IJSO 2019 DOHA, QATAR

16th International Junior Science Olympiad

Practical Exam

ANSWER SHEET

DECEMBER 9th, 2019

Country			
	Student 1	Student 2	Student 3
Name			
Code			
Signature			

Task 1:

Identification of Contaminated Water Samples

Part-A	Record the obtained colour in the Table below (Table 1) by putting a check mark (√) in the corresponding column.
Lugol's Test Points: (0.75 pt.)	

Table 1. Data obtained from Lugol's test.

Observed colour	Sample (BIOL-A)	Sample (BIOL-B)	Sample (BIOL-C)	Sample (BIOL-D)
Yellowish brown				
Bluish black				

Part-B	Record the obtained colour in the Table below (Table 2) by putting a check mark (√) in the corresponding column.
Biuret Test Points: (0.75 pt.)	

Table 2. Data obtained from Biuret test.

Observed colour	Sample (BIOL-A)	Sample (BIOL-B)	Sample (BIOL-C)	Sample (BIOL-D)
Violet				
Blue				

Part-C

1. **Observe the slides under the microscope; draw one cell per sample that you see in each slide, title each drawing with the appropriate sample name.**

Provide a fully labelled biological drawing, including the magnification (for both of the slides) as well as to include the following key in either of the slides.

W	**Cell wall**
X	**Nucleus**
Y	**Central Vacuole**
Z	**Plasma membrane**

Points: (8 pts.)	
Points: Total 2.0 pts	**2- Identify the water samples, by putting a check mark (√) in the corresponding column in front of the appropriate sample name.**

	BIOL-A	BIOL-B	BIOL-C	BIOL-D
Desalinated water				
Seawater				
Water contaminated with albumin				
Water contaminated with starch				

Points: 0.50 pt	**3- Onion cells in desalinated water may be described as …… (Please circle only one correct option)** I. Turgid II. Flaccid III. Plasmolyzed IV. None of the above is correct
Points: 0.50 pt	**4- Blood cells do not have the same structure as plant cells. What do you think could happen to a blood cell in a desalinated water sample after 30 minutes? (Please circle only one correct option)** I. Becomes plasmolysed II. Shrinks III. Remains the same IV. Undergoes hemolysis

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Total points for TASK ONE	
Signature	**Scorer:**
	Reviewer:
	Table leader:

Task 2:

Further Validation of Water Samples' Salinity Using Physics Approaches

First Method (Optics)	Record your measurements in Table 3
Points: 3.25 pts	

Table 3. Data and calculations.

Measured distances (cm)	Trial 1	Trial 2	Trial 3	Mean ± uncertainty
For empty concave mirror (PR)				
For PHYS-A- filled mirror ($SR^{\backslash}$)				
For PHYS-B- filled mirror ($SR^{\backslash}$)				

Points: 0.50 pt

A. Find the focal length (f) of the concave mirror you used in this experiment.

$f \pm \Delta f =$

Points: 0.50 pt

B. Determine the refractive index of sample PHYS-A with respect to the air in the form (n_A), where n_A symbolizes the refractive index of sample PHYS-A. Show your calculations

Points: 0.50 pt

C. Determine the refractive index of sample PHYS-B with respect to the air in the form (n_B), where n_B symbolizes the refractive index of the sample PHYS-B. Show your calculations.

	D. Based on your findings from the above method (Optics), identify the identity of samples PHYS-A and PHYS-B. Circle the right answer in each case. PHYS-A: Seawater/ desalinated water PHYS-B: Seawater/ desalinated water

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Total points for optics.	
Signature	**Scorer:**
	Reviewer:
	Table leader:

Record your measurements in Table 4

Table 4. Data collection sheet.

Time (s)	Temp (^{O}C) for PHYS-A	Temp (^{O}C) for PHYS-B	Energy transferred (J)

(Second Method (Thermodynamics):	
Points: 1.75 pts	A. Plot (on the same graph) the measured temperature (T) against time (t) for both samples.
Points: 1.0 Pt	B. From the graphs, deduce the gradients and intercepts of the initial straight-line portion on the T-axis. $Slope_A$ = $Slope_B$ = $Intercept_A$ = $Intercept_B$ = **Note:** *A denotes sample* PHYS-A and *B denotes* PHYS-*B.*
Points: 0.50 pt	C. Write an equation that describes how temperature varies with time before the boiling point is reached.
Points: 1 pt	D. From your graphs deduce the boiling point, $T_{(boil)}$ of sample PHYS-A and sample PHYS-B. $T_{(boil)}$ of sample PHYS-A: $T_{(boil)}$ of sample PHYS-B:
Points: 1.75 pts	E. Plot on another graph paper the measured temperature (T) against energy transferred (Q) for both samples. Use the graph paper provided and insert in the yellow answer sheet.

Points: 0.50 pt	F. What does the gradient of the initial straight-line portion of each plot (drawn in the previous question) relate to? Circle the correct answer I. mc II. $\frac{1}{mc}$ III. c IV. $\frac{1}{c}$
Points: 0.75 pt	G. Using your measured data, deduce the specific heat capacity, C, for samples PHYS-A and PHYS-B. Give your answer with the appropriate units. - the specific heat capacity, c, for sample PHYS-A. - the specific heat capacity, c, for sample PHYS-B.
Points: 1.0 pt	H. Based on your findings from the above method (thermodynamics), confirm the correct identity of samples PHYS-A and PHYS-B. Put a check mark (√) in front of the correct choice.

	Method 1 (Optics)		Method 2 (Thermodynamics)	
Seawater	PHYS-A	PHYS-B	PHYS-A	PHYS-B
Desalinated water	PHYS-A	PHYS-B	PHYS-A	PHYS-B

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Total points for thermodynamics.	
Total points for TASK TWO	
Signature	Scorer:
	Reviewer:
	Table leader:

Task 3: Chemistry - Determination of Water Hardness

Chemistry Question	Record your measurements in Table 6:
Points 2.25 pts	

Table 6. Determination of total hardness of water sample # CHEM-A.

	Trial 1	Trial 2	Trial 3
Volume of water sample (mL)			
Initial volume of EDTA solution (V_i, mL)			
Final volume of EDTA solution (V_f, mL)			
Change in the volume of EDTA solution (ΔV, mL)			

Points: 0.25 pt	A. Calculate the average volume of EDTA solution (mL) used. Average volume of EDTA solution used (mL) =
Points: 0.50 pt (5 pts for precision and 5 pts for accuracy) **Total 10.50 pts**	B. Calculate the % relative standard deviation (%RSD) for the volume of EDTA solution (mL) recorded in Table 6, knowing that *%RSD = **(S*100)/average.*** Report your answer as Average ± %RSD.

Points: 1.25 pts	C. Using the **average** volume of EDTA solution you reported in Table 6, calculate the hardness of Sample CHEM-A. Show detailed calculations in the space provided below: C1. Moles of EDTA = C2. Moles of Ca^{2+} in the sample = C3. Moles of Ca^{2+} per litre = C4. Mass (g) of $CaCO_3$ in 1 litre = C5. Water Hardness (ppm) using the formula under the Principle section =

Points: 0.25 pts	D. Using the water hardness scale in Table 5, identify the type of water – Sample CHEM-A. Tick the appropriate box. ☐ Soft ☐ Moderately soft ☐ Slightly hard ☐ Moderately hard ☐ Hard ☐ Very hard

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Total points for TASK THREE	
Signature	Scorer:
	Reviewer:
	Table leader:

	Student 1	Student 2	Student 3
Name			
Signature			