2009-2010 SC/BIOL 1010 6.0 December Exam - Dec. 21, 2009

Section B [Taught by Dr. Tanya Noel]

ANSWER KEY

This test consists of **57 multiple choice questions** (including section and version indicators). There are **15 pages**. This test is **90 minutes** long.

The entire question booklet and your scantron must be submitted to receive a grade. **Indicate your full name and student number on the scantron and on this page. (Please double-check your student number bubbling.)** Be sure to sign the sign-in sheet. **Your name must be written in permanent ink in all places.**

Please **answer all questions on the scantron**.

Choose **the single best answer** out of the options for each question. Read each question (and all possible answers) carefully.

Calculators, cell phones, mp3 players and other electronic devices are NOT permitted, and must be put away.

Invigilators reserve the right to move students during the test. This may not reflect any suspicion of you (e.g., someone behind you may be looking at your paper). However, please note that aiding and abetting cheating is considered an academic honesty offense in itself.

If you have not finished by 8:25 PM, you must remain at your seat until the exam is over and your test has been picked up.

Good luck!

Last name	First name
Student number	

Please check that you have bubbled your student number correctly on the scantron.

1. You are in BIOL 1010 **B**. (If you are NOT in Section B of the course, see an invigilator IMMEDIATELY.) Indicate B on the scantron. [This helps us keep things organized!]

   A. No **X**
   B. Pick me!!! ✓
   C. No **X**
   D. No **X**
   E. No **X**

2. You have exam version **A**, which must be indicated on the scantron to get credit for test questions.

   A. Pick me!!! ✓
   B. No **X**
   C. No **X**
   D. No **X**
   E. No **X**

3. Which of the following statements regarding enzymes is true?

   A. Enzymes decrease the free energy change (ΔG) of a reaction.
   B. **Enzymes increase the rate of a reaction**.
   C. Enzymes change the direction of chemical reactions.
   D. Enzymes are permanently altered by the reactions they catalyze.
   E. Enzymes prevent changes in substrate concentrations.

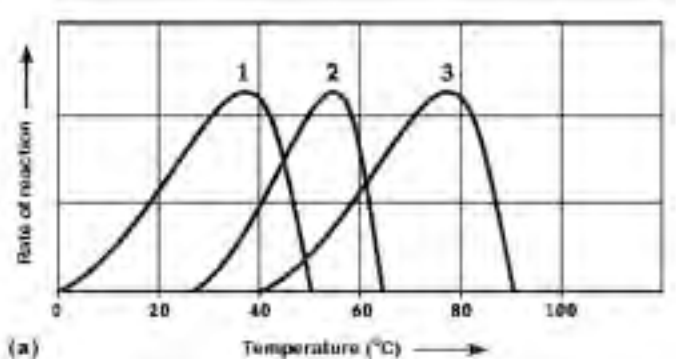


Figure 1. Enzymes tested under varying temperatures.

4. In the above figure, which curve represents the behaviour of an enzyme taken from a bacterium that lives in hot springs at 70°C - 80°C?

   A. curve 1
   B. curve 2
   C. **curve 3**.
   D. Both curve 1 and 2.
   E. Both curve 2 and 3.

5. Which of the following best describes the process of competitive feedback inhibition?

   A. **The products of the reaction block the active site of the enzyme**.
   B. The products of the reaction bind to a site other than the active site of the enzyme and block enzyme activity indirectly.
   C. The substrate and cofactors compete with one another for the active site.
   D. The inhibitor binds to the substrates of the reaction.

6. Which of the following statements about ATP synthesis in bacteria and archaea is true?

   A. **They oxidize NADH on the plasma membrane**.
   B. They are unable to use oxygen.
   C. They do not make ATP.
   D. Most ATP is produced in their mitochondria.

7. Where, in the eukaryotic cell, does glycolysis take place?

   A. inner membrane of mitochondria.
   B. intermembrane compartment of mitochondria.
   C. mitochondrial matrix.
   D. **cytoplasm**.
   E. plasma membrane.

8. During cellular respiration, the carbons present in pyruvate initially derive from _____ and are ultimately converted to _____.

