General Chemistry II Exam 4 Practice Problems

1.In which of the following is the oxidation number of the underlined element given **incorrectly**?

		oxidation number
a.	$K_2\underline{Cr}_2O_7$	+6
b.	$NaAl(OH)_4$	+3
c.	$H\underline{I}O_4$	+5
d.	$(NH_4)_2\underline{S}O_4$	+6
e.	$NaH\underline{S}O_3$	+4

2.What is the coefficient of NaCl in the balanced formula unit equation?

$NaClO_3 + H_2O + I_2 \rightarrow HIO_3 + NaCl$

a. 1
b. 2
c. 3
d. 4
e. 5

3.Balance the following equation. How many HCl are there on the left side of the balanced equation?

$K_2Cr_2O_7 + Na_2SO_3 + HCl \rightarrow KCl + Na_2SO_4 + CrCl_3 + H_2O$

a. 1
b. 2
c. 3
d. 4
e. 8

4.Balance this equation for a reaction in basic solution. What is the coefficient of H_2O?

$KOH + Cl_2 \rightarrow KClO_3 + KCl + H_2O$

a. 8
b. 2
c. 3
d. 4
e. 6

5.Balance the following formula unit equation. What is the sum of **all** of the coefficients?

$KMnO_4 + H_2O_2 + H_2SO_4 \rightarrow O_2 + MnSO_4 + K_2SO_4 + H_2O$

a. 22
b. 24
c. 26
d. 28
e. 30

6.Balance the following equation. What is the sum of all coefficients?

$Cu + H^+ + SO_4^{2-} \rightarrow Cu^{2+} + H_2O + SO_2$

a. 9
b. 10
c. 11

d. 12
e. 13

7.Balance the following net ionic equation. What is the sum of the coefficients?

$MnO_4^- + I^- + H_2O \rightarrow I_2 + MnO_2 + OH^-$

a. 21
b. 23
c. 25
d. 27
e. 29

____ 8. Balance the following net ionic equation. Use H^+ rather than H_3O^+. What is the sum of the coefficients?

$H_2O_2 + Fe^{2+} \rightarrow Fe^{3+}$ (in acidic solution)

a. 13
b. 15
c. 7
d. 9
e. 11

9.What volume of 0.0100 *M* $KMnO_4$ solution is required to oxidize 42.5 mL of 0.0100 *M* $FeSO_4$ sulfuric acid solution?

$MnO_4^- + 8H^+ + 5Fe^{2+} \rightarrow Mn^{2+} + 5Fe^{3+} + 4H_2O$

a. 16.0 mL
b. 8.5 mL
c. 21.3 mL
d. 80.0 mL
e. 31.9 mL

10.What is the molarity of a solution of $FeSO_4$ if 25.06 mL of it reacts with 38.19 mL of 0.1214 *M* $KMnO_4$?

$MnO_4^- + 8H^+ + 5Fe^{2+} \rightarrow Mn^{2+} + 5Fe^{3+} + 4H_2O$

a. 0.1854 *M*
b. 0.3992 *M*
c. 0.07985 *M*
d. 0.4267 *M*
e. 0.9250 *M*

11.What volume of 0.1084 *M* $(COOH)_2$ solution would be required to react with 0.1268 grams of $KMnO_4$?

$(COOH)_2 + MnO_4^- + H^+ \rightarrow CO_2 + Mn^{2+} + H_2O$ (unbalanced)

a. 18.50 mL
b. 37.02 mL
c. 55.51 mL
d. 24.02 mL
e. 66.61 mL

12.When household ammonia is mixed with bleach, NaOCl, toxic chlorine gas and hydrazine, N_2H_4 is produced. What volume of 0.75 *M* NH_3 would react with 100 mL of 0.35 *M* NaOCl?

