EXPERIMENT (1):

EVALUATION OF ERROR, ACCURACY AND PRECISION

- Experimental error (Δx) is defined as the absolute value of the difference between the experimental value of the measured quantity (x) and the its actual value (x_0).

Experimental error = Experimental value – Actual value

$$\Delta x = |x - x_0|$$

قيمة التجربة - تشغيل السالب (القيمة مطلقة)

- The *percent error* is the ratio of the experimental error (Δx) to the actual (x) value multiplied by 100.

$$\text{Error } \% = \frac{\text{Experminal Error}}{\text{Actual Value}} \times 100 \qquad Error(\%) = \frac{\Delta x}{x_0} X100$$

التكرار

- The *precision* of a measurement is a measure of the reproducibility of a set of measurements, and is recorded as:

قريب من الهدف

مدى تكرارية النتائج متقاربة

Precision = measured value ± Δx

accuracy

مدى اقترابنا للهدف

- The significant figures displayed on an instrument are an indication of its precision.

Part one: Evaluation of percent error

In This part, a substance will be weighed and the percent error will be calculated.

Equipment and reagents

1. Balance
2. Beaker
3. Known weight Object ← (salt)

Procedure

1. Zero the balance.
2. Weigh the object. Record this mass as **m**.
3. Record the balance precision as ± **Δm**.
4. Calculate the percent error for the mass of the salt.
5. Record the salt mass with precision m ± **Δm**.

Results and calculation

1. Tabulate the results:

m(g)	Δm(g)
0.13	0.01

2. Calculate the experimental error, error percentage and precision.

$\Delta m = |m - m_0|$

$\Delta m = |0.13 - 0.12|$

$\boxed{\Delta m = 0.01}$

$Error(\%) = \frac{\Delta m}{m_0} \times 100$

12 $Error(\%) = \frac{0.01}{0.12} \times 100$

$\boxed{Error(\%) = 8.33\%}$

Precision = measured value ± Δm

$\boxed{Precision = 0.13 \pm 0.01}$

وزن الماء = حجم الماء لأن كثافته ١

مدى دقة الهدف   مدى التكرارية

Part two: Determination of accuracy and precision

In this part, the average mass $\overline{m}$ the experimental error in mass (Δm), the percent error of the measured mass (m %), and the accuracy of mass measurement will be determined as follows:

- **Determining of $\overline{m}$**

$$\overline{m} = \frac{m_1 + m_2 + m_3 + \cdots + m_n}{n}$$

n is the number of measurements.

- **Determining of Δm:**

نسبة الخطأ ← $\Delta m = m_{measured} - m_{actual}$

- **Determining of m%:**

$$m\% = \frac{\Delta m}{\overline{m}} \times 100$$

المحسوبة ← $\overline{m}$

- **Determining the accuracy of measurement:**

Accuracy in m value = $\overline{m} \pm \Delta m$

Equipment and reagents

1. Balance.
2. 50-mL graduated cylinder
3. 50-ml flask with a stopper
4. 25 mL graduated burette

Procedure

1. Weight an empty beaker and record the mass as $m_{empty\ beaker}$
1. Into the dry beaker, add 25 mL of distilled water measured carefully by a dry 50- mL graduated cylinder.
2. Empty the water from the beaker and repeat the above steps two more times.
3. Weight the beaker with the added water and record the mass you get as $m_{beaker\ and\ water}$
4. Repeat all of the above steps using a dry 50 mL- graduated burette .

$m = m_{beaker\ and\ water} - m_{empty\ beaker}$

Results and Calculation

- Tabulate the results.

	m1	m2	m3
graduated cylinder	23.90	23.50	23.50
burette	24.92	24.91	24.78

Calculate the average $\overline{m}$, the experimental error (Δm), the percent error (m%), and the the. Accuracy of the mass value ($\overline{m} \pm \Delta m$)

- State which is more accurate the graduated cylinder or the graduated burette?

– the graduated burette is more accurate .

graduated burette

$\overline{m} = \frac{24.92+24.91+24.78}{3} = 24.87$

$\Delta m = |24.87 - 25| = 0.13$

$m\% = \frac{0.13}{24.87} \times 100 = 0.5\%$

Accuracy = 24.87 ± 0.13

graduated cylinder

$\overline{m} = \frac{23.90+23.50+23.50}{3} = 23.63$

$\Delta m = |23.63 - 25| = 1.37$

$m\% = \frac{1.37}{23.63} \times 100 = 5.8\%$

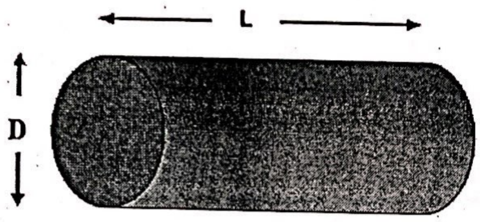
Accurracy = 23.63 ± 1.37

First method

Determination of density directly by calculation of volume and weighting mass of a geometric specimen .

