BIOLOGY 311C - Brand
Spring 2009

NAME (printed very legibly) _____**Key**_____ UT-EID _____

EXAMINATION I

Before beginning, check to be sure that this exam contains 7 pages (including front and back) numbered consecutively, and that you have been provided with a clean Answer Sheet. Then immediately print your name and UT-EID legibly at the top of this page. Also print and bubble in your name and your UT-EID (not your social security number) on the front of the Answer Sheet in the spaces provided. The first 38 questions are "multiple choice", with only one correct answer. Mark the letter corresponding to the correct answer to each of these questions in the appropriate location on the Answer Sheet, using a No. 2 pencil. Write answers to Questions 39 – 42 directly on this exam, in the spaces provided with the questions. Print neatly if your handwriting is likely to be difficult to read. Turn in both this exam and the Answer Sheet after checking to be sure that your name is clearly written in both places and all questions have been answered in the appropriate locations. You must turn in your exam on or before 9:55 a.m.

1. A divalent cation contains:
   a. a total of two electrons.
   b. a total of two protons.
   c. two net positive charges.
   d. two net negative charges.

2. If a hydrogen molecule is separated into its two separate atoms such that each atom keeps one of the previously shared electrons, then:
   a. each of the atoms can be written as H^+.
   b. one of the atoms is an anion while the other atom is a cation.
   c. both atoms will be an electrically neutral hydrogen atom.
   d. each of the separated atoms will be chemically stable.

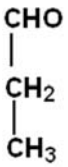
3. Which one of the following atoms, when it occurs in biological molecules, does not have a covalency higher than 2?
   a. S
   b. N
   c. P
   d. C

4. Most of the largest molecules in living cells:
   a. simultaneously carry multiple positive and negative electric charges.
   b. carry a few (3 – 10) electric charges.
   c. do not carry any net electrical charge.
   d. have a net positive charge.

5. An illustration of a molecule that demonstrates its 3-dimensional shape is called a:
   a. chemical formula.
   b. geometric formula.
   c. structural formula.
   d. stereo formula.

6. Which one of the following is considered to be an organic compound?
   a. H_2O
   b. CO_2
   c. $CH_3\text{-}NH_2$
   d. H_2CO_3

7. Which one of the following functional groups is illustrated in the molecule shown in abbreviated form at right?



   a. An alcohol
   b. An aldehyde
   c. A carboxylic acid
   d. A ketone

8. Which one of the atoms whose chemical symbol is shown below is least electronegative?
   a. O
   b. H
   c. N
   d. S

9. The characteristic bond angle for the covalent bonds extending from a carbon atom in an organic molecule such as methane is:
   a. 26 degrees.
   b. 45 degrees.
   c. 109 degrees.
   d. 180 degrees.

10. A typical bond strength (in kJ/mole) of a hydrogen bond is:
   a. 3.
   b. 40.
   c. 400.
   d. 3×10^4.

11. A radioactive isotope is an atom of an element:
   a. that is converted to a cation.
   b. whose nucleus has an unequal number of protons and neutrons.
   c. that is heavier or lighter than other atoms of the same element.
   d. whose nucleus decays spontaneously.

12. The cohesion of water molecules which, for example, allows water to be transported up through a tree, is due primarily to:
   a. hydrogen bonds.
   b. polar bonds.
   c. covalent bonding.
   d. ionic (electrovalent) bonding.

13. Black-box properties of the living state are applicable to:
   a. only cells.
   b. only whole organisms.
   c. only the biosphere.
   d. all three of the above.

14. The relatively independent existence of individual cells in plants and animals was first described by:
    a. Mathias Schlieden and Theodor Schwann.
    b. Louis Pasteur.
    c. Anton van Leeuwenhoek.
    d. James Watson and Francis Crick.

15. Which one of the following is not true of all living cells?
    a. They are surrounded by a plasma membrane.
    b. They contain a nucleus surrounded by an envelope.
    c. They contain nucleic acids and proteins.
    d. They undergo chemical reactions that require enzymes.

16. The information content of cells is stored and transferred to various places in living cells primarily by:
    a. lipids.
    b. carbohydrates.
    c. proteins.
    d. nucleic acids.

17. An important class of chemical reaction in living cells that results from the loss of hydrogen atoms is:
    a. hydrolysis.
    b. ionization.
    c. energy release from ATP.
    d. oxidation.

18. Consider a spherical cell whose volume is as large as it can get because of its limiting surface-to-volume ratio. Which one of following changes in the cell would not be expected to allow the cell to increase in volume.
    a. increase its rate of metabolism.
    b. change its shape to a highly irregular form.
    c. change its shape to very long and thin.
    d. provide a large central vacuole within the cell.

19. In addition to bacteria, the prokaryotes (kingdom monera) include.
    a. protists.
    b. Archea.
    c. fungi.
    d. Domain Eukaryota.

20. A staphylococcus bacterium contains:
    a. packets of cells.
    b. rod-shaped cells.
    c. long filaments (chains) of cells.
    d. spiral-shaped cells.

21. Plasmids in prokaryotic cells are:
    a. characterized by their ability to perform photosynthesis.
    b. found within the nucleoid.
    c. circles of DNA.
    d. a storage form of energy.

22. Which one of the following is not considered to be a component of the cell envelope of prokaryotic cells?
    a. A periplasmic space
    b. The plasma membrane
    c. An outer membrane (cell wall)
    d. A capsule

23. Which one of the following is not a major model organism used in cell biology studies?
    a. *E. coli* (a bacterium)
    b. *Hevea* (a rubber-producing plant)
    c. *Caenorhabditis* (a round worm)
    d. *Arabidopsis* (a weedy plant)

24. All of the living substance of a eukaryotic cell between the plasma membrane and the nucleus is properly called the:
    a. cytoplasm.
    b. cytosol.
    c. cytogel.
    d. cytoplasmic matrix.

