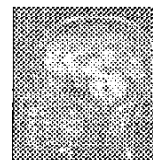




Chemistry 1A Fall 1999



Midterm Exam II, version A

October 12, 1999

(Closed book, 90 minutes, 145 points)

Name: _____

Section Number: _____

SID: _____

T.A. Name: _____

Identification Sticker

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

- Write your name on all 5 pages.
- There are two parts to this 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 for which you want credit and do not forget to include units!
- You may use the back side of the exam pages to show your work and/or for scratch paper.

Potentially useful information:

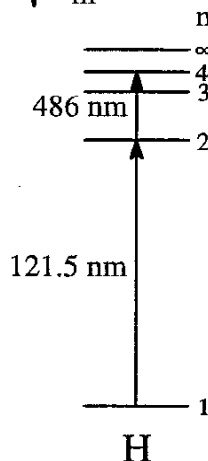
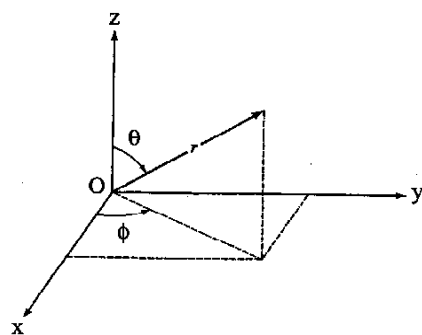
Unit Prefixes

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

$$PV = nRT$$

$$E_k = \frac{3RT}{2}$$

$$v_{rms} = \sqrt{\frac{3RT}{m}} = \sqrt{\frac{3 k_B T}{m}}$$



$$E_n = -R_\infty \frac{Z^2}{n^2} \quad \Delta E = -R_\infty Z^2 \left(\frac{1}{n_f^2} - \frac{1}{n_i^2} \right)$$

$$A = \log\left(\frac{I_o}{I_t}\right) = -\log\left(\frac{I_t}{I_o}\right) = \epsilon \cdot l \cdot C$$

$$\lambda = \frac{h}{p} = \frac{h}{mv} \quad E = h\nu = \frac{hc}{\lambda}$$

(Do not write in this box, it's for official use only)

Problems	Points
multiple choice	/ 40
Part 2, # 1	/ 25
Part 2, # 2	/ 30
Part 2, # 3	/ 25
Part 2, # 4	/ 25
all	/ 145

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Name: _____

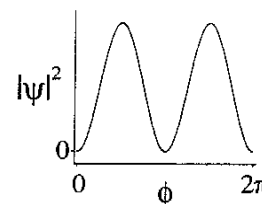
Part 1: Multiple Choice.**(5 pts each, 40 pts total)**

Instructions: Bubble in the correct answer on your Scantron™ form AND circle the answer on your exam. Each question has one correct answer.

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

2.) To which orbital does the plot of $|\psi|^2$ vs ϕ correspond?

A.) 1s B.) 2s C.) $2p_x$ D.) $2p_y$ E.) $2p_z$



3.) The ionization of which with UV light at 90 nm will produce electrons with the longest de Broglie wavelength?

A.) H (1s) B.) H (2s) C.) H (4s) D.) He^+ (4s) E.) He^+ (8s)

4.) Identify the atom or ion with the electronic configuration $[\text{Ne}]3s3p^6$?

A.) Ar^+ B.) K^+ C.) Ar D.) K E.) Cl^-

5.) Which has the largest atomic or ionic radius?

A.) Ar^+ B.) K^+ C.) Ar D.) K E.) Cl^-

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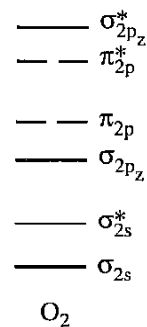
Name: _____

6.) Which is the most electronegative?

- A.) H B.) Na C.) K D.) Cl E.) Br

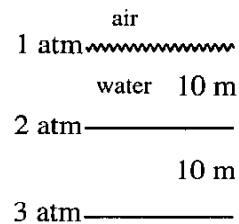
7.) Which is *not* paramagnetic in its ground state?

