LAB REPORT FOR EXPERIMENT 2

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7.5/10

PHYSICS LAB EXPERIMENT 2:
SPECIFIC CHARGE OF COPPER IONS

I. PURPOSE

to determine the specific charge of cupper ions

II. DATA AND DATA ANALYSIS

1. Enter your data of the masses, $\mathbf{m_1}$ and $\mathbf{m_2}$ in **kg** as related to the current, **I**, in **Ampere** and time, **t**, in **minutes** in Table 2.1 below:

Table(2.1)

Current(I) (A)	Time (t) (min)	Amount of charge (It) (Coulomb)	m_1 (Kg)	m_2 (Kg)	Deposited mass $M_{cu} = (m_2 - m_1)$ (Kg)
~~0.6A~~ 1	~~20~~ 10	$1 \times 10 \times 60 = 600$ C	34.98×10^{-3}	35.22×10^{-3}	0.24×10^{-3}
~~0.3A~~ 1	~~20~~ 5	300 C	35.22×10^{-3}	35.37×10^{-3}	0.15×10^{-3}
~~0.3A~~ 0.5	~~10~~ 5	150C	35.37×10^{-3}	35.40×10^{-3}	0.03×10^{-3} *****

2. Use the data in Table (2.1) to **plot** the amount of charge **(It)** versus **the mass of the deposited copper M_{cu}** .

What type of relationship do you see between $\mathbf{M_{cu}}$ and **It**?

direct linear

4. From your graph find the specific charge, **K**, of copper ions by calculating the slope.

$K = \text{slope} = \frac{\Delta Q}{\Delta M} = \frac{300}{.15} = 2 \times 10^{-3}$ C/kg

5. What are the units of K?

colomb/kg

colomb/kg

6. Estimate the error, ΔK, in your value and write the result as $K \pm \Delta K$.

7. Calculate the **charge** carried by each **copper ion** in the solution.

$Q_{cu} = KM_{cu}$ slope*(63.6*1.66*10^-27)

= slope/(relative atomic mass of Cu^{2+} * atomic mass unit)

$= 2 * 63.6 * 1.66 * 10^{-27} * 10^{-3}$

$= 211.152 * 10^{-27}$

$= 2.1152 * 10^{-25} * 10^{-3}$

$= 2.1152 * 10^{-28}$ Coulomb

Use the result above to calculate the **charge of the electron e**. *How does it compare with the* **standard value**?

