

Dr. Grandinetti

Chemistry 121  
Autumn Quarter 2007  
Exam 2B

Tuesday  
Nov. 13, 2007  
11:30 AM - 12:48 PM

Name \_\_\_\_\_ Rec. Instr. \_\_\_\_\_

Signature \_\_\_\_\_ Lab. Instr. \_\_\_\_\_

**INSTRUCTIONS**

1. First fill out the answer sheet as follows, using pencil only. (**Ink will not record**).
  - (a) Print your last name, starting at the far left, **FILL IN THE CORRESPONDING LETTER UNDER EACH LETTER IN YOUR LAST NAME.**
  - (b) Leaving one space after the last name, print your first name and **FILL IN THE CORRESPONDING LETTER UNDER EACH LETTER IN YOUR FIRST NAME.**
  - (c) MI means “middle initial”. Leave one space after your first name; print your middle initial, **FILL IN THE CORRESPONDING LETTER UNDER YOUR MIDDLE INITIAL.**
  - (d) Place your signature on the line above your printed name.
  - (e) You **MUST** indicate your two-digit section number.
    - i. Locate your **LAB day/time FIRST** on the table below,
    - ii. Find your **TA’s NAME**,
    - iii. Fill in the **TWO-DIGIT NUMBER** for your section on the answer sheet starting in **COLUMN “K”** in the **SPECIAL CODES SECTION.**

**Lab. Section Numbers**

Monday 11:30	Section	Wednesday 11:30	Section	Friday 11:30	Section
Deirdre Zwilling	63	Xianwen Chen	69	Wade Duym	71
Wenlan Chen	64	Rachel Golden	70	Yuning Chang	72
Deanna Jones	65			Ruiyang Xiao	73
Ruiyang Xiao	66			Miranda McClain	74
Rachel Golden	67				
Jo Marie Bacusmo	68				

- (f) Fill in the **IDENTIFICATION NUMBER** starting in **COLUMN A** with your Carmen Student ID Number.
  - (g) **DO NOT** fill in sex or birth date.
2. When the proctor gives the signal, but not before, check to see that there are 7 numbered pages, a Periodic Table, and 2 blank pages.
  3. There are 21 multiple choice questions for a total score of 175 points.
  4. You must mark answers on the answer sheet in PENCIL. Fill in all answers COMPLETELY with PENCIL. If you wish to change an answer, erase the unwanted mark COMPLETELY.
  5. Use the blank pages for scratch work, but note that only the marks you make on the answer sheet will be observed by the grading equipment.
  6. The time allowed is 1 hour, 18 minutes.
  7. At the end of the examination, you must hand in the ANSWER SHEET before leaving the room.

### Useful Relations and Fundamental Constants

	$1 \text{ J}\cdot\text{s}^2 = 1000 \text{ g}\cdot\text{m}^2$
Kinetic Energy:	$E_{kinetic} = 1/2mv^2$
Potential Energy:	$E_{potential} = mgh$
Momentum:	$p = mv$
Photoelectric Effect:	$E_{kinetic} = h\nu - h\nu_0$
DeBroglie Relation:	$p = h/\lambda$
Hydrogen Spectrum:	$E = -2.180 \times 10^{-18} \left( \frac{1}{n_f^2} - \frac{1}{n_i^2} \right)$ Joules
Photon Energy:	$E_{photon} = h\nu = hc/\lambda$
Gas Constant:	$R = 0.082058 \text{ L}\cdot\text{atm}/\text{K}\cdot\text{mol}$
Planck's Constant:	$h = 6.63 \times 10^{-34} \text{ J}\cdot\text{s}$
Gravity:	$g = 9.81 \text{ m}/\text{s}^2$
Speed of light:	$c = 3.00 \times 10^8 \text{ m}/\text{s}$

1. Which Exam are you taking?

- a. Exam 2A      b. Exam 2B      c. Exam 2C      d. Exam 2D      e. Exam 2E

2. [14 points]  $\Delta H^\circ$  for  $\text{HCl}(\text{aq}) + \text{KOH}(\text{aq}) \rightarrow \text{H}_2\text{O}(\text{l}) + \text{KCl}(\text{aq})$  is -56.0 kJ. If the specific heat of the solution resulting from neutralization of 50.0 mL of 0.220 M HCl with 0.400 M KOH is 4.18 J/g $^\circ\text{C}$  and its density is assumed to be 1.01 g/mL, what is the final solution temperature if the initial temperature is 22.2 $^\circ\text{C}$ ?

- a. 3.4 $^\circ\text{C}$       b. 24.1 $^\circ\text{C}$       c. 27.8 $^\circ\text{C}$       d. 36.9 $^\circ\text{C}$       e. 41.1 $^\circ\text{C}$

3. [7 points] A chemical reaction that absorbs heat from the surroundings at constant pressure is said to be \_\_\_\_\_ and has a \_\_\_\_\_ value of  $\Delta H$ .

- a. endothermic, positive  
b. endothermic, negative  
c. exothermic, negative  
d. exothermic, positive  
e. none of these

4. [7 points] When ultraviolet light of wavelength 131 nm strikes a polished nickel surface, the kinetic energy of ejected electrons is measured to be  $7.04 \times 10^{-19}$  J. Calculate the work function (i.e. binding energy) of nickel.

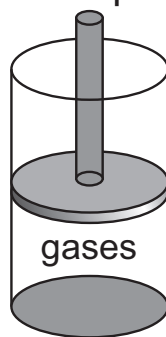
- a.  $1.52 \times 10^{-18}$  J    b.  $7.0 \times 10^{-19}$  J    c. 4.0 J    d.  $8.1 \times 10^{-19}$  J    e. none of these

5. [7 points] Which one of the following is not a valid value for the magnetic quantum number of the electrons in a 5d subshell?

- a. 2    b. 0    c. 5    d. -2    e. 1

6. [7 points] The reaction of two gases in a bomb calorimeter released 480 J of heat to the surroundings. The same two gases are confined to a cylinder with a sliding piston under atmospheric pressure, as shown. When they react, the piston is moved outward, doing 50 J of work. What are  $\Delta U$  and  $\Delta H$  for the reaction that took place in the cylinder?

1 atmosphere



- a.  $\Delta U = 480$  J,  $\Delta H = -430$  J  
b.  $\Delta U = 530$  J,  $\Delta H = 480$  J  
c.  $\Delta U = -480$  J,  $\Delta H = -430$  J  
d.  $\Delta U = -530$  J,  $\Delta H = -480$  J  
e. none of the above

7. [14 points] When a ball of mass  $m$  is dropped through a height difference  $\Delta h$ , its potential energy changes by an amount  $mg\Delta h$ , where  $g$  is the acceleration of gravity, equal to  $9.81 \text{ m/s}^2$ . Suppose all this energy gets dissipated into the internal energy of the ball once it has stopped bouncing. If the specific heat of the material in the ball is  $0.850 \text{ J/g-K}$ , calculate the height from which the ball must be dropped to increase the temperature of the ball by  $1.00^\circ\text{C}$ .

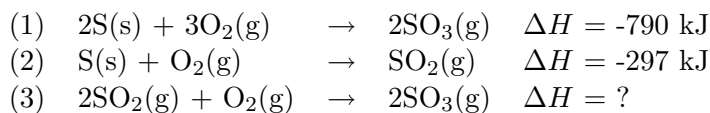
- a. 0.0867 m      b. not enough data      c. 83.4 m      d. 86.6 m      e. none of these

8. [7 points] Arrange the following elements in order of decreasing first ionization energy.

