

**BIOLOGY 205**  
**FINAL EXAM - 07 June 2010**  
**(135 points total)**

Name \_\_\_\_\_

**Multiple choice questions – 3 points each (single best answer for each).**

1. A cell is composed of compounds that include proteins, nucleic acids, lipids, and carbohydrates. A cell is capable of reproduction, but when the compounds of the cell are isolated, none of them can reproduce. Therefore, cell reproduction is an example of ...
  - A. Growth
  - B. A molecule
  - C. An emergent property
  - D. Adaptation
  - E. Metabolism
  
2. Louis Pasteur designed an experiment using the swan-necked flask to prove that:
  - A. Bacterial organisms cannot be killed by heat
  - B. Life does not arise spontaneously from nonliving matter
  - C. Earth was really much older than people of the time thought
  - D. The half-life of uranium<sup>238</sup> is 10 billion years
  - E. Maggots grow in meat
  
3. In sugar cane (a C<sub>4</sub> plant), CO<sub>2</sub> is released for use in the Calvin-Benson cycle:
  - A. In the bundle sheath cells
  - B. During the daytime only
  - C. In glucose molecules
  - D. In the stroma
  - E. None of the above
  
4. The substrate for adenylyl cyclase is \_\_\_\_\_ and its product is \_\_\_\_\_?
  - A. GTP, GDP
  - B. GTP, ATP
  - C. ATP, ADP
  - D. ATP, cAMP
  - E. ATP, AMP
  
5. One of the following biologically important macromolecules is NOT a polymer in the same sense as the other three, which molecule is it?
  - A. Nucleic acids
  - B. Proteins
  - C. Lipids
  - D. Polysaccharides

6. The evolutionary biology concept of “rust the crust” refers to the idea that:
- A. Iron is necessary for the cytochromes in the respiratory chain
  - B. Iron gets used in hemoglobin
  - C. Iron had to get oxidized before oxygen could exist in the atmosphere
  - D. Iron is needed for the biosynthesis of polymers
  - E. Iron is the fourth most abundant element on Earth
7. During glycolysis, which compound has the least available free energy, i.e., is the most oxidized?
- A. Phosphoenolpyruvate
  - B. Glyceraldehyde 3-phosphate (G3P)
  - C. 3-phosphoglycerate (3PG)
  - D. Fructose-bisphosphate
  - E. Glucose
8. Histone acetyl transferases (HATs) would act as \_\_\_\_\_ of transcription?
- A. Silencers
  - B. Repressors
  - C. Corepressors
  - D. Initiators
  - E. Enhancers
9. For photosystem I, after electron excitation, what compound gets reduced first in the electron transport chain?
- A. Plastoquinone
  - B. Ferredoxin
  - C. Pheophytin-I
  - D. Plastocyanin
  - E. Cytochrome complex
10. Ribosomes are a collection of:
- A. small proteins that function in translation
  - B. proteins and rRNAs that function in translation
  - C. proteins and tRNAs that function in transcription
  - D. proteins and mRNAs that function in translation
  - E. mRNAs and tRNAs that function in translation
11. How many moles of ATP (equivalents) are generated for each mole of acetyl-CoA introduced into the citric acid cycle strictly by substrate-level phosphorylation?
- A. 1
  - B. 2
  - C. 3
  - D. 4
  - E. 6

