

2007 Semi-Final Exam

- 1. Reactions involved in the light dependent phase of photosynthesis (in eukaryotic cells) may be found in:**
 - A. grana lamellae only.
 - B. stroma lamellae only.
 - C. inner surface on the thylakoids only.
 - D. inner and outer surface of the thylakoids.
 - E. outer membrane of the chloroplast envelope.
- 2. Lowering the level of a hedge with a hedge trimmer stimulates the hedge to become bushy because:**
 - A. it stimulates the production of ethylene gas.
 - B. removing the apical meristems produces more auxin, which stimulates lateral branch buds to grow.
 - C. removing the apical meristems produces less ethylene, which stimulates lateral branches to grow.
 - D. removing the apical meristems produces less auxin, which allows lateral branches to grow.
 - E. removing the lateral buds results in apical dominance under the influence of cytokinins.
- 3. The function of an electron in the electron transport chain is to:**
 - A. transfer energy from complex II to complex I.
 - B. pump hydrogen ions across the membrane using complex II.
 - C. pump protons against their concentration gradient.
 - D. combine ADP with phosphate when ATP is synthesized.
 - E. react with ATP synthase.
- 4. Fatigue in iron deficiency anemia may be explained in part by all of the following EXCEPT:**
 - A. a lack of functional hemoglobin in the blood.
 - B. an inability to transport oxygen.
 - C. a lack of functional cytochromes in the ETC.
 - D. the inability to synthesize ATP.
 - E. a lack of functional Coenzyme Q.
- 5. Concerning the generation of ATP by oxidative phosphorylation, all of the following are true EXCEPT:**
 - A. NADH produced in the cytosol of the cell will generate approximately 2.5 ATP's.
 - B. NADH produced in the mitochondria will generate approximately 2.5 ATP's.
 - C. NADH produced by the succinate thiokinase reaction will generate approximately 1.5 GTP's.
 - D. FADH₂ produced in the mitochondria will generate approximately 1.5 ATP's.
 - E. acetyl CoA entering the TCA cycle will produce approximately 10 ATP's.

6. The best description of the relationships between fundamental niches (FN) and realized niches (RN) of two competing species that COEXIST is:
- $FN_A = RN_A; FN_B = RN_B$.
 - $FN_A > RN_A; FN_B > RN_B$.
 - $FN_A < RN_A; FN_B < RN_B$.
 - $FN_A > RN_A; FN_B > RN_B$.
 - $FN_B = FN_A, RN_B = RN_A$.
7. A baby is born with congenital lactic acidosis because she has a defective electron transport protein. This causes a decrease in the rate at which NADH and FADH can be oxidized to produce ATP using oxidative phosphorylation. You would expect all of the following EXCEPT:
- the concentration of ADP in the cell would increase and activate glycolysis.
 - increased glycolysis would produce increased NADH and pyruvate.
 - the inhibition of the electron transport chain would increase the concentration of NADH.
 - increased concentration of NADH would increase the conversion of pyruvate to acetyl CoA.
 - extra NADH and pyruvate would be converted to lactate by lactate dehydrogenase.
8. All of the following statements concerning TPA are true EXCEPT:
- TPA stands for tissue plasminogen activator.
 - TPA is an enzyme.
 - TPA converts fibrinogen to fibrin.
 - plasmin is a protease that digests fibrin.
 - plasminogen is a normal constituent of blood.
9. A potato tuber, although found underground, is considered to be a stem rather than a root. This determination is made, in part, because of the presence of:
- lateral appendages.
 - a meristem.
 - buds.
 - anomalous growth.
 - secondary xylem.
10. Your patient had a heart attack and was administered a vasodilating agent in an effort to reduce her hypertension. The vasodilating agent will lower all of the following EXCEPT:
- rate of utilization of ATP.
 - mitochondrial proton gradient.
 - work done by the heart.
 - chance of cell lyses.
 - oxygen consumption.
11. What enzyme does a retrovirus primarily rely on to create a copy of its genome that is ready for integration into the host genome?
- DNA gyrase
 - RNA polymerase
 - Reverse transcriptase
 - DNA polymerase
 - DNA helicase

