BIOLOGY 311C - Brand
Spring 2007

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

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FINAL EXAMINATION

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 50 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 51 – 56 directly on this exam, in the spaces provided with the questions. Write in complete sentences if an explanation or a description is required. 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 5:00 p.m.

1. In molecular biology, the word "assembly" refers to:
   a. synthesis of a macromolecule with a specific primary structure.
   b. insertion and organization of macromolecules into a larger unit.
   c. transporting a macromolecule through a membrane.
   d. alignment of macromolecules in a specific orientation with respect to the cytoskeleton.

2. With respect to the diameter of a typical prokaryotic cell, the diameter of a typical virus is approximately:
   a. the same size.
   b. 1/10 - 1/20 as long.
   c. 1/500 - 1/1000 as long.
   d. 1/5,000 - 1/10,000 as long.

3. Plant cells do not blow up and burst by osmosis because they:
   a. contain a large central vacuole.
   b. contain contractile vacuoles.
   c. are surrounded by a strong cell wall.
   d. are bathed in solution isotonic with their cytoplasm.

4. Which one of the following is the longest (in length) kind of molecule in living cells?
   a. DNA
   b. RNA
   c. Protein
   d. Polysaccharide

5. Most cells in the human body can divide only a finite number of times. A likely explanation is that:
   a. errors in copying the template DNA during each cycle of replication render the DNA nonfunctional after a finite number of replications.
   b. the concentration of DNA polymerase is reduced in each successive generation of cells.
   c. chromatin becomes less organized after each replication, until the nucleolus ceases to produce functional ribosomal subunits.
   d. the telomeres get shorter with each DNA replication, eventually destroying functional DNA.

6. Which one of the following is a substrate for DNA polymerase during synthesis of a molecule of DNA?
   a. UDP
   b. Activated amino acid
   c. 2'-deoxy-CTP
   d. AMP

7. The two polynucleotide chains of a molecule of DNA are held together by:
   a. covalent bonds.
   b. hydrophobic bonding.
   c. hydrogen bonds.
   d. electrovalent (ionic) bonding.

8. The function of primase during the synthesis of a molecule of DNA is:
   a. unwinding the double helix.
   b. repairing errors in nucleotide insertion into a polynucleotide chain.
   c. attaching the polymerase to the growing polynucleotide chain and the template DNA strand.
   d. synthesizing a RNA oligonucleotide complementary to a DNA template.

9. Which one of the following occurs exclusively during the S phase of the eukaryotic cell cycle?
   a. Cytokinesis
   b. Protein synthesis
   c. DNA replication
   d. Respiration

10. Which one of the following is true of the synthesis of polypeptide chains within living cells?
   a. The C-terminal end is always synthesized first.
   b. The N-terminal end is always synthesized first.
   c. Synthesis starts with a amino acid to be in the center of a polypeptide chain, then proceeds in both C-terminal and N-terminal directions.
   d. The N-terminal end is synthesized first in eukaryotes while the C-terminal end is synthesized first in prokaryotes.

11. A gene is a functional unit of:
   a. DNA.
   b. RNA.
   c. a ribosome.
   d. protein.

12. A tRNA molecules becomes charged in preparation for participation in translation by bonding covalently:
   a. to a hydrophobic surface of a protein.
   b. to the membrane surface of endoplasmic reticulum.
   c. to a nuclear pore complex.
   d. to an amino acid.

13. Which one of the following is a posttranscriptional modification that alters the 3' end of molecules destined to become mRNA?
   a. The addition of a poly-A tail
   b. The addition of a modified G cap
   c. The chemical modification of nitrogen bases in an exon
   d. The removal of an intron

14. Post-transcriptional processing in eukaryotic cells takes place in:
    a. the nucleus.
    b. the cytoplasm.
    c. the endoplasmic reticulum.
    d. secretory vesicles.

15. Repression of RNA synthesis occurs when a repressor molecule binds to a(n):
    a. intron.
    b. exon.
    c. snRNP.
    d. promoter.

16. snRNPs (small nuclear RiboNucleoProteins) are central components of:
    a. ribosomes.
    b. chaperons.
    c. spliceosomes.
    d. proteasome.

