#### **BIOLOGY 311C - Brand** Spring 2010

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 (not your social security number) on the front of the Answer Sheet in the spaces provided. The first 61 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 62 - 66 directly on this exam, in the spaces provided with the questions. 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 by 10:00 p.m.

- 1. Which one of the following would be expected to carry a positive electrical charge at pH 7?
  - a. An organic phosphate
  - b. An alcohol
  - **c.** An amine
  - d. A carboxylic acid
- 2. Living cells, with a steady flow of food and energy in, and waste materials out, are said to be in a state of: **a.** homeostasis.
  - b. static equilibrium.
  - c. dynamic equilibrium.
  - d. suspended animation.
- 3. The outer boundary of the living component of the cell is often considered to be the:
  - a. cytogel.
  - b. nuclear envelope.
  - c. extracellular matrix.
  - **d.** plasma membrane.

#### 4. The diameters of almost all kinds of living cells fall into the range of:

- a. 10 nm 50 µm.
- **b.** 500 nm 100 μm.
- c. 20 µm 0.5 mm.
- d. 50 nm 2 mm.
- 5. A substrate of protein kinase enzyme is:
  - a. pyruvate.
  - <u>**b.**</u> ATP.
  - c. RuBP.
  - d. a polynucleotide.
- 6. Biologists describe a model organism as a(n):
  - a. organism that responds to a laboratory environment exactly as it does to its natural environment.
  - **b.** species that is studied extensively in order to infer characteristics of a broad range of organisms.
  - c. organism whose characteristics are optimum for cell biology studies.
  - d. species whose metabolism can be modeled mathematically.

- 7. Which one of the following is a major component of chromatin?
  - a. Oligosacharides
  - **b.** Histones
  - c. snRNP
  - d. Hexokinase
- 8. Which one of the following contains acid hydrolase enzymes?
  - <u>a.</u> Lysosome
  - b. Plasma membrane
  - c. Peroxysome
  - d. Golgi
- 9. Which one of the following is <u>not</u> a part of the endomembrane system of eukaryotic cells?
  - a. Plasma membrane
  - b. Golgi
  - c. Nuclear envelope
  - d. Mitochondrion
- 10. Which one of the following does <u>not</u> contain the machinery necessary for storing genetic information and expressing it as proteins?
  - a. Mitochondrion
  - **<u>b.</u>** Peroxysome
  - c. Plastid
  - d. Prokaryotic cell
- 11. Which of the following expends energy in translocation of organelles within a eukaryotic cell?
  - a. Microtubules
  - b. Microfilaments
  - **<u>c.</u>** Motor molecules
  - d. Intermediate filaments
- 12. The largest organelle in a typical mature plant cell is the:
  - a. chloroplast.
  - b. nucleus.
  - c. plasmodesmata.
  - <u>**d.**</u> central vacuole.
- 13. Which of the following is true of plants, as compared to animals?
  - **<u>a.</u>** They have a more generalized metabolism.
  - b. Their cells are generally smaller.
  - c. They contain many more lysosomes per cell.
  - d. They contain centrioles.
- 14. The kind of molecular interaction most important for the arrangement of polar lipids in biological membranes is:
  - a. covalent bonding.
  - b. hydrogen bonding.
  - c. electrovalent bonding.
  - <u>**d.**</u> hydrophobic bonding.

- 15. Which one of the following is present in highest concentration in active living cells?
  - a. Carbohydrate
  - b. Protein
  - <u>c.</u> Water
  - d. Inorganic ions
- 16. Which one of the following kinds of atom is not directly involved in hydrogen bonds in living cells?
  - а. Н
  - b. O
  - <u>c.</u> C
  - d. N

17. Which one of the following occurs at lowest concentration in living cells?

- a. K<sup>+</sup>
- <u>**b.</u>** Na<sup>+</sup></u>
- $\overline{c}$ . Mg<sup>2+</sup>
- d.  $HPO_4^2$
- 18. The molecule whose structure is illustrated at right is a(n):
  - a. lipid.
  - **b.** sugar.
  - c. amino acid.
  - d. nucleoside.
- 19. Steroids and isoprenoids are examples of:
  - <u>a.</u> lipids.
  - b. carbohydrates.
  - c. polypeptides.
  - d. polynucleotides.

20. Which one of the following is a component of the molecule whose structure is illustrated at right?

- a. Glycerol
- b. Sugar
- **<u>c.</u>** Amino acid
- d. Nucleoside



- a. active site.
- b. tertiary structure.
- c. ligand.
- <u>d.</u> domain.
- 22. The compound called xylulose is expected to be a:
  - a. glyceride lipid.
  - b. enzyme.
  - c. nucleotide.
  - **<u>d.</u>** carbohydrate.