   A. NAD^+; ATP
   B. Acetyl CoA; CO_2
   C. **Glucose; CO_2**
   D. Glucose; ATP

9. Glycolysis is regulated in response to the amount of ATP in the cell. Specifically, high levels of ATP regulate the activity of phosphofructokinase, a key enzyme in glycolysis. How does this regulation occur?

   A. ATP binds to the enzyme's active site, increasing enzyme activity.
   B. ATP inhibits the synthesis of new enzyme molecules.
   C. **ATP binds to the enzyme's regulatory site, resulting in a conformational change that inhibits enzyme activity**.
   D. ATP activates the production of new enzyme molecules.

10. Many anaerobic organisms, when under conditions of oxygen deprivation, will carry out

    A. **glycolysis and fermentation**.
    B. glycolysis and the Krebs cycle.
    C. the Krebs cycle only.
    D. glycolysis only.
    E. fermentation only.

Fermentation alone isn't of much use – the reactions allow glycolysis to continue, generating more ATP.

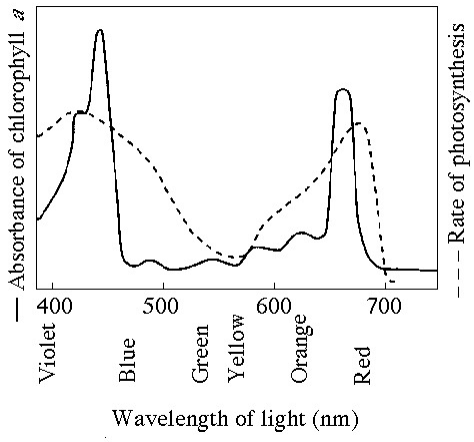


Fig. 2. The absorption spectrum for chlorophyll *a* and the action spectrum for photosynthesis in *Mysterius plantus*.

11. Please consult Figure 2. Of the following, which wavelength of light (as shown in the figure) is most effective in driving photosynthesis?

    A. **420 nm**
    B. 475 nm
    C. 575 nm
    D. 675 nm
    E. 730 nm

12. Which of the following statements best represents the relationships between the light reactions and the Calvin cycle?

    A. **The light reactions provide ATP and NADPH to the Calvin cycle, and the cycle returns ADP, Pi, and $NADP^+$ to the light reactions**.
    B. The light reactions provide ATP and NADPH to the carbon fixation step of the Calvin cycle, and the cycle provides water and electrons to the light reactions.
    C. The light reactions supply the Calvin cycle with CO_2 to produce sugars, and the Calvin cycle supplies the light reactions with sugars to produce ATP.
    D. The light reactions provide the Calvin cycle with oxygen for electron flow, and the Calvin cycle provides the light reactions with water to split.
    E. There is no relationship between the light reactions and the Calvin cycle.

13. Which of the following is the best explanation for why the light reactions have both cyclic and noncyclic electron pathways?

    A. **because the light-independent reactions require ATP and NADPH in different amounts than are generated by noncyclic electron flow**.
    B. to ensure that ATP and NAPDH are generated in a 1:1 molar ratio.
    C. because the different pathways generate different carbon skeletons for use in later reactions.
    D. to provide more electrons from water than would be released by the noncyclic pathway.

14. All of the following statements are true regarding both eukaryotic respiration and photosynthesis, ***EXCEPT***:

    A. ATP generation by chemiosmosis occurs inside the organelles.
    B. Electron carriers (NAD^+ or $NADP^+$) are involved in some key reaction steps.
    C. Transfer of electrons occurs via electron acceptors, including cytochrome complexes.
    D. **Oxygen is the final electron acceptor in both sets of reactions**.
    E. Both processes involve a series of redox reactions.

15. Which of the following statements is correct regarding photorespiration?

    A. **Photorespiration is an energy-requiring process that reduces the efficiency of photosynthesis**.
    B. Photorespiration does not occur in living plants because the structure of the chloroplast prevents oxygen from binding to rubisco.
    C. Photorespiration takes place in the cytoplasm, and carbon fixation takes place in the chloroplast.
    D. Photorespiration does not require energy, so it does not affect the efficiency of photosynthesis.
    E. Photorespiration takes place in the mitochodria while photosynthesis is underway.

