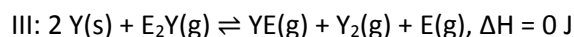
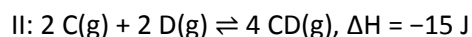


1) The equilibrium constant K_c for forming Nitrogen monoxide gas from its elements is 1.0×10^{-5} at 1500K. If 0.80 mol of N_2 and 0.20 mol of O_2 were placed in a 1L flask, what is the equilibrium concentration of NO?

- A) 6.32×10^{-4} M
- B) 1.26×10^{-3} M
- C) 3.16×10^{-4} M
- D) 8.94×10^{-4} M
- E) 1.79×10^{-3} M

2) K_c for the reaction $C_2 + D_2 \leftrightarrow 2CD$ is 2.0 at 600°C. 0.50 mol of each reactant are put in a 2L flask, predict the percent yield of CD at 600°C.

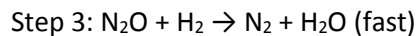
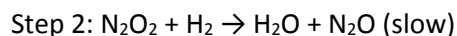
3) For which of the following reactions does $K_c = K_p$ at 25°C?



- A) I only B) II only C) III only D) I and II only E) II and III only

4) Sodium-24 is a radioactive isotope that decays via first order kinetics and has a half-life of 15 hours. What fraction of an original sample of sodium-24 will decompose in 3 days?

5) Given the overall reaction $2H_2 + 2NO \rightarrow 2H_2O + N_2$ and the following mechanism:



Which of the following is/are true?

I: The rate law for the overall reaction is $\text{Rate} = k[N_2O_2][H_2]$

II: The absolute value of the rate of change of H_2 is $\frac{1}{2}$ the rate of change of N_2

III: The rate of the reaction is dependent only on H_2

- A) Only I B) Only II C) II and III D) I and II E) None

6) Draw all the structural isomers of C_5H_{12} .

7) Given the reaction for the following hypothetical weak acid: $\text{HA} + \text{H}_2\text{O} \rightleftharpoons \text{NaA} + \text{H}_3\text{O}^+$, which would increase the buffer component concentration ratio?

I: Adding 0.1 M NaOH to the buffer II: Adding 0.1 M HCl to the buffer

A) I only B) II only C) both D) none

8) Calculate the pH of a 0.20 M Na_2CO_3 solution. K_a of HCO_3^- is 4.8×10^{-11}

- A) 8.49
- B) 2.19
- C) 5.51
- D) 11.81
- E) 9.62

9) A 1.00g piece of chalk containing CaCO_3 (and other materials) was placed in 500. mL of hydrochloric acid solution with an initial pH of 1.00. After all of the CaCO_3 reacts with the HCl (forming CO_2 gas, H_2O , Ca^{2+} , and Cl^-), the final pH is 1.19. About what mass percent of the chalk was CaCO_3 ?

10) Hypobromous acid is a commonly used disinfectant in swimming pools. At 25°C HBrO dissociates in water with a $K_a = 2.3 \times 10^{-9}$. Is this dissociation a spontaneous process when $[\text{H}_3\text{O}^+] = 6.0 \times 10^{-4}$ M, $[\text{BrO}^-] = 0.10$ M, and $[\text{HBrO}] = 0.20$ M?

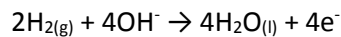
- A) Yes, because $\Delta G > 0$
- B) No, because $\Delta G > 0$
- C) Yes, because $\Delta G < 0$
- D) No, because $\Delta G < 0$

11) What is the value for the standard free energy of the following reaction:



A) +432.3 kJ/mol B) -432.3 kJ/mol C) +216.1 kJ/mol D) -216.1 kJ/mol

12) A hydrogen fuel cell operates with the following reaction taking place at the anode:



What volume of H_2 gas at 30°C and 120 atm is required for the fuel cell to run a motor drawing 8.5A for 10.0 hours?

13) The magnetic moment of an inorganic complex represents the number of unpaired electrons present in its d-orbital splitting configuration. A complex $[\text{MCl}_6]^{4-}$ has a magnetic moment of around 3. Which two elements in the 3d block could be "M"?

- A) V and Ni B) V and Co C) Sc and Ni D) Sc and Co

14) Rank the following in order of increasing magnetism. I: $[\text{Mn}(\text{NO}_2)_6]^{1-}$ II: $[\text{Fe}(\text{en})_3]^{2+}$ III: $[\text{CoCl}_3\text{F}_3]^{3-}$

- A) I < II < III B) I < III < II C) II < III < I D) II < I < III E) III < I < II

15) What is the binding energy per nucleon of fluorine?

16) Which of the following would buffer systems would you most optimally choose to create a buffer of pH = 6.50? The K_a of $\text{H}_2\text{B} = 1 \times 10^{-5}$ and the k_a of $\text{HB}^- = 1 \times 10^{-7}$.

- A) $\text{B}^{2-} / \text{H}_2\text{B}$
B) $\text{B}^{2-} / \text{HB}^-$
C) $\text{HB}^- / \text{H}_2\text{B}$
D) $\text{HB}^- / \text{HB}_2$
E) $\text{B}^{2-} / \text{HB}_2$

17) Calculate the molar solubility of Ag_2CO_3 at 25°C. $K_{sp} = 8.1 \times 10^{-12}$

18) Which of the following reactions would you expect to be spontaneous at high temperatures but nonspontaneous at low temperatures?

- A) An exothermic reaction with $S^\circ_{\text{reaction}} < 0$
B) An endothermic reaction with $S^\circ_{\text{reaction}} < 0$
C) An exothermic reaction with $S^\circ_{\text{reaction}} > 0$
D) An endothermic reaction with $S^\circ_{\text{reaction}} > 0$
E) Such a reaction does not exist

19) Is MnO_4^- or Br_2 a stronger oxidizing agent? Explain.

20) True or False: CaO is a more basic oxide than Rb₂O.

21) Consider the complex trans-[Co(CH₃NH₂)₄Cl₂]NO₃, what is the coordination number and the oxidation state, respectively, of the transition metal ion?