

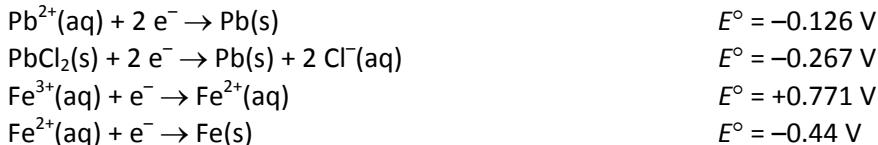
Exam 3 Review Problems:

Useful Equations: $\Delta G^\circ = -RT \ln K$ $\Delta G^\circ = \Delta H^\circ - T\Delta S^\circ$ $\Delta G^\circ = -nFE^\circ$ $\ln K = nE^\circ/0.0257$
 $E_{\text{cell}} = E_{\text{cell}}^\circ - RT/nF \ln Q$

- Assuming the following reaction proceeds in the forward direction,
 $2 \text{Ni}^{2+}(\text{aq}) + \text{Zn}(\text{s}) \rightarrow 2 \text{Ni}(\text{s}) + \text{Zn}^{2+}(\text{aq})$
 - $\text{Zn}(\text{s})$ is the reducing agent and $\text{Zn}^{2+}(\text{s})$ is the oxidizing agent.
 - $\text{Zn}(\text{s})$ is the reducing agent and $\text{Ni}(\text{s})$ is the oxidizing agent.
 - $\text{Ni}^{2+}(\text{aq})$ is the reducing agent and $\text{Ni}(\text{s})$ is the oxidizing agent.
 - $\text{Zn}(\text{s})$ is the reducing agent and $\text{Ni}^{2+}(\text{s})$ is the oxidizing agent.
- The following reaction occurs spontaneously.
 $2 \text{H}^+(\text{aq}) + \text{Sr}(\text{s}) \rightarrow \text{Sr}^{2+}(\text{aq}) + \text{H}_2(\text{g})$
Write the balanced reduction half-reaction.
- Write a balanced half-reaction for the reduction of hydrogen peroxide to water in an acidic solution.
- Write a balanced half-reaction for the reduction of $\text{SO}_4^{2-}(\text{aq})$ to $\text{SO}_2(\text{g})$ in an acidic solution.
- Write a balanced half-reaction for the reduction of $\text{MnO}_2(\text{s})$ to $\text{Mn}(\text{OH})_2(\text{s})$ in a basic solution.
- Write a balanced chemical equation for the oxidation of $\text{Fe}^{2+}(\text{aq})$ by concentrated nitric acid. Two products of the reaction are $\text{NO}(\text{g})$ and $\text{Fe}^{3+}(\text{aq})$.
- Write a balanced chemical equation for the following reaction in a basic solution.
 $\text{ClO}^-(\text{aq}) + \text{Cr}(\text{OH})_3(\text{s}) \rightarrow \text{Cl}^-(\text{aq}) + \text{CrO}_4^{2-}(\text{aq})$
- All of the following statements concerning voltaic cells are true EXCEPT
 - a voltaic cell can be used as a source of energy.
 - electrons flow from the anode to the cathode in the external circuit.
 - a salt bridge allows cations and anions to move between the half-cells.
 - oxidation occurs at the cathode.
- What is the correct cell notation for a voltaic cell based on the reaction below?
 $\text{Ag}^+(\text{aq}) + \text{Sn}(\text{s}) \rightarrow \text{Ag}(\text{s}) + \text{Sn}^{2+}(\text{aq})$
- What is a correct cell notation for a voltaic cell based on the reaction below?
 $\text{PbBr}_2(\text{s}) + 2 \text{Zn}(\text{s}) \rightarrow \text{Pb}(\text{s}) + \text{Zn}^{2+}(\text{aq}) + 2 \text{Br}^-(\text{aq})$
- Write a balanced chemical equation for the overall reaction represented by the cell notation below.
 $\text{Pt} \mid \text{H}_2(\text{g}) \mid \text{H}^+(\text{aq}) \parallel \text{SO}_4^{2-}(\text{aq}) \mid \text{PbSO}_4(\text{s}) \mid \text{Pb}(\text{s})$
- The unit for electromotive force, emf, is the Volt. A Volt is equal to
 - one coulomb per joule.
 - one joule per second.
 - one joule per coulomb.
 - one coulomb per second.

