

Form H

Chemistry 1441-023

Test #3

Zumdahl, Chapters 6 and 7

November 2, 2004

Name (please print) _____

Last Name

First Name

IA																VIII A				
1 H 1.01	IIA										IIIA					2 He 4.00				
3 Li 6.94	4 Be 9.01											5 B 10.81	6 C 12.01	7 N 14.01	8 O 15.999	9 F 18.998	10 Ne 20.18			
11 Na 22.99	12 Mg 24.31	IIIB	IVB	VB	VIB	VII B	VIII B			IB	IIB	13 Al 26.98	14 Si 28.086	15 P 30.97	16 S 32.06	17 Cl 35.45	18 Ar 39.95			
19 K 39.10	20 Ca 40.08	21 Sc 44.96	22 Ti 47.90	23 V 50.94	24 Cr 51.996	25 Mn 54.94	26 Fe 55.85	27 Co 58.93	28 Ni 58.70	29 Cu 63.55	30 Zn 65.38	31 Ga 69.72	32 Ge 72.59	33 As 74.92	34 Se 78.96	35 Br 79.90	36 Kr 83.80			
37 Rb 85.47	38 Sr 87.62	39 Y 88.91	40 Zr 91.22	41 Nb 92.91	42 Mo 95.94	43 Tc (98)	44 Ru 101.07	45 Rh 102.91	46 Pd 106.4	47 Ag 107.87	48 Cd 112.41	49 In 114.82	50 Sn 118.69	51 Sb 121.75	52 Te 127.60	53 I 126.90	54 Xe 131.30			
55 Cs 132.91	56 Ba 137.33	57 La 138.91	72 Hf 178.49	73 Ta 180.95	74 W 183.85	75 Re 186.21	76 Os 190.2	77 Ir 192.22	78 Pt 195.09	79 Au 196.97	80 Hg 200.59	81 Tl 204.37	82 Pb 207.2	83 Bi 208.98	84 Po (209)	85 At (210)	86 Rn (222)			
87 Fr (223)	88 Ra 226.03	89 Ac 227.03	104 Unq (261)	105 Unp (262)	106 Unh (263)															

58 Ce 140.12	59 Pr 140.91	60 Nd 144.24	61 Pm (145)	62 Sm 150.4	63 Eu 151.96	64 Gd 157.25	65 Tb 158.93	66 Dy 162.50	67 Ho 164.93	68 Er 167.26	69 Tm 168.93	70 Yb 173.04	71 Lu 174.97
90 Th 232.04	91 Pa 231.04	92 U 238.03	93 Np 237.05	94 Pu (244)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (251)	99 Es (252)	100 Fm (257)	101 Md (258)	102 No (259)	103 Lr (260)

Instructions:

- This exam consists of **25** questions.
- No scratch paper is allowed.** You may do the work in the test margins and on the backs of the test pages.
- Mark the answers you choose on the test itself for your own information and also on the standard answer sheet you provided.
Scoring will be based on the answer sheet.
- When you finish, turn in both the test form and the answer form. The test form and your personal report will be returned to you at the next class. Write your name on both forms.

Useful Information:

$$h = 6.626 \times 10^{-34} \text{ J}\cdot\text{s}$$

$$c = 2.998 \times 10^8 \text{ m}\cdot\text{s}^{-1}$$

$$1 \text{ J} = 1 \text{ kg}\cdot\text{m}^2\cdot\text{s}^{-2}$$

$$N_A = 6.022 \times 10^{23}$$

$$R_H = 2.178 \times 10^{-18} \text{ J}$$

$$1 \text{ L}\cdot\text{atm} = 101.3 \text{ J}$$

$$R = 8.314 \text{ J}\cdot\text{mol}^{-1}\cdot\text{K} = 0.08206 \text{ L}\cdot\text{atm}\cdot\text{mol}^{-1}\cdot\text{K}$$

- A certain reaction was performed under a constant pressure of 6.75 atm. During the reaction, the volume expanded from 2.35 L to 9.75 L, and 4.33 kJ of heat was given off. What is the ΔE for this reaction?
 - 0.73 kJ
 - 54.3 kJ
 - 45.6 kJ
 - 9.39 kJ
 - 45.6 kJ

2. A 65.0 g sample of iron is heated to 100.0°C and then placed in 100.0 g of water at 20.0°C. What is the final temperature of the mixture of water and iron, assuming that all of the heat lost by the iron is gained by the water? (The specific heat capacity of iron is 0.450 J/g·°C; the specific heat capacity of water is 4.18 J/g·°C.)

