

Name \_\_\_\_\_

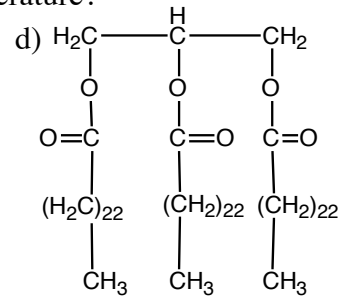
Sample Exam 2  
Chemistry 118

**Part I- Multiple Choice.** Please choose the **single** correct answer.

- Increasing the temperature of a swimming pool causes the water molecules to
  - form more hydrogen bonds
  - collide less frequently
  - move around faster
  - react with O<sub>2</sub> in the atmosphere
- The conversion of diamond to graphite does not occur in your jewelry because
  - the diamonds are coated during processing
  - the reaction has a high activation energy
  - the reaction is not spontaneous
  - graphite is higher in energy than diamond
- Oxidation of wood is
  - thermodynamically favorable but kinetically unfavorable
  - thermodynamically unfavorable and kinetically unfavorable
  - thermodynamically favorable and kinetically favorable
  - thermodynamically unfavorable but kinetically favorable
- After you eat lunch, your body metabolizes the food to form the molecule ATP. Later that afternoon, you go for a run, powered by ATP. What is true about this process?
  - Potential energy in food is transformed to chemical energy that can be used for work
  - Because energy is conserved, all the energy is trapped during each transformation with no loss to the surroundings
  - Kinetic energy is transformed to potential energy
  - These transformations are far less efficient than those that occur in an internal combustion engine, which operates at almost 100% efficiency
- Which of the following contains the most potential energy?
  - a gallon of gasoline
  - a glow stick
  - a hot pack
  - a mole of candy bars
- Which of the following statements about DNA is *not* true?
  - The two strands are held together by covalent bonds between A and T and between G and C.
  - The four bases in DNA code for 20 different amino acids in proteins.
  - The Human Genome Project was completed several years ahead of schedule.
  - Many diseases are the result of an error in the DNA code.

7. Which of the following would be most likely to be a liquid at room temperature?

- a) animal fat                      **b) unsaturated fat**                      c) saturated fat



8. Aspirin blocks the activity of an enzyme that makes prostaglandins, mediators of fever, pain, and inflammation. Aspirin is a(n)

- a) restriction enzyme                      **b) enzyme inhibitor**  
c) steroid                                      d) antibody

9. The Polymerase Chain Reaction

- a) refers to a patented reaction in the polymer industry to make nylon stockings.  
**b) allows amplification of DNA to produce millions of exact copies.**  
c) was used to construct the first successful atomic bomb at Los Alamos.  
d) allows mass production of gold jewelry for such celebrities as Mr. T.

10. What would be the best chemical solution if you find that your cat has just drunk antifreeze?

- a) Administer water to flush out the antifreeze  
b) Administer vegetable oil to dissolve the antifreeze  
c) Administer salt to precipitate the antifreeze  
**d) Administer ethanol to compete with the antifreeze**

11. Errors sometimes occur in the base sequence of a strand of DNA, yet some errors do not result in the incorporation of an incorrect amino acid during translation. How is this possible?

- a) The cell accounts for errors by changing the code used during protein synthesis.  
b) The error is corrected by repair of the mRNA.  
**c) The genetic code is redundant with different codes specifying the same amino acid.**  
d) Protein synthesis is also error-prone, so the two errors can cancel.

12. A suspect is accused of two crimes, one in Great Britain and the other in the United States. Forensic investigators in each country match the suspect's profile to samples found at the local crime scene, and circumstantial evidence links him to both crimes. However, when scientists compare the profiles from the two crime scenes, they do not match. What is the best explanation for this discrepancy?

- a) The suspect must have an identical twin.  
b) The suspect must have had an accomplice at one of the crimes.  
**c) The scientists were probably analyzing different hypervariable regions.**  
d) One of the scientists must have engaged in forensic fraud.

