BCH3033 PreTest

Principle: BCH3033 is the chemistry of biology which is a combination of both General Chemistry and Organic Chemistry of molecules that make up biological organisms. These are also the molecules from the environment that life uses as energy sources, carbon sources, other nutritional sources or have to detoxify. Absolutely essential about BCH3033 is the ability to **use your knowledge from General Chem and Organic**...the courses you have taken, now we will use these principles, concepts and facts to investigate the chemistry of life. This PreTest will help you assess what in General Chem and Organic Chem you need to have as active knowledge in biochemical problem solving. If you can not do all of the problem solving in this PreTest you need to spend serious time getting these as working knowledge, only then will you be able to do well in the course. **You need a working chemical knowledge.**

If your chemical background is weak, drop BCH 3033 NOW. While not at all comprehensive, this PreTest is to alert you to what you must overcome BEFORE taking BCH3033. General Biochemistry has a huge amount of material. It is more than a standard course. Consider that a simple bacterium such as *Escherichia coli* synthesizes at any one time more than 2,000 different proteins (enzymes and structural proteins) each one in many copies. In General Biochemistry we will go through most all major metabolic pathways involving hundreds of enzymes as well as learning the structures of proteins, carbohydrates, lipids and nucleic acids. There is a tremendous amount of material to learn and in order to do well you will have to USE your chemical abilities attained in General and Organic Chemistry. A major fault many students make is to loose track of units...they solve a problem but do not indicate what the units are. In BCH3033 the correct number is *meaningless without it's units* and in this course, there is ZERO partial credit for meaningless numbers on exams. Be sure you know these well before taking BCH3033.

General Chemistry.

1. You need to know about water. It's ionization and how it interacts with strong and weak acids. Water can ionize: $H_2O \rightleftharpoons H^+ + OH^-$. So, if the pH of a solution of a HCl is 3.0 what is the concentration of protons? of hydroxide ions? What is the [HCl] that brought pure water to pH 3.0?

2. Suppose you had 3 grams of NaCl that you dissolved into 200 ml of pure water. What is the concentration of NaCl? of Na^+? of Cl^-? of H^+? of OH^-?

3. You need to be able to rapidly convert between metric units. Biochemists like to use mM, µl, ng and so forth. What is 15 mM in units of M, in units of nM. What is 4 µl in units of ml? of liters? What is 20 nm (the thickness of the bacterial flagella) in m? Be sure that you know the progression from m to mm to µm to nm to pm to fm to am. "am" has nothing to do with the morning! It works the same for M to mM to µM to nM to pM to fM to aM.

What's so important about all this? Most concentrations of molecules in cells or in blood are in mM and µM, many hormones work at the nM and fM range. Biochemists

like to use these as a short hand for scientific notation.

4. If you don't know about moles/l forget BCH3033 right now, go back and seriously repeat Gen Chem and Organic Chem before taking Biochem. Biochemists can often express concentrations using this shorthand for example what is 5 µmoles/ml which is what in units of M? in units of mM?

5. You have found a bottle on which the label does not indicate what it is...it has been degraded so that the only part of the label reads _____ acid. So, you decide to titrate this acid to find out about its properties. The contents of the bottle is liquid. So you add 10 ml of this ?_acid to 90 ml of pure water. It has a pH of 2.1 and a funny smell. You accurately prepare an *exact* 0.3 M solution of KOH. The lab you are working in does not have a burette, but it does have pipettes that can dispense µl volumes. You use this pipette to accurately add your solution of KOH to the diluted acid and measure the pH after each addition:

µl of KOH added	Resulting pH	µl of KOH added	Resulting pH
0	2.1	360	8.48
20	2.9	380	9.50
40	3.7	400	10.6
60	4.1	410	11.5
80	4.25	420	12.5
90	4.38	440	13.4
100	4.49	460	13.7
120	4.57	480	13.8
140	4.66	490	13.9
160	4.74	500	14.0
180	4.82	520	14.0
200	4.91	540	14.0
220	5.00	560	14.0
240	5.11	580	14.0
260	5.24	600	14.0
280	5.49	620	14.0
300	5.99	640	14.0
320	6.78	660	14.0
340	7.58	680	14.0

Plot this titration data using pH on the ordinate and µl of KOH on the abscissa. If you don't know how to do this, don't take General Biochemistry. If you don't know how to

find graph paper don't take this course. What does this graph show you? How many equivalents were required to titrate this acid? What about the experiment is extremely stupid...so that it looks like a computer did it rather than a human? Now can you get to the molecular weight of the acid? To do this you need first to calculate the moles present...give it a try.

6. What are the units of E^o? What is the Faraday constant ($\mathcal{F}$ = ? and you must write it with its units...***ALWAYS REMEMBER THAT ANY NUMBER IS MEANINGLESS WITHOUT UNITS***). What is the gas constant, R =? What is 25°C in degrees Kelvin?