$Q_{Cu^{2+}} = 2e$

$e = \frac{Q^{+2}}{2}$

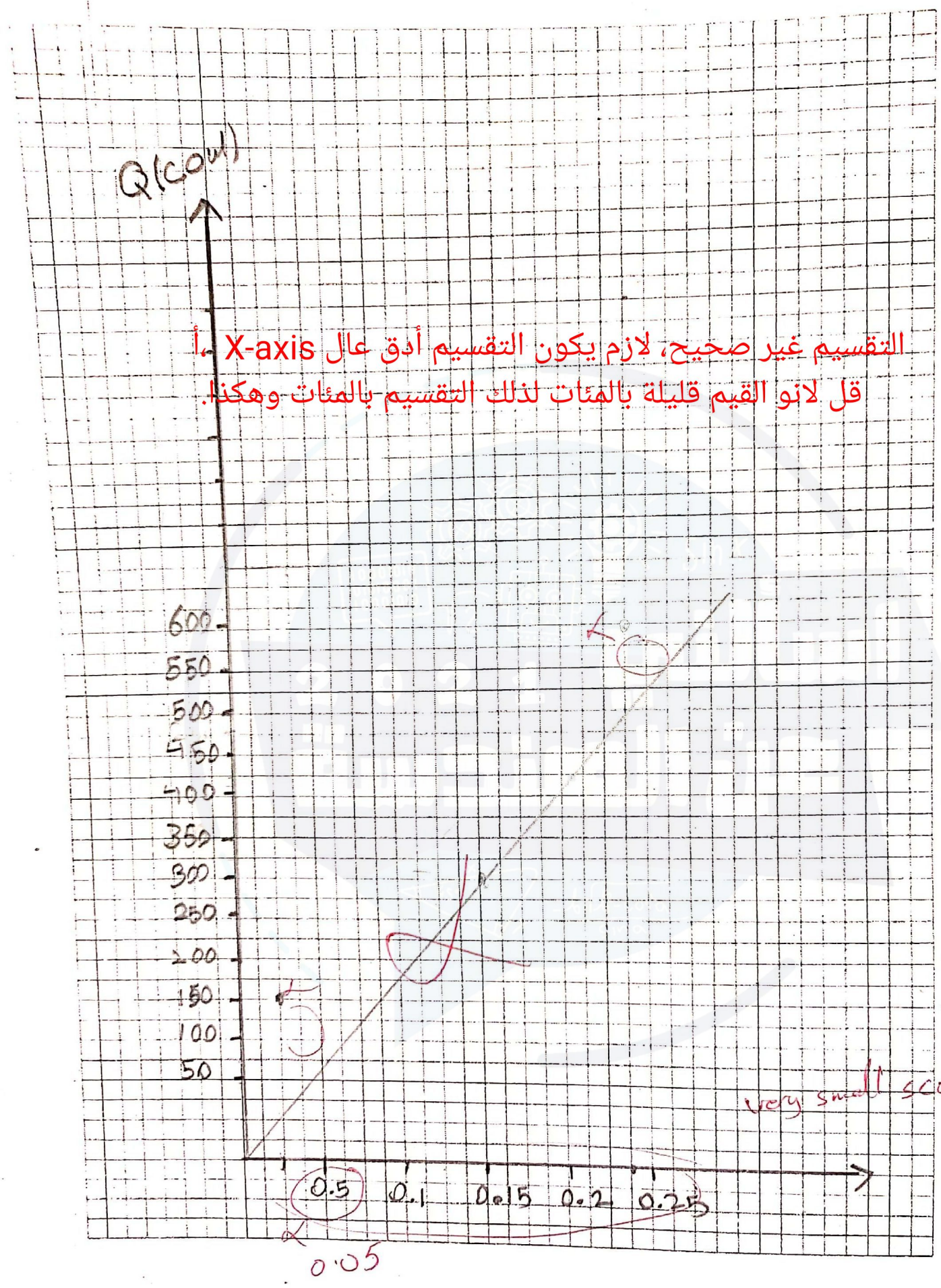
$= 1.05576 * 10^{-28}$ coulomn

percentage error $= \left(\frac{1.6 * 10^{-19} - 1.0576 * 10^{-28}}{1.6 * 10^{-19}} \right)$

$= (9.994 * 10^{-39}) * 100\%$

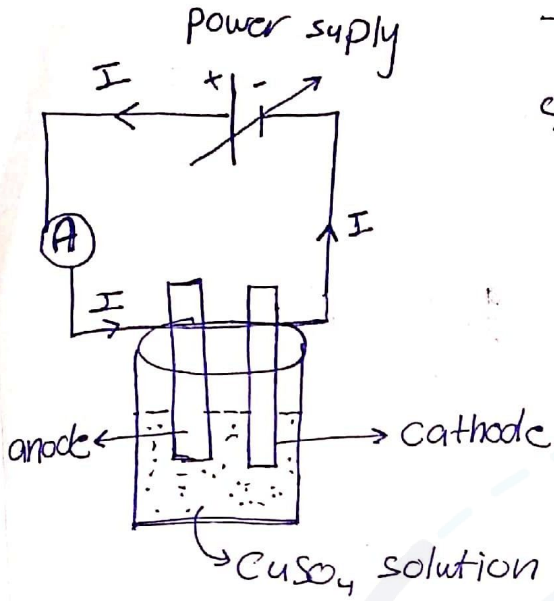
percentage error=|q for electron(stadard)- q for electron from experience |/ 1.6*10^-19

note: abs value at the top of fractional.



