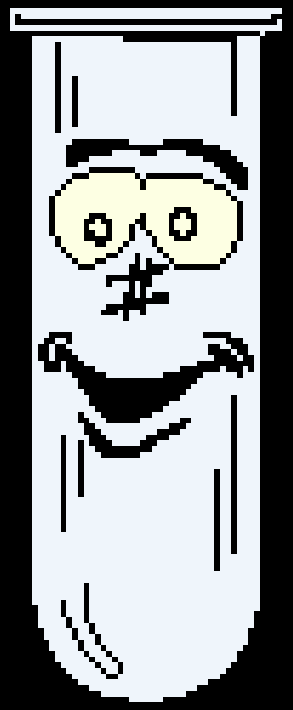
Determiniation of % Iron



- The goal of this experiment is to determine the percent Iron in an unknown sample.

What do we need so solve our objective?

- Percent mass of Iron.
- Need mass of Iron sample.
- Need the mass of the Iron
- Divide mass of iron by total mass
- Fe_{mass} /total mass * 100 = % mass

How Do we determine the mass of the iron?

- Titrate against a known standard.
- Standard -- $KMnO_4 \rightarrow K^+ + MnO_4^-$
  - MnO_4^- is a strong Oxidizer. In other words, It has Oxygen which it can give up.
  - $MnO_4^- \rightarrow Mn^{2+}$ (Manganate's most stable state is Mn^{2+})
  - What is the reaction??

Standardizing known MnO_4^-

$MnO_4^- + C_2O_4^{-2} \leftrightarrow Mn^{2+} + CO_2$

- Why did we have to standardize the MnO_4^-
  - Verify/determine the concentration of known.
  - Why is this extra step needed?
    - Many times the solid substance has water integrated in with the crystal. This water can very. Some substances absorb water from the atmosphere, hydroscopic.
    - Therefore if you mass out 1.1 grams of your known are you really sure all of that 1.1 grams is your chemical or is some of that water.
    - Many times your known is standardized by a dried sample one that is not hydroscopic.
    - Standardization is a common and very important lab concept.

Lets Do Some Math

- Goal: Determine concentration of MnO_4^-

	$Na_2C_2O_4$	$KMnO_4$
Molarity	X (solid)	?
mol	Measure →	
Liters	X (solid)	Measured from buret

MnO_4^- vs. *Fe sample*

- $8H^+_{(aq)} + MnO_4^-{}_{(aq)} + 5Fe^{2+}_{(aq)} \rightarrow Mn^{2+}_{(aq)} + 5Fe^{3+} + 4H_2O$

- NOTE:
  - MnO_4^- is a very dark purple substance
  - Fe^{2+} is colorless
  - Mn^{2+} is colorless
  - Fe^{3+} has a light yellow tint.

- As the titration takes place the purple is consumed by the iron ions. After all the iron is consumed purple color will remain.
- For every $5Fe^{2+}$ present 1 MnO_4^- ions are consumed.

So how did that give us the answer???

- Note: In order to determine an unknown you must have a known to compare it to.
- In this case the MnO_4^- is our known standard.
- If in the titration we consumed .71 moles of our MnO_4^- then we know the it is a 1:5 ratio between the known(MnO_4^-) and the unknown (Fe^{2+})
- .284 moles of our unknown was present in the sample tested.

Don't lose sight of the objective and what you need to achieve.

- We need our mass of the iron so we can determine the mass percent.
- Once we have determined the moles of the Fe present in the sample we can convert that to mass
- Mass Fe/total mass of sample. * 100 = % mass

Error analysis

- How would your percent iron be affected by the following (think a minute)?
  - $KMnO_4$ absorbing water before massing?
  - Adding additional water to your Iron sample during titration in order to make stirring easier.
  - Titrating to the first purple color present.

$KMnO_4$ absorbing water before massing?

- Absorbing water would mean we actually have less MnO_4^-.
- Which means our concentration is lower.
- Therefore it will take more MnO_4^- which will increase our moles of MnO_4^- and by the stoich ratio will increase our moles of Fe^{2+}.
- Increasing our moles of Fe^{2+} increases the mass and therefore increases our percent mass.