17. Ribosomes are constructed of proteins and:
    a. carbohydrate.
    b. RNA.
    c. DNA.
    d. lipid.

18. The site of assembly of ribosomal subunits in eukaryotic cells is the:
    a. nucleolus.
    b. surface of endoplasmic reticulum.
    c. cytoplasmic matrix.
    d. interior of chaperonins.

19. According to the endosymbiont theory of the origin of organelles, which one of the following kinds of organelle is believed to have arisen from the uptake and assimilation of a prokaryotic cell by another cell?
    a. Lysosome
    b. Golgi body
    c. Vacuole
    d. Mitochondrion

20. When components of the protein-synthesizing machinery first assemble together to start polypeptide chain synthesis, the last component to join the initiation complex is:
    a. the ribosomal small subunit.
    b. the ribosomal large subunit.
    c. a charged t-RNA.
    d. mRNA.

21. Polypeptide chain synthesis stops at the termination of translation, and the completed polypeptide chain is released, when the ribosome:
    a. reaches the 5'end of the bound mRNA.
    b. reaches the 3'end of the bound mRNA.
    c. reaches a stop codon.
    d. is pushed away by the polypeptide chain starting to fold into a tertiary structure.

22. Which one of the following is an example of post-translational processing?

a. Addition of a prosthetic group to a protein
b. Addition of a modified G cap to RNA
c. Communication of a signal across the plasma membrane
d. Movement of a pair of homologous chromosomes to opposite poles of a cell prior to cytokinesis

23. The diameters of the smallest living cells are approximately:
a. 2 nm.
b. 50 nm.
c. 0.5 μm.
c. 0.02 mm.

24. In facilitating flagellar movement, dynein serves as a(n):
a. ionic bridge.
b. motor molecule.
c. intermediate filament.
d. initial signal molecule in a signal transduction pathway.

25. The envelope of a typical prokaryotic cell consists of:
a. two membranes enclosing an intermembrane space.
b. a thick cell wall containing cellulose.
c. a glycocalyx that included collagen.
d. chitin and lignin.

26. Which one of the following is not a component of the endomembrane system of eukaryotic cells?
a. Lysosomes
b. Smooth endoplasmic reticulum
c. The plasma membrane
d. Mitochondria

27. Basal bodies and centrioles of eukaryotic cells contain:
a. mitochondria.
b. histones.
c. RNA.
d. microtubules.

28. Keratin and lamins are examples of:
a. pigments in chloroplasts.
b. transmembrane proteins.
c. oxygen-carrying molecules.
d. intermediate filaments.

29. Which one of the following is true of typical plant cells but not true of typical animal cells?
a. They exhibit post-transcriptional processing.
b. They contain a large central vacuole.
c. They contain lysosomes.
d. They contain plasmids.

30. Endocytosis by animal cells is an example of:
a. active transport of specific molecules.
b. facilitated diffusion..
c. bulk transport.
d. osmosis.

31. Which one of the following functional groups is not capable of hydrogen bonding to a molecule of water?

a. Carboxylic acid
b. Amine
c. Aldehyde
d. Sulfhydryl

32. Which one of the atoms whose chemical symbol is shown here is most electronegative?
a. O
b. C
c. S
d. P

33. If a chemical reaction has a K_{eq} greater than 1 (one), then under standard conditions:
a. it is endergonic.
b. is it spontaneous.
c. it has a ΔG^{o} value greater than zero.
d. it requires an enzyme in order to proceed in the forward direction.

34. Which of the following serves as a second messenger in many kinds of cells?
a. H_3O^+
b. Ca^{2+}
c. K^+
d. NH_4^+

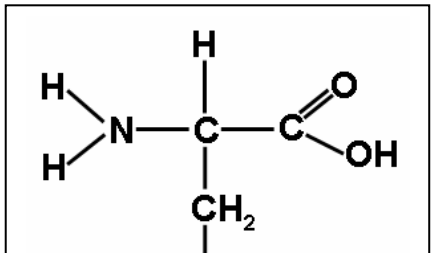
35. The suffix "ase" at the end of the name of a biological molecule suggests that it is a(n):
a. carbohydrate.
b. nucleic acid.
c. enzyme.
d. hydrogen-carrier molecule.

