

Name _____ KEY _____ Section _____ chm152 sp09 Exam 2

If you think that there is information which you need to solve a problem, PLEASE ASK.

I will SELL you a hint on any problem; hints will cost a few points.

Instructions:

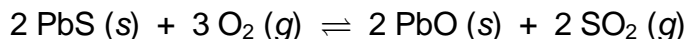
- PRINT your name and section number on this sheet **AND** on the scantron form
- Record the answers to the True/False and Multiple Choice questions on the scantron form. **Mark A for TRUE and B for FALSE.** There is NO PARTIAL CREDIT on these portions of the exam.

True/False Section (4 pts each)

- 1) T/F A reaction is said to be at equilibrium when the concentration of products and reactants is equal.
- 2) T/F A reaction with a K_c value equal to 1.57×10^{-4} , has a higher concentration of reactants than products at equilibrium.
- 3) T/F A reaction with a K_c value equal to 12.69 and Q_c value equal to 0.37 will produce more products to reach equilibrium.
- 4) T/F The value of K_w is equal to 1.0×10^{-14} only for strong acids and bases.
- 5) T/F Strong acids always produce strong conjugate bases.
- 6) T/F The conjugate base of HF is H^+ .
- 7) T/F An acid with $K_a = 5.6 \times 10^{-10}$ is stronger than an acid with $K_a = 1.8 \times 10^{-5}$.
- 8) T/F Water (H_2O) can be both an acid and a base.
- 9) T/F A weak acid with an initial concentration of 0.1 M has a pH = 1.00.
- 10) T/F Increasing the pressure in any gaseous reaction shifts the reaction to produce more products.

Multiple Choice (4 pts each)

11) Which one of the following choices is the correct **equilibrium constant expression** for the reaction below?



A) $K_c = \frac{[\text{PbO}][\text{SO}_2]}{[\text{PbS}][\text{O}_2]}$

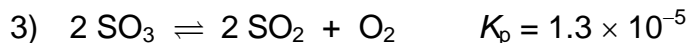
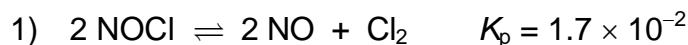
B) $K_c = \frac{[\text{PbO}]^2[\text{SO}_2]^2}{[\text{PbS}]^2[\text{O}_2]^3}$

C) $K_c = \frac{[\text{SO}_2]^2}{[\text{O}_2]^3}$

D) $K_c = \frac{[\text{O}_2]^3}{[\text{SO}_2]^2}$

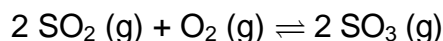
E) $K_c = \frac{[\text{PbS}]^2[\text{O}_2]^3}{[\text{PbO}]^2[\text{SO}_2]^2}$

12) For the following reactions at equilibrium, use the K_p values to arrange them in order of increasing products (least \rightarrow greatest).



A) $2 < 1 < 3$ **B) $3 < 1 < 2$** C) $1 < 2 < 3$ D) $3 < 2 < 1$ E) $1 < 3 < 2$

13) The following reaction has the equilibrium constant, $K_c = 4.3 \times 10^{-4}$.



For a solution with the following initial concentrations, is the reaction **at equilibrium**?

$$[\text{SO}_2] = 0.10 \text{ M} \quad [\text{O}_2] = 0.10 \text{ M} \quad [\text{SO}_3] = 10.0 \text{ M}$$

A) Yes, it is at equilibrium

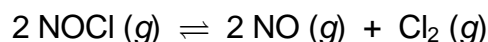
B) No, the reaction will proceed towards reactants

C) No, the reaction will proceed towards products

D) No, but there is not enough information to determine direction

E) Because this is a gaseous reaction, I need a K_p to determine

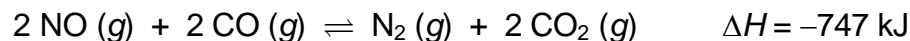
14) At 35°C , the equilibrium constant, K_c , for the following reaction is 1.6×10^{-5} .



If the **equilibrium concentrations** of Cl_2 and NOCl are 0.012 M and 0.28 M , respectively, at 35°C , what is the **equilibrium concentration** of NO ?

A) $1.0 \times 10^{-4} \text{ M}$ **B) $1.0 \times 10^{-2} \text{ M}$** C) $3.7 \times 10^{-4} \text{ M}$ D) $1.9 \times 10^{-2} \text{ M}$ E) $6.4 \times 10^2 \text{ M}$

15) Consider the reaction system



Once equilibrium is established, what conditions favor a shift to **products**?

- A) high temperature and high pressure
- B) low temperature and low pressure
- C) low temperature and high pressure**
- D) high temperature and low pressure
- E) none of the above

16) The conjugate base of HSO_4^- is _____ .

- A) OH^-
- B) SO_4^{2-}**
- C) H_2SO_4
- D) H_2O
- E) H_3O^+

17) Calculate the **pH** of a 0.28 M HNO_3 (strong acid) solution at 25°C.

- A) -0.55
- B) 0.28
- C) 0.55**
- D) 1.27
- E) 13.45

18) What is the concentration of **hydronium ions, H_3O^+** , in a solution with a pH = 11.45?

- A) $3.5 \times 10^{-12} \text{ M}$**
- B) $9.4 \times 10^{-10} \text{ M}$
- C) $1.1 \times 10^{-5} \text{ M}$
- D) $2.8 \times 10^{-3} \text{ M}$
- E) $7.8 \times 10^{-2} \text{ M}$

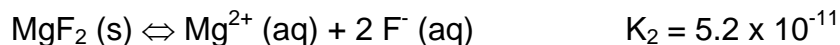
19) Assuming equal initial concentrations, which of the following weak acids has the **strongest conjugate base** in an aqueous solution?

- A) acetic acid ($K_a = 1.8 \times 10^{-5}$)
- B) formic acid ($K_a = 1.8 \times 10^{-4}$)
- C) hydrogen sulfite ion ($K_a = 6.2 \times 10^{-8}$)**
- D) phosphoric acid ($K_a = 7.5 \times 10^{-3}$)
- E) nitrous acid ($K_a = 4.5 \times 10^{-4}$)

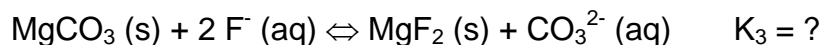
20) Consider a solution with a pH = 2.74. What is the **percent ionization** of the weak acid if the initial concentration were 0.5 M?

- A) 18.24 %
- B) 0.18 %
- C) 3.60 %
- D) 36.00 %
- E) 0.36 %**

21) Given the following reactions,



Determine the equilibrium constant for the following reaction.



A) 2.8×10^{15} **B) 1.3×10^5** C) 7.6×10^{-6} D) 6.8×10^{-6} E) 3.5×10^{-16}

22) Calculate the **pH** of a solution made from 0.1 M of the strong base NaOH.

A) 1.0 B) 0.1 **C) 13.0** D) 1.0×10^{-13} E) need the K_a to determine

23) Based on bond strength, which of the following weak acids will have the **lowest pH** when 0.5 M solutions are made from each?

Answer Choice	Weak Acid	Bond Enthalpy (kJ/mol)
A	HF	568.2
B	HI	298.3
C	HCl	431.9
D	HBr	366.1
E	All pH values are EQUAL!	

24) Which of the following statements is **TRUE** regarding a solution made from 0.1 M of a weak acid (HA)?

A) $[\text{H}^+] = [\text{A}^-]$ B) $\text{pH} = 1.00$ C) $[\text{H}^+] = [\text{OH}^-]$ D) $[\text{H}^+] > [\text{A}^-]$ E) $[\text{H}^+] = [\text{HA}]$

25) Which of the following strong base solutions will have the **highest pH**?

A) 0.10 M KOH B) 0.2 M KOH C) 0.15 M NaOH **D) 0.15 M $\text{Ba}(\text{OH})_2$** E) 0.1 M NaOH