التقسيم غير صحيح، لازم يكون التقسيم أدق عال X-axis لأ.
قل لانو القيم قليلة بالمئات لذلك التقسيم بالمئات وهكذا.

specific charge of copper Ions



• كم مقدار الشحنة في 1 كغ من أيونات النحاس ؟
specific charge :

رمزها K وحدتها : $\frac{C}{Kg}$

- الأدوات :- solutions , 2electrodes , Ameter , powersupply

1 الelectrode الأول موصول مع + ال power supplay وهو الـ anode

2 الـ elect. الثاني موصل مع ال - لل power supplay

• المحلول يحمل أيونات النحاس Cu^{2+} , SO_4^{-2}
↓ + charge ↓ - charge

- داخل المحلول electric field اتجاهه من ال anode للـ cathode

- أيونات النحاس تتحرك مع E.f وتترسب على ال cathod نتيجة الترسيب

1 نوصل ال power supplay بعدها بوقفه ونوزن ال cathode ، سبب الزيادة؟

Current (I) A	Time (t) (S)	charge (It) (C)	m_1 (Kg)	m_2 (Kg)	Deposited mass $m_{cu} = m_2 - m_1$ (Kg)
I_1	t_1	$I_1 t$	m_1	$\bar{m}_1$	$m_2 - m_1$
I_2	t_2	$I_2 t_2$	$\bar{m}_1$	$\bar{\bar{m}}_2$	$\bar{m}_2 - \bar{m}_1$
I_3	t_3	$I_3 t_3$	$\bar{\bar{m}}_2$	m_3	$m_3 - \bar{\bar{m}}_2$

(نفسها)

W: charge = q $W = It$

$m_2 - m_1 = m_{cu}$ W

$m_2 - m_1 = m_{cu} \frac{It}{q}$ → $It = \frac{q}{m_{cu}} (m_2 - m_1)$

↓ كمية الشحنة اللي بتمر

الـ Current ثابت ممكن أو time ثابت
المهم حاصل ضربهم مختلفة

- حمر عدد شحنات الـ Cu اللي ترسبت في زمن t

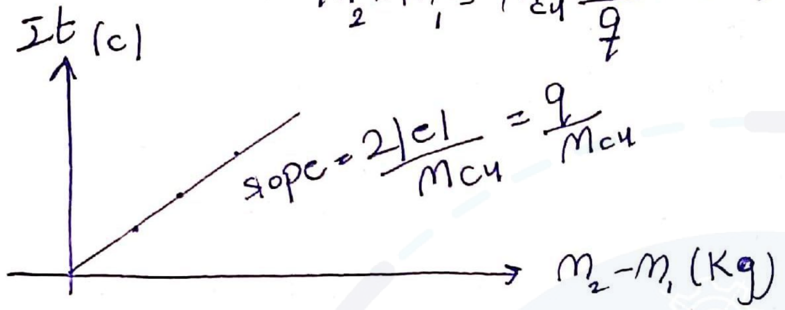
$$q\,N = I\,t$$

كتلة الأيونات اللي ترسبت ع الـ cathode هي $M_{Cu}\,N$

كتلة الـ cathode ← M_{Cu} ، عدد الأيونات ← N

بدل الـ N:

$$m_2 - m_1 = M_{Cu}\,\frac{It}{q} \longrightarrow \therefore It = \frac{q\,(m_2 - m_1)}{M_{Cu}}$$



