## BIOLOGY 311C - Brand Spring 2009

NAME (printed very legibly) \_\_\_\_\_ Key UT-EID \_\_\_\_\_

## FINAL EXAM

Before beginning, check to be sure that this exam contains 10 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 (<u>not</u> your social security number) on the front of the Answer Sheet in the spaces provided. The first 55 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 56 - 60 directly on this exam, in the spaces provided with the questions. <u>Print</u> neatly if your handwriting is likely to be difficult to read. Turn in <u>both</u> this exam and the Answer Sheet after checking to be sure that your name is written clearly on both, and that all questions have been answered in the appropriate locations. You must turn in your exam on or before 12:00 noon.

- 1. The observations that the cell is the smallest unit of the living state and that every cell arose from an existing cell are expressions of:
  - a. the central dogma.
  - **<u>b.</u>** the cell doctrine.
  - c. the universal genetic code.
  - d. the law of diminishing returns.
- 2. The nitrogen bases of two antiparallel polynucleotide chains are held together by:
  - a. covalent bonds.
  - b. hydrophobic bonding.
  - c. electrovalent bonds.
  - **<u>d.</u>** hydrogen bonds.

3. The diameters of the smallest living cells are approximately:

- a. 0.1 mm.
- b. 100 μm.
- <u>c.</u> 500 nm.
- d. 20 Å.
- 4. According to a modern system of classification of all living organisms, Bacteria, Archea and Eukaryota are divided into three distinct groups called:
  - a. domains.
  - b. kingdoms.
  - c. phyla.
  - d. classes.
- 5. Which one of the following is <u>not</u> a model organism that is used extensively for modern cell and molecular biology research?
  - a. E. coli (a bacterium)
  - b. Caenorhabditis elegans (a roundworm)
  - c. Mus musculus (a mouse)
  - **<u>d.</u>** Spizella arborea (a bird)

- 6. A structure within a cell that is large enough to see with some kind of microscopy, and that is not surrounded by a membrane, is called a(n):
  - a. organelle.
  - **<u>b.</u>** occlusion.
  - c. plasmid.
  - d. scaffold.
- 7. The nucleolus of eukaryotic cells is the site of:
  - **<u>a.</u>** synthesis of ribosomal RNA.
  - b. hydrolytic breakdown of proteins.
  - c. translocation of lipids.
  - d. fixation of carbon dioxide.
- 8. In eukaryotes, a growing polypeptide chain that contains a signal peptide at its amino-terminal end targets the polypeptide chain to:
  - a. lysosomes.
  - b. the nucleus.
  - c. the plasma membrane.
  - <u>**d.**</u> endoplasmic reticulum.
- 9. Intracellular digestion occurs in animal cells within:
  - a. contractile vacuoles.
  - **<u>b.</u>** lysosomes.
  - c. chaperonins.
  - d. peroxysomes.
- 10. Which one of the following does not contain DNA?
  - <u>a.</u> Persoxysome
  - b. Plastid
  - c. Plasmid
  - d. Mitochondrion
- 11. Which one of the following does not contain microtubules?
  - a. Centrioles
  - b. Cilia
  - c. Bacterial flagella
  - d. Basal bodies
- 12. Which one of the following is a component of the cytoskeleton that consists of fibrous proteins?
  - a. Cellulose fibril
  - b. Microfilament
  - **<u>c.</u>** Intermediate filament
  - d. Microtubules
- 13. Which one of the following cell components is believed by most scientists to have arisen from the endosymbiotic uptake of one cell by another?
  - <u>a.</u> Chloroplast
  - b. Tonoplast
  - c. Ribosome
  - d. Peroxysome

- 14. Which one of the following pairs of atoms forms the most polar covalent bond?
  - a. A bond between an atom of carbon and an atom of hydrogen
  - b. A bond between an atom of carbon and another atom of carbon
  - c. A bond between an atom of carbon and an atom of sulfur
  - **<u>d.</u>** A bond between an atom of carbon and an atom of oxygen
- 15. Which one of the following functional groups, when added to pure water, is most effective in causing water molecules to become protonated?
  - **<u>a.</u>** Carboxylic acid
  - b. Amine
  - c. Alcohol
  - d. Sulfhydryl

