

Biology 150: 1st in-class examination

Name _____

Sept. 17, 2004

Circle the lab you attend: Monday, 3:00-4:50, Friday, 1:00-2:50, Friday, 3:00-4:50

Answer the questions in the space provided and you may also use the back of the page to complete your response. There are xx questions worth a total of 50 points (plus a 2 point bonus question). The point value of individual questions appears in parentheses.

1. What is the name given to active maintenance of complex organization by living things? (1)
2. The scientific method is general seen as consisting of a four step process. Name the steps in order. (1)
3. Experiments designed to test or rule out alternative hypotheses are called _____ . (1)
4. In his experiments with oat seedlings, Charles Darwin covered the coleoptile tip with foil of some plants and covered the lower portions of the coleoptile of other plants. Which of these were still able to grow toward the light? (1)
5. A unique form of matter that can't be converted or broken down into another form is called _____. (1)
6. Phosphorus, Hydrogen, Oxygen, Potassium, and Carbon; which is most abundant by weight in the human body? (1)
7. Explain the difference between compounds and mixtures. (2)
8. ^{12}C and ^{14}C are both _____ of carbon. In the case of ^{14}C , each atom contains 6 protons, _____ neutrons, _____ electrons and forms _____ bonds. (4)
9. Define ion. (1)
10. Give an example of a non-polar covalent bond. (1)

11. What is the term given for molecules that are insoluble in water? (1)
12. What is the concentration of H^+ in pure water? (1)
13. What is the specific heat of water? (1)
14. Organic molecules tend to have a carbon skeleton with functional groups attached. (2)
- (a) What is meant by the term 'functional group'?
- (b) Give an example of such a group.
15. *L*-lactic acid is more common in your body than *D*-lactic acid. What proportion of the lactic acid in your body is *L*-lactic acid? (1)
16. Monosaccharides naturally occurring in living organisms contain a variable number of carbon atoms ranging from _____ to _____. (1)
17. Name three disaccharides and name the subunits of each. (3)
18. What polysaccharide results from the polymerization of N-acetylglucosamine? (1)
19. What type of reaction uses water to disassemble polysaccharides into monosaccharides?(1)
20. Oils and fats of living organisms are collectively called _____. These molecules are composed of a central _____ molecule. Connected by dehydration synthesis to three _____ molecules. (3)
21. Describe the composition of phospholipid molecules. (2)

22. Describe the composition of waxes. (1)
23. What type of lipid is testosterone? (1)
24. Amino acids are characterized by having a central carbon bound to a variable group and what other atoms or functional groups. (3)
25. What is meant by the tertiary structure of proteins? (1)
26. Nucleotides are composed of a _____ and a _____ (which together are called a _____) and one to three _____. (4)
27. Nucleic acids contain both purines and pyrimidines. Name the purines found in nucleic acids and name the pyrimidines found in nucleic acids and indicate which are found in which nucleic acid. (3)
28. Which purines and pyrimidines base-pair in DNA? (1)
29. DNA is antiparallel. Explain. (1)
30. What does the first law of thermodynamics state? (1)

31. What is the change Gibbs free energy (i.e. ΔG) equal to? (1)

32. Exergonic, endergonic, endothermic, exothermic; which term(s) apply to melting ice? (1)

33. What is activation energy? (1)

Bonus questions:

1. Explain how the insects known as water striders are able to rest on top of water. (1)

2. Briefly describe the theme of this course. (1)

Biology 150: 2nd in-class examination
Oct 8, 2004

Name _____

Circle the lab you attend: **Monday, 3:00-4:50,** **Friday, 1:00-2:50,** **Friday, 3:00-4:50**

Answer the questions in the space provided and you may also use the back of the page to complete your response. There are 30 questions worth a total of 50 points (plus a two point bonus question). The point value of individual questions appears in parentheses.

1. What is the symbol K_{eq} called and what does it equal? (1)
2. If K_{eq} has a value of 0.8 will the reaction proceed? (1)
3. Feedback inhibition of enzymes can be either competitive or non-competitive. Explain. (3)
4. Describes how ATP hydrolysis drives coupled reactions. (3)
5. State Virchow's "cell theory". (2)
6. Diffusion is the net movement of one kind of molecules in response to _____ . (1)

25. The golgi complex has a cis and a trans face which is which? (1)
26. Distinguish between a primary and a secondary lysosome. (2)
27. What is the space inside the inner membrane of mitochondria called? (1)
28. What is the space inside the inner membrane of chloroplast called? (1)
29. During the development of chloroplasts, small vesicles called _____ pinch off the inner membrane. These become arranged into stacks called _____. (2)
30. Describe the endosymbiosis hypothesis. To what structures does it supply? What evidence supports this idea? (4)

BONUS QUESTION.

