HW1: Chapter 1 Problems 2, 7, 9, 16 Crossword 1

(2) Rod shaped 2×10^{-6} m long
0.8×10^{-6} m diameter

$V = \pi r^2 h$

a) Density of Escherichia coli = 1.1×10^{3} g/L

$D = \frac{m}{V}$

$V = \pi\left((0.8\times10^{-6}\text{ m})/2\right)^2 (2\times10^{-6}\text{ m})$

$V = 1.0\times10^{-18}\text{ m}^3 \times \frac{1\text{ mL}}{1\text{ cm}^3} \times \left(\frac{100\text{ cm}}{\text{m}}\right)^3 \times \frac{1\text{ L}}{1000\text{ mL}}$

$V = 1\times10^{-15}$ L

$D = \frac{m}{V}$ $\quad 1.1\times10^{3}\text{ g/L} = \frac{m}{1\times10^{-15}\text{ L}}$

$\boxed{m = 1\times10^{-12}\text{ g}}$

b) Calculate the volume of the cell with and without the envelope.

Cell with envelope: 2×10^{-6} m long
0.8×10^{-6} m diameter

Cell without envelope: $(2\times10^{-6}\text{ m} - 2(10\times10^{-9}\text{ m}))$ long $= 1.98\times10^{-6}$ m
$0.4\times10^{-6}\text{ m} - 10\times10^{-9}\text{ m} = 3.9\times10^{-7}$ m

V with envelope $= \pi(8.4\times10^{-6}\text{ m})^2(2\times10^{-6}\text{ m}) = 1.0\times10^{-18}\text{ m}^3$

V without envelope $= \pi(3.97\times10^{-7})^2(1.98\times10^{-6}\text{ m}) = 9.8\times10^{-19}\text{ m}^3$

The percentage that doesn't include envelope is

$$\left(\frac{V_{without}}{V_{with}}\right) \times 100$$

$$\left(\frac{9.8\times10^{-9}\ m^3}{1\times10^{-18}\ m^3}\right) \times 100 = \boxed{98\% \text{ of the cell doesn't include envelope}}$$

c) Calculate the total volume of ALL the ribosomes and relate it to the total volume of the cell.

Volume of ribosomes $= \frac{4\pi r^3}{3} \times 15000$

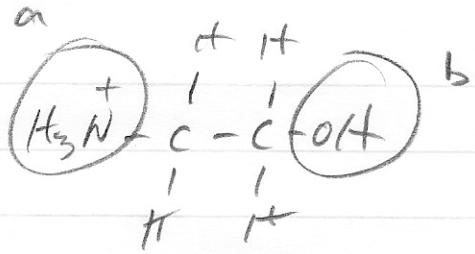
$$= \left(\left(\frac{4}{3}\right)\pi\left(9\times10^{-9}m\right)^3\right) \times 15000$$

$$= 4.58\times10^{-20}\ m^3$$

$\left(\frac{V \text{ of ribosomes}}{V \text{ of all}}\right) \times 100 =$ % of all volume occupied by ribosomes

$\boxed{\text{Vol \%} = 4.58\%}$

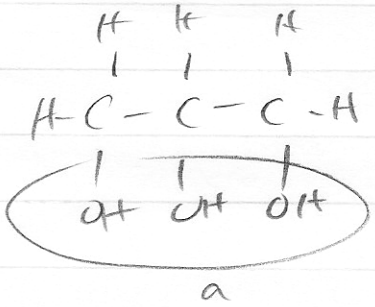
(7) a)



ethanolamine

a = amino
b = alcohol / hydroxyl

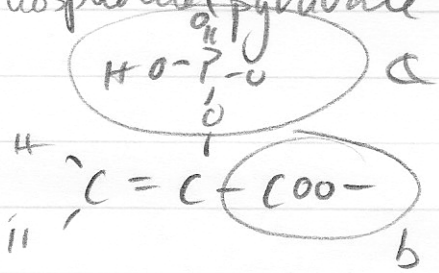
b)



