# AMERICAN INTERNATIONAL UNIVERSITY-BANGLADESH

# CHEMISTRY-LAB
## SECTION: M

**DIRECTED BY:**

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# EXPERIMENT- 6

## Estimation of copper (Cu) contained in a supplied solution of copper salt by iodometric method

## INTRODUCTION

The amount of copper ions in a supplied solution of copper salt will be measured by iodometric oxidation-reduction titration. $K_2Cr_2O_7$ is a primary standard substance, an oxidizing agent and $Na_2S_2O_3.5H_2O$ is a secondary standard substance, a reducing agent.

## REACTION

The balanced reactions are as follows:

$2CuSO_4 + 4KI = 2K_2SO_4 + 2CuI \downarrow + I_2$

$2Na_2S_2O_3 + I_2 = Na_2S_4O_6 + 2NaI$

**Redox Half Reactions**

For 1: (a) $2I^-_{(aq.)} \rightarrow I_{2\,(aq.)} + 2e$ *(oxid. half reaction)*

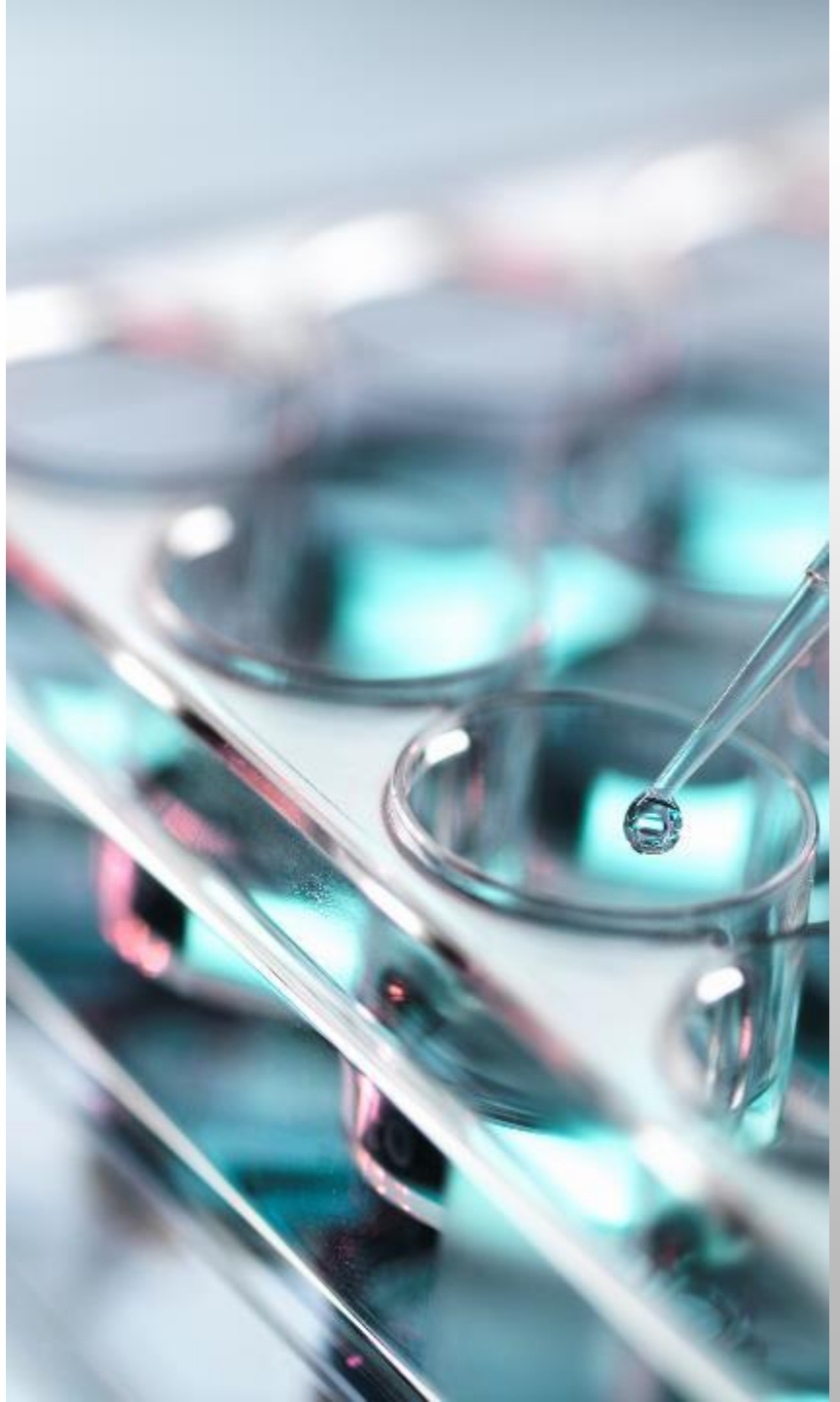
(b) $2Cu^{2+}_{(aq.)} + 2e \rightarrow 2Cu^+_{(aq.)}$ *(red. half reaction)*

