EXAM FORM D5

Name _____ **Chemistry 115-T**

Section _____ **FINAL EXAM** **Total Points = 210**

TA _____ Monday, 3:20 PM

December 11, 2006

THIS EXAM IS FOR STUDENTS WITH TUESDAY-THURSDAY 8:30 or 9:30 LECTURE. YOU SHOULD HAVE A TAN COMPUTER ANSWER SHEET!

Directions:

1. Each student is responsible for following directions. Read this page carefully.

2. Write your name and other requested information on this page and on the separate answer sheet.

3. CODE your name on the answer sheet using an ordinary (#2) pencil.

4. CODE your correct ***10-digit*** identification number (PUID) on the answer sheet. **THIS IS VERY IMPORTANT!**

5. CODE your section number on the answer sheet. Please use all four digits, 0101, 0102, 0201, etc. **This is also very important!**

6. CODE the test number or letter shown in the upper right-hand corner of this page onto the answer sheet in the block labeled "Test Form" under the Date line at the top right-hand side. **This is Test Form D5.**

7. Put all calculations on the examination pages. **DO NOT PUT ANY EXTRA MARKS ON THE COMPUTER ANSWER SHEET!**

8. This exam consists of 35 multiple-choice questions worth 6 points each. Choose the one best or correct answer for each question and write it both on your exam paper and on the computer answer sheet. **The computer answer sheet is the only one that will be graded!**

9. This exam consists of 11 pages plus Useful Information (2 pages), a Periodic Table, and 2 sheets of scratch paper. Please check to be sure that you have them all!

AT the END OF the EXAM

1) Please make sure that you have entered 35 answers on your scan sheet.

2) Make sure that you have entered your name, ID number, and lab section number (4 digits) on your scan sheet and Exam Form.

3) You MUST turn the scan sheet in to your TA before leaving the exam!

_____ 1. What is the half-life of an isotope if it decays to 12.5% of its radioactivity in 18 minutes?

(a) 9 minutes
(b) 8 minutes
(c) 12 minutes
(d) 6 minutes
(e) 0.17 minutes

Use the following information for questions 2 and 3: Element 118 was discovered in October, 2006. It has a half-life of several milliseconds and decays to element 116 in one step.

_____ 2. The nucleus of element 118 most likely has the following composition:

(a) 59 protons and 59 neutrons
(b) 118 protons and 116 neutrons
(c) 118 protons and 118 neutrons
(d) 118 neutrons and 118 electrons
(e) 118 protons and 175 neutrons

_____ 3. The mode of decay for element 118 is:

(a) β-decay
(b) positron emission
(c) electron capture
(d) α-decay
(e) ionization

_____ 4. Alexander Litvinenko, a Russian dissident, was poisoned with polonium-210. The poison was ingested and it took weeks for him to die. The half-life of polonium-210 is 138 days, and the isotope decays through α-decay . The product of the decay is(are):

(a) Pb and He
(b) Rn (from Po + He)
(c) Pb and H
(d) ^{206}Po
(e) Bi (from Po + e^-)

_____ 5. Which lists the three spectral regions in order from shortest to longest wavelength?

(a) ultra-violet < visible < infrared
(b) ultra-violet < infrared < visible
(c) visible < infrared < ultra-violet
(d) visible < ultra-violet < infrared
(e) infrared < visible < ultra-violet

_____ 6. Consider the wave shown below, which represents electromagnetic radiation. In which region of the electromagnetic spectrum does this wave belong?

