)

7Marks

Using the data in table 1, draw a graph on the graph paper provided. Based on your data for the three regions A, B and C, apply the line of best fit for each region and label accordingly (Region A, B and C).

Task B.1.3

Determine the region of the unknown sample (sample 14) and tick the appropriate box

2Marks

☐ **A**   ☐ **B**   ☐ **C**

Task B.1.4

Calculation of Dry Cell Weight (DCW) (mg L^{-1}) of the determined region of the unknown sample

2   Marks

Calibration curve equation (shown on the spectrophotometer)
Dry Cell Weight (DCW) (mg L^{-1}) = ……..**x**OD$_{750}$

Calculations

Culture time (Days)	OD$_{750}$	DCW (mg L^{-1})
0		
3		
6		
9		
12		

TABLE 2: DRY CELL WEIGHT FOR THE SAMPLES OF THE DETERMINED REGION (mg L^{-1})

Task B.1.5 Draw a graph of Dry Cell Weight (mg L^{-1}) vs. Time (Days)

3 Marks

Using the data in table 2, draw a graph on the graph paper provided. Apply the line of best fit derived from your data for the respective region of the unknown sample. Determine graphically the DCW of the unknown sample.

This is graph 2.

Task B.1.6

2Marks

A. Giventhat thealga*Nannochloropsis sp.*isabletoaccumulate 50% triglycerides initsdry biomass, calculate the concentration (mg L^{-1}) of triglyceridesof the twelfth day of maximum Dry Cell Biomass production.

Calculation

B. According to the reaction known as transesterification and considering that the conversion rate is 100%, each mole of triglyceride produces 3 moles of methyl esters (biodiesel). Calculate the dry weight (mg) of the methyl esters (biodiesel)

Calculation

QUESTIONS

1. Which region would you select to establish a microalgae biodiesel production unit? **1 Mark**

   a. Region A

   b. Region B

   c. Region C

2. Which criteria were taken into consideration? **1 Mark**

   a. your parents grew up in that area

   b. there are great CO_2 emissions released in that area

   c. there are low CO_2 emissions released in that area

   d. you know the mayor of that particular area

3. Which culture day would you choose to ensure maximum yield ?

1 Mark

a. 3rd

b. 12th

c. 9th

d. 6th

4. The blank sample that you used in the spectrophotometer contained:

1 Mark

a. Exactly what the other samples contain, but in significantly lower amounts

b. Everything that the other samples contain, except for the microalga

c. Microalga in sea water

d. Microalga in fresh water

5. Microalgae are photosynthetic organisms. It is known that 1.800 kg of CO_2 is absorbed for the production of 1 tone of biomass per year. According to international agreements, by the year 2020 every country is required to establish dry biomass units in order to reduce gas emmisions related to the greenhouse effect. In Greece, 12 units of the above mentioned capacity **(1 tone of biomass)** will be established near big industrial areas. What is the total amount of CO_2 that will be collectively absorbed?

1 Mark

calculations

6. What advantages and what disadvantages can you identify in the process of biodiesel production from microalgae? Add a '+' next to what you consider and advantage and a '-' next to what you consider a disadvantage.

2 Marks

a	Can be cultivated in seawater, brackish water, or waste water instead of fresh (drinking) water	
b	Do not compete for arable land with conventional agriculture species	
c	Microalgae have a high growth rate	
d	Anopenculture of microalgae can be infected and crash	
e	Contributes to the reduction of CO_2 concentration which is a greenhouse gas	
f	Anopencultureofmicroalgaeissensitiveto weather changes	
g	Microalgae dry biomass contains high percentage of triglycerides	
h	It is derived from biomass therefore is renewable bio gradable and quasi-carbon neutral under sustainable production	
i	The biochemical composition of the algal biomass can easily be modulated by varying growth conditions resulting in higher oil content	
j	It is not toxic and contains reduced levels of particulates CO ,soot, hydrocarbons and SO_X	

OK! YOU HAVE NOW COMPLETED TASK B1

Task B2.1 Chemistry Answer sheet

Inthefollowingquestions, circlethecorrectanswerorfillintheblankas needed. There is only one correct answer.

Che 1. Is the experimental setup according to instructions given in 2.3?

5 Marks

a) Yes

b) No

(Note: The Lab supervisor will check out your answer and sign next to it)

Che2. Write the equation for the reaction thatoccurswhenconcentrated H_2SO_4 is added to NaCl?

2 Marks

………

Che3. Inthechemical reaction with NaCl, concentrated$H_2SO_4$is used instead of diluteH_2SO_4 because:

2 Marks

a) concentratedH_2SO_4isastronger acid than dilute.

b) concentratedH_2SO_4 increases the rate and the yield of the reaction

c) concentratedH_2SO_4 is a strong oxidizing agent while the diluted one is not.

d)if the diluted acid was used, a bigger volume would be needed and as such, a bigger round bottom flask **(A)**.

Che4. Which is the gas produced in beaker (G) in the form of bubbles? ....

2 Marks

Che5.Determine the mass (x= ?)of purifiedNaCl required to be added in 15 mL of distilled water in order to produce a saturated solution.

x= .... g

2 Marks

Che 6. Which test tube has a less cloudy solution after the addition of $BaCl_2$?