13. An SHE electrode has been assigned a standard reduction potential, E° , of 0.00 Volts. Which reaction occurs at this electrode?
- $\text{Li}^+(\text{aq}) + \text{e}^- \rightarrow \text{Li}(\text{s})$
 - $2 \text{H}^+(\text{aq}) + 2 \text{e}^- \rightarrow \text{H}_2(\text{g})$
 - $2 \text{H}_2\text{O}(\ell) + 2 \text{e}^- \rightarrow \text{H}_2(\text{g}) + 2 \text{OH}^-(\text{aq})$
 - $\text{Hg}_2\text{Cl}_2(\text{s}) + 2 \text{e}^- \rightarrow 2 \text{Hg}(\ell) + 2 \text{Cl}^-(\text{aq})$
14. Use the standard reduction potentials below to determine which element or ion is the best oxidizing agent.
- | | |
|--|------------------------------|
| $\text{Hg}_2^{2+}(\text{aq}) + 2 \text{e}^- \rightarrow 2 \text{Hg}(\ell)$ | $E^\circ = +0.789 \text{ V}$ |
| $\text{I}_2(\text{s}) + 2 \text{e}^- \rightarrow 2 \text{I}^-(\text{aq})$ | $E^\circ = +0.535 \text{ V}$ |
| $\text{Ni}^{2+}(\text{aq}) + 2 \text{e}^- \rightarrow \text{Ni}(\text{s})$ | $E^\circ = -0.25 \text{ V}$ |
- $\text{I}^-(\text{aq})$
 - $\text{Hg}(\ell)$
 - $\text{Hg}_2^{2+}(\text{aq})$
 - $\text{I}_2(\text{s})$
15. Use the standard reduction potentials below to determine which element or ion is the best reducing agent.
- | | |
|--|-----------------------------|
| $\text{Pd}^{2+}(\text{aq}) + 2 \text{e}^- \rightarrow \text{Pd}(\text{s})$ | $E^\circ = +0.90 \text{ V}$ |
| $2 \text{H}^+(\text{aq}) + 2 \text{e}^- \rightarrow \text{H}_2(\text{g})$ | $E^\circ = 0.00 \text{ V}$ |
| $\text{Mn}^{2+}(\text{aq}) + 2 \text{e}^- \rightarrow \text{Mn}(\text{s})$ | $E^\circ = -1.18 \text{ V}$ |
- $\text{Pd}(\text{s})$
 - $\text{Mn}(\text{s})$
 - $\text{H}^+(\text{aq})$
 - $\text{Mn}^{2+}(\text{aq})$
16. Consider the following half-reactions:
- | | |
|--|-----------------------------|
| $\text{F}_2(\text{g}) + 2 \text{e}^- \rightarrow 2 \text{F}^-(\text{aq})$ | $E^\circ = +2.87 \text{ V}$ |
| $\text{Cu}^{2+}(\text{aq}) + 2 \text{e}^- \rightarrow \text{Cu}(\text{s})$ | $E^\circ = +0.34 \text{ V}$ |
| $\text{Sn}^{2+}(\text{aq}) + 2 \text{e}^- \rightarrow \text{Sn}(\text{s})$ | $E^\circ = -0.14 \text{ V}$ |
| $\text{Al}^{3+}(\text{aq}) + 3 \text{e}^- \rightarrow \text{Al}(\text{s})$ | $E^\circ = -1.66 \text{ V}$ |
| $\text{Na}^+(\text{aq}) + \text{e}^- \rightarrow \text{Na}(\text{s})$ | $E^\circ = -2.71 \text{ V}$ |
- Which of the above elements or ions will reduce $\text{Sn}^{2+}(\text{aq})$?
- $\text{Cu}(\text{s})$ and $\text{Al}^{3+}(\text{aq})$
 - $\text{F}^-(\text{aq})$ and $\text{Cu}(\text{s})$
 - $\text{Al}^{3+}(\text{aq})$ and $\text{Na}^+(\text{aq})$
 - $\text{Al}(\text{s})$ and $\text{Na}(\text{s})$
17. Given the following two half-reactions, write the overall balanced reaction in the direction in which it is spontaneous and calculate the standard cell potential.
- | | |
|--|-----------------------------|
| $\text{Cr}^{3+}(\text{aq}) + 3 \text{e}^- \rightarrow \text{Cr}(\text{s})$ | $E^\circ = -0.41 \text{ V}$ |
| $\text{Sn}^{2+}(\text{aq}) + 2 \text{e}^- \rightarrow \text{Sn}(\text{s})$ | $E^\circ = -0.14 \text{ V}$ |
- $3 \text{Cr}(\text{s}) + 2 \text{Sn}^{2+}(\text{aq}) \rightarrow 3 \text{Cr}^{3+}(\text{aq}) + 2 \text{Sn}(\text{s})$ $E^\circ_{\text{cell}} = -0.55 \text{ V}$
 - $2 \text{Cr}(\text{s}) + 3 \text{Sn}^{2+}(\text{aq}) \rightarrow 2 \text{Cr}^{3+}(\text{aq}) + 3 \text{Sn}(\text{s})$ $E^\circ_{\text{cell}} = +0.27 \text{ V}$
 - $2 \text{Cr}^{3+}(\text{aq}) + 3 \text{Sn}(\text{s}) \rightarrow 2 \text{Cr}(\text{s}) + 3 \text{Sn}^{2+}(\text{aq})$ $E^\circ_{\text{cell}} = +0.55 \text{ V}$
 - $2 \text{Cr}(\text{s}) + 3 \text{Sn}^{2+}(\text{aq}) \rightarrow 2 \text{Cr}^{3+}(\text{aq}) + 3 \text{Sn}(\text{s})$ $E^\circ_{\text{cell}} = +0.40 \text{ V}$
18. Calculate E°_{cell} for the reaction below,
- $$2 \text{Ag}^+(\text{aq}) + \text{Pb}(\text{s}) + \text{SO}_4^{2-}(\text{aq}) \rightarrow 2 \text{Ag}(\text{s}) + \text{PbSO}_4(\text{s})$$
- given the following standard reduction potentials.
- | | |
|--|------------------------------|
| $\text{PbSO}_4(\text{s}) + 2 \text{e}^- \rightarrow \text{Pb}(\text{s}) + \text{SO}_4^{2-}(\text{aq})$ | $E^\circ = -0.356 \text{ V}$ |
| $\text{Ag}^+(\text{aq}) + \text{e}^- \rightarrow \text{Ag}(\text{s})$ | $E^\circ = +0.799 \text{ V}$ |
19. Calculate E°_{cell} for the electrochemical cell below,

