

# FOR SUBMIT



**11<sup>th</sup> International Junior Science Olympiad**

**Experimental Test: Answer Sheet**

**December 8<sup>th</sup>, 2014**



Experimental test: Answer Sheet

|                   |  |
|-------------------|--|
| GROUP CODE        |  |
| PARTICIPANT CODES |  |
|                   |  |
|                   |  |

11<sup>th</sup> International Junior Science Olympiad,  
Mendoza, Argentina

Time : 4 hrs  
Marks : 40

## Experimental Test: Answer Sheet December 8<sup>th</sup>, 2014

**Time: 4 hrs**

**Marks: 40** [Section 1: 25.0 Marks, Section 2: 15.0 Marks]

---

**Complete the following:**

|           |                                  |
|-----------|----------------------------------|
| NAME:     | 1. _____<br>2. _____<br>3. _____ |
| SEAT N°:  |                                  |
| COUNTRY:  |                                  |
| SIGNATURE | 1. _____<br>2. _____<br>3. _____ |



|                   |  |
|-------------------|--|
| GROUP CODE        |  |
| PARTICIPANT CODES |  |
|                   |  |
|                   |  |

Experimental test: Answer Sheet

## Experimental Tasks

### SECTION 1: ALCOHOLIC FERMENTATION [25.0 Marks]

#### D. Recording experimental data of fermentation.

D.3.

**Table 1.1: Recording fermentation data [8.5 Marks=7.0 (Record data) + 1.5 (Flow calculation)]**

| Initial temperature of warm water for preparing suspension A and solution B: |  |                        |
|--|--|------------------------|
| Initial Temperature of suspension A+B (inside reaction flask):               |  |                        |
| Time [min]   | Accumulated gas volume $V_a(t)$ ; [ml] | Flow $F(t)$ , [ml/min] |
| 0  |  |                        |
| 2  |  |                        |
| 4  |  |                        |
| 6  |  |                        |
| 8  |  |                        |
| 10   |  |                        |
| 12   |  |                        |
| 14   |  |                        |
| 16   |  |                        |
| 18   |  |                        |
| 20   |  |                        |
| 22   |  |                        |
| 24   |  |                        |
| 26   |  |                        |
| 28   |  |                        |
| 30   |  |                        |
| 32   |  |                        |
| 34   |  |                        |
| 36   |  |                        |
| 38   |  |                        |
| 40   |  |                        |



Experimental test: Answer Sheet

|                   |  |
|-------------------|--|
| GROUP CODE        |  |
| PARTICIPANT CODES |  |
|                   |  |
|                   |  |

11<sup>th</sup> International Junior Science Olympiad,  
Mendoza, Argentina

Time : 4 hrs  
Marks : 40

**E. Recording Experimental data of fermentation reactivation** [2.5 Marks=2.0 (Record data) +0.5 (Flow calculation)]

**E.7. TABLE 1.2.**

| Time [min] | Accumulated gas volume $V_a(t)$ ; [ml] | Flow $F(t)$ , [ml/min] |
|------------|--|------------------------|
| 42         |  |                        |
| 44         |  |                        |
| 46         |  |                        |
| 48         |  |                        |
| 50         |  |                        |

**F. Identification of the gaseous product**

F.1 Reaction with  $\text{Ca}(\text{OH})_2$ .

F.1.3. Choose the correct answer by ticking the appropriate box. [0.5 Marks]

- White precipitate is observed
- Black precipitate is observed
- Precipitate is not observed

|                          |
|--------------------------|
| <input type="checkbox"/> |
| <input type="checkbox"/> |
| <input type="checkbox"/> |

F.1.4. Formulate stoichiometric equation of reaction [0.5 Marks]

|  |
|--|
| <br><br><br><br><br><br><br><br><br><br> |
|--|



|                   |  |
|-------------------|--|
| GROUP CODE        |  |
| PARTICIPANT CODES |  |
|                   |  |
|                   |  |

Experimental test: Answer Sheet

F.2.Reaction with bromthymol blue indicator

F.2.2.1.. Choose the correct answer by ticking the appropriate box. [0.2 Marks]

- Yellow color is observed
- Blue color is observed
- Red color is observed
- White color is observed

|  |
|--|
|  |
|  |
|  |
|  |

F.2.2.2. What can you deduce from the observation of the bromothymol blue solution? (Mark the correct answer). [0.2 Marks]

