Chemistry 1A Fall 2000

Midterm Exam I, version B
September 19, 2000

(Closed book, 75 minutes, 105 points)

Name: _____ Section Number: _____

SID: _____ T.A. Name: _____

Identification Sticker

Exam information, extra directions, and useful hints to maximize your score:

- Write your name on all six pages.
- There are two parts to the exam: 1) multiple choice and 2) short answer problems.
- **For the multiple choice problems, fill in the Scantron™ form AND circle the answer on your exam.**
- Answer the questions you know how to do first, then work on the questions you skipped.
- Show all work on the short answer problems for which you want credit and do not forget to include units!
- You may use the back side of the exam for scratch paper.

Unit Prefixes

milli, m (x 10^{-3})	micro, μ (x 10^{-6})	nano, n (x 10^{-9})
kilo, k (x 10^{3})	mega, M (x10^{6})	giga, G (x 10^{9})

Some possibly useful information:

$E_{photon} = h\nu = hc/\lambda$

$E_{kin}\ (e^-) = h\nu - \Phi = h\nu - h\nu_o = mv^2/2$

$\lambda_{de\ Broglie} = h/p = h/mv$

(Do not write in this box; it is for official use only.)

Page	Points
2-4	/ 45
5	/ 30
6	/ 30
Total	/ 105

 Name:_____

Part 1: Multiple Choice.
(3 pts each, 45 pts total)
Instructions: Bubble in the correct answer on your Scantron sheet AND circle the answer on your exam. Each question has one correct answer.

1.) The answer to question 1 is **B**. Bubble in **B** on your Scantron™ form.

2.) Which is required in the greatest quantity (mass) in order to produce 1 gram of Br_2?

A.) HBr B.) NaBr **C.) KBr** D.) $MgBr_2$ E.) $CaBr_2$

3.) Which has $\lambda_{\text{de Broglie}}$ equal to twice that of ^{16}O at the same speed?

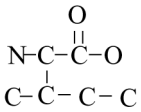
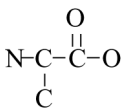
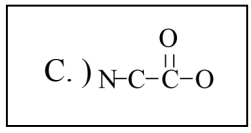
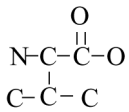
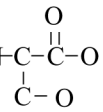
A.) ^{4}He **B.) ^{8}B** C.) ^{20}Ne D.) ^{24}Mg E.) ^{32}S

4.) Including the structure below, how many structural isomers of propanol exist?

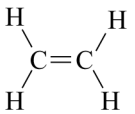
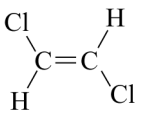
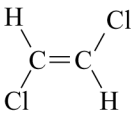
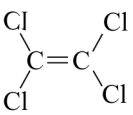
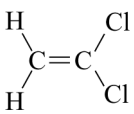
$$CH_3-CH_2-CH_2-OH$$

A.) 0 B.) 1 C.) 2 **D.) 3** E.) 4

5.) Which of the following amino acids is *not* chiral? (note: the H atoms are not shown)

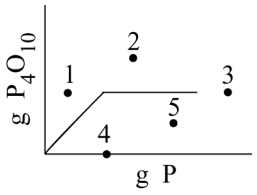
A.)  B.)  **C.)**  D.)  E.) 

6.) Which of the following molcules does have an electric dipole moment?

A.)  B.)  C.)  D.)  **E.)** 

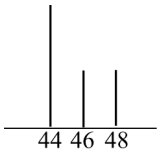
 Name:_____

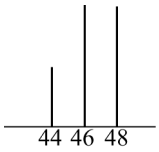
7.) Shown is the graph depicting the quantity of P_4O_{10} accumulated in the oxidation of P as a function of added P for a fixed amount of O_2. Through which point would the graph pass for a similar reaction with access to half the amount of O_2?

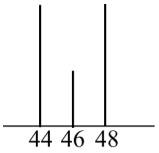


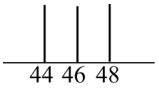
A.) 1 B.) 2 C.) 3 D.) 4 **E.) 5**

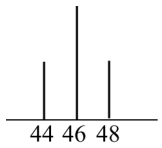
8.) A mixture of one-third ^{12}C, one-third ^{16}O, and one-third ^{18}O reacts to form pure CO_2. Which is the correct mass spectrum of the CO_2?

A.) 

B.) 

C.) 

D.) 

E.) 

9.) How many grams of $CaCO_3$ are formed from the reaction of 56 g of CaO and 56 g of CO_2?

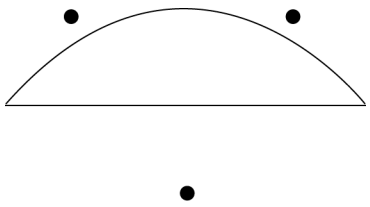
A.) 44 B.) 56 **C.) 100** D.) 112 E.) 128

10.) For which of the following are all ions isoelectronic with Ar?

A.) NaCl B.) $MgCl_2$ **C.) KCl** D.) $CaBr_2$ E.) NaBr

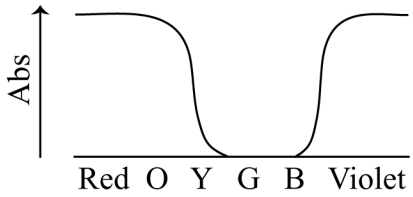
11.) Shown is the standing wave electron wave function for n=1. For which n will the wave function pass through all three points?

A.) 0 B.) 1 C.) 2 **D.) 3** E.) 4



 Name:_____

12.) The absorption spectrum of a given compound is shown below. What color does it appear under illumination with green light?



A.) black B.) red **C.) green** D.) blue E.) white

13.) Consider the electrolysis of 10 g of liquid water into hydrogen and oxygen gas. Approximately what volume of gas will be formed?

A.) ~ 1 m^3 B.) ~ 1 L C.) ~ 10 mL **D.) ~ 10 L** E.) ~ 1 kL

14.) Which of the following has a linear molecular structure?

A.) NH_2^- **B.) ICl_2^-** C.) IF_2^+ D.) H_2S E.) SO_2

15.) Ionization energy (IE) is the energy required to remove an electron from an atom. For which pair X + Y below will transfer of an electron from X to Y occur at the longest distance to form ions X^+ and Y^-?

IE ←
Li Na K Rb Cs

A.) Li + Br B.) Na + Br C.) K + Br D.) Rb + Br **E.) Cs + Br**

 Name:_____

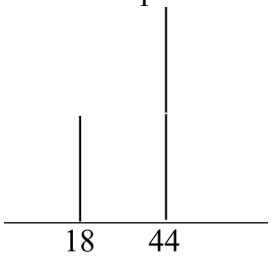
Part 2: Short Answer Problems (60 pts total)

Instructions: Enter answers in the boxes provided. Show your work. Where requested write explanations in fifteen words or less.

(30 pts)

1.) A compound containing only carbon and hydrogen is combusted with oxygen.

a) Shown is a mass spectrum of the combustion products. Identify the products.



Product 1:	Product 2:
H_2O **(M.W. = 18 g/mol)**	**CO_2** **(M.W. = 44 g/mol)**

b) Based on the ratio of peak heights in the mass spectrum, determine the empirical formula of the unknown.

From mass spectrum molar ratio of product CO_2:H_2O is 2:1
Molar ratio of product C:H is 1:1
Molar ratio of reactant C:H is 1:1

Answer: **CH**

c) The molecular mass of the unknown is 26 g/mol. What is its molecular formula?

Molar weight corresponding to empirical formula is 13g/mol
Therefore, molecular formula must have twice as many moles of each atom.

Answer: **C_2H_2**

d) Draw the Lewis electron dot structure for the unknown.

Structure:

H-C≡C-H

e) Which is true for the H–C–C bond angle (θ) in the unknown? Circle the appropriate answer and explain.

θ = 109.5° θ = 120° **θ = 180°**

Explanation:

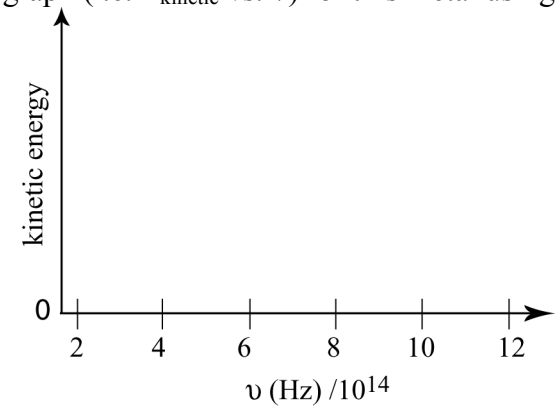
Steric Number: 2 means linear structure

 Name:_____

(30 pts)

2.) The minimum amount of energy a photon needs to eject an electron from a metal M, occurs in the infrared at λ = 800nm.

a) Sketch the photoelectric graph (i.e. $E_{kinetic}$ vs. ν) for this metal using the given axes.



b) What is the energy of an incident blue photon with λ = 400nm?

$$\mathbf{E = hc/\lambda}$$

Answer:
4.97×10^{-19} J
#Sig Figs (1) is not important

c) What is the kinetic energy of an electron ejected from M by the photon in part b)?

$$\mathbf{E = hc/\lambda - hc/\lambda_0}$$

Answer:
2.49×10^{-19} J

d) Calculate the de Broglie wavelength for the electron ejected in part c).

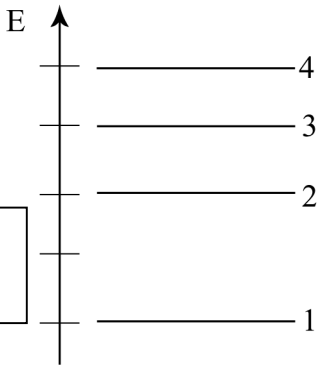
$$\mathbf{\lambda = h/p = h/(2m_eE_{Kin})^{1/2}}$$

Answer:
0.984 nm

e) 800 nm light corresponds to transition 3→1 in the energy level diagram shown below. What λ corresponds to the 4→1 transition?

$$\mathbf{E_{4\to1} = 4/3\ E_{3\to1}}$$

$$\mathbf{\lambda_{4\to1} = 3/4\ \lambda_{3\to1}}$$



Answer:
600 nm