For 2: (a) $2S_2O_3^{2-}{}_{(aq.)} \rightarrow S_4O_6^{2-} + 2e$ *(oxid. half reaction)*

(b) $I_{2\,(aq.)} + 2e \rightarrow 2I^-_{(aq.)}$ *(red. half reaction)*

# APPARATUS

- BURETTE (50ML),
- PIPETTE (10ML),
- CONICAL FLASK (250ML),
- VOLUMETRIC FLASK (100ML),
- WATCH GLASS,
- PIPETTE FILLER,
- DROPPER,
- STAND AND CLAMP.



# REQUIRED CHEMICALS

- 12% KI (Potassium iodide) solution,
- Copper salt solution
- $NaHCO_3$ (Sodium bicarbonate) solid,
- 6M $NH_4OH$ (Ammonium hydroxide )
- Conc. HCl (Hydrochloric acid),
- Conc. $CH_3COOH$ (Acetic acid)
- Standard $K_2Cr_2O_7$ (Potassium dichromate) solution,
- 10% $NH_4SCN$ (Ammonium thiocyanate) solution,
- $Na_2S_2O_3$ (Sodium thiosulphate) solution,
- Starch solution

# PROCEDURE

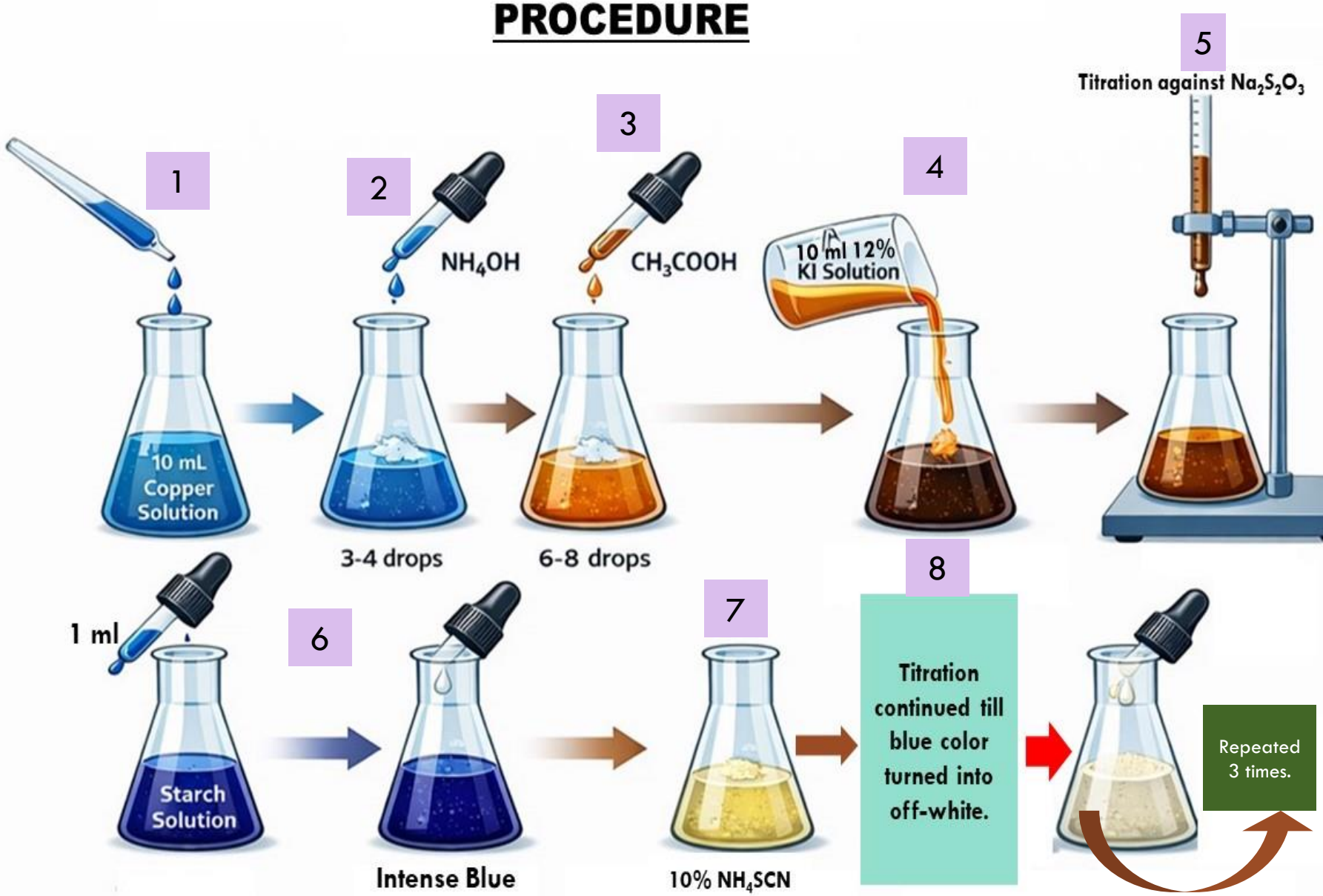



***Figure:* Estimation of copper (Cu) contained in a supplied solution of copper salt by iodometric method**

***Reference: (Modified version) created using ChatGPT (OpenAI,2025)***

# EXPERIMENTAL DATA:

**Table-1:** ***Standardization of supplied $Na_2S_2O_3$ solution against standard $K_2Cr_2O_7$ solution by oxidation-reduction titration.***

| No. of reading | Vol. of $K_2Cr_2O_7$ (in mL) | Vol. of $Na_2S_2O_3$ (burette reading) (in mL) | | | Mean (in mL) |
|---|---|---|---|---|---|