16. Which one of the following occurs in highest concentration in the cytoplasmic matrix of living cells?

- a.  $Ca^{2+}$
- b. Na<sup>+</sup>
- <u>c.</u> K<sup>+</sup>
- d. OH

17. How many asymmetric carbon atoms occur in an aldotriose molecule?

- a. 0
- <u>b.</u> 1
- c. 2
- d. 3
- 18. The characteristic bonding arrangements of monomers that are covalently bonded together in a polysaccharide is:
  - a. peptide bonds.
  - **b.** glycosidic bonds.
  - c. ester bonds.
  - d. phosphodiester bonds.
- 19. The characteristic bonding arrangements of monomers that are covalently bonded together in a polynucleotide is:
  - a. peptide bonds.
  - b. glycosidic bonds.
  - c. ester bonds.
  - **<u>d.</u>** phosphodiester bonds.
- 20 Which one of the following is not a typical component of phospholipids?
  - a. Glycerol
  - b. Phosphodiester bond
  - **<u>c.</u>** Steroid ring structure
  - d. Fatty acid
- 21. Which one of the following kinds of lipid is most polar?
  - a. Phospholipid
  - b. Steroid
  - c. Triglyceride
  - d. Hydrocarbon

- 22. The central carbon atom of nearly all amino acids:
  - **<u>a.</u>** is asymmetric.
  - b. is electrically charged.
  - c. is covalently bonded to a sulfur atom.
  - d. is a component of a peptide bond when the amino acid forms a peptide bond with another amino acid.
- 23. The amino acid sequence of a polypeptide chain is called its:
  - **<u>a.</u>** primary structure.
  - b. secondary structure.
  - c. tertiary structure.
  - d. quaternary structure.
- 24. Purines and pyrimidines are components of
  - a. lipids.
  - b. proteins.
  - c. carbohydrates.
  - d. nucleotides.

25. Which one of the following contains at least one phosphate anhydride bond?

- a. GMP
- **b.** dCTP
- c. A dipeptide
- d. Glucose-6-phosphate
- 26. The lipids and transmembrane proteins within a biological membrane maintain their proper orientation by:
  - a. covalent bonding between molecules.
  - b. hydrogen bonding between molecules.
  - **<u>c.</u>** hydrophobic bonding.
  - d. electrovalent bonding.
- 27. Which one of the following is <u>not</u> true of the process of facilitated diffusion across a biological membrane? a. It does not require any source of energy such as ATP.
  - b. It is specific for a single kind of molecule or ion transported.
  - c. It uses transmembrane protein.
  - **<u>d.</u>** It is a kind of bulk transport.
- 28. Human red blood cells are able to avoid osmotic damage because they:
  - a. are surrounded by a rigid cell wall.
  - **b**. are isotonic with respect to the blood that surrounds them.
  - c. contain contractile vacuoles.
  - d. contain a central vacuole.

29. A chemical reaction with a  $K_{eq}$  value of 1 would have a  $\Delta G^\circ$  value:

- a. less than 0.
- <u>**b.**</u> of 0.
- c. between 0 and 1.
- d. of 1.
- 30. Enzymes are capable of speeding up metabolic reactions by:
  - a. making reactions more exergonic.
  - b. binding more tightly to the product(s) of reactions than to reactants.
  - c. increasing the temperature of the solution that surrounds enzymes.
  - **<u>d.</u>** decreasing the energy of activation of reactions.

- 31. Which one of the following is an isomerization reaction?
  - a. Conversion of an aldotriose to a ketotriose
  - b. Conversion of a carboxylic acid to a carboxylate ion
  - c. Conversion of an alcohol functional group to an aldehyde functional group
  - d. Hydrolysis of a disaccharide to two monosaccharides

32. Which one of the following is a chemical reduction?

- a. Conversion of a carbon-carbon double bond to an alcohol functional group
- b. Conversion of a ketone functional group to an aldehyde functional group
- c. Conversion of a hydrocarbon to an alcohol
- d. Conversion of a disulfide to two sulfhydryl functional groups
- 33. The primary function of FAD in cells is to:
  - **<u>a.</u>** carry hydrogen atoms.
  - b. direct energy to enzymatic reactions.
  - c. transport molecules and/or ions across biological membranes.
  - d. catalyze hydrolysis/dehydration reactions.
- 34. An allosteric inhibitor of a metabolic pathway:
  - a. blocks transcription so that the enzymes of the pathway are not synthesized.
  - b. is a signal molecule that inhibits the pathway by binding to the cell surface.
  - **<u>c.</u>** inhibits by binding to a regulatory site on an enzyme of the pathway.
  - d. affects the function of only the enzyme of the last reaction of the pathway.