K: charge carried by one Kg of Cu ions

$K = q$ * number of Cu ions in one Kg of Cu ions

$$K = q * \frac{1\,Kg}{M_{Cu}\,Kg} \rightarrow \frac{1\,Kg}{\dots}$$

كتلة أيون النحاس الواحد بكتلة Kg

$$\boxed{K = \frac{q}{M_{Cu}}}$$

- charge of one copper ione (electron)

atomic mass of Cu = 63.6 u → وحدة كتلة ذرية $= 1.67 * 10^{-27}$ Kg

mass of 1 mol of Cu = 63.6 g

$$K = \frac{1000}{63.6} * N_A * q \Longrightarrow$$

- بعدما نضرب بـ q بيعطيني الشحنة في 1Kg

$\frac{1000}{63.6}$ ← بيعطيني عدد المولات في 1 Kg من النحاس

N_A ← عدد أفوجادرو

$\frac{1000}{63.6} * N_A$ ← عدد أيونات النحاس في 1Kg

$$q = 2|e|$$

$$|e| = \frac{q}{2}$$

※ الجزء العملي ※

1] بنشف الـ cathod وبوزنه

2] بوصل الـ Anode مع الـ + لل power supplay

3] الـ cathod بشبكه مع الأميتر مباشرة (يعني الملف بين الـ cathod والـ A)

4] بشبك الأميتر القطب الفاضي مع negative power supplay

• بقدر التحكم بالـ current لازم يكون ثابت.

وبغير وقت وبستنى لبين يخلص t_1 باخذ الـ cathod بغسلو وبنشفو وبوزنه بالسشوار وبسجل القراءة

↓ ما غسلناه هنا

※ بعدها برجع بحطه نفسه وبستنى وقت ثاني وهكذا ※

$$qN = It$$

$$m_2 - m_1 = M_{cu} N$$

$$m_2 - m_1 = M_{cu}\left(\frac{It}{q}\right)$$

$$It = q(m_2 - m_1)$$

$$It = \frac{q}{M_{cu}}(m_2 - m_1)$$

It → at y-axis ; $\frac{q}{M_{cu}}$ → slope ; $(m_2 - m_1)$ → at x-axis

$$\frac{q}{M_{cu}} = K$$

$$\frac{q}{M_{cu}} = \frac{2|e|}{M_{cu}} = K \qquad \therefore e = \frac{K_a M_{cu}}{2}$$

EXPERIMENT 2
SPECIFIC CHARGE OF COPPER IONS

- In this experiment, the **Specific Charge K (Coul/kg) of Copper Ions** will be determined.
- From **K**, the **Electronic Charge "e"** will be **Calculated** and **Compared** to the standard vaule of **1.6×10^{-19}** Coulomb.
- **K** is the amount of charge carried by a unit mass of copper ions in an electrolyte solution.
- Experiment is based on the **Electrolysis** of diluted copper sulfates, **$CuSO_4$**.
- In this experiment (See Figure 1), we want to:
  - **Build up simple electric circuit** using different **circuit elements** including:
    - **Electric wires** (considered as perfect conductors eventhough they tend to heat up during the experiment, hence, their power dessipation is ignored).
    - **Variable Power Supply** that will allow monitoring, controlling, and the adjustment of the current at all times
    - **Ammeter** to be connected in series (in order to register the current).
    - **Copper Voltameter with clean electrodes (Anode & Cathode)**.
    - **Liquid Conductor** (Electrolyte – $CuSO_4$).
    - **Stopwatch.**
    - **Sandpaper.**
    - **Calibrated Digital Balance.**
    - **Dryer.**

    Note: be careful when using the dryer not to blow away the deposited ions on the electrode, and carry the electrode carefully.
  - From circuit in **Figure 1**, and after collecting the data points, **Plot** them as **$I \times t$** (Coul) as dependent variable versus **M_{Cu}** (kg) as the independent variable, then find the **Slope** of the graph, and state what **Conclusion** you can make.
  - Finally, **Calculate** the **charge carried by each copper ion** in the solution, then **deduce** from it the **charge of the electron** and **compare** it with the standard value:

    - Atomic Mass of Cu = 63.6 amu
    - 1 amu = 1.66×10^{-27} kg

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