12. Integral transmembrane proteins are proteins embedded in the cell membrane. Which of the following amino acids would you MOST expect to find in the transmembrane region of such proteins?
- A. Tryptophan
 - B. Lysine
 - C. Arginine
 - D. Serine
 - E. Glutamate
13. The fluidity of a lipid bilayer is enhanced with:
- A. decreased temperature.
 - B. increased unsaturation in fatty acid tails.
 - C. increased unsaturation in polar head groups.
 - D. increased saturation in fatty acid tails.
 - E. increased fatty acid chain length.
14. The function of a hypothetical protein PRO is lost in many types of cancer. Wild-type PRO is MOST likely a:
- A. proto-oncogene.
 - B. tumor suppressor.
 - C. positive regulator of cell cycle progression.
 - D. gene required for DNA replication.
 - E. gene required for translation.
15. Sodium or chloride ions are placed in a Petri dish with adult *C. elegans* hermaphrodites. Shortly thereafter an aversive stimulus such as garlic is placed in the Petri dish. Subsequently, when tested in a chemotaxis assay, these animals avoided the ion that had been paired with garlic. This is an example of:
- A. habituation.
 - B. imprinting.
 - C. associative learning.
 - D. spatial learning.
 - E. pheromone communication.
16. The major functional difference between agarose and polyacrylamide gels is the:
- A. higher pH at which the polyacrylamide gels must be run.
 - B. higher temperatures at which the agarose gels can be run.
 - C. fact that agarose gels run horizontally.
 - D. higher resolution that can be achieved with the polyacrylamide gel.
 - E. higher resolution that can be achieved with the agarose gel.
17. Damage to the enteric nervous system has inhibited small intestine motility. This would, in turn, inhibit:
- A. intercellular communications.
 - B. protein digestion to polypeptides.
 - C. water reabsorption.
 - D. parasympathetic motor input.
 - E. chyme interaction with villi.
18. The first type of cell to recognize donor tissue as non-self is:
- A. dendritic.
 - B. cytotoxic T.
 - C. B.
 - D. helper T.
 - E. natural killer.

19. If the glomerular hydrostatic pressure (P_{GC}) is ≈ 45 mmHg and the pressure in Bowman's capsule (P_{BC}) is ≈ 10 mmHg, what is the net filtrative force of the fluid in the glomerular capillaries?
- A. 55 mm Hg
 - B. 450 mm Hg
 - C. 35 mm Hg
 - D. 550 mm Hg
 - E. cannot be calculated as it is dependent on other factors not stated
20. Hyperventilation results in all of the following EXCEPT:
- A. a reduction of the CO_2 concentration in the blood.
 - B. vasoconstriction.
 - C. an increase in blood pH.
 - D. alkalization of serum proteins which decreases their calcium affinity.
 - E. all of the above are appropriate statements.
21. The influence of the Casparian strip in a plant root will:
- A. protect the vascular core from pathogens.
 - B. induce an apoplastic transport of nutrients.
 - C. induce a symplastic transport of nutrients.
 - D. provide nutrients to the seedling.
 - E. reduce the rate of transpiration.
22. Interleukin-2 is inactivated by an antibody. This inactivation would inhibit which immune system component?
- A. Complement activation
 - B. Antigen presentation
 - C. T-cell activation
 - D. Immunoglobulin E activation
 - E. Apoptosis by natural killer cells
23. Some fishes retain urea, usually considered to be a toxic chemical, in their blood. The adaptive role of this seemingly unusual retention may be:
- A. it helps counteract ammonia, which is more lethal than urea.
 - B. to aid certain fish to better adapt to changing environmental salinity.
 - C. it provides additional available nitrogen for protein metabolism.
 - D. it helps to keep other predators from attacking them.
 - E. to create a negative buoyancy through interaction with blood albumin.
24. Within the Protista, which of the following groups would contain an organism having these characteristics; unicellular, eukaryotic, dikaryotic and heterokaryotic, transverse binary fission, conjugation.
- A. Apicomplexa
 - B. Ciliophora
 - C. Dinoflagellata
 - D. Euglenozoa
 - E. Myxogastriada
25. Type O blood is known as the universal donor because its erythrocytes lack both antigens A and B and will not be agglutinated by any type of plasma into which they are introduced. Therefore, it is acceptable to say that:
- A. type O plasma contains anti-A and anti-B agglutinins.
 - B. type O red blood cells contain isoagglutinin A and isoagglutinin B.
 - C. individuals with type O blood can be transfused with blood that is genotypically $I^A I^B$.
 - D. there is a genetic advantage to having type O blood.
 - E. type O blood is determined by the presence of three alleles.

- 26. The concept of Minimum Viable Population size (MVP) refers to:**
- A. populations that are so small that they are about to go extinct.
 - B. the smallest possible size at which a population can exist without facing extinction.
 - C. the smallest population that can safely be harvested.
 - D. the population size at which harvesting yield is maximal.
 - E. the population size that can be sustained at an equilibrium level in a particular environment.
- 27. Suppose a cell is subjected to Aspirin, T4 or some other chemical uncoupler of oxidative phosphorylation. One would expect an increase in the rate of all of the following EXCEPT:**
- A. ATP synthesis.
 - B. proton pumping by the electron transport chain.
 - C. heat generation by the mitochondria.
 - D. oxygen utilization by the cell.
 - E. NADH oxidation by NADH dehydrogenase.
- 28. The expansion of plant cells occurs differently from that of animal cells. The primary reason for this difference is associated with:**
- A. the presence of a central vacuole in a plant cell.
 - B. the presence of a cell wall in plant cells.
 - C. a difference in protein synthesis in plant cells.
 - D. the absence of golgi apparatus in plant cells.
 - E. a difference in microtubular organization in plant cells.
- 29. Drosophila flies homozygous for the mutant allele Eye have eyes much smaller than normal. A new mutation X is found that gives flies that are double mutant for Eye and X nearly normal eyes. The X mutation is:**
- A. an enhancer of Eye.
 - B. a suppressor of Eye.
 - C. epistatic to Eye.
 - D. a new allele of Eye.
 - E. in a linkage group with Eye.
- 30. Assume that a person is injected with an antibody that binds to and deactivates interleukin-2. Which of the following immune system components would be affected?**
- A. antigen presentation
 - B. complement system
 - C. cytotoxic T-lymphocytes
 - D. natural killer cells
 - E. cytokine release
- 31. Which of the following statements about restriction enzymes is INCORRECT?**
- A. If DNA from an organism is cut with one restriction enzyme, one of the DNA fragments produced can be ligated into a plasmid that has been cut with the same enzyme.
 - B. After DNA has been digested with a restriction enzyme, the DNA fragments produced may have regions of single stranded DNA at their ends.
 - C. Restriction enzymes are only used to insert fragments into plasmids for genetic engineering.
 - D. A restriction site is a short sequence of DNA that can be cleaved within the sequence leaving sticky or blunt ends.
 - E. Restriction enzymes that recognize four base pair long sequences cut more frequently than those that recognize six base pair long sequences.