36. Which one of the following does not require an enzyme in order to occur efficiently in living cells?
a. Deprotonation of a phosphoric acid functional group
b. Isomerization of an aldose to a ketose
c. Oxidation of an alcohol functional group to an aldehyde
d. Hydrolysis of a dipeptide

37. Which one of the following is an indication that a metabolic pathway is anabolic?
a. Substrate releases energy which is captured as ATP.
b. Substrate becomes more reduced by the addition of hydrogen atoms.
c. A large initial reactant becomes broken down into smaller final products.
d. The final product of the pathway is discarded from the cell as waste.

38. A molecule that is called a glycoprotein is expected to contain (in addition to protein):
a. lipid.
b. DNA.
c. RNA.
d. carbohydrate.

The following three questions (No. 39 - 41) relate to the molecule whose structural formula is shown at right.



39. How many asymmetric carbon atoms occur in this molecule?

a. 0
b. 1
c. 2
d. 3

40. How many electrical charges would this molecule carry at pH 7?
    a. 0
    b. 1
    c. 2
    d. 3

41. To which class of molecules does this molecule belong?
    a. Modified sugar
    b. Nucleoside
    c. Amino acid
    d. Isoprenoid

42. A bacterial virus is called a(n):
    a. adenovirus.
    b. plasmid.
    c. pilus.
    d. bacteriophage.

43. A temperate virus (in contrast to a virulent virus):
    a. assimilates its DNA into the host cell DNA without causing damage to the host cell.
    b. dictates use of the host cell endomembrane system to synthesize viral membrane components.
    c. causes budding instead of lysis.
    d. has a very narrow host range.

44. The HIV virus contains a single enzyme, which is:
    a. RNA polymerase.
    b. hexokinase.
    c. RNA ligase.
    d. reverse transcriptase.

45. Tiny circular molecules of RNA that infect plant cells are called:
    a. prions.
    b. viroids.
    c. proviruses.
    d. plasmids.

46. The lipid bilayer structure of biological membranes is determined principally by:
    a. covalent bonds.
    b. hydrogen bonds.
    c. hydrophobic bonding.
    d. electrovalent bonding.

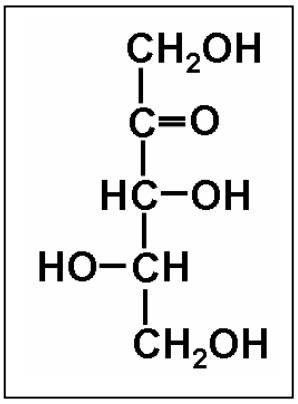
47. The modification of photosynthesis known as Crassulacean Acid Metabolism (CAM) is of most benefit to plants under which one of the following conditions?
    a. Severe drought
    b. Very low light intensity
    c. High stress due to disease

d. Low temperature

48. When an NADH molecule loses a hydrogen atom and an electron, it is said to be:
a. oxidized.
b. reduced.
c. protonated.
d. deprotonated.

49. Rubisco is an important enzyme in the process of:
a. transcription.
b. translation.
c. respiration.
d. photosynthesis.

50. The illustration at right represents a(n):
a. steroid.
b. simple sugar.
c. pentasaccharide.
d. amino acid.



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51 In the space provided below, describe what features of the molecule represented at right cause it to be placed into the category you selected as an answer to question number 50.

- It is a straight-chain organic molecule containing 5 (between 3 and 7) carbon atoms;
- One of the carbon atoms forms a ketone functional group;
- All other carbon atoms form alcohol functional groups.

52. In the space below, explain what is meant by the statement that the genetic code is universal.

The amino acid specified by each mRNA codon is the same in all cells of all living organisms.

53. For each item below, select a class of molecule from the list at right, and write the corresponding letter in the space provided. Answers may be used more than once.

