

[TP] What does the following chemical equation tell us?

$Cu(s) + 2\ Ag^+(aq) \rightleftharpoons Cu^{2+}(aq) + 2\ Ag(s)$

14% 1. If 0.731 mol Cu reacts, then 0.731 mol Cu^{2+} will be formed
14% 2. 2 mol of Ag^+ will form 1 mol Cu^{2+}
14% 3. 10 g Cu will form 10 g Cu^{2+}
14% 4. 1 and 3
14% 5. 2 and 3
14% 6. All of the above
14% 7. None of the above

Response Counter 10

Lecture 10 CH101 A1 (MWF 9 am)

Friday, September 30, 2016

For today ...

- Complete Ch4: (secs 1, 3, and 4 only): How the atmosphere warms
  Think about It e4.4: Collisional heating http://goo.gl/vQ0Nz
  Think about It e4.5: IR windows http://goo.gl/I8IGz

Begin ch5: Chemical reaction, chemical equations

- What a chemical equation tells us
- Balancing chemical equations
- Stoichiometry: Amounts in chemical transformations

Next lecture: Complete ch5: Limiting reagent and percent yield; begin ch6: Water chemistry: H-bonding in ice and water

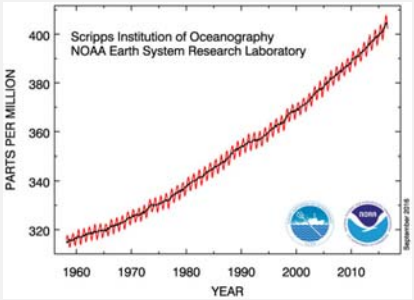
e4.4: Heating due to Greenhouse Gases

Think about It e4.4: http://goo.gl/vQ0Nz

e4.5: IR spectral windows

e4.5: http://goo.gl/I8IGz

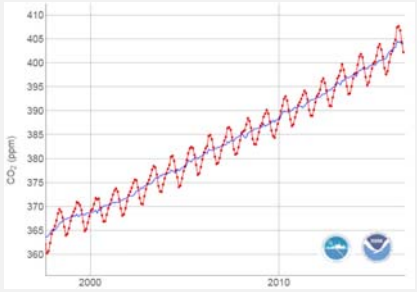
Atmospheric CO_2 at Mauna Loa Observatory



1958: 315 ppm → 2016: 404 ppm

Increase = **89 ppm**, 89/315 x 100% = **28%**

Atmospheric CO_2 at Mauna Loa Observatory



1997: 364 ppm → 2016: 404 ppm

Increase = **40 ppm**, 40/364 x 100% = **11%**

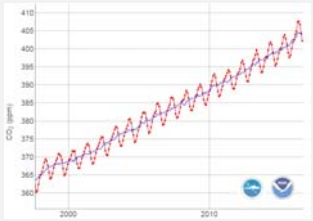
1997 → 2016: 40 ppm additional CO_2

40 ppm = 40 μmol CO_2/(mol air)

Atmosphere is 5.2×10^{18} kg, 29 g/mol (~ 80% N_2, 20% O_2)

How many kg of CO_2 added to atmosphere since 1997?

- mol of air = 1.8×10^{20} mol
- mol of CO_2 = $40 \times 10^{-6} \times$ mol air
- mass of CO_2 = ...
  - mol CO_2 x 0.044 kg/mol = ...
    - 3.2×10^{14} kg



[TP] Which do you think is true about the atmosphere

13% 1. Human activity has added greenhouse gases
13% 2. Reducing water content would lower temperature
13% 3. Reducing greenhouse gas content would lower temperature
13% 4. Temperature will continue to rise
13% 5. 2 and 3
13% 6. 1, 2, and 3
13% 7. 2, 3, and 4
13% 8. All of the above

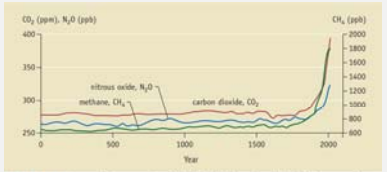


FIGURE 4.4 Atmospheric concentration of CH_4 (ppb), CO_2 (ppm), and N_2O (ppb) gases over the past 2000 years.

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[Quiz] Which is true?