32. A man afflicted with a genetic disorder marries a phenotypically normal woman who later bears by him four normal sons and four afflicted daughters. These results suggest that the disease is inherited as a (an) :
- A. autosomal dominant.
 - B. X-linked dominant.
 - C. X-linked recessive.
 - D. autosomal recessive.
 - E. Y-linked dominant.
33. The outcome of the Lotka-Volterra competition model depends, in part, on α and β , the competition coefficients. These parameters quantify:
- A. when co-existence or exclusion will occur.
 - B. the extent of resource limitation on species 1 and species 2.
 - C. the population size of one species expressed in terms of its competitor 'equivalents'.
 - D. the competitive effects that species 2 has on species 1, and vice versa.
 - E. carrying capacities of both competing species.
34. Which of the following comments about dominance hierarchies is NOT CORRECT?
- A. They establish stability within the social group
 - B. Dominance hierarchies often regulate population size
 - C. In all social species, females have a lower social status than males
 - D. The dominant animal tends to breed more often
 - E. The dominant animal tends to gain greater resources
35. Cladistics is preferred over phenetics because cladistics focuses on:
- A. phenotypic similarity.
 - B. behavior.
 - C. common ancestry.
 - D. taxonomy.
 - E. analogous structures.

Turn page for Part B. Continue marking on Scantron© answer sheet.

ID number _____ *2007 SEMIFINAL EXAM - PART B*

Questions 36-42. The following characteristics correspond to different levels of protein structure indicated below by letters A - D. For each characteristic mark a level MOST OFTEN associated with the characteristic. A level can be used more than once. (3 points, each ans. 0.5 points)

- A. Primary
- B. Secondary
- C. Tertiary
- D. Quaternary

36. Beta pleated sheets

37. Hydrogen bonds between R groups (amino acid side chains)

38. Hydrogen bonds between repeated constituents of the polypeptide backbone

39. Disulfide bridges

40. Amino acid sequence

41. Multiple associated polypeptide chains

42. Van der Waals forces between non-polar R groups

Use the following answers for questions 43 through 47. A choice is used only once.

- A. neurons
- B. liver cells
- C. cardiac myocytes
- D. neutrophils
- E. striated muscle cells

In terms of interaction between function and structure, in which cells would you expect the greatest number/amount of: (5 points, 1 pt. each)

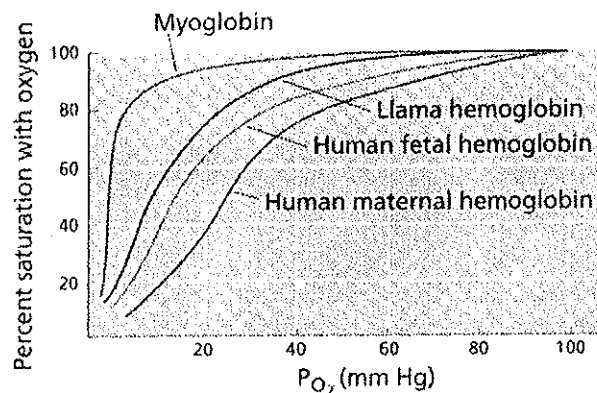
43. rough endoplasmic reticulum?

44. peroxisomes?

45. gap junctions?

46. lysosomes?

47. mitochondria?



