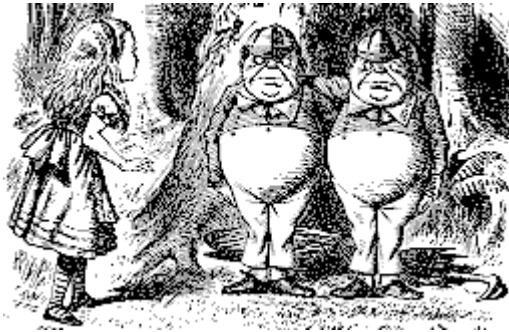


### Exam #1



"I know what you're thinking about", said Tweedledum, "but it isn't so, no how."

"Contrariwise," continued Tweedledee, "if it was so, it might be; and if it were so, it would be; but as it isn't, it ain't. That's logic."

Through the Looking Glass  
Lewis Carroll

**GENERAL DIRECTIONS:** Using your best logic, answer the following questions. Code your name on the answer sheet. Write your name on the answer sheet AND on the exam booklet. Please sign the pledge at the end of the exam if you have complied with its terms. And remember, life itself would be impossible without chemistry!

**MULTIPLE CHOICE QUESTIONS:** *Darken the correct response on the answer sheet. (1 pt each)*

1. Observational (or descriptive) science involves a control group and experimental group.
  - a. False
  - b. True
  
2. Arrange the following stages of the scientific method in the correct sequence.
  1. prediction
  2. experiment
  3. hypothesis
  4. conclusion
  5. results
  - a. 1, 2, 3, 4, 5
  - b. 3, 5, 1, 3, 5
  - c. 2, 4, 1, 3, 5
  - d. 3, 1, 2, 5, 4
  - e. 1, 2, 5, 3, 4
  
3. Some scientists use computers to create three-dimensional images of proteins and other molecules. They manipulate these images to study how the shape of the molecules responds to various conditions. This is a good example of \_\_\_\_\_.
  - a. observational science
  - b. model-building science
  - c. the hypothetico-deductive method
  - d. taxonomic science
  
4. Anatomy is a good example of a(n):
  - a. experimental (hypothetico-deductive) science
  - b. model building science
  - c. observational science
  - d. taxonomic (or systematic) science
  
5. An organism best classified in the Domain Archaea is a:
  - a. deep ocean fish
  - b. mushroom
  - c. dandelion
  - d. bacterium in yogurt
  - e. microbe growing in a hot springs

6. A friend of yours calls to say that his car would not start this morning. He asks for your help. You say that you think the battery must be dead, and that if so, then jump-starting the car from a good battery will solve the problem. In doing so, you are:
- stating a hypothesis for why the car won't start
  - searching for observations that might inspire a hypothesis for why the car won't start
  - stating a prediction and a specific hypothesis about why the car won't start
  - performing an experimental test of a hypothesis for why the car won't start
7. Inductive logic:
- is expressed in the form of if...then.... statements
  - proceeds from a generalization to a specific example
  - proceeds from a specific example to a generalization
  - is used to generate testable predictions in an experiment
8. Which of the following is a part of Darwin's theory of natural selection?
- individuals in a population vary
  - organisms tend to over-reproduce themselves
  - there are limited resources for which individuals compete
  - variations possessed by individuals of a population are inherited
  - all of the above
9. In biology, the term fitness refers to:
- how well trained and muscular an individual is, relative to others in the same population
  - how slim an individual is, relative to others in the same population
  - how long a particular individual lives
  - the ability to survive and reproduce
10. The chemical properties of an element are mainly determined by:
- the number of protons
  - the number of neutrons in the nucleus
  - the number of electrons in the outer shell
  - its atomic mass
11. If an atom has a charge of +1, which of the following is true?
- It has the same number of protons as neutrons.
  - It has the same number of protons as electrons.
  - It has one more electron than it does protons.
  - It has one more proton than it does electrons.
12. When the atoms involved in a covalent bond have the same electronegativity, what type of bond results?
- a double bond
  - a hydrogen bond
  - a non-polar covalent bond
  - a polar covalent bond
13. A large boulder is balanced on top of a hill. You give the boulder a push, and it rolls down the hill. This is an example of transferring \_\_\_\_\_ energy into \_\_\_\_\_ energy.
- kinetic; potential
  - potential; kinetic
  - kinetic; thermal
  - potential; more potential energy

**Carbon Atom Questions.** Recall that the most abundant isotope of carbon has an atomic number of 6 and a mass number of 12.

