MULTIPLE-MULTIPLE CHOICE: Choose all that apply. Multiple answers are possible.

1. Nucleotides can be
   a. intracellular messengers such as cAMP.
   b. part of other molecules such as NADH.
   c. building blocks for proteins.
   d. a major structural component of biological membranes.
   e. building blocks for nucleic acids.

2. Which of the following classes of macromolecules have been found to have members capable of catalysis?
   a. RNA
   b. DNA
   c. carbohydrates
   d. proteins
   e. lipids

3. Electrons that are removed from glucose during its breakdown are carried by
   a. NADH.
   b. FADH₂.
   c. ATP.
   d. enzymes.
   e. All of the above.

MULTIPLE CHOICE:

4. Which of the following ending statements is not correct?
   One difference between electron microscopy and light microscopy is that…
   a. electrons rather than photons of visible light provide the illumination.
   b. the resolution is about 100 times better.
   c. electron microscopy has better resolution because the wavelength of an electron is longer than that of visible light.
   d. the emissions from the illumination source are focused by electromagnets rather than glass lenses.

5. Phospholipids are
   a. hydrophobic.
   b. hydrophilic.
   c. contain charged groups.
   d. all of the above.
   e. none of the above.

6. Proteins are polymers of
   a. nucleotides.
   b. monosaccharides.
   c. nitrogenous bases.
   d. amino acids.
   e. glucose.
7. Nucleotides in a polynucleotide chain are held together by
   a. glycosidic bonds.
   b. hydrogen bonds.
   c. hydrophobic interactions.
   d. phosphodiester bonds.
   e. peptide bonds.

8. The two ends of a polypeptide chain are referred to by which of the following designations?
   a. α, β.
   b. Start, stop
   c. N terminus, C terminus.
   d. 5′, 3′.
   e. right, left.

9. All of the following are functions of carbohydrates except
   a. energy storage.
   b. biological catalysis.
   c. structural support of some cells
   d. cell surface markers involved in cell recognition.
   e. All of the above are functions of carbohydrates.

10. Membrane fluidity is affected by the
    a. number of double bonds in the fatty acid chains of phospholipids.
    b. concentration of cholesterol in the membrane.
    c. Both a and b.
    d. Neither a nor b.

11. By what mechanism will A move into the cell?

    Key: A is Ca²⁺
    B is a lipid
    00 = carrier protein

    ![Diagram of cell membrane with carrier protein]

    a. Simple diffusion
    b. Facilitated diffusion
    c. Active transport
    d. Endocytosis
12. Biological membranes can differ in all of the following except the
   a. presence or absence of lipids.
   b. specific phospholipid composition.
   c. types of proteins.
   d. fluidity.
   e. specific function.

13. Active transport and facilitated diffusion are very similar, but differ in that
   a. only one uses a carrier.
   b. only facilitated diffusion requires energy.
   c. only facilitated diffusion can bring things into a cell.
   d. only active transport can move things from an area of low to an area of high concentration

14. An example of secondary structure is
   a. β-pleated sheet.
   b. globular domain.
   c. linear sequence of amino acids.
   d. peptide bonds.
   e. subunits.

15. The nuclear lamins are a family of proteins that have similar 3D structures. One hallmark of these proteins is that two molecules (polypeptide chains) interact together by forming a coil between the alpha helix of one polypeptide and the alpha helix of another polypeptide. This is an example of ____________ structure.
   a. primary.
   b. secondary.
   c. tertiary.
   d. quaternary.

16. Enzymes
   a. add energy into the reaction to overcome the activation energy.
   b. make a reaction more exergonic.
   c. speed up reactions that are not spontaneous.
   d. decrease the activation energy.
   e. decrease the specificity of the reaction.

17. The activity of an enzyme is sensitive to pH and temperature because these factors
   a. supply energy to overcome the activation energy.
   b. can affect the 3D structure of a protein, which is held in place primarily by weak bonds.
   c. speed up reactions that are not spontaneous.
   d. decrease the activation energy.
   e. decrease the specificity of the reaction.

