

Day 4: 25 Multiple Choice questions
25 points **Section I Part A and B Practice**

Start: Answer all questions on this day before stopping.

Note: NO CALCULATORS may be used for questions on this day.

You may use ONLY the Periodic Table provided on page 337

Note: For all questions, assume that the temperature is 298 K, the pressure is 1.00 atmosphere and solutions are aqueous unless otherwise noted.

Questions 1 through 4 refer to the following elements.

- (A) K
- (B) Mn
- (C) Cr
- (D) Zn
- (E) Ag

1. Which element reacts exothermically with cold water to form basic solutions?
2. Which element exhibits the greatest number of different oxidation states?
3. Which element has the lowest electronegativity?
4. Which element has no unpaired electrons in its ground state?

Questions 5 through 8 refer to the following change in entropy.

- (A) Entropy change will be positive.
- (B) Entropy change will be zero.
- (C) Entropy change will be negative.
- (D) Entropy change can be either positive or negative.
- (E) Entropy change cannot be determined from the information given.

5. $F_2(g) \rightleftharpoons 2F(g)$
6. $H_2(g)$ at 5.0 atm $\rightleftharpoons H_2(g)$ at 1.0 atm
7. $2H_2(g) + O_2(g) \rightleftharpoons 2H_2O(g)$
8. $PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$

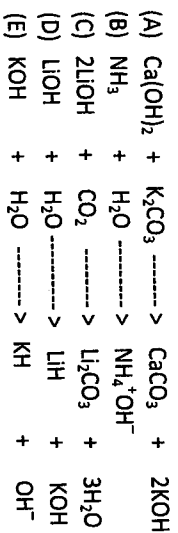
Day 4: Continue

9. Which of the following substances would be least soluble in water?
- (A) $Zn(NO_3)_2$
 - (B) $Na_2[Zn(OH)_4]$
 - (C) $ZnCl_2 \cdot xH_2O$
 - (D) $Zn(OH)_2$
 - (E) $ZnCl_2$

10. When a solid melts, which of the following is true?
- (A) $\Delta H > 0$, $\Delta S > 0$
 - (B) $\Delta H < 0$, $\Delta S < 0$
 - (C) $\Delta H > 0$, $\Delta S < 0$
 - (D) $\Delta H < 0$, $\Delta S > 0$
 - (E) More information is required in order to determine the signs of ΔH and ΔS .

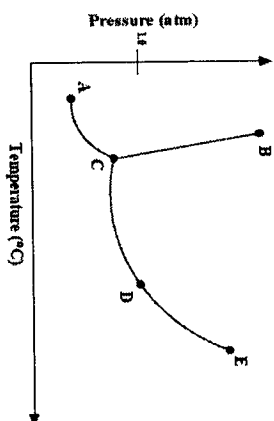
11. Which of the following is an isomer of n-hexane?
- (A) 2,3-dimethylbutane
 - (B) 2-methylbutane
 - (C) 2,2-dimethylpropane
 - (D) 2,3-dimethylpentane
 - (E) 3-ethyl-2-methylpentane

12. $H_2O < NH_3 < Ca(OH)_2 < LiOH < KOH < OH^-$
Six bases are listed above in order of increasing base strength. Which of the following reactions must have an equilibrium constant with a value less than 1?



Day 4: Continue

Questions 13 and 14: The phase diagram of an unknown substance is shown below.



13. The lowest temperature above which this substance cannot be liquefied at any applied pressure is located at point

- (A) A
- (B) B
- (C) C
- (D) D
- (E) E

14. Which point represents the normal boiling point for this substance?

- (A) A
- (B) B
- (C) C
- (D) D
- (E) E

15. Which of the following changes will decrease the rate of collisions between gaseous molecules of type X and Y in a closed container?

- (A) decrease the volume of the container
- (B) increase the temperature of the system
- (C) add molecules of X
- (D) take away molecules of Y
- (E) add a catalyst

Day 4: Continue

16. A student placed three moles of hydrogen gas and three moles of iodine gas into a 1-liter flask and heated the flask to 298°C. The equilibrium expression would be equal to

(A) $K_c = \frac{(2x)^2}{(3-x)^2}$

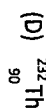
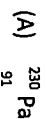
(B) $K_c = \frac{(2x)^2}{(2-x)^2}$

(C) $K_c = \frac{x^2}{(2-x)^2}$

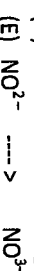
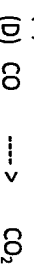
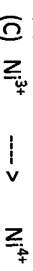
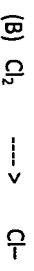
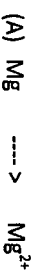
(D) $K_c = \frac{(2x-2)^2}{3-x}$

(E) $K_c = \frac{(2x)^2}{x-2}$

17. When $^{238}_{92}\text{U}$ decays, the emission consists consecutively of a beta particle, then two alpha particles, and finally another beta particle. The resulting stable nucleus is



18. Which of the following represents a process in which a species is reduced?



Day 4: Continue

19. An aqueous solution of silver nitrate (AgNO_3 , molar mass 169.9 g) is prepared by adding 200.0 g of AgNO_3 to 1000 g H_2O . If K_f for H_2O is $1.86^\circ\text{C}\cdot\text{m}^{-1}$, the freezing point of the solution should be

(A) 0.00°C

(B) -0.219°C

(C) -0.438°C

(D) -2.19°C

(E) -4.38°C

20. Frequency of a photon was determined to be 3.00×10^{14} / sec. Calculate the wavelength of the photon. (Speed of light = 3.00×10^8 m/s and 1 meter = 10^9 nanometers.)

