Acid/Base & Redox After School Regents Review Practice

1. Why is potassium nitrate classified as an electrolyte?

   A) It is a molecular compound.
   B) It contains a metal.
   C) It can conduct electricity as a solid.
   D) It releases ions in an aqueous solution.

2. Which substance is an electrolyte?

   A) CCl_4 B) $C_6H_{12}O_6$
   C) SiO_2 **D) H_2SO_4**

3. Which laboratory test result can be used to determine if KCl(s) is an electrolyte?

   A) pH of KCl(aq)
   B) pH of KCl(s)
   C) electrical conductivity of KCl(aq)
   D) electrical conductivity of KCl(s)

4. Which pair of compounds represents one Arrhenius acid and one Arrhenius base?

   A) CH_3OH and NaOH B) CH_3OH and HCl
   C) HNO_3 and NaOH D) HNO_3 and HCl

5. Given the equation representing a reaction:

   $H_2CO_3 + NH_3 \rightarrow NH_4^+ + HCO_3^-$

   According to one acid-base theory, the compound NH_3 acts as a base because it

   A) accepts a hydrogen ion
   B) donates a hydrogen ion
   C) accepts a hydroxide ion
   D) donates a hydroxide ion

6. Which substance yields $H^+(aq)$ as the only positive ion in an aqueous solution?

   A) CH_3CHO B) CH_3CH_2OH
   C) CH_3COOH D) CH_3OCH_3

7. Given the equation:

   $HCl(g) + H_2O(\ell) \rightarrow X(aq) + Cl^-(aq)$
   Which ion is represented by *X*?

   A) hydroxide **B) hydronium**
   C) hypochlorite D) perchlorate

8. When the concentration of hydrogen ions in a solution is *decreased* by a factor of ten, the pH of the solution

   A) increases by 1 B) increases by 10
   C) decreases by 1 D) decreases by 10

9. Compared to a solution with a pH value of 7, a solution with a thousand times greater hydronium ion concentration has a pH value of

   A) 10 B) 7 C) 3 **D) 4**

10. Which statement describes characteristics of a 0.01 M KOH(aq) solution?

    A) The solution is acidic with a pH less than 7.
    B) The solution is acidic with a pH greater than 7.
    C) The solution is basic with a pH less than 7.
    D) The solution is basic with a pH greater than 7.

11. Both $HNO_3(aq)$ and $CH_3COOH(aq)$ can be classified as

    A) Arrhenius acids that turn blue litmus red
    B) Arrhenius bases that turn blue litmus red
    C) Arrhenius acids that turn red litmus blue
    D) Arrhenius bases that turn red litmus blue

12. Which type of reaction occurs when $H^+(aq)$ reacts with $OH^-(aq)$?

    A) combustion B) decomposition
    C) fermentation **D) neutralization**

13. Which statement explains why 10.0 mL of a 0.50 M $H_2SO_4(aq)$ solution exactly neutralizes 5.0 mL of a 2.0 M NaOH(aq) solution?

    A) The moles of $H^+(aq)$ equal the moles of $OH^-(aq)$.
    B) The moles of $H_2SO_4(aq)$ equal the moles of NaOH(aq).
    C) The moles of $H_2SO_4(aq)$ are greater than the moles of NaOH(aq).
    D) The moles of $H^+(aq)$ are greater than the moles of $OH^-(aq)$.

14. Which solution reacts with LiOH(aq) to produce a salt and water?

    A) KCl(aq) B) CaO(aq)
    C) NaOH(aq) **D) $H_2SO_4(aq)$**

15. Which equation represents a neutralization reaction?

    A) $4Fe(s) + 3O_2(g) \rightarrow Fe_2O_3(s)$
    B) $2H_2(g) + O_2(g) \rightarrow 2H_2O(\ell)$
    C) $HNO_3(aq) + KOH(aq) \rightarrow KNO_3(aq) + H_2O(\ell)$
    D) $AgNO_3(aq) + KCl(aq) \rightarrow KNO_3(aq) + AgCl(s)$

16. Which reactants form the salt $CaSO_4(s)$ in a neutralization reaction?

    A) $H_2S(g)$ and $Ca(ClO_4)_2(s)$
    B) $H_2SO_3(aq)$ and $Ca(NO_3)_2(aq)$
    C) $H_2SO_4(aq)$ and $Ca(OH)_2(aq)$
    D) $SO_2(g)$ and $CaO(s)$

17. Which laboratory process is used to determine the concentration of one solution by using a volume of another solution of known concentration?

