Choose the correct answer for the following questions

1. Which one of the following statements **is not true** regarding the electrolysis of concentrated sodium chloride solution?
   A) Chlorine gas is produced at the anode. B) Hydrogen gas is formed at the cathode.
   C) Oxygen gas is produced at the anode. D) After the electrolysis, the remaining solution becomes basic.
2. Which one of the following statements about the Daniell cell **is false**? A) Zinc metal immersed in zinc sulphate solution acts as the anode. B) Copper metal dipped in copper sulphate solution acts as the cathode. C) Anode is the positive electrode and cathode is the negative electrode. D) Electrons flow from anode to cathode in the external circuit.
3. What are the oxidation numbers for nickel, sulfur, and oxygen in $Ni_2(SO4)_3$?
   A) Ni +3; S +6; O -2 B) Ni +2; S +4; O -2 C) Ni +3; S +4; O -2 D) Ni +2; S +2; O -2
4. What was oxidized and what was reduced in the following reaction? $2Hg^{2+} + N_2H_4 \rightarrow 2Hg + N_2 + 4H^+$
   A) Hg^{2+} was oxidized; N_2H_4 was reduced B) Hg^{2+} was reduced; N_2H_4 was oxidized C) Hg^{2+} was oxidized; N_2H_4 was oxidized D) Hg^{2+} was reduced; N_2H_4 was reduced
5. Which of the following statements is true about electrochemical cells?
   A) Reduction occurs at the anode B) An element with a high affinity for electrons is likely to be easily oxidized
   C) Oxidation occurs at the anode D) Oxidation takes place on the cathode
6. Which of the following **is not correct** about the electrolysis of copper sulphate aqueous solution using inert electrodes?
   A) O_2 gas produced at the anode B) Cathode mass increased after electrolysis C) The color of electrolyte remains unchanged D) The electrolyte is changed to acid (sulphuric acid formation)
7. What grams mass of nickel could be electroplated from a solution of nickel (II) chloride by a current 0.25A flowing for 10hrs? A) 12 g B) 5.5 g C) 0.046 g D) 2.75 g E) 6.0 g
8. Molten $AlCl_3$ is electrolyzed for 5.0 hours with a current of 0.40 amperes. 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 when the electrode efficiency is only 65%? A) 0.55 L B) 0.63 L C) 0.84 L D) 0.98 L E) 1.02 L
9. How long (in hours) must a current of 5.0 amperes be maintained to electroplate 60 g of calcium from molten $CaCl_2$? A) 27 hours B) 8.3 hours C) 11 hours D) 16 hours
10. How long, in hours, would be required for the electroplating of 78 g of platinum from a solution of $[PtCl_6]^{2-}$, using an average current of 10 amperes at an 80% electrode efficiency? (Mmass of Pt=195g/mole)
    A) 8.4 B) 5.4 C) 16.8 D) 11.2 E) 12.4
11. How many faradays are required to reduce 1.00 g of aluminum (III) to the aluminum metal?
    A) 1.00 B) 1.50 C) 3.00 D) 0.111 E) 0.250
12. Which of the following is the strongest oxidizing agent? A) Pb^{2+} B) I_2 C) Ag^+ D) Cu^{2+}
13. For a voltaic (or galvanic) cell using Ag, Ag^+ (1.0 M) and Zn, Zn^{2+} (1.0 M) half-cells, which of the following statements **is incorrect**? A) The zinc electrode is the anode. B) Electrons will flow through the external circuit from the zinc to the silver electrode. C) Reduction occurs at the zinc electrode as the cell operates. D) The mass of the zinc electrode will decrease as the cell operates. E) The concentration of Ag^+ will decrease as the cell operates.
14. Which of the following statements is (are) **true for all** voltaic cells? (I) Reduction occurs at the cathode. (II) The anode gains mass during discharge (III) The voltage is less than or equal to zero. A) only III B) only II C) only I D) II and III E) I, II, and III
15. In the standard notation for a voltaic cell, the double vertical line "||" represents: A) a phase boundary B) gas electrode C) a wire (metal) connection D) a salt bridge E) a standard hydrogen electrode
16. Which one is the basic difference between a fuel cell and a battery? A) A fuel cell is rechargeable, while a battery is not B) Both a fuel cell and a battery are rechargeable C) A fuel cell does not store chemical energy, but a battery can store chemical energy D) A fuel cell is a galvanic but battery is an electrolytic cell
17. Which of the following statement **is true**? A) A battery is rechargeable B) A battery has generally no liquid components C) A battery produces electricity spontaneously D) A battery produces the same amount of electricity, regardless of composition
18. What is the standard potential of the cell, with cell notation: $Fe_{(s)} /Fe^{2+} (aq) // Ni^{2+} (aq) /Ni(s)$?
    ϵ^0_{red} of $Ni^{2+}/Ni = -0.25v$ ϵ^0_{red} of $Fe^{2+}/Fe = -0.44v$ A) 0.19v B. -0.69v C. -0.19v D. 0.69v
