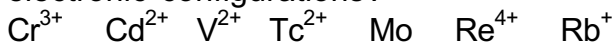


CHE 107-002
Examination 3
November 20, 1997

1. Which of the following ions have identical electronic configurations?

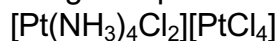


- A. Re^{4+} and Mo
- B. Cr^{3+} and V^{2+}
- C. Rb^{+} and Cd^{2+}
- D. V^{2+} and Re^{4+}

2. Which one of the following complex ions has **no** unpaired electrons?

- A. FeF_6^{3-}
- B. $[\text{Cu}(\text{H}_2\text{O})_4]^{2+}$
- C. $[\text{V}(\text{en})_3]^{3+}$
- D. $[\text{Zn}(\text{NH}_3)_4]^{2+}$

3. If the oxidation number of platinum in the tetrachloroplatinate anion is +2, what is the oxidation number of platinum in the cation of the following compound?



- A. -4
- B. 0
- C. +2
- D. +4

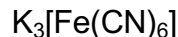
4. Which one of the following pairs of hydrated ions contains two colored ions?

- A. Cd^{2+} and Fe^{3+}
- B. Ca^{2+} and Na^{+}
- C. Cr^{2+} and Fe^{3+}
- D. Cd^{2+} and Ca^{2+}

5. How many unpaired electrons are in $\text{V}(\text{en})_3^{3+}$?

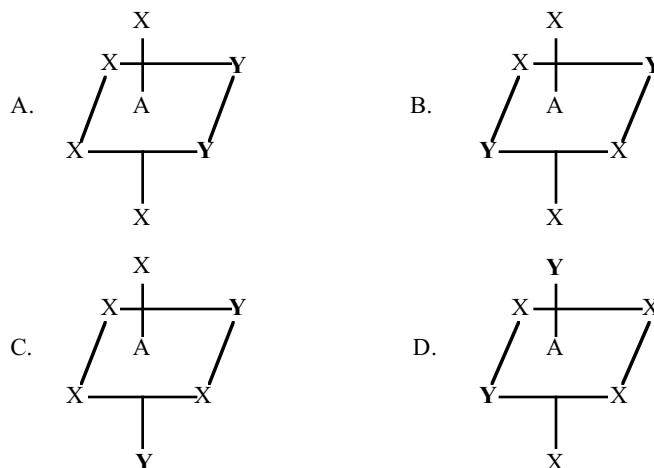
- A. 0
- B. 1
- C. 2
- D. 3

6. Which name below is correct for the compound shown.



- A. potassium hexacyanoiron(III)
- B. tripotassium iron(III)hexacyanide
- C. potassium hexacyanoferrate (III)
- D. potassium(I) hexacyanoiron(III)

7. All the structures below (AX_4Y_2) exhibit octahedral geometry. One isomer is different from the other three. Which one is different?



8. What is the coordination number of cobalt in the coordination compound, $[\text{Co}(\text{en})_3]\text{Cl}_3$?

- A. 3
- B. 6
- C. 9
- D. 12

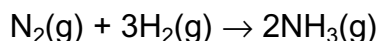
9. K_a for acetic acid is 1.8×10^{-5} at 25°C . What is ΔG° (in kJ/mol) for this reaction at 25°C ?

- A. -2.27
- B. -2.71×10^4
- C. 11.8
- D. 27.1

10. The molar heat of fusion of benzene is 10.9 kJ/mol. At one atmosphere, benzene melts at 6°C. What is the entropy change (in J/Kmol) that accompanies the melting of solid benzene to liquid benzene?

- A. -36.6
- B. 0.0367
- C. 39.1
- D. 1816

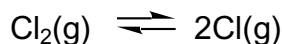
11. For the reaction below, $\Delta H^\circ = -92.6$ kJ/mol and $\Delta S^\circ = -199$ J/Kmol.



What is the minimum temperature (in K) at which the process will be spontaneous?

- A. 0.356
- B. 2.15
- C. 232
- D. 465

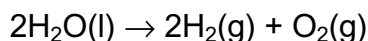
12. Consider the following reaction.



At high temperatures:

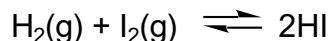
- A. ΔG° should be negative.
- B. ΔS° should be negative.
- C. ΔH° should be negative.
- D. T should be negative.

13. Calculate ΔG° (in kJ/mol) for the reaction below. The standard enthalpy of formation of $\text{H}_2\text{O}(\text{l})$ is -285.8 kJ/mol. Standard entropies in J/Kmol are given in brackets: $\text{H}_2\text{O}(\text{l})$ [69.9], $\text{H}_2(\text{g})$ [131], $\text{O}_2(\text{g})$ [205].



- A. -1.88×10^2
- B. 188
- C. 474
- D. 9.69×10^4

14. The ΔG° for the reaction



is 2.60 kJ/mol at 25°C. In one experiment, the initial pressures are $P_{\text{H}_2} = 4.26$ atm, $P_{\text{I}_2} = 0.24$ atm, and $P_{\text{HI}} = 0.23$ atm. What will happen to the partial pressure of HI?

- A. It will decrease.
- B. It will increase.
- C. It will change to zero.
- D. It will stay unchanged.