48. In reference to what you know about oxygen and the above graph, which of the following statements is **INCORRECT**: (2 points)
- A. The hemoglobin of llamas has a higher affinity for oxygen at lower oxygen levels than does the hemoglobin of a mammal dwelling exclusively at sea level
 - B. The partial pressure of oxygen is higher at lower altitudes and lower at higher altitudes
 - C. At a partial pressure of 20 mmHg, llama hemoglobin saturation exceeds human fetal hemoglobin saturation
 - D. The maternal hemoglobin has a higher affinity for oxygen than fetal hemoglobin resulting in release of maternal oxygen to fetal hemoglobin
 - E. Human maternal hemoglobin will release oxygen to the muscular myoglobin prior to releasing oxygen to human fetal hemoglobin

49. Which of the following describes the effect of light on rod and bipolar cells in the human eye: (2 points)
- A. conformational change in rhodopsin activates transducin, sodium (Na^+) channels open; glutamate is released
 - B. conformational change in rhodopsin activates transducin, sodium (Na^+) channels close; no glutamate is released
 - C. conformational change in rhodopsin activates transducin, sodium (Na^+) channels close; glutamate is released
 - D. conformational change in transducin activates rhodopsin, sodium (Na^+) channels open; glutamate is released
 - E. conformational change in transducin activates rhodopsin, sodium (Na^+) channels close; no glutamate is released

50. You are a technician studying inheritance patterns in Alligators. Some of your alligators have angry dispositions while some are friendly. You determine that the attitude trait is encoded by a single locus. You cross a true-breeding friendly male alligator by a true-breeding angry female alligator and notice that all of the off-spring (male or female) are angry. (2 points)

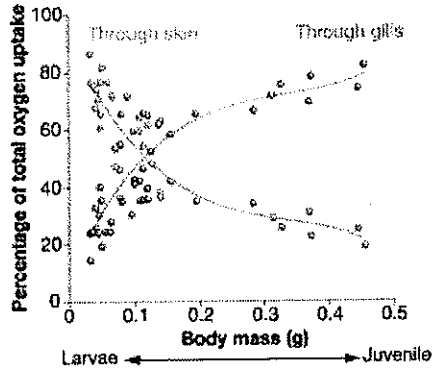
Choose all POSSIBLE modes of inheritance of angry dispositions in your alligators.

- I. Autosomal dominant
- II. Autosomal recessive
- III. Sex-linked dominant
- IV. Sex-linked recessive

- A. I only.
- B. III only,
- C. II only
- D. I and II only
- E. I and III only

Patrick Wells and Alan Pinder conducted experiments to explore how gas exchange occurs in Atlantic salmon at various stages of their life. They found that the percentage of oxygen uptake by the gills increases as the organism grows. They summarized their data in graphic form as shown below.

(c) Breathing changes from skin to gills as larvae grow.



51. Which of the following could explain this result? (2 points)

- A. As an individual grows, the skin surface area decreases in relation to its volume (the surface-to-volume ratio drops). In order to avoid suffocation, gills must take over the bulk of the gas exchange activity
- B. The gills provide a much lower surface-to-volume ratio, so that gas transfer becomes more efficient as the organisms gets larger
- C. As an individual grows, the skin surface area increases in relation to its volume (the surface-to-volume ratio increases). In order to avoid suffocation, gills must take over the bulk of the gas exchange activity
- D. The surface area of skin is much larger than the surface area of the gills
- E. Gills are not developed until adulthood

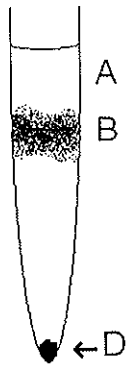
52. Which of the following characteristics are advantageous to a virus? (2 points)

- I. Long incubation period
 - II. Air transmission
 - III. Extremely efficient lytic cycle
 - IV. Inaccurate genomic replication
- A. II only
 - B. I, II, and III only
 - C. I and III only
 - D. I, II, and IV only
 - E. I, II, III and IV

53. Photosystem II of photosynthesis is called _____ because it _____ the pair of electrons to the original chlorophyll molecule. (2 points)

- A. non-cyclic, returns
- B. non-cyclic, does not return
- C. cyclic, returns
- D. cyclic, does not return

The following figure refers to questions 54 – 57. You lyse a sample of cauliflower cells and extract the cytoplasmic contents. You spin the lysed cells at low speed for 30 minutes and are left with the tube shown below. (6 points)



54. List two features of subcellular particles that contribute to their rate of separation in a centrifugal force. (2 points)

- A. Size and polarity
- B. Shape and polarity
- C. Size and shape
- D. Shape and charge
- E. Polarity and charge

55. Fraction D is known as the: (1 point)

- A. Supernatant
- B. Pellet
- C. Matrix
- D. Solvent
- E. Solute

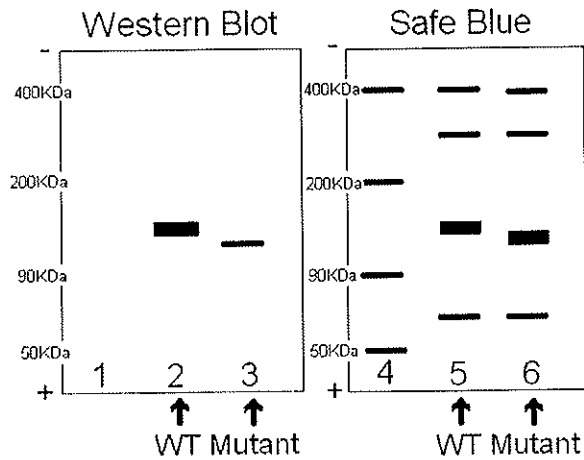
56. Name two cellular structures or organelles most probably found in fraction D. (2 points)