A.	**simple sugar**
B.	**polysaccharide**
C.	**amino acid**
D.	**polypeptide**
E.	**nucleotide**
F.	**polynucleotide**
G.	**lipid**

i. ___**F**__ Contains hundreds of nitrogen bases

ii. ___**C**__ Is activated by its covalently bonding to a tRNA

iii. ___**G**__ Cholesterol

iv. ___**A**__ Glucose

v. ___**B**__ Starch

vi. ___**E**__ Cyclic AMP

vii. ___**A**__ Final product of photosynthesis

viii. ___**D**__ Subunit (monomer) of actin

54. For each item below, select a number or a range of numbers from the list at right that best fits the description, and write the corresponding letter in the space provided. Answers may be used more than once.

A.	**0**
B.	**1**
C.	**2**
D.	**3**
E.	**4**
F.	**5**
G.	**6 - 7**
H.	**8 - 20**
I.	**21 - 40**
J.	**41 -100**
K.	**over 100**

i. ___**C**__ The number of high-energy phosphate bonds in a molecule of the nucleotide GTP

ii. ___**D**__ The number of carbon atoms in a ketotriose

iii. ___**I**__ The number of ATP molecules produced from the respiration of one molecule of D-glucose

iv. ___**K**__ The bond strength, in kJ/mole, of a typical covalent bond

v. ___**A**__ The number of amino acids in a polynucleotide chain

vi. ___**J**__ The number of quanta of light required in the light reactions of photosynthesis to facilitate the synthesis of one molecule of hexose in the Calvin cycle

vii. ___**K**__ The diameter, in nm, of a typical prokaryotic cell (note the units of length)

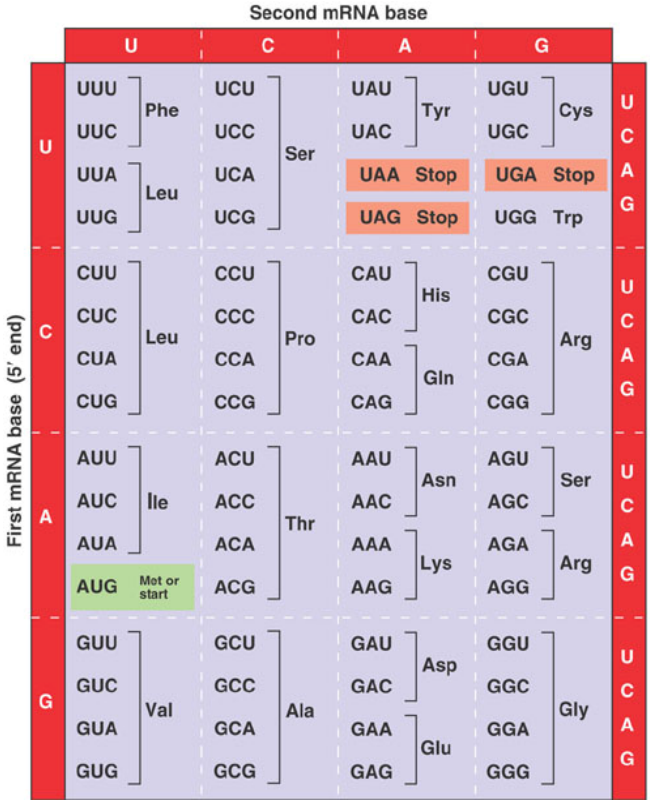
viii. ___**F**__ The number of high energy phosphate bonds that must be hydrolyzed for each amino acid that is activated, then inserted into a growing polypeptide chain during translation in a living cell

