

Name: _____

Period: _____

Seat#: _____

Directions: Show all work and/or annotate with an AP Chem level explanation for non-math answers. Use binder paper as needed.

1985 NChO Exam

43. The rxn taking place in a dry cell may be written
$$\text{Zn(s)} + 2\text{H}^+(\text{aq}) + 2\text{MnO}_2(\text{s}) \rightarrow \text{Zn}^{2+}(\text{aq}) + 2\text{MnO}(\text{OH}).$$

The battery is to be discarded after 2.00 g of zinc is converted to $\text{Zn}^{2+}(\text{aq})$. If 0.0100 amperes of current is continuously drawn, for how many seconds can the battery operate?

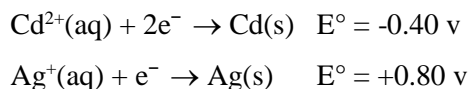
- a) $[(65.4)(0.0100)] \div [(2)(96,500)]$
b) $[(2)(96,500)] \div [(0.0100)(65.4)]$
c) $[(2)(65.4)(96,500)] \div (0.0100)$
d) $[(2.00)(2)(96,500)] \div [(65.4)(0.0100)]$
44. $\text{Sn}^{4+} + 2\text{Fe}^{2+} \rightarrow 2\text{Fe}^{3+} + \text{Sn}^{2+}$
a) Sn^{4+} is the oxidizing agent and Fe^{2+} is the reducing agent.
b) Sn^{4+} is the reducing agent and Fe^{2+} is the oxidizing agent.
c) Sn^{4+} is the reducing agent and Fe^{3+} is the oxidizing agent.
d) Fe^{3+} is the oxidizing agent and Sn^{2+} is the reducing agent.

45. Given the standard reduction potentials
$$\text{Cu}^{2+} + 2\text{e}^- \rightleftharpoons \text{Cu(s)} \quad E^\circ = +0.34 \text{ Volt}$$
$$\text{Al}^{3+} + 3\text{e}^- \rightleftharpoons \text{Al(s)} \quad E^\circ = -1.66 \text{ Volt}$$
Calculate the standard voltage for the reaction
$$2\text{Al(s)} + 3\text{Cu}^{2+} \rightarrow 2\text{Al}^{3+} + 3\text{Cu(s)}$$

a) -1.22 Volt b) +2.00 Volt
c) +4.34 Volt d) +5.86 Volt

1986 NChO Exam

46. Given the standard electrode (reduction) potentials:



What would be the E° for a cadmium-silver cell?

- a) 0.4 v b) 0.5 v
c) 1.2 v d) 2.0 v

48. A current of 10.0 amperes flows for 2.00 hours through an electrolytic cell containing a molten salt of metal x. This results in the decomposition of 0.250 mole of metal x at the cathode. The oxidation state of x in the molten salt is
a) 1+ b) 2+ c) 3+ d) 4+

49. In a voltaic cell, oxidation occurs at the
a) anode
b) cathode
c) salt bridge
d) electrode at which electrons enter from the outside

50. The free energy change for the chemical reaction that occurs in a voltaic cell when it is discharging and producing an electric current must be
a) positive b) negative
c) zero d) unpredictable

1988 NChO Exam

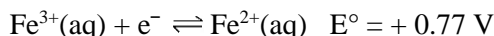
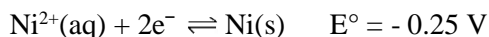
34. In the reaction
$$\text{SO}_2 + 2\text{H}_2\text{S} \rightarrow 3\text{S} + 2\text{H}_2\text{O}$$

a) sulfur is oxidized and hydrogen is reduced
b) sulfur is reduced and there is no oxidation
c) sulfur is reduced and hydrogen is oxidized
d) sulfur is both reduced and oxidized

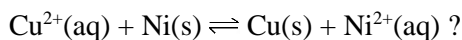
35. Which group among the representative (main-group) elements contains the most powerful oxidizing agent?
a) group I b) group III
c) group VI d) group VII

