

NAME: _____

Lab Section: 1(TuTh@3:30) 2(TuTh@6) 3(TuTh@9) 4(MW@1)

CHM 101
100 points, 2 hrs 15 mins

Fall 2008
week 10

Exam #2

Chemistry, 7th ed., Zumdahl & Zumdahl, ch. 4-6

Wallace

revised 11/20/2008

Unless otherwise specified, each question is worth 5 points.

1. Identify each of the following as strong electrolyte, weak electrolyte, or nonelectrolyte: (*1 point each*)

a. KCl	STRONG	WEAK	NON
b. HNO ₃	STRONG	WEAK	NON
c. HC ₂ H ₃ O ₂	STRONG	WEAK	NON
d. C ₁₂ H ₂₂ O ₁₁	STRONG	WEAK	NON

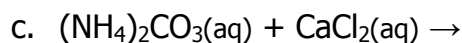
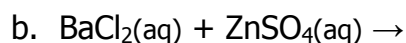
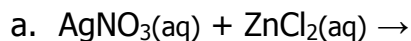
2. How many moles of chloride are present in 60.0 mL of a 0.100 M MgCl₂ solution?

3. Identify the following compounds as soluble or insoluble in water: (*1 point each*)

a. Na ₃ PO ₄	SOLUBLE	INSOLUBLE
b. Mn(OH) ₂	SOLUBLE	INSOLUBLE
c. PbSO ₄	SOLUBLE	INSOLUBLE
d. FeCl ₃	SOLUBLE	INSOLUBLE

Unless otherwise specified, each question is worth 5 points.

4. Write the balanced net ionic equation for each of the following (*precipitation*) reactions, including products, if it occurs. If no reaction occurs, write "N. R.". (2 points each)



5. Identify each of the following as a weak or strong acid or base: (2 points each)

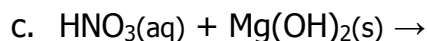
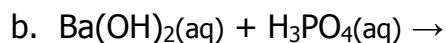
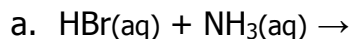
a. $\text{NH}_3(\text{aq})$ ACID BASE STRONG WEAK

b. $\text{H}_3\text{PO}_4(\text{aq})$ ACID BASE STRONG WEAK

c. $\text{HI}(\text{aq})$ ACID BASE STRONG WEAK

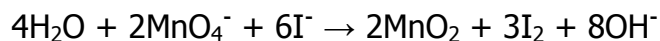
d. $\text{LiOH}(\text{aq})$ ACID BASE STRONG WEAK

6. Write the balanced net ionic equation for each of the following (*acid-base*) reactions, including products, if it occurs. If no reaction occurs, write "N. R.". (2 points each)



Unless otherwise specified, each question is worth 5 points.

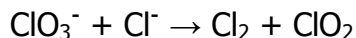
7. Consider the following redox reaction to answer this question. (1 point each)



Identify the...

- a. Element reduced: _____
- b. Element oxidized: _____
- c. Reducing agent: _____
- d. Oxidizing agent: _____

8. Balance the following redox reaction (in an aqueous, acidic solution) by the half-reaction method.



9. A typical barometric pressure in the lab at LTCC is 61.5 cm Hg. What is this pressure in atmospheres (atm)? (3 points)

10. You collect 280. mL of gas in the lab at 22.0°C and 610. mmHg. How many moles of gas have you collected?

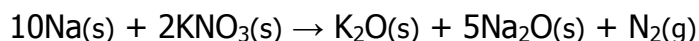
Unless otherwise specified, each question is worth 5 points.

11. There are 2 major reactions that produce nitrogen gas in an airbag. The first reaction is the decomposition of sodium azide to produce nitrogen gas and sodium metal:



When an airbag is inflated using 130. grams (a typical quantity) of NaN_3 , this reaction produces 73.4 L of N_2 gas (at 25.0°C and 1.00 atm). Unfortunately, this reaction also produces sodium metal which is highly reactive and toxic.

To "clean up" the sodium, a second reaction occurs:



What volume of nitrogen gas is formed from this second reaction (at 25.0°C and 1.00 atm)? Assume 100% yield for all reactions, and that there is excess KNO_3 for the second reaction.

12. Explain or define the following words in terms of the Kinetic Molecular Theory of Gases: (2 points each)

a. Pressure

b. Temperature

c. volume

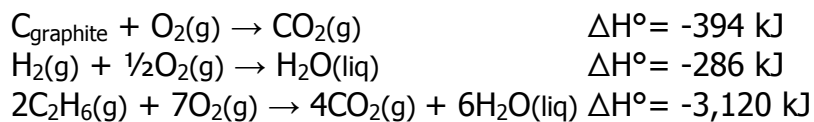
Unless otherwise specified, each question is worth 5 points.

