Chemistry 20	Unit 4
Lesson 1 - Introduction to Stoichiometry	84 mins

Chemical Reactions Review

Single Replacement Reaction $A + BC \rightarrow B + AC$	Silver is formed when copper wire is placed in a solution of silver nitrate overnight. $Cu_{(s)} + 2AgNO_{3(aq)} \rightarrow 2Ag_{(s)} + Cu(NO_3)_{2(aq)}$ ***Questions left unanswered:*** - ***What does pure copper look like?*** - ***What does an aqueous solution of silver nitrate look like?*** - ***What kind of apparatus should be used to contain this reaction?*** - ***Does it matter if the silver nitrate is dissolved in water?*** - ***How much copper would be reasonable to use? How much silver nitrate would be reasonable to use?*** - ***How much water would be reasonable to use?***

Limitations to Reactions Equations

Consider the reaction of a candle

$$C_{25}H_{52(s)} + 38\ O_{2(g)} \rightarrow 25\ CO_{2(g)} + 26\ H_2O_{(g)} + \text{heat energy}$$

What does the equation tell us? - ***Wax and oxygen combine to make 2 invisible gases and heat.*** - ***We can see this with tests for CO_2, H_2O*** - ***We can see the flame and feel the heat energy*** - ***How much of each substance is needed in relation to the others*** - ***How much products are made.***	***What does the equation NOT tell us?*** - ***Flame is caused by unreacted C (incomplete combustion) getting excited.. Flame would be blue otherwise*** - ***Wax is stated as a solid… but in reality only gaseous wax can burn***

Chemical equations do not describe or explain: - What conditions are needed for the reaction (temperature and pressure) - How the products are actually formed from the reactants. - How long the reaction will take - What measurable quantities are needed for the reaction to happen	Generally STAP unless otherwise stated This can be a simple one step or SEVERAL steps before the products are formed… $2Mg_{(s)} + O_{2(s)} \rightarrow 2MgO_{(s)} + \text{Heat}$ - Could be slow… oxidation (rusting) - Could be fast! Old time camera flashes Is a solution of 1.0M strong enough? Or too strong?????

Reaction Assumptions

What are some assumptions that we make when talking about reactions?

- Reactions are FAST
- Reactions are spontaneous
- Reactions are ***quantitative***, React fully
  - At least one reactant will be completely used up.
- Reactions are ***stoichiometric***, the simple whole number ratios never change no matter what conditions the reaction is in.

Some reactions are slow (Rusting
Some reactions ONLY happen in special conditions

- Gasoline will not combust unless a spark (heat) is added…. Even in 100% oxygen.

What happens to wood when burned? Is all the oxygen used up? All the wood?
Is CO_2 and H_2O the ONLY products when burning a candle? Will that change when it's hot out or cold?

How do Reactions Occur?

Collision theory

- The idea that reactants have to bump into one another to chemically react

Generally why we use solutions.

- Generally the easiest way to ensure that the chemicals have a chance to collid.
- Can easily control the concentration, effectively controlling the reaction speed.

Net Ionic Equations

- A simplified equation showing ONLY what is actually changing.

Ask yourself:
What is occurring? Is any ions just spectators?

Look at:

$$Cu_{(s)} + 2AgNO_{3(aq)} \rightarrow 2Ag_{(s)} + Cu(NO_3)_{2(aq)}$$

1) split up any ionic compounds.

$$Cu_{(s)} + 2Ag^{+}_{(aq)} + 2NO_3^{-}{}_{(aq)} \rightarrow 2Ag_{(s)} + Cu^{2+}_{(aq)} + 2NO_3^{-}{}_{(aq)}$$

2) Remove any ions/chemicals that are the EXACT same on both sides

$$Cu_{(s)} + 2Ag^{+}_{(aq)} + \cancel{2NO_3^{-}{}_{(aq)}} \rightarrow 2Ag_{(s)} + Cu^{2+}_{(aq)} + \cancel{2NO_3^{-}{}_{(aq)}}$$

3) Rewrite what is left over (Net Ionic Equation)

$$Cu_{(s)} + 2Ag^{+}_{(aq)} \rightarrow 2Ag_{(s)} + Cu^{2+}_{(aq)}$$

$$Pb(NO_3)_{2(aq)} + 2\,NaI_{(aq)} \rightarrow PbI_{2(s)} + 2\,NaNO_{3(aq)}$$

$$Pb^{2+}_{(aq)} + \cancel{2NO_3^{-}{}_{(aq)}} + \cancel{2Na^{+}_{(aq)}} + 2I^{-}_{(aq)} \rightarrow PbI_{2(s)} + \cancel{2Na^{+}_{(aq)}} + \cancel{2NO_3^{-}{}_{(aq)}}$$

Net Ionic

$$Pb^{2+}_{(aq)} + 2I^{-}_{(aq)} \rightarrow PbI_{2(s)}$$

$$Pb(CH_3COO)_{2(aq)} + MgI_{2(aq)} \rightarrow PbI_{2(s)} + Mg(CH_3COO)_{2(aq)}$$

$$Pb^{2+}_{(aq)} + \cancel{2CH_3COO^{-}_{(aq)}} + \cancel{Mg^{2+}_{(aq)}} + 2I^{-}_{(aq)}) \rightarrow PbI_{2(s)} + \cancel{Mg^{2+}_{(aq)}} + \cancel{2CH_3COO^{-}_{(aq)}}$$

Net Ionic

$$Pb^{2+}_{(aq)} + 2I^{-}_{(aq)} \rightarrow PbI_{2(s)}$$

- We can conclude that these are the same reaction

Chemistry 20 - Unit 4 - Introduction to Stoichiometry

Name: _____

1) An acceptable method for the treatment of soluble lead waste is to precipitate the lead as a low solubility lead(II) silicate.
    a) Write the net ionic equation for the reaction of aqueous lead(II) nitrate and aqueous sodium silicate.

    b) What can we assume about the ambient conditions and the container that likely could be used?

    c) Identify the spectator ions in this reaction.

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2) In a hard water analysis, sodium oxalate solution reacts with calcium hydrogen carbonate present in the hard water to precipitate a calcium compound. Write the net ionic equation for this reaction.

3) Write a net ionic equation for the reaction of vinegar (acetic acid solution) with a scale deposit in a kettle (assume solid calcium hydroxide).

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