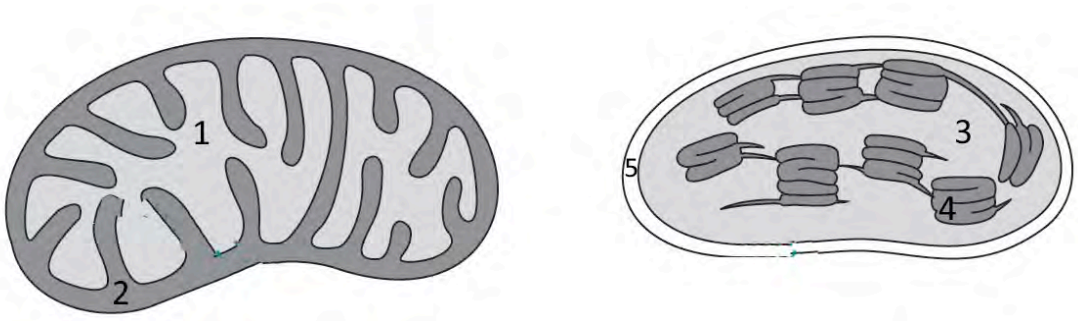


Figure 3

16. Which numbers in the above figure correspond to regions where you would expect a high concentration of protons?

    A. 1 and 3.
    B. **2 and 4**.
    C. 1 and 4.
    D. 2 and 3.
    E. 2 and 5.

17. Which of the following statements does ***NOT*** describe what occurs in meiosis I?

    A. Crossing over of non-sister chromatids occurs.
    B. Tetrads migrate to the metaphase plate.
    C. **Sister chromatids separate and begin moving to opposite sides of the cell**.
    D. Homologous chromosomes separate and begin moving to opposite sides of the cell.
    E. Overall chromosome number is reduced.

18. Bacteria with circular chromosomes do not produce/require telomerases. This is because

    A. **circular molecules have no end**.
    B. bacteria do not possess chromosomes.
    C. bacteria have different DNA polymerase enzymes.
    D. bacteria lack ribosomes.
    E. bacteria can lose many hundreds of genes over a lifetime without ill-effect.

19. Choose the option that best represents the **largest → smallest** order:

    A. Gene, genome, chromosome
    B. Chromosome, gene, genome
    C. **Genome, chromosome, gene**.
    D. Chromosome, genome, gene
    E. Genome, gene, chromosome

20. Which of the following is true regarding cancer?

    A. While cancer can occur in different regions of the body, it is considered a similar disease in terms of pathology and treatment.
    B. **Cancer involves uncontrolled cell division**.
    C. Most cancers are the result of a single mutation.
    D. Cancer involves the interference with tumour suppressor genes by proto-oncogenes.
    E. More than one of the above statements in A through D is true.

21. Pepsin, a digestive enzyme that degrades proteins in the stomach, is synthesized as pepsinogen and converted to active pepsin in the stomach by the removal of several amino acids. The activation of pepsin is an example of

    A. transcriptional regulation.
    B. translational regulation.
    C. posttranscriptional regulation.
    D. **posttranslational regulation**.

22. A cell contains 92 chromatids in G_2 phase. After completion of mitosis each daughter cell nucleus would contain how many chromosomes?

    A. 12
    B. 16
    C. 23
    D. **46**
    E. 92

23. Control of the eukaryotic cell cycle involves all of the following in A through D, ***EXCEPT***:

    A. direct control by complexes of cyclins and cyclin-dependent protein kinases (CDKs).
    B. internal controls at checkpoints to ensure that the reactions of one stage are complete before the cycle proceeds to the next stage
    C. external controls recognized by surface receptors that bind signals such as peptide hormones, growth factors, and lead to signal transduction pathways affecting progression of the cell cycle.
    D. activities of proteins encoded by tumour suppressor genes, such as p53, which can lead to programmed cell death under some circumstances.
    E. **All of the above are involved in control of the cell cycle**.