    A) crystallization B) distillation
    C) filtration **D) titration**

Base your answers to questions **18** through **21** on the information below and on your knowledge of chemistry.

A company produces a colorless vinegar that is 5.0% $HC_2H_3O_2$ in water. Using thymol blue as an indicator, a student titrates a 15.0-milliliter sample of the vinegar with 43.1 milliliters of a 0.30 M NaOH (aq) solution until the acid is neutralized.

18. Determine the molarity of the $HC_2H_3O_2$ in the vinegar sample, using the titration data.

19. The concentration of the base used in this titration is expressed to what number of significant figures?

20. Identify the negative ion in the NaOH(aq) used in this titration.

21. Based on Table *M*, what is the color of the indicator in the vinegar solution before any base is added?

22. Base your answer to the following question on the information below and on your knowledge of chemistry.

The incomplete data table below shows the pH value of solutions *A* and *B* and the hydrogen ion concentration of solution *A*.

Hydrogen Ion and pH Data for HCl(aq) Solutions

HCl(aq) Solution	Hydrogen Ion Concentration (M)	pH
A	1.0×10^{-2}	2.0
B	?	5.0

Determine the hydrogen ion concentration of solution *B*.

23. Base your answer to the following question on the information below and on your knowledge of chemistry.

In a titration, 50.0 milliliters of 0.026 M HCl(aq) is neutralized by 38.5 milliliters of KOH(aq).

Complete the equation for the neutralization by writing the formula of the missing product.

$$\mathrm{KOH(aq) + HCl(aq) \rightarrow \_\_\_\_\_\ (aq) + H_2O(\ell)}$$

24. Given the balanced equation representing a reaction:

$2KClO_3(s) \rightarrow 2KCl(s) + 3O_2(g)$

The oxidation state of chlorine in this reaction changes from

A) –1 to +1 B) –1 to +5
C) +1 to –1 **D) +5 to –1**

25. What occurs when Cr^{3+} ions are reduced to Cr^{2+} ions?

A) Electrons are lost and the oxidation number of chromium increases.
B) Electrons are lost and the oxidation number of chromium decreases.
C) Electrons are gained and the oxidation number of chromium increases.
D) Electrons are gained and the oxidation number of chromium decreases.

26. Which type of reaction involves the transfer of electrons?

A) alpha decay
B) double replacement
C) neutralization
D) oxidation-reduction

27. Which half-reaction correctly represents reduction?

A) $Mn^{4+} \rightarrow Mn^{3+} + e^-$
B) $Mn^{4+} \rightarrow Mn^{7+} + 3e^-$
C) $Mn^{4+} + e^- \rightarrow Mn^{3+}$
D) $Mn^{4+} + 3e^- \rightarrow Mn^{7+}$

28. Given the balanced ionic equation representing a reaction:

$$2\ Al^{3+}(aq) + 3\ Mg(s) \rightarrow 3\ Mg^{2+}(aq) + 2\ Al(s)$$

In this reaction, electrons are transferred from

A) Al to Mg^{2+} B) Al^{3+} to Mg
C) Mg to Al^{3+} D) Mg^{2+} to Al

29. Which ion is most easily reduced?

    A) Zn^{2+} B) Mg^{2+} **C) Co^{2+}** D) Ca^{2+}

30. Given the balanced ionic equation representing a reaction:

    $$2Al(s) + 3Cu^{2+}(aq) \rightarrow 2Al^{3+}(aq) + 3Cu(s)$$

    Which half-reaction represents the reduction that occurs?