- A.) O B.) O⁻ C.) O²⁻ D.) O₂ E.) O₂⁻



8.) After diving, which ascent poses the gravest danger to a diver holding his or her breath?

- A.) 10m→0m B.) 20m→10m C.) 40m→20m
D.) 60m→30m E.) 100m→40m



9.) The atoms or molecules of which ideal gas have the greatest average kinetic energy?

- A.) Ar at 200 °C B.) He at 400 °C C.) He at 100 °C
D.) H₂ at 200 °C E.) H₂ at 100 °C

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Name: _____

Part 2: Short Answer Problems (105 pts total)

Instructions: Enter answers in the boxes provided. Show your work and justify your answer.

(25 pts)1.) Consider the H atom and He^+ ion.

a) What is the maximum wavelength of light that will ionize H(2s)?

Answer:

b) Light of what wavelength will induce the $n=4 \rightarrow n=8$ transition in He^+ ?

Answer:

(30 pts)

2.) Consider an atom of the element aluminum (Al) in its ground state.

a) Write the electron configuration for an atom of Al.

Answer:

b) Write down the values of the quantum numbers for an electron in the highest occupied orbital.

n:	l:
m_l :	m_s :

c) Sketch the highest occupied atomic orbital and indicate number and type of nodes.

Answer:

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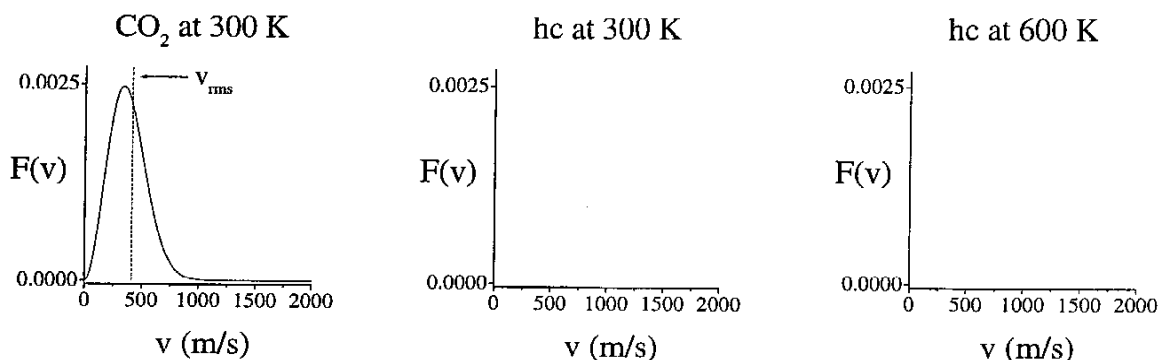
Name: _____

(25 pts)3.) Consider 4.4 g of a hydrocarbon (hc) gas with the empirical formula C_3H_8 .

- a) The hydrocarbon fills a balloon to 0.56 L at 4.4 atm and 300 K. What is the molecular formula of the hydrocarbon?

Answer:

- b) Shown is a plot of the molecular speed distribution,
- $F(v)$
- , and
- v_{rms}
- for
- CO_2
- at 300 K. Sketch
- $F(v)$
- and indicate
- v_{rms}
- for the hydrocarbon gas at 300 K and 600 K.

**(25 pts)**4.) Two sunscreen products (X and Y) have the following extinction coefficients, ϵ , at 310 nm: $X = 3.0 \text{ cm}^2/\text{g}$ and $Y = 1.0 \text{ cm}^2/\text{g}$. For the following questions, the absorbance should be calculated for a 1 cm sample path length.

- a) What is the absorbance of a 0.1 g/mL sample of X?

Answer:

- b) A 0.10 g/mL sample of either X or Y is placed in the spectrometer. The measured ratio of the intensity of the transmitted light to the intensity of the incident light is 0.80 at 310 nm. Is the sample sunscreen X or Y?

Answer: