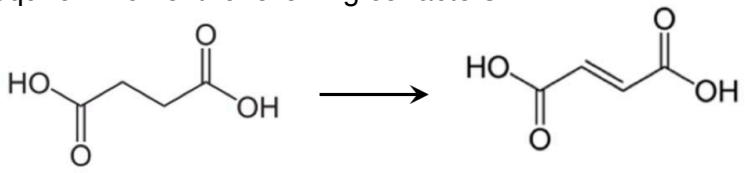
CHEM 115 Transition **MLA #2** **Name:** Answer Key

Part One: Multiple choice & matching questions **(2 pt each)**

1. Which of the following does *not* describe a type of ***redox*** reaction?
   a) Burning wood
   b) putting a chunk of pure lithium metal (Li) into hydrochloric acid (HCl)
   c) making margarine (saturated fat) from corn oil (unsaturated fat) by industrial hydrogenation
   d) mixing sodium hydroxide (NaOH) with hydrobromic acid (HBr) to produce salt and water

2. Oxidation of a secondary alcohol produces what kind of functional group?
   a) carboxylic acid b) ketone c) aldehyde d) primary alcohol

3. The reaction shown below would require which of the following co-factors?
   a) FAD
   b) NAD+
   c) Coenzyme A
   d) Mg^{2+}



4. Hydrolysis and hydration reactions both utilize water as a reactant, but can be distinguished because hydrolysis reactions start with _____ molecule and produce _____, whereas hydration reactions start with _____ and produce _____.
   a) 1 → 2; 2 → 1
   b) 2 → 2; 1 → 1
   c) 1 → 2; 1 → 1
   d) 2 → 1 ; 1 → 2

5. Which of the following terms does *not* describe a set of distinct, chiral molecules?
   a) Stereoisomers b) Diastereomers c) Enantiomers d) Geometric isomers

6. Nucleotides in complementary DNA strands base-pair with each other by:
   a) Dispersion forces b) Ionic interactions c) Hydrogen bonds d) Covalent bonds

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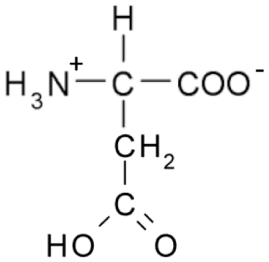
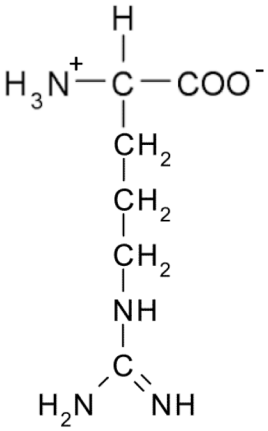
7. For the following four problems, match each amino acid shown to one of the following classes: **(4 pts)**

   a) Non-polar **b)** Polar/neutral **c)** Polar/acidic **d)** Polar/basic

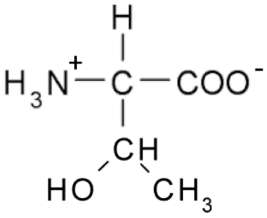
aspartate: c



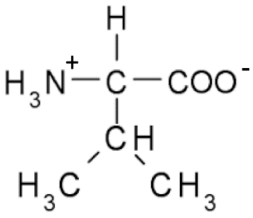
arginine: d



threonine: b

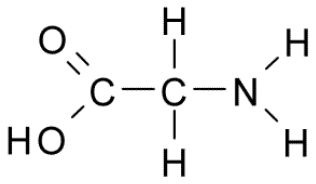


valine: a



8. Which of the following properties is *different* in a pair of enantiomers?
   a) Chemical reactivity c) Molecular mass e) all of these are different
   b) Solubility in water d) Melting point f) none of these are different

9. If the amino acid glycine—shown below—were placed into an aqueous solution at pH 12, what would you expect the overall charge on the molecule to be?



   a) +2 b) +1 c) 0 d) -1 e) -2

10. Which level(s) of folding would you expect to be altered by placing a protein into a highly acidic solution? (***circle all that apply***)
   a) Primary b) Secondary c) Tertiary e) Quaternary

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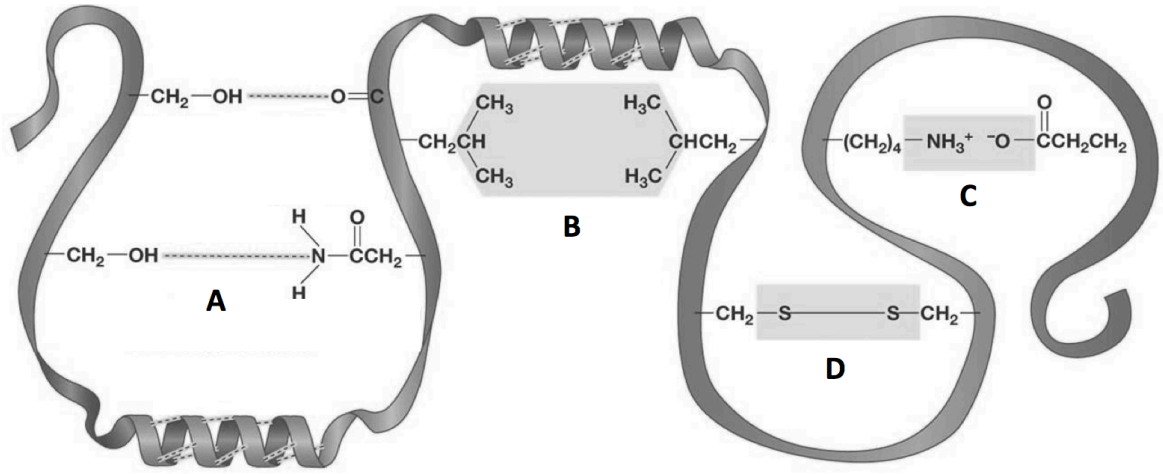
11. In the structure shown below, identify <u>what type of tertiary interaction</u> is being represented for each of the four letters on the diagram. (**4 pts**)



A. Hydrogen bond **C.** Salt bride (ionic bond)

B. Dispersion forces **D.** Disulfide bond (covalent)

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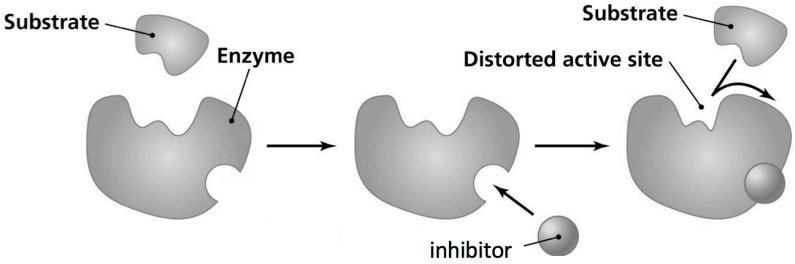
12. Match the following protein types with the class you would expect them to be classified within:
   a) Globular b) Fibrous c) Membrane (**4 pts**)

   - Cytosolic enzymes (eg. *hexokinase*) : a
   - Ion transporters (eg. *Na^+ channel*): c
   - Extracellular structural proteins (eg. *collagen*): b
   - Water-soluble secreted proteins (eg. *insulin*): a

13. What type of intermolecular force is responsible for secondary folding of proteins into alpha-helicies and beta-pleated sheets?
   a. Hydrogen bonds between R-groups c. Hydrogen bonds in the peptide backbone
   b. Salt bridges between R-groups d. Dispersion forces in the peptide backbone

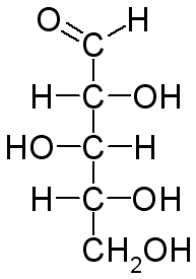
14. The diagram shown to the right provides a cartoon example of what class of inhibitor?
    a) Non-specific
    b) Specific, competitive
    c) Specific, non-competitive (allosteric)
    d) cannot be determined



15. Which of the following molecular formulas represents a simple carbohydrate?

    a) $C_3H_6O_6$ b) $C_4H_{12}O_4$ c) $C_5H_{10}O_5$ d) $C_6H_{12}O_8$

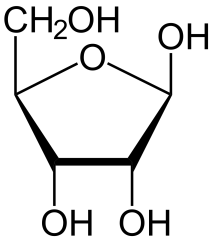
16. What two categories correctly describe the sugar D-xylose, shown to the right?
    a) Pentose; aldose
    b) Pentose; ketose
    c) Hexose; aldose
    d) Hexose; ketose



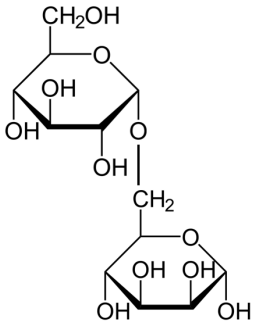
17. Naturally occurring amino acids are found exclusively in the _____ stereoisomer configuration, while monosaccharides are found exclusively in the _____ configuration.

    a) L; L b) *L; D* c) *D; L* d) *D; D*

18. In the Hayworth projection shown to the right, what is the correct nomenclature associated with this form of D-ribose?
    a) Alpha (α), furanose
    b) Alpha (α), pyranose
    c) Beta (β), furanose
    d) Beta (β), pyranose



19. What specific type of glycosidic bond is shown in the disaccharide to the right?
    a) α(1→4)
    b) α(1→6)
    c) β(1→4)
    d) β(1→6)



20. The type of enzyme that would be required to break the bond shown in the disaccharide to the right is called a _____.
    a) Hydrolase
    b) Isomerase
    c) Kinase
    d) Dehydrogenase

21. Which of the following is *not* an energy storage carbohydrate?
    a) Starch
    b) Cellulose
    c) Glycogen
    d) Amylose
    e) Amylopectin

22. The overall purpose of lactic acid or ethanol fermentation is to:
    a) Produce more oxygen
    b) Generate more pyruvate
    c) Convert glucose to CO_2
    d) Regenerate NAD^+ by oxidizing NADH

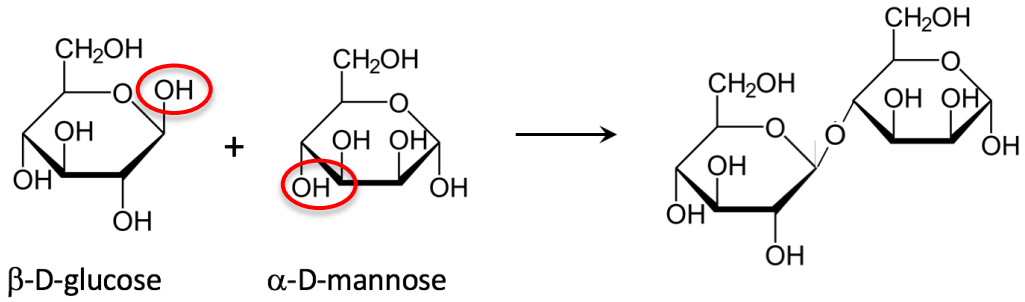
23. Genomic DNA found in the nucleus of a cell is packaged into chromosomes after winding it around a cluster of positively charged proteins, which are called:
    a) Chromatin b) Nucleosomes c) DNA polymerase d) Histones

Part Two: Chemical Reaction Types

1. For each of the following condensation reactions: **(a)** **Circle** the two functional groups involved in the reaction, and **(b)** **fill in** the type of chemical bond formed by each reaction.

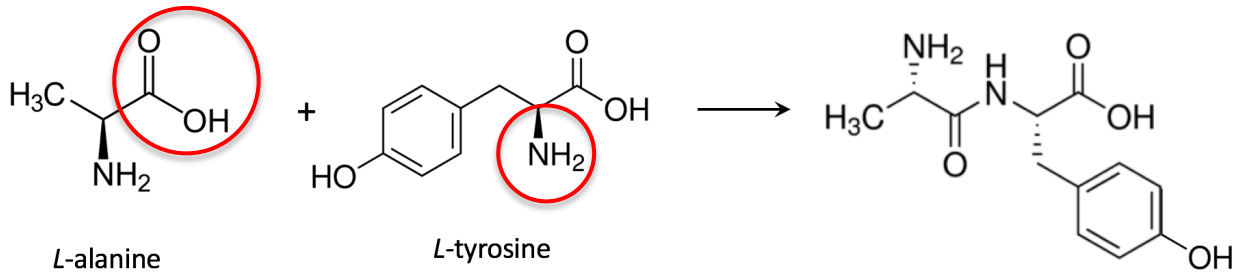
(**9 pts**)

A. Two **monosaccharides**: **(b)** Bond type? Glycosidic bond



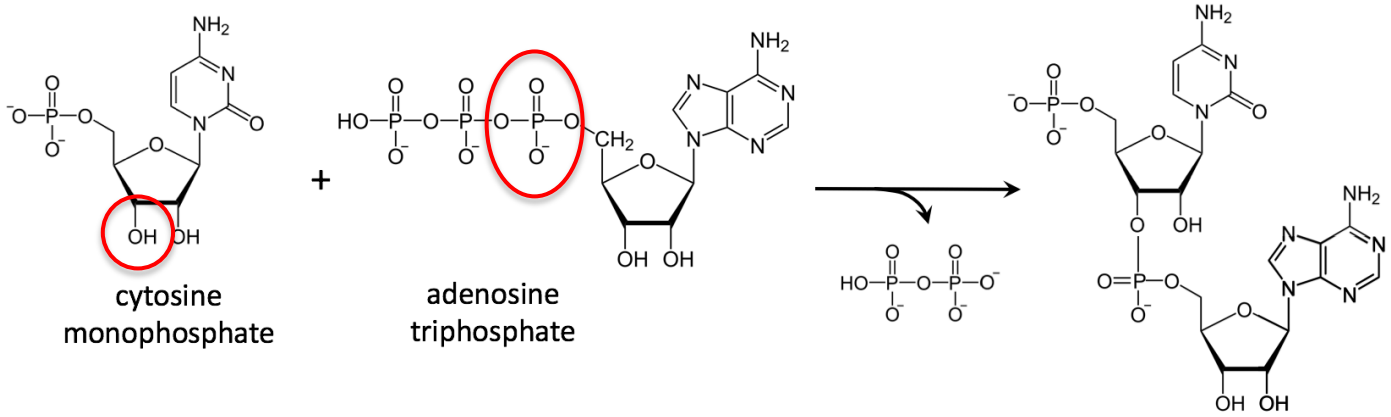
β-D-glucose α-D-mannose

B. Two **amino acids**: **(b)** Bond type? Peptide bond



L-alanine *L*-tyrosine

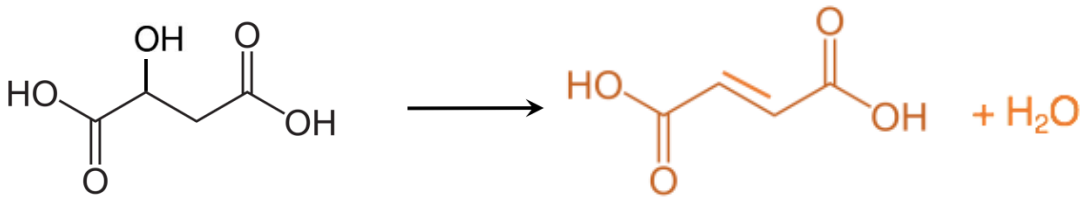
C. Two **nucleotides**: **(b)** Bond type? Phosphate ester bond (phosphodiester)