# 23. The number of "high-energy" phosphate bonds in a molecule of GTP is:

- a. 0.
- b. 1.
- <u>c.</u> 2.
- d. 3.
- 24. A stem-loop structure is characteristic of:





- a. enzymes.
- b. polysaccharides.
- c. triglycerides.
- <u>**d.</u> RNA.</u></u>**
- 25. A <u>difference</u> between active transport and facilitated diffusion across a biological membrane is that facilitated diffusion:
  - **<u>a.</u>** can transport a substance in either direction.
  - b. requires ATP to function.
  - c. transports many molecules at a time (in bulk) across the membrane.
  - d. does not require a specific transport membrane (permease).
- 26. If a biological reaction has a  $\Delta G^{\circ}$  value of 0, then the K<sub>eq</sub> of the reaction will be:
  - a. 0.
  - <u>b.</u> 1.
  - c. 5.7.
  - d. 10.
- 27. Which one of the following would be expected to have the most <u>positive</u>  $\Delta G^{\circ}$  value?
  - a. Hydrolysis of ATP to  $ADP + P_i$
  - **b.** Formation of ADP from AMP + P<sub>i</sub>
  - c. Isomerization of a sugar
  - d. Hydrolysis of a disaccharide to form two sugars.
- 28. Which one of the following components of a typical biological reaction has been changed when the reaction is complete?
  - a. Enzyme
  - b. Cofactor
  - c. Prosthetic group
  - <u>d.</u> Substrate

29. Conversion of an aldehyde to a carboxylic acid functional group is an example of a(n):

- **<u>a.</u>** oxidation.
- b. reduction.
- c. deprotonation.
- d. isomerization.
- 30. Which one of the following is a <u>catabolic</u> pathway or process?
  - a. The reaction catalyzed by DNA polymerase
  - **b.** The Krebs cycle (citric acid cycle)
  - c. The Calvin Cycle ("dark" reactions)
  - d. Synthesis of a polypeptide chain
- 31. Which one of the substrates whose chemical formula is shown here is a reduced compound that becomes oxidized in the complete respiration of a molecule of glucose?
  - a. O<sub>2</sub>
  - **<u>b.</u>** C<sub>6</sub>H<sub>12</sub>O<sub>6</sub>
  - c. H<sub>2</sub>O
  - d.  $CO_2$
- 32. Which one of the following is an aggregation of enzymes (a metabolic pathway) that occurs in the mitochondrial matrix and uses Coenzyme A (Co-A) as a reactant?

- a. Glycolysis
- b. The Kreb cycle
- **<u>c.</u>** Pyruvate dehydrogenase
- d. Oxidative phosphorylation
- 33. The function of NADPH in the Calvin Cycle of photosynthesis is:
  - a. capture of light energy.
  - b. fixation of CO<sub>2</sub>.
  - **<u>c.</u>** reduction of substrate.
  - d. synthesis of ATP.

34. Which one of the following is not a feature common to both respiration and photosynthesis?

- a. They utilize electron transport chains.
- b. In eukaryotes, they occur in organelles that contain protein-synthesizing machinery.
- c. They use ATP synthase in a chemiosmotic mechanism to synthesize ATP.
- **<u>d.</u>** They are catabolic processes.
- 35. Which one of the following is not true of the CO<sub>2</sub>-fixing enzyme called rubisco)?
  - a. Either  $CO_2$  or  $O_2$  can serve as its substrates.
  - **<u>b.</u>** It is highly efficient in its ability to fix CO<sub>2</sub>.
  - c. Part of it is synthesized in the cytoplasmic matrix and part is synthesized in the chloroplast.
  - d. It is probably the most abundant enzyme on earth.
- 36. C<sub>4</sub> and CAM plants differ from C<sub>3</sub> plants in that both C<sub>4</sub> and CAM plants:
  - a. are incapable of photosynthetic molecular oxygen production.
  - b. perform photosynthesis only at night.
  - **<u>c.</u>** separate initial carbon dioxide capture from the rest of photosynthesis in location or in time.
  - d. are capable only of noncyclic photophosphorylation.
- 37. A signaling molecule of a multicellular organism that is produced in one kind of cell and travels to a second kind of cell, where it elicits a response, is called a(n):
  - a. secondary messenger.
  - **<u>b.</u>** hormone.
  - c. elicitor.
  - d. operator.
- 38. An example of a molecular switch in various signal transduction pathways is:
  - a. insulin.
  - b. helicase.
  - c. actin.
  - <u>d.</u> G-protein.
- 39. Apoptotis is a process of:
  - a. regulating directional growth.
  - **b.** programmed cell death.
  - c. switching the cell from the  $G_1$  phase to the S phase.
  - d. switching a cell from anaerobic to aerobic metabolism.