7. If the hydrogen standard half cell is -0.42 v and the nitrate half cell is 0.42 v, which way would electrons flow if these cells were connected? What would become oxidized? What would become reduced? Which has the most energy and why??

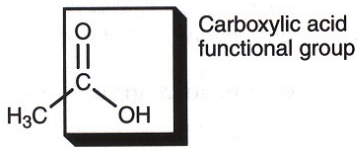
8. If a reaction has a ΔG of -3.4 kJ/mole and another reaction has a ΔG of -30.5 kJ/mole, which is most likely to proceed given that they both have nearly the same activation energies? How do catalysts change all this? What is the difference between ΔG and ΔG^o?

Organic Chemistry.

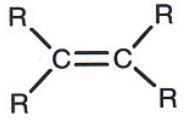
1. You know the functional groups of carbon. So what are they from the most reduced to the most oxidized?

2. Below are several structures, you should be able to name them (if not, repeat Organic Chem before you start Biochem):

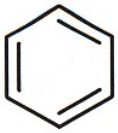
a) $H_3C—CH_3$

b) 

Carbon Functional Groups:

a) 

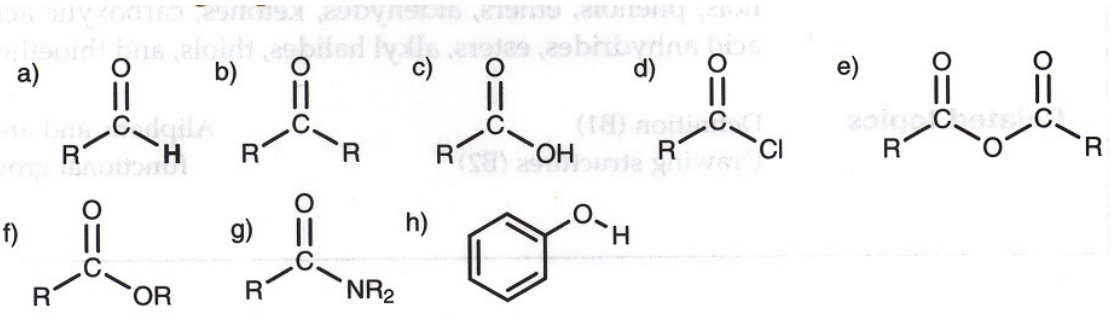
b) 

c) 

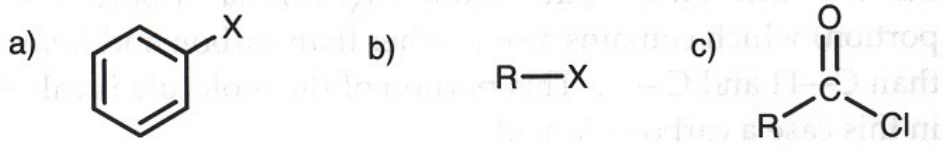
Nitrogen Functional Groups

Oxygen Functional Groups

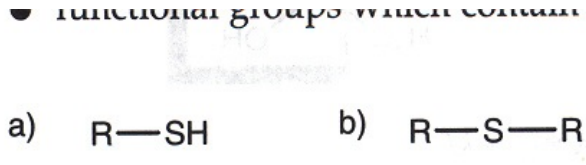
and more:



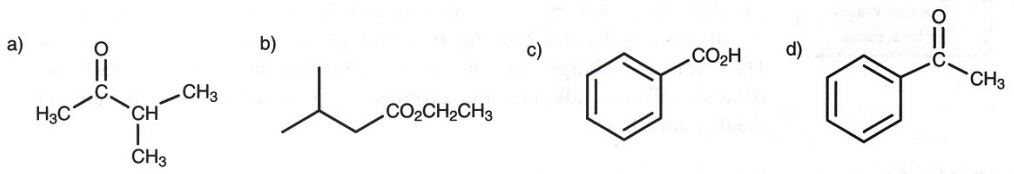
Halide Functional Groups

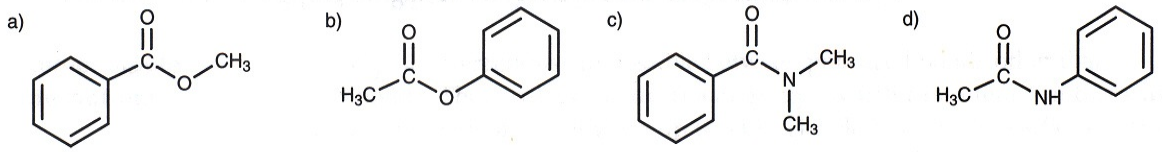


Sulfur Functional Groups



Aliphatic or Aromatic Functional Groups





3. What is a hybrid orbital? Why is that important (or how is that related to the total existence of life?)? What is π bonding and stabilization of what?

4. You should have a good grasp of organic reactions, most enzymes catalyze by acid-base reactions, nucleophilic and electrophilic attacks on particular groups. In Biochem we will be studying the major metabolic pathways, each step catalyzed by a different enzyme carrying out a particular reaction, you need to be ready for that.