$\text{Pb(s)} \mid \text{PbCl}_2\text{(s)} \mid \text{Cl}^-\text{(aq, 1.0 M)} \parallel \text{Fe}^{3+}\text{(aq, 1.0 M), Fe}^{2+}\text{(aq, 1.0 M)} \mid \text{Pt(s)}$
 given the following reduction half-reactions.



20. Which of the following equations is a correct form of the Nernst equation?

a. $E = E^\circ - \left(\frac{RT}{nF} \right) \log Q$

c. $E = E^\circ + \log \left(\frac{RT}{nF} \right)$

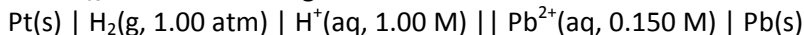
b. $E^\circ = E - \left(\frac{RT}{nF} \right) \ln Q$

d. $E = E^\circ - \left(\frac{RT}{nF} \right) \ln Q$

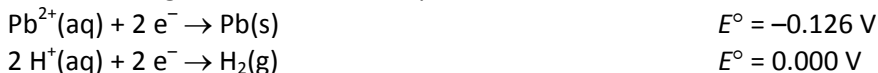
21. A Faraday, F , is defined as

- a. the charge on a single electron.
- b. the voltage required to reduce one mole of reactant.
- c. the moles of electrons required to reduce one mole of reactant.
- d. the charge, in coulombs, carried by one mole of electrons.

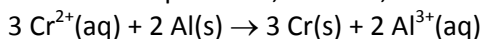
22. Calculate E_{cell} for the following electrochemical cell at 25 °C



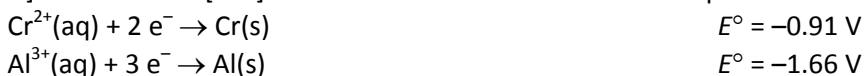
given the following standard reduction potentials.



23. Calculate the cell potential, at 25 °C, based upon the overall reaction



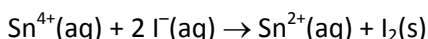
if $[\text{Cr}^{2+}] = 0.15 \text{ M}$ and $[\text{Al}^{3+}] = 0.0040 \text{ M}$. The standard reduction potentials are as follows:



24. What is the pH of the solution at the cathode if $E_{\text{cell}}^\circ = -0.094 \text{ V}$ for the following electrochemical cell at 25 °C?