13. Medically speaking, why is consumption of human brains unwise?
- Nonpolar drugs accumulate in brains, potentially leading to overdoses
  - Brains can be infected with Creutzfeldt-Jakob Disease, the human form of mad cow disease
  - Brains are high in saturated fat and cholesterol, leading to increased risk of heart attack
  - Radioactive iodine accumulates in the thymus of the brain
14. Which statement best describes the chemistry of soaps?
- They contain both a nonpolar group and a polar group
  - They contain only a nonpolar group
  - They contain only a charged group
  - They are highly polar, charged compounds
15. Which of the following is *not* true about acid-base indicators?
- They act as sensors of  $H^+$  by changing color.
  - They account for the fact that roses are red and violets are blue.
  - They are found in pH paper.
  - They form the basis of the Scott test for cocaine.
16. Water boils at  $100^\circ C$ ; methanol, at  $65^\circ C$ ; ammonia, at  $-33^\circ C$ . The relative strengths of the intermolecular forces for these molecules are as follows:
- water > ammonia > methanol
  - ammonia > methanol > water
  - methanol > water > ammonia
  - water > methanol > ammonia

## Part II- Short Answer

1. Circle all the processes below that result in an increase in entropy.

- $AgCl(s) \rightarrow Ag^+(aq) + Cl^-(aq)$
- Dropping a piece of sodium metal in water to form sodium hydroxide and hydrogen gas
- Water boiling on the stove
- A hydrogen balloon igniting in the presence of oxygen to form water
- Burning paper
- Ice cubes subliming in the freezer

2. Circle all the endothermic processes below.

- Dissolving solid KBr in water (the solution gets colder)
- Johnson Pond freezing over
- A hydrogen balloon igniting in the presence of oxygen to form water
- Ice cubes subliming in the freezer
- Liquid nitrogen boiling at room temperature
- Melting ice

3. A recent report describes production of genetically engineered cattle that lack a functional gene for the normal cellular version of the prion protein.

a) What advantage might these genetically engineered cattle have over normal cattle?

**They might be resistant to mad cow disease (the hope).**

b) What disadvantage might these genetically engineered cattle have over normal cattle?

**If the prion protein has a necessary function, they will not be able to carry this out.**

4. Fill in the letter(s) of the appropriate description(s) for each of these molecules.

**Molecules:**

**C, D Carbohydrate**

**A, D, F Lipid**

**D, E Protein**

**B, D, E Nucleic Acid**

**Descriptions (may be used more than once):**

A) hydrophobic compound

B) composed of nucleotide building blocks

C) the product of photosynthesis

D) building block of cells

E) its mutation may lead to disease

F) testosterone and estradiol belong to this class of compound

5. Circle the type(s) of DNA analysis best described in each case. (Note: “mt” is mitochondrial)

- |   |      |         |       |
|---|------|---------|-------|
| a) Proved that Anna Anderson was not Anastasia  | RFLP | PCR-STR | mtDNA |
| b) Used in the case against O.J. Simpson  | RFLP | PCR-STR | mtDNA |
| c) Implicated Colin Pitchfork as the murderer of two girls in Leicestershire, England | RFLP | PCR-STR | mtDNA |
| d) Used to create profiles that occur uniquely in the world’s population              | RFLP | PCR-STR | mtDNA |
| e) Most useful in the case of badly damaged remains                                   | RFLP | PCR-STR | mtDNA |
| f) Requires a DNA sequencing step   | RFLP | PCR-STR | mtDNA |
| g) Requires a restriction enzyme  | RFLP | PCR-STR | mtDNA |

6. In class, we observed the reaction of starch with iodine, as shown here. Circle any of the following that would increase the rate of this reaction.

