

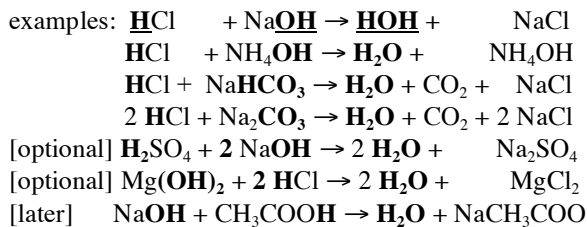
Exam 3 – Learning Objectives (by CR for 89-90)

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 .

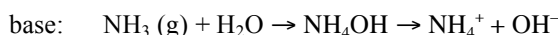
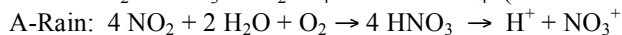
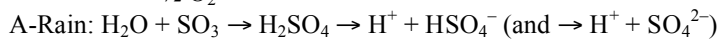
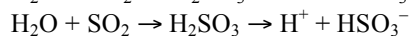
“Main Concepts” (objectives on Study Guide for Exam 3):

1a-b-c-d (below), 2a-b-c-d (at end), 3f/3j & 4a-4b (above), 3e/5a (handout #6, middle “2a, 2a”), 3a-b-c-d (ho #6, “2b, 2b”), 5b (ho #7a). We can talk about these (+ old exams...) T-W-R-E.

These ideas (left, below) are for demos (NH_3 , S) & 3f/3j, 4a/4b.

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.



LABS: check reactions above, calculations in both old exams.
demos: NH_3 (above, #6 bottom-left), cond/pH (#6 middle), lead iodide (L 21, sld 30, $\rightarrow \text{PbI}_2(\text{s})$), S (rxns above).

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.

* also 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 meanings (here, Asmt 4), \neq . [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 (not atoms, diatomic symmetric molecules) absorb IR.

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 $\bullet\text{OH}$, I'm not sure about CO_2 (here or in 9e; see *, p 131 table); **9d/9e** (GWP is per molecule, concentration is 2nd factor; GWP depends on amount of IR-absorption, if it absorbs in “windows”, atmospheric lifetime; **9a** (p 132).

I.O.U. – Tonight & tomorrow morning, I'll revise this semifinal version, and will add a few comments about the two Old Exams.