Final exam: Thursday, June 27th at 9:15 AM

1) $2NO(g) + O_2(g) + Na_2CO_3(g) \longrightarrow 2NaNO_2(aq) + CO_2(g)$

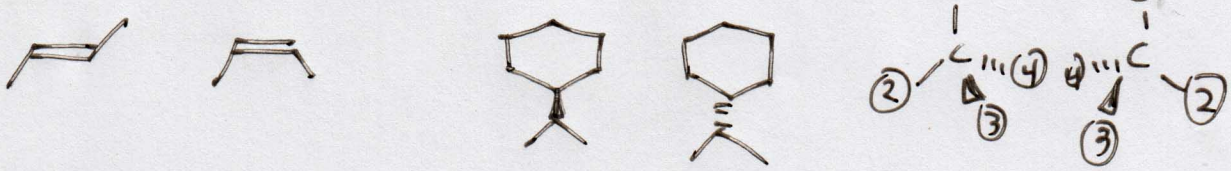
(+2 −2; 0; +1 −2; +1 −2; +4 −2; +4; +3)

N: +2 → +3 N was oxidized, so NO was the reducing agent

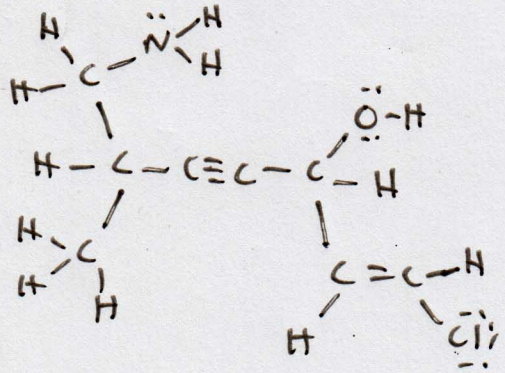
O: 0 → −2 O was reduced, so O_2 was the oxidizing agent

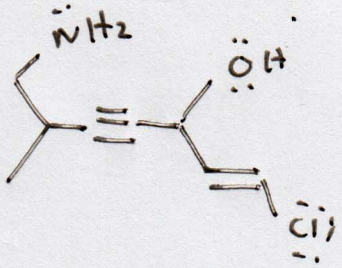
2) Constitutional isomers have the same molecular formula but different structures (different bond connectivity).

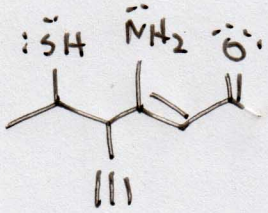
Stereoisomers have the same bond connectivity but different 3D arrangement

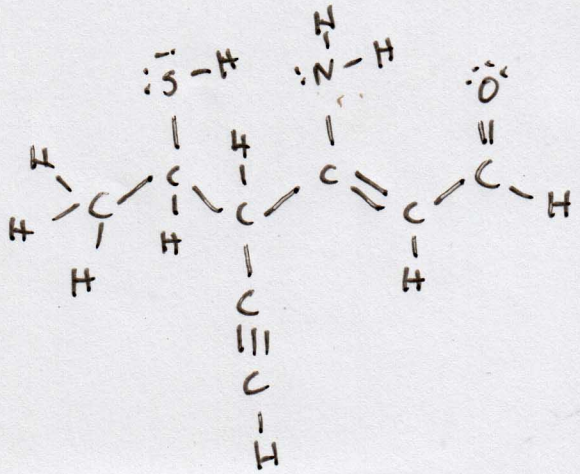


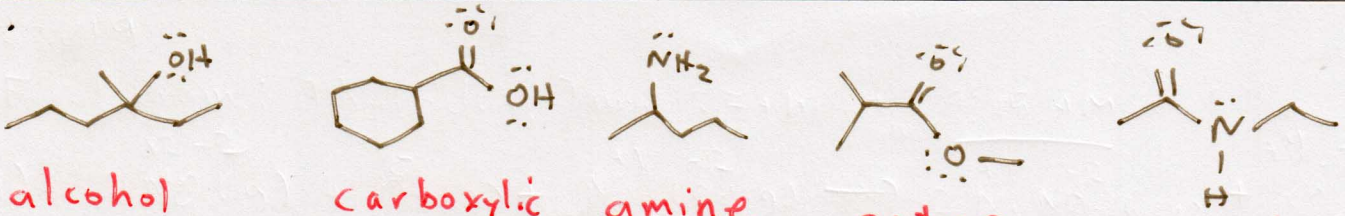
3)