Adding additional water to your Iron sample during titration in order to make stirring easier.

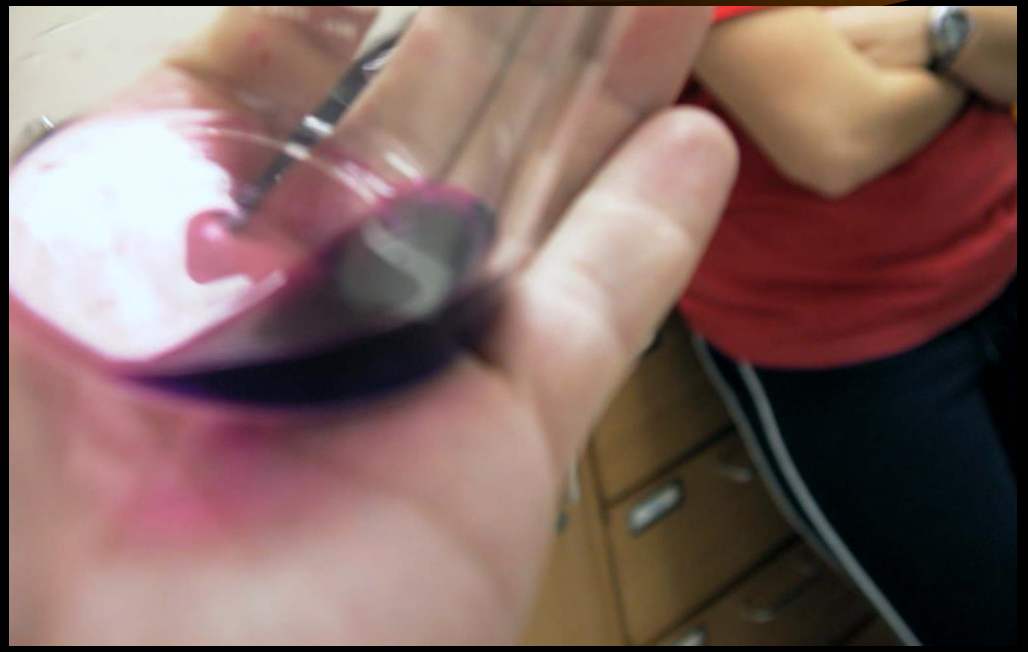
- We are titrating on a mole basis. You have already recorded the mass of iron and your additional water will not affect your chemical reaction nor the stoich ratio therefore additional water will not affect the result.

Titrating to the first purple color present.

- Technically titrating to the first purple color would yield an incorrect result.
- Remember, When you see a purple color that means that all of the Fe^{2+} is already gone so you have over titrated (although slightly) To correct a back titration could be used.
- An increased MnO_4^- means increased Fe^{2+} and therefore increased % mass of Fe.

Descriptive Chemistry?

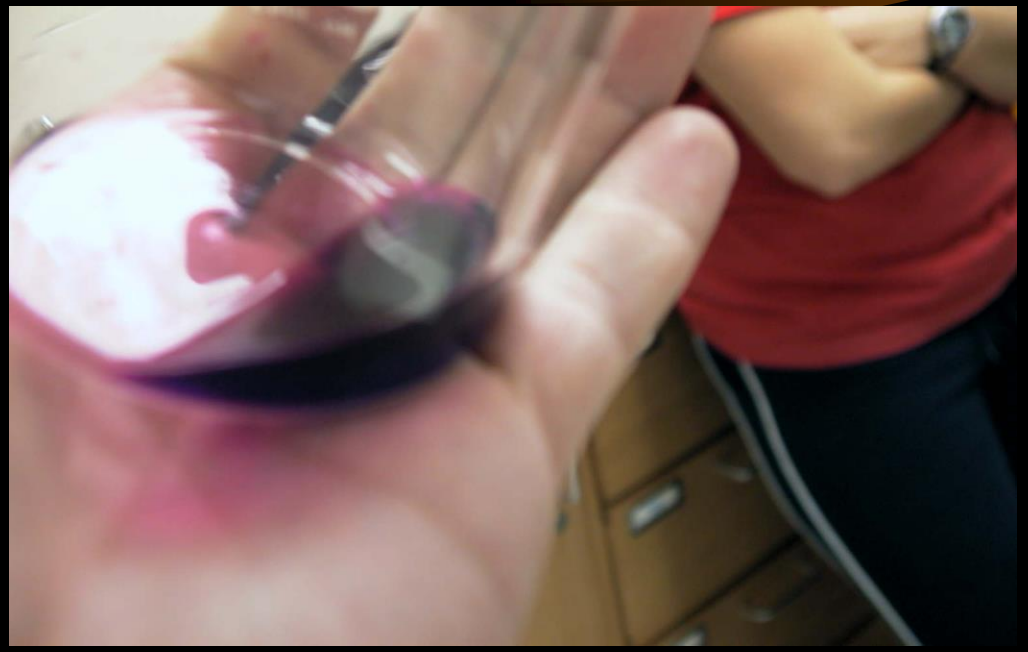
- What is the formula of the purple substance?