15. Which one of the following reactions should have the largest value of ΔS° ?

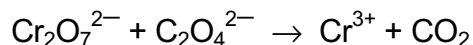
- A. $\text{CO}(\text{g}) + \text{Cl}_2(\text{g}) \rightarrow \text{COCl}_2(\text{g})$
- B. $\text{CH}_4(\text{g}) + \text{H}_2\text{O}(\text{g}) \rightarrow \text{CO}(\text{g}) + 3\text{H}_2(\text{g})$
- C. $2\text{Mg}(\text{s}) + \text{O}_2(\text{g}) \rightarrow 2\text{MgO}(\text{s})$
- D. $\text{N}_2(\text{g}) + \text{O}_2(\text{g}) \rightarrow 2\text{NO}(\text{g})$

16. Which one of the following processes involves an increase in the entropy of the system?

- A. Condensation of gaseous nitrogen to form liquid nitrogen.
- B. When solid sodium chloride dissolve in water to form a solution.
- C. When water freezes to form ice.
- D. Precipitation of BaSO_4 from a solution of BaNO_3 and Na_2SO_4 .

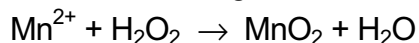
17. If the following redox reaction (which occurs in acidic solution) were balanced, what would be the sum of all species present

(including H_2O , H^+ and OH^-)?



- A. 6
- B. 13
- C. 26
- D. 33

18. For the following redox reaction

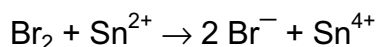


- A. Mn^{2+} is the reducing agent.
- B. Mn^{2+} is reduced.
- C. H_2O_2 is the reducing agent.
- D. H_2O_2 is oxidized.

19. Which of the following oxidizing agents will oxidize Ni to Ni^{2+} ? (See attached table.)

- A. Pb^{2+}
- B. Ca^{2+}
- C. Mn^{2+}
- D. Zn^{2+}

20. What is the cell potential (in V) for the following spontaneous reaction in aqueous solution at 25°C ? Assume that the initial concentrations of dissolved species are all 1.0 M. (See attached table.)

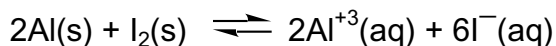


- A. +1.20
- B. +0.94
- C. -0.94
- D. -1.20

21. For a certain oxidation-reduction reaction, E° is negative. It follows that

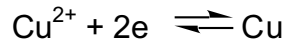
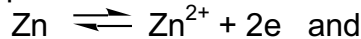
- A. ΔG° is negative and $K_{\text{eq}} > 1$.
- B. ΔG° is negative and $K_{\text{eq}} < 1$.
- C. ΔG° is positive and $K_{\text{eq}} < 1$.
- D. ΔG° is positive and $K_{\text{eq}} > 1$.

22. What is ΔG° (in kJ/mol) for the following reaction? (See attached table.)



- A. 1.27×10^3
- B. 6.34×10^2
- C. 4.23×10^2
- D. -4.23×10^2

23. What is the potential (in V) of a cell made up of:



half-cells at 25°C , if $[\text{Zn}^{2+}]$ is 0.40 M and $[\text{Cu}^{2+}]$ is 0.16 M? (See attached table.)

- A. 0.41
- B. 1.09
- C. 1.11
- D. 2.19

24. How many seconds will it take to plate out all of the silver from 0.36 L of a solution containing 0.25 M Ag^+ ? A current of 2.53 A is used.

- A. 2.36×10^{-6}
- B. $3.43 \times 10^{+3}$
- C. $2.20 \times 10^{+4}$
- D. $4.24 \times 10^{+5}$

25. Metallic aluminum is usually prepared by the electrolysis of bauxite ore ($\text{Al}_2\text{O}_3 \cdot 2\text{H}_2\text{O}$). What half-reaction describes this reaction?

- A. $\text{Al}^{3+} + 3e^- \rightarrow \text{Al}$
- B. $\text{Al} + 3e^- \rightarrow \text{Al}^{3+}$
- C. $\text{Al}^{3+} \rightarrow \text{Al} + 3e^-$
- D. $\text{Al} \rightarrow \text{Al}^{3+} + 3e^-$

Standard Reduction Potentials at 25°C

$\text{Ca}^{2+}(\text{aq}) + 2\text{e}^{-} \rightarrow \text{Ca}(\text{s})$	-2.87 V
$\text{Al}^{3+}(\text{aq}) + 3\text{e}^{-} \rightarrow \text{Al}(\text{s})$	-1.66 V
$\text{Mn}^{2+}(\text{aq}) + 2\text{e}^{-} \rightarrow \text{Mn}(\text{s})$	-1.18 V
$\text{Zn}^{2+}(\text{aq}) + 2\text{e}^{-} \rightarrow \text{Zn}(\text{s})$	-0.76 V
$\text{Ni}^{2+}(\text{aq}) + 2\text{e}^{-} \rightarrow \text{Ni}(\text{s})$	-0.25 V
$\text{Sn}^{2+}(\text{aq}) + 2\text{e}^{-} \rightarrow \text{Sn}(\text{s})$	-0.14 V
$\text{Pb}^{2+}(\text{aq}) + 2\text{e}^{-} \rightarrow \text{Pb}(\text{s})$	-0.13 V
$\text{Sn}^{4+}(\text{aq}) + 2\text{e}^{-} \rightarrow \text{Sn}^{2+}(\text{aq})$	+0.13 V
$\text{Cu}^{2+}(\text{aq}) + 2\text{e}^{-} \rightarrow \text{Cu}(\text{s})$	+0.34 V
$\text{I}_2(\text{s}) + 2\text{e}^{-} \rightarrow 2\text{I}^{-}(\text{aq})$	+0.53 V
$\text{Ag}^{+}(\text{aq}) + \text{e}^{-} \rightarrow \text{Ag}(\text{s})$	+0.80 V
$\text{Br}_2(\text{l}) + 2\text{e}^{-} \rightarrow 2\text{Br}^{-}(\text{aq})$	+1.07 V