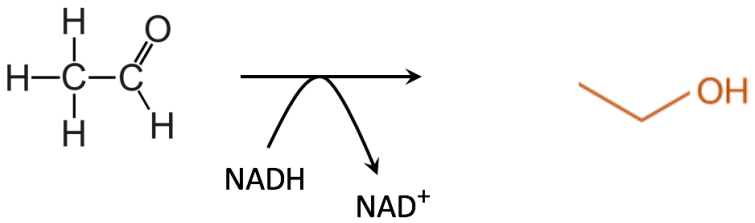
cytosine monophosphate adenosine triphosphate

2. Sketch out the product that you would expect to find in the following reactions (**Please use skeletal line structures**): (**3 pts each**)

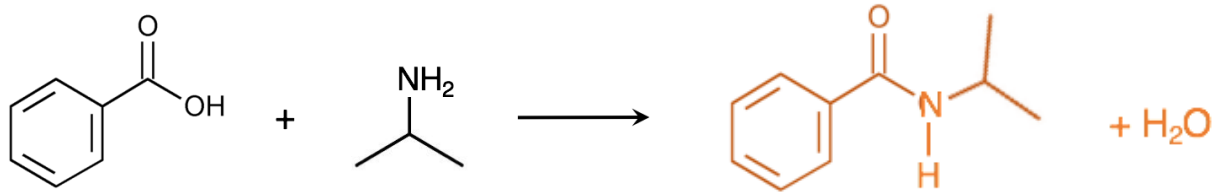
a. **Dehydration reaction**



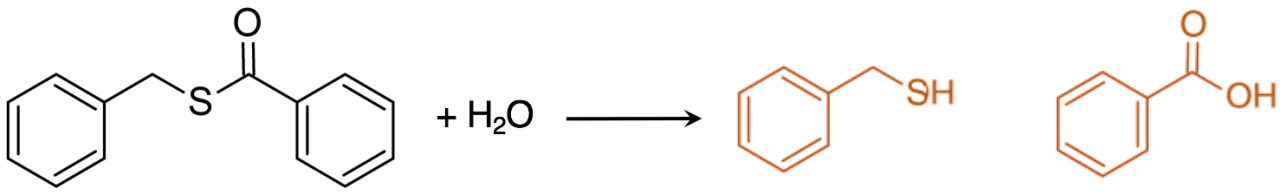
b. **Redox reaction** (*note*: reactant is being reduced here)



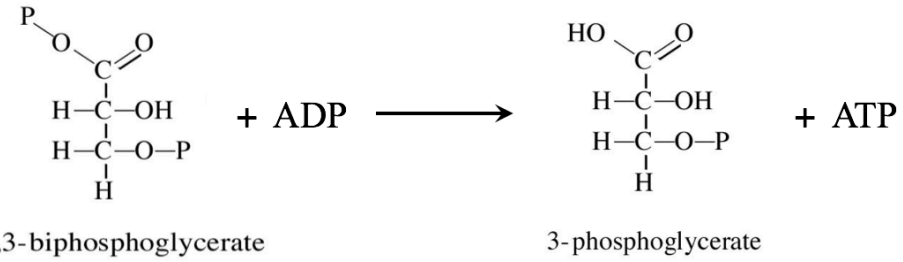
c. **Condensation reaction**



d. **Hydrolysis reaction**



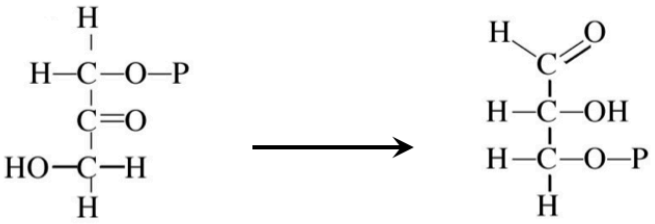
3. Indicate **(a)** the <u>kind of reaction</u> and **(b)** the <u>type of enzyme</u> for each of the following glycolytic reactions shown below: (**2 pts each**)