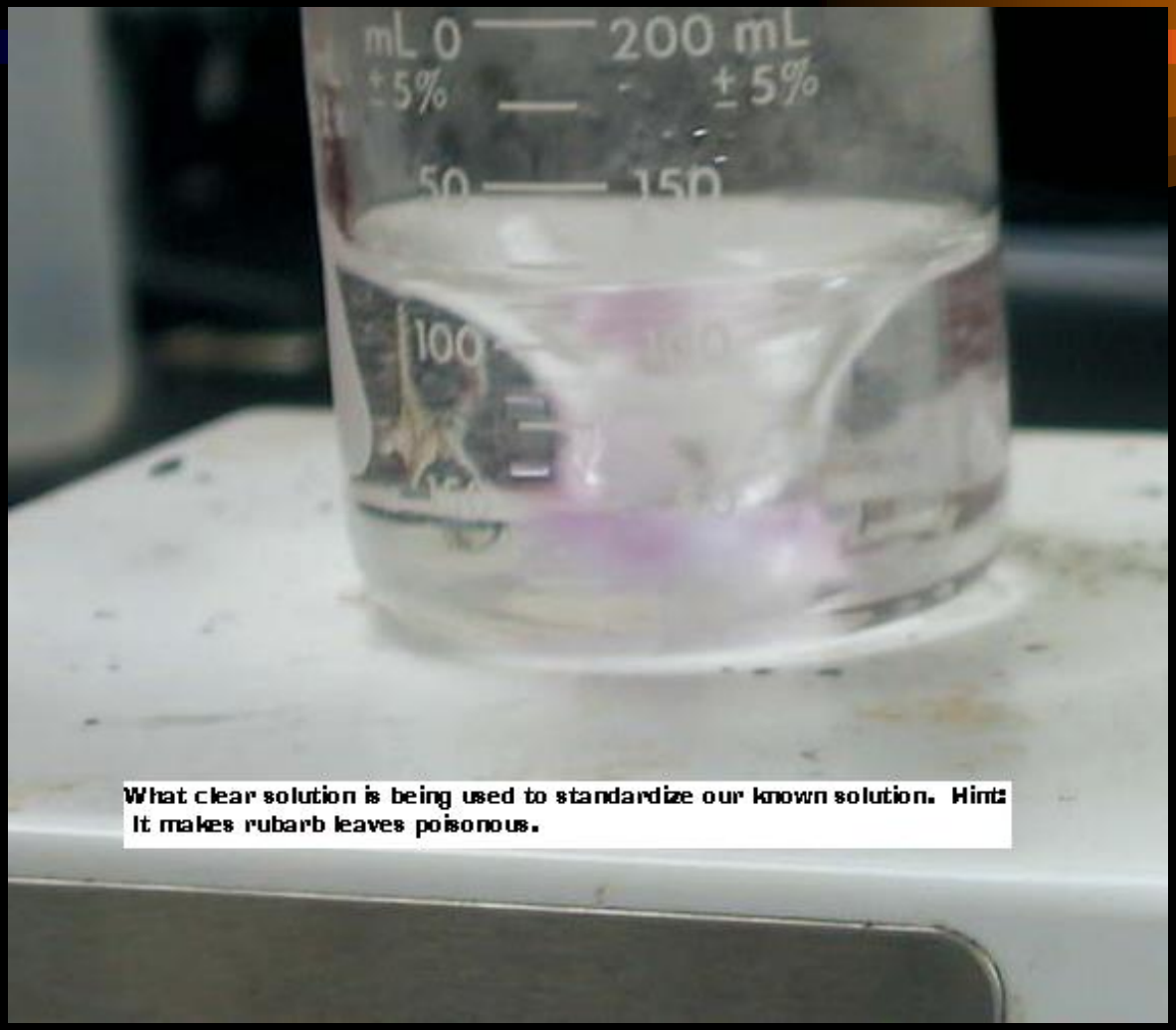
Descriptive Chemistry?