    A) $Al \rightarrow Al^{3+} + 3e$
    B) $Al^{3+} + 3e \rightarrow Al$
    C) $Cu \rightarrow Cu^{2+} + 2e$
    D) $Cu^{2+} + 2e \rightarrow Cu$

31. Which equation represents an oxidation- reduction reaction?

    A) $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$
    B) $H_2SO_4 + Ca(OH)_2 \rightarrow CaSO_4 + 2H_2O$
    C) $MgCrO_4 + BaCl_2 \rightarrow MgCl_2 + BaCrO_4$
    D) $Zn(NO_3)_2 + Na_2CO_3 \rightarrow 2NaNO_3 + ZnCO_3$

32. Which metal will spontaneously react with $Zn^{2+}(aq)$, but will *not* spontaneously react with $Mg^{2+}(aq)$?

    A) Mn(s) B) Cu(s)
    C) Ni(s) D) Ba(s)

33. Which reaction occurs spontaneously?

    A) $Cl_2(g) + 2NaBr(aq) \rightarrow Br_2(\ell) + 2NaCl(aq)$
    B) $Cl_2(g) + 2NaF(aq) \rightarrow F_2(g) + 2NaCl(aq)$
    C) $I_2(s) + 2NaBr(aq) \rightarrow Br_2(\ell) + 2NaI(aq)$
    D) $I_2(s) + 2NaF(aq) \rightarrow F_2(g) + 2NaI(aq)$

34. Given the reaction:

    $$\_\_ Cl_2(g) + \_\_ Fe^{2+}(aq) \rightarrow \_\_ Fe^{3+}(aq) + \_\_ Cl^{-}(aq)$$

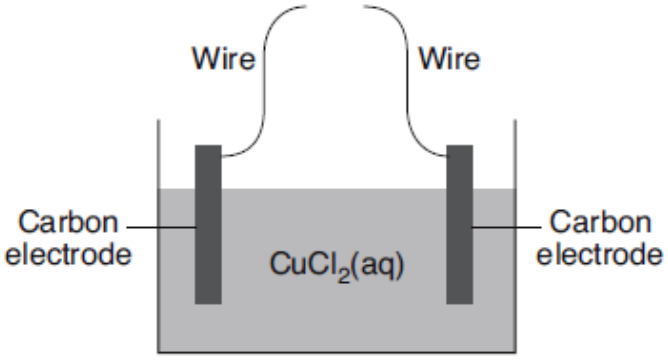
    When the equation is correctly balanced using *smallest* whole numbers, the coefficient of $Cl^{-}(aq)$ will be

    A) 1 **B) 2** C) 6 D) 7

35. Which statement describes where the oxidation and reduction half-reactions occur in an operating electrochemical cell?

A) Oxidation and reduction both occur at the anode.
B) Oxidation and reduction both occur at the cathode.
C) Oxidation occurs at the anode, and reduction occurs at the cathode.
D) Oxidation occurs at the cathode, and reduction occurs at the anode.

36. Given the diagram representing an incomplete electrochemical cell:



Solid copper will be deposited on one of the carbon electrodes when the wires are connected to

A) each other
B) a battery
C) a switch
D) a voltmeter

37. A student collects the materials and equipment below to construct a voltaic cell:

• two 250-mL beakers
• wire and a switch
• one strip of magnesium
• one strip of copper
• 125 mL of 0.20 M $Mg(NO_3)_2(aq)$
• 125 mL of 0.20 M $Cu(NO_3)_2(aq)$

Which additional item is required for the construction of the voltaic cell?