- An increase in pH
- A decrease in pH
- No change in pH

|  |
|--|
|  |
|  |
|  |

F.2.2.3. Formulate and balance the dissociation equation of CO<sub>2</sub> dissolved in water, which explain the pH change in the indicator solution [0.6 Marks]

|  |
|--|
|  |
|--|



Experimental test: Answer Sheet

|                   |  |
|-------------------|--|
| GROUP CODE        |  |
| PARTICIPANT CODES |  |
|                   |  |
|                   |  |

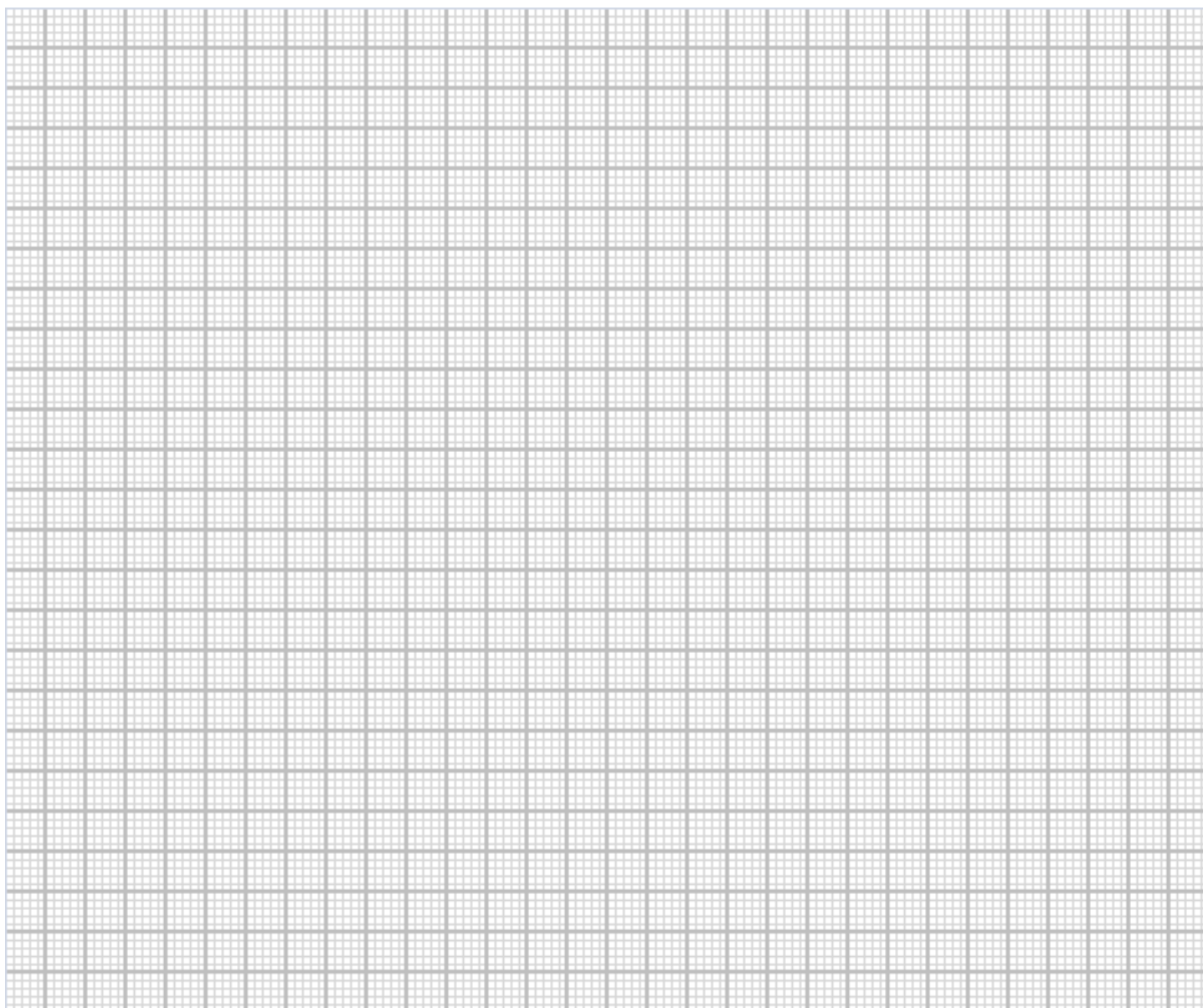
11<sup>th</sup> International Junior Science Olympiad,  
Mendoza, Argentina

Time : 4 hrs  
Marks : 40

### G. Data processing and analysis

G.2. Plot the data of Table 1.1. and Table 1.2. [2.5 Marks]

G.2.1.: **GRAPH A:** Accumulated gas volume  $V_a(t)$ ; [ml] vs. Fermentation time [min].