In a human body the toxin produced by the bacterium *Clostridium botulinum* blocks the fusion of exocytosis vesicles with the cell membrane in motor neuron cells. How does this result in death? (2)

Biology 150: 3rd in-class examination

Name _____

Nov 3, 2004

Circle the lab you attend: Monday, 3:00-4:50, Friday, 1:00-2:50, Friday, 3:00-4:50

Answer the questions in the space provided and you may also use the back of the page to complete your response. There are 20 questions worth a total of 50 points (a two-point bonus questions). The point value of individual questions appears in parentheses.

1. Describe the origin of basal bodies (i.e. where do they come from)? How does their internal structure differ from that of cilia and flagella? (3)
2. What is the name given to the loss of electrons from a less electronegative atom or molecule to a more electronegative atom or molecule? (1)
3. Where inside the cell do the reactions of glycolysis occur? (1)
4. Name one chemical intermediate of glycolysis between glucose and pyruvic acid. (1)
5. While some of the energy liberated in glycolysis is lost as heat, some is captured in the form of what two types of molecules? Which contains more captured (i.e. useable) energy? (2)
6. What critical function does fermentation serve? (1)
7. In a yeast cell, in the presence of adequate O₂, describe the reaction that consumes the pyruvic acid produced by glycolysis. Where, specifically, inside the cell does this reaction occur? (3)

14. Describe the chemiosmosis hypothesis. To what organelles is it relevant? (3)
15. In an experiment first performed in the 1960's, Peter Michel ground up spinach and isolated a solution rich in chloroplasts. He then shone a light on the solution while measuring the pH. What do you imagine happened? (1)
16. Describe (and/or diagram) the dark reactions of photosynthesis. Indicate the initial reacting molecules, at least two chemical intermediates, and the points where energy is inputted from energy carrier molecules. (6)
17. Who first discovered nucleic acids? (1)
18. Describe the Hershey and Chase experiment. What could be concluded from the experiment? (4)

19. Describe the experimental discovery of bacterial transformation. (2)

20. What was Erwin Chargaff's 1950 discovery concerning the nature of DNA? What feature of DNA explains his observation? (2)

BONUS QUESTION:

(1) The chemical dinitrophenol (DNP) is a lipid soluble molecule that collapses pH gradients across membranes by shuttling hydrogen ions across the membrane. This molecule is poisonous to your cells. Why? (2)

(2) James Watson, Francis Crick, and _____ won the Nobel Prize for discovering the structure of DNA. _____ died too soon to be included among the winners as the prize is never given posthumously.

10. Assume the following sequence represents one end of a mRNA (shown 5' to 3'):

methyl-GGAAGGAGGUAACACAUGCUUCCUUACUGGGCGGAUAAA....

a) list the first 6 amino acids that would appear in the resulting peptide (3)

b) list the anti-codons, in order, of the first 6 tRNAs involved in the synthesis of that peptide (3)

c) give the base sequence of the gene transcribed into the mRNA (3)

11. Describe how restriction enzymes produce sticky ends. (1)

12. Describe (briefly) how you might construct a DNA library of the human genome using bacteria transformation. (5)

13. Briefly describe how *Agrobacterium* is used in the transformation of many plants. (2)
14. You are given a small sample of human DNA and asked to use the polymerase chain reaction to make a large quantity of a small portion of the DNA of one particular chromosome. Describe how you would do this mentioning what you would need. (3)

BONUS QUESTIONS:

1. In the genetic code 61 codons functionally code for amino acids, yet cells synthesize less than 30 different tRNAs. The explanation for this paradox is apparently explained by the “wobble hypothesis” suggested in the late 1960’s by Francis Crick. He suggested that for most tRNAs only two anti-codon bases actually base-pair with the codon and that the other is bent away from the mRNA.
In the anticodon, first, second, or third, which base does not base-pair? (1)
What evidence supports this hypothesis? (1)
2. Francis Crick made two other major contributions to our understanding of cell biology, name or describe them both (2).
3. What year did Francis Crick receive the Nobel prize? (1)