25. E_{cell}° for the following galvanic cell is -0.39 V .



What is $\Delta_r G^\circ$ for this reaction?

26. Calculate $\Delta_r G^\circ$ for the disproportionation reaction of Cu^+ at 25 °C,



given the following thermodynamic information.



27. Given the following standard reduction potentials,
- | | |
|--|------------------------------|
| $\text{Hg}_2^{2+}(\text{aq}) + 2 \text{e}^- \rightarrow 2 \text{Hg}(\ell)$ | $E^\circ = +0.789 \text{ V}$ |
| $\text{Hg}_2\text{Cl}_2(\text{s}) + 2 \text{e}^- \rightarrow 2 \text{Hg}(\ell) + 2 \text{Cl}^-(\text{aq})$ | $E^\circ = +0.271 \text{ V}$ |
- determine K_{sp} for $\text{Hg}_2\text{Cl}_2(\text{s})$ at 25°C .
- a. 4.5×10^{-41} b. 9.0×10^{-36} c. 3.0×10^{-18} d. 1.4×10^{-36}
28. What charge, in coulombs, is required to deposit 0.34 g $\text{Al}(\text{s})$ from a solution of $\text{Al}^{3+}(\text{aq})$?
- a. $3.3 \times 10^4 \text{ C}$ b. $3.6 \times 10^3 \text{ C}$ c. $7.2 \times 10^3 \text{ C}$ d. $9.8 \times 10^4 \text{ C}$
29. The use of electrical energy to produce chemical change is known as _____. An example of this process is the reduction of $\text{NaCl}(\ell)$ to produce $\text{Na}(\text{s})$.
30. If electric current is passed through a solution of molten NaBr , the product at the anode is _____.
31. When a secondary battery provides electrical energy, it is acting as a(n) _____ cell. When the battery is recharging, it is operating as an electrolytic cell.
32. Which of the following species are likely to behave as oxidizing agents: $\text{K}(\text{s})$, $\text{H}_2(\text{g})$, $\text{Cr}_2\text{O}_7^{2-}(\text{aq})$, and $\text{I}_2(\text{s})$?
- a. $\text{K}(\text{s})$ only c. $\text{K}(\text{s})$ and $\text{Cr}_2\text{O}_7^{2-}(\text{aq})$
 b. $\text{Cr}_2\text{O}_7^{2-}(\text{aq})$ and $\text{I}_2(\text{s})$ d. $\text{H}_2(\text{g})$ and $\text{I}_2(\text{s})$
33. Which of the following ions have an $[\text{Ar}]3d^6$ electron configuration: Co^{2+} , Fe^{2+} , and Ni^{2+} ?
34. Identify the element with the ground state electron configuration $[\text{Xe}]4f^{14}5d^76s^2$.
35. What is the highest oxidation state for manganese?
- a. +3 b. +7 c. +10 d. +6
36. Which element from the first transition series does NOT react with hydrochloric acid?
- a. copper b. nickel c. cobalt d. chromium
37. Ions such as $[\text{Co}(\text{H}_2\text{O})_6]^{3+}$ and $[\text{Ag}(\text{CN})_2]^-$ are called ____.
- a. Lewis bases c. chelates
 b. coordination complexes d. ligands
38. Which molecule or ion does NOT act as a ligand?
- a. OH^- b. H_2O c. NH_4^+ d. CO
39. All of the following molecules or ions can act as polydentate ligands EXCEPT ____.
- a. acetylacetonate ion; $\text{CH}_3\text{COCHCOCH}_3^-$ c. oxalate ion; $\text{C}_2\text{O}_4^{2-}$
 b. ethylenediamine; $\text{H}_2\text{NCH}_2\text{CH}_2\text{NH}_2$ d. dimethylamine; $(\text{CH}_3)_2\text{NH}_2$
40. What is the coordination number of the central metal ion in $[\text{Fe}(\text{H}_2\text{O})_4(\text{CN})_2]\text{Cl}$?
41. What is the coordination number of the central metal ion in $[\text{Co}(\text{C}_2\text{O}_4)_2(\text{OH})_2]^{3-}$?
42. What is the oxidation state of iron in $\text{K}[\text{Fe}(\text{NH}_3)_2(\text{CN})_4]$?
43. What is the oxidation state of cobalt in $[\text{Co}(\text{NH}_3)_3(\text{H}_2\text{O})_2\text{Cl}]\text{Cl}_2$?