- A. cell wall and nucleus
- B. cell wall and chloroplasts
- C. nucleus and mitochondria
- D. mitochondria and chloroplasts
- E. golgi apparatus and endoplasmic reticulum

57. Which of the following would most likely purify the subcellular components found in fraction B? (1 point)

- A. Resuspend the pellet and centrifuge at a lower speed than previously performed
- B. Resuspend the pellet and centrifuge at a higher speed than previously performed
- C. Remove the supernatant and centrifuge at a lower speed than previously performed
- D. Remove the supernatant and centrifuge at a higher speed than previously performed

You identify a mutant form of protein transferrin. You purify both mutant and wild-type transferrin from two separate cloned bacterial cell lines. You run two SDS PAGE gels with samples of identical concentration and develop one with Cerulean Safe Blue. With a second gel, you follow a western blot and development procedure using an antibody to transferrin conjugated to horseradish peroxidase (HRP). (Use the following figure in answering questions 58 – 62. (8 points)

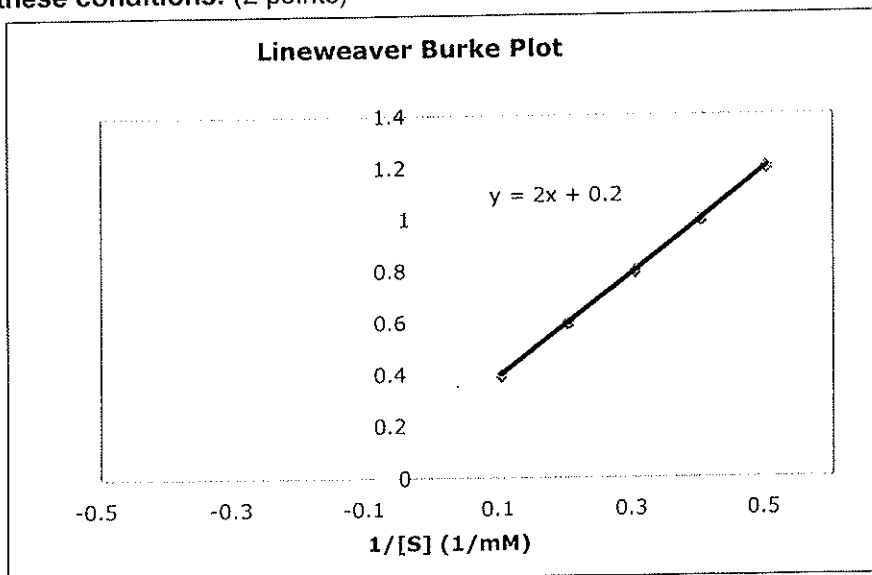


58. Mutant transferrin is _____ than wild-type transferrin. (1 points)
- longer
 - shorter
59. What is the approximate molecular weight of mutant transferrin? (2 points)
- About 180 KDa
 - About 130 KDa
 - About 300 KDa
 - About 90 KDa
 - Impossible to determine from the information provided.
60. The sample in lane 4 is called a _____ marker. (1 point)
- reference
 - dispersion
 - molecular weight
 - polarity
 - bonding
61. Which of the following most likely explains why the transferrin band in lane 2 is darker than the band in lane 3? (2 points)
- The mutant band in lane 3 is not transferrin
 - HRP binds more efficiently to wild-type transferrin than to mutant transferrin
 - The epitope of mutant transferrin, to which the primary antibody binds, is similar but not identical to that of the wild type transferrin
 - You added too much primary antibody in lane 2
 - There is less mutant transferrin than wild-type transferrin
62. Suppose you develop your western blot and see purple coloring covering the entirety of the nitrocellulose. Which step in the western blotting procedure probably was forgotten? What is your reasoning? (2 points)
- Improper buffer use caused a secondary reaction that colored the nitrocellulose
 - None - Contamination by a purple-colored compound occurred during separation with SDS-PAGE
 - Milk proteins were not added thus no protective coating formed over the nitrocellulose
 - Primary antibodies were not added thus the specific protein was not bound
 - Secondary antibody-enzyme conjugate not added thus the primary antibody is not recognized

Questions 63 - 67 refer to an investigation of the action of a mutant of an enzyme called Redsoxase. (7 points)

Redsoxase catalyzes the reaction $WI_2N_2 \rightarrow L(OSS)_3$. The reaction progress can be measured by the loss of red color.