24. Which of the following statements is/are true regarding cellular signalling?

    A. It includes signal reception, transduction and response processes.
    B. Signals may be recognized by membrane-bound proteins or in the cytosol by intracellular receptors.
    C. It occurs in animal cells, but not in plants nor in fungi.
    D. All of the above statements in A through C are true of cellular signalling.
    E. **Only two (2) of the statements in A through C are true of cellular signalling**.

Cell signalling occurs in all types of organisms.

25. The process of transcription refers to the use of information encoded in ____ to make a ____.

    A. RNA; complementary DNA strand
    B. DNA; polypeptide
    C. **DNA; complementary RNA copy**
    D. a polypeptide; complementary RNA copy
    E. DNA; complementary DNA strand

26. If a cell has a diploid number of 32, how many chromosomes are present in the nucleus at the beginning of meiosis? How many chromosomes are present in each resulting cell at the end of meiosis?

    A. beginning: 32; end: 32.
    B. beginning: 32; end: 64.
    C. beginning: 16; end: 32.
    D. **beginning: 32; end: 16**.
    E. beginning 16; end 8.

27. Which of the following is ***FALSE*** regarding cell division?

A. In bacteria, cell division typically occurs via binary fission, yielding two (2) genetically identical daughter cells.
B. In eukaryotes, mitotic cell division yields two (2) genetically identical daughter cells.
C. **In eukaryotes, meiotic cell division yields four (4) genetically identical daughter cells**.
D. Cell division is involved in healing and regeneration processes of multicellular organisms.

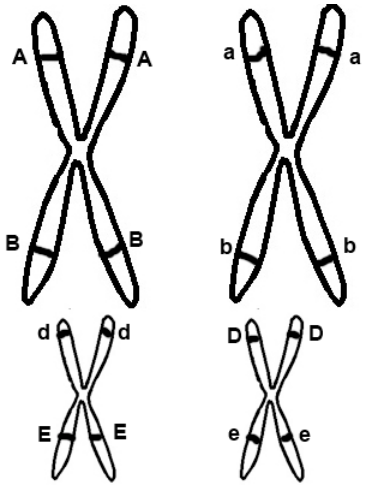
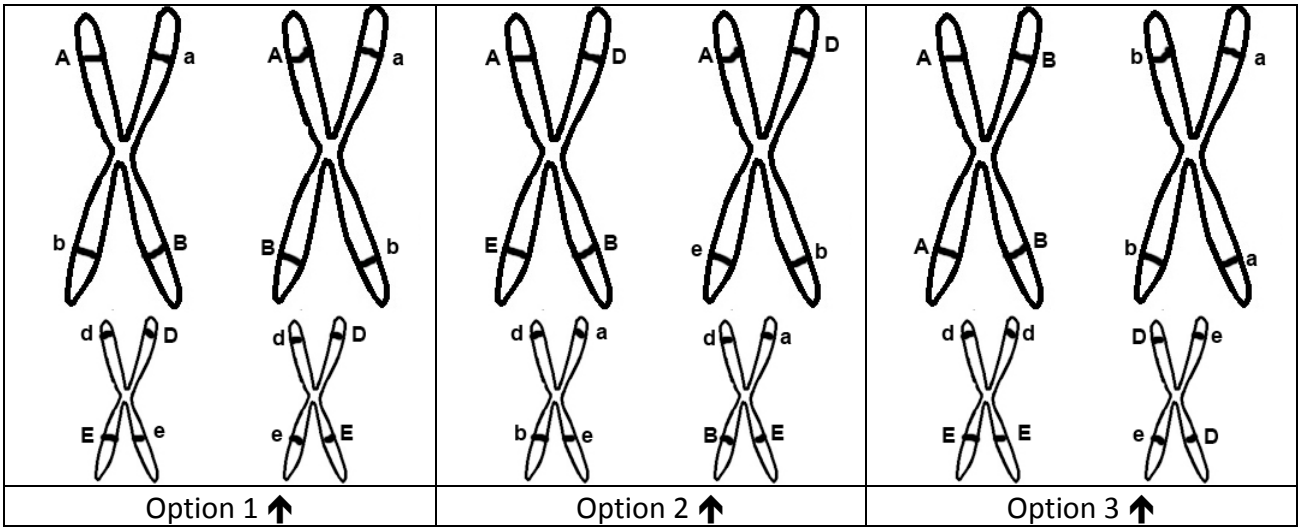


Fig. 4 – Chromosomes before Meiosis

28. You are working with a 2n = 4 organism. The above figure shows allele arrangements on the chromosomes just before Meiosis I. If normal crossing over occurs, which of the following would be possible going into metaphase I?