18. The complete oxidation of glucose includes all of the following except
   a. release of carbon dioxide.
   b. fermentation reactions.
   c. production of ATP.
   d. substrate-level phosphorylation.
   e. shuttling of electrons to the electron transport chain.
19. Which of the following involve complementary base pairing to transfer information?
   a. Replication.
   b. Transcription.
   c. Translation.
   d. Both a and b.
   e. All of the above.

20. The type of probe used to detect proteins is a(n) _______ probe.
   a. antibody
   b. pH
   c. nucleic acid
   d. PCR
   e. fluorescent

21. Diploid cells contain two copies of each chromosome. These two copies are called
   a. homologs.
   b. alleles.
   c. mitosis.
   d. haploids
   e. genes.

22. Restriction enzymes
   a. cut the DNA backbone.
   b. amplify small amounts of DNA.
   c. rearrange the DNA sequence.
   d. break hydrogen bonds.
   e. hybridize recombinant DNA molecules.

23. Entrance into and out of the nucleus occurs by way of
   a. membrane transporter proteins.
   b. nuclear pores.
   c. endocytosis & exocytosis.
   d. molecular pumps.
   e. Both a and b.

24. Import into the nucleus can be regulated by a number of mechanisms. The nuclear
    transcription factor NFκB is stimulated to enter the nucleus in activated lymphocytes.
    Which of the following events occurs when NFκB is stimulated to enter the nucleus?
    a. A phosphatase adds a phosphate to NFκB.
    b. IκB is degraded
    c. NFκB interacts with exportin
    d. IκB binds to the nuclear localization signal on NFκB
    e. NFκB is degraded.

25. What type of enzyme covalently attaches a phosphate to an amino acid of a protein?
    a. phosphatase
    b. DNA polymerase
    c. RNase
    d. kinase
    e. GTPase
**LABELS & DIAGRAMS**

From the following diagram of a membrane, choose an example to match the description.

![Membrane Diagram]

_____  26. A peripheral protein

_____  27. An integral membrane protein

_____  28. A transmembrane protein

_____  29. A lipoprotein

From the list below, identify the molecules:

<table>
<thead>
<tr>
<th>Fatty acid</th>
<th>Sterol/steroid</th>
<th>Amino acid</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nucleotide</td>
<td>Carbohydrate</td>
<td>Nucleic acid</td>
</tr>
<tr>
<td>Phospholipid</td>
<td>Protein</td>
<td>Triglyceride</td>
</tr>
</tbody>
</table>

30. Composed of three fatty acid chains attached to glycerol._____________________

31. ______________________

32. _________________________
MATCHING

From the following list, choose the organelle or structure that fits the function listed.

- Mitochondria
- Plasma membrane
- Lysosomes
- Nucleus
- Vacuoles
- Cytoskeleton
- Chloroplast
- Cell wall
- Endoplasmic reticulum
- Golgi
- Ribosome

33. Site of RNA synthesis _______________________________
34. Site of oxidative phosphorylation ___________________________
35. Sorting of proteins to final destination _______________________

From the following list, choose the simplest cell model that would be most appropriate for each experimental question listed.

- Dictyostelium discoideum
- E. coli
- Xenopus laevis
- Caenorhabditis elegans
- Yeast
- Arabidopsis thaliana
- Drosophila melanogaster
- Transgenic mice

If the experimental question is concerning:

36. Plant development ______________________________
37. Protein sorting (eg: to the mitochondria) _________________

SHORT ANSWER

38. Why is it believed that oxidative metabolism evolved after photosynthesis?

39. Eukaryotes have organelles that create compartments. Using one organelle as an example to illustrate your point, describe one advantage that compartments create.

40. In general, why is it valid to extrapolate information gained from one cell type to another? When is it not valid to do so?

41. What are the two main components of cell membranes? What is the major function of each of these components?
42. Proteins found in the cytosol generally have hydrophilic amino acids located on the exterior and hydrophobic amino acids located on the interior of the protein. Channel proteins, however, will often have a large number of hydrophobic amino acids on the outside and many hydrophilic amino acids on the inside. Explain why cytosolic proteins usually have the arrangement described and why the arrangement for channel proteins differs.

43. Targeting molecules to specific locations within the cell is an essential function. Nuclear localization signals (NLS) target molecules to the nucleus. What is a nuclear localization signal and where is it found?