3 Marks

a) Test tube 1

b) Test tube 2

(Note. The lab supervisor will check out your answer and will sign next to it.)

Che7. Write the chemical equation for the reaction that may be taking place whenBaCl$_2$(aq) is added to test tubes 1 and 2:

2 Marks

……

Che 8. If the sample produced does not have a satisfactory degree of purity what would you propose to do in order to increase it?

1 Marks

a) Repeat the procedure using a supersaturated solution of NaCl.

b) Use an electrolytic method of purification.

c) Repeat the experiment with a saturated solution of the purified NaCl.

d) AddtheconcentratedH$_2$SO$_4$directly to the saturatedNaCl solution.

Che9.The experimental method you used for the purification of NaCl is based on:

1 Marks

a) the difference in volatility of the impurities compared to that of pure NaCl.

b) thedifferenceinsolubilityof the impurities compared to that of pure NaCl.

c) the difference in melting or boiling point of the impurities compared to those of pure NaCl.

d) the difference in chemical reactivity of the impurities compared to those of pure NaCl

Che10.ThisexperimentalmethodofpurificationofNaClisnotusedinindustrybecause:

1 Marks

a) the yield is small.

b) the cost is high.

c) NaCl does not need so high purification.

d) it requires a lot of glassware which makes it "fragile".

Che11.The solubility of NaCl in water is 36 g /100 gH_2O at 25 °C. A solution is made by adding 100 g of NaCl to 300 g of water at 25 °C.Which of the following statement(s) regarding the above solution is/are correct?

2 Marks

i)   No more salt can be dissolved, as the made solution is saturated.

ii) If one adds 10 g of salt to the solution, crystals of NaClwill appear at the bottom of the beaker.

iii)   If one adds an extra 5 g of salt, the solution will become saturated.

Che12. Can you follow the same procedure given in this experiment for the purification of NaI;

2 Marks

a) YES because the reaction between NaI and concentrated H_2SO_4 is:

………………………………………………………………………………………………………..

b) NO because the reaction between NaI and concentrated H_2SO_4 is:

………………………………………………………………………………………………………..

TASK B2.2 Chemistry Answer Sheet

Inthefollowingquestions, circlethecorrectanswerorfillintheblankas needed. There is only one correct answer.

Che 13. What is formed when **KI(*aq*)** is added to **solution A**?   1 Mark

      a) H_2
      b) Cl_2
      c) I_2
      d) O_2

Che 14. Write the chemical equation for the reaction that occurs: 2 Marks

…………………………………………………………………………..............................

Che 15. With which of the following can you identify the element produced during this reaction?   1.5 Marks

      a) piece of bread

      b) phenolphthalein

      c) NaCl

      d) KI

Che 16. Which of the following is formed at the **anode**?   1 Mark

      a) H_2
      b) Cl_2
      c) Na
      d) O_2

Che 17. Write the half equation for the reaction that occurs at the **anode:**1 Mark

…………………………………………………………………………….......................

Che 18. The above reaction represents: 1 Mark

      a)oxidation

      b) reduction

      c) neutralization

      d) single displacement

Che 19. Which of the following is formed at the **cathode?**   1 Mark

   a) H_2

   b) Cl_2

   c) Na

   d) O_2

Che 20. Solution C is**:**   1.5 Marks

   a) acidic

   b) basic

   c) neutral

Che 21. Write the half equation for the reaction that occurs at the **cathode**:2 Marks

……..

Che 22. The above reaction represents: 1   Mark

   a)oxidation

   b) reduction

   c) neutralization

   d) single displacement

Che 23. If you carry out electrolysis using as electrolyte NaOH*(l)* instead of NaCl*(aq):*

a) NO extra safety precautions should be taken compared to NaCl(*aq*)electrolysis because similar reactions are taken place

b) YES extra safety precautions should be taken because this reaction takes place

……
                                                                          2 Marks

TASK B3 - PHYSICS

Experimental procedure

Please be careful and follow the instructions

Task 1 to 5

Draw and build the circuit:3 marks.

Total: 2+3marks

[Thesupervisor signs the circuit diagram above and checks: a) the circuit (b) theplacementofthe solutionsasdefinedinthetext, (c) the correctsetupoftheelectrodesinto the test-tube containing the solution, (d) theadjustment of voltage and frequency of the generator]

FilltableA.

TABLE A			
ρ_A / (g / 100 mL)	V / V	I / mA	G / mS
2.0			
3.0			
4.0			
5.0			
6.0			

Total: 6marks

Data processing and evaluation

Task 1

Plot the graph.

Total: 7marks

Task 2

Usingthegraph, determinetheconstants λ and G_0

Calculations:

_____

_____

_____

$\lambda = $ _____

$G_0 = $ _____

Total: 6marks

Task 3

Experimentallydeterminetheconcentrationinsodiumchlorideofthegiven solution (solutionX)..

Experimentally determine conductivity G_X of solution X:

$G_X = $ _____

Determinethe massconcentration of solution X.

_____

_____

_____

$\rho_X = $ _____

Total: 6marks

Totalforthe 2nd task in Physics: 30 marks