Theoretical information

- Example: Specimen (massive cylinder)



- The mass, m, in grams, is obtained directly by weighting the specimen (massive cylinder) using the balance.
- The degree of precision is calculated from the Δm taken from the balance (precision) and from the measurement tool for volume (precision) using the following relation:

Procedure

1. Using a proper an accurate ruler, measure the length (L) and the diameter of the specimen (massive cylinder) (D). → 1.1 (L: 1.9)
2. Weigh the mass (m) of your specimen (massive cylinder). ← 16.34

Results and calculations

1. Report your measurements as follows:

نسبة خطأ المسطرة

L (cm)	D (cm)	m
1.9	1.1	16.34

$1.1^2 = 1.21$

2. Calculate the volume of your specimen (massive cylinder).

$$Volume = \frac{\pi D^2 L}{4} = \frac{\pi (1.1)^2 1.9}{4} = \frac{7.22}{4} = 1.8\ cm^3$$

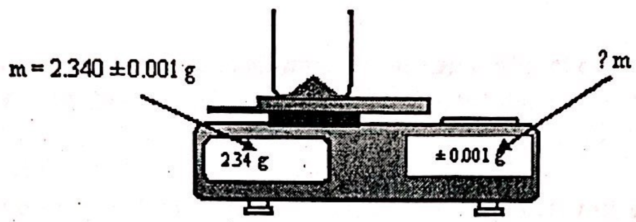
3. Calculate the density of your specimen (massive cylinder).

$$Density = \frac{m}{V} = \frac{16.34\ g}{1.8\ cm^3} = 9.08\ g/cm^3$$

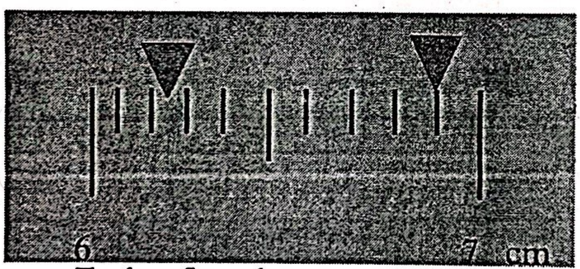
4-Tabulate your errors of measurements:

Δm (g)	ΔL (cm)	ΔD (cm)
0.01	0.1	0.1

Δm is the error occurred during the weighing on the balance.
The figure below shows how you find the value of Δm
is taken as follows



ΔL and ΔD are the errors occurred during the measurement of the length and the diameter of the cylinder using a ruler.
The figure below shows how you find the value of ΔL and ΔD



The above figure shows two measurements.
The correct reading of the first is 6.2 cm ± 0.1 cm
The correct reading of the second is 6.8 cm ± 0.1 cm

4. Calculate the error in the density (Δdensity), and its accuracy:

نسبة الخطأ ← $\Delta Density = \pm density[\frac{\Delta D}{D} + \frac{\Delta L}{L} + \frac{\Delta m}{m}]$ $= \pm 9.08 \left(\frac{0.1}{1.1} + \frac{0.1}{1.9} + \frac{0.01}{16.34}\right)$

$= \pm 9.08 (0.09 + 0.05 + 0.0006)$

The accurate density = density ± Δdensity $\Delta D = \pm 1.28$

accurate density = 9.08 ± 1.28

Second method 201 ; 81

Determination of density by displacement of water

Theoretical information

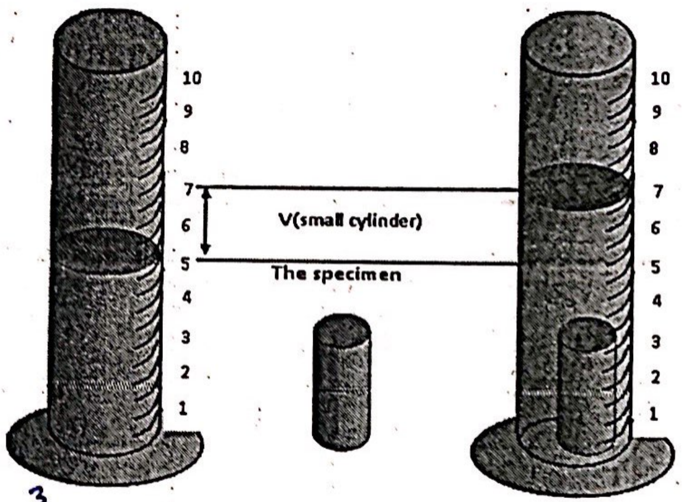
When volume of an object cannot be calculated by a mathematical equation, or if it is desired to determine the volume without using the mathematical equation, it can be determined by water displacement.

Procedure

(Here you will determine the volume of the same object used in the first method)

1. Pour water into the graduated cylinder. Record the exact volume as V_1.
2. Place your specimen (massive cylinder) which you used in the first part inside the graduated cylinder. Record the new volume as V_2.