- 40. The final step in the signal transduction pathway initiated by growth factor binding to a receptive cell is:
  - **<u>a.</u>** the alteration of transcription factor.
  - b. a temporary change in the genetic code.
  - c. release of the growth factor from the plasma membrane.
  - d. death of the cell.
- 41. Calcium ions and cyclic AMP in cells are examples of which one of the following?
  - a. Components of biological membranes
  - b. Electron transport carriers
  - c. Second messengers
  - d. Hormones
- 42. At which phase of the cell cycle does a eukaryotic cell make the irreversible decision to either become a mature functioning cell or else to divide?
  - <u>a.</u> G<sub>1</sub>
  - $b. \quad G_2$
  - c. S
  - d. M
- 43. Consider a bacterial cell that carries a single molecule of DNA. The Cell synthesizes a copy of the DNA and then divides. The two new cells then each synthesize new DNA and divide. Finally, each of these four cells synthesizes new DNA and divides. Then how many of the eight new bacterial cells will carry a DNA polynucleotide chain from the original bacterium?
  - a. 0.
  - <u>b.</u> 2.
  - c. 4.
  - d. 8.
- 44. The function of primase during DNA replication is to:
  - **<u>a.</u>** synthesize RNA from a DNA template.
  - b. prevent supercoiling of the DNA as it unwinds.
  - c. ligate two pieces of DNA together.
  - d. unwind the two strands of the double helix.
- 45. Even though synthesis of the lagging strand of DNA in short segments during replication seems inefficient, it is necessary because:
  - a. otherwise the strands of the DNA double helix could not be separated.
  - b. otherwise replication would occur too rapidly for the replication machine to correct for errors.
  - c. there are two replication forks that are active at the same time.
  - **<u>d.</u>** nucleotides are only inserted into the new polynucleotide chain in the 5'-to-3' direction.
- 46. Telomeres are segments of eukaryotic DNA that:
  - **a.** shorten at each round of DNA replication.
  - b. connect to microtubules during migration of chromosomes during mitosis.
  - c. are capable of moving from one location to another within chromosomes.
  - d. have no known function.
- 47. Which one of the following is <u>not</u> a structural gene?
  - a. A gene that provides coding information for synthesis of a polypeptide chain
  - **b.** A gene that serves as a promoter
  - c. A gene that transcribes rRNA
  - d. A gene that is used as a template for the synthesis of snRNA

- 48. In eukaryotes, the 5' end of a processed molecule of mRNA contains a(n):
  - a. long sequence of A (poly-A).
  - b. intron.
  - **<u>c.</u>** modified G cap.
  - d. short segment of DNA.
- 49. Separate exons in a molecule of RNA often correspond to distinct:
  - a. regulatory sequences of an operon.
  - b. different molecules of tRNA.
  - **<u>c.</u>** domains of a polypeptide chain.
  - d. stop codons that are used during translation of a polypeptide chain.
- 50. A tRNA molecule is said to be charged when it is covalently attached to a(n):
  - **<u>a.</u>** amino acid.
  - b. cyclic-AMP.
  - c. ribosome.
  - d. snRNP.
- 51. Which one of the following anticodons associates with the codon: 5'... A-C-C... 3'?
  - a. 5'... A-C-C... 3'
  - b. 3'... A-C-C... 5'
  - c. 5'… U-G-G… 3'
  - <u>**d.</u> 3'… U-G-G… 5'</u></u>**
- 52. Chaperonins are structures that:
  - a. remove introns from RNA.
  - b. facilitate movement of RNA through nuclear pores.
  - **<u>c.</u>** help proteins fold into a correct tertiary structure.
  - d. target ribosomes to the endoplasmic reticulum.
- 53. A protein that is ubiquitinated is destined to be:
  - a. exported from the cell.
  - **<u>b.</u>** destroyed.
  - c. combined with other proteins and RNA to form a ribosome.
  - d. transported to the nucleus through the nuclear envelope.
- 54. Which one of the following is associated with <u>all</u> viruses, even when they are not in a cell?
  - a. Protein
  - b. RNA
  - c. DNA
  - d. Lipid
- 55. A phage is a virus that:
  - a. uses budding in its reproductive cycle.
  - **b.** has a bacterial host.
  - c. contains RNA.
  - d. has a membrane coat.

56. A virus that usually becomes lysogenic when invading a cell is said to be:

- a. virulent.
- b. budding.
- c. almost always a plant virus.
- <u>**d.**</u> temperate.