a). 3 hydroxyls

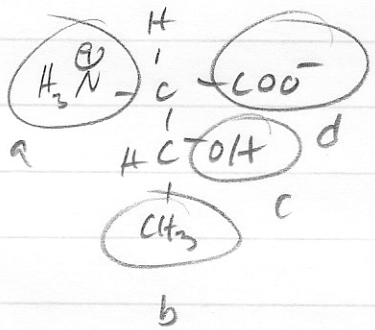
Glycerol

c) Phosphoenolpyruvate



a = Phosphoryl
b = Carboxylate

d)

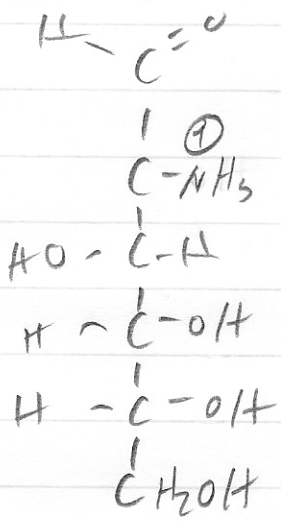


a = amino
b = methyl
c = hydroxyl
d) Carboxylate

e) Pantothenate
From top →

carboxyl
amide
hydroxyl
methyl

f)



aldehyde
amine
hydroxyls

(9) a) Amino acids from fatty acids

i) Fatty acids are much more nonpolar so I would take advantage of that

ii) Most importantly, the amino group has a positive charge at pH 7 and there is no positive charge on the fatty acid @ any pH.

b) Nucleotide from Glucose

The nitrogenous base has large aromatic rings and phosphate groups, so I would use size or the negative charge of the phosphate group.

(16) a) A more negative ΔG means a larger K_{eq} from:

$\Delta G = -RT \ln K_{eq}$

A larger Keq for binding means more products or tighter binding

Tighter binding = more sweetness

b) less time, less subjectivity / more objectivity in a computer model
what if the compounds are toxic? The tester might get sick.

c) you are looking for hydroxyl or carbonyl oxygens within a single bond length or at most 2 bond lengths away from another electronegative atom.

There are lots of them

d) those are common groups found on lots of molecules so their sentence isn't discriminating enough

e) Sucrose and Deoxysucrose. Deoxysucrose is less sweet than sucrose and it lacks a single hydroxyl group

f) Best example is tetrabromosucrose and sucrose. Tetrabromosucrose has all the same AH-B groups yet is 13,000 times sweeter!

g) To get a true, non-biased measurement.