13. What does Mendel's Law of segregation state? (1)
14. Mendel's Law of Independent Assortment state? (1)
15. You are a geneticist working with fruit flies. You have a true breeding strain of flies with dark pigmentation of the thorax and another with tan thoraxes. You cross a male with a tan thorax with a female with a dark thoax and all the progeny have dark thoraxes. You then cross the F1 and the result is 317 dark thorax flies and 104 tan thorax flies. What do the results suggest to you? (2)
16. In a monohybrid cross between a heterozygous individual and homozygous recessive individual, what proportion of the progeny would be expected to display the dominant phenotype? (1)
17. What genotypes, and in what proportions, would be expected to result from a cross between AaBb and AaBb? What phenotype and in what proportions would be expected? (4)
18. In a cross between AaBbCcddEE and aabbCCDdEe, what proportion of the offspring would be heterozygous for all four genes (2)
19. What is genetic recombination? (1)

20. What is gene linkage how does tight linkage differ from loose linkage? (3)
21. Experiments designed to test or rule out alternative hypotheses are called _____.
(1)
22. What is the concentration of H^+ in pure water? (1)
23. Organic molecules tend to have a carbon skeleton with functional groups attached. (2)
(a) What is meant by the term 'functional group'?

(b) Give an example of such a group.
24. *L*-lactic acid is more common in your body than *D*-lactic acid. What proportion of the lactic acid in your body is *L*-lactic acid? (1)
25. What type of lipid is testosterone? (1)
26. Amino acids are characterized by having a central carbon bound to a variable group and what other atoms or functional groups. (3)
27. Which purines and pyrimidines base-pair in DNA? (1)
28. DNA is antiparallel. Explain. (1)
29. Exergonic, endergonic, endothermic, exothermic; which term(s) apply to melting ice? (1)
30. What is activation energy? (1)
31. If K_{eq} has a value of 0.8 will the reaction proceed? (1)

32. Explain how the Sodium Potassium pump establishes a voltage gradient. (3)
33. What is a nucleosome? (1)
34. What is the function of the nucleolus? (2)
35. What is the function of the smooth endoplasmic reticulum? (1)
36. What is the function of the rough endoplasmic reticulum? (1)
37. Distinguish between a primary and a secondary lysosome. (2)
38. Describe the endosymbiosis hypothesis. To what structures does it apply? What evidence supports this idea? (4)
39. Describe the origin of basal bodies (i.e. where do they come from)? How does their internal structure differ from that of cilia and flagella? (3)
40. What critical function does fermentation serve? (1)

41. Describe (and/or diagram) mitochondrial electron transport. Indicate where it occurs, where electrons are donated by what molecules, the direction associated ions are transported and the terminal electron acceptor. (4)
42. Where in the chloroplast do the light-independent reactions (i.e. dark reactions) occur? (1)
43. What reaction center occurs in cyclic photophosphorylation? (1)
44. Beginning at the point that a mRNA molecule has already complexed with both ribosomal subunits, describe the events of protein synthesis to the point 3 amino acids are linked together. (4)
45. Describe how restriction enzymes produce sticky ends. (1)
46. Describe (briefly) how you might construct a DNA library of the human genome using bacteria transformation. (5)

BONUS QUESTIONS:

1. Once again you are the same geneticist in the fly lab working with the tan and dark thorax fruit fly strains. You take a closer look at the results of your earlier experimental matings (recall the F1 were all dark and the F2 consisted of 317 dark thorax flies and 104 tan thorax flies) and observe that F2

flies are approximately 50:50 male and female and all of the female flies have tan thoraxes but half the males have dark thoraxes and half have tan thoraxes (i.e. all of the tan thorax flies are males). What do these results suggest? (1)

2. During what decade (i.e. 1820s, 1830s, 1840s etc) did Gregor Mendel perform most of his pea breeding experiments? (1)
3. Who discovered gene linkage? (1)
4. In an experiment $aabb$ was crossed with $AaBb$ the progeny were $AaBb$, $aabb$, $Aabb$, and $aaBb$ were found in a ratio of 91:91:9:9. What can you tell about the loci involved from these results? (2)