63. If the reaction is progressing forward, over time, you would expect your optical density (OD) readings to: (1 point)
- A. increase
 - B. decrease.
64. You have a mutant of Redsoxase that does not bind substrate as well as the wild type. Which of the following do you expect to change? (1 point)
- A. V_{max}
 - B. K_m
 - C. k_{cat}
 - D. Both A and C
 - E. All of the above
65. You have an additional mutant which does not convert WI_2N_2 to $L(OSS)_3$ as efficiently. Which of the following do you expect to change? (1 point)
- A. V_{max}
 - B. K_m
 - C. k_{cat}
 - D. Both A and C
 - E. All of the above
66. You calculate the V_{max} and K_m for a 0.5 M Redsoxase at 37°C, in 10 mM NaCl, pH 8.5 using a Michaelis-Menten plot. You want to use these constants for comparison in future experiments. Which of the following parameters does NOT need to be kept constant in your new experiments for your comparisons to remain valid? (2 points)
- A. Constant pH (pH 8.5)
 - B. Constant concentration of substrate (10% solution)
 - C. Constant temperature of 37°C
 - D. Constant salt (10 mM NaCl)
 - E. Constant concentration of 0.5 M Redsoxase
67. Using the Lineweaver-Burke plot below, calculate K_m , V_{max} for Redsoxase under these conditions. (2 points)



- A. $K_m = 5 \text{ mM/s}$, $V_{max} = 10 \text{ mM}$
- B. $K_m = 10 \text{ mM/s}$, $V_{max} = 5 \text{ mM}$
- C. $K_m = 10 \text{ mM}$, $V_{max} = 5 \text{ mM/s}$
- D. $K_m = 1 \text{ mM}$, $V_{max} = 0.5 \text{ mM/s}$
- E. $K_m = 0.5 \text{ mM}$, $V_{max} = 1 \text{ mM/s}$

68. In Photosynthesis, ATP is generated in the _____ reactions as a direct product of the _____. (2 points)

- A. light, electron transport chain
- B. dark, electron transport chain
- C. light, formation of an electrochemical gradient
- D. dark, formation of an electrochemical gradient

69. Infanticide is usually encountered in species with what mating structure? (2 points)

- A. Monogamy
- B. Polyandry
- C. Polygyny
- D. Asexual reproduction
- E. Promiscuity/Panmixia

70. Which of the following is NOT a part of the nitrogen cycle? (2 points)

- A. Ammonification as decomposers turn organic nitrogen to NH_4^+
- B. Nitrifying bacteria turn NH_4^+ into NO_2^-
- C. Soil bacteria convert N_2 into ammonia
- D. Animals convert NH_4^+ into amino acids
- E. Nitrifying bacteria turn NO_2^- into NO_3^-

Questions 71 – 73. The human brain has many activities that it is responsible for and is divided into many component parts. Below (left) are three parts of the brain and a list of possible functions (right). Match the part on the left with the function on the right, indicating the letter of the appropriate match on your answer sheet. (3 points)

71. The Cerebral Cortex A. This is the largest part of the human brain, and the part responsible for intelligence and creativity, and also involved in memory. The 'gray matter' of this part is the center that receives information from the thalamus and all the other lower centers in the brain.

72. The hypothalamus B. This section of the brain functions primarily as a relay station for the crossing of motor tracts between the spinal cord and the brain. It also contains the respiratory, vasomotor and cardiac centers, as well as many mechanisms for controlling reflex activities such as coughing, gagging, swallowing and vomiting.

73. The Cerebrum C. This section of the brain is found next to the thalamus and is involved in many regulatory functions such as osmoregulation and thermoregulation. This section of the brain has a degree of control over the pituitary gland and also controls sleeping patterns, speech and eating and drinking. This part of the brain deals with almost all of the higher functions of an intelligent being. It is this part of the brain that deals with the masses of information incoming from the peripheral nervous system. It is this part that translates nervous impulses into understandable quantifiable feelings and thoughts.

74. Red flour beetles express “tonic immobility” (pretending death). These episodes of complete immobility are of variable length but demonstrate a daily rhythm although episodes are shorter when the weevils are hungry. Furthermore, long tonic immobility beetles are less likely to be prey. After observing a red flour beetle population, researchers selected 20 beetles that stayed immobile longer than most beetles and 20 beetles that did so only briefly. After 10 generations of selective laboratory breeding the inbred, long tonic immobility beetles stayed immobile for more than 2 minutes while the inbred short immobility beetles rarely went still. (2 points)

Choose the concept that is coherent with the above results.

- A. Ultimate causation of the longer tonic immobility behavior has a genetic component
- B. Ultimate causation of the shorter tonic immobility behavior is a result of abundant food supplies in the laboratory
- C. Proximate causation of the longer tonic immobility behavior has a genetic component
- D. Proximate causation of the shorter tonic immobility behavior is a result of abundant food supplies in the laboratory
- E. Proximate causation of the longer tonic immobility behavior is a defense against a predator

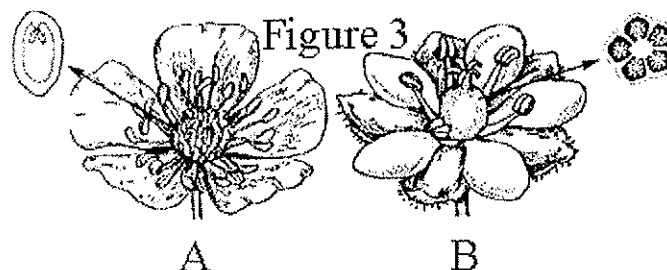
75. Read the following statements carefully. Which of the following is/are INCORRECT statements (2 points)