A. **Only Option 1**.
B. Only Option 2
C. Only Option 3
D. More than one of the options (1 through 3) above would be possible.
E. None of the above options (1 through 3) would be possible.

Crossing over only occurs between same regions (with alleles of same genes) of homologous chromosomes

29. In the case where a particular gene has one allele that is dominant while the other is recessive, which of the following is true?

    A. The recessive allele is less common in the general population compared to the dominant allele.
    B. **It will not be possible to observe a phenotypic difference between the homozygote for the dominant allele and the heterozygote**.
    C. The dominant allele prevents the expression (at the transcriptional level) of the recessive allele in heterozygous individuals.
    D. Individuals who are homozygous for the recessive allele will exhibit less fitness than heterozygotes or individuals homozygous for the dominant allele.

30. Which of the following is ***NOT*** a recognized way in which genetic diversity can arise?

    A. horizontal gene transfer in bacteria
    B. crossing over in meiosis of eukaryotes
    C. fusion of different gametes in sexual reproduction
    D. mutation in bacteria and eukaryotes
    E. **vertical gene transfer in bacteria**

Bacterial cell division produces identical daughter cells - vertical gene transfer does not introduce diversity here.

31. Which of the following (in A through D) is/are ***NOT*** directly involved in the process of translation?

    A. ribosome.
    B. mRNA encoding the polypeptide
    C. tRNA molecules (with attached amino acids)
    D. **RNA polymerase**
    E. All of the above are directly involved in translation.

RNA polymerase is directly involved in **transcription**, not translation.

32. A black guinea pig is crossed with an albino guinea pig, and 12 black offspring result. When the albino guinea pig was crossed with second black guinea pig, 6 black offspring and 6 albino offspring were produced. What is the best explanation for this genetic situation?

    A. **Albino is recessive; black is dominant**.
    B. Black is recessive; albino is dominant.
    C. Albino and black are codominant.
    D. Incomplete dominance is occurring.
    E. Epistasis.

33. An organism's phenotype is _____.

    A. its entire genome.
    B. determined only by the sequence of DNA in the organism's alleles.
    C. **the organism's exhibited trait(s)**.
    D. the result of the blending of its parents' phenotypes.

34. When two genes are located on different chromosomes, ____ of the offspring from a dihybrid testcross for genetic linkage should have a recombinant phenotype.

    A. over 75%
    B. **about 50%**
    C. about 25%
    D. under 10%

The maximum frequency of recombination is 50%, indicating independent assortment (i.e., no linkage).

35. How many possible genotypes can result from a mating between individuals of genotypes *GgFF* and *ggFf,* assuming independent assortment of the genes?

    A. 16
    B. 8
    C. 6
    D. **4**
    E. 2

Possible genotypes that could arise:
GgFF
ggFF
GgFf
ggFf

36. Assume that there is a recessive human genetic disorder that can be caused by different mutations in a particular protein-coding gene. Depending on the type of mutation, mutated alleles may have a nonsense mutation early in the coding sequence, a missense mutation near the end of the coding sequence, or a silent mutation that can occur near the middle of the gene. Which of the following would be most likely?

    A. **Individuals with nonsense mutations would be expected to have more severe cases of the disease than those with silent mutations**.
    B. Individuals with silent mutations would be expected to have more severe cases of the disease than those with missense mutations.
    C. The presence of a mutated allele (of any known mutation type) will prevent a normal allele of the gene from being expressed in heterozygous individuals.
    D. An affected individual must have two maternal copies (or two paternal copies) of the gene.

37. Lee's mother has albinism, which is a recessive autosomal trait. Lee's father has phenylketonuria (PKU), also recessive autosomal. Lee just got married and discovers that his new father-in-law has albinism and PKU. What is the probability that Lee's first child will have **BOTH** albinism and PKU?