- What is the formula of the purple substance?

$KMnO_4$

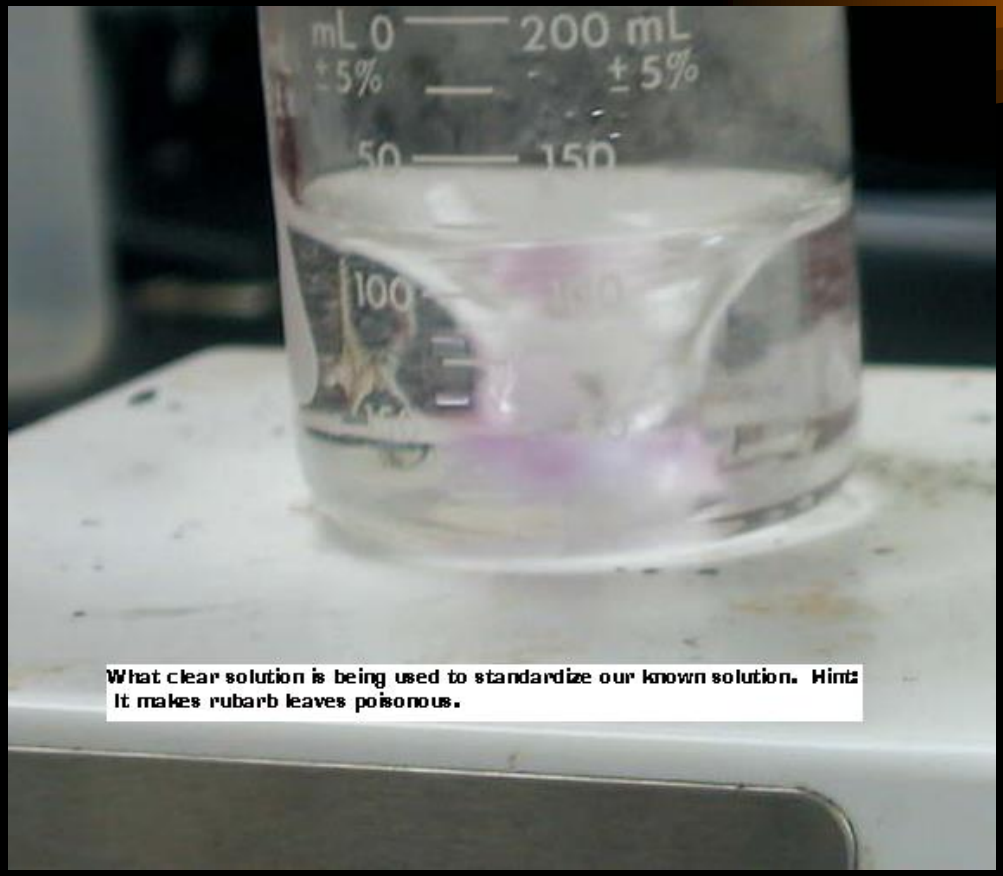


Descriptive Chemistry?



Descriptive Chemistry?

$Na_2C_2O_4$



Descriptive Chemistry

- What is the yellow solution?

Descriptive Chemistry

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- Fe^{3+}

Descriptive Chemistry

- What is this yellow powder?

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- Yellows and reds are common Iron compounds..