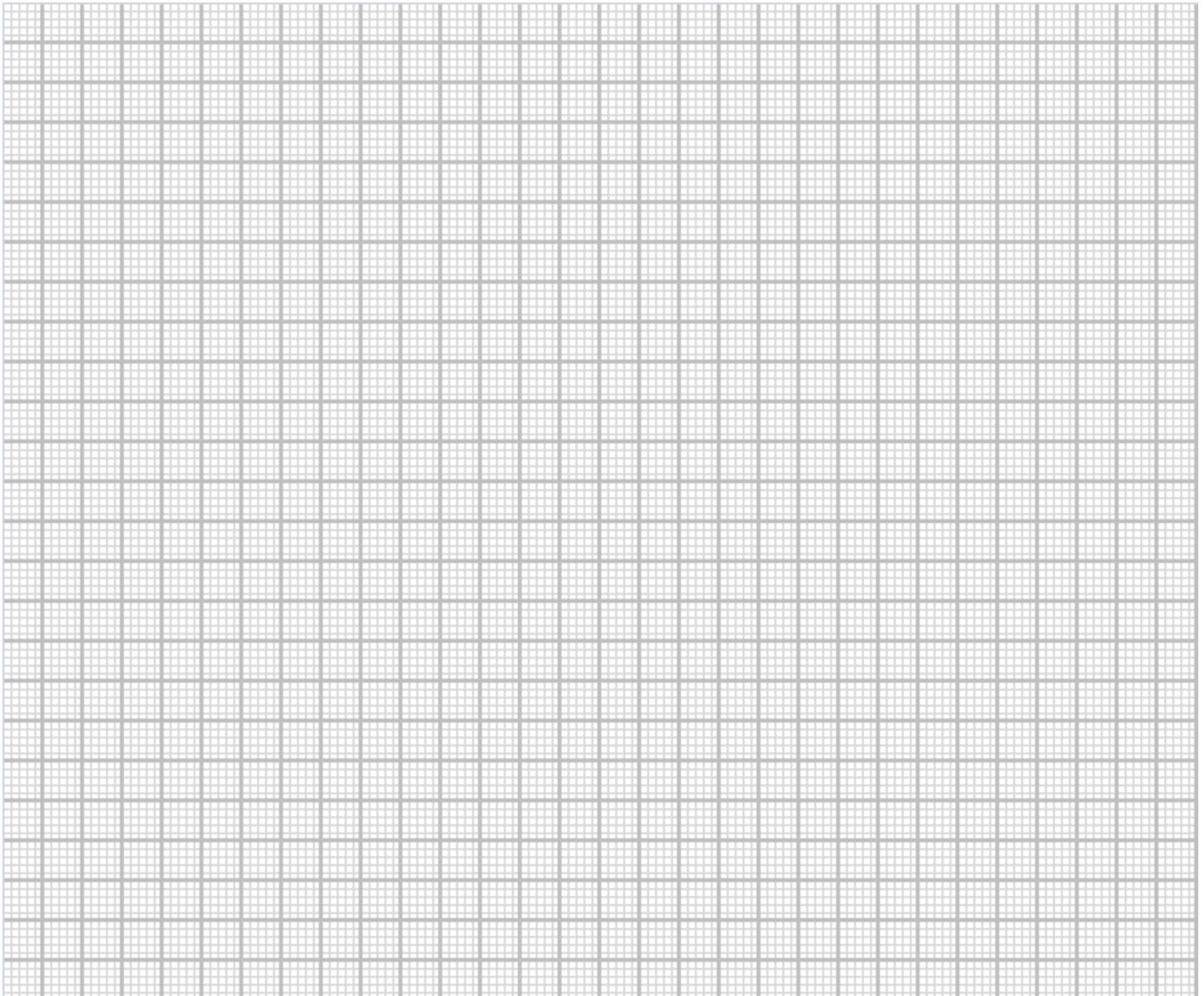
Experimental test: Answer Sheet

|                   |  |
|-------------------|--|
| GROUP CODE        |  |
| PARTICIPANT CODES |  |
|                   |  |
|                   |  |

11<sup>th</sup> International Junior Science Olympiad,  
Mendoza, Argentina

Time : 4 hrs  
Marks : 40

**G.2.2. GRAPH B:**  $F(t)$ ; [ml/min] vs. Fermentation time [min]. [1.8 Marks=1.5 Marks (plotting data) + 0.3 identify fermentation stages]





