

1442 Review Test 4 Chapters 20 and 21

Website: <http://dipowell1.home.mindspring.com>

Equations: $\Delta H_{\text{reaction}} = \sum H_{\text{products}} - \sum H_{\text{reactants}}$ (Also works for S and G)

$$\Delta G = \Delta H - T\Delta S \quad \Delta G = -RT \ln K \quad (R = 8.314 \text{ J/mol.K})$$

$$\Delta G = \Delta G^\circ + RT \ln Q \quad E_{\text{cell}} = E_{\text{oxidation}} + E_{\text{reduction}}$$

$$\Delta G = -nFE_{\text{cell}} \quad (F = 96,500 \text{ C}) \quad \log K = nE^\circ_{\text{cell}} / 0.0592V$$

$$E_{\text{cell}} = E^\circ_{\text{cell}} - 0.0592V/n \log Q$$

**$it = nFe$ $i = \text{amps}$ $t = \text{seconds}$ $n = \text{moles an element}$
 $e = \text{moles of electrons transferred in the reaction}$**

Chapter 20

- Which of the following is necessary and sufficient to assure that a process is spontaneous? (a) $\Delta H < 0$ (b) $\Delta S > 0$ (c) $\Delta G < 0$ (d) $\Delta S < 0$ (e) none
- The enthalpy change for the following is -891 kJ : $\text{CH}_4 + 2 \text{O}_2 \rightarrow \text{CO}_2 + 2 \text{H}_2\text{O}$
What is the enthalpy change associated with the complete combustion of 1.00 g of CH_4 ?
- In which case will a reaction be spontaneous only at high temperature? (a) $\Delta H = -$, $\Delta S = +$ (b) $\Delta H = -$, $\Delta S = -$ (c) $\Delta H = +$, $\Delta S = +$ (d) $\Delta H = +$, $\Delta S = -$
- Given the reactions:
(1) $2 \text{Fe}_2\text{O}_3(\text{s}) \rightarrow 4 \text{Fe}(\text{s}) + 3 \text{O}_2(\text{g})$
(2) $\text{Ag}^+(\text{aq}) + \text{Cl}^-(\text{aq}) \rightarrow \text{AgCl}(\text{s})$
(3) $\text{H}_2\text{O}(\text{g}) \rightarrow \text{H}_2\text{O}(\text{l})$
In which reactions does the entropy decrease?
- Given the reaction: $\text{CaO}(\text{s}) + \text{SO}_3(\text{g}) \rightarrow \text{CaSO}_4(\text{s})$ for which $\Delta H = -403.13 \text{ kJ}$ and $\Delta S = -189.3 \text{ J/mole.K}$. What is the value of ΔG in kJ/mole at 0°C ?
- For the reaction in equilibrium at 298 K : $\text{CaSO}_4(\text{s}) + \text{CO}_2(\text{g}) \leftrightarrow \text{CaCO}_3(\text{s}) + \text{SO}_3(\text{g})$. If $\Delta G = 217 \text{ kJ/mol}$, what is the value of K ?
- $2 \text{NH}_3(\text{g}) + 7/2 \text{O}_2(\text{g}) \rightarrow 2 \text{NO}_2(\text{g}) + 3 \text{H}_2\text{O}(\text{g})$. The following values for ΔS_f are: $\text{NH}_3 = 192.5 \text{ J/Kmol}$, $\text{O}_2 = 205 \text{ J/Kmol}$, $\text{NO}_2 = 240.4 \text{ J/Kmol}$, $\text{H}_2\text{O} = 188.7 \text{ J/Kmol}$. What is ΔS for the reaction?

Chapter 21

8. In the following reaction, determine which element is the oxidizing agent and which element is oxidized. $\text{XeF}_2 + \text{BrO}_3^- + \text{H}_2\text{O} \rightarrow \text{Xe} + 2 \text{HF} + \text{BrO}_4^-$
9. Balance the following equation in acidic and then basic solution:
 $\text{MnO}_4^- + \text{Fe}^{2+} \rightarrow \text{Mn}^{2+} + \text{Fe}^{3+}$
10. Which statement is correct? (a) the reducing agent is reduced in a reaction (b) the oxidizing agent loses electrons (c) the reducing agent is oxidized in the reaction (d) the reducing agent may lose oxygen in the reaction (e) the reducing agent must not contain any oxygen.
11. A species that has a strong affinity for gaining electrons would be: (a) oxidizing agent (b) reducing agent (c) easily oxidized (d) difficult to reduce (e) none
12. Given the following half-cells below, what reaction occurs when the half-cells are suitably connected at standard conditions? $\text{Ti}^{2+} + 2 e \rightarrow \text{Ti} \quad E^\circ = -1.63 \text{ V}$
 $\text{CdS} + 2 e \rightarrow \text{Cd} + \text{S}^{2-} \quad E^\circ = -1.21 \text{ V}$
13. Given the two half-cell reactions below, what will the standard EMF of the cell be when the half-cells are suitably connected at standard conditions? Is the reaction spontaneous?
 $\text{Pd}^{2+} + 2e \rightarrow \text{Pd} \quad E^\circ = .99 \text{ V} \quad \text{Ag}^+ + e \rightarrow \text{Ag} \quad E^\circ = 0.8 \text{ V}$
14. Calculate E for the following cell: $\text{Fe} + \text{Sn}^{2+} \rightarrow \text{Fe}^{2+} + \text{Sn}$
Useful Information: $\text{Fe}^{2+} + 2e \rightarrow \text{Fe} \quad E^\circ = -0.44 \text{ V}$
 $\text{Sn}^{2+} + 2e \rightarrow \text{Sn} \quad E^\circ = -0.14 \text{ V}$
 $[\text{Fe}^{2+}] = 0.5 \text{ M} \quad [\text{Sn}^{2+}] = 0.001 \text{ M}$
15. E° for the reaction: $2 \text{Mn}^{3+} + 2 \text{H}_2\text{O} \rightarrow \text{Mn}^{2+} + \text{MnO}_2 + 4 \text{H}^+$ is 0.5 V.
Calculate ΔG for the process under standard conditions. ($F = 96,500 \text{ C}$)
16. A constant current of 10 amps was passed through a solution of NiCl_2 for 10 minutes. How many grams of Ni metal plated out on the cathode?
17. E° for the process: $\text{NO}_3^- + \text{H}_2\text{O} + \text{H}_2 \rightarrow \text{NO}_2^- + 2 \text{OH}^- + 2 \text{H}^+$ is 0.01 volts under standard conditions. What is the value of K?
18. The relevant reduction potentials are: $\text{Ag}^+ + e \rightarrow \text{Ag} \quad E^\circ = 0.8 \text{ V}$
 $\text{Zn}^{2+} + 2e \rightarrow \text{Zn} \quad E^\circ = -0.76 \text{ V}$

Which of the following statements is False? (a) the silver electrode is the cathode (b) increasing the Zn^{2+} will increase the cell voltage (c) electrons in the external

circuit will flow from Zn to Ag (d) Standard conditions prevail in the cell (e) Zn is the anode

19. Solid nickel will spontaneously reduce which of the following?

I. Fe^{2+} II. Zn^{2+} III. Pb^{2+} IV. Cu^{2+}

a) I and II b) III and IV c) II only d) I, III, and IV e) none

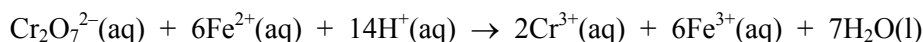
20. Which of the following is the best oxidizing agent under standard conditions at 25°C?

a) $\text{Cu}^{2+}(\text{aq})$ b) $\text{I}(\text{aq})$ c) $\text{Pb}(\text{s})$ d) $\text{Mg}^{2+}(\text{aq})$ e) $\text{Cd}^{2+}(\text{aq})$