(Because you object is the same object used in the first method, do not weigh it, but use the mass you obtained in the first method)



Results, calculations and comparison

1. Report your measurements as follows:

V_1 (cm^3)	V_2 (cm^3)	m
20	22	16.34

2. Calculate the volume of your specimen (massive cylinder):

$V = V_2 - V_1$ $= 22 - 20 = 2\ cm^3$

3. Calculate the density of specimen (massive cylinder):

$$Density = \frac{m}{V} = \frac{16.34\ g}{2\ cm^3}$$

$D = 8.17\ g/cm^3$

☆ تجربة إيجاد الكثافة مهمة هي و تجربة 4 الحرارة "ستأتي في الاختبار"

Evaluate the values of Δm ΔV_1 and ΔV_2 as follows:
Δm is evaluated exactly as described in the first method of this experiment.

ΔV_1 and ΔV_2 are evaluated as follows :

$\Delta V_1 = \Delta V_2 = \Delta V_{graduated\ cylinder}$

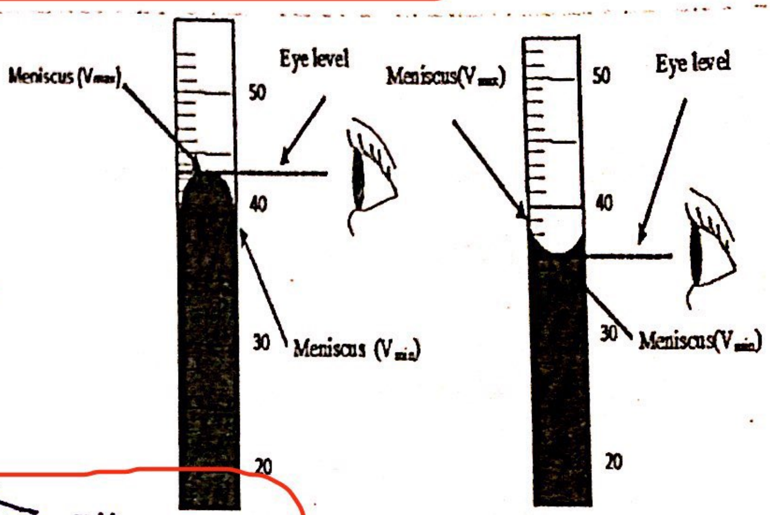
$\Delta V_{graduated\ cylinder}$ is written on the top of the cylinder.

If not written it can be evaluated By using the following equation:

نسبة الخطأ ← $\Delta V_{graduated\ cylinder} = \frac{V_{max} - V_{min}}{}$

لا نقسم على 2
نرجو لتصحيح الخطأ

As is described in the scheme.



4. Tabulate the values of experimental errors:

ΔV_1	ΔV_2	Δm
0.5	0.5	0.01

5. Calculate the error in the density (Δdensity), and its accuracy:

$$\Delta Density = \pm density\left[\frac{\Delta V1}{V1} + \frac{\Delta V2}{V2} + \frac{\Delta m}{m}\right]$$

$$= \pm 8.17\left(\frac{0.5}{20} + \frac{0.5}{22} + \frac{0.01}{16.39}\right) = \Delta D = \pm 0.395$$

The accurate of density = density ± Δdensity

$$= 8.17 \pm 0.395$$

6. Calculate the absolute difference between the density determined by this method and that determined by the first method as follows:

$$\Delta \textbf{density} = |\textbf{density}_{\textbf{first method}} - \textbf{density}_{\textbf{scond method}}|$$

$$\Delta\ density = 9.08 - 8.17 = 0.91\ g/cm^3$$

Third method

"غير مقررة علينا"

الفكرة هنا في حال لدينا قطعة لا تنغمر في الماء فلا نستطيع إيجاد إزاحتها ومن ثم كثافتها لذلك نضيف الملح تدريجياً حتى تنغمر ونطبق كما تعلمنا في الطريقة 2

Determination of the density by adjusting the density of a fluid

Theoretical information

(***Volume of an object can be obtained not only by mathematical equation or by water displacement but also can be determined by this method.***)

- The idea of this method is based on the fact that when an object (***that does not swell or dissolve in the fluid***) is in a fluid it takes one of the three following situations:
  Fist: if the body is heavier than the fluid it will sink down.
  Second: if the body is lighter than the fluid it will float up.
  Third: if the body and the fluid are of the same heaviness, the body will suspend in the middle of the fluid.

Procedure

1. Weight a wide 100 mL-graduate cylinder. Record its mass (m_{gc1}).
2. Pour 50 mL of water inside the cylinder.
3. Immerse a cylindrical specimen in the water inside the cylinder.
4. Fill a separation funnel with a saturated solution of the salt.
5. Slowly and carefully and gradually, pour the salt solution into the graduated cylinder. Use a glass stirrer to insure that the added solution is completely mixed with the water.
6. Continue doing the previous step until you see the cylindrical specimen is positioned in the midpoint of the cylinder.
7. Get the cylindrical specimen back.
8. Read the total volume of the solution remained in the cylinder. Record this volume as final volume ($V_{soluion}$)
9. Weight the wide 100 mL-graduate cylinder with the remaining solution. Record its mass (m_{gc2}).