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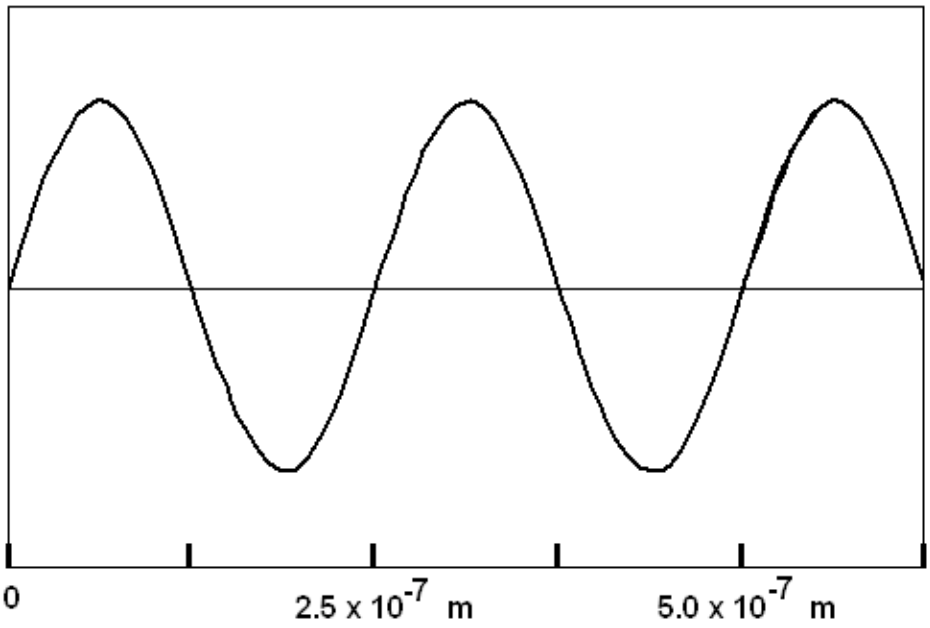


(a) x-ray
(b) ultra-violet
(c) visible
(d) infrared
(e) microwave

_____ 7. Hydrogen bonds can occur when hydrogen bonds to atoms such as nitrogen and oxygen. What property of nitrogen and oxygen is important for this?

(a) atomic mass
(b) ionizability
(c) hydrophobicity
(d) electronegativity
(e) None of the above

_____ 8. Which list has the substances listed in order of increasing bond polarity.

(a) $BF_3 < NO_2 < P_4 < CO_2$

(b) $CO_2 < P_4 < NO_2 < BF_3$

(c) $P_4 < NO_2 < CO_2 < BF_3$

(d) $BF_3 < NO_2 < CO_2 < P_4$

(e) $P_4 < BF_3 < NO_2 < CO_2$

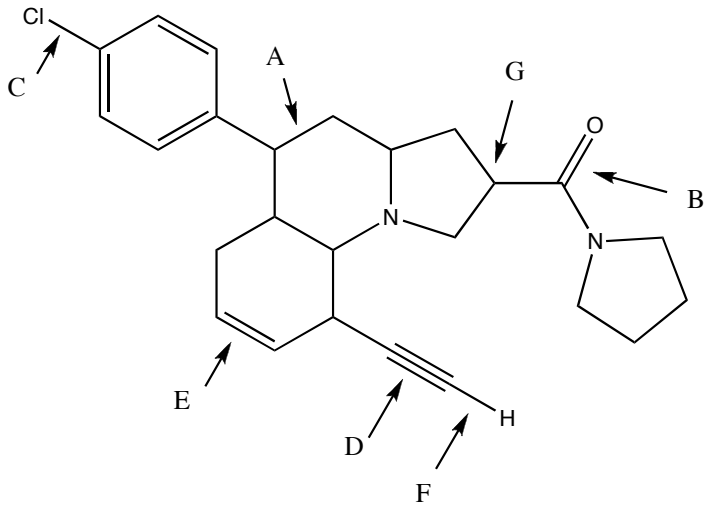
_____ 9. What is the O-C-O bond angle in CO_3^{2-} ?

(a) 90^o
(b) 180^o
(c) 109.5^o
(d) slightly less than 109.5^o
(e) 120E

_____ 10. Based on the Lewis structure, which is an incorrect formula?

(a) CH_2=CHF
(b) CH_3CH=CH_2
(c) C_6H_5CH=CH_2
(d) CH_2=CHCN
(e) CH_2=CHCl–CH=CH_2

Questions P11 – P13 refer to the alkaloid shown below:



_____ 11. Which of the indicated bonds is the longest?

(a) A
(b) B
(c) C
(d) D
(e) E

_____ 12. How many hydrogen atoms are bonded to the atom marked "G"?

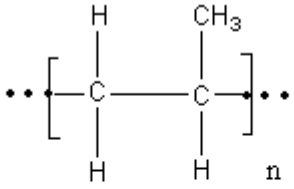
(a) 0
(b) 1
(c) 2
(d) 3

(e) 4

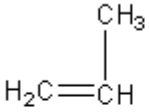
_____ 13. Which of the following features is NOT present in the molecule?

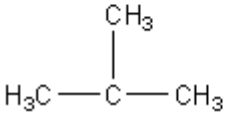
(a) benzene ring
(b) carbonyl
(c) carboxylic acid
(d) cyclohexene ring
(e) triple bond

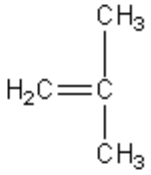
_____ 14. The addition polymer shown below came from what monomer?



(a) $H_2C=CH_2$

(b) 

(c) 

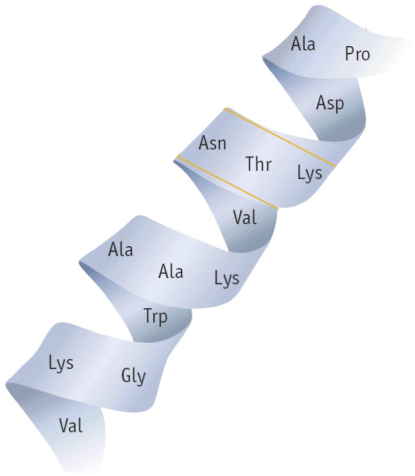
(d) 

(e) None of these

_____ 15. A β-sheet is an example of what level of protein structure?

(a) primary structure
(b) secondary structure
(c) tertiary structure
(d) quaternary structure
(e) all of the above

_____ 16. The features in the protein shown below are examples of:

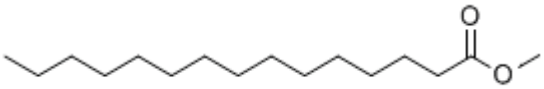


(a) primary structure
(b) secondary structure
(c) tertiary structure
(d) quaternary structure
(e) primary and secondary structures

_____ 17. An addition polymer forms during the preparation of:

(a) luminol
(b) aspirin
(c) nylon
(d) alum
(e) None of these

_____ 18. The following fragment is found in which of the following?



(a) DNA
(b) lactose
(c) a lipid
(d) a protein
(e) starch

_____ 19. When 0.10 g of a polymer is dissolved in toluene to form 1.00×10^2 mL of solution, the osmotic pressure is 5.4 torr at 20°C. What is the molar mass of the polymer?

(a) 3.4×10^3 g/mol
(b) 4.5×10^3 g/mol
(c) 1.3×10^3 g/mol
(d) 2.9×10^2 g/mol

(e) 2.3×10^2 g/mol

_____ 20. A chemist studying water pollution used a spectrometric method to measure total phosphate and obtained the following data for known standards:

Absorbance (400nm)	Concentration (mol/L)
0	0.0
0.1	2.5×10^{-5}
0.16	3.2×10^{-5}
0.20	4.4×10^{-5}
0.25	5.6×10^{-5}
0.38	8.4×10^{-5}
0.48	10.5×10^{-5}
0.62	13.8×10^{-5}
0.76	17.0×10^{-5}
0.88	19.4×10^{-5}

If a sample of lake water has an absorbance of 0.55, what is the phosphate concentration?

(a) 1.22×10^{-4} m

(b) 1.22×10^{-4} M

(c) 1.22×10^{-4} mol

(d) 1.22×10^{-4} mol %

(e) 1.22×10^{-5} mol/L

_____ 21. The titration of a 25.0 mL sample of a barium hydroxide solution requires 34.45 mL of 0.100 M $HClO_4$. What is the molarity of the barium hydroxide solution?

$$Ba(OH)_2(aq) + 2\ HClO_4(aq) \rightarrow Ba(ClO_4)_2(aq) + 2\ H_2O(\ell)$$

(a) 6.89 M
(b) 0.0689 M
(c) 0.138 M
(d) 0.276 M
(e) 0.0363 M

_____ 22. What is the mass percent of fluorine in potassium cobalt fluoride, a compound that crystallizes with Co ions on the corners of a cubic unit cell, F ions in the middle of each edge of the unit cell, and a K ion at the center of the cell?

(a) 16.2 %
(b) 27.9 %
(c) 32.7 %
(d) 33.3 %
(e) 36.8 %

_____ 23. The unit cell in a certain lattice consists of a cube formed by an anion at each corner, an anion in the center, and a cation at the center of each face. The unit cell contains:

(a) 5 anions and 6 cations.

(b) 5 anions and 3 cations.

(c) 2 anions and 3 cations.

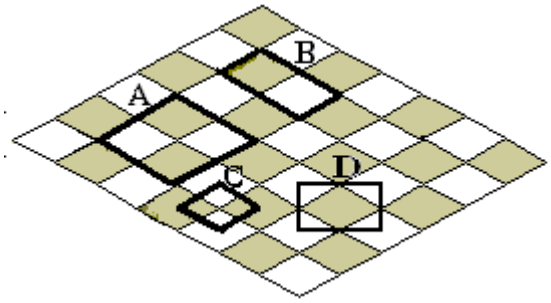
(d) 3 anions and 4 cations.

(e) 2 anions and 2 cations.

_____ 24. Thallium bromide crystallizes in a cubic unit with bromide ions on the corners and a thallium ion at the center of the unit cell. What is the radius of the thallium ion if the unit cell has an edge of 397 pm and the radius of a bromide ion is 196 pm?

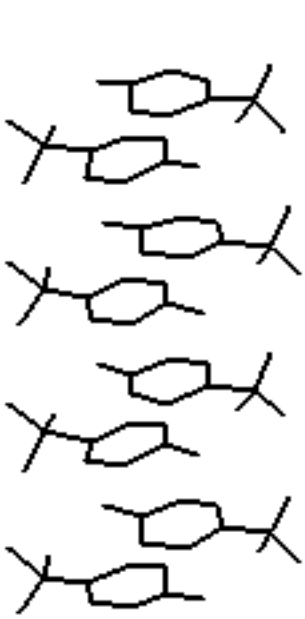
(a) 25 pm
(b) 100 pm
(c) 134 pm
(d) 148 pm
(e) 201 pm

_____ 25. Which of the blocks in the pattern below constitute proper unit cells?

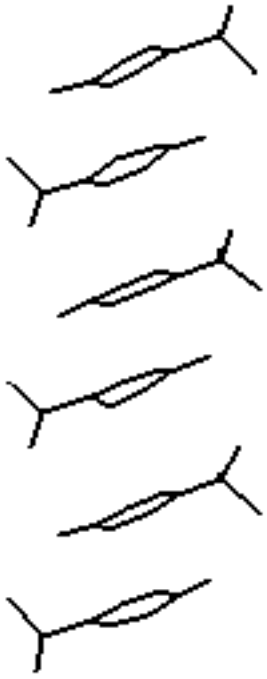


(a) A and B
(b) A and C
(c) A and D
(d) B and C
(e) B and D

_____ 26. Sulfanilamide molecules are arranged differently in the columns in two different crystals



Column in crystal I



Column in crystal II

Crystal I and Crystal II are:

(a) isomers
(b) allotropes
(c) polymorphs
(d) isotopes
(e) different forms of DNA

_____ 27. Crystal I in the previous question is an example of a(an):

(a) Covalent network solid
(b) Metallic solid
(c) Atomic solid
(d) Molecular solid
(e) Ionic solid

_____ 28. The mineral greenockite (CdS) is known as cadmium yellow and is used as a pigment in paints. Cadmium sulfide has a medium sized band gap of 4.2×10^{-19} J. What wavelength of light does cadmium sulfide absorb?

(a) 928 nm
(b) 211 nm
(c) 835 nm
(d) 156 nm
(e) 473 nm

_____ 29. Which of the following elements could be used to create an n-doped germanium semiconductor?

(a) As
(b) Sn
(c) Ga
(d) Al
(e) Si

_____ 30. Which involves an exothermic process?

(a) the boiling of water.
(b) he sublimation of dry ice [i.e., the conversion of $CO_2(s)$ directly to $CO_2(g)$].
(c) "Hot packs", used by athletes and others, based on the crystallization of sodium acetate from a highly concentrated solution.
(d) "Cold packs", used by athletes and others, based on the dissolving of ammonium nitrate in water.
(e) All are exothermic.

_____ 31. Calculate ΔH^o_{rxn} for $N_2O\ (g) + NO_2\ (g) \rightarrow 3\ NO(g)$

Known reactions:

$N_2(g) + O_2\ (g) \rightarrow 2\ NO\ (g)$ $\quad \Delta H^o_{rxn} = -180.7$ kJ

$2\ NO\ (g) + O_2\ (g) \rightarrow 2\ NO_2\ (g)$ $\quad \Delta H^o_{rxn} = -113.1$ kJ

$2\ N_2O\ (g) \rightarrow 2\ N_2(g) + O_2\ (g)$ $\quad \Delta H^o_{rxn} = -163.2$ kJ

(a) −457.0 kJ
(b) −276.3 kJ
(c) −42.6 kJ
(d) −205.8 kJ
(e) 318.9 kJ

_____ 32. Consider the following decomposition reaction and determine much heat is absorbed when 43.3 g of HgO is decomposed.