21. Which of the following is the best reducing agent under standard conditions at 25°C?

a) $\text{Cu}^{2+}(\text{aq})$ b) $\text{I}(\text{aq})$ c) $\text{Pb}(\text{s})$ d) Mg^{2+} e) $\text{Cd}^{2+}(\text{aq})$

22. What is the appropriate cell notation for a galvanic cell utilizing the reaction below?



- a) $\text{Fe}(\text{s}) \mid \text{Fe}^{2+}(\text{aq}), \text{Fe}^{3+}(\text{aq}) \parallel \text{Cr}_2\text{O}_7^{2-}(\text{aq}), \text{Cr}^{3+}(\text{aq}) \mid \text{Cr}(\text{s})$
b) $\text{Cr}(\text{s}) \mid \text{Cr}_2\text{O}_7^{2-}(\text{aq}), \text{Cr}^{3+}(\text{aq}) \parallel \text{Fe}^{2+}(\text{aq}), \text{Fe}^{3+}(\text{aq}) \mid \text{Fe}(\text{s})$
c) $\text{Pt}(\text{s}) \mid \text{Cr}_2\text{O}_7^{2-}(\text{aq}), \text{Cr}^{3+}(\text{aq}) \parallel \text{Fe}^{2+}(\text{aq}), \text{Fe}^{3+}(\text{aq}) \mid \text{Pt}(\text{s})$
d) $\text{Pt}(\text{s}) \mid \text{Fe}^{2+}(\text{aq}) \mid \text{Fe}^{3+}(\text{aq}) \parallel \text{Cr}_2\text{O}_7^{2-}(\text{aq}) \mid \text{Cr}^{3+}(\text{aq}) \mid \text{Pt}(\text{s})$
e) $\text{Pt}(\text{s}) \mid \text{Fe}^{2+}(\text{aq}), \text{Fe}^{3+}(\text{aq}) \parallel \text{Cr}_2\text{O}_7^{2-}(\text{aq}), \text{Cr}^{3+}(\text{aq}) \mid \text{Pt}(\text{s})$

23. What substances are produced at the anode and cathode when an aqueous solution of MgF_2 is electrolyzed?

- a) $\text{F}_2(\text{g})$ is produced at the anode, and $\text{Mg}(\text{s})$ is produced at the cathode.
b) $\text{Mg}(\text{s})$ is produced at the anode, and $\text{F}_2(\text{g})$ is produced at the cathode.
c) $\text{F}_2(\text{g})$ is produced at the anode, and $\text{H}_2(\text{g})$ is produced at the cathode.
d) $\text{O}_2(\text{g})$ is produced at the anode, and $\text{Mg}(\text{s})$ is produced at the cathode.
e) $\text{O}_2(\text{g})$ is produced at the anode, and $\text{H}_2(\text{g})$ is produced at the cathode.

24. Electrolysis of a molten salt with the formula MCl , using a current of 3.86 A for 972 s, deposits 1.52 g of the metal. Identify the metal.

- a) Li b) Na c) K d) Rb e) Cs

Rules for Balancing Redox Reactions: (1) write the two half-reactions (2) Balance all elements except H and O (3) balance O with water (4) Balance H with H^+ (5) balance charge with e^- (6) multiply by a factor which will make the electrons equal in both half reactions (7) Combine like terms

If in basic solution only: Add a number of OH^- to each side equal to the H^+ . On the side with the H^+ , the $\text{H}^+ + \text{OH}^- \rightarrow \text{H}_2\text{O}$. Then recombine waters.

Rules for assigning oxidation numbers: (1) Group IA and II A are always +1 and +2 respectively. (2) F is always -1 (3) Give H a +1 (it can be -1 if combines with

group IA or II A) (4) Give) a -2 (as a peroxide it can be -1) (5) elements by themselves have an oxidation number of 0.