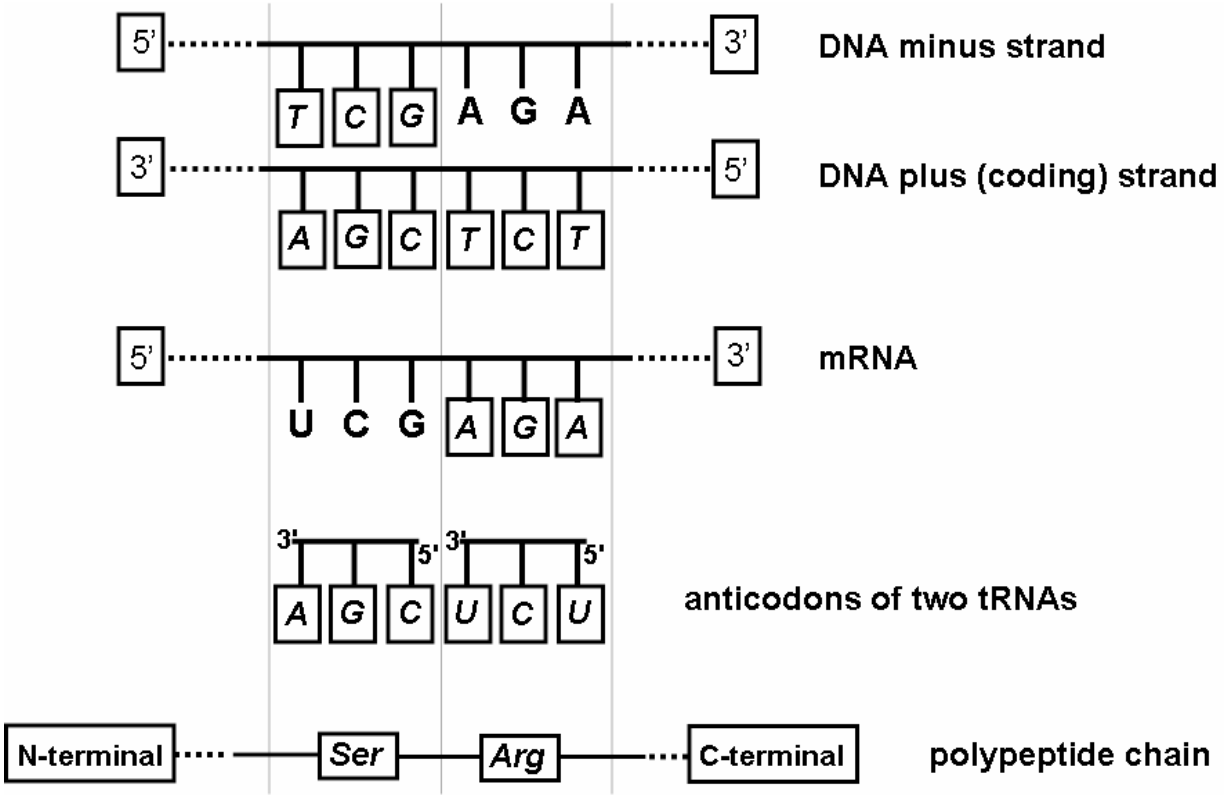
ix. ___**H**__ The number of microtubule doublets that occur in a typical flagellum

x. ___**K**__ The number of nucleotides in a typical primary transcript that will eventually become a molecule of mRNA

55. a. ___**AUG**__ Use the genetic code shown at right to determine the first amino acid inserted into a each new polypeptide chain during translation and write the name (three-letter designation) in the space provided.

b. The diagram below illustrates aligned polynucleotides and a polypeptide chain, showing a codon on a molecule of mRNA and a triplet of nucleotides in a minus strand of DNA. Apply the base-pairing rules for nucleotides and the genetic code (see the table at right) to fill in the empty rectangles in the diagram below. The rectangles at the ends of each illustrated molecule represent 3' and 5' ends of a nucleotide or else C-terminal and N-terminal ends of a polypeptide chain. The rectangles shown in the interior of these molecules represent either nucleotides or amino acids. Do not show the "d" prefix on nucleotides of DNA.





56. For each item listed below, write in the space provided the name of the membrane-bounded organelle or kind of membrane that best fits the description:

a. __***chloroplast***_____ Intracellular Site of photosynthesis in plants.

b. __**lysosome**_____ Site of intracellular digestion in animals.

c. **rough endoplasmic reticulum** Site of membrane-bound ribosomes.

d. __**mitochondrion**_____ Site of the Kreb cycle of respiration.

e. __**plasma membrane**_____ Site of binding of receptors for hydrophilic hormones.

f. __**nucleus (or nuclear envelope)**_ Site of pores through which ribosomes pass.

g. __**peroxysome**_____ Site of destruction of hydrogen peroxide in eukaryotes.

h. __**golgi**_____ Site of sorting membrane material before forming vesicles that will be used to construct other membrane-bounded organelles.