Be, Ca, Cs, Mg, K

- a.  $\text{Mg} > \text{Be} > \text{Ca} > \text{K} > \text{Cs}$   
b.  $\text{Be} > \text{Mg} > \text{Ca} > \text{K} > \text{Cs}$   
c.  $\text{Cs} > \text{K} > \text{Ca} > \text{Be} > \text{Mg}$   
d.  $\text{Ca} > \text{Mg} > \text{Be} > \text{Cs} > \text{K}$   
e.  $\text{Ca} > \text{Mg} > \text{Be} > \text{K} > \text{Cs}$

9. [7 points] Use the information shown for equations (1) and (2) below to determine the value of  $\Delta H$  (in kJ) for equation (3).

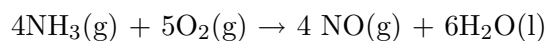


- a. -196      b. 196      c. -1384      d. 1087      e. none of these

10. [14 points] At what velocity must a 20.0 g object be moving in order to possess a kinetic energy of 1.00 J?

- a. 1 m/s      b. 10 m/s      c. 100 m/s      d. 50 m/s      e. 1000 m/s

11. [7 points] Calculate the value of  $\Delta H^\circ$  (in kJ) for the following reaction.



Substance	$\Delta H_f^\circ$ (in kJ/mole)
H <sub>2</sub> O(l)	-286
NO(g)	90
NO <sub>2</sub> (g)	34
HNO <sub>3</sub> (aq)	-207
NH <sub>3</sub> (g)	-46

- a. -1540      b. -1172      c. -150      d. -1892      e. none of these

12. [7 points] The electronic configuration  $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^6$  represents the element \_\_\_\_\_.

- a. Se      b. Mn      c. Co      d. Kr      e. Fe

13. [7 points] For the Mn atom, which subshell is partially filled?

a. 4s

b. 4p

c. 3s

d. 3d

e. 4d

14. [7 points] The de Broglie wavelength of an electron is  $8.7 \times 10^{-11}$  m. The mass of this electron is  $9.1 \times 10^{-31}$  kg. What is the velocity (in m/s) of this electron?

a.  $1.2 \times 10^{-7}$

b.  $6.9 \times 10^{-54}$

c.  $8.4 \times 10^3$

d.  $8.4 \times 10^6$

e. none of these

15. [7 points] Indicate which of the following is independent of the path by which a change occurs:

a. the change in potential energy when a book is transferred from table to shelf.

b. the heat evolved when a cube of sugar is oxidized to  $\text{CO}_2(\text{g})$  and  $\text{H}_2\text{O}(\text{g})$ .

c. the work accomplished in burning a gallon of gasoline.

d. none of the above

16. [14 points] A 50.0 g sample of water at 55.0° is added to a calorimeter containing 50.0 g of water at 25.0°C and the final temperature after mixing is 35.0°C. What is the heat capacity (J/°C) of the calorimeter alone? The heat capacity of water is 4.18 J/K-g.
- a. 200 J/°C      b. 225 J/°C      c. 209 J/°C      d. 150 J/°C      e. none of these
17. [14 points] The density of gold is 19.3 g/cm<sup>3</sup>. The heat capacity of gold is 0.13 J/g-°C. A cube of gold at 75.0°C is dropped into 150 g of water at 25.0°C. The final temperature of the mixture is 27.5°C. What is the length of an edge of the gold cube? (Heat capacity of H<sub>2</sub>O = 4.184 J/g-°C)
- a. 2.4 cm      b. 13 cm      c. 6.3 cm      d. 0.42 cm      e. none of these
18. [7 points] Which one of the following experiences the greatest effective nuclear charge in a many electron atom?
- a. 4d      b. 4s      c. 4f      d. 4p      e. all are equivalent

19. [7 points] The third ( $n = 3$ ) energy level of an atom can hold a maximum of \_\_\_\_\_ electrons.
- a. 8                      b. 16                      c. 18                      d. 2                      e. 25
20. [7 points] What is the frequency (in Hz) of electromagnetic radiation necessary to move an electron from  $n = 2$  to  $n = 4$  in a hydrogen atom?
- a.  $4.1 \times 10^{-19}$       b.  $8.2 \times 10^{14}$       c.  $4.9 \times 10^{-7}$       d.  $6.2 \times 10^{14}$       e.  $5.4 \times 10^{-19}$
21. [7 points] Which of the following elements has the most negative electron affinity?
- a. S                      b. Se                      c. Si                      d. P                      e. Te