- a) 22.1°C
- b) 25.2°C
- c) 29.7°C
- d) 36.3°C
- e) 85.0°C

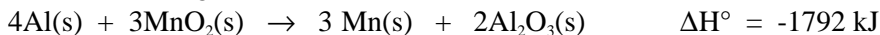
3. Solid sodium reacts with water according to the following thermochemical equation:



What is the enthalpy change when 25.0 g of sodium reacts with excess water?

- a) -100. kJ
- b) -200. kJ
- c) -300. kJ
- d) -400. kJ
- e) -500. kJ

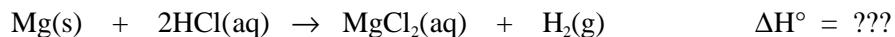
4. Given the following thermochemical equations:



Determine the molar enthalpy of formation of MnO₂(s).

- a) +675 kJ/mol
- b) +520 kJ/mol
- c) -520 kJ/mol
- d) +1715 kJ/mol
- e) -1715 kJ/mol

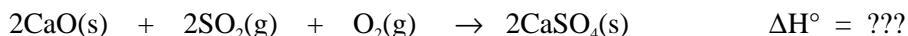
5. In a coffee cup calorimeter, 1.50 g of Mg(s) is dissolved in 100.0 mL of excess hydrochloric acid solution originally at 20.0°C. If the final temperature of the solution is 88.9°C, determine the ΔH for the reaction below in units of kJ/mol Mg. (Assume that the specific heat capacity of the solution is 4.18 J/g·°C, and that the total mass of the solution is 100.0 g. Also, assume that none of the heat is lost to the calorimeter.)



- a) -467 kJ/mol
- b) -28.8 kJ/mol
- c) -71.9 kJ/mol
- d) -122 kJ/mol
- e) -57.6 kJ/mol

6. According to the first law of thermodynamics, the total energy of the universe...
- is constant.
 - decreases over time.
 - increases over time.
 - decreases for an endothermic process and increases for an exothermic process.
 - increases for an endothermic process and decreases for an exothermic process.
7. The specific heat of copper metal is $0.385 \text{ J/g}\cdot\text{C}$. How many joules of heat are required to raise the temperature of a 1.42 kg block of copper from 25.0°C to 88.5°C ?
- 34.7 J
 - 48.4 J
 - 62.1 J
 - $3.47 \times 10^4 \text{ J}$
 - $6.21 \times 10^3 \text{ J}$
8. All of the following have a standard enthalpy of formation equal to zero at 25°C and 1.00 atm except
- Cl(g)
 - Fe(s)
 - $\text{O}_2\text{(g)}$
 - Ne(g)
9. The standard enthalpy of formation, ΔH_f° of carbon monoxide is -111 kJ/mol . Which of the thermochemical equations below corresponds to the heat of formation of carbon monoxide?
- $2\text{C}(\text{graphite}) + \text{O}_2\text{(g)} \rightleftharpoons 2\text{CO(g)} \quad \Delta H^\circ = -111 \text{ kJ}$
 - $\text{C}(\text{graphite}) + \text{O(g)} \rightleftharpoons \text{CO(g)} \quad \Delta H^\circ = -111 \text{ kJ}$
 - $\text{C}(\text{graphite}) + 1/2 \text{O}_2\text{(g)} \rightleftharpoons \text{CO(g)} \quad \Delta H^\circ = -111 \text{ kJ}$
 - $\text{C}(\text{graphite}) + \text{CO}_2\text{(g)} \rightleftharpoons 2\text{CO(g)} \quad \Delta H^\circ = -111 \text{ kJ}$
 - Any of the above.

10. Using the standard enthalpies of formation listed below, determine the standard enthalpy change for the following reaction:



$$\Delta H_f^\circ \text{ for CaO(s)} = -635.1 \text{ kJ/mol}$$

$$\Delta H_f^\circ \text{ for SO}_2\text{(g)} = -296.8 \text{ kJ/mol}$$

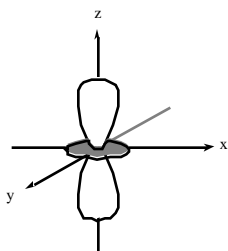
$$\Delta H_f^\circ \text{ for CaSO}_4\text{(s)} = -1434.1 \text{ kJ/mol}$$

- $+1004.4 \text{ kJ}$
- -1004.4 kJ
- -2835.6 kJ
- -502.2 kJ
- $+502.2 \text{ kJ}$

11. Place the following regions of the electromagnetic spectrum in order of increasing wavelength:
blue light, X rays, infrared light, orange light, gamma rays, microwaves
- microwaves, blue light, orange light, infrared light, X rays, gamma rays
 - microwaves, infrared light, orange light, blue light, X rays, gamma rays
 - X rays, microwaves, infrared light, orange light, blue light, gamma rays
 - gamma rays, X rays, microwaves, blue light, orange light, infrared light
 - gamma rays, X rays, blue light, orange light, infrared light, microwaves
12. Microwave ovens operate by irradiating food with microwave radiation. Assuming that the wavelength of this radiation is 15.0 cm, what is the energy of this radiation expressed in kJ/mol?
- 7.98×10^{-4} kJ/mol
 - 1.32×10^{-24} kJ/mol
 - 7.98×10^{-6} kJ/mol
 - 7.98×10^{-3} kJ/mol
 - 5.99×10^{-11} kJ/mol
13. If an electron in a hydrogen atom makes a transition from the $n = 2$ state to the $n = 4$ state, what wavelength of light is emitted or absorbed?
- 146 nm absorbed
 - 365 nm emitted
 - 365 nm absorbed
 - 486 nm emitted
 - 486 nm absorbed
14. Which of the following energy level transitions in a hydrogen atom would involve emission of a photon having the longest wavelength?
- $n = 1 \rightarrow n = 2$
 - $n = 2 \rightarrow n = 1$
 - $n = 4 \rightarrow n = 3$
 - $n = 1 \rightarrow n = \infty$
 - $n = 3 \rightarrow n = 2$
15. What is the de Broglie wavelength associated with an electron moving at 10.0% of the speed of light? (The mass of an electron is 9.109×10^{-31} kg.)
- 6.32×10^{-10} m
 - 3.07×10^{-10} m
 - 9.11×10^{-11} m
 - 7.42×10^{-11} m
 - 2.43×10^{-11} m

16. What is/are the possible angular momentum quantum number(s) for the highest energy electron in a ground state sodium atom?
- 0
 - 2
 - 3
 - 0, 1, or 2
 - 2, -1, 0, +1, +2
17. What is the maximum number of electrons in an atom that can have the quantum numbers $n = 3$, $l = 1$?
- 2
 - 6
 - 10
 - 14
 - 18
18. Two electrons in the same atom that have identical values of the quantum number n but have different values of l and m_l are said to be in...
- the same shell and subshell, but different orbitals
 - the same shell and orbital, but different subshells
 - the same orbital and subshell, but different shells
 - the same shell, but different subshells and different orbitals
 - the same orbital, but different shells and different subshells

19. What is the name of the orbital shown below?



- p_x
 - $d_{x^2-y^2}$
 - d_{z^2}
 - p_z
 - s
20. According to the aufbau principle, which orbital is occupied immediately after a 4s subshell is filled in a multielectron atom?
- 4d
 - 4p
 - 4f
 - 5s
 - 3d

21. Which statement is true concerning the electron configuration shown below?



- It is incorrect because it violates the aufbau procedure
- It is incorrect because it violates the Pauli exclusion principle.
- It is incorrect because it violates Hund's rule.
- It is incorrect because it violates the Heisenberg uncertainty principle.
- It is the correct ground state electron configuration for oxygen.

22. What is the ground state electron configuration for chromium, Cr?

- $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 4d^4$
- $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^4$
- $1s^2 2s^2 2p^6 3s^2 3p^6 4s^1 4d^5$
- $1s^2 2s^2 2p^6 3s^2 3p^6 4s^1 3d^5$
- $1s^2 2s^2 2p^6 3s^2 3p^6 3d^6$

23. How many unpaired electrons are present in an iron atom?

- 6
- 4
- 3
- 1
- 0

24. Which of the atoms listed below has the smallest radius?

- B
- C
- N
- Si
- P

25. Which of the following electron configurations, if any, is incorrect?

- S: $[\text{Ne}] 3s^2 3p^4$
- Cu: $[\text{Ar}] 4s^1 3d^{10}$
- Kr: $[\text{Ar}] 4s^2 3d^{10} 4p^6$
- Pb: $[\text{Xe}] 6s^2 5d^{10} 6p^2$
- All of these electron configurations are correct.

Answer Key:

- | | | | | |
|------|-------|-------|-------|-------|
| 1. D | 6. A | 11. E | 16. A | 21. E |
| 2. B | 7. D | 12. A | 17. B | 22. D |
| 3. B | 8. A | 13. E | 18. D | 23. B |
| 4. C | 9. C | 14. C | 19. C | 24. C |
| 5. A | 10. B | 15. E | 20. E | 25. D |