| | | Initial | Final | Difference | |
| 1 | 10 | 0 | 10.9 | 10.9 | 10.3 |
| 2 | 10 | 10.9 | 20.6 | 9.7 | |

**Table-2:** ***Determination of the amount of copper in a supplied solution of blue vitriol by iodometric method.***

| No. of reading | Vol. of Copper salt solution (in mL) | Vol. of $Na_2S_2O_3$ (burette reading) (in mL) | | | Mean (in mL) (V) |
|---|---|---|---|---|---|
| | | Initial | Final | Difference | |
| 1 | 10 | 0 | 9.1 | 9.1 | 8.73 |
| 2 | 10 | 9.1 | 17.7 | 8.6 | |
| 3 | 10 | 17.7 | 26.2 | 8.5 | |

# CALCULATIONS:

*Strength of $K_2Cr_2O_7$ solution* = $\frac{Weight\ taken\ (in\ gm) \times 0.1}{0.49}$ (N) = $\frac{0.5 \times 0.1}{0.49} = 0.102$ N

*Strength of supplied $Na_2S_2O_3$ solution* (S): $V_{thio}$ x $N_{thio}$ = $V_{dichromate}$ x $N_{dichromate}$

or, $N_{thio}$ = $\frac{10 \times 0.102}{10.3} = 0.099$ N

$2\ CuSO_4 \equiv I_2 \equiv 2\ Na_2S_2O_3$

1 ml 1N $Na_2S_2O_3 \equiv$ 0.06354 gm of $Cu^{2+}$

*Amount of copper ions in 10 mL of copper salt solution* = 0.06354 × V × S gm
= 0.06354 × 8.73× 0.099 gm
= 0.054 gm.

*Amount of copper ions in 500 mL of copper salt solution* = 0.06354 × V × S × 50 gm
= 0.06354 × 8.73× 0.099 × 50 gm
= 2.70 gm.

*Observe value of $Cu^{2+}$ (in 500mL solution)* = 2.70 gm.

*Known value of $Cu^{2+}$ (in 500mL solution)* = 2.543 gm.