19. Which one of the following **is not true** about the equation given below?
    $Mg(s) + Zn^{2+} (aq) \rightarrow Zn (s) + Mg^{2+}(aq)$: A) Mg is a reducing agent B) Zn^{2+} is an Oxidizing agent
    C) Mg^{2+} is oxidized D) Zn^{2+} is reduced

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20. Inform students that in an investigation, strips of gold, silver, and tin were placed in beakers containing their ions, resulting in the following reactions: a) $Sn(s) + Ag^+(aq) \longrightarrow$ Ag deposited b) $Au^{3+}(aq) + Sn(s) \longrightarrow$ Au deposited c) $Au(s) + Ag^+(aq) \longrightarrow$ no reaction. According to the investigation students arrange the ions in order of decreasing tendency to attract electrons. A) $Ag^+ < Au^{3+} < Sn^{2+}$ B) $Au^{3+} > Ag^+ > Sn^{2+}$ C) $Au^{3+} < Ag^+ < Sn^{2+}$ D) $Sn^{2+} > Ag^+ > Au^{3+}$
21. Calculate emf of the following cell : $Zn(s)/Zn^{2+}$ (0.1 M) ‖ (0.01 M) Ag+ /Ag(s): $E°\ Zn^{2+}/Zn = -0.76$ V, $E°\ Ag^+/Ag = +0.80$ V: A) 1.56v B) 1.53v C) 1.59v D) -1.59v
22. E° cell for the given redox reaction is 2.71 V; $Mg(s) + Cu^{2+}(0.01\ M) \longrightarrow Mg^{2+}(0.001\ M) + Cu(s)$, Calculate E-cell for the reaction. A) 2.68v B) 2.79v C) 2.74v D) 2.82v
23. How many coulombs are required for the oxidation of 1 mol of H_2O_2 to O_2?
A) 9.65×10^4 C B) 93000 C C) 1.93×10^5 C D) 19.3×10^2 C
24. Which is the best reducing agent? A) F^- B) Cl^- C) Br^- D) I^-
25. If a salt bridge is removed between the half cells, the voltage: A) drops to zero B) does not change C) increase gradually D) increases rapidly
26. The process in which chemical change occurs on passing electricity is termed:
A) Ionization B) neutralization C) electrolysis D) hydrolysis
27. A current of 9.65A flowing for 10 minutes deposits 3.0 g of a metal. The equivalent wt. of the metal is:
A) 10 g B) 30 g C) 50 g D) 96.5 g
28. When lead storage battery is on charging it is: A) an electrolytic cell B) a galvanic cell C) Daniell cell D) A and B
29. Which one of the following items **does not** characterize an oxidizing agent?
A) An oxidizing agent gains electrons. B) An oxidizing agent causes another species to be oxidized.
C) The oxidation number of an oxidizing agent decreases. D) Alkali metals are good oxidizing agents
30. Which statement about a voltaic cell is **not correct**?
A) Chemical species can have their oxidation number decreased at the cathode. B) Reduction occurs at the cathode.
C) Oxidation occurs at the anode. D) Elemental metal is routinely converted to metal cations at the cathode
31. Which of the following statement **is true** about a Zn-Ag galvanic cell?
A) Electrons flow from Zn to Ag B) Electrons flow from Ag to Zinc C) The zinc electrode will get larger
D) Anions will flow through the "bridge" from the zinc side to the silver side
32. If the standard reduction potentials of Ag^+/Ag and Cu^{2+}/Cu are +0.80V & +0.34V, respectively. Which of the following **is not correct**? A) Cu-electrode size deceases because of its oxidation B) Ag^+ reduced on the cathode by gaining of electron C) Electrons flow from silver to Copper in the cell D) E°cell of this cell is 0.46V
33. Consider the following standard reduction potentials of Al^{3+}/Al, E°= -1.66, Mg^{2+}/Mg: E°= -2.37, K^+/K; E°= -2.93, Pb^{2+}/Pb; E°= -0.124, which species would react with Al^{3+}? A) Pb B) Mg^{2+} C) K D) K^+
34. Which of the following **is correct** about the given redox reaction? $2ClO_3^- + 2I^- \longrightarrow 2Cl^- + I_2 + 3O_2$
A) Chlorine is oxidized B) Iodine is reduced C) ClO_3^- is a reducing agent D) Iodine is a reducing agent
35. Which of the following is an oxidation half-reaction? A) $Zn^{2+} + 2e^- \longrightarrow Zn$ B) $Na^+ + e^- \longrightarrow Na$
C) $H_2 \longrightarrow 2H^+ + 2e$ D) $I_2 + 2e^- \longrightarrow 2I^-$
36. Which one of the following processes is an example of electro-refining? A) Extraction of aluminum from bauxite B) Purification of lead from an impure anode C) Recovery of Zinc from a zinc sulphate solution D) Production of chlorine from a sodium chloride solution
37. The purpose of the salt bridge in an electrochemical cell is to _____.
A) Provide a source of ions to react at the anode and cathode. B) Provide oxygen to facilitate oxidation at the anode. C) Provide a means for electrons to travel from the anode to the cathode.
D) Maintain electrical neutrality in the half-cells via migration of ions.