$NH_3 + OCl^- \rightarrow Cl_2 + N_2H_4$ (unbalanced)

a. 23.5 Ml

b. 100 mL
c. 94 mL
d. 26 mL
e. 47 mL

13. A 50.0-mL sample of $K_2Cr_2O_7$ solution oxidizes 1.500 g of Na_2SO_3 to Na_2SO_4. $Cr_2(SO_4)_3$ is also produced. What is the molarity of the $K_2Cr_2O_7$ solution?
a. 0.0794 *M*
b. 0.476 *M*
c. 2.96 *M*
d. 0.0952 *M*
e. 0.0158 *M*

14. In **any** electrochemical cell, the anode is **always** .
a. the positive electrode
b. the negative electrode
c. the electrode at which some species gains electrons
d. the electrode at which some species loses electrons
e. the electrode at which reduction occurs

15. During the electrolysis of molten sodium bromide, sodium ions move .
a. to the anode, which is positively charged
b. to the anode, which is negatively charged
c. to the cathode, which is positively charged
d. to the cathode, which is negatively charged
e. through the wire to the battery

16. The electrolysis of an aqueous sodium chloride solution using inert electrodes produces gaseous chlorine at one electrode. At the other electrode gaseous hydrogen is produced, and the solution becomes basic around the electrode. Which of the following is the equation for the cathode half-reaction in this electrolytic cell?
a. $2Cl^- \rightarrow Cl_2 + 2e^-$
b. $2H_2O + 2e^- \rightarrow H_2 + 2OH^-$
c. $Cl_2 + 2e^- \rightarrow 2Cl^-$
d. $H_2 + 2OH^- \rightarrow 2H_2O + 2e^-$
e. none of these

17. How many coulombs of charge pass through a cell if 2.40 amperes of current are passed through the cell for 85.0 minutes?
a. 2.04×10^2 C
b. 1.33×10^{-1} C
c. 1.22×10^4 C
d. 2.12×10^3 C
e. 3.40 C

18. How many moles of chromium would be electroplated by passing a current of 5.2 amperes through a solution of $Cr_2(SO_4)_3$ for 45.0 minutes?
a. 0.048 mol
b. 2.9 mol
c. 0.15 mol
d. 6.9 mol
e. 0.073 mol

19. How many grams of metallic nickel can be produced by the electrolysis of aqueous nickel(II) chloride, $NiCl_2$, with a 0.350 ampere current for 5.00 hours?
a. 1.19 g
b. 1.92 g
c. 7.66 g
d. 2.76 g
e. 3.83 g

20.How long would a constant current of 4.5 amperes be required to flow in order to plate out 15 g of chromium from a chromium(III) sulfate solution?

a. 268 hr
b. 309 hr
c. 5.15 hr
d. 23.2 hr
e. 1.72 hr

21.Molten $AlCl_3$ is electrolyzed for 5.0 hours with a current of 0.40 ampere. Metallic aluminum is produced at one electrode and chlorine gas, Cl_2, is produced at the other. How many liters of Cl_2 measured at STP are produced at the other electrode?

a. 0.56 L
b. 0.63 L
c. 0.84 L
d. 0.98 L
e. 1.02 L

22.Calculate the quantity of charge necessary to produce 10 liters of $H_2(g)$ at STP from the electrolysis of water.

a. 8.6×10^4 coulombs
b. 3.7×10^4 coulombs
c. 1.7×10^4 coulombs
d. 5.3×10^4 coulombs
e. 4.8×10^4 coulombs

23.Oxidation occurs at the in a voltaic cell and oxidation occurs at the in an electrolytic cell.

a. anode, anode
b. cathode, cathode
c. anode, cathode
d. cathode, anode
e. anode, salt bridge

24.A current of 15.0 amperes electroplated 50.0 g of hafnium (Hf) metal from an aqueous solution in 2.00 hours. What is the oxidation number (charge) of hafnium in the solution?

a. +1
b. +2
c. +3
d. +4
e. +5

25.A voltaic cell is constructed by immersing a strip of copper metal in 1.0 *M* $CuSO_4$ solution and a strip of aluminum in 0.50 *M* $Al_2(SO_4)_3$ solution. A wire and a salt bridge complete the circuit. The aluminum strip loses mass, and the concentration of aluminum ions in the solution increases. The copper electrode gains mass, and the concentration of copper ions decreases. Which of the following are applicable to the copper electrode?

