

Dr. Zellmer
Time: 7 PM Sun.
40 min

Chemistry 1220
Spring Semester 2023
Quiz IX

All Sections
April 2, 2023

Name _____ Rec. TA/time _____

Show **ALL** your work or **EXPLAIN** to receive full credit. $R = 0.08206 \text{ L}\cdot\text{atm/mol}\cdot\text{K} = 8.314 \text{ J/mol}\cdot\text{K}$

1. (4 pts) Will Ag_2SO_4 precipitate when 100.0 mL of 0.050 M AgNO_3 is mixed with 15.0 mL of 0.050 M Na_2SO_4 . ($K_{\text{sp}} = 1.5 \times 10^{-5}$ for Ag_2SO_4)

2. (6 pts) Solid Na_2CO_3 is added to a solution which contains $1.5 \times 10^{-3} \text{ M}$ $\text{Zn}(\text{NO}_3)_2$ and $1.5 \times 10^{-3} \text{ M}$ AgNO_3 . (K_{sp} for $\text{ZnCO}_3 = 1.0 \times 10^{-10}$ and K_{sp} for $\text{Ag}_2\text{CO}_3 = 8.1 \times 10^{-12}$) **Show ALL work & explain!**

a) (4 pts) Which compound will precipitate first and what concentration of Na_2CO_3 is required to cause this precipitation?

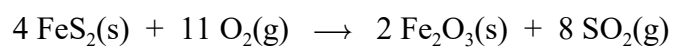
b) (2 pts) What concentration of Na_2CO_3 is needed to achieve maximum separation of the Zn^{2+} and Ag^+ ?

3. (6 pts) For a particular **spontaneous** process the **entropy change** of the **system** , ΔS_{sys} , is -65.0 J/K.
- a) What does this mean about the change in entropy of the surroundings, ΔS_{surr} ? Use the 2nd Law of Thermodynamics to explain your answer.
- b) Using Boltzmann's Law (eqn) describe what this ΔS_{sys} means about the change in the number of microstates for this process (i.e. Does the number of microstates increase or decrease?). Explain!
4. (3 pts) Calculate the ΔS (J/mol•K) of fusion for ethane which melts at -183.0 °C. The heat of fusion is 2.86 kJ/mole.

5. (3 pts) Of the following gaseous molecules, which should have the largest number of microstates at 25°C and 1 atm?
- a) H_2 b) C_2H_6 c) C_2H_2 d) CH_4 e) all are the same
6. (4 pts) Predict the **sign** of ΔS of the system **or** if it's **approximately zero** for the following reactions and **explain** your choices.
- a) $\text{CaCO}_3(\text{s}) + 2 \text{HCl}(\text{g}) \rightarrow \text{CaCl}_2(\text{s}) + \text{CO}_2(\text{g}) + \text{H}_2\text{O}(\ell)$
- b) $\text{Al}_2\text{O}_3(\text{s}) + 3 \text{H}_2(\text{g}) \rightarrow 2 \text{Al}(\text{s}) + 3 \text{H}_2\text{O}(\text{g})$
7. (5 pts) Determine the entropy of reaction (ΔS°) (in J/K) for the following reaction at 25°C.
- | | | | | | | | |
|---------------------|--------------------------------|---|--------------------------|---------------|---------------------------|---|------------------------------|
| | $2 \text{CH}_3\text{OH}(\ell)$ | + | $3 \text{O}_2(\text{g})$ | $\rightarrow$ | $2 \text{CO}_2(\text{g})$ | + | $4 \text{H}_2\text{O}(\ell)$ |
| S° (J/mol•K) | 126.8 | | 205.0 | | 213.6 | | 69.91 |

8. (3 pts) Write the reaction for the formation of NH_4NO_3 (s) which corresponds to ΔH_f° and ΔG_f° **and** explain why you've written it the way you have.

9. (3 pts) Given $\Delta G^\circ = -3217.4$ kJ/mol and the listed ΔG_f° values calculate ΔG_f° for SO_2 (g).



ΔG_f° (kJ/mole)	-166.7	0.0	-740.9	?
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USEFUL INFORMATION

$$R = 0.08206 \text{ L-atm/mol-K} = 8.3145 \text{ J/mol-K}$$

$$k = 1.38 \times 10^{-23} \text{ J/K}$$

$$1 \text{ J} = 1 \text{ C} \cdot \text{V}, 1 \text{ C} = 1 \text{ A} \cdot \text{s}, F = 96,485 \text{ C/mol e}^-$$

$$\Delta G = \Delta H - T\Delta S$$

$$\Delta G^\circ = \Delta H^\circ - T\Delta S^\circ$$

$$\Delta G = \Delta G^\circ + RT \cdot \ln Q$$

$$\Delta G^\circ = -RT \cdot \ln K$$

$$S = k \cdot \ln W$$

	IA	IIA	IIIB	IVB	VB	VIB	VII B	VIII B			IB	IIB	IIIA	IVA	VA	VIA	VIIA	VIIIA
1	1.008 H 1																	4.003 He 2
2	6.941 Li 3	9.012 Be 4											10.811 B 5	12.011 C 6	14.007 N 7	15.999 O 8	18.998 F 9	20.179 Ne 10
3	22.990 Na 11	24.305 Mg 12											26.98 Al 13	28.09 Si 14	30.974 P 15	32.06 S 16	35.453 Cl 17	39.948 Ar 18
4	39.098 K 19	40.08 Ca 20	44.96 Sc 21	47.88 Ti 22	50.94 V 23	52.00 Cr 24	54.94 Mn 25	55.85 Fe 26	58.93 Co 27	58.69 Ni 28	63.546 Cu 29	65.38 Zn 30	69.72 Ga 31	72.59 Ge 32	74.92 As 33	78.96 Se 34	79.904 Br 35	83.80 Kr 36
5	85.47 Rb 37	87.62 Sr 38	88.91 Y 39	91.22 Zr 40	92.91 Nb 41	95.94 Mo 42	98 Tc 43	101.07 Ru 44	102.91 Rh 45	106.42 Pd 46	107.87 Ag 47	112.41 Cd 48	114.82 In 49	118.69 Sn 50	121.75 Sb 51	127.60 Te 52	126.90 I 53	131.39 Xe 54
6	132.91 Cs 55	137.33 Ba 56	138.91 La 57	178.39 Hf 72	180.95 Ta 73	183.85 W 74	186.21 Re 75	190.23 Os 76	192.22 Ir 77	195.08 Pt 78	196.97 Au 79	200.59 Hg 80	204.38 Tl 81	207.2 Pb 82	208.98 Bi 83	209 Po 84	210 At 85	222 Rn 86
7	223 Fr 87	226.03 Ra 88	227.03 Ac 89	261 Rf 104	262 Ha 105	263 Sg 106	262 Ns 107	265 Hs 108	266 Mt 109	269 Uue 110	272 Uuh 111	277 Uus 112						

Lanthanide Series	140.12 Ce 58	140.91 Pr 59	144.24 Nd 60	145 Pm 61	150.36 Sm 62	151.96 Eu 63	157.25 Gd 64	158.93 Tb 65	162.50 Dy 66	164.93 Ho 67	167.26 Er 68	168.93 Tm 69	173.04 Yb 70	173.04 Lu 71
Actinide Series	232.04 Th 90	231.04 Pa 91	238.03 U 92	237.05 Np 93	Pu 94	Am 95	Cm 96	Bk 97	Cf 98	Es 99	Fm 100	Md 101	No 102	Lr 103

A PERIODIC CHART OF THE ELEMENTS
(Based on ¹²C)