12. When carbon dioxide is added to RuBP, the first stable product synthesized is?
- A. Pyruvate
  - B. Glyceraldehyde 3-phosphate (G3P)
  - C. 3-phosphoglycerate (3PG)
  - D. ATP
  - E. Acetyl-CoA
13. What is by far the number one most abundant protein/enzyme found on the planet?
- A. ATP synthase
  - B. RuBisCo
  - C. Isocitrate dehydrogenase
  - D. Phosphofructokinase
  - E. aminoacyl-tRNA synthetase
14. Consider the rate limiting cellular process when it comes to the growth of cells. Which of the following is the rate limiting or slowest process for *Bacteria*, *Archaea*, and *Eucarya* cells?
- A. replication
  - B. transcription
  - C. translation
  - D. translocation
  - E. transformation
15. Prion diseases like “mad cow disease” are caused by which of the following?
- A. Erroneous chaperonins
  - B. Loss of control by Cyclin-Cdk complexes
  - C. Receptor-mediated endocytosis
  - D. Mutation of pseudogenes
  - E. Sexually transmitted viruses
16. Consider the structure and function of the chromosome, which of the following is NOT involved during the organization of chromatin material?
- A. Histones
  - B. Mesosomes
  - C. Cohesins & condensins
  - D. Nucleosomes
  - E. Looped domains
17. During photosynthesis, which of the following zones becomes more acidic (i.e., increased in protons)?
- A. thylakoid space
  - B. matrix
  - C. inter membrane space
  - D. mesosome
  - E. cytoplasm

18. Microtubules provide an avenue for the movement of organelles within the cell. Which of the following is the “motor” protein that provides the mechanism for this movement towards the positive end?
- A. Kinesin
  - B. Dynein
  - C. Actin
  - D. Myosin
  - E. Keratin
19. When a plant cell is placed in an isotonic solution, which of the following occurs?
- A. The cell takes up water until balanced by the pressure potential of the cell wall
  - B. The cell takes up water and eventually bursts
  - C. The cell shrinks away from the cell wall
  - D. There is no net movement of water into or out of the cell
  - E. Water moves into the cell
20. Consider the features of gene expression and control in *Eucarya*, which of the following is NOT a true statement?
- A. Eucarya have multiple RNA polymerases.
  - B. Eucarya have complex transcription factors.
  - C. Eucarya have both local and distal control elements.
  - D. Eucarya have sets of multiple genes under operon control.
  - E. Eucarya have to contend with chromatin structure.
21. Electron transport is coupled to ATP synthesis in mitochondria, chloroplasts, and the hyperthermophilic archaeum *Methanococcus*. Which of the following are likely to affect the coupling of electron transport to ATP synthesis in ALL of these systems?
- A. A potent inhibitor of cytochrome oxidase
  - B. The removal of oxygen
  - C. The absence of light
  - D. An ADP analogue that inhibits ATP synthase
  - E. The production of methane
22. Which of the following occurs during cyclic photophosphorylation?
- A. O<sub>2</sub> gas is released
  - B. ATP is formed
  - C. H<sub>2</sub>O donates electrons and protons
  - D. NADPH + H<sup>+</sup> forms
  - E. CO<sub>2</sub> reacts with RuBP

23. Structures that contain networks of keratin fibers and hold adjacent cells together are called:
- A. Extracellular matrices
  - B. Glycoproteins
  - C. Gap junctions
  - D. Desmosomes
  - E. Phospholipid bilayers
24. In photosynthesis, electrons from which ultimate source (donor) replenish chlorophyll molecules in P<sub>680</sub> that have given up excited electrons?
- A. Carbon Dioxide
  - B. Water
  - C. NADPH + H<sup>+</sup>
  - D. Oxygen
  - E. ATP
25. Animals inhale air-containing oxygen and exhale air with less oxygen and more carbon dioxide. Later, the oxygen from the air will most likely be found in....
- A. The carbon dioxide that is exhaled
  - B. Water
  - C. Organic molecules
  - D. Ethanol
  - E. Lactate
26. Which of the following features summarizes the molecular architecture of DNA?
- A. The two strands run in opposite directions
  - B. The molecule twists in the same direction as the threads of most screws (RT-handed)
  - C. The molecule is a double-stranded helix
  - D. DNA has a uniform diameter
  - E. All of the above
27. The enzyme that removes the RNA primers is called...
- A. DNA ligase
  - B. primase
  - C. reverse transcriptase
  - D. helicase
  - E. DNA polymerase I
28. The TATA box is:
- A. a sequence rich in A's and T's common to the promoter region of many genes
  - B. an operator site that aids in the regulation of transcription
  - C. an enhancer consensus sequence
  - D. an activator sequence necessary for proper translation
  - E. a corepressor sequence needed for translocation