13. In general, how does nitric acid ultimately form in the atmosphere as a result of burning gasoline in internal combustion engines? You don't need to balance chemical equations or explain each step in great detail, but you should describe at least
14. A toy balloon, while ascending into the air, loses 342 J of energy to the surroundings by cooling. At the same time, the volume of the balloon increases from 2.00 L to 2.85 L against an average pressure of 550. torr. Calculate the change in internal energy (ΔE) in joules.
15. When a reaction takes place in 200. g of water, the temperature increases from 21.5 to 43.6°C. Calculate the heat of this reaction (q_{reaction}). The specific heat capacity of water is 4.18 J/g°C.

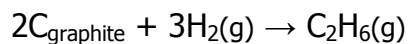
Unless otherwise specified, each question is worth 5 points.

16. A quantity of 1.00×10^2 mL of 1.0 M HCl is mixed with 1.00×10^2 mL of 1.0 M NaOH in a coffee cup calorimeter (like we did in lab). The initial temperature of each solution was 20.5°C , and the heat of neutralization is -56.2 kJ/mol. Find the final temperature of the mixed solution. Assume that the specific heat of the solution is the same as that of pure water: 4.18 J/g $^\circ\text{C}$, and that the density of water is 1.00 g/mL.

17. From the following data,

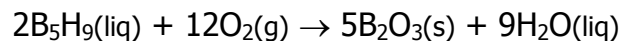


calculate the enthalpy change for the reaction:



Unless otherwise specified, each question is worth 5 points.

18. Pentaborane-9 (B_5H_9) is a colorless, highly reactive liquid that will burst into flames when exposed to oxygen. The reaction is



Calculate the kilojoules of heat released per gram of Pentaborane-9 when it reacts with oxygen. Standard enthalpies of formation are provided below:

SUBSTANCE	ΔH°_f [kJ/mol]
$B_5H_9(liq)$	73
$B_2O_3(s)$	-1264
$H_2O(liq)$	-286

19. List two significant reasons to support the argument that it would be a good idea to stop using petroleum as a major component of energy supply in the near future. In a sentence or two, explain your reasoning for each of your choices. (*2 points each*)

Unless otherwise specified, each question is worth 5 points.

20. The approximate standard enthalpies of combustion for coal (C_{coal}), natural gas (approximated as CH_4), and gasoline (approximated as C_8H_{18}) are listed below.

$$\Delta H^\circ_{\text{combustion}}(\text{coal}) = -390 \text{ kJ / mol coal}$$

$$\Delta H^\circ_{\text{combustion}}(\text{CH}_4) = -890 \text{ kJ / mole CH}_4$$

$$\Delta H^\circ_{\text{combustion}}(\text{C}_8\text{H}_{18}) = -5,500 \text{ kJ / mol C}_8\text{H}_{18}$$

Which of these produces the least amount energy per mole of $\text{CO}_2(\text{g})$ produced during combustion? Support your answer with calculations.

Which produces the greatest amount of energy per mole of $\text{CO}_2(\text{g})$ produced during combustion? Support your answer with calculations.

Show your work to receive full credit; answers provided without calculations are worth 0 points.

Unless otherwise specified, each question is worth 5 points.

Generic Grading Rubric for Chemistry @ LTCC: (rev. 11/21/08)

In general, incorrect answers will be assigned pro-rated partial credit proportional to the amount of the supporting work that is correct. Pro-rated points will typically be rounded to whole numbers. Other deductions will be assigned per question as described below:

- a) any combination of wrong significant figures and/or missing or incorrect units and/or "dumb" math error(s)..... -1 point
- b) no answer provided / blank-100%
- c) incorrect answer; no work shown.....-100%
- d) correct answer, but no supporting work is shown when complex, multi-step calculations are required (*This looks suspiciously like cheating.*)-100%
- e) completely incorrect concept or approach, but some correct calculations associated with this type of problem are shown..... - ~60-80%
- f) description and/or outline of correct approach or concept, but calculations performed or answers calculated are missing or incomplete - ~30-40%

EXAM SCORE: _____ points / 100

OVERALL GRADE (*as of Dec. 1, 2008*):..... _____points / 430*
with lowest lab report, lowest homework set, AND lowest quiz score dropped. (*9(-1) lab reports + 6(-1) homework sets + 5(-1) quizzes + 2 exams = 80 + 50 + 100 + 200 = 430**)

OVERALL LETTER GRADE (*as of Dec. 1, 2008*): A B C D F

Unless otherwise specified, each question is worth 5 points.

Abbreviated Periodic Table of the Elements

1 1A																		18 8A
1 H 1.01	2 2A												13 3A	14 4A	15 5A	16 6A	17 7A	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 16.00	9 F 19.00	10 Ne 20.18
11 Na 22.99	12 Mg 24.31	3 3B	4 4B	5 5B	6 6B	7 7B	8 8B	9 8B	10 8B	11 1B	12 2B	13 Al 26.98	14 Si 28.09	15 P 30.97	16 S 32.07	17 Cl 35.45	18 Ar 39.95	
19 K 39.10	20 Ca 40.08	21 Sc 44.96	22 Ti 47.88	23 V 50.94	24 Cr 52.00	25 Mn 54.94	26 Fe 55.85	27 Co 58.93	28 Ni 58.69	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 101.1	45 Rh 102.9	46 Pd 106.4	47 Ag 107.9	48 Cd 112.4	49 In 114.8	50 Sn 118.7	51 Sb 121.8	52 Te 127.6	53 I 126.9	54 Xe 131.3	
55 Cs 132.9	56 Ba 137.3	57 La* 138.9	72 Hf 178.5	73 Ta 180.9	74 W 183.9	75 Re 186.2	76 Os 190.2	77 Ir 192.2	78 Pt 195.1	79 Au 197.0	80 Hg 200.6	81 Tl 204.4	82 Pb 207.2	83 Bi 209.0	84 Po (209)	85 At (210)	86 Rn (222)	
87 Fr (223)	88 Ra 226	89 Ac** (227)	104 Rf	105 Db	106 Sg	107 Bh	108 Hs	109 Mt	110 Uun	111 Uuu	112 Uub							

POSSIBLY HELPFUL INFORMATION:

$$R \text{ (gas constant)} = 0.08206 \left(\frac{\text{L}\cdot\text{atm}}{\text{mol}\cdot\text{K}} \right)$$

$$K = ^\circ\text{C} + 273.15$$

$$1 \text{ atm} = 760 \text{ mmHg} = 760 \text{ torr}$$

$$1 \text{ L}\cdot\text{atm} = 101.333 \text{ J}$$

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Water Solubility Rules (ref. Table 4.1, p. 144, *Chemistry, seventh edition, Zumdahl & Zumdahl*)

Note that there may be a number of exceptions to these rules, and/or there are more subtle classifications ("partially soluble", "somewhat soluble", "marginally soluble", etc.), but these are the rules that we will use in CHM 101.

0. Any ionic compound that is indicated as aqueous(aq), should be considered water soluble for CHM 101.
1. (*Required memorization*)
2. (*Required memorization*)
3. Most chloride, bromide, and iodide salts are soluble. EXCEPTIONS (for CHM 101): chloride, bromide, and iodide salts containing Ag^+ , Pb^{2+} , and Hg_2^{2+} are INSOLUBLE.
4. Most sulfate salts are soluble. EXCEPTIONS (for CHM 101): BaSO_4 , PbSO_4 , Hg_2SO_4 , and CaSO_4 , are INSOLUBLE.
5. Most hydroxide salts are insoluble, unless rule #2 applies to the compound.
6. Most sulfide (S^{2-}), carbonate (CO_3^{2-}), chromate (CrO_4^{2-}), and phosphate (PO_4^{3-}) salts are insoluble, unless rule #2 applies to the compound.

SOME of the Rules for ASSIGNING OXIDATION NUMBERS: (ref. Table 4.2, p. 156, *Chemistry, seventh edition, Zumdahl & Zumdahl*)

1. (*required memorization*)
2. (*required memorization*)
3. **fluorine** = -1 (HF , CF_4 , ...)
4. **oxygen** = -2 (H_2O , CO_2 , ...); except peroxide = $\text{O}_2^{2-} = -1$ (H_2O_2 , NaO ,...)
5. **hydrogen** = $+1$ (H_2O , NH_3 ,...)
6. (*required memorization*)
7. (*required memorization*)

SOME of the steps for Balancing Oxidation-Reduction ("Redox") Reactions (ref. chapter 4, section 4.10, *Chemistry, seventh edition, Zumdahl & Zumdahl*)

- 2a. balance all elements other than O & H
- 2b. balance O with H_2O
- 2c. balance H with H^+
- 2d. balance charge with electrons (e^-)