- I. Cartilage heals slower than skin because cartilage is a deeper tissue.
 - II. The inside lining of the intestine has a large surface area because of the presence of cilia.
 - III. Adipose is a type of connective tissue because that is where fat is stored.
- A. all are correct statements
 - B. only I and II are incorrect
 - C. only II and III are incorrect
 - D. only I and III are incorrect
 - E. all are incorrect statements

76. While on a trip to the desert, a friend of yours was bitten by a rattlesnake. He nearly died from hemolysis. You have analyzed the snake venom and found three enzymes: phospholipase, neuraminidase, and protease. Which of these enzymes do you think was responsible for his near fatal red blood cell hemolysis and in what way would it lead to hemolysis? (Indicate which of the following explanations would be appropriate) (2 points)

- A. The neuraminidase would lyse the carbohydrate rich glycocalyx leading to cell breakage since this layer is responsible for strengthening the cell membrane.
- B. The protease would degrade transmembrane proteins leading to cell lysis.
- C. The phospholipase would degrade the phospholipids thus inhibiting diffusion.

The diagram shown below should be referred to in answering questions 77 – 79. (6 points)



77. In which one of the following ways do flowers A and B DIFFER? (2 points)

- A. flower A is zygomorphic whereas flower B is actinomorphic
- B. flower A is imperfect whereas flower B is perfect
- C. flower A is epigynous whereas flower B is hypogynous
- D. flower A is apocarpous whereas flower B is syncarpous
- E. flower A is epipetalous whereas flower B is sympetalous

78. Of the two flowers depicted above, which has more carpels? (2 points)

- A. flower A
- B. flower B
- C. both the same

79. Placentation types depicted by the ovary cross-sections for flowers A and B respectively are known as: (2 points)

- A. marginal, free central
- B. free central, axile
- C. marginal, axile
- D. marginal, parietal
- E. parietal, axile

Match the cell or structure associated with vision with the description (Questions 80 – 84.) (5 points)

- A. Bipolar cell
- B. Ganglion cell
- C. Optic nerve fibers
- D. Horizontal cell
- E. Rods

80. Light must first pass through this before reaching any other sensory cells

81. These cells connect photoreceptors with each other

82. These cells transmit signals directly to the optic nerve fibers

83. When exposed to darkness, these cells depolarize and release glutamate as a neurotransmitter

84. These cells connect receptor cells to ganglion cells

Questions 85 – 88 – Match the animal group on the left with the predominant type of gas exchange given on the left. (4 points)

85. Actinopterygii

A. Book lungs

86. Annelida

B. Gills

87. Arachnids

C. lungs

88. Orthoptera

D. Skin

E. Tracheal system

In the picture below – taken from the work of N. Tinbergen – a cardinal feeds minnows, which rose to the surface looking for food. During several weeks the bird fed them, probably because his nest had been destroyed.



89. The cardinal's behavior is best understood as:

- A. Habituation
- B. Imprinting
- C. Fixed Action Pattern
- D. Associative Learning
- E. Operant conditioning

Questions 90 – 94. The following enzymes are associated with the process of food digestion. For each enzyme given, state your answer on the basis of the key given below. A choice may be used more than once or may not be used at all. (5 points – 1 point for each correct answer)

- A. Produced by the pancreas and acts in the stomach
- B. Produced by the pancreas and acts in the small intestine
- C. Produced by the mouth and acts in the mouth
- D. Produced by the stomach and acts in the stomach
- E. Produced by the small intestine and acts in the small intestine

90. aminopeptidase

93. pepsinogen

91. carbonic anhydrase

94. trypsinogen

92. chymotrypsinogen

Turn Page
Write your answers for
Part C in your Test Booklet
DO NOT ANSWER ON THE
SCANTRON® SHEET

ID Number _____ 2007 SEMIFINAL EXAM - PART C

1. In your research on alligators you find some alligators always seem to be angry while others are friendly. You study this trait and find it is inheritable and through repeated crosses find it is due to a single autosomal gene with angry (A) being completely dominant over friendly (a). You cross a homozygous angry alligator with a homozygous friendly alligator. You then cross an F1 generation angry, female alligator with an F1 generation angry, male alligator. What will be the phenotypic AND genotypic ratios of the resulting offspring? (2 points)

2. As you continue your study of alligators you notice that oftentimes the angry alligators have long tails while the friendly alligators have short tails. In your study of this condition you find that the short-tailed phenotype is dominant while the long-tailed phenotype is recessive. You want to determine if tail length and attitude are linked.. You cross a true-breeding, angry, long-tailed male alligator with a true-breeding, friendly, female alligator to get an F1 progeny. You then cross your F1 generation and look at the results in the F2 generation. Use A to refer to the dominant attitude allele and a to refer to the recessive attitude allele. Use T to refer to the dominant tail length allele and t to refer the recessive tail length allele. (12 points)