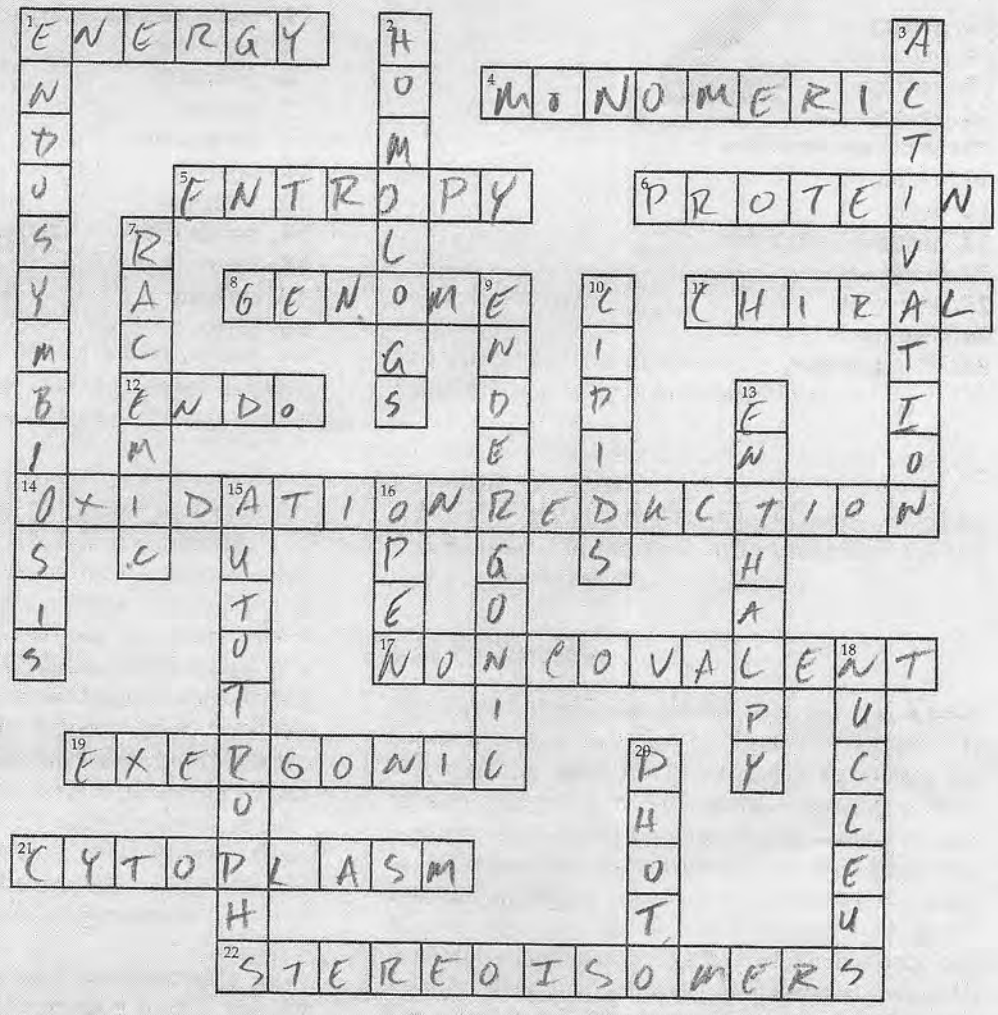
h) ΔG and K_{eq} are related by an exponential so a 1.3 fold increase in ΔG is a 10 fold increase in K_{eq}. Since MRS and K_{eq} are directly related, there should be a 10 fold increase in MRS.

SELF-TEST

Do You Know the Terms?

ACROSS

1. *G*; free _____.
4. Amino acids are the _____ subunits of proteins.
5. The randomness of the components of a chemical system; *S*.
6. Amino acid is to _____ as monomer is to polymer.
8. The complete set of genetic material needed for the growth and development of an organism.
11. Glycine is the only amino acid lacking an _____ asymmetric or carbon.
12. Reactions requiring an input of energy from the surroundings _____ are thermic reactions.
14. In _____ - _____ reactions, electrons are transferred from a more reduced to a more oxidized molecule.
17. A type of weak interaction that stabilizes the native conformation of a biomolecule or supramolecular complex.
19. Describes a reaction for which the free-energy change (ΔG) is negative.
21. The internal components of cells and the aqueous solution in which they are suspended.
22. Molecules having the same composition and order of atomic connections, but different spatial arrangements among the atoms.



DOWN

1. Mitochondria are thought to have evolved from bacteria that formed _____ associations with the ancestors of modern eukaryotes.
2. Proteins encoded by two genes that share similar nucleotide sequences.
3. Enzymes enhance the rate of chemical reactions by lowering the _____ energy that constitutes an energy barrier between reactants and products.
7. An equimolar mixture of the D and L isomers of an optically active compound is a _____ mixture.
9. Describes a reaction for which the free-energy change (ΔG) is positive.
10. Structural components of membranes; energy storage molecules.
13. The energy or heat content of a system; *H*.
15. Organisms that can synthesize most of the molecules necessary for their growth from simple compounds, such as CO_2 and NH_3.
16. A system that exchanges energy and material with its surroundings is said to be _____.
18. Membrane-bounded compartment, present only in eukaryotes, that contains chromosomes.
20. _____ -synthetic organisms convert solar energy into ATP.