Experimental test: Answer Sheet

|                   |  |
|-------------------|--|
| GROUP CODE        |  |
| PARTICIPANT CODES |  |
|                   |  |
|                   |  |

11<sup>th</sup> International Junior Science Olympiad,  
Mendoza, Argentina

Time : 4 hrs  
Marks : 40

**G.3.1.** Amount (in grams) of metabolized glucose at t=40 min. [1.0 Marks]

**Resolution**

**Answer**







Experimental test: Answer Sheet

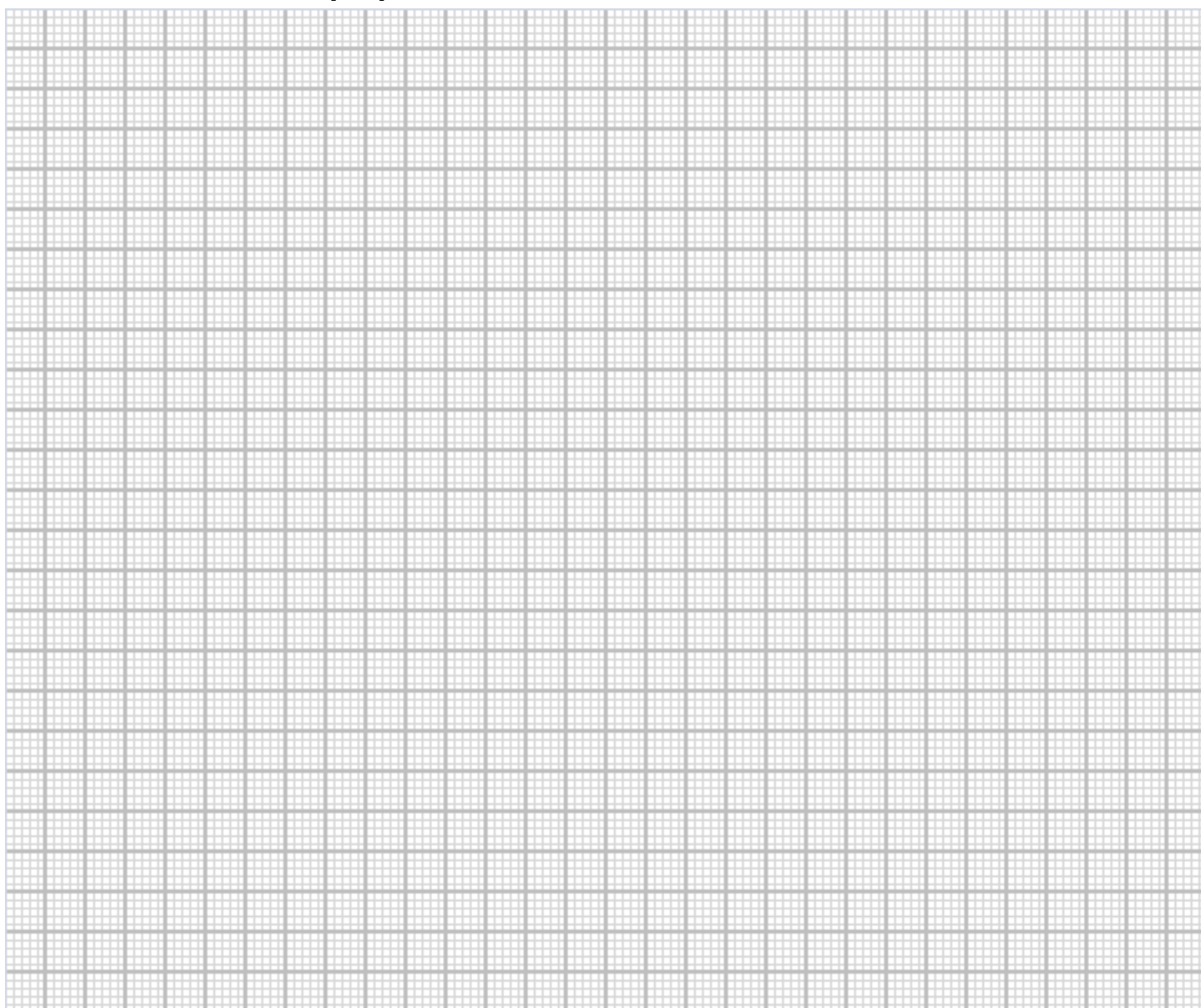
|                   |  |
|-------------------|--|
| GROUP CODE        |  |
| PARTICIPANT CODES |  |
|                   |  |
|                   |  |