I. The anode
II. The cathode
III. The positive electrode
IV. The electrode at which electrons are produced
V. The negative electrode
VI. The electrode at which electrons are used up

a. I, III, and V
b. I, IV, and V
c. II, IV, and V
d. II, III, and VI
e. None of the first four responses contains all the correct choices and no others.

26.Which of the following species is the strongest oxidizing agent?

a. Sn^{2+}
b. Sn^{4+}
c. Br_2

d. Br^-
e. Li

27. Which one of the following statements about the half-cell processes is true for the cell,

$Cd|Cd^{2+}(1\ M)||Cu^{2+}(1\ M)|Cu$?

a. Cu^{2+} is reduced at the anode.
b. Cu^{2+} is reduced at the cathode.
c. Cd^{2+} is reduced at the anode.
d. Cd^{2+} is reduced at the cathode.
e. The spontaneous reaction that occurs in this cell is not a redox reaction.

28. Which one of the following reactions is spontaneous (in the direction given) under standard electrochemical conditions?

a. $Pb^{2+} + 2I^- \rightarrow Pb + I_2$
b. $Cu^{2+} + Fe \rightarrow Cu + Fe^{2+}$
c. $2Au + Pt^{2+} \rightarrow 2Au^+ + Pt$
d. $Mg^{2+} + 2Br^- \rightarrow Mg + Br_2$
e. $2Hg + 2Cl^- + 2H^+ \rightarrow Hg_2Cl_2 + H_2$

29. What is the cell potential for a cell constructed by immersing a strip of manganese in a 1. *M* $MnSO_4$ solution and a strip of iron in a 1.0 *M* $FeSO_4$ solution and completing the circuit by a wire and a salt bridge?

a. -1.62 V
b. +1.62 V
c. -0.74 V
d. +0.74 V
e. +1.21 V

30. A voltaic cell is constructed by immersing a strip of copper metal in 1.0 *M* $CuSO_4$ solution and a strip of aluminum in 0.50 *M* $Al_2(SO_4)_3$ solution. A wire and a salt bridge complete the circuit. The aluminum strip loses mass, and the concentration of aluminum ions in the solution increases. The copper electrode gains mass, and the concentration of copper ions decreases. What is the cell potential?

a. +1.28 V
b. +2.00 V
c. +2.34 V
d. +2.50 V
e. +3.66 V

31. Given the following standard electrode potentials:

Half-Reaction	E^0
$O_2(g) + 4H^+ + 4e^- \rightarrow 2H_2O$	+1.23 V
$2CO_2(g) + 2H^+ + 2e^- \rightarrow (COOH)_2$	-0.49 V

Which response contains all the true statements and no others? (Assume all species are present under standard electrochemical conditions.)

I. H_2O will spontaneously oxidize $(COOH)_2$ to form CO_2.
II. $O_2(g)$ will spontaneously oxidize $(COOH)_2$ to form CO_2.
III. $(COOH)_2$ will spontaneously reduce $O_2(g)$ to form H_2O.
IV. H^+ will spontaneously reduce $(COOH)_2$ to form CO_2.
V. CO_2 will spontaneously oxidize H_2O to form $O_2(g)$.

a. II, IV, and V
b. I, III, and IV
c. II and III
d. I and IV

e. III and V

32. Which response lists all of the following reactions that are spontaneous?

I. $F_2(g) + SO_2 + 2H_2O \rightarrow 2F^- + SO_4^{2-} + 4H^+$
II. $Cl_2(g) + Sn^{2+} \rightarrow 2Cl^- + Sn^{4+}$
III. $2NO(g) + 4H_2O + 3Br_2(l) \rightarrow 6Br^- + 2NO_3^- + 8H^+$
IV. $H_2O_2 + 2H^+ + 2I^- \rightarrow 2H_2O(l) + I_2(s)$

a. I and III
b. II and IV
c. I, II, and III
d. II, III, and IV
e. I, II, III, and IV

