

	ΔH	ΔG	ΔS
A.	>0	<0	>0
B.	>0	>0	>0
C.	>0	>0	<0
D.	<0	<0	<0

6. Given $\Delta H = -10.$ kJ and $\Delta S = -40.$ J/K for a reaction at constant pressure, which one of the following is a correct statement?
- A. The reaction is spontaneous at 200 K.
 B. The reaction is spontaneous at 300 K.
 C. The reaction is spontaneous at all temperatures.
 D. The reaction is nonspontaneous at all temperatures.
7. The molar heat of vaporization of acetone is 30.25 kJ/mol and the molar entropy of vaporization is 91.9 J/mol·K. What is the normal boiling point of acetone?
- A. 3.04 K B. 278 K C. 373 K D. 329 K
8. Consider the following reaction at 25 °C:
- $$\text{Fe(OH)}_2(s) \longrightarrow \text{Fe}^{2+}(aq) + 2 \text{OH}^-(aq)$$
- K_{sp} for Fe(OH)_2 is 1.6×10^{-14} . What is ΔG for the reaction?
- A. -34 kJ B. 34 kJ C. -79 kJ D. 79 kJ
9. For the reaction
- $$\text{I}_2(s) + \text{Cl}_2(g) \rightleftharpoons 2 \text{ICl}(g)$$
- $\Delta G = -10.9$ kJ at 25 °C. What is ΔG for the reaction when $P_{\text{ICl}} = 0.800$ atm and $P_{\text{Cl}_2} = 2.1 \times 10^{-3}$ atm at 25 °C?
- A. -10.9 kJ B. 3.8 kJ C. 3.3 kJ D. -25.1 kJ
10. The following reaction has a $\Delta H_{\text{xn}} = 188.3$ kJ at 25 °C.
- $$\text{NH}_4\text{Br}(s) \longrightarrow \text{NH}_3(g) + \text{HBr}(g)$$
- Which of the following statements describes the thermodynamic spontaneity of the reaction?

- A. The reaction is spontaneous at all temperatures.
- B. The reaction is not spontaneous at any temperature.
- C. The reaction is spontaneous only at relatively low temperatures.
- D. The reaction is spontaneous only at relatively high temperatures.

11.	<p>Calculate the equilibrium constant for the reaction at 25 °C</p> $\text{H}_2(\text{g}) + \text{CO}(\text{g}) \longrightarrow \text{CH}_2\text{O}(\text{g})$ <p>if $\Delta G = +34.6 \text{ kJ}$.</p>
<p>A. 8.61×10^{-7} B. 4.27×10^{-5} C. 1.05×10^1 D. 1.29×10^6</p>	

12.	<p>If the following redox reaction were balanced, what would the sum of all the coefficients (including H^+ and H_2O) be?</p> $\text{Cr}_2\text{O}^- + \text{C}_2\text{O}^- \longrightarrow \text{Cr}^{3+} + \text{CO}_2 \quad (\text{acidic solution})$
<p>A. 26 B. 27 C. 33 D. 36</p>	

A table of reduction potentials is provided for use in the following problems.

13.	<p>What is the E^0 of a galvanic cell that has a cell diagram of</p> $\text{Fe}(\text{s}) \mid \text{Fe}^{2+}(\text{aq}) \mid \text{salt bridge} \mid \text{Co}^{2+}(\text{aq}) \mid \text{Co}(\text{s}) ?$ <p>Use the reduction potentials provided.</p>
<p>A. 0.16 V B. 0.72 V C. -0.72 V D. -0.16 V</p>	

14.	<p>A <u>galvanic</u> cell is set up using:</p> $\text{MnO} + 8 \text{H}^+ + 5 \text{e}^- \longrightarrow \text{Mn}^{2+} + 4 \text{H}_2\text{O}(\text{l})$ <p>and</p> $\text{NO} + 4 \text{H}^+ + 3 \text{e}^- \longrightarrow \text{NO} + 2 \text{H}_2\text{O}(\text{l})$ <p>Which statement is true under standard state conditions?</p>
<p>A. NO will reduce MnO to Mn^{2+}. C. NO will oxidize Mn^{2+} to MnO. B. MnO will oxidize NO to NO. D. MnO is the reducing agent.</p>	

15.	<p>Which statement is true for the following electrochemical cell?</p> $\text{Pt}(\text{s}) \mid \text{H}_2(\text{g}, 1 \text{ atm}) \mid \text{H}^+(1 \text{ M}) \mid \text{KCl}(\text{sat'd}) \mid \text{Ag}^+(\text{aq}, 1 \text{ M}) \mid \text{Ag}(\text{s})$
<p>A. Ag is reduced at the cathode. C. H_2 is oxidized at the cathode. B. H^+ is produced at the anode. D. Ag^+ is the reducing agent.</p>	

- A. Cathodic protection is a process in which the metal to be protected is made the cathode in an electrochemical cell.
- B. The Nernst equation gives the relationship between the cell emf and the concentrations of reactants and products under standard state conditions.
- C. Corrosion is the deterioration of metals by an electrochemical process.
- D. Electrolysis is the use of an electric current from an external source to drive a nonspontaneous chemical reaction.

22.	<p>The overall reaction in the dry cell battery is</p> $\text{Zn} + 2 \text{NH}_3 + 2 \text{MnO}_2 \longrightarrow \text{Zn}^{2+} + 2 \text{NH}_3 + \text{H}_2\text{O} + \text{Mn}_2\text{O}_3$ <p>Which is the half-reaction occurring at the anode?</p>
	<ul style="list-style-type: none"> A. $2 \text{NH}_3 + 2 \text{MnO}_2 + 2 \text{e}^- \longrightarrow 2 \text{NH}_3 + \text{H}_2\text{O} + \text{Mn}_2\text{O}_3$ B. $\text{Zn}^{2+} + 2 \text{e}^- \longrightarrow \text{Zn}$ C. $\text{Zn} \longrightarrow \text{Zn}^{2+} + 2 \text{e}^-$ D. $\text{NH}_3 + \text{e}^- \longrightarrow \text{NH}_3 + \text{H}^+$

23.	<p>Which one of the following is a false statement?</p>
	<ul style="list-style-type: none"> A. Obtaining a metal from its ore is a reduction process. B. In the electrolysis of <u>molten</u> NaCl, Cl₂ is produced at the anode. C. Fuel cells store energy like batteries. D. In a galvanic cell, electricity is produced by means of a spontaneous redox reaction.

24.	<p>Which of the following metals could be used in the cathodic protection of Fe?</p> <p style="text-align: center;">Mg, Pb, Sn, Zn</p>
	<p>A. Mg and Zn B. Pb and Sn C. all four D. none</p>

25.	<p>A metal object is to be gold-plated by an electrolytic procedure using aqueous AuCl₃ electrolyte. Calculate the number of moles of gold deposited in 3.0 minutes by a constant current of 10 A.</p>
	<p>A. 6.2×10^{-3} mol C. 1.8×10^{-2} mol</p> <p>B. 9×10^{-3} mol D. 3.5×10^{-5} mol</p>