14. Therefore, carbon-12 has \_\_\_\_\_ electrons, \_\_\_\_\_ protons and \_\_\_\_\_ neutrons.

- a. 6, 6, 6
- b. 12, 12, 12
- c. 6, 12, 12
- d. 12, 6, 6
- e. 2, 6, 8

15. Carbon-11 is a radioactive isotope of carbon that is used in plant physiology tracer studies because it has a very short half-life and emits high-energy radiation that is easy to monitor. Carbon-11 has \_\_\_\_\_ electrons, \_\_\_\_\_ protons and \_\_\_\_\_ neutrons.

- a. 6, 6, 5
- b. 12, 11, 11
- c. 11, 11, 6
- d. 11, 6, 12
- e. 6, 12, 6

16. An atom of carbon-12 has \_\_\_\_\_ electrons in its outermost energy shell.

- a. 2
- b. 4
- c. 5
- d. 6
- e. 8

17. Carbon-13 is another isotope of carbon. Thus, we know that both carbon-13 and carbon-12 have:

- a. the same mass number
- b. different atomic number
- c. the same number of neutrons
- d. four electrons in the outermost energy shell
- e. the same physical properties

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18. Which statement about hydrogen bonds is NOT true?

- a. It is relatively weak bond.
- b. It forms between atoms in compounds like NaCl
- c. It involves a hydrogen atom with a weak positive charge
- d. It involves electronegative elements

19. In Fig 4.7, which two molecules contain a carbonyl group?

- a. a and b
- b. b and c
- c. c and d
- d. d and e
- e. a and e

20. Which molecule in Fig 4.7 has a carbonyl group in the form of a ketone? \_\_\_\_\_

21. Which molecule in Fig 4.7 has a carboxyl group? \_\_\_\_\_

22. Now, let's have some real fun. Imagine placing a cat in a homogenizer. After a spin on the "atomic puree" cycle, you open the lid and begin to sample the atoms in the blender. Your sample will show large concentrations of all of the following atoms except:

- a. carbon
- b. hydrogen
- c. nitrogen
- d. oxygen
- e. potassium

23. The atoms in the molecules of the cat are joined together to form macromolecules primarily by:

- a. covalent bonds
- b. hydrogen bonds
- c. ionic bonds
- d. hydrophobic interactions
- e. U.S. Treasury bonds

24. If 100 molecules of the type shown in Fig 5.1 were covalently joined together in a chain, the molecule that results would be a:

- a. monosaccharide
- b. amino acid
- c. polypeptide
- d. polysaccharide
- e. lipid

25. The chemical reaction illustrated in Figure 5.5 results in the formation of:

- a. glycosidic bonds
- b. hydrogen bond
- c. ionic bonds
- d. peptide bonds
- e. an isotope

26. In fig 5.6, at which bond would water need to be added to achieve hydrolysis to this molecule back to its monomers? \_\_\_\_\_

27. The diagram below represents a solute molecule surrounded by a hydration shell of water. Based on your knowledge of the polarity of water, the solute molecule is most likely:

- a. positively charged
- b. negatively charged
- c. neutral in charge
- d. hydrophobic
- e. non-polar

28. Water has the ability to resist changes in temperature because of its:

- a. high heat of fusion
- b. high heat of vaporization
- c. crystal structure
- d. high specific heat (heat capacity)

-----  
Use the following pH data to answer the questions below:

sour pickles - pH 3; green beans - pH 5; saliva - pH 7; ammonia - pH 9

29. Which has the highest proton concentration?

- a. ammonia
- b. beans
- c. saliva
- d. sour pickles
- e. the proton concentration of all four is the same

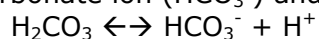
30. The concentration of hydroxide ions in green beans is \_\_\_\_\_ mol/liter.

- a.  $10^{-5}$
- b.  $10^{-9}$
- c.  $10^{-11}$
- d.  $10^{-14}$
- e. 0.0000000001

31. Sour pickles have \_\_\_\_\_ times more protons than a solution of ammonia

- a. 6
  - b. 60
  - c. 10,000
  - d. 1 million
  - e. not enough info is provided
-

One of the buffers in human blood is carbonic acid ( $\text{H}_2\text{CO}_3$ ) that dissociates in water into a bicarbonate ion ( $\text{HCO}_3^-$ ) and a hydrogen ion ( $\text{H}^+$ ). This equation is written:



32. Buffers are usually comprised of a proton donor and a proton acceptor. Which is the proton donor in this buffer?
- bicarbonate
  - carbon dioxide
  - carbonic acid
  - hydrogen ions
  - water
33. If excess protons enter the blood stream, the pH of the blood remains constant. This occurs because soon after the protons enter the blood the concentration of \_\_\_\_\_ increases and the concentration of \_\_\_\_\_ decreases.
- bicarbonate ions; hydrogen ions
  - carbonic acid; bicarbonate ions
  - bicarbonate ions; carbonic acid
  - protons; bicarbonate
34. In an exergonic reaction:
- energy is required
  - molecules are typically synthesized
  - the free energy change ( $\Delta G$ ) is negative
  - the products have more energy than the reactants
  - the reactants have less potential energy than the products
35. Organisms are able to complete endergonic reactions by:
- denaturing the enzymes in their cells
  - decreasing the temperature of their cells.
  - coupling the endergonic reaction to an exergonic reaction
  - coupling the endergonic reaction to another endergonic reaction
  - organisms are unable to complete any endergonic reactions
36. The mechanism of enzyme action is analogous to a "lock and key." Given this analogy, which of the following is analogous to the key?
- active site
  - enzyme
  - enzyme-substrate complex
  - product
  - substrate
37. Which one of the following statements about enzymes is TRUE?
- Enzymes are carbohydrates.
  - Enzymes are substrate specific.
  - Enzymes increase the activation energy for a reaction.
  - Enzymes are destroyed in the reactions they catalyze.
  - Each enzyme can catalyze more than one kind of reaction.
38. The solid line on the graph depicted below shows the frequency distribution of energy content for a population of molecules. The dotted line represents the population of molecules AFTER:
- heating
  - adding a catalyst
  - adding additional reactants
  - both a and c are correct

Use the following responses to answer the next questions (Some choices may be used more than once, others not at all.)

a.                                  b.                                  c.                                  d.                                  e.

*not inserted*

39. The graph that best depicts the rate of an enzyme catalyzed reaction versus substrate concentration is: \_\_\_\_\_.
40. The graph that best depicts the relationship between the rate of an enzyme catalyzed reaction and pH is \_\_\_\_\_.
41. Recall that catalase breaks down hydrogen peroxide into water and oxygen. Catalase occurs in cells in a potato tuber. Two Biol 121 students placed a cube of fresh potato in a test tube containing hydrogen peroxide (10 mM) and then measured the milliliters of oxygen in the tube every minute for 10 minutes. They plotted these results in a graph. The graph that would best depict their experimental results would be \_\_\_\_\_.
42. The "Y" axis (ordinate) for their graph (in the question above) should be labeled:
- time (minutes)
  - absorbance at 580 nm
  - mL of oxygen produced
  - substrate concentration (mM)
  - hydrogen peroxide concentration (mM)
43. Which graph best depicts the concentration of hydrogen peroxide (substrate) in the test tube during the course of this experiment? \_\_\_\_\_.
44. Now, assume that the students heat the potato cube for 15 minutes in a microwave oven before putting it into the test tube with hydrogen peroxide (10 mM) and measuring the amount of oxygen (mL) produced. Which of the graphs would best depict their experimental results? \_\_\_\_\_
45. Enzymes lower the activation energy requirement for a reaction by:
- increasing the concentration of the substrates near the enzyme
  - positioning the substrates for favorable reactivity
  - straining the bonds of the substrate molecule
  - providing a microenvironment that is favorable for the reaction
  - all of the above
46. The enzyme abbreviated "Rubisco" normally binds carbon dioxide to a five carbon sugar (RuBP). If carbon dioxide levels are low and oxygen concentration is high, rubisco will also bind oxygen to RuBP. Thus, oxygen is an example of a(n) \_\_\_\_\_ of rubisco.
- allosteric regulator
  - coenzyme
  - cofactor
  - competitive inhibitor
  - non-competitive inhibitor