Results and calculations

1. Report your measurements as follows:

m_{gc1} (g)	m_{gc2} (g)	$V_{soluion}$ (cm^3)

2. Calculate the mass of the solution ($m_{solution}$):

$$m_{solution} = m_{gc2} - m_{gc1}$$

3. Calculate the density of the solution which is at the same time equals that of the cylindrical specimen.

$$\text{Density of the cylindrical specimen} = \text{Density of the solution} = \frac{m_{solution}}{V_{soluion}}$$

EXPERIMENT (3):

★ موجودة في اليوتيوب في قناة الأستاذ سلطان
رقم المقطع التجربة 4

العناصر المتفاعلة

REACTION STOICHIOMETRY: DETERMINATION OF THE LIMITING REACTANT AND YIELD PERCENTAGE

Objectives

The objectives of this experiment are the determination of:

1. The limiting reactant.
2. The percentage of the yield.

Theoretical information

$$2HCl\,(aq) + Na_2CO_3(s) \rightarrow 2NaCl\,(aq) + CO_2\,(g)\uparrow + H_2O\,(l)$$

The balancing coefficients indicate that there is a 1:2 mole ratio between Na_2CO_3 and HCl. This means that for every one mole of sodium carbonate that reacts, two moles of HCl should react and two moles of NaCl should be produced.

Safety

- Be careful when handling the hydrochloric acid, it can cause chemical burns to the skin.
- If any acid spills on you, rinse immediately under running water for 15 minutes and report the accident to your instructor.
- Acid spills may also can be neutralized using sodium bicarbonate solution on the sinks.
- Be sure to exercise appropriate caution when using the Bunsen burner and handling hot equipment.

★ المول الواحد يساوي عدد أفوجادرو 6.02×10^{23}
جزيئات في الذرة الواحدة .

Materials and equipment

- Sodium carbonate (Na_2CO_3),
- Hydrochloric acid Solution HCl (1 M)
- Balance.
- Evaporating dish.
- Watch glass (to fit as a cover for the evaporating dish),
- Stand and ring clamp and wire gauze.
- 10 mL-pipette
- small beaker
- Bunsen burner or hot plate

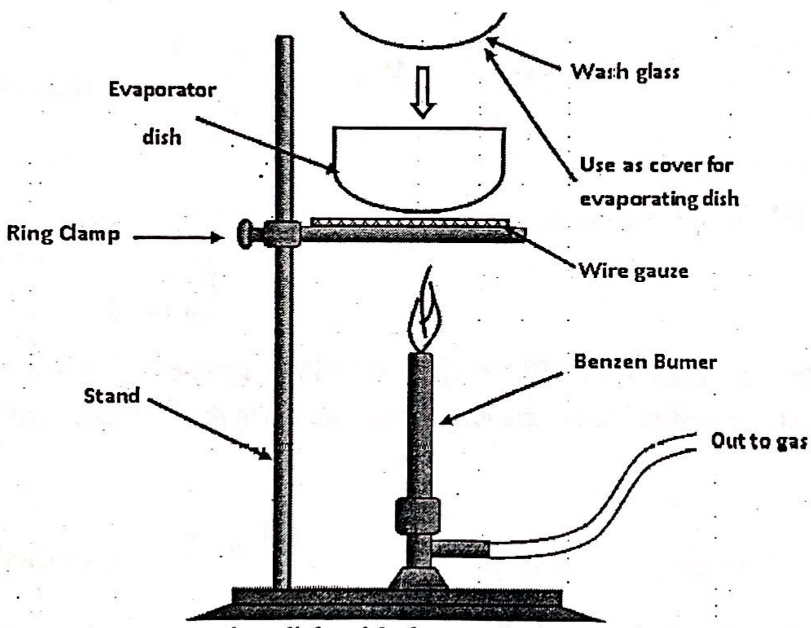
★ عندما تكون المادتين قابلة للتفاعل
فسيستمر التفاعل
حتى انتهاء واحدة من المواد
وهي اللي عدد مولاتها أقل (تنتهي بسرعة)

Procedure

1. Measure and record the mass of your clean dry evaporating dish with watch glass. Record this mass as $m_{INITIAL.}$=117.96g
2. Carefully weigh 0.3 – 0.4 g of Na_2CO_3 to the evaporating dish. Record the exact mass as $m_{(reactant)}$=0.35g
3. Using your dropper pipette, obtain exactly 10.0 mL of the 1.0 molar HCl (aq). Record the exact volume as V_{HCl}=10mL → 0.01L
4. Add hydrochloric acid drop by drop to the sodium bicarbonate in the evaporating dish.

   (The reaction will be evident by the bubbling that takes place.)
5. Carefully mix the reactants after every 4-5 drops of HCl.
6. Continue adding HCl to its last drop.