# PERCENTAGE OF ERROR:

$$\left| \frac{\text{Known value} - \text{Observed value}}{\text{Known value}} \right| \times 100\%$$

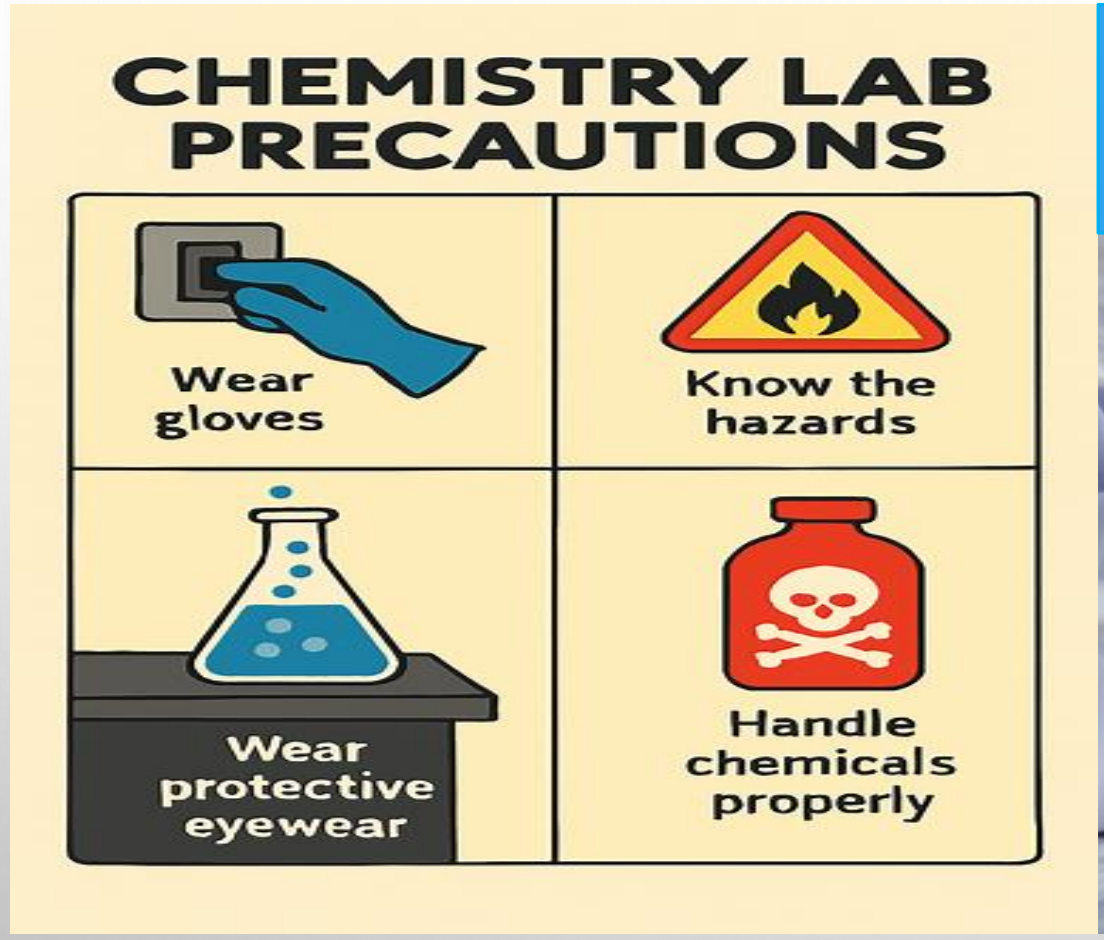
$$= \left| \frac{2.543 - 2.70}{2.543} \right| \times 100\%$$

