

Announcements

- Website is UP!
-no lecture slides . . . yet . . .
- Thankyou for the emails!
-if you emailed me, you *should* have received a response from me
- Office hours/review session scheduling
-I hope to have info for you by Friday

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How do we write a reaction?

- In words:
oxygen + hydrogen -> (product)
- In symbols:
 $O_2(g) + 2H_2(g) \rightarrow 2H_2O(g) (+heat)$
- called a **combustion reaction**
- Symbols indicate *structure*:
 $O=O + 2H-H \rightarrow 2H-O-H$

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Chemical Change

- Bonds were broken (H-H and O=O)
- Bonds were formed (2H-O bonds)
- The *IDENTITIES* of the reactant compounds were **CHANGED by the process**
- *How does this differ from a purely physical change?*

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Reaction Energetics

- Energy is *consumed* to break bonds
 - Energy is **released when making bonds**
- If $E_{\text{released}} > E_{\text{consumed}}$,
HEAT is given off
- (*Thermodynamics!*)

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Quantifying Chemical Change

- H₂ and O₂ react in a 2:1 ratio to make water

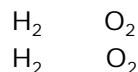
-*reaction must be balanced*
(Conservation of Mass)

-for a compound, elements always present in *definite proportions*
(*Stoichiometry*)

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Quantifying Chemical Change

- In our experiment, we had a 1:1 mixture of gases:



Both React *Only ONE Reacts*

(Limiting Reagent) (EXCESS Reagent)

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Quantifying Chemical Change

- Energy release:

8.0 x 10⁻¹⁹ Joules
(for each molecule of O₂)

In our balloon: 15,000 Joules

- about 3.5 KCalories (Kcals)
- Calories does not = "Calories"

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Gas Properties

- Why did the balloon EXPLODE?

-rapidly heated gases
-rapid *EXPANSION* of gases
-***explosive shockwave!***

- How can we make a *bigger* explosion?

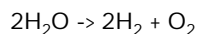
- Where did the product (water) go?

-2 grams of reactant gases make less than a thimbleful of water
-***vaporized!***

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Other Questions:

- Can the *REVERSE* reaction occur?



How?

- Why doesn't the H_2/O_2 mixture spontaneously explode (without being ignited)?

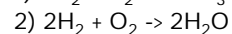
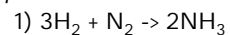
KINETICS!

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Still More Questions!

- What happened with Balloon III?

Two possible reactions:



(#1 is too slow; #2 got O_2 from the air)

- How do we *know* that atoms and molecules exist?

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Some History

- Democritus

-Greek Philosopher (5th Century B.C.)

Asked: "Is there a limit to which something can be divided and yet still remain the same material?"

YES!

Atomos ("indivisible")

BUT: there was no experimental evidence
"Show us!" - Aristotle and Plato

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More History

- Lavoisier

-18th Century Frenchman

-Wrote the 1st Chemistry text

-Considered the "Father of Chemistry"

Rigorously quantified masses **before and after** a chemical reaction (in a closed system):

Law of Conservation of Mass

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