47. Hydrogen peroxide slowly breaks down over time and loses its potency. This suggests that:
- this is an endergonic reaction
  - the  $\Delta G$  of this reaction is negative
  - hydrogen peroxide breakdown is not spontaneous
  - catalase is present in the hydrogen peroxide solution
48. The reaction,  $\text{Fe}^{3+} \rightarrow \text{Fe}^{2+}$  is an example of:
- oxidation
  - reduction
49. The reaction shown at the right is an example of a(n):
- oxidation
  - reduction
50. Biology 121 exams are:
- more fun than a hot tub full of jello
  - easy as falling off a log
  - better than sliced bread
  - a great way to spend the morning
  - all of the above

***You finished the multiple choice questions! Keep up the good work.***

**Complete the Sentence Question:** *Like a loquacious Tweedledum, complete the following sentences. (1 point each)* **ANSWER ANY THREE**

1. A paradigm is. . .
2. According to Occam's razor. . .
3. Hatters were mad because. . .
4. A dehydration synthesis. . .

**Diagram Question:** The diagram below represents the evolutionary branching pattern for the three major domains of life.

1. Label the branches with the appropriate domain (Archaea, Bacteria, Eukarya)
2. Circle the domain(s) that has/have prokaryotic cells.

**Compare and Contrast Question:** *Using complete sentences compare and contrast the following. When doing so, be sure to briefly describe or define each and then indicate how they are similar and/or different.* **Answer TWO**

1. Compare and contrast causal and non-causal correlations.
2. Compare and contrast active site and allosteric site. How are they similar? How do they differ?
3. Compare and contrast chemical evolution and Biological Evolution.

**Short Answer Question:** *Using complete sentences that would leave Tweedledee tongue-tied, answer the following.* **Answer any THREE**

1. Biologists argue that it should be theoretically possible to create life in a test tube. On what evidence do these scientists base their conclusion?
2. What is the cell theory?
3. What is natural selection?
4. What factors lead to the evolution of carbon, hydrogen, oxygen, and nitrogen as the elements of life?



***Congratulations, you made it!!!! You've completed your first BIOL 121 Exam.***

<p><b><u>Pledge:</u></b> I have neither given nor received help when taking this exam.  signature _____ date _____</p>
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*I consider an exam to be an athletic event for the mind. Just like an athlete on the day of an athletic competition, I provide an opportunity for you to warm up and cool down. At the beginning of the exam, there is a quote and some other goofy stuff to "warm up on." To cool your brain off after the exam, I have included some additional questions at the end of the exam. You can earn points for any Bonus Questions; the other questions are for fun only. I will respond to any comments you make.*

**Bonus Question:** *Earn one bonus point for each correct response. No points are deducted for incorrect responses.*

1. What is the Endosymbiont Hypothesis?
2. What is artificial blood?
3. What is capsaicin?

**Genius Question:** *Automatic "A" on the test and Ph.D degree to the university of your choice. No partial credit.*

Diagram the entire evolutionary tree of humans. For all ancestors, include scientific names, common names, and favorite TV shows.

**Trivia Question:** *Aren't they all? (For fun only)*

What is Darwin's birthday? How old would he be if he were alive today?

**Dumb Question:** *My specialty*

Can you shave with Occam's razor?

**Obvious Answer Question:** *Correct answers will win a sticker!*

The best professor at CSB/SJU is \_\_\_\_\_.