11<sup>th</sup> International Junior Science Olympiad,  
Mendoza, Argentina

Time : 4 hrs  
Marks : 40

**G.3.2.3.** Plot the data of Table 2.1 [1.0 Marks]

**GRAPH C:** ln F vs. time [min]



**G.3.2.4.** Draw a straight line that best fits the data points of **GRAPH C.** [1.0 Marks]



Experimental test: Answer Sheet

|                   |  |
|-------------------|--|
| GROUP CODE        |  |
| PARTICIPANT CODES |  |
|                   |  |
|                   |  |

11<sup>th</sup> International Junior Science Olympiad,  
Mendoza, Argentina

Time : 4 hrs  
Marks : 40

### G.3.2.5. Data fitting

Calculation of the slope of the calibration curve (A) [0.3 Marks]

**Resolution**

**Answer**

Calculation of the intercept of the calibration curve (B) [0.3 Marks]

**Resolution**

**Answer**



Experimental test: Answer Sheet

|                   |  |
|-------------------|--|
| GROUP CODE        |  |
| PARTICIPANT CODES |  |
|                   |  |
|                   |  |

11<sup>th</sup> International Junior Science Olympiad,  
Mendoza, Argentina

Time : 4 hrs  
Marks : 40

**Table 2.2:** Linear equation of calibration curve

|                 |  |
|-----------------|--|
| Linear equation |  |
| Slope(A)        |  |
| Intercept (B)   |  |

[0.1 Marks for equation]

**G.3.2.6.** Hypothetical volume ( $V_h$ ) of fermentation. [0.2 Marks]

|                   |  |
|-------------------|--|
| <b>Resolution</b> |  |
| <b>Answer</b>     |  |



Experimental test: Answer Sheet

|                   |  |
|-------------------|--|
| GROUP CODE        |  |
| PARTICIPANT CODES |  |
|                   |  |
|                   |  |

11<sup>th</sup> International Junior Science Olympiad,  
Mendoza, Argentina

Time : 4 hrs  
Marks : 40

**G.3.2.7.** Mass of glucose that corresponds to the volume  $V_h$  of  $\text{CO}_2$  [0.4 Marks]

|                   |  |
|-------------------|--|
| <b>Resolution</b> |  |
| <b>Answer</b>     |  |



Experimental test: Answer Sheet

|                   |  |
|-------------------|--|
| GROUP CODE        |  |
| PARTICIPANT CODES |  |
|                   |  |
|                   |  |

11<sup>th</sup> International Junior Science Olympiad,  
Mendoza, Argentina

Time : 4 hrs  
Marks : 40

**G.3.2.8. Total Mass of Glucose fermented during the 40 min fermentation [0.2 Marks]**

**Resolution**

**Answer**

**G.3.2.9. Total Mass of CO<sub>2</sub> produced by the glucose consumed [0.4 Marks]**

**Resolution**

**Answer**



Experimental test: Answer Sheet

|                   |  |
|-------------------|--|
| GROUP CODE        |  |
| PARTICIPANT CODES |  |
|                   |  |
|                   |  |

11<sup>th</sup> International Junior Science Olympiad,  
Mendoza, Argentina

Time : 4 hrs  
Marks : 40

**G.3.2.10.** Mass of CO<sub>2</sub> released to the graduated cylinder during the 40 min fermentation [ 0.4 Marks]

**Resolution**

**Answer**

**G.3.2.11.** Mass of CO<sub>2</sub> dissolved in the reaction flask. [0.2 Marks]

**Resolution**

**Answer**



Experimental test: Answer Sheet

|                   |  |
|-------------------|--|
| GROUP CODE        |  |
| PARTICIPANT CODES |  |
|                   |  |
|                   |  |

11<sup>th</sup> International Junior Science Olympiad,  
Mendoza, Argentina

Time : 4 hrs  
Marks : 40

**G.3.2.12.** Solubility of CO<sub>2</sub> (g/L) in the reaction flask. [0.3 marks]

**Resolution**

**Answer**

**G.3.3.** Moles of ethanol produced at t=40 min. [0.4 Marks]

**Resolution**

**Answer**





Experimental test: Answer Sheet

|                   |  |
|-------------------|--|
| GROUP CODE        |  |
| PARTICIPANT CODES |  |
|                   |  |
|                   |  |

11<sup>th</sup> International Junior Science Olympiad,  
Mendoza, Argentina

Time : 4 hrs  
Marks : 40

**G.3.4.** Concentration of ethanol ( % w/v) produced at t=40 min. [0.5 Marks]

**Resolution**

**Answer**

**G.3.5.** Justification of the fermentation process stopping. Choose the primary reason by ticking the appropriate box. Consider alcohol concentration calculated previously (G.3.4) , and toxic concentration threshold for yeast, which is 14 g/100 ml (w/v). [0.5 Marks]

- a. Death yeast
- b. Inhibition of yeast due to the concentration of alcohol.
- c. Shortage of fermentable substrate

|  |
|--|
|  |
|  |
|  |



|                   |  |
|-------------------|--|
| GROUP CODE        |  |
| PARTICIPANT CODES |  |
|                   |  |
|                   |  |

11<sup>th</sup> International Junior Science Olympiad,  
Mendoza, Argentina

Time : 4 hrs  
Marks : 40

Experimental test: Answer Sheet

## SECTION 2: REFRACTOMETRIC DETERMINATION OF SUCROSE CONCENTRATION [15.0 Marks]

---

### B. PREPARATION OF CALIBRATION CURVE

B.1. Preparation of standard solutions of different concentration

B.1.1. Calculation of sucrose solution volume (62.5 g/100 ml) for preparation of standard solutions. [1.2 Marks]

**Solution A**

**Answer**



|                   |  |
|-------------------|--|
| GROUP CODE        |  |
| PARTICIPANT CODES |  |
|                   |  |
|                   |  |

11<sup>th</sup> International Junior Science Olympiad,  
Mendoza, Argentina

Time : 4 hrs  
Marks : 40

Experimental test: Answer Sheet

**Solution B.**

**Answer**



|                   |  |
|-------------------|--|
| GROUP CODE        |  |
| PARTICIPANT CODES |  |
|                   |  |
|                   |  |

11<sup>th</sup> International Junior Science Olympiad,  
Mendoza, Argentina

Time : 4 hrs  
Marks : 40

Experimental test: Answer Sheet

## Solution C

Answer



|                   |  |
|-------------------|--|
| GROUP CODE        |  |
| PARTICIPANT CODES |  |
|                   |  |
|                   |  |

11<sup>th</sup> International Junior Science Olympiad,  
Mendoza, Argentina

Time : 4 hrs  
Marks : 40

Experimental test: Answer Sheet

**olution D**

**Answer**



Experimental test: Answer Sheet

|                   |  |
|-------------------|--|
| GROUP CODE        |  |
| PARTICIPANT CODES |  |
|                   |  |
|                   |  |

11<sup>th</sup> International Junior Science Olympiad,  
Mendoza, Argentina

Time : 4 hrs  
Marks : 40

## Solution E

Answer



Experimental test: Answer Sheet

|                   |  |
|-------------------|--|
| GROUP CODE        |  |
| PARTICIPANT CODES |  |
|                   |  |
|                   |  |

11<sup>th</sup> International Junior Science Olympiad,  
Mendoza, Argentina

Time : 4 hrs  
Marks : 40

**Table 3.1:** Summary of standard solutions data

| Solution identification | Initial Concentration [g/100 ml] | Initial Volume [ml] | Final Concentration [g/100 ml] | Final Volume [ml] |
|-------------------------|----------------------------------|---------------------|--------------------------------|-------------------|
| A                       | 62.5                             |                     | 5                              | 50                |
| B                       | 62.5                             |                     | 10                             | 50                |
| C                       | 62.5                             |                     | 15                             | 50                |
| D                       | 62.5                             |                     | 20                             | 50                |
| E                       | 62.5                             |                     | 25                             | 50                |

**B.2.5.3.**

**Table 3.2:** Calibration curve data [4.0 Marks]

| Solution Name | Sucrose Concentration [g/100 ml] | Laser beam deviation from the zero point [mm] |
|---------------|----------------------------------|---|
| Water         | 0                                | 0   |
| A             | 5                                |   |
| B             | 10                               |   |
| C             | 15                               |   |
| D             | 20                               |   |
| E             | 25                               |   |



|                   |  |
|-------------------|--|
| GROUP CODE        |  |
| PARTICIPANT CODES |  |
|                   |  |
|                   |  |