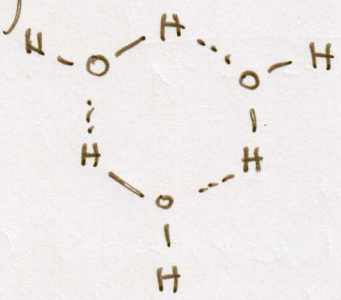










5) 

At low temperature, the hydrogen bonds in water are able to pull water molecules apart, creating spaces and therefore increasing the volume, which decreases the density. Ice floats because it is less dense than water.

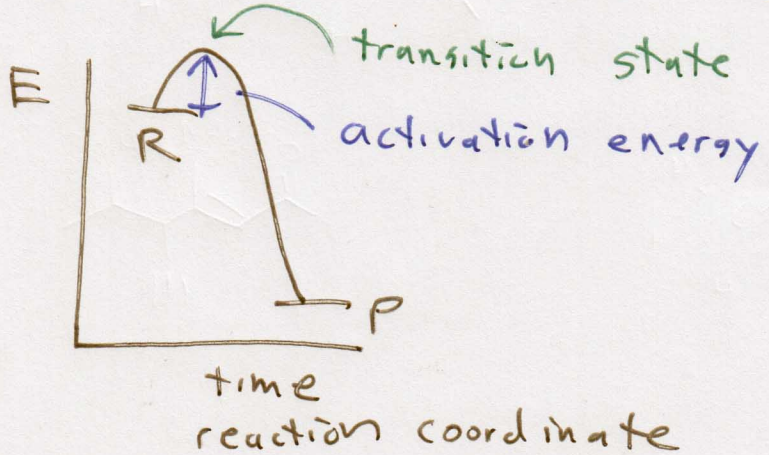
6) Specific heat is the amount of energy needed to raise 1g of a substance 1°C/K in temperature.

$$\Delta E = s \cdot m \cdot \Delta T = 4.18 \frac{J}{g \cdot K} \times 275 g \times (80°C - 25°)$$
$$= 63{,}000 \text{ J}$$

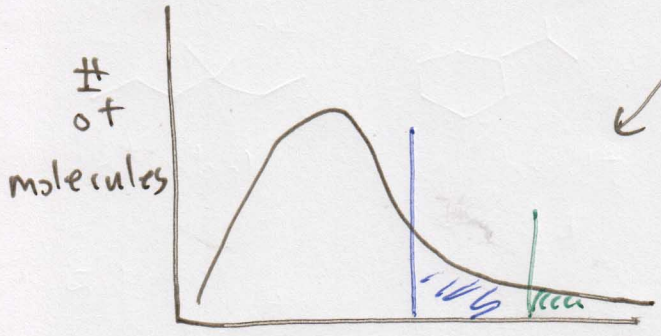
7) $2 H_2(g) + O_2(g) \longrightarrow 2 H_2O(e)$

Breaking a bond requires energy so it is an endothermic process.

$$\Delta E = 2 \times (H\text{-}H) + (O{=}O) - 4(O\text{-}H)$$
$$= 2 \times 435 + 502 - 4 \times 464 = -484 \text{ kJ/mol}$$
exothermic



Activation energy is the energy needed to reach the transition state to start a reaction.



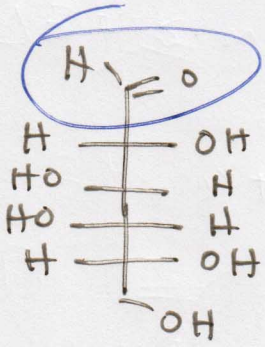
If there is a higher activation energy, fewer molecules have that energy, so the reaction proceeds more slowly.

A catalyst provides an alternate reaction pathway that has a lower activation energy.