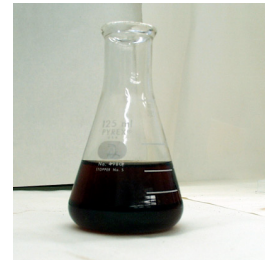
increasing the temperature

increasing the activation energy

turning off the room lights

increasing the concentration of starch

using a larger flask



7. Remains of a soldier shot down over Vietnam in 1972 and buried in the Tomb of the Unknowns in 1984 were identified by the Armed Forces DNA Identification Laboratory in 1998. These tests were based on matching mitochondrial DNA from the soldier’s bones with mitochondrial DNA from his mother.

a) Why were these tests not done *before* the remains were placed in the Tomb?

The technology did not exist.

b) Why was mitochondrial DNA used in lieu of nuclear DNA?

The remains were fairly old, and mitochondrial DNA is more robust. Furthermore, a genuine sample from the soldier in question would have been needed as a control sample for a positive identification with nuclear DNA.

c) Could the father’s DNA have been used to make the match instead of the mother’s? Explain.

No, the soldier’s mtDNA would not have matched his father’s because mtDNA is passed down the maternal line.

8. Circle all examples of potential energy below. (Flash is my dog.)

Flash taking a nap

Flash at the top of a hill on a sled

Flash's body fat

Flash's dinner

Flash ready to jump off a dock

Flash chasing a soccer ball

9. Circle any of the following that could be an acid. A solution that:

tastes bitter

turns litmus red

reacts with sodium hydroxide to produce salt water

dissolves in water to produce OH<sup>-</sup>

reacts with sodium to produce H<sub>2</sub>

has a pH = 7.0

10. For each of the following compounds,

a) Circle the correct type of bonding. You may need to circle two choices for one compound.

b) Predict whether the compound dissolves significantly in water.

(Necessary electronegativity values are as follows: C = 2.5; H = 2.1; O = 3.5; N = 3.0)

	a) Type of bonding?			b) Dissolves in water?	
CH <sub>4</sub>	ionic	polar covalent	nonpolar covalent	Yes	No
HCN (C is the central atom)	ionic	polar covalent	nonpolar covalent	Yes	No
CaO	ionic	polar covalent	nonpolar covalent	Yes	No

11. Rank CH<sub>4</sub>, HCN, and CaO in terms of expected boiling point.

CH<sub>4</sub>  
lowest

HCN  
intermediate

CaO  
highest

Part III- Problems. You must clearly show your work for full credit.

1. 100 mL of 0.1 M NaCl is added to 0.4 L water. What is the concentration of NaCl?

$$0.1 \text{ M} \times \frac{100 \text{ mL}}{500 \text{ mL}} = 0.02 \text{ M}$$

2. Glucose ( $C_6H_{12}O_6$ ; molar mass = 180 g/mol) undergoes combustion in the body to release 2540 kJ of heat per mole. The products are  $CO_2$  and  $H_2O$ .

a) Write a balanced equation for this reaction, including the energy term.



b) How much heat is released if 5.0 moles of glucose undergo this reaction?

$$5.0 \text{ mole glucose} \times 2540 \text{ kJ/mole glucose} = 12,700 \text{ kJ}$$

c) How much heat is released if 900 grams of glucose undergo this reaction?

$$900 \text{ g glucose} \times 1 \text{ mole}/180 \text{ g} \times 2540 \text{ kJ/ mole glucose} = 12,700 \text{ kJ}$$

3. A closed vessel contains 104 g of  $C_2H_2$  and 300 g of  $O_2$  that react to form carbon dioxide and water. 236 kJ of heat are released per mole of  $C_2H_2$ .

a) Write the balanced equation for this reaction.



b) How much heat is released in this reaction?

$$104 \text{ g } C_2H_2 \times 1 \text{ mol}/26 \text{ g} = 4 \text{ mol}$$

$$300 \text{ g } O_2 \times 1 \text{ mol}/32 \text{ g} = 9.375 \text{ mol } O_2$$

From the balanced equation, 4 mol  $C_2H_2$  requires 10 mol  $O_2$ . Thus,  $O_2$  is limiting.

$$9.375 \text{ mol } O_2 \times 472 \text{ kJ}/5 \text{ mol } O_2 = 885 \text{ kJ}$$