

Chem 127
Prof. Mark Jensen
Exam #2
10/29/04

Name _____

Pledge:

When you have completed this exam, please consider the following:

I affirm that I have neither committed nor witnessed a violation of academic integrity in the completion of this exam.

Signed _____

Answer the questions on the following pages, paying strict attention to significant figures where applicable. Answers given without supporting work WILL NOT be given full credit.

Some potentially useful information:

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

$$C(\text{H}_2\text{O}, \ell) = 4.184 \text{ J/g}\cdot\text{K}$$

$$C(\text{H}_2\text{O}, \text{g}) = 2.0 \text{ J/g}\cdot\text{K}$$

$$\Delta H_{\text{fus}}(\text{H}_2\text{O}) = 333.5 \text{ J/g}$$

$$\Delta H_{\text{vap}}(\text{H}_2\text{O}) = 2256 \text{ J/g}$$

1											18						
IA											VIIIA						
1 H 1.008	2 IIA										13 IIIA	14 IVA	15 VA	16 VIA	17 VIIA	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 IIIB	4 IVB	5 VB	6 VIB	7 VIIB	8 -	9 VIIB	10 -	11 IB	12 IIB	13 Al 26.98	14 Si 28.09	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 47.88	23 V 50.94	24 Cr 52.00	25 Mn 54.94	26 Fe 55.85	27 Co 58.93	28 Ni 58.71	29 Cu 63.54	30 Zn 65.37	31 Ga 69.72	32 Ge 72.59	33 As 74.92	34 Se 78.96	35 Br 79.91	36 Kr 83.30
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 98.91	44 Ru 101.07	45 Rh 102.91	46 Pd 106.4	47 Ag 107.87	48 Cd 112.40	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 137.34	71 Lu 174.97	72 Hf 178.49	73 Ta 180.95	74 W 183.85	75 Re 186.2	76 Os 190.2	77 Ir 192.2	78 Pt 195.09	79 Au 196.97	80 Hg 200.59	81 Tl 204.37	82 Pb 207.19	83 Bi 208.98	84 Po 210	85 At 210	86 Rn 222
87 Fr 223	88 Ra 226.03	103 Lr 262.1	104 Rf	105 Db	106 Sg	107 Bh	108 Hs	109 Mt									

57 La 138.91	58 Ce 140.12	59 Pr 140.91	60 Nd 144.24	61 Pm 146.92	62 Sm 150.35	63 Eu 151.96	64 Gd 157.25	65 Tb 158.92	66 Dy 162.50	67 Ho 164.93	68 Er 167.26	69 Tm 168.93	70 Yb 173.04
89 Ac 227.03	90 Th 232.04	91 Pa 231.04	92 U 238.03	93 Np 237.05	94 Pu 239.05	95 Am 241.06	96 Cm 247.07	97 Bk 249.08	98 Cf 251.08	99 Es 254.09	100 Fm 257.10	101 Md 258.10	102 No 255

Name _____

No calculators are permitted in answering the following:

1. (10 pts) Label the following compounds as soluble (S) or insoluble (I) in water:

a) $\text{Mg}_3(\text{PO}_4)_2$ _____

d) $\text{Cu}(\text{OH})_2$ _____

b) $\text{Zn}(\text{ClO}_3)_2$ _____

e) $\text{Ca}(\text{CH}_3\text{CO}_2)_2$ _____

c) Hg_2I_2 _____

2. (6 pts) Write the chemical formulas of the six strong acids:

i) _____

iv) _____

ii) _____

v) _____

iii) _____

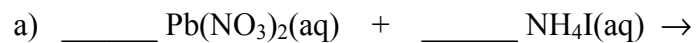
vi) _____

Turn in this portion of the exam.

Name _____

You are now permitted to use calculators.

3. (21 pts) Complete and balance the following reactions, then give the net ionic equation and indicate the spectator ions.



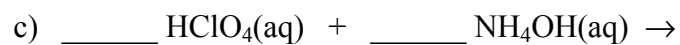
Net Ionic:

Spectator Ions:



Net Ionic:

Spectator Ions:

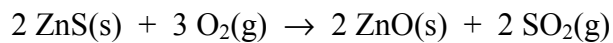


Net Ionic:

Spectator Ions:

4. (10 pts) Terephthalic acid is an important chemical used in the manufacture of polyesters and plasticizers. It contains only carbon, hydrogen, and oxygen. Combustion of 19.81 mg of terephthalic acid produced 41.98 mg CO_2 and 6.45 mg H_2O . What is the empirical formula of terephthalic acid?

5. (18 pts) Zinc is found in nature in the form of the mineral sphalerite (ZnS, 97.46 g/mol). A step in the smelting of zinc is the roasting of sphalerite with oxygen to produce zinc oxide:



- a) Use the following table to determine ΔH° for this reaction.

compound	ΔH_f° (kJ/mol)
ZnS(s)	-205.98
ZnO(s)	-348.28
SO ₂ (g)	-296.83

- b) Imagine all the heat from this reaction could be used to heat a beaker of water. How many grams of sphalerite would be required to raise the temperature of 100.0 mL of water from 25.0°C to 75.0°C?

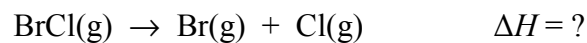
6. (12 pts) An 11.31-g sample of ethanol, C_2H_5OH (46.07 g/mol), is reacted with 13.48 g of phosphorus trichloride, PCl_3 (137.3 g/mol). The products of the reaction are chloroethane, C_2H_5Cl (64.51 g/mol), and phosphorous acid, H_3PO_3 (82.00 g/mol).

a) Write a balanced equation for this reaction.

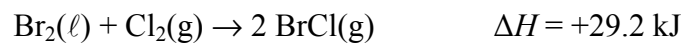
b) What is the percent yield if 12.4 g of chloroethane are produced?

7. (8 pts) A 1.00-g sample of an unknown acid is dissolved to make 100.0 mL of solution and titrated with 0.250 M NaOH. It required 86.9 mL of NaOH to reach the endpoint of the titration. Assuming that the acid has only one acidic hydrogen per molecule, compute the formula mass of the acid.

8. (12 pts) Calculate the enthalpy change for the reaction:



by using the following data:



Would you expect this reaction to be product-favored or reactant-favored? Why?

9. (20 pts) A 1.00-g sample of NaCl (58.44 g/mol) and a 0.500-g sample of MgCl₂ (95.21 g/mol) are mixed together, dissolved in water, and diluted to a final volume of 100.0 mL.

a) What is the concentration of sodium ion, in mol/L, in the final solution?

b) What is the concentration of chloride ion, in mol/L, in the final solution?

c) Imagine that 20.00 mL of the solution are pipetted into a separate flask and diluted to a final volume of 50.00 mL. What is the concentration of sodium ion, in mol/L, in this new solution?

10. (10 pts) In lab you determined that the heat of neutralization of HCl(aq) and NaOH(aq) is around -55.9 kJ per mole of H_2O produced. If 50.00 mL of 2.00 M HCl at 30.6°C is added to 51.00 mL of 2.00 M NaOH at 30.6°C in a coffee-cup calorimeter, what will the highest temperature of the resulting mixture be after the reaction has occurred? (Assume the mixture has a heat capacity of 3.89 J/g \cdot K a density of 1.04 g/mL.)

Remember to consider the pledge!!