44. What is the name of the compound having the formula $K_3[CoCl_6]$?
45. What is the name of the compound having the formula $[Cr(en)_2(NH_3)_2]Cl_2$?
46. What is the name of the compound having the formula $(NH_4)_4[Ni(CN)_6]$?
47. What is the formula for dibromobis(ethylenediamine)titanium(IV) bromide?
48. What is the formula for potassium diamminetetrachlorovanadate(III)?
49. What are the possible geometries of a metal complex with a coordination number of 6?
1. square planar
 2. tetrahedral
 3. octahedral
- a. 1 only c. 3 only d. 1 and 2 e. 1, 2, and 3
- b. 2 only
50. Which of the following pairs of coordination compounds are coordination isomers?
- a. $[Co(NH_3)_4(H_2O)_2]Cl_2$ and $[Co(NH_3)_2(H_2O)_4]Cl_2$
 - b. $[Fe(NH_3)_6]Br_2$ and $[Fe(NH_3)_6]Br_3$
 - c. $[Ni(H_2O)_6]SO_4$ and $[Ni(H_2O)_6]SO_3$
 - d. $[Fe(NH_3)_5Br]SO_4$ and $[Fe(NH_3)_5SO_4]Br$
51. Which of the following species have geometric isomers: $[Fe(CN)_6]^{3-}$, $[Fe(CN)_5H_2O]^{2-}$, $[Fe(CN)_4(H_2O)_2]^-$, and $[Fe(CN)_3(H_2O)_3]$?
- a. $[Fe(CN)_4(H_2O)_2]^-$ and $[Fe(CN)_3(H_2O)_3]$
 - b. $[Fe(CN)_3(H_2O)_3]$ only
 - c. $[Fe(CN)_6]^{3-}$ only
 - d. $[Fe(CN)_5H_2O]^{2-}$, $[Fe(CN)_4(H_2O)_2]^-$, and $[Fe(CN)_3(H_2O)_3]$
52. Which of the following compounds may have linkage isomers?
- a. $[Cr(NH_3)_4Cl_2]Cl$
 - b. $[Cr(H_2O)_4Cl_2]Cl$
 - c. $[Cr(H_2O)_5(NO_2)]SO_4$
 - d. $[Cr(H_2O)_5Cl](SCN)_2$
53. Which one of the following complex ions has an optical isomer?
- a. $[Cu(CN)_4]^{2-}$
 - b. $[Zn(phen)_2]^{2+}$
 - c. $[Ni(en)_3]^{2+}$
 - d. $[Co(H_2O)_4en]^{2+}$
54. How many geometric isomers may exist for the square-planar complex ion $[Pt(CN)_2Cl_2]^{2-}$?
- a. 4
 - b. 5
 - c. 2
 - d. 6
55. In an octahedral complex, electrons in d_{z^2} and $d_{x^2-y^2}$ orbitals experience a greater repulsion from the lone pairs of electrons on ligands because these orbitals
- a. are oriented directly toward the incoming ligand electron pairs.
 - b. are located a greater distance from the metal ion nucleus.
 - c. are roughly spherical in shape, much like an s orbital.
 - d. each contain one unpaired electron.

56. All of the following statements concerning crystal field theory are true EXCEPT
- the crystal field splitting is larger in low-spin complexes than high-spin complexes.
 - low-spin complexes contain the maximum number of unpaired electrons.
 - in an isolated atom or ion, the five d orbitals have identical energy.
 - in low-spin complexes, electrons are concentrated in the d_{xy} , d_{yz} , and d_{xz} orbitals.
57. What is the number of unpaired electrons in an octahedral, high-spin Mn(II) complex?
- 1
 - 5
 - 4
 - 2
58. Determine the number of unpaired electrons in an octahedral, low-spin Cr(II) complex.
- 1
 - 2
 - 5
 - 4
59. If an octahedral cobalt(III) complex is paramagnetic, which of the following sets of conditions best describes the complex?
- low-spin, Δ_0 small
 - low-spin, Δ_0 large
 - high-spin, Δ_0 small
 - high-spin, Δ_0 large
 - none of these
60. Determine the number of unpaired electrons in the tetrahedral complex ion $[\text{Co}(\text{NH}_3)_4]^{2+}$.
- 1
 - 3
 - 2
 - 0
61. All of the following complexes will be colored (in the visible) EXCEPT ____.
- $[\text{Zn}(\text{en})_3]^{2+}$
 - $[\text{Ni}(\text{H}_2\text{O})_6]^{2+}$
 - $[\text{Cu}(\text{NH}_3)_4]^{2+}$
 - $[\text{Cr}(\text{NH}_3)_6]^{3+}$
62. The spectrochemical series
- lists ligands in the order of their electronegativity.
 - lists complex ions in order of their color.
 - lists ligands in order from monodentate to hexadentate.
 - lists ligands in order of their tendency to split d orbitals.
63. The effective atomic number (EAN) rule states that organometallic coordination compounds are likely to be stable if
- the sum of the metal valence electrons plus the electrons donated by the ligand equals 18.
 - the oxidation state of the metal is zero.
 - the ligand field splitting is small.
 - the metal has an odd atomic number.