35. During aerobic respiration, hydrogen atoms are finally delivered to:

- a.  $NADP^+$ .
- <u>**b.**</u> O<sub>2</sub>.
- c. pyruvate.
- d. glucose.
- 36. A final product of ethanolic fermentation of glucose is:
  - a. lactate.
  - b. pyruvate.
  - c. acetate.
  - <u>**d.**</u> CO<sub>2</sub>.
- 37. Which one of the following is not a metabolic pathway/process of respiration?
  - a. The Krebs cycle
  - b. An electron transport chain
  - c. Photophosphorylation
  - d. Glycolysis

38. A molecule that participates directly in primary electrical charge separation in photosynthesis is:

- **<u>a.</u>** chlorophyll.
- b. cytochrome.
- c. RUBISCO.
- d. topoisomerase.
- 39. The form of stored energy that results in ATP synthesis during photosynthesis is:
  - a. GTP.
  - **<u>b.</u>** a proton concentration difference across a membrane.
  - c. a protein in an unstable conformation.
  - d. a motor molecule attached to a component of the cytoskeleton.

- 40. Cyclic AMP in cells serves especially as a(n):
  - a. energy carrier molecule.
  - b. hydrogen-atom carrier molecule.
  - **<u>c.</u>** signal transduction molecule.
  - d. hormone.
- 41. G-protein-linked receptors and tyrosine kinase-linked receptors of eukaryotic cells bind tightly to:
  - **<u>a.</u>** the plasma membrane.
  - b. chromatin.
  - c. chloroplast thylakoids.
  - d. ribosomes.

## 42. An example of a second messenger molecule in cells is:

- a. insulin.
- **<u>b.</u>**  $Ca^{2+}$ .
- c. tyrosine kinase.
- d. RNA polymerase.
- 43. Which one of the following is <u>not</u> considered to be an "information molecule" in cells?
  - a. Polydeoxyribonucleic acid
  - b. Polyribonucleic acid
  - **<u>c.</u>** Polysaccharide
  - d. Polypeptide
- 44. During which phase of the cell cycle of eukaryotic cells does a cell make the decision whether to divide or else to develop into a mature cell?
  - <u>a.</u> G<sub>1</sub>
  - b. G<sub>2</sub>
  - c. S
  - d. M
- 45. The ligase function of insertion of deoxyribonucleotides during DNA synthesis involves two coupled reactions for each nucleotide inserted. One of the substrates that participates in that pair of reactions is: a. t-RNA.
  - **b.** pyrophosphate.
  - c. tyrosine kinase.
  - d. ribose.
- 46. A "hybrid" polynucleotide chain containing a short segment of RNA ligated to a segment of DNA occurs temporarily during the process of:
  - a. DNA replication.
  - b. DNA repair.
  - c. transcription.
  - d. post-transcriptional processing.
- 47. A gene that is expressed by serving as a template for RNA synthesis is called a(n):
  - a. regulatory gene.
  - **<u>b.</u>** structural gene.
  - c. alpha-gene.
  - d. translational gene.

48. The initial binding site of RNA polymerase prior to synthesis of a molecule of RNA is called a(n):

- <u>a.</u> promoter.
- b. inducer.
- c. codon.
- d. intron.

49. The  $\Delta G^{\circ}$  of the two-reaction process of inserting each nucleotide into a growing polynucleotide chain during transcription is approximately:

- a. 0.
- b. +30 kJ/mole.
- <u>**c.</u>** -45 kJ/mole.</u>
- d. -5.3 kJ/mole.

50. snRNPs are structures found in eukaryotic nuclei that function in:

- a. DNA repair.
- b. destruction of inactive proteins.
- c. synthesis of ribosomes.
- d. RNA processing.