Dougherty Valley HS Chemistry - AP Electrochemistry – NChO Practice

36. The following standard electrode (reduction) potentials refer to aqueous solution at 25°C.



What is the standard potential for the reaction



- a) 0.09 V b) 0.59 V
c) 0.86 V d) 1.02 V
37. Which ion, in solution, can be oxidized by appropriate chemical means but also can be reduced by a different chemical reaction?
- a) Fe^{2+} b) F^{-}
c) CO_3^{2-} d) NO_3^{-}

1989 NChO Exam

49. Zinc reacts with dilute acid to produce H_2 and Zn^{2+} but silver does not liberate hydrogen from an acid.

This information enables one to predict that

- a) $\text{H}_2(\text{g}) + \text{Zn}^{2+}(\text{aq}) \rightarrow 2\text{H}^{+}(\text{aq}) + \text{Zn}(\text{s})$
b) $2 \text{Ag}(\text{s}) + \text{Zn}^{2+}(\text{aq}) \rightarrow 2\text{Ag}^{+}(\text{aq}) + \text{Zn}(\text{s})$
c) $2 \text{Ag}^{+}(\text{aq}) + \text{Zn}(\text{s}) \rightarrow 2\text{Ag}(\text{s}) + \text{Zn}^{2+}(\text{aq})$
d) $2 \text{Ag}(\text{s}) + 2\text{H}^{+}(\text{aq}) \rightarrow \text{H}_2(\text{g}) + 2 \text{Ag}^{+}(\text{aq})$
50. In the electroplating of silver from cyanide solution the cathode reaction is
 $\text{Ag}(\text{CN})_2^{-}(\text{aq}) + \text{e}^{-} \rightarrow \text{Ag}(\text{s}) + 2\text{CN}^{-}(\text{aq})$
How many grams of silver should be deposited by a current of 4.50 amperes in 28.0 minutes?
a) 0.141 g b) 4.23 g
c) 8.45 g d) 12.53 g

1990 NChO Exam

17. For the reaction shown below, which statement is true? $2\text{Fe} + 3 \text{CdCl}_2 \rightleftharpoons 2 \text{FeCl}_3 + 3\text{Cd}$
a) Fe is the oxidizing agent
b) Cd undergoes oxidation
c) Cd is the reducing agent
d) Fe undergoes oxidation

19. What is the potential in volts for the spontaneous reaction between the Ag/Ag^{2+} and Zn/Zn^{2+} half-cells?

$\text{Zn}^{2+} + 2\text{e}^{-} \rightarrow \text{Zn}$	$E^{\circ} = -0.763 \text{ V}$
$\text{Ag}^{+} + \text{e}^{-} \rightarrow \text{Ag}$	$E^{\circ} = 0.799 \text{ V}$

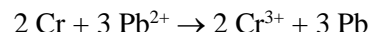
- a) -2.361 b) -1.562
c) 1.562 d) 2.361

1991 NChO Exam

47. Given the standard reduction potentials,

$\text{Cr}^{3+} + 3\text{e}^{-} \rightarrow \text{Cr}$	-0.74 V
$\text{Pb}^{2+} + 2\text{e}^{-} \rightarrow \text{Pb}$	-0.13 V

what is the standard potential, E° , for the reaction?



- a) 0.61 V b) 0.87 V
c) 1.09 V d) 1.87 V

Half-cell reaction	E°
$\text{Cu}^{2+}(\text{aq}) + 2\text{e}^{-} \rightarrow \text{Cu}(\text{s})$	-0.25 V
$\text{Ni}^{2+}(\text{aq}) + 2\text{e}^{-} \rightarrow \text{Ni}(\text{s})$	+0.34 V

65. When two half-cells are connected using a salt bridge,
a) galvanic cell will result - Cu is the cathode
b) galvanic cell will result - Cu is the anode
c) electrolytic cell will result - Ni is the cathode
d) electrolytic cell will result - Ni is the anode

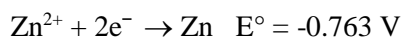
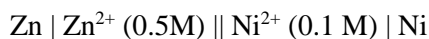
1992 NChO Exam

58. Corrosion of ships can be minimized by attaching a "sacrificial plate" of zinc to the hull. This plate corrodes instead of the steel of the ship because
a) the zinc behaves as a cathode, and is oxidized to zinc ions.
b) the zinc behaves as an anode, and is oxidized to zinc ions.
c) the steel hull behaves as a cathode, and is reduced to iron ions.
d) the steel hull behaves as an anode, and is reduced to iron ions.