$$= 6.17\%$$

# RESULTS:

***Amount of copper ions in 500 mL of copper salt solution*** **= 2.70 gm**

# DISCUSSIONS

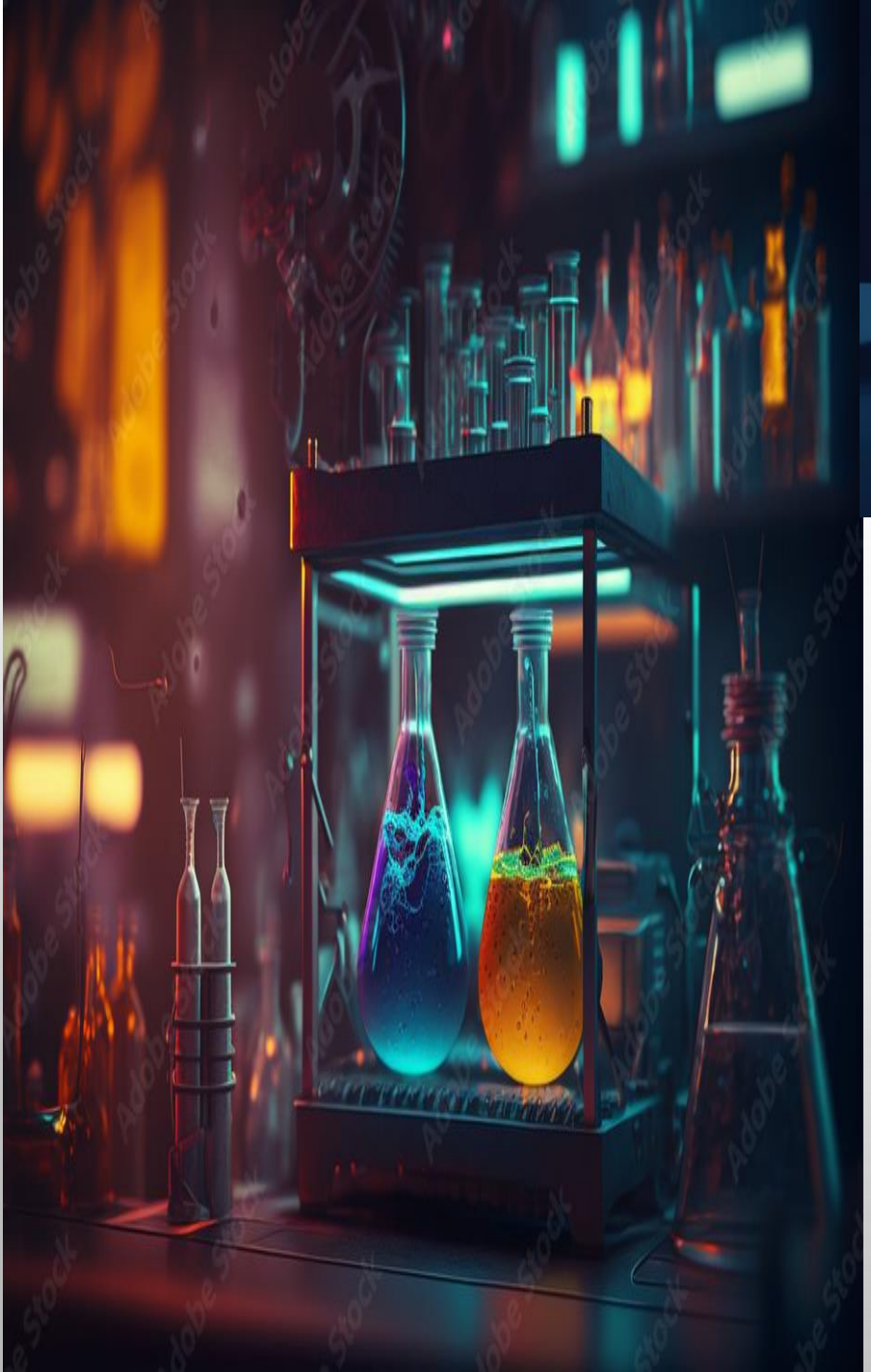



## *POSSIBLE ERRORS*

**In this experiment, the percentage of error obtained was 6.17%, which may be occurred due to lack of precautions or possible errors. The precautions taken for this experiment and possible errors that could have been occurred are as follows:-**

## ***PRECAUTIONS TAKEN:***

- **The burette was checked for air bubbles in the nozzle before starting the titration to ensure correct volume delivery.**
- **The flask was gently swirled continuously during titration to ensure uniform mixing of reactants.**
- **All glassware such as burette, pipette, and conical flask were properly cleaned with distilled water before use to avoid wrong volume.**
- **The sodium thiosulphate solution was protected from air and light as it can decompose on exposure, which may affect its strength.**
- **The titration was carried out slowly near the end point to ensure accurate detection of the color change.**



## ***POSSIBLE ERRORS:***

- **Impurities present in the supplied copper salt solution may interfere with the liberation of iodine.**
- **Inaccurate standardization of sodium thiosulphate solution directly affects the calculated copper content.**
- **Parallax error may occur while reading the burette, which can cause slight variation in volume measurement.**
- **Incomplete mixing of the solution during titration may result in uneven reaction and inaccurate end point detection.**
- **Excess addition of ammonium hydroxide or acetic acid may disturb the reaction conditions, affecting the final result.**

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# ON BEHALF OF GROUP-7

***THANK YOU***