**True or False – (1 point each)**

29. \_\_\_\_\_ Respiration transfers electrons from carbon to oxygen.
30. \_\_\_\_\_ Photosynthesis reduces carbon. Respiration oxidizes carbon.
31. \_\_\_\_\_ Electron micrographs have shown that mitochondria in heart muscle have a higher density of cristae than mitochondria in skin cells.
32. \_\_\_\_\_ One mole of oxaloacetate is required for every mole of acetyl CoA that is metabolized via the citric acid cycle.
33. \_\_\_\_\_ Plants do photophosphorylation only during the daytime and oxidative phosphorylation only at night.

**Matching – 1 point each.** Use single best answer to match the organelle with the characteristic/process that is best described or associated with it. The possible answers are: (A) Ribosomes, (B) Mitochondria, (C) Lysosome, (D) Nucleus, and (E) Chloroplast.

- |           |                     |           |               |
|-----------|---------------------|-----------|---------------|
| 34. _____ | snRNPs              | 39. _____ | Phagocytosis  |
| 35. _____ | Translation         | 40. _____ | Transposition |
| 36. _____ | Histone Acetylation | 41. _____ | Transcription |
| 37. _____ | RuBisCo             | 42. _____ | Matrix        |
| 38. _____ | DNA replication     | 43. _____ | Stroma        |

**More Matching – 1 point each.** Match the proper catabolic stage of glucose catabolism. The possible answers are (A) Glycolysis, (B) Oxidation of Pyruvate to Acetyl-CoA, (C) Citric Acid Cycle; (D) Oxidative Phosphorylation, (E) Respiratory or Electron Transport Chain.

44. \_\_\_\_\_ At which stage does  $\text{NAD}^+$  first get reduced to  $\text{NADH} + \text{H}^+$ ?
45. \_\_\_\_\_ At which stage is the carbon skeleton of glucose split?
46. \_\_\_\_\_ At which stage do hydrogen ions (i.e., protons) diffuse down a gradient?
47. \_\_\_\_\_ At which stage in aerobic respiration is the first molecule of  $\text{CO}_2$  produced?
48. \_\_\_\_\_ At which stage does  $\text{FAD}^+$  first get reduced to  $\text{FADH}_2$ ?

**Short answer – Number of points in parentheses.**

- 49. (6 points)** (A) Name **two** different pathways that each contain a step where a particular molecule gets **two** phosphate groups attached **AND** (B) describe the step and/or enzyme within each of these pathways where this step occurs. **Finally** (C), describe why each of these steps are so critically important to each pathway.
- 50. (6 points)** Consider **negative** operon control. (A) Name a pathway that undergoes this type of control, (B) what is the repressor made from, (C) what is the operator made from, **AND** (D) how does the repressor cause negative control to occur?
- 51. (6 points)** The citric acid cycle generates  $\text{NADH}+\text{H}^+$  and  $\text{FADH}_2$ , which are then used in the process of oxidative phosphorylation to make ATP. If the citric acid cycle (which does not use oxygen) and oxphos are separate processes, as they are, then why is it that the citric acid cycle stops almost immediately upon removal of  $\text{O}_2$ ?

52. **(9 points)** What are three specific mechanisms (AND when these occur) for introducing genetic variation from one generation to the next in sexually reproducing organisms?

Process

Stage in cell cycle when this occurs (be specific)

53. **(4 points)** Consider issues that relate to photorespiration. **(A)** Under what conditions might photorespiration be more likely to occur AND why? **(B)** What is the “hard to recycle” waste product generated during photorespiration?

54. **Extra Credit (6 points max)** **(A)** How many ATP-equivalents are contained within a glucose when considering aerobic respiration with optimal conditions? **(B)** How many ATP-equivalents does it take to build a glucose from scratch using optimal “light-independent” methods? **(C)** Why is there such a large difference between these two numbers?