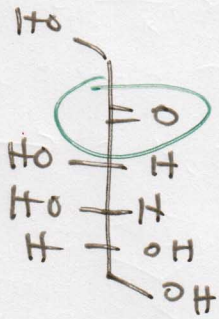
carbohydrate – A substance with the formula $(CH_2O)_x$

monosaccharide – contains only one sugar unit

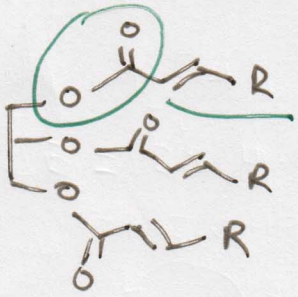
disaccharide – contains two sugar units



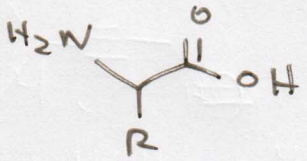
aldose – contains an aldehyde



ketose – contains a ketone



ester



an amino acid

An amide links amino acids together in proteins.

The sequence of a protein is the order of amino acids in that protein.

Final Exam

Chapter 1

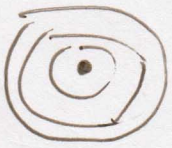
1.5 – mass versus weight
physical & chemical changes
1.6 – element, substance, mixture, compound
1.7 – metric units – m, kg, s, K, mol (L)
metric prefixes – G, M, k, c, m, μ, n
square & cubic units
unit conversions
1.8 – density
1.9 – Kelvin

Chapter 2

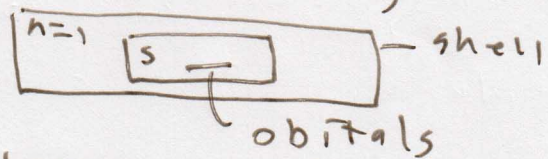
2.2 – law of conservation of mass
law of definite proportion
2.3 – law of multiple proportion
Dalton's atomic theory
2.4 – mole & molar mass
amu
2.6 – molecule H_2O versus NaCl

Chapter 3

3.1 – ion, cation, anion
3.4 – Rutherford Gold foil experiment
3.5 – proton, neutron, electron; nucleus
atomic #, mass #
isotopes
3.6 – Bohr model of atom



3.7 – orbitals, shells, subshells



electron configurations
3.8 – group, period
valence electron

Chapter 4

4.2 – Lewis dot structures (atom)
4.3 – ionic bonds
4.4 – octet rule
ion charges
4.5 – names of ionic compounds
4.6 – covalent bond
lone pairs; single, double, triple bonds
4.7 – electronegativity
4.9 – polyatomic ions
4.10 – Lewis dot structures (no formal charge)
4.11 – VSEPR theory
4.12 – molecular polarity versus bond polarity

Chapter 5

5.1 – Balance chemical equations
5.3 – percent composition
5.4 – stoichiometry
5.5 – solutions, solute, solvent
molarity (M) [ ]
concentration
mass %, volume %, ppm

Chapter 6

6.1 – solids, liquids, gasses
phase changes
6.3 – intermolecular forces (IMF)
dipole-dipole; hydrogen bonding
dispersion forces
6.4 – forces in solutions (ionic versus covalent)
6.5 – kinetic molecular theory
ideal gas
6.6 – behavior of gasses (balloon + can)
6.7 – ideal gas law ($PV=nRT$)

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$$

Chapter 7

7.1 - indicator
7.2 - Arrhenius + Brønsted-Lowry definitions of acids + bases
neutralized
7.4 - strong + weak acids + bases
7.6 - pH scale
neutral

Chapter 8

8.1 - oxidation + reduction (focus on electrons)
oxidation states
8.2 - oxidizing agents + reducing agents
8.3 - electrochemical cells
electrode - anode, cathode
salt bridge

Chapter 9

9.1 - line structures
hydrocarbons
functional groups
isomers - constitutional + stereo isomers
9.4 - list of functional groups
-9.7

Chapter 14

14.1 - water's unique behavior
- expansion of ice
- amphoteric
- specific heat

Chapter 15

15.2 - endothermic + exothermic
bond energies
15.3 - reaction coordinate diagram
activation energy + transition states
catalysts

Chapter 16

16.2 – carbohydrates – mono + di-saccharides
aldoses + ketoses

16.3 – fats (triglycerides)
fatty acids

16.4 – proteins
amino acids
sequence

End of Chem 10