57. Which one of the following is an enzyme that occurs within the HIV virus?

- a. Reverse transcriptase
- b. RNAase
- c. Protein phosphorylase
- d. Hexokinase

### 58. In <u>contrast</u> to eukaryotic viruses, bacterial viruses typically:

- a. are larger in size.
- b. carry RNA as their genetic material.
- **<u>c.</u>** are more complex in shape.
- d. passively enter their host cell.

59. Viruses can on occasion help a cell by:

- a. stimulating the rate of host cell respiration.
- b. making the host cell plasma membrane more porous to molecules in the environment.
- **<u>c.</u>** inserting a useful gene into the host cell genome.
- d. decreasing the rate of protein synthesis within the host cell.
- 60. In the trp operon, the amino acid trypotophan (trp) and the product of the gene "trpI" together serve as a(n):
  - a. operator.
  - b. promoter.
  - c. inducer.
  - <u>d.</u> repressor.

61. The two essential components of a prokaryote operon are a unit of transcription and an upstream:

- a. operator.
- **<u>b.</u>** promoter.
- c. inducer.
- d. repressor.
- 62. Each of the statements below is made of a specific class of biological molecule. For each item below, select the one best answer from the list at right.
  - i. **D** Promoter
  - ii.  $\_C\_$  Topoisomerase and helicase
  - iii. \_A\_\_ Oligosaccharide
  - iv. **D** tRNA
  - v. **B**\_\_ Cholesterol
  - vi. **\_D\_\_** Exon

- A carbohydrate
- **B** lipid
- C polypeptide/protein
- D polynucleotide/nucleic acid

- 63. For each of the statements below, select the <u>one</u> best answer from the list at right and write the corresponding letter in the space provided.
  - i. \_A\_\_ Synthesis of rRNA
  - ii. **D** Addition of a heme to hemoglobin
  - iii. \_C\_\_ Addition of a poly-A tail to a molecule of RNA
  - iv. **D**\_ Addition of a functional group to histone
  - v. **B** Synthesis of a molecule of hexokinase
  - vi. **D** Protein kinase function
- 64. For each of the statements below, select the answer from the list at right that best fits the description and write the corresponding letter in the space provided.
  - i. \_C\_\_ Plasmids
  - ii. \_A\_\_ Plastids
  - iii. **\_D\_\_** Nuclear envelope
  - iv. **D**\_ 80S ribosomes

v. \_**E**\_\_ RNA polymerase

- vi. **B** Centrioles
- vii. **\_D\_\_** poly-A tail on mRNA
- 65. Each kind or category of molecule whose name is listed below is held together by a characteristic kind of bonding. For each item below select from the list at right the kind of bond that best characterizes it. Items at right may be used more than once.
  - i. \_A\_\_ microfilament
  - ii.  $C_{cellulose}$
  - ііі. **\_Е\_\_** АТР
  - iv. **\_B\_**, **\_D\_** phospholipid (two answers)
  - v. \_A\_\_ enzyme

- A An example of transcription
- **B** An example of translation
- C An example of post-transcriptional processing
- D An example of post-translational processing

- A Characteristic of mostly or exclusively of plants
- B Characteristic mostly or exclusively of animals
- C Characteristic mostly or exclusively of prokaryotes
- D Characteristic of both plants and animals, but not prokaryotes
- E Characteristic of all living organisms

- A peptide bond
- B glyceride bond
- C glycosidic bond
- D phosphodiester bond
- E acid anhydride bond

66. The nucleotide sequence shown in the illustration below represents a segment of a <u>minus</u> (non-coding) strand of a molecule of DNA. It includes the "start" site for polypeptide chain synthesis, and information for the insertion of <u>the first two amino acids</u> into a new polypeptide chain. Answer the following questions, using the rules for information flow in cells and the table for the genetic code provided at the bottom of this page.

# 5'...... G C A T G T C A........ 3'

a. In the space provided below, show the nucleotide sequence of the <u>plus</u> (coding) strand corresponding to this 8-nucleotide segment of DNA. Show the 3' and 5' ends on your sequence.

b. In the space provided below, show the nucleotide sequence of the segment of mRNA corresponding to this 8- nucleotide segment of DNA? Show the 3' and 5' ends on your sequence.

# 5'...... G C A U G U C A...... 3'

c. In the space provided below, show the <u>dipeptide</u> sequence corresponding to the nucleotide sequence of the plus (coding) strand corresponding to the coded portion of this segment of DNA. Show the N-terminal end and the C-terminal end on your sequence.



# N······ Met — Ser ······ C

# End of Exam