Exam 3 Review Problems

Answer Section

1. ANS: D
2. ANS: $2 \text{H}^+(\text{aq}) + 2 \text{e}^- \rightarrow \text{H}_2(\text{g})$
3. ANS: $\text{H}_2\text{O}_2(\ell) + 2 \text{H}^+(\text{aq}) + 2 \text{e}^- \rightarrow 2 \text{H}_2\text{O}(\ell)$
4. ANS: $\text{SO}_4^{2-}(\text{aq}) + 4 \text{H}^+(\text{aq}) + 2 \text{e}^- \rightarrow \text{SO}_2(\text{g}) + 2 \text{H}_2\text{O}(\ell)$
5. ANS: $\text{MnO}_2(\text{s}) + 2 \text{H}_2\text{O}(\ell) + 2 \text{e}^- \rightarrow \text{Mn}(\text{OH})_2(\text{s}) + 2 \text{OH}^-(\text{aq})$
6. ANS: $4 \text{HNO}_3(\text{aq}) + 3 \text{Fe}^{2+}(\text{aq}) \rightarrow 3 \text{Fe}^{3+}(\text{aq}) + \text{NO}(\text{g}) + 2 \text{H}_2\text{O}(\ell) + 3 \text{NO}_3^-(\text{aq})$
7. ANS: $3 \text{ClO}^-(\text{aq}) + 2 \text{Cr}(\text{OH})_3(\text{s}) + 4 \text{OH}^-(\text{aq}) \rightarrow 3 \text{Cl}^-(\text{aq}) + 2 \text{CrO}_4^{2-}(\text{aq}) + 5 \text{H}_2\text{O}(\ell)$
8. ANS: D
9. ANS: $\text{Sn}(\text{s}) \mid \text{Sn}^{2+}(\text{aq}) \parallel \text{Ag}^+(\text{aq}) \mid \text{Ag}(\text{s})$
10. ANS: $\text{Zn}(\text{s}) \mid \text{Zn}^{2+}(\text{aq}) \parallel \text{Br}^-(\text{aq}) \mid \text{PbBr}_2(\text{s}) \mid \text{Pb}(\text{s})$
11. ANS: $\text{PbSO}_4(\text{s}) + \text{H}_2(\text{g}) \rightarrow \text{Pb}(\text{s}) + 2 \text{H}^+(\text{aq}) + \text{SO}_4^{2-}(\text{aq})$
12. ANS: C
13. ANS: B
14. ANS: C
15. ANS: B
16. ANS: D
17. ANS: B
18. ANS: +1.155 V
19. ANS: +1.038 V
20. ANS: D
21. ANS: D
22. ANS: -0.150 V
23. ANS: +0.77 V
24. ANS: 1.59
25. ANS: 75 kJ
26. ANS: -34.9 kJ
27. ANS: C
28. ANS: B
29. ANS: electrolysis
30. ANS: $\text{Br}_2(\text{g})$
31. ANS: voltaic
32. ANS: B
33. ANS: Fe^{2+} only
34. ANS: Ir
35. ANS: B
36. ANS: A
37. ANS: B
38. ANS: C
39. ANS: D
40. ANS: 6
41. ANS: 6
42. ANS: +3
43. ANS: +3
44. ANS: potassium hexachlorocobaltate(III)
45. ANS: diamminebis(ethylenediamine)chromium(II) chloride
46. ANS: ammonium hexacyanonickelate(II)
47. ANS: $[\text{TiBr}_2(\text{en})_2]\text{Br}_2$
48. ANS: $\text{K}[\text{V}(\text{NH}_3)_2\text{Cl}_4]$
49. ANS: C
50. ANS: D
51. ANS: A
52. ANS: C
53. ANS: C
54. ANS: C
55. ANS: A
56. ANS: B
57. ANS: B
58. ANS: B
59. ANS: C
60. ANS: B
61. ANS: A
62. ANS: D
63. ANS: A