   (The reaction is complete once no more bubbling is noticed.)
7. As shown in the figure below, assemble the stand, ring clamp and wire gauze apparatus for heating.



8. Cover the evaporating dish with the watch glass and place it on the wire gauze.
9. Carefully heat the solution in the covered evaporating dish with a Bunsen burner flame in order to remove the water generated in the reaction (as well as any excess HCl present).

   (The flame should be adjusted to a lower temperature and wafted under the evaporating dish constantly.)
10. Continue heating until the contents are completely dry. Note that the watch glass cover should also be dry!
11. Allow the evaporating dish to cool to room temperature.
12. Measure the mass of the evaporating dish + watch glass + residue (NaCl). Record the exact mass as $m_{(product)}$=118.23g
    m total

Results and calculations

Tabulate your experimental results:

$m_{Na_2CO_3}$ (g)	V_{HCl} (L)	M HCl (mol/L)
0.35	10mL → 0.01L	1 molar

← معطى

(Molar masses /g mol^{-1}: H = 1.008, C = 12.01, O = 16, Na = 22.99, Cl = 35.45)

1. **The limiting reactant**

- To determine which of the reactants is the limiting reactant, number of moles used in the experiment ($n_{Na_2CO_3}$) and (n_{HCl}) must be known.

قانون عدد مولات المواد الصلبة

$$n_{Na2CO3} = \frac{m_{Na2CO3}}{Mw_{Na2CO3}}$$

$$Mw_{Na2CO3} = (23x2) + 12 + (16x3) = 106\ g/mol$$

$$n_{Na2CO3} = \frac{0.35}{106} = 3.3 \times 10^{-3} \text{ mol}$$

قانون عدد مولات المواد السائلة

$$n_{HCl} = M_{HCl} \times V_{HCl} \longrightarrow n_{HCl} = 1 \times 0.01 = 0.01 \text{ mol}$$

$M = \frac{n}{V_L}$ ← مشتق من

- $n_{Na_2CO_3}$ and n_{HCl} must be divided by the coefficient of each reactants in equation.
- The reactant which gives the lowest quotient is the limiting reactant.

$$\frac{n_{Na2CO3}}{1} = \frac{3.3 \times 10^{-3}}{1} = 3.3 \times 10^{-3} \text{ mol (lowest)}$$

$$\frac{n_{HCl}}{2} = \frac{0.01}{2} = 5 \times 10^{-3} \text{ mol}$$

So the limiting reactant is Na_2CO_3.

المحصول

2. The yield percentage

- Calculate the mass of NaCl prodused (m_{NaCl}):

$m_{NaCl,actual} = m_{TOTAL(product)} - m_{INITIAL}$

$= 118.23 - 117.96 = 0.27g$

- The consumed amount of the limiting reactant will be used stoichiometrically to calculate the amount of NaCl that should be produced theoretically .

1 mole of Na_2CO_3 ⟶ 2 mole of NaCl

3.3×10^{-3}..... mole of Na_2CO_3 ⟶ X mole of NaCl

... mole ⟶ ....mole
... Molecular w ⟶ X
لو عنصر نكتب molar mass

X mole of NaCl ($n_{NaCl, theorical}$) $= 3.3\times10^{-3} \times 2 = 6.6\times10^{-3}$ mol

Determined ($m_{NaCl, theorical}$) using the following equation:

$n_{NaCl} = \frac{m_{NaCl}}{Mw_{NaCl}}$

$m_{NaCl, theorical} = n_{NaCl, theorical} \times Mw_{NaCl}$

$Mw_{NaCl} = 23 + 35.5 = 58.5\ g/mol$ (.45, .45)

$m_{NaCl, theorical} = 6.6\times10^{-3} mol \times 58.45 g/mol = 0.38 g$

- The yield percentage of NaCl can be calculated by the following equation:

$$NaCl\ yield\% = \frac{m_{NaCl, actual}}{m_{NaCl, theoretical}} \times 100$$

١- نحدد المادة المحددة لسرعة التفاعل

$$NaCl\ yeald\% = \frac{0.27}{0.38} \times 100 = 71\%$$

2- ثم نطلع منها yield

★ موجودة في مقطع التجربة 5&6 باليوتيوب "قناة الأستاذ سلطان"
من بداية المقطع وحتى الدقيقة 11:22

EXPERIMENT (4):

★ التجربة مهمة وتأتي في الاختبارات

DETERMINATION OF THE TRANSFERED THERMAL ENERGY:ENDOTHERMIC AND EXOTHEMIC

Objectives

Measurement of the amount of Heat (Q) change because of mixing of two substances.

Theoretical information

- In this experiment, you will measure the amount of heat involved two mixtures (solid-liquid and liquid-liquid).using the following relationship:

(طاقة J) كمية الحرارة ← $Q = m \times \rho \times (T_{final} - T_{initial})$

جول

Where: (ρ ← الحرارة النوعية ← تعريفها: هي كمية الحرارة اللازمة لرفع درجة حرارة 1 كيلوغرام من المادة درجة مئوية واحدة)

m is the mass, in grams, of the solid or the liquid substance.