25% 1. Only methane and other carbon containing molecules contribute to atmospheric heating

25% 2. Water molecules contribute to atmospheric heating

25% 3. Absorption of IR light by N_2 and O_2 causes atmospheric heating

25% 4. Only 2 and 3 are true

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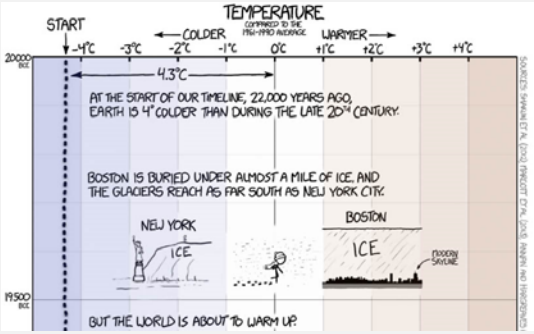
Timeline of Earth's average temperature …

… since the last ice age glaciation

When people say "the climate has changed before,"
these are the kind's of changes they're talking about.

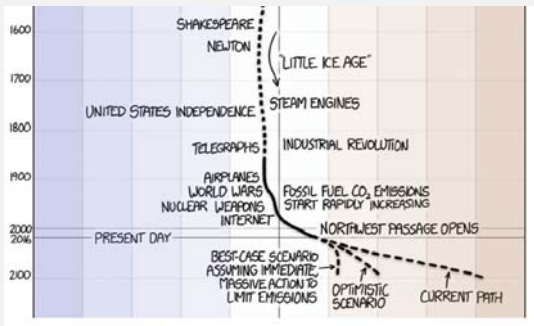
http://xkcd.com/1732/

Timeline of Earth's average temperature …



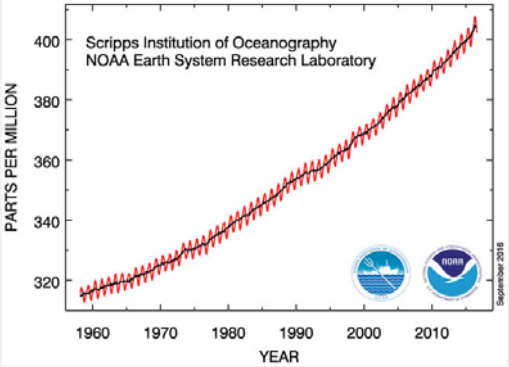
http://xkcd.com/1732/

Timeline of Earth's average temperature …



http://xkcd.com/1732/

And so it goes …



Ch5: Chemical reaction, chemical equations

A chemical equation tells us …

$$Cu(s) + 2\ Ag^{+}(aq) \rightleftharpoons Cu^{2+}(aq) + 2\ Ag(s)$$

- Relative amounts (in mol) of species that are needed to react and that could be formed

A chemical equation cannot tell us …

$$Cu(s) + 2\ Ag^{+}(aq) \rightleftharpoons Cu^{2+}(aq) + 2\ Ag(s)$$

- How much of each species reacts
- How much reactants are present
- Which direction is spontaneous
- Whether energy is released or absorbed
- How fast a reaction proceeds
- The microscopic mechanism of the reaction

All of these are goals of the remainder of CH101 and CH102

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Balancing chemical equations (by inspection)

Balancing chemical equations (by inspection)

$$C_6H_{12}O_6(s) + O_2(g) \rightarrow CO_2(g) + H_2O(l)$$

- Adjust coefficients (but never change subscripts)
- Coefficients are molar amounts, so fractions OK
- Set coefficient of most complicated molecule to 1
- Save elements for last
- Don't forget about states (*s*, *l*, *g*, and *aq*)
- Check your final result (never partial credit!)

Practice

$$C_6H_{12}O_6(s) + O_2(g) \rightarrow CO_2(g) + H_2O(l)$$

$$C_6H_{12}O_6(s) + O_2(g) \rightarrow \mathbf{6}\ CO_2(g) + H_2O(l)$$

$$C_6H_{12}O_6(s) + O_2(g) \rightarrow 6\ CO_2(g) + \mathbf{6}\ H_2O(l)$$

$$C_6H_{12}O_6(s) + \mathbf{6}\ O_2(g) \rightarrow 6\ CO_2(g) + 6\ H_2O(l)$$

Stoichiometry: Amounts in chemical transformations

[TP] Intense exercise uses lactic acid,
$CH_3CH(OH)C(O)OH$ and shown at below,
as a combustion fuel. How many moles of carbon dioxide are formed for each mole of lactic acid "burned" completely in the oxygen of air, forming CO_2 and water?

20% 1. 3 mol CO_2
20% 2. 6 mol CO_2
20% 3. 9 mol CO_2
20% 4. 12 mol CO_2
20% 5. None of the above

Lactic Acid