	IA																		VIIIA			
1	1.008 1H Hydrogen	IIA														10.81 5B Boron	12.011 6C Carbon	14.007 7N Nitrogen	15.999 8O Oxygen	18.998 9F Fluorine	4.003 2He Helium	
2	6.941 3Li Lithium	9.012 4Be Beryllium															26.98 13Al Aluminum	28.09 14Si Silicon	30.974 15P Phosphorus	32.06 16S Sulfur	35.453 17Cl Chlorine	20.179 10Ne Neon
3	22.990 11Na Sodium	24.305 12Mg Magnesium	IIIB	IVB	VB	VIB	VIIB	VIII B				IB	IIB	69.72 31Ga Gallium	72.59 32Ge Germanium	74.92 33As Arsenic	78.96 34Se Selenium	35.453 17Cl Chlorine	39.948 18Ar Argon			
4	39.098 19K Potassium	40.08 20Ca Calcium	44.96 21Sc Scandium	47.88 22Ti Titanium	50.94 23V Vanadium	52.00 24Cr Chromium	54.94 25Mn Manganese	55.85 26Fe Iron	58.93 27Co Cobalt	58.69 28Ni Nickel	63.546 29Cu Copper	65.38 30Zn Zinc	69.72 31Ga Gallium	72.59 32Ge Germanium	74.92 33As Arsenic	78.96 34Se Selenium	79.904 35Br Bromine	83.80 36Kr Krypton				
5	85.47 37Rb Rubidium	87.62 38Sr Strontium	88.91 39Y Yttrium	91.22 40Zr Zirconium	92.91 41Nb Niobium	95.94 42Mo Molybdenum	(98) 43Tc Technetium	101.1 44Ru Ruthenium	102.91 45Rh Rhodium	106.4 46Pd Palladium	107.87 47Ag Silver	112.41 48Cd Cadmium	114.82 49In Indium	118.69 50Sn Tin	121.75 51Sb Antimony	127.60 52Te Tellurium	126.90 53I Iodine	131.29 54Xe Xenon				
6	132.91 55Cs Cesium	137.33 56Ba Barium	138.91 57La Lanthanum	178.49 72Hf Hafnium	180.95 73Ta Tantalum	183.85 74W Tungsten	186.2 75Re Rhenium	190.2 76Os Osmium	192.2 77Ir Iridium	195.08 78Pt Platinum	196.97 79Au Gold	200.59 80Hg Mercury	204.38 81Tl Thallium	207.2 82Pb Lead	208.98 83Bi Bismuth	(244) 84Po Polonium	(210) 85At Astatine	(222) 86Rn Radon				
7	(223) 87Fr Francium	226.03 88Rd Radium	227.03 89Ac Actinium																			

Lanthanide Series	140.12 58Ce Cerium	140.9077 59Pr Praseodymium	144.24 60Nd Neodymium	(145) 61Pm Promethium	150.36 62Sm Samarium	151.96 63Eu Europium	157.25 64Gd Gadolinium	158.93 65Tb Terbium	162.50 66Dy Dysprosium	164.93 67Ho Holmium	167.26 68Er Erbium	168.93 69Tm Thulium	173.04 70Yb Ytterbium	174.97 71Lu Lutetium
Actinide Series	232.04 90Th Thorium	231.0359 91Pa Protactinium	238.03 92U Uranium	237.05 93Np Neptunium	(244) 94Pu Plutonium	(243) 95Am Americium	(247) 96Cm Curium	(247) 97Bk Berkelium	(251) 98Cf Californium	(254) 99Es Einsteinium	(257) 100Fm Fermium	(258) 101Md Mendelevium	(259) 102No Nobelium	(260) 103Lr Lawrencium