ρ is the specific heat (°C/J.g).

T_{final} and $T_{initial}$ are the temperature at the before and after the mixing respectively.

- When two substances having different temperatures were mixed together in an adiabatic container, (لا يتبادل الحرارة (شبيه بالمعزول) ← الحرارة المكتسبة تساوي الحرارة المفقودة) the substance that has the lower temperature gains the energy and its sign will be positive ($Q_{Endothermic}$) and that having the higher temperature loses the same energy and its sign will be negative ($Q_{Exothermic}$).

$$Q_{Endo} = m_1 \times \rho_1 \times (T_{final} - T_{initial})$$
$$Q_{Exo} = m_2 \times \rho_2 \times (T_{final} - T_{initial})$$
$$Q_{Endo} = -Q_{Exo}$$

Materials and equipment

Water
Glass rod (ساق زجاجي/أو معدني)
Stir stick (محرك)
250 –mL beaker
Balance
Thermometers (0 - 100°C) (مقياس حرارة)
two large styro-foam cups → كأس الفلين
100-mL graduated cylinder
Bunsen burner or hot plate

Procedure:

1 = كثافة الماء بحكم أنّا ★
100g = 100ml

Part one

(NOTE: ***Considering the density of water is 1.0 g/cm³,)***

1. Weigh out 100 g of water and put it in a 250 -ml beaker. Record its mass as m_{water}.
2. Record the initial temperature as $T_{initial\ water}$.
3. Weigh a glass rod and record its mass as m_{rod}.
4. Put the glass rod in the heated water.
5. After waiting for one minute. Record its temperature as $T_{initial,rod}$.
6. Take the glass rod at $T_{initial,rod}$ outside and insert it immediately in the previous styro-foam cup (الفلين ←) which contains water at $T_{initial,water}$.
7. After waiting for one minute, record the new temperature as T_{final}.

Results and calculations

1. Tabulate your results as follows:

درجة حرارة الحمام المائي: 94°C

m_{water}	$T_{initial,water}$	m_{rod}	$T_{initial,rod}$	T_{final}
100g	25°C	2.48 g	94°C	25.5°C

2. Given that ρ_{water} = 4.184 J/g °C, ρ_{rod} = 0.836 J/g °C and from your tabulated data, calculate the heat quantity changes, in the units of Joule, as follows:
   - First: Heat gained by water:

$$Q_{water} = m_{water} \times \rho_{water} \times (T_{final} - T_{initial})$$

$$Q_{water} = 100g \times 4.184\ J/g°C \times (25.5°C - 25°C)$$

$$Q_{water} = 209.2\ J$$

   - Second: Heat lost by the rod:

$$Q_{rod} = m_{rod} \times \rho_{glass} \times (T_{final} - T_{initial})$$

$$Q_{rod} = 2.48g \times 0.836\ J/g°C \times (25.5°C - 94°C)$$

$$Q_{rod} = -142.02\ J$$

★ إشارة السالب لا تدل على قيمة سالبة إنما توضح لنا هل هذه مكتسبة أم مفقودة فقط لا غير

★ المفترض الحرارة المكتسبة تساوي المفقودة

لكن يعود عدم تساوي النتائج في تجربتنا لسبب عدم استخدام نظام معزول (فلين)

★ مهمة؛

Part two

1. In 250-ml beaker, put 100 g of water is heated to its boiling temperature. record the temperature $T_{Initial,Hot\ water}$
2. In a separate beaker, add about 100 mL of water at ambient temperature. Record this temperature as $T_{Initial,water}$.
3. Add an amount of the water at $T_{ambient}$ to the hot water. Record your temperature as T_{final}.

بدرجة حرارة المحيط (الغرفة)

Results and calculations

1. Tabulate your results as follows:

m_{water}	$m_{hot\ water}$	$T_{initial\ water}$	$T_{initial,hot\ water}$	T_{final}
100 g	50 g	25 C°	94 C°	45 C°

2. Given that $\rho_{water} = \rho_{hot\ water} = 4.184$ J/g °C, and from your tabulated data, calculate the heat quantity changes as follows:
   - First: Heat gained by water in the units of Joule:

$$Q_{water} = m_{water} \times \rho_{water} \times (T_{final} - T_{initial,water})$$

$$Q_{water} = 100g \times 4.184\ J/g\,°C \times (45°C - 25°C)$$

$$Q_{water} = 8368\ J$$

   - Second: Heat lost by hot water in the units of Joule:

$$Q_{hot\ water} = m_{hot\ water} \times \rho_{hot\ water} \times (T_{final} - T_{initial,\ hot\ water})$$

$$Q_{hot\ water} = 50g \times 4.184\ J/g\,°C \times (45°C - 94°C)$$

$$Q_{hot\ water} = -10250.8\ J$$

3. Depending on the previous calculation, calculate the mass of water (m_{water}) you need to add to your tea in order to make the temperature of the tea low enough to be drinkable: (Consider tea as hot water, Drinkable temperature is 55 ° C).