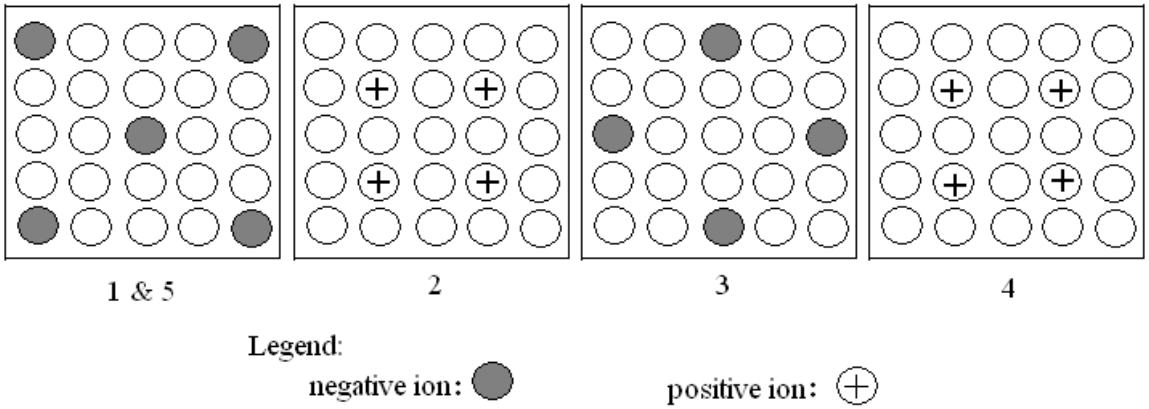
$$2\ HgO(s) \rightarrow 2\ Hg(\ell) + O_2(g) \qquad \Delta H^o = 181.66\ kJ$$

(a) 36.3 kJ
(b) 18.2 kJ
(c) 3930 kJ
(d) 1966 kJ
(e) 9.08 kJ

_____ 33. The energy balance of soy diesel is determined from:

(a) The amount of energy used to grow the soybeans and to extract and refine oil from the beans.
(b) The amount of energy used to process the soy oil into a diesel fuel alternative.
(c) The amount of energy contained in soy diesel.
(d) The amount of energy required to plant and grow soybeans, the energy required to process the beans into various products, and the energy contained in the final products.
(e) The amount of energy in a gallon of soy diesel and the amount of energy in a gallon of regular diesel.

_____ 34. In lab you made a structure represented by the following diagram:



This diagram represents the structure of:

(a) NaCl
(b) CsCl
(c) ZnS
(d) K_2O
(e) CaF_2

_____ 35. Biodiesel is:

(a) an ester produced from vegetable oil.
(b) an alcohol produced by fermentation.
(c) a hydrocarbon produced from vegetable oil.
(d) a ketone produced by fermentation.
(e) methane gas produced by fermentation.

Useful Information (cont.)

$K = 273.15 + EC$

$PV = nRT$

$E = h\nu =$

$$\frac{1}{\lambda} = R_H\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$$

$$\ln\left(\frac{N_0}{N_t}\right) = kt$$

$k\,t_{1/2} = \ln 2$

$\Delta T = km$

$\pi = MRT$

$R_g = (n_{avg}\,\ell_0^2/6)^{1/2}$

$$\%\text{ by volume} = \frac{\text{volume of solute}}{\text{volume of solution}} \times 100$$

$1\ ft^3 = 28.32\ L$

$R = 8.206 \times 10^{-2}\ L \cong atm/(mol \cong K)$

1 atm = 760 mm Hg = 760 torr

$c = 3.00 \times 10^8\ m/s$

$1\ amu = 1.661 \times 10^{-27}\ kg$

$h = 6.63 \times 10^{-34}\ J \cong s$

1 amu = 931.5 MeV

$1\ MeV = 1.602 \times 10^{-13}\ J$

R_H (Rydberg constant) $= 1.096776 \times 10^7\ m^{-1}$

$1\ J = 1\ kg \cong m^2/s^2$

K_b for $H_2O = 0.512EC/m$

K_f for $H_2O = 1.86EC/m$