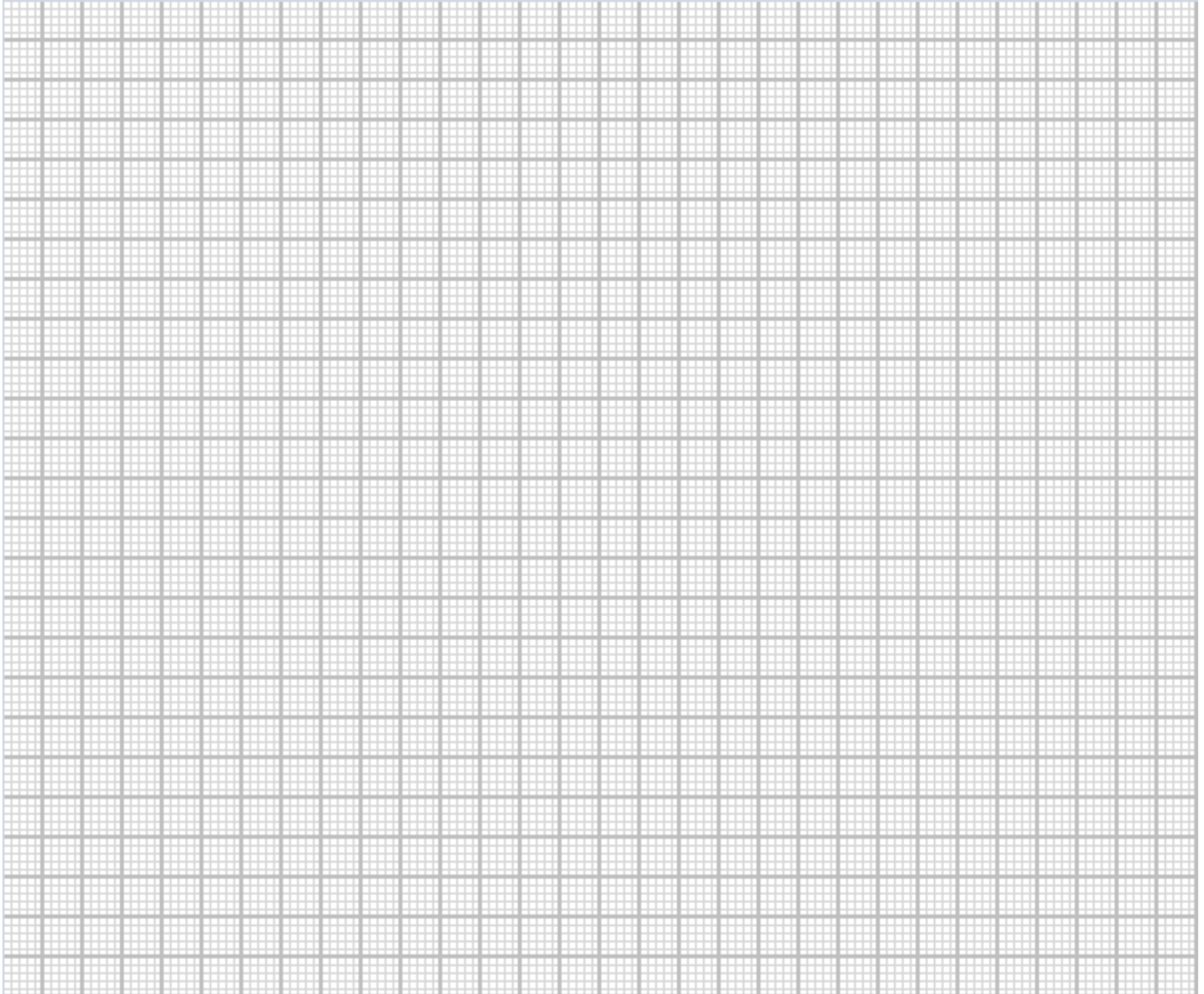
11<sup>th</sup> International Junior Science Olympiad,  
Mendoza, Argentina

Time : 4 hrs  
Marks : 40

Experimental test: Answer Sheet

### B.3: Calibration curve

**GRAPH D:** Laser beam deviation from the zero point[mm] vs. Sucrose concentration [g/100 ml] [3.0 Marks]







|                   |  |
|-------------------|--|
| GROUP CODE        |  |
| PARTICIPANT CODES |  |
|                   |  |
|                   |  |

Experimental test: Answer Sheet

### B.3.3: Data fitting [0.9 Marks]

#### Calculation of the slope of the calibration curve (A)

|        |
|--------|
|        |
| Answer |

**Table 3.3:** Linear equation of calibration curve

|                 |  |
|-----------------|--|
| Linear Equation |  |
| Slope           |  |
| Intercept       |  |