$$Q_{water} = -Q_{tea}$$

هذا الأصل ← ؛ نحذف لأنه على كلا الطرفين متساوي ؛ ← T_{final}

$$m_{water} \times \rho_{water} \times (T_{final} - T_{initial,water}) = -m_{hot\ water} \times \rho_{hot\ water} \times (T_{final} - T_{initial,\ hot\ water})$$

$$? \times 4.184 \times (55 - 25) = -50 \times 4.184 \times (55 - 94)$$

$$m_{water} = -\frac{m_{hot\ water} \times (T_{final} - T_{initial,\ hot\ water})}{(T_{final} - T_{initial\ water})}$$

بمعنى حرارة فقدت ← ؛ لاحظ ؛ سالب و سالب تصبح موجب

$$m_{water} = -\frac{50 \times (55 - 94)}{(55 - 25)} = -\frac{50 \times -39}{30} = -\frac{-1950}{30}$$

$$m_{water} = 65\ g$$

الـmass دائمًا يكون ناتجها بالموجب
سواء كنا نتحدث عن mass of water أو mass of hot water

لأن علامة + و - تكون للـQ فقط المقصود بها كمية الحرارة
لتبين لنا اتجاه هذه الحرارة
هل للداخل (أكتسبت) أم للخارج (أفتقدت)

أي أننا نحتاج لإضافة هذا القدر من الماء لإنزال درجة حرارة الشاي من 94°C إلى 55°C ليصبح قابل للشرب

★ هي التجربة الوحيدة الذي لم أجد لها مقطعاً في اليوتيوب في قناة الأستاذ سلطان

EXPERIMENT (5):

★ ما تجي في الاختبار عملياً لكن نظرياً قد تأتي

Graham's Law of Gas Diffusion

تدفق وانتشار

Graham's law states that a gas will effuse at a rate inversely proportional to the square root of it's molecular mass under same conditions of temperature and pressure .

$$r_1 \sqrt{\frac{1}{m}} \text{ or } r_1 \sqrt{\frac{1}{d}}$$

مسافة الانتشار — الوزن الجزيئي — الكثافة

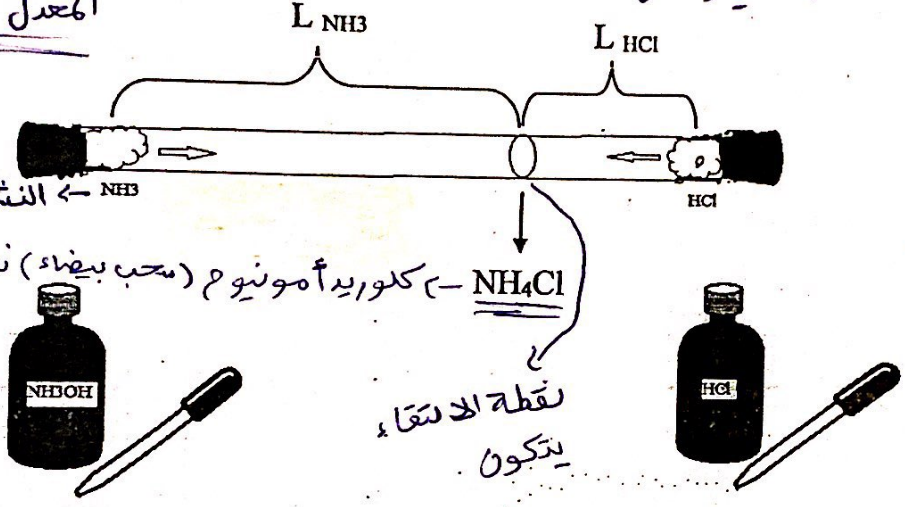
$$\frac{r_1}{r_2} = \frac{L_1}{L_2} = \frac{\sqrt{M_2}}{\sqrt{M_1}} = \frac{\sqrt{d_2}}{\sqrt{d_1}} = \frac{t_2}{t_1}$$

★ الجزيئات ذات الوزن الجزيئي القليل تنتشر بشكل أسرع

r = ratio المعدل

التناسب عكسي

اللي ينتشر أسرع زمنه يكون أقل



النشادر (أمونيا) ← NH3

كلوريد أمونيوم (سحب بيضاء) نلاحظها ← NH_4Cl

نقطة الالتقاء يتكون .

Reaction Equation : $NH_3 + HCl \longrightarrow NH_4Cl$

Ghraham Law for this reaction is:

$$\frac{L_{NH3}}{L_{HCl}} = \frac{\sqrt{M_{HCl}}}{\sqrt{M_{NH3}}} = \frac{\sqrt{d_{HCl}}}{\sqrt{d_{NH3}}}$$

Materials and equipment

Glass tube (40 cm x 1 cm) — Two stoppers

HCl and NH4OH solutions . — Cotton

للفائدة : ← هذا عبارة عن :
$NH_3 + H_2O$
↑ نتيجة ذوبان النشادر في الماء .