A) an anode
B) a battery
C) a cathode
D) a salt bridge

38. Given the balanced equation representing the reaction occurring in a voltaic cell:
$Zn(s) + Pb^{2+}(aq) \rightarrow Zn^{2+}(aq) + Pb(s)$
In the completed external circuit, the electrons flow from

A) Pb(s) to Zn(s)
B) $Pb^{2+}(aq)$ to $Zn^{2+}(aq)$
C) Zn(s) to Pb(s)
D) $Zn^{2+}(aq)$ to $Pb^{2+}(aq)$

39. Which device requires electrical energy to produce a chemical change?

A) electrolytic cell
B) salt bridge
C) voltaic cell
D) voltmeter

40. An electrolytic cell differs from a voltaic cell because an electrolytic cell

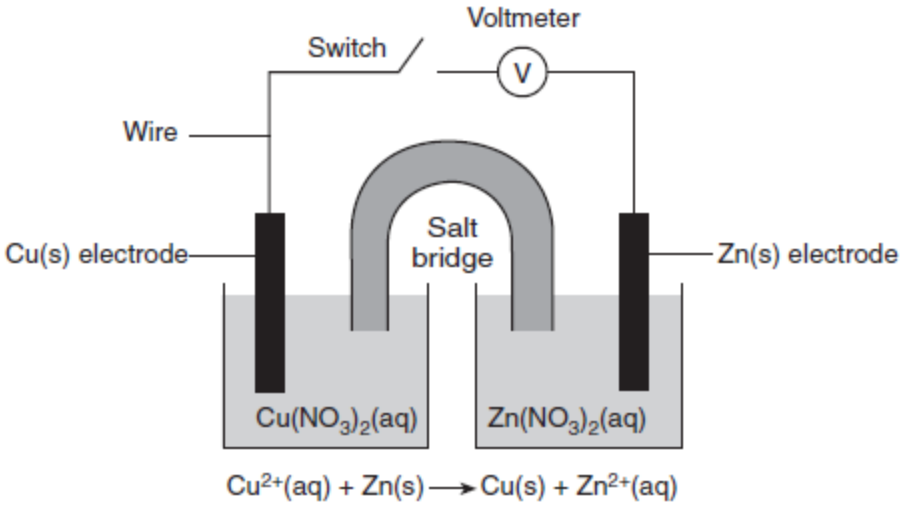
A) generates its own energy from a spontaneous physical reaction
B) generates its own energy from a nonspontaneous physical reaction
C) requires an outside energy source for a spontaneous chemical reaction to occur
D) requires an outside energy source for a nonspontaneous chemical reaction to occur

41. Energy is required to produce a chemical change during

A) chromatography
B) electrolysis
C) boiling
D) melting

Base your answers to questions **42** through **45** on the information below and on your knowledge of chemistry.

A student constructs an electrochemical cell during a laboratory investigation. When the switch is closed, electrons flow through the external circuit. The diagram and ionic equation below represent this cell and the reaction that occurs.



42. State what happens to the mass of the Cu electrode and the mass of the Zn electrode in the operating cell.

43. Write a balanced equation for the half-reaction that occurs in the Cu half-cell when the cell operates.

44. State in terms of the Cu(s) electrode and the Zn(s) electrode, the direction of electron flow in the external circuit when the cell operates.

45. State the form of energy that is converted to electrical energy in the operating cell.

46. Base your answer to the following question on the information below and on your knowledge of chemistry.

A student develops the list shown below that includes laboratory equipment and materials for constructing a voltaic cell.