1,3-biphosphoglycerate → 3-phosphoglycerate

(a) phosphoryl group transfer

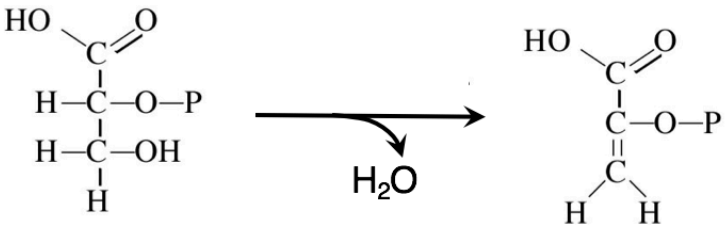
(b) kinase



dihydroxyacetone phosphate → Glyceraldehyde-3-phosphate

(a) isomerization

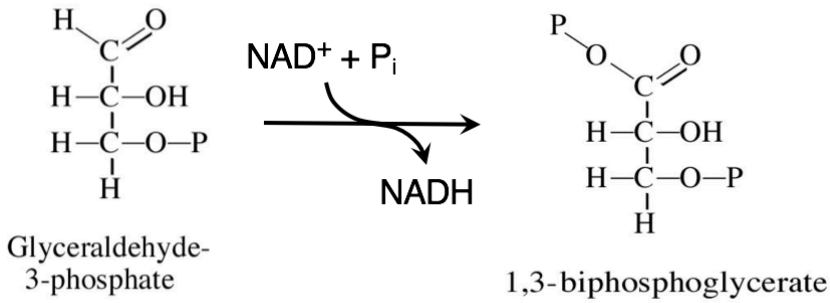
(b) isomerase



2- phosphoglycerate → Phosphoenolpyruvate

(a) dehydration

(b) dehydratase

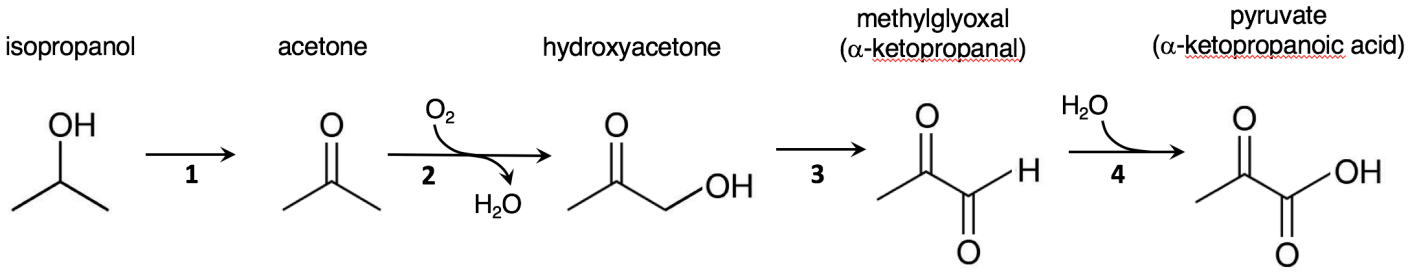


Glyceraldehyde-3-phosphate → 1,3-biphosphoglycerate

(a) redox (oxidation)

(b) dehydrogenase

4. **Isopropanol**—also known as "rubbing alcohol"—is a toxic alcohol that severely damages the liver when consumed. It can be metabolized in very small amounts, however, by the pathway shown below.



Answer the following questions about this metabolic process. (**9 pts**)

a. Indicate the <u>type of reaction</u> that is occurring <u>to the molecules that are shown</u> at all four steps of the metabolic pathway. (***hint***: it is the <u>same</u> for all four steps)

Oxidation (½ pt for "redox", but not for reduction)

b. What ***functional groups*** are changing at each step of the pathway?

1) Secondary alchol → ketone
2) Methyl (-CH_3) → primary alcohol
3) Primary alchol → aldehyde
4) Aldehyde → carboxylic acid

c. What ***cofactor*** is required for steps 1, 3 and 4?

NAD+ (oxidized form; ½ pt for NADH)

d. What <u>type of reaction</u> is this cofactor undergoing at each of these steps?

