

Acid/Base & Redox After School Regents Review Practice

- Why is potassium nitrate classified as an electrolyte?
 - It is a molecular compound.
 - It contains a metal.
 - It can conduct electricity as a solid.
 - It releases ions in an aqueous solution.
- Which substance is an electrolyte?
 - CCl₄
 - C₆H₁₂O₆
 - SiO₂
 - H₂SO₄
- Which laboratory test result can be used to determine if KCl(s) is an electrolyte?
 - pH of KCl(aq)
 - pH of KCl(s)
 - electrical conductivity of KCl(aq)
 - electrical conductivity of KCl(s)
- Which pair of compounds represents one Arrhenius acid and one Arrhenius base?
 - CH₃OH and NaOH
 - CH₃OH and HCl
 - HNO₃ and NaOH
 - HNO₃ and HCl
- Given the equation representing a reaction:
$$\text{H}_2\text{CO}_3 + \text{NH}_3 \rightarrow \text{NH}_4^+ + \text{HCO}_3^-$$
According to one acid-base theory, the compound NH₃ acts as a base because it
 - accepts a hydrogen ion
 - donates a hydrogen ion
 - accepts a hydroxide ion
 - donates a hydroxide ion
- Which substance yields H⁺(aq) as the only positive ion in an aqueous solution?
 - CH₃CHO
 - CH₃CH₂OH
 - CH₃COOH
 - CH₃OCH₃
- Given the equation:
$$\text{HCl}(\text{g}) + \text{H}_2\text{O}(\ell) \rightarrow \text{X}(\text{aq}) + \text{Cl}^-(\text{aq})$$
Which ion is represented by X?
 - hydroxide
 - hydronium
 - hypochlorite
 - perchlorate
- When the concentration of hydrogen ions in a solution is *decreased* by a factor of ten, the pH of the solution
 - increases by 1
 - increases by 10
 - decreases by 1
 - decreases by 10
- 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
 - 10
 - 7
 - 3
 - 4
- Which statement describes characteristics of a 0.01 M KOH(aq) solution?
 - The solution is acidic with a pH less than 7.
 - The solution is acidic with a pH greater than 7.
 - The solution is basic with a pH less than 7.
 - The solution is basic with a pH greater than 7.
- Both HNO₃(aq) and CH₃COOH(aq) can be classified as
 - Arrhenius acids that turn blue litmus red
 - Arrhenius bases that turn blue litmus red
 - Arrhenius acids that turn red litmus blue
 - Arrhenius bases that turn red litmus blue
- Which type of reaction occurs when H⁺(aq) reacts with OH⁻(aq)?
 - combustion
 - decomposition
 - fermentation
 - neutralization
- Which statement explains why 10.0 mL of a 0.50 M H₂SO₄(aq) solution exactly neutralizes 5.0 mL of a 2.0 M NaOH(aq) solution?
 - The moles of H⁺(aq) equal the moles of OH⁻(aq).
 - The moles of H₂SO₄(aq) equal the moles of NaOH(aq).
 - The moles of H₂SO₄(aq) are greater than the moles of NaOH(aq).
 - The moles of H⁺(aq) are greater than the moles of OH⁻(aq).
- Which solution reacts with LiOH(aq) to produce a salt and water?
 - KCl(aq)
 - CaO(aq)
 - NaOH(aq)
 - H₂SO₄(aq)

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15. Which equation represents a neutralization reaction?

- A) $4\text{Fe(s)} + 3\text{O}_2\text{(g)} \rightarrow \text{Fe}_2\text{O}_3\text{(s)}$
- B) $2\text{H}_2\text{(g)} + \text{O}_2\text{(g)} \rightarrow 2\text{H}_2\text{O(l)}$
- C) $\text{HNO}_3\text{(aq)} + \text{KOH(aq)} \rightarrow \text{KNO}_3\text{(aq)} + \text{H}_2\text{O(l)}$
- D) $\text{AgNO}_3\text{(aq)} + \text{KCl(aq)} \rightarrow \text{KNO}_3\text{(aq)} + \text{AgCl(s)}$

16. Which reactants form the salt $\text{CaSO}_4\text{(s)}$ in a neutralization reaction?

- A) $\text{H}_2\text{S(g)}$ and $\text{Ca(ClO}_4)_2\text{(s)}$
- B) $\text{H}_2\text{SO}_3\text{(aq)}$ and $\text{Ca(NO}_3)_2\text{(aq)}$
- C) $\text{H}_2\text{SO}_4\text{(aq)}$ and $\text{Ca(OH)}_2\text{(aq)}$
- D) $\text{SO}_2\text{(g)}$ 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% $\text{HC}_2\text{H}_3\text{O}_2$ 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 $\text{HC}_2\text{H}_3\text{O}_2$ 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.

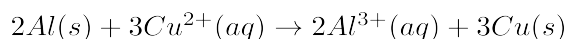
21. Based on Table *M*, what is the color of the indicator in the vinegar solution before any base is added?

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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:



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) $Zn(NO_3)_2 + Na_2CO_3 \rightarrow 2NaNO_3 + ZnCO_3$

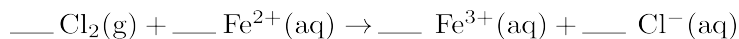
32. Which metal will spontaneously react with $Zn^{2+}(aq)$, but will *not* spontaneously react with $Mg^{2+}(aq)$?

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

33. Which reaction occurs spontaneously?

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

34. Given the reaction:



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

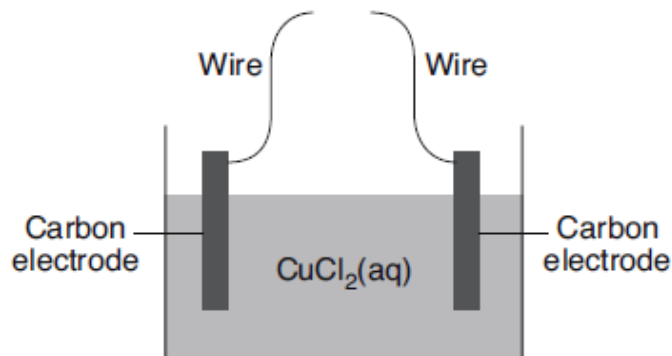
- A) 1 B) 2 C) 6 D) 7
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35. Which statement describes where the oxidation and reduction half-reactions occur in an operating electrochemical cell?

- 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

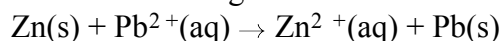
37. A student collects the materials and equipment below to construct a voltaic cell:

- two 250-mL beakers
- wire and a switch
- one strip of magnesium
- one strip of copper
- 125 mL of 0.20 M $\text{Mg}(\text{NO}_3)_2(\text{aq})$
- 125 mL of 0.20 M $\text{Cu}(\text{NO}_3)_2(\text{aq})$

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:



In the completed external circuit, the electrons flow from

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

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

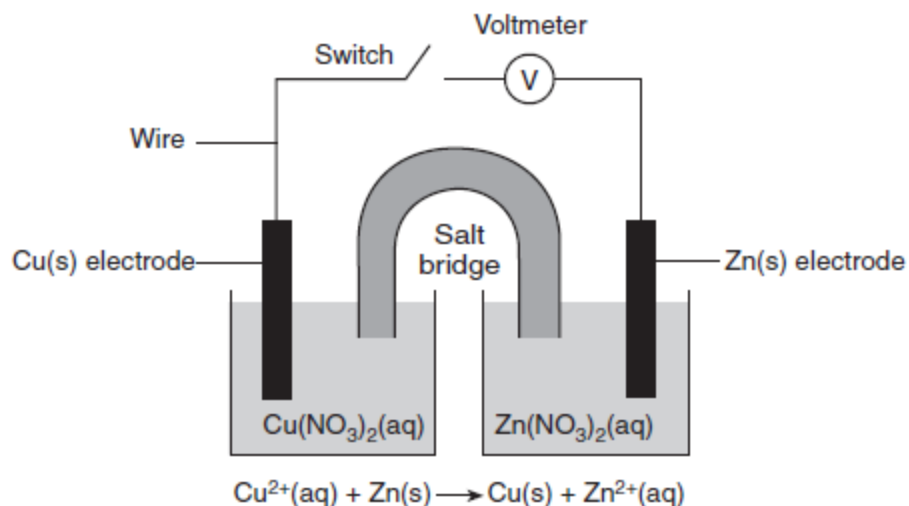
41. Energy is required to produce a chemical change during

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

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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.
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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.

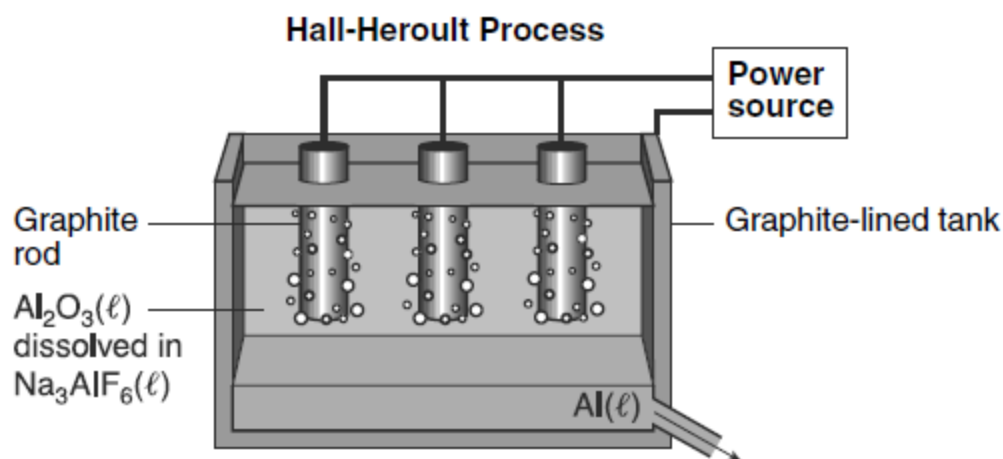
Laboratory Equipment and Materials

- 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, $\text{Al}_2\text{O}_3(\ell)$ extracted from bauxite is dissolved in $\text{Na}_3\text{AlF}_6(\ell)$ 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 $\text{Al}(\ell)$ with the density of the mixture of $\text{Al}_2\text{O}_3(\ell)$ and $\text{Na}_3\text{AlF}_6(\ell)$.
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 $\text{Na}_3\text{AlF}_6(\ell)$.
50. Compare the chemical properties of a 300.-kilogram sample of $\text{Al}_2\text{O}_3(\ell)$ with the chemical properties of a 600.-kilogram sample of $\text{Al}_2\text{O}_3(\ell)$.
-