**Dougherty Valley HS Chemistry - AP
Electrochemistry – NChO Practice**

59. A spoon is made the cathode in an electroplating apparatus containing a AgNO_3 solution. How many grams of Ag will be plated on the spoon if a current of 2.00 A is passed through the apparatus for 1.90 min.?
- a) 0.255 g b) 0.150 g
c) 0.128 g d) 0.0638 g

60. A cell is set up using the following reactions:



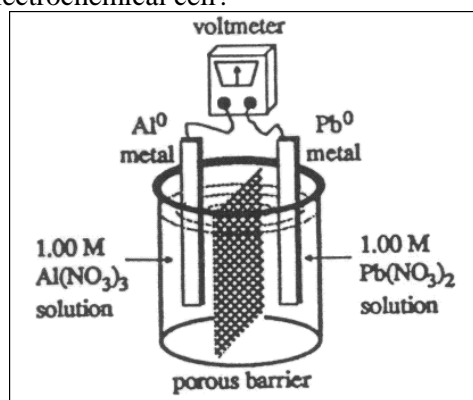
What is the voltage of the cell?

- a) -0.513 V b) -1.013 V
c) 0.492 V d) 0.513 V

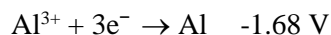
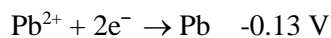
1993 NChO Exam

67. How many grams of Co will be deposited when a solution of cobalt(II) chloride is electrolyzed with a current of 10. amp for 109 minutes?
- a) 0.66 b) 4.0
c) 20 d) 40

66. What voltage will be produced by the electrochemical cell?



Reduction Potentials



- a) 2.97V b) 1.55V
c) -1.81V d) -2.97V

1994 NChO Exam

46. If solid nickel metal were added to separate aqueous solutions each containing 1M concentrations of Ag^+ , Cd^{2+} , and Sn^{2+} ions, how many metals would plate out, based on the given standard reaction potentials?

Standard Reduction Potentials



- a) zero b) one
c) two d) three

48. Solutions of Ag^+ , Cu^{2+} , Fe^{3+} and Ti^{4+} are electrolyzed with a constant current until 0.10 mol of metal is deposited. Which will require the greatest length of time?

- a) Ag^+ b) Cu^{2+}
c) Fe^{3+} d) Ti^{4+}

1996 NChO Exam

43. Use these reduction potentials to determine which one of the reactions below is spontaneous.

Reaction	Reduction Potentials, E°
$\text{Ag}^+ + \text{e}^- \rightarrow \text{Ag}$	0.800 V
$\text{Pb}^{2+} + 2\text{e}^- \rightarrow \text{Pb}$	-0.126 V
$\text{V}^{2+} + 2\text{e}^- \rightarrow \text{V}$	-1.18 V

- a) $\text{V}^{2+} + 2 \text{Ag} \rightarrow \text{V} + 2 \text{Ag}^+$
b) $\text{V}^{2+} + \text{Pb} \rightarrow \text{V} + \text{Pb}^{2+}$
c) $2 \text{Ag}^+ + \text{Pb}^{2+} \rightarrow 2 \text{Ag} + \text{Pb}$
d) $2 \text{Ag}^+ + \text{Pb} \rightarrow 2 \text{Ag} + \text{Pb}^{2+}$

44. It is possible to produce chlorine gas by electrolyzing any of these chlorine-containing compounds under the proper conditions. Which compound will require the smallest number of coulombs to produce one mole of chlorine?