Reduction (½ pt for "redox", but not for oxidation)

e. How would you characterize this metabolic pathway? (*<u>circle one</u>*)

Aerobic or Anaerobic

f. This process occurs in the liver, which is also where the process of **gluconeogenesis** (aka. 'glucose re-synthesis') occurs. Based on the information above, *how many molecules of isopropanol* would be required to synthesize 1 molecule of glucose by the process of gluconeogenesis?

It would take <u>2 x 3-carbon isopropanols</u> to make 2 x pyruvates, which are required to make a single 6-carbon glucose

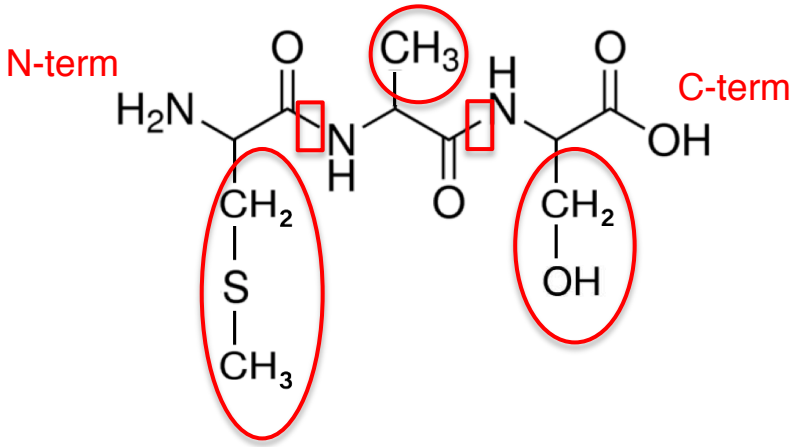
Part Three: Molecular & Chemical Structure Relationships

1. The tripeptide **Met-Ala-Ser** is shown below. Identify the following components of this molecule: (**6 pts**)

   a) Put a **box** around all of the peptide bonds

   b) **Circle** each of the R-groups (side chains) for each amino acid

   c) **Label** the N-terminus and the C-terminus



Second letter

First letter	U	C	A	G	Third letter
U	UUU, UUC: Phe; UUA, UUG: Leu	UCU, UCC, UCA, UCG: Ser	UAU, UAC: Tyr; UAA: Stop; UAG: Stop	UGU, UGC: Cys; UGA: Stop; UGG: Trp	U C A G
C	CUU, CUC, CUA, CUG: Leu	CCU, CCC, CCA, CCG: Pro	CAU, CAC: His; CAA, CAG: Gln	CGU, CGC, CGA, CGG: Arg	U C A G
A	AUU, AUC, AUA: Ile; AUG: Met/Start	ACU, ACC, ACA, ACG: Thr	AAU, AAC: Asn; AAA, AAG: Lys	AGU, AGC: Ser; AGA, AGG: Arg	U C A G
G	GUU, GUC, GUA, GUG: Val	GCU, GCC, GCA, GCG: Ala	GAU, GAC: Asp; GAA, GAG: Glu	GGU, GGC, GGA, GGG: Gly	U C A G

2. For a given DNA sequence, answer the following questions. Use the codon chart shown to the left to help you identify the genetic code.

a) Fill in the complementary mRNA sequence to the DNA strand below, assuming that the **bottom strand** is the template strand for transcription:

5'-CTATGGGCATTCGCGATTGACG -3'
3'-GATACCCGTAAGCGCTAACTGC-5'

mRNA 5'CU AUG GGC AUU CGC GAU UGA CG 3'

b) Indicate the **peptide sequence** encoded by this mRNA strand. You should identify the '*reading frame*' by identifying a **start codon**.

(start) Met – Gly – Ile – Arg – Asp – (stop)

3. For the nucleotide diagram shown to the right (cytosine), **(a) draw circles** around, and **(b) label** the following elements: (**4 pts**)

   I. 3' functional group

   II. 5' functional group

   III. The specific part of the molecule that will be involved in base-pairing to guanosine

   IV. The functional group that identifies this as a ***ribonucleotide***, rather than a deoxyribonucleotide.