25. According to the definitions used in this course, an organelle of a eukaryotic cell is:
    a. a membrane-bounded organelle.
    b. an occlusion.
    c. a component of the cytoskeleton.
    d. not a living component of the cell.

26. The function of ribosomes is:
    a. H_2O_2 detoxification.
    b. DNA replication.
    c. protein synthesis.
    d. acid hydrolysis.

27. Which one of the following is not a component of the lumen (nucleoplasm) of a cell nucleus?
    a. Ribosomes
    b. Lamin
    c. Histone
    d. Microfilaments

28. Which one of the following intracellular locations contains membrane-bound ribosomes?
    a. The lumen of the rough endoplasmic reticulum
    b. The cytoplasmic surface of smooth endoplasmic reticulum
    c. The cytoplasmic face of the nuclear envelope
    d. The intermembrane space of mitochondria

29. The detoxification of toxic organic molecules, such as those with benzene rings, occurs in:
    a. the smooth endoplasmic reticulum.
    b. lysosomes.
    c. mitochondria.
    d. peroxysomes.

30. The plasma membrane of eukaryotic cells expands by fusion with vesicles that come directly from:
    a. vacuoles.
    b. lysosomes.
    c. rough endoplasmic reticulum.
    d. golgi bodies.

31. One tissue may be degraded while another is being formed during animal development, such as when the tail disappears from a tadpole during leg development to produce a frog. The organelle most important for the disassembly of molecules in the degraded tissue is:
    a. smooth endoplasmic reticulum.
    b. lysosomes.
    c. mitochondria.
    d. peroxysomes.

32. Safe destruction of hydrogen peroxide in eukaryotic cells occurs within:
    a. smooth endoplasmic reticulum.
    b. lysosomes.
    c. mitochondria.
    d. peroxysomes.

33. Which one of the following is not a component of the endomembrane system of eukaryotic cells?
    a. Plastid
    b. Vesicles derived from smooth endoplasmic reticulum
    c. Nuclear envelope
    d. Lysosomes

34. A large central vacuole is a feature of:
    a. prokaryotic cells that are surrounded by a sheath.
    b. mature plant cells.
    c. irregularly-shaped animal cells.
    d. flagellated protist cells.

35. The plasmodesmata of plant cells:
    a. are organelles that contain DNA and protein-synthesis machinery.
    b. contain cellulose.
    c. serve the same function as animal lysosomes.
    d. are cytoplasmic connections between adjacent cells.

36. Which one of the following does not contain DNA?
    a. Proplastid
    b. Chloroplast
    c. Tonoplast
    d. Mitochondrion

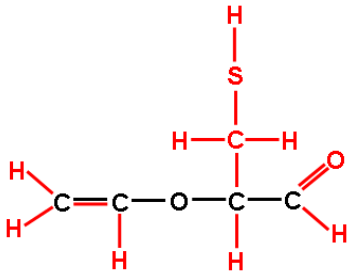
37. According to the endosymbiontic theory of the origin of eukaryotic cells, the incorporation of a photosynthetic prokaryote led to the development of:
    a. plastids.
    b. peroxysomes.
    c. the central vacuole.
    d. flagella.

38. Approximately 99% of the dry weight of cells is:
    a. water.
    b. inorganic ions.
    c. organic molecules.
    d. ATP.

Write answers to the following in the spaces provided, directly on the exam.

39. Show a complete structural formula of a covalently bonded molecule, starting with and adding to the skeleton shown below. Each atom must demonstrate the covalency that it would have in a biological molecule. In addition, the molecule must conform to the instructions listed below (read carefully).
- All atoms and all covalent bonds should be shown.
- The molecule should contain exactly one additional carbon atom.
- The molecule should have a branched chain.
- The molecule should have exactly one carbon-carbon double bond.
- The molecule should contain exactly one sulfhydryl functional group.
- The molecule should contain exactly one aldehyde functional group.

For example:



40. For each item below, select the item from the size ranges listed at left that best fits its typical size, and write the corresponding letter in the space provided.

A) < 1 nm
B) 4 – 40 nm
C) 0.5 – 5 µm
D) 6 – 15 µm
E) > 15 µm

i. __**B**_ The diameter of a ribosome
ii. __**C**_ The diameter of a bacterium
iii. __**A**_ The diameter of a molecule of water
iv. __**C**_ The diameter of a mitochondrion
v. __**A**_ The length of a covalent bond
vi. __**E**_ The diameter of a typical mature plant cell

41. For each item below, select the one component of the cytoskeleton from the list at left that best fits the description, and write the corresponding letter in the space provided.

A) microfilaments
B) microtubules
C) intermediate filaments
D) motor molecules

i. __**D**_ Dynein is an example
ii. __**C**_ Constructed of (not globular) filamentous protein
iii. __**A**_ Actin is an example
iv. __**B**_ Constructed like a hollow tube.
v. __**C**_ Keratin is an example
vi. __**B**_ The major component of basal bodies.
vii. __**D**_ Use energy of ATP to move organelles along tracks
viii. __**B**_ Constructed of globular dimers in the cytoplasmic matrix.
ix. __**B**_ Used to construct the mitotic spindle for chromosome separation.

42. Show an aldehyde function group hydrogen bonded to the water molecule illustrated below. Show all atoms and bonds in the functional group and illustrate the remainder of the aldehyde-containing molecule with the letter "R". Use a dotted line to show the hydrogen bond. Show the correct bond angle of the hydrogen bond.