### C. Samples analysis

#### C.1.7. Data of samples with unknown sugar concentration

**Table 3.4:** Data of analyzed samples [2.1 Marks]

| Unknown Samples | Millimeters deviation [mm] |
|-----------------|----------------------------|
| ID # X          |                            |
| ID # XI         |                            |
| ID # XII        |                            |



Experimental test: Answer Sheet

|                   |  |
|-------------------|--|
| GROUP CODE        |  |
| PARTICIPANT CODES |  |
|                   |  |
|                   |  |

11<sup>th</sup> International Junior Science Olympiad,  
Mendoza, Argentina

Time : 4 hrs  
Marks : 40

## C.2. Determine the sucrose concentration of the samples [2.3 Marks]

Table 3.5. Graphical and analytical determination of sucrose concentration in analyzed samples

| Unknown Samples | Sucrose concentration <u>graphically obtained</u> [g/100 ml] | Sucrose concentration <u>analytically obtained</u> [g/100 ml] | Concentration Difference [%] |
|-----------------|--|---|------------------------------|
| ID # X          |  |   |                              |
| ID # XI         |  |   |                              |
| ID # XII        |  |   |                              |

### C.2.2. Analytical determination

Resolution ID# X

Answer



|                   |  |
|-------------------|--|
| GROUP CODE        |  |
| PARTICIPANT CODES |  |
|                   |  |
|                   |  |

11<sup>th</sup> International Junior Science Olympiad,  
Mendoza, Argentina

Time : 4 hrs  
Marks : 40

Experimental test: Answer Sheet

**Resolution ID# XI**

**Answer**

**Resolution ID# XII**

**Answer**



|                   |  |
|-------------------|--|
| GROUP CODE        |  |
| PARTICIPANT CODES |  |
|                   |  |
|                   |  |

11<sup>th</sup> International Junior Science Olympiad,  
Mendoza, Argentina

Time : 4 hrs  
Marks : 40

Experimental test: Answer Sheet

### C.2.3. Calculation of the percentage difference [D(%)]

**Resolution ID# X**

**Answer**

**Resolution ID# XI**

**Answer**



Experimental test: Answer Sheet

|                   |  |
|-------------------|--|
| GROUP CODE        |  |
| PARTICIPANT CODES |  |
|                   |  |
|                   |  |

11<sup>th</sup> International Junior Science Olympiad,  
Mendoza, Argentina

Time : 4 hrs  
Marks : 40

Resolution ID# XII

Answer

**D: Additional calculations and data analysis of samples XI and XII**

**D.1:** Sucrose concentration in original honey sample [0.3 Marks]

**Table 3.6.**

| Unknown Samples | Sucrose original concentration in honey [°Brix] |
|-----------------|---|
| ID # XI         |   |



|                   |  |
|-------------------|--|
| GROUP CODE        |  |
| PARTICIPANT CODES |  |
|                   |  |
|                   |  |

11<sup>th</sup> International Junior Science Olympiad,  
Mendoza, Argentina

Time : 4 hrs  
Marks : 40

Experimental test: Answer Sheet

### D.1. Calculation of original sucrose concentration of honey sample

**Resolution**

**Answer**

### D.2. Safe preservation of honey

**Table 3.7.** [0.2 Marks]

| SAFE | NOT SAFE |
|------|----------|
|      |          |

### D.3: Theoretical calculations [0.5 Marks]



Experimental test: Answer Sheet

|                   |  |
|-------------------|--|
| GROUP CODE        |  |
| PARTICIPANT CODES |  |
|                   |  |
|                   |  |

11<sup>th</sup> International Junior Science Olympiad,  
Mendoza, Argentina

Time : 4 hrs  
Marks : 40

## Resolution

Answer

**Table 3.8.:** Theoretical deviation of the laser beam [mm] for a solution  
8.5g/100 ml sucrose concentration

| Calculation | Theoretical deviation of the laser beam<br>[mm] |
|-------------|---|
| Analytical  |   |
| Graphical   |   |



|                   |  |
|-------------------|--|
| GROUP CODE        |  |
| PARTICIPANT CODES |  |
|                   |  |
|                   |  |

11<sup>th</sup> International Junior Science Olympiad,  
Mendoza, Argentina

Time : 4 hrs  
Marks : 40

Experimental test: Answer Sheet

D.4. Sucrose concentration found in the analysed beverage. [0.5 Marks]

**Resolution**

---

**Answer**

---

**Table 3.9.:** Analysed beverage specification according to the statement on the package label

|            |  |
|------------|--|
| <b>Yes</b> |  |
| <b>No</b>  |  |