    A. **1/16**
    B. 1/8
    C. 1/4
    D. 1/2
    E. 2/3

Lee must be carrier for BOTH PKU and albinism, as is his wife.
Probability that child will have BOTH conditions: ¼ (PKU) * ¼ (albinism) = 1/16

38. Imagine that a cell acquired a genetic mutation so that the primase enzyme is unable to make RNA primers. Assuming that all of the other enzymes directly involved in DNA replication are still functional in these cells, how much of the process of DNA replication would you expect to see in these cells?

    A. The leading strand would be synthesized, but not the lagging strand.
    B. None of it at all; no part of the DNA replication process could occur.
    C. **The DNA helix would be unwound by helicase, but no new strands would be produced**.
    D. Both the leading and lagging strand would be synthesized, but Okazaki fragments would not be joined together.

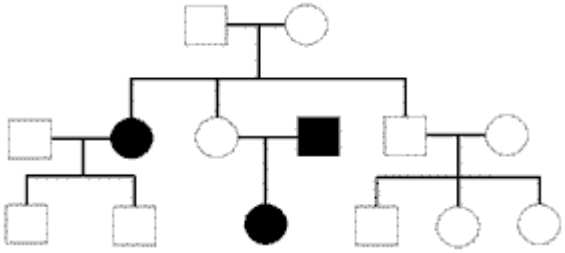


Figure 5. Pedigree.

39. Examine the pedigree in the figure above. Which of the following inheritance patterns is most likely responsible for the "affected" condition?

    A. autosomal dominant
    B. **autosomal recessive**
    C. X-linked recessive
    D. X-linked dominant

Note unaffected parents having affected children of both sexes.

40. An XXY individual may have resulted from nondisjunction occurring in any of the following ***EXCEPT***:

    A. meiosis I in the father's sperm production.
    B. **meiosis II in the father's sperm production**.
    C. meiosis I in the mother's egg production.
    D. meiosis II in the mother's egg production.

41. In *Drosophila melanogaster* (fruit flies), the allele for long wings is dominant over the allele for vestigial wings, and the allele for a brown body is dominant over the allele for a black body. A testcross was done, with the following results were observed for the offspring:

    410 flies with long wings and a black body
    105 flies with long wings and a brown body
    390 flies with vestigial wings and a brown body
    95 flies with vestigial wings and a black body

    Which of the choices below best represents the map distance between the genes for these two traits?

A. 100 map units
B. 25 map units
C. **20 map units**
D. 10 map units
E. 2 map units
F. 1 map unit

95+105 [recomb]/410+105+390+95 [all]

200/1000 = 0.2 * 100 = 20% recombination = 20 m. u.

42. A relationship between phenomena that has been established based on large amounts of observational and experimental data is referred to as a/an:

A. **theory**.
B. variable.
C. assumption.
D. control.
E. hypothesis.

43. In order for light to be used by an organism, photons must be

A. reflected.
B. transmitted.
C. **absorbed**.
D. reflected, transmitted, and absorbed.

44. Bacteria differ from eukaryotes in which of the following ways?

A. Membrane composition and structure.
B. Nature of the material used for information storage (heredity).
C. **Range of metabolic diversity**.
D. None of the above.

45. Biological molecule damage from _____ can be prevented by _____.

A. **UV radiation; melanin**.
B. visible light; melatonin.
C. infrared radiation; carotenoids.
D. ionizing radiation; pyrimidine dimers.
E. visible light; chlorophyll.

46. Central ideas of Darwin's theory of evolution by natural selection include all of the following ***EXCEPT***:

A. Individual organisms in a population vary in many heritable traits.
B. Any population has the potential to produce far more offspring than the environment can support.
C. Some individuals have traits that provide them with an advantage in their local environment.
D. Organisms more likely to survive and reproduce pass on favourable traits to their offspring, and the incidence of trait(s) in the population will change.
E. **Over time, individuals of the population will approach perfection**.

47. The cell theory states that

A. all living organisms are composed of cells.
B. cells are the functional units of life.
C. cells arise only from preexisting cells by a process of division.
D. Only 2 of the above statements in A through C are stated in the cell theory.
E. **A, B and C**.