51. Telomeres are sites at the ends of molecules of DNA in eukaryotic cells. They function:

- a. as binding sites for histones and other positively-charged proteins.
- **<u>b.</u>** by allowing DNA molecules to become shorter during replication without destroying functions.
- c. by aligning chromosomes correctly within the spindle in preparation for mitosis.
- d. to determine which genes are expressed and which remain silent during each stage of the cell cycle.
- 52. A t-RNA molecule that is charged contains a covalently bound:
  - a. pyrophosphate.
  - b. sugar.
  - c. steroid.
  - <u>d.</u> amino acid.
- 53. A lysogenic virus:
  - **<u>a.</u>** inserts its genetic information into the DNA of a host cell.
  - b. lyses a host cell after infection.
  - c. is a budding virus.
  - d. is capable of replicating outside of a host cell.
- 54. Which one of the following is <u>not</u> a feature that distinguishes bacterial viruses from animal viruses?
  - a. Bacterial viruses are more complex in shape than are animal viruses.
  - b. Bacterial viruses actively insert their genetic material into a host cell while animal viruses are actively taken up by the host cell.
  - c. Bacterial viruses don't undergo budding while many animal viruses do undergo budding.
  - **<u>d</u>**. Each bacterial virus can infect only one or a very few kinds of host cell while an animal virus can infect a broad range of kinds of host cells.
- 55. Which one of the following is true of HIV.
  - a. It is a lytic virus.
  - b. It carries genetic information as DNA.
  - c. It is capable of infecting bacterial cells.
  - **<u>d.</u>** It is surrounded by a bilayer membrane.

- 56. Answer the following questions by selecting the functional group that fits the description, and writing the corresponding letter(s) in the space provided.
  - i. \_\_\_\_B\_\_\_\_ Hydrocarbon (one answer).
  - ii.. \_\_\_\_A\_\_, \_\_\_C\_\_ Two functional groups that are at the same oxidation state.
  - iii. <u>E</u> Functional group(s) that ionize(s) in the cytoplasmic matrix of cells (one or more answers).
  - iv.  $\underline{\mathbf{E}}_{listed}$ . The one most oxidized functional group of those listed.
  - v.\_\_\_\_A, C, D\_\_\_\_ Functional group(s) that is(are) commonly found in the straight-chain form of simple sugars (one or more correct answers).
- 57. For each of the items listed below, select the <u>one</u> best answer from the list at right and place the corresponding letter in the space provided.
  - i. **\_\_B\_\_** Contain Golgi bodies
  - ii. \_\_C\_\_ Contain DNA as their genetic information
  - iii. \_\_A\_\_ Contain cytoplasmic 70S ribosomes
  - iv.  $\_C\_$  Perform both transcription and translation
  - v. A Are enclosed in an envelope consisting of two membranes
  - vi. **B** mRNA contains a poly-A tail and a modified G cap
- 58. For each of the items listed below, select the <u>one</u> best right answer from the list at right and place the corresponding letter in the space provided.
  - i. **\_\_B\_\_** Contain plasmodesmata
  - ii. \_\_A\_\_ Contain lysosomes but not a central vacuole
  - iii. \_\_C\_\_ Contain mitochondria
  - iv. \_A\_ Contain flagella or cilia
  - v. **\_\_B**\_\_ Contain plastids
  - vi. \_C\_ Contain actin



- A Characteristic of prokaryotes only
- B Characteristic of eukaryotes only
- C Characteristic of both prokaryotes and eukaryotes

- A Characteristic of animal cells, but not plant cells
- B Characteristic of plant cells, but not animal cells
- C Characteristic of both plant and animal cells

59. The illustration below shows three t-RNA anticodons. Also shown are illustrations of the corresponding sequence of each strand of DNA along with the corresponding sequence of mRNA, with each nucleotide shown only as an empty box. Corresponding amino acids of a polypeptide chain that would be synthesized from that information are also shown as empty boxes. Use the base-pairing rules for nitrogen bases and the table of the genetic code shown at the bottom of the page to fill in each box with the abbreviated name for the correct nucleotide or amino acid.



OK to leave off the "d" in front of the designations for DNA nucleotides.



Continue on next page.

- 60. For each item listed below, select the one best right answer from the list at right and place the corresponding letter in the space provided.
  - i. **\_\_D\_\_** Aminoacyl-tRNA synthase function
  - ii. \_\_C\_\_ Addition of a poly-A tail
  - iii. **B** RNA polymerase function
  - iv. \_\_A\_\_ Topoisomerase function
  - v. \_\_**D**\_\_ Ribosome P site function
  - vi. \_\_E\_\_ Removal of a portion of a pro-insulin molecule
  - vii. \_\_D\_\_ Polypeptide chain elongation
  - viii. <u>E</u> Attachment of a heme molecule to hemoglobin apoprotein
  - ix. \_\_A\_\_ Primase function
  - x. \_\_C\_\_ Spliceosome function

- A DNA replication
- **B** Transcription
- C Post-transcriptional processing
- **D** Translation
- E Post-translational processing