Procedure:

1- Put the glass tube in horizontal position as in diagram
2- Insert the cotton in the ends of glass tube.
3- At the same time, inject equal amount of each solution in the cotton (one in each side) and close them quickly by stoppers.
4- Observe the formation of white smoke inside the glass tube and mark it with pen.
5- Measure the distance moved by each gas (from center of the cotton to the white smoke).

Results:

1- Distance moved by HCl gas (L_{HCl}) = 14 cm.
2- Distance moved by NH3 gas (L_{NH3}) = 26 cm.

★ إذا تساوى غازيين في أوزانهم الجزيئية يتساوون في الانتشار

Molar masses (g/mol): H =1 , N =14 , C =12 , Cl =35.5

$M_{HCl} = 1+35.5 = 36.5$

Calculation : $M_{NH_3} = 14 + 1\times3 = 17$

1- The theoretical ratio between the molar masses of the two gases (Y) = $\frac{\sqrt{M_{HCl}}}{\sqrt{M_{NH_3}}}$

$$Y = \frac{\sqrt{M_{HCl}}}{\sqrt{M_{NH_3}}} = \frac{\sqrt{36.5}}{\sqrt{17}} = 1.46$$

2- The measured ratio between the molar masses of the two gases (X) = $\frac{L_{NH_3}}{L_{HCl}}$

$$X = \frac{L_{NH_3}}{L_{HCl}} = \frac{26}{14} = 1.86$$

3- Error percentage :

$$Error\ \% = \pm\frac{Y - X}{Y} X100 \quad \Big| \quad Error\% = \pm\frac{1.46-1.86}{1.46} \times 100 = \pm 27.1\ \%$$

16 وزنه الجزيئي (من الجدول الدوري H=1, C=12)

Question:

★ Unknown gas faster two times than methane (CH4), calculate its molar mass?

$$\frac{r_1}{r_2} = \frac{\sqrt{M_2}}{\sqrt{M_1}} \quad \Big| \quad \frac{2}{1} = \frac{\sqrt{M_{CH_4}}}{\sqrt{M_{Unk}}} \quad \Big| \quad \frac{2}{1} \times \frac{\sqrt{16}}{\sqrt{M_{Unk}}} \quad \Big| \quad 2\sqrt{M_{Unk}} = 4 \quad \Big| \quad \sqrt{M_{Unk}} = \frac{4}{2} = 2$$

عملية الضرب التبادلي

★ لكي نتخلص من الجذر نربّع الطرفين

$$\sqrt{M_{Unk}}^2 = 2^2 \quad \Big| \quad M_{Unk} = 4$$

★ موجودة في آخر دقيقة من مقطع التجربة 5&6 الخاص بالأستاذ سلطان في اليوتيوب

★ التجارب 7، 8، 9، 10 موجودة كما هي في اليوتيوب رقم التجربة يطابق رقم الفيديو

EXPERIMENT (6):
ENTHALPY OF REACTION: HESS'S LAW

Theoretical information

- Hess's law states that *the enthalpy of any change (physical or chemical) in any system depends on the state of the system before and after the change, and it never depends on what path the system went through to accomplish this change.*
- In this experiment, you will measure and compare the change of Enthalpy involved in the following three reactions:

REACTION 1:

$NaOH(s) + HCl(aq) \rightarrow NaCl(aq) + H_2O(l)$ $\Delta H = \Delta H_1$

REACTION 2:

$NaOH(s) + H_2O(l) \rightarrow NaOH(aq)$ $\Delta H = \Delta H_2$

REACTION 3:

$NaOH(aq) + HCl(aq) \rightarrow NaCl(aq) + H_2O(l)$ $\Delta H = \Delta H_3$

- It is clear that because reaction 1 is the sum of the reactions 2 and 3,

$$(\Delta H_1) = (\Delta H_2 + \Delta H_3)$$

Objectives

- Measuring the reactions' enthalpy and verifying Hess's Law.

Materials

Solid Sodium hydroxide (NaOH) .
0.50 mol/L sodium hydroxide solution
0.50 mol/L Hydrochloric acid solution
0.25 mol/L Hydrochloric acid solution
Balance
Thermometer
styro-foam cup calorimeter.
100-mL graduated cylinder
2 Small beakers
50-mL automatic burette
50-ml graduated burette

Safety

- Avoid direct contact with hydrochloric acid and sodium hydroxide (*BOTH ARE CORROSIVE*).
- If any touches your skin, wash it off immediately.
- Solid sodium hydroxide is especially dangerous because it absorbs moisture rapidly from the air, forming an extremely corrosive liquid.
- If solid sodium hydroxide spills, clean it up immediately.
- Always keep the bottles of solid sodium hydroxide securely closed.