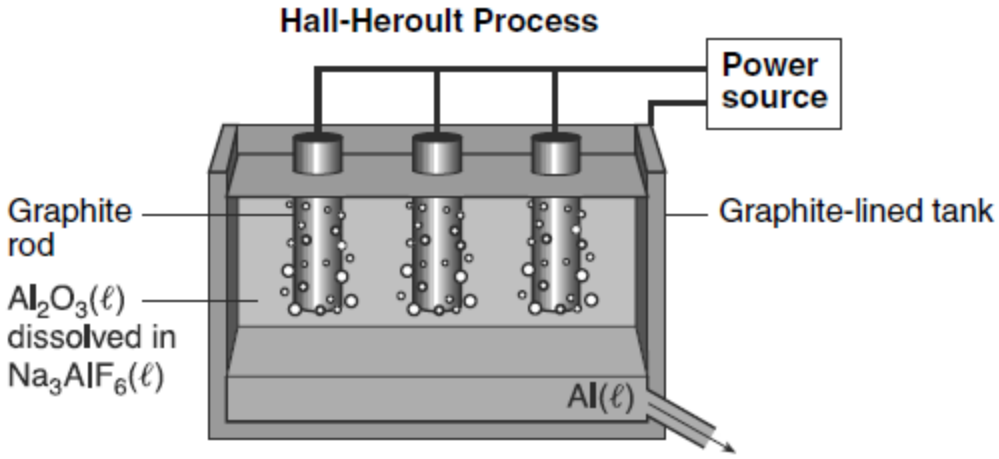
Laboratory Equipment and Materials

- a strip of zinc
- a strip of copper
- a 250-mL beaker containing 150 mL of 0.1 M zinc nitrate
- a 250-mL beaker containing 150 mL of 0.1 M copper (II) nitrate
- wires
- a voltmeter
- a switch
- a salt bridge

State the purpose of the salt bridge in the voltaic cell.

Base your answers to questions **47** through **50** on the information below and on your knowledge of chemistry.

In the late 19th century, the Hall-Herroult process was invented as an inexpensive way to produce aluminum. In this process, $Al_2O_3(\ell)$ extracted from bauxite is dissolved in $Na_3AlF_6(\ell)$ in a graphite-lined tank, as shown in the diagram below. The products are carbon dioxide and molten aluminum metal.



47. Compare the density of the $Al(\ell)$ with the density of the mixture of $Al_2O_3(\ell)$ and $Na_3AlF_6(\ell)$.

48. What is the melting point of the substance that collects at the bottom of the tank?

49. Write the chemical name for the liquid compound dissolved in the $Na_3AlF_6(\ell)$.

50. Compare the chemical properties of a 300.-kilogram sample of $Al_2O_3(\ell)$ with the chemical properties of a 600.-kilogram sample of $Al_2O_3(\ell)$.

Answer Key
Review Acids and Bases/Redox

1. **D**
2. **D**
3. **C**
4. **C**
5. **A**
6. **C**
7. **B**
8. **A**
9. **D**
10. **D**
11. **A**
12. **D**
13. **A**
14. **D**
15. **C**
16. **C**
17. **D**
18. — 0.86 M *or* — 0.862 M
19. — 2 *or* two
20. — OH^- *or* hydroxide
21. — yellow
22. 1.0×10^{-5} M

    1×10^{-5} M

    0.000 01 M

    10^{-5} M
23. – KCI – ClK – K^+ (aq) + CL^-(aq) – K^+ + Cl^-
24. **D**
25. **D**
26. **D**
27. **C**
28. **C**
29. **C**
30. **D**
31. **A**
32. **A**
33. **A**
34. **B**
35. **C**
36. **B**
37. **D**
38. **C**
39. **A**
40. **D**
41. **B**
42. — Cu electrode : mass increases, — Zn electrode : mass decreases
43. $Cu^{2+}(aq) + 2e^- \rightarrow Cu(s)$

    $2e^- + Cu^{+2} \rightarrow Cu$
44. — Electrons flow from the zinc electrode to the copper electrode through the wires and voltmeter. — The e^- flow is from Zn to Cu.
45. — Chemical potential energy, — Chemical, — Potential
46. — The salt bridge allows ions to migrate between the half-cells. — Electrical neutrality of the solutions is maintained. — The purpose is to prevent polarization. — allows charge to flow
47. –The density of the aluminum is greater than the density of the Al_2O_3 and $Na_3AlF_6(\ell)$ mixture. –The density of Al(ℓ) is greater.
48. 933 K.
49. aluminum oxide
50. –Both samples have the same chemical properties.