33. Calculate the reduction potential of the Zn^{2+}/Zn electrode when $[Zn^{2+}] = 1.0 \times 10^{-8}$ *M*.

a. -0.73 V
b. -0.75 V
c. -0.76 V
d. -0.77 V
e. -1.00 V

34. A cell is constructed by immersing a strip of silver in 0.10 *M* $AgNO_3$ solution and a strip of lead in 1.0 *M* $Pb(NO_3)_2$ solution. A wire and salt bridge complete the cell. What is the potential of the silver electrode in the cell?

a. 0.74 V
b. 0.80 V
c. 0.83 V
d. 0.86 V
e. 0.88 V

35. What is the cell potential for the reaction below if $[Cr_2O_7^{2-}] = 0.0010$ *M*, $[Cr^{3+}] = 0.150$ *M*, $[H^+] = 1.00$ *M*, and $[Br^-] =$ 0.450 *M*, and some bromine is also present initially?

$Cr_2O_7^{2-} + 14H^+ + 6Br^- \rightarrow 3Br_2(l) + 2Cr^{3+} + 7H_2O(l)$

a. +0.28 V
b. +0.31 V
c. 0.22 V
d. +0.24 V
e. +0.29 V

36. Calculate E_{cell} for the following voltaic cell.

$Ag|Ag^+(1.0 \times 10^{-5}\ M)||Au^{3+}(1.0 \times 10^{-1}\ M)|Au$

a. +0.78 V
b. +0.46 V
c. +0.88 V
d. +0.98 V
e. +2.58 V

37. What is ΔG^0 at 25°C for the reaction below? (F = 96,500 J/V•mol e^-)

$Cu^{2+} + Cd \rightarrow Cu + Cd^{2+}$

a. -71.1 kJ
b. -143 kJ
c. 597 kJ

d. 193 kJ
e. +71.1 kJ

38. What product is formed at the anode when molten sodium chloride, NaCl, is electrolyzed using a Downs cell?
a. O_2
b. Cl_2
c. NaOH
d. H_2
e. Na metal

39. How long would a constant current of 18.0 amperes be required to flow in order for 9000. coulombs of charge to pass through a cell?
a. 200. s
b. 500. s
c. 0.002 s
d. 50. s
e. 1.6×10^5 s

40. Current is passed through a cell where the half-reaction that occurs at the cathode is $5e^- + MnO_4^- + 8H^+ \rightarrow Mn^{2+} + 4H_2O$. All the MnO_4^- ions present in 25.0 mL of solution have been reduced after a current of 0.600 ampere has passed for 844 seconds. What was the original concentration of MnO_4^- ions?
a. 7.10×10^{-3} *M*
b. 1.02×10^{-1} *M*
c. 0.21 *M*
d. 1.47 *M*
e. 4.20×10^{-2} *M*

41. A zinc bar weighing 3.0 kg is attached to a buried iron pipe to protect the pipe from corrosion. An average current of 0.020 A flows between the bar and the pipe. How many years will be required for the zinc bar to be entirely consumed? (1 yr = 3.16×10^7 s)
a. 600yr
b. 14.0 yr
c. 5.99 yr
d. 7.00 yr
e. 6.66 yr

