A. Single-choice problems (30%)

1. The amino and carboxyl groups of amino acids react in a head-to-tail fashion, eliminating water, and forming a covalent ______ linkage typically referred to as a ______ bond.
   a. ester, aromatic
   b. anhydride, phosphoanhydride
   c. amide, peptide
   d. dehydration, hydrogen
   e. none of the above

2. All are true for stereoisomers EXCEPT:
   a. A diastereomer is a nonsuperimposable non-mirror image.
   b. An enantiomer is a nonsuperimposable mirror image.
   c. Diastereomers have different melting points.
   d. Diastereomers rotate plane polarized light in equal but opposite directions.
   e. None, all are true.

3. A gene can be defined as:
   a. the unique function that some cells have but other cells do not have.
   b. a specific segment of nucleotide bases in DNA that encode for the synthesis of a particular protein.
   c. a single strand of DNA that is designated as the sense strand.
   d. a functional segment of a unique protein.
   e. the segment of DNA that is changed in a mutation.

4. Hemoglobin is an α₂, β₂ ______ whereas, glutamine synthetase from E. coli is an α₁₂ ______.
   a. -homodimer, -homomultimer
   b. -heteromultimer, -homomultimer
   c. -homomultimer, -heterodimer
   d. -heterodimer, -monomeric protein
   e. -heterodimer, -homomultimer

5. Membrane proteins differ from globular proteins in that:
   a. membrane associated amino acids usually have polar side chains.
   b. membrane proteins are much more soluble in detergents than water.
   c. membrane proteins usually have more hydrophobic amino acids.
   d. globular proteins are water insoluble.
   e. All are true.

6. Protein isolation and purification include all of the techniques EXCEPT:
   a. gas-liquid chromatography.
   b. ion exchange chromatography.
   c. electrophoresis.
   d. solubility ("salting in" and "salting out").
   e. affinity chromatography.
7. Which of the following sugars is an aldopentose?
   a. galactose
   b. ribulose
   c. ribose
   d. xylulose
   e. mannose

8. All of the statements about the following pairs of sugars are correct EXCEPT:
   a. Galactose and mannose are diastereomers.
   b. L-galactose and D-galactose are enantiomers.
   c. Glyceroldehyde and dihydroxyacetone are stereoisomers.
   d. Glucose and mannose are epimers.
   e. Glucose has less chiral centers that fructose.

9. Dietary essential fatty acids for humans include
   a. γ-linolenic and oleic acids.
   b. oleic and linoleic acids.
   c. palmitic and oleic acids.
   d. linoleic and γ-linolenic acids.
   e. all are true.

10. Diets aimed at reducing coronary heart disease should be:
    a. low in trans-fatty acids and high in saturated fatty acids.
    b. high in trans-fatty acids and high in saturated fatty acids.
    c. high in trans-fatty acids and low in saturated fatty acids.
    d. low in trans-fatty acids and low in saturated fatty acids.
    e. low in trans-fatty acids and low in unsaturated fatty acids.

11. Lipids that spontaneously form micelles, monolayers and bilayers have what property?
    a. waxy
    b. polar
    c. amphipathic
    d. bipolar
    e. polysisoprenoid

12. cAMP and cGMP are ____ with phosphate esterified as a cyclic ____ and are important as ____ of cellular metabolism.
    a. nucleotides; phosphodiester; inhibitors
    b. nucleotides; phosphomonoesters, regulators
    c. nucleotides; phosphodiesters, regulators
    d. nucleosides; phosphomonoesters, stimulators
    e. all of the above
13. All are true for the DNA double helix EXCEPT:
   a. the two strands are parallel.
   b. the two strands are held together by interchain hydrogen bonds.
   c. the two strands have complementary base pairing.
   d. they are easily sheared into shorter fragments during isolation procedures.
   e. all are true.

14. How is radioactivity incorporated into the newly synthesized DNA using the chain termination protocol for sequencing DNA?
   a. One of the dNTPs are labeled with $^{32}$P.
   b. The primer strand is labeled with $^{32}$P.
   c. The template strand is labeled prior to the experiment with $^{32}$P.
   d. The 5'-end is labeled with $^{32}$P.
   e. The dideoxynucleotide is labeled with $^{32}$P.

15. All are characteristic of plasmids EXCEPT:
   a. naturally occurring, circular extrachromosomal DNA.
   b. able to perpetuate themselves without a host organism.
   c. artificial plasmids can be constructed by restriction endonuclease digestion, insertion, and ligation.
   d. harbor genes for novel metabolic activities.
   e. an origin of replication must be included in the plasmid to facilitate propagation.

B. Explain these terms: (30%)
   a. PCR,
   b. exon,
   c. isoenzyme,
   d. Tm,
   e. lactose intolerance,
   f. lac operon

C. Protein structure is described in four levels of organization. What are the primary, secondary, tertiary and quaternary structures in proteins? (10%)

D. How are fatty acid palmitate (16:0) broken down to produce energy? (10%)

E. What are the structure and metabolic fates of pyruvate? (10%)

F. How do cells regulate enzyme activity? (10%)