

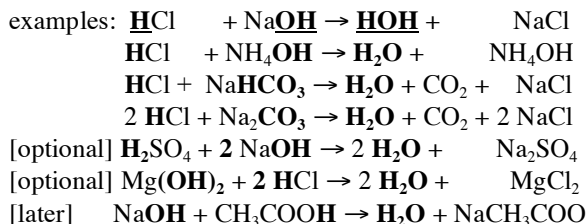
Exam 3 – Learning Objectives (by CR for 89-90)

ACID-BASE Reactions (explained in sections 6.1-6.4 of CiC)

Step 1: write neutral ion-combos (e.g. Na_2CO_3 not NaCO_3)

Step 2: match reactors with correct numbers (e.g. $\text{H}^+ + \text{OH}^-$ to form H_2O ; or $\text{H}^+ + \text{HCO}_3^-$ to form H_2CO_3 , or $2\text{H}^+ + \text{CO}_3^{2-}$)

Step 3: React-and-Balance (reactors $\rightarrow \text{H}_2\text{O}$ or H_2CO_3 [or $\text{H}_2\text{O}(\text{l}) + \text{CO}_2(\text{g})$], and spectators \rightarrow salt, which is a +/- combo that isn't an acid, isn't a base] Here are **neutralization** rxns:



For the two lines below, you can look at a pH scale (e.g. as on my Quiz 6 handout) while you're thinking about pH relationships. up/down relationships: for $\text{SO}_3 + \text{H}_2\text{O}$, $[\text{H}^+]$ increases (acidity \uparrow , pH \downarrow); $\text{NH}_3 + \text{H}_2\text{O}$, $[\text{OH}^-]$ increases (basicity \uparrow , pH \uparrow , acidity \downarrow). dilutions: diluting acid makes it more neutral (pH = 7), less acidic, pH \uparrow ; diluting base makes it more neutral, less basic, pH \downarrow .

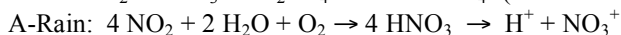
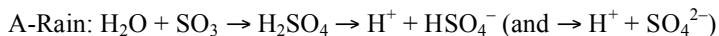
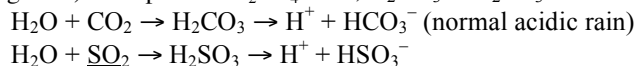
“Main Concepts” on Study Guide (all covered on *handouts*),

Above: Acid-Base (3f/3i), Acid Rain (4ab), demos (NH_3 , S).

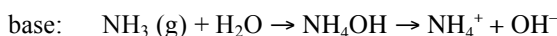
Quiz 6: CFCs [top], pH scale & calculations (3e/5a) [middle], [lower-middle] Solutions (3abcd) & conductivity/pH demo.

Acid-Forming Reactions (from Exam 2, Refrigerator Lab, ...)

On pages 255-256 of CiC, 2 sources of Acid Rain are SO_3 (from combustion of S to SO_2 -(air) \rightarrow oxidized to SO_3) and NO_2 (from NO (in high-temp engines/furnaces) -(air) \rightarrow oxidized to NO_2); normal (unpolluted) rain is slightly acidic (pH \approx 5.3 on Nov 2, slide 25) due to dissolved CO_2 but this isn't defined as Acid Rain (pH range 3-5). 2nd proton: H_2SO_4 most, H_2CO_3 & H_2SO_3 a little.



NO



Quiz 7a: mole calculations (5b) & lab calcltns, E balance (2bc).
Quiz 7b: HC isomers (6), polarity (1), calculation-precision.
Below: Polarity (1), Greenhouse balance/gases (2 = 7 8 9 10).

1a-b-c-d: polarity of molecule is determined by electronegativity (metals $\text{H} \approx \text{C} \text{ N/Cl O F}$) & molecular geometry (“canceling” due to symmetry?). polarity of molecule is observed in properties (like dissolves like, with polar water); if dissolves, it's polar [or it reacts and “disappears” into solution]; if (e.g., CFCs) doesn't dissolve, it's *nonpolar*. [also see bottom of #6, middle-right of #7b]

	name of gas	molecular shape	polar?	reacts with H_2O ?	name of rxn-product
NH_3	ammonia	trigonal pyramid	yes!	yes, $\rightarrow \text{NH}_4\text{OH}$	ammonium hydroxide *
HCl	hydrogen chloride	(trivially linear)	yes!	yes, $\rightarrow \text{HCl}(\text{aq})$	hydrochloric acid
NO_2	nitrogen dioxide	bent (: , 3 dirns) •	yes	yes, $\rightarrow \text{HNO}_3$	nitric acid
SO_3	sulfur trioxide	trigonal planar	no	yes, $\rightarrow \text{H}_2\text{SO}_4$	sulfuric acid
SO_2	sulfur dioxide	bent (: , 3 dirns)	yes	yes, $\rightarrow \text{H}_2\text{SO}_3$	sulfurous acid
<i>Does gas “wash out in rain”? above yes, below no</i>			<i>2 factors affect solubility</i>		
CO_2	carbon dioxide	linear	no	yes, $\rightarrow \text{H}_2\text{CO}_3$	carbonic acid
CF_2Cl_2	dichlorodifluorom...	tetrahedral	small	no	n.a.
O_2	oxygen	(trivially linear)	no	no	n.a.
N_2	nitrogen	(trivially linear)	no	no	n.a.

* aka household ammonia (solution of ammonia in water); ammonia fountain demo (bottom-left of ho #6), more is above-and-right.

Additional Study Questions in the final part (6, 7 8 9 10) of the “Exam 3 Study Guide”; look at it while you read my comments.

6a/e: “drawing isomers” (#7b): W , C_5H_{12} & C_5H_{10} . F , C_6H_{14} .

6b: creativity + (“only connectivity matters”) same or different?

7a: “windows” has two \neq meanings (here, Asmt 4) [p 108-110]

7d/e, 10a-10g: Nov 9 (slides 11-33, 65-86); bottom of my #7a.

10e: fluorescence-ACE (Absorb UV, Convert, Emit visible) \approx pavement-ACE (Abs visible, Convert [\neq], Emit IR), sl 25-28.

8a-e,h: Nov 9/12, Slides 34-66. CiC, pages 119-123. Asmt 4.

8d: concentrations, CO_2 (.04%), O_2 (21%), N_2 (78%), Ar (.9%); most absorb IR (not atoms, diatomic symmetric molecules).

8h: Nov 9/12, sl 23-24. (over arrow: visible light, chlorophyll)

9a-g: Nov 9/12, sl 73-113/end. **9c** (CFCs by UV-C $\rightarrow \text{Cl}^\bullet$, in stratosphere, CH_4 by $\bullet\text{OH}$, CO_2 by ? (p 131 table, * comment); **9d/9e** (GWP is per molecule, concentration is 2nd factor; GWP depends on amount of IR-absorption, if absorbs in “windows”, atmospheric lifetime. **9a** (sources of methane, p 132).

lead iodide demo {L 21, sl 30, $\rightarrow \text{PbI}_2$ (s)}, heterogeneous soltn

Old Exams: lab-calculations for $\text{HCO}_3^-/\text{CO}_3^{2-}$ (2011-I, 2012-II); graph-labels (e.g. transm vs abs); answer using **correct units!** Comments about Coverage-Changes are in **our sections-page**.