38. Which one of the following types of elements is most likely to be a good oxidizing agent?
A) Transition elements B) Alkaline earth elements C) Alkali metals D) Halogens
39. When MnO_4^- reacts to form Mn^{2+}, the manganese in MnO_4^- is: A) Reduced as its oxidation number increases. B) Reduced as its oxidation number deceases. C) Oxidized as its oxidation number increases.
D) Oxidized as its oxidation number decreases
40. Which one of the following **is true** about a galvanic cell? A) The non-spontaneous redox reaction generates electricity B) Requires electrical energy to produce chemical change C) Cathode is negatively charged electrode on which reduction takes place D) Anode is negatively charged electrode through which electrons flow to cathode
41. The electrolysis products of the following solutions are the same, except, one.
A) Electrolysis of dilute hydrochloric acid solution C) Electrolysis of dilute sodium hydroxide solution
B) Electrolysis of dilute sodium chloride solution D) Electrolysis of dilute copper sulphate solution

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42. If you want to plate a spoon made of iron with silver, one of the following **is not correct**.
A) The Spoon is used as cathode B) Strip of silver metal is used as anode
C) Iron salt solution is used as an electrolyte D) Electrical energy source is used
43. Which of the following batteries is different from the others? A) Alkaline battery B) Copper (II) oxide battery
C) Leclanche dry cell D) Nickel – cadmium battery
44. Which one of the following **is not true** about an electrolytic cell? A) The cell requires electrical energy to produce chemical change B) Non spontaneous redox reaction generates electricity C) Anode is an electrode which connected on the positive terminal of battery D) The cell converts electrical energy to chemical energy
45. The standard reduction potentials of: $Fe^{2+}/Fe = -0.44v$, $Cu^{2+}/Cu = +0.34v$, which one of the following **is not true** about the galvanic cell containing iron and copper? A) $E°_{Cell} = 0.78v$ B) Cu is anode C) Electrons flow from Fe to Cu
D) Salt bridge is used to keep electro-neutrality
46. Calculate the standard free energy change ($\Delta G°$) for the following reaction at 25°c.
$Mg_{(s)} + Zn^{2+}(1.0M) \longrightarrow Zn_{(s)} + Mg^{2+}(1.0M)$; $Mg^{2+}/Mg = -2.37v$, $Zn^{2+}/Zn = -0.76v$
A) -310.7J B) 310.7kJ C) -310.7kJ D) 310.7J
47. Consider the following reaction: $2H_2S + SO_2 \longrightarrow 3S + 2H_2O$, which species is an oxidizing agent in the given chemical reaction? A) SO_2 B) H_2S C) H_2O D) Oxygen
48. In an electrolysis experiment, a current was passed for 5 hours through two cells connected in series. The first cell contains a solution gold salt and the second cell contains copper sulphate solution. 9.85 g of gold was deposited in the first cell. If the oxidation number of gold is +3, find the amount of copper deposited on the cathode in the second cell, atomic weight (Cu = 64, Au = 197): A) 4.8g B) 6.5g C) 32g D) 32g
49. How long has a current of 3 ampere to be applied through a solution of silver nitrate to coat a metal surface of 80 cm^2 with 0.005 cm thick layer? Density of silver is $10.5g/cm^3$. A) 4.2mn B) 1h C) 3752.8s D) 1250.92s
50. Which substance is the reducing agent in the reaction below? $Pb + PbO_2 + 2H_2SO_4 \longleftrightarrow 2PbSO_4 + 2H_2O$
A) H_2O B) Pb C) PbO_2 D) $PbSO_4$ E) H_2SO_4
51. The relationship between the change in Gibbs free energy and the emf of an electrochemical cell is given by:
A) $\Delta G = -E/nF$ B) $\Delta G = -nEF$ C) $-nRTF$ D) $\Delta G = -nE°F$
52. One of the differences between a voltaic cell and an electrolytic cell is that in an electrolytic cell _____. A) electrons flow toward the anode B) a non-spontaneous reaction is forced to occur C) an electric current is produced by a chemical reaction D) O_2 gas is produced at the cathode
53. Which law is used to calculate the emf of a cell from standard electrode potentials?
A) Raoult's Law B) Nernst Equation C) Henry's Law D) Faraday's Law
54. Which of the following statements **is correct** about a concentration cell? A) The cell operates by the difference in electrode materials. B) The cell emf depends on the difference in ion concentrations.
C) The standard electrode potentials of both electrodes are different. D) It requires a liquid junction potential to work.
55. For a redox reaction to occur in an electrochemical cell, the Gibbs free energy change must be:
A) Positive B) Zero C) Negative D) Dependent on temperature only
56. Which of the following correctly describes the primary difference between a primary cell and a secondary cell?
A) Primary cells can store more store more energy than secondary cells.
B) Primary cells are non-rechargeable, whereas secondary cells are rechargeable.
C) Secondary cells have higher voltage than primary cells.
D) Primary cells use liquid electrolytes, whereas secondary cells used solid electrolyte.
57. In electroplating, how does the protective layer prevent corrosion? A) By forming a barrier against moisture and oxygen.
B) By increasing the conductivity of the metal surface. C) By reducing the density of the metal.
D) By increasing the surface area for electrochemical reactions

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