- a) What were the genotypes of the parental generation? (2 point)
- b) What is(are) the genotype(s) of the F1 generation? (1 point)
- c) What is(are) the phenotype(s) of the F1 generation? (1 points)
- d) What phenotypic ratio would you expect to see in the F2 generation if the traits are completely linked? (2 points)
- e) What phenotypic ratio would you expect to see in the F2 generation if the traits are not linked? (2 points)
- f) What genotypic ratio would you expect to see in the F2 generation if the traits show complete linkage with no recombination? (2 points)
- g) What genotypic ratio would you expect to see in the F2 generation if the traits assort independently? (2 points)

3. You decide that studying angry alligators is not a long-term career path for you and you decide to turn your attention to a much less hostile organism, the fruit fly. You begin another research project in a drosophila lab. Your advisor tells you that you have to count thousands of flies and you begin to wonder if alligators might be better after all. (10 points)

You are studying two genes known to be linked, wing shape and body color.

- a) If two genes are linked, where are they located in relation to one another in the genome? Please be precise. (2 points)
- b) Do two genes showing linked inheritance have to show a related function? Why or why not? (2 points)

Rounded wings (R) are dominant over pointed wings (r) and black bodies (B) are dominant over brown bodies (b). You perform the following cross:

Male: $\frac{R}{r} \frac{B}{b}$ X Female: $\frac{r}{R} \frac{b}{B}$

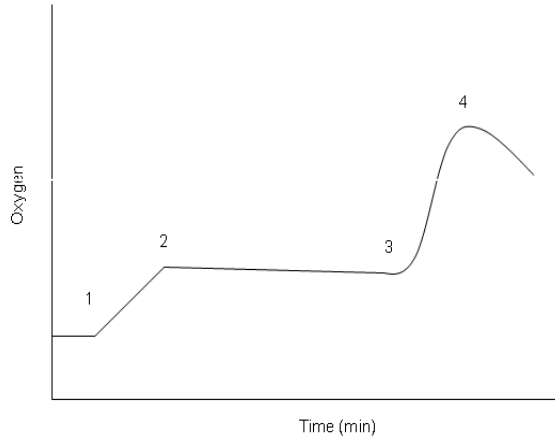
- c) What are the expected genotypes and genotype ratios of the offspring if there is no recombination between these two loci? (2 points)
- d) What are the expected phenotypes and phenotype ratios of the offspring if there is no recombination between these two genes? (2 points)

After you perform your cross, you get the following result:

725 Round wing, black body flies
255 Pointed wing, brown body flies
12 Round wing, brown body flies
8 Pointed wing, black body flies

- e) What is the recombination frequency between wing shape and body color? Show your work. (2 points)

4. You and your partner are in lab. You use the oxygen probe to graph oxygen production in a photosynthesis experiment (see graph below). You are distracted and forget to record the order in which you change the chlorophyll solution conditions. (4 points)



- a) Which area on the graph (1, 2, 3, or 4) most likely corresponds to the point at which DCMU was added? Why? (2 points)
- b) Which area on the graph (1, 2, 3, or 4) most likely corresponds to the point at which NH_4Cl was added? Why? (2 points)

5. Compare and contrast a dicot root with the stem of that same plant placing the LETTER(S) of the correct contrasting member of a pair in the blanks provided in the following table. Terms may be used more than once or not at all. (5 points)

Character	Root	Stem
Pith		
Primary xylem		
Pericycle		
Vascular tissue		
Lateral appendages		

- A. endarch origin ; B. exarch origin
 C. endogenous ; D. exogenous
 E. generally present ; F. generally absent
 G. in bundles ; H. not in bundles

6. The Academic Coordinator for the USABO went to Indonesia as an educational consultant and was provided with a house as living quarters. Soon two geckos moved in with him and shortly thereafter a large cluster of eggs were noted. As a scientist, he observed the population over the next 7 months and found the results shown below (totals in each age category are rounded off for simplicity). (12.5 points)

Table 1 – Number of Geckos in age groups over time.

Month	Age category					Total N
	0 - 0.99	1 - 1.99	2 - 2.99	3 - 3.99	4 - 4.99	
1	1000	0	0	0	0	1000
2	0	1000	0	0	0	1000
3	0	0	1000	0	0	1000
4	200	0	0	200	0	400
5	800	200	0	0	0	1000
6	0	800	200	0	0	1000
7	40	0	800	40	0	880
8	320	40	0	160	0	520

- 1) Construct a life table giving x , l_x , b_x , and $l_x b_x$ placing your calculations in the following table. (5 points)

Table 2 – Life table based on Gecko data in Table 1

Month	x	l_x	b_x	$l_x b_x$
1				
2				
3				
4				
5				

- 2) If the investigator had stayed another month, what values would you expect to find for each age category in month 8? (fill out the last line of the projection matrix in Table 1). (1.5 points)
- 3) In the long term (over, say 100 months), will the Gecko population increase or decrease in size? (state which you think will occur) (0.5 point)
- 4) Provide a mathematical relationship that will support your answer to the above question. (1.5 points)
- 5) What type of survivorship curve does this population have? (2 point)
- 6) Explain why you answered as you did in question 5). (2 points)

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