(A) 1.00×10^{-6} nm

(B) 3.00×10^{-3} nm

(C) 1.00×10^3 nm

(D) 3.00×10^5 nm

(E) 3.00×10^{22} nm

21. Photoelectric effect is most easily detected in which elements?

(A) noble gases

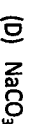
(B) alkali metals

(C) halogen elements

(D) transition metals

(E) the chalcogens

22. Copper (II) chloride will be least soluble in a 0.1 M solution of which of the following compound?



Day 4: Continue

23. PI bonding occurs in each of the following species except

- (A) N_2F_2
- (B) C_2H_2
- (C) HCN
- (D) C_6H_6
- (E) CCl_4

24. You can prepare 0.75 molal NaCl by dissolving 15 g NaCl in what amount of water?

- (A) 0.40kg
- (B) 0.34kg
- (C) 0.27kg
- (D) 0.20kg
- (E) 0.26kg

25. The formulas CH_3CH_2COOH and CH_3COCH_2OH would be expected to have the same values for which of the following? (Assume ideal behavior.)

- (A) Freezing points
- (B) Boiling points
- (C) Specific heat capacity
- (D) Percent composition
- (E) Heats of combustion

Day 4

STOP. Correct your answers and note how many correct **points**

Day 5: 2 Free Response Questions
20 points
Section II Part A Practice

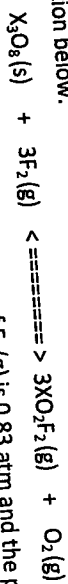
START: Answer all questions on this day before stopping.

Note: You may use a calculator for questions on this day.
You may use any of the reference material provided on pg 337-340

CLEARLY SHOW THE METHOD USED AND THE STEPS INVOLVED IN ARRIVING AT YOUR ANSWERS. It is to your advantage to do this, since you may obtain partial credit if you do and you will receive little or no credit if you do not. Attention should be paid to significant figures.

10 points

1. Fluorine gas, $F_2(g)$, and a solid oxide, X_2O_8 , are combined and heated in a 2.5 L flask to 721°C. The equilibrium reaction is shown in the balanced equation below.



At equilibrium, the partial pressure of $F_2(g)$ is 0.83 atm and the partial pressure of $XO_2F_2(g)$ is 2.64×10^{-5} atm.

- At 721°C, calculate the partial pressure of $O_2(g)$
- What is the value of equilibrium constant, K_p , for this reaction?
- Calculate the Gibb's Free energy change, ΔG° , for the reaction at 721°C.
- What will be the sign for the entropy change, ΔS° , for the reaction at 721°C. Explain your answer.
- What will be the sign for the enthalpy change, ΔH° , for the reaction at 721°C. Justify your answer.

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Day 5: Continue

2. (10 points)

A pure sample of a nonvolatile compound containing only carbon, hydrogen and oxygen is analyzed. It is found to be a nonelectrolyte. Data from a combustion reaction of the compound was analyzed, and it is determined that the compound has mass percents of 31.57% C and 5.30% H.

a) Determine the empirical formula of the compound.

b) A 30.0 g sample of the compound is dissolved in 250.0 g of benzene C_6H_6 . The freezing point of this solution is $1.46^\circ C$. (The freezing point of benzene is $5.51^\circ C$ and K_f is $5.12^\circ C \cdot kg^{-1} \cdot mol^{-1}$)

(i) Determine the molecular mass of the substance.

(ii) Determine the molecular formula for the compound.

(iii) Determine the mole fraction of the solute.

c) Determine the osmotic pressure of the solution if its density is 1.15 g/mL at $25.0^\circ C$.

d) Determine the vapor pressure of the solution at $25.0^\circ C$. (The equilibrium vapor pressure of benzene is 95 mm Hg at $25.0^\circ C$.)

Day 5 Question 2: Space for Work and Answers

Day 5

STOP. Correct your answers and note how many correct points

Day 6: 2 Free Response Questions.
24 points
Section II Part B practice

START: Answer all questions on this day before stopping.

Note: NO CALCULATORS should be used for questions on this day.
You may use any of the Reference Materials provided on Pg 337-340

1. For each of the following three reactions, write a balanced equation for the reaction in part (i) and answer the question about the reaction in part (ii). In part (i), coefficients should be in terms of lowest whole numbers. Assume that solutions are aqueous unless otherwise indicated. Represent substances in solutions as ions if the substances are extensively ionized. Omit formulas for any ions or molecules that are unchanged by the reaction. (15 points)

(a) Sulfur trioxide gas is heated in the presence of solid calcium oxide.

(i) Balanced equation:

(ii) Draw the Lewis-dot structure for the product that forms?

(b) Copper sulfate pentahydrate is heated over high heat.

(i) Balanced equation:

(ii) If 5 grams of the hydrate was heated in a crucible to a constant mass, calculate the mass of the solid substance in the crucible.

(c) Equal molar and volume of barium chloride and sodium carbonate solutions are mixed, resulting in the formation of a precipitate.

(i) Balanced equation:

(ii) Describe what will occur if the precipitate is dried and a few drops of a dilute hydrochloric acid are added.