- a) $\text{Ca}(\text{OCl})_2$ b) NaClO_2
c) KClO_3 d) $\text{Mg}(\text{ClO}_4)_2$

**Dougherty Valley HS Chemistry - AP
Electrochemistry – NChO Practice**

1997 NChO Exam

43. What is the function of H_2O_2 in this reaction?
 $6\text{H}^+ + 2\text{MnO}_4^- + 5\text{H}_2\text{O}_2 \rightarrow 2\text{Mn}^{2+} + 5\text{O}_2 + 8\text{H}_2\text{O}$
 a) catalyst b) reducing agent
 c) oxidizing agent d) inhibitor
44. How much hydrogen is produced from the electrolysis of water in the same time that 2.2 L of oxygen is formed?
 a) 0.14 L b) 1.1 L
 c) 2.2 L d) 4.4 L
45. Which of these changes will cause the value of the potential for this half-reaction to be less negative? ($E^\circ = -0.28 \text{ V}$ for the reaction.)
 $\text{Co}^{2+}(\text{aq}) + 2 \text{e}^- \rightarrow \text{Co}(\text{s})$
 a) increasing the amount of solid Co
 b) decreasing the amount of solid Co
 c) increasing the concentration of $\text{Co}^{2+}(\text{aq})$
 d) decreasing the concentration of $\text{Co}^{2+}(\text{aq})$

1998 NChO Exam

40. For this reaction, $E^\circ_{\text{cell}} = 0.79 \text{ V}$.
 $6\text{I}^- (\text{aq}) + \text{Cr}_2\text{O}_7^{2-} (\text{aq}) + 14\text{H}^+$
 $\rightarrow 3\text{I}_2 (\text{aq}) + 2\text{Cr}^{3+} (\text{aq}) + 7\text{H}_2\text{O} (\text{aq})$
 Given that the standard reduction potential for $\text{Cr}_2\text{O}_7^{2-} (\text{aq}) \rightarrow 2\text{Cr}^{3+} (\text{aq})$ is 1.33 V, what is E°_{red} for $\text{I}_2(\text{aq})$?
 a) +0.54 V b) -0.54 V
 c) +0.18 V d) -0.18 V
41. What is the product formed at the anode in the electrolysis of 1.0 M $\text{NaNO}_3(\text{aq})$?
 a) $\text{H}_2(\text{g})$ b) $\text{NO}_2(\text{g})$
 c) $\text{O}_2(\text{g})$ d) $\text{Na}(\text{s})$

42. Which of these ions is the best reducing agent?

Standard Reduction Potentials, E°	
$\text{Fe}^{3+}(\text{aq}) + \text{e}^- \rightarrow \text{Fe}^{2+}(\text{aq})$	+0.77 V
$\text{Cu}^{2+}(\text{aq}) + \text{e}^- \rightarrow \text{Cu}^+(\text{aq})$	+0.15 V

- a) Fe^{3+} b) Fe^{2+}
 c) Cu^{2+} d) Cu^+

43. $\text{Zn}(\text{s}) + \text{Cl}_2(\text{g}, 1 \text{ atm})$
 $\rightleftharpoons \text{Zn}^{2+}(\text{aq}, 1 \text{ M}) + 2\text{Cl}^-(\text{aq}, 1 \text{ M})$
 An electrochemical cell based on this reaction has a cell voltage, E° , of 2.12 V. Which change could make the cell voltage greater than 2.12 V?
 a) add more $\text{Zn}(\text{s})$
 b) add more $\text{Cl}^-(\text{aq})$ ions
 c) decrease the concentration of $\text{Zn}^{2+}(\text{aq})$ ions
 d) decrease the partial pressure of Cl_2

43) C	45) C	44) A	48) D	66) B	60) C
42) D	44) D	43) D	46) C	67) C	59) A
41) C	43) B	1997	1994	1993	58) B
40) A	1998	1996	37) A	50) B	1992
			36) B	49) A	45) B
			35) D	48) C	44) A
			34) D	46) C	43) D
		1989	1988	1986	1985
65) B	19) C	50) C			Answers
47) A	17) D	49) C			
1991	1990	1989			