48. Which of the following is ***NOT*** a characteristic of all living organisms?

A. Genetic information directs the synthesis of proteins.
B. Genetic information is passed to the next generation.
C. **DNA is present, contained within a nucleus**. Bacteria & archaea lack a nucleus.
D. Energy is obtained from the surrounding environment.
E. Populations of organisms change over generations.

49. All of the following are part of the endomembrane system ***EXCEPT***:

A. the endoplasmic reticulum (ER).
B. **the nuclear envelope**.
C. the plasma membrane.
D. the Golgi complex.

50. Each of the statements below describes evidence that supports the endosymbiotic theory (i.e., mitochondria and chloroplasts descended from bacteria), ***EXCEPT***:

    A. The organelles each contain their own circular DNA.
    B. Ribosomes are present in these organelles, and resemble bacterial ribosomes rather than ones found in the eukaryotic cytosol/endoplasmic reticulum.
    C. These organelles are similar to bacteria in terms of size and morphology.
    D. **These organelles can survive and reproduce on their own after being removed from a eukaryotic cell**.
    E. Electron transport occurs in membranes of the organelles similar to electron transport on bacterial plasma membranes.

51. Which of the following statements (in A through D) is/are true regarding metabolism?

    A. **Many reactions are oxidation-reduction (redox) reactions**.
    B. Reactions in both cellular respiration and photosynthesis require the direct absorption of light photons to occur.
    C. Individual organisms carry out photosynthesis or cellular respiration, but not both.
    D. Metabolic reactions occur in eukaryotes, but not in bacteria.
    E. More than one of the above statements is true.

52. Energy flow according to trophic roles is best shown as:

    A. **producers → primary consumers → secondary consumers → decomposers**.
    B. primary consumers → secondary consumers → producers →decomposers.
    C. producers → secondary consumers → primary consumers → decomposers.
    D. decomposers → producers → secondary consumers → primary consumers.
    E. cell → organism → population → ecosystem → community → biosphere.

53. Plasma membranes of eukaryotes include each of the following functions, ***EXCEPT***:

    A. regulating passage of nutrients into the cell.
    B. regulating passage of wastes outside of the cell.
    C. **site for electron transport steps in cellular respiration**.
    D. provide mechanisms for cell adhesion (e.g., to nearby cells in tissues).
    E. All of the functions in A through D are true of eukaryotic plasma membranes.

54. Each DNA nucleotide is made up of

    A. a six-carbon sugar, a phosphate group, and one of twenty amino acids.
    B. a five-carbon sugar, a nitrogenous base, and one of twenty amino acids.
    C. **a five-carbon sugar, a phosphate group, and one of four nitrogenous bases**.
    D. a six-carbon sugar, a nitrogenous base, and one of four amino acids.
    E. a five-carbon sugar, a phosphate group, and one of twenty nitrogenous bases.

55. Which of the following is true regarding the eukaryotic cytoskeleton?

A. Cytoskeletal elements on the exterior of the plasma membrane provide structural support to plant cells.
B. Microtubules and microfilaments are primarily involved in support functions; intermediate filaments are normally involved in movement functions.
C. **Motor proteins associate with microtubules and microfilaments in carrying out certain functions in animal cell division**.
D. Cytoskeletal elements are composed primarily of long polymers of carbohydrates (e.g., starch, glycogen).
E. None of the above statements are true.

56. In what way do the various membranes of a cell differ?

A. Phospholipids are found only in certain membranes.
B. **Certain proteins are unique to each membrane**.
C. Only certain membranes exhibit fluidity.
D. Only certain membranes of a cell are selectively permeable.
E. None of the above; membranes of a cell are identical.

57. All of the following statements (in A through D) are true of ATP, ***EXCEPT***

A. ATP is used to transfer energy from energy-yielding reactions to energy-consuming reactions in the cell.
B. ATP is present in all living organisms.
C. ATP is a type of nucleotide.
D. **ATP hydrolysis is an endergonic reaction**.
E. All of the above statements are true.

END OF TEST – Enjoy the holidays!