42. Calculate ΔG^0 for the following reaction from its *E*value.

F = 96,500 J/V•mol e^-)
$3Hg_2Cl_2 + 2Cr \rightarrow 2Cr^{3+} + 6Hg + 6Cl^-$

a. -1.12×10^3 kJ
b. -585 kJ
c. -361 kJ
d. 1.62×10^3 kJ
e. -1.78×10^3 kJ

General Chemistry II Exam 4 Practice Problems
Answer Section

MULTIPLE CHOICE

1. ANS: C PTS: 1 TOP: Balancing Redox Reactions
2. ANS: E PTS: 1 TOP: Balancing Redox Reactions
3. ANS: E PTS: 1 TOP: Balancing Redox Reactions
4. ANS: C PTS: 1 TOP: Balancing Redox Reactions
5. ANS: C PTS: 1 TOP: Balancing Redox Reactions
6. ANS: B PTS: 1 TOP: Balancing Redox Reactions
7. ANS: C PTS: 1 TOP: Balancing Redox Reactions
8. ANS: D PTS: 1 TOP: Balancing Redox Reactions
9. ANS: B PTS: 1 TOP: Stoichiometry of Redox Reactions
10. ANS: E PTS: 1 TOP: Stoichiometry of Redox Reactions
11. ANS: A PTS: 1 TOP: Stoichiometry of Redox Reactions
12. ANS: E PTS: 1 TOP: Stoichiometry of Redox Reactions
13. ANS: A PTS: 1 TOP: Stoichiometry of Redox Reactions
14. ANS: D PTS: 1 TOP: Electrodes
15. ANS: D PTS: 1 TOP: The Electrolysis of Molten Salts
16. ANS: B PTS: 1 TOP: The Electrolysis of Aqueous Salt Solutions
17. ANS: C PTS: 1 TOP: Faraday's Law of Electrolysis
18. ANS: A PTS: 1 TOP: Faraday's Law of Electrolysis
19. ANS: B PTS: 1 TOP: Faraday's Law of Electrolysis
20. ANS: C PTS: 1 TOP: Faraday's Law of Electrolysis
21. ANS: C PTS: 1 TOP: Faraday's Law of Electrolysis
22. ANS: A PTS: 1 TOP: Faraday's Law of Electrolysis
23. ANS: A PTS: 1 TOP: Voltaic or Galvanic Cells
24. ANS: D PTS: 1
25. ANS: D
    A table of standard electrode potentials may be necessary for this question.

    PTS: 1 TOP: Voltaic or Galvanic Cells
26. ANS: C
    A table of standard electrode potentials may be necessary for this question.

    PTS: 1 TOP: Standard Electrode Potentials
27. ANS: B
    A table of standard electrode potentials may be necessary for this question.

    PTS: 1 TOP: Uses of Standard Electrode Potentials
28. ANS: B
    A table of standard electrode potentials may be necessary for this question.

    PTS: 1 TOP: Uses of Standard Electrode Potentials
29. ANS: D
    A table of standard electrode potentials may be necessary for this question.

    PTS: 1 TOP: Uses of Standard Electrode Potentials
30. ANS: B

A table of standard electrode potentials may be necessary for this question.

PTS: 1 TOP: Uses of Standard Electrode Potentials

31. ANS: C
A table of standard electrode potentials may be necessary for this question.

PTS: 1 TOP: Standard Electrode Potentials for Other Half-Reactions

32. ANS: E
A table of standard electrode potentials may be necessary for this question.

PTS: 1 TOP: Standard Electrode Potentials for Other Half-Reactions

33. ANS: E
A table of standard electrode potentials may be necessary for this question.

PTS: 1 TOP: The Nernst Equation

34. ANS: A
A table of standard electrode potentials may be necessary for this question.

PTS: 1 TOP: The Nernst Equation

35. ANS: C
A table of standard electrode potentials may be necessary for this question.

PTS: 1 TOP: The Nernst Equation

36. ANS: D
A table of standard electrode potentials may be necessary for this question.

PTS: 1 TOP: The Nernst Equation

37. ANS: B
A table of standard electrode potentials may be necessary for this question.

PTS: 1 TOP: The Relationship of E... to Delta G0 and K

38. ANS: B PTS: 1 TOP: The Electrolysis of Molten Salts
39. ANS: B PTS: 1 TOP: Faraday's Law of Electrolysis
40. ANS: E PTS: 1 TOP: Faraday's Law of Electrolysis
41. ANS: B
A table of standard electrode potentials may be necessary for this question.

PTS: 1 TOP: Corrosion Protection

42. ANS: B PTS: 1 TOP: The Relationship of E... to Delta G0 and K