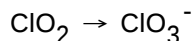


MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

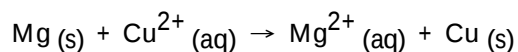
- 1) When the following half-reaction is balanced, the number of electrons and the type of process (oxidation or reduction) is



- A) 1, oxidation. B) 3, oxidation. C) 1, reduction. D) 2, oxidation. E) 2, reduction.

Answer: A

- 2) Which of the species in the following electrochemical reaction is oxidized?



- A) Cu (s)
B) Cu^{2+} (aq)
C) Mg^{2+} (aq)
D) Mg (s)
E) not a redox reaction

Answer: D

- 3) Which of the following nuclides would be most likely to be radioactive?

- A) ^{13}C B) ^{18}O C) ^{23}Na D) ^{28}P E) ^{27}Al

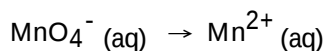
Answer: D

- 4) Which of the following variables are NOT needed to solve the van't Hoff equation?

- A) temperature
B) enthalpy
C) entropy
D) equilibrium constant
E) universal gas constant

Answer: C

- 5) When the following half-reaction is balanced, the number of electrons and the type of process (oxidation or reduction) is



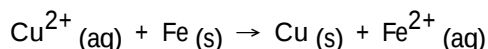
- A) 5, oxidation. B) 1, oxidation. C) 1, reduction. D) 3, oxidation. E) 5, reduction.

Answer: E

Table 18.1 Selected Standard Electrode Potentials at 25°C

Reaction	E° , V
$\text{Mg}^{2+}(\text{aq}) + 2\text{e}^- \rightarrow \text{Mg}(\text{s})$	-2.356
$\text{Fe}^{2+}(\text{aq}) + 2\text{e}^- \rightarrow \text{Fe}(\text{s})$	-0.440
$\text{Pb}^{2+}(\text{aq}) + 2\text{e}^- \rightarrow \text{Pb}(\text{s})$	-0.125
$2\text{H}^+(\text{aq}) + 2\text{e}^- \rightarrow \text{H}_2(\text{g})$	0.0
$\text{Cu}^{2+}(\text{aq}) + 2\text{e}^- \rightarrow \text{Cu}(\text{s})$	+0.337
$\text{I}_2(\text{s}) + 2\text{e}^- \rightarrow 2\text{I}^-(\text{aq})$	+0.535
$\text{Fe}^{3+}(\text{aq}) + 2\text{e}^- \rightarrow \text{Fe}^{2+}(\text{aq})$	+0.771
$\text{Ag}^+(\text{aq}) + \text{e}^- \rightarrow \text{Ag}(\text{s})$	+0.800
$\text{O}_2(\text{g}) + 4\text{H}^+(\text{aq}) + 2\text{e}^- \rightarrow 2\text{H}_2\text{O}$	+1.229
$\text{Cl}_2(\text{g}) + 2\text{e}^- \rightarrow 2\text{Cl}^-(\text{aq})$	+1.358
$\text{F}_2(\text{g}) + 2\text{e}^- \rightarrow 2\text{F}^-(\text{aq})$	+2.866

6) (Refer to Table 18.1) Will the following reaction occur spontaneously as written?



A) no

B) yes

C) impossible to tell

Answer: B

7) (Refer to Table 18.1) Which metal listed would make the best sacrificial anode?

A) Fe

B) Mg

C) Cu

D) Pb

E) Ag

Answer: B

8) (Refer to Table 18.1) Which is the most easily oxidized?

A) Cu

B) Mg

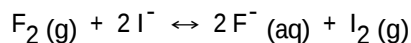
C) Fe

D) H^+

E) Cl^-

Answer: B

9) (Refer to Table 18.1) Calculate the value of K_{eq} at 25° C for the reaction:



A) 5.3×10^{39}

B) 5.6×10^{78}

C) 2.6×10^{39}

D) 1.4×10^{-79}

E) 2.33

Answer: B

10) (Refer to Table 18.1) A voltaic cell has a copper electrode in 1 M CuSO_4 and a silver electrode in 1 M AgNO_3 . What is E°_{cell} for this cell?

A) +0.270 V

B) +1.137 V

C) -0.463 V

D) -1.137 V

E) +0.463 V

Answer: E

11) (Refer to Table 18.1) Which is the best reducing agent?

- A) Pb B) F^- C) Fe^{2+} D) Mg E) Ag

Answer: D

12) In the process of electroplating a metal spoon with silver metal, the spoon is the

- A) anode.
B) cathode.
C) salt bridge.
D) Both A and B are correct.
E) none of the above

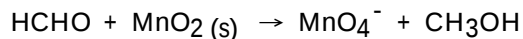
Answer: B

13) What mass, in g, of copper will be deposited from a solution of Cu^{2+} by a current of 2.50 A in 2.00 h?

- A) 5.93 B) 1.65 C) 11.9 D) 23.7 E) 0.187

Answer: A

14) Balance the following half-reaction under basic conditions and indicate the coefficient of water and the side of the reaction to which it is added.



- A) 4, left B) 1, right C) 3, left D) 2, left E) 2, right

Answer: D

15) In the plot of $\ln(k)$ versus $1/T$ for a first order reaction, the frequency factor (A) can be determined by

- A) the intercept of the x-axis.
B) the negative of the slope of the line times R.
C) the intercept on the y-axis.
D) the slope of the line.
E) the slope of the line times R.

Answer: C

16) How many coulombs of charge are required to produce 100. g of Al from Al^{3+} ?

- A) 3.71 B) 3.56×10^5 C) 1.11 D) 3.21×10^6 E) 1.07×10^6

Answer: E

17) Determine the nuclide that undergoes α decay to form ^{238}U .

- A) Pu^{242}
B) None of above
C) Th^{238}
D) Pu^{238}
E) Th^{242}

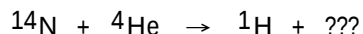
Answer: A

18) Predict the products from the electrolysis of concentrated, aqueous NaCl.

- A) $\text{H}_2(\text{g})$, $\text{O}_2(\text{g})$
- B) $\text{Na}^+(\text{aq})$, $\text{Cl}_2(\text{g})$
- C) $\text{Na}(\text{s})$, $\text{Cl}_2(\text{g})$
- D) $\text{H}_2(\text{g})$, $\text{Cl}_2(\text{g})$
- E) $\text{Na}(\text{s})$, $\text{O}_2(\text{g})$

Answer: D

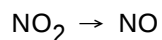
19) What is the identity of the missing species in the following reaction?



- A) ^{19}F
- B) ^{17}N
- C) ^{17}O
- D) ^{18}O
- E) ^{19}O

Answer: C

20) Balance the following half-reaction (assume an acidic solution) and indicate the number of electrons involved and whether the process is one of oxidation or reduction.



- A) 2e^- , reduction
- B) 4e^- , oxidation
- C) 1e^- , reduction
- D) 2e^- , oxidation
- E) 3e^- , reduction

Answer: A

21) What is the product formed from ^{232}Th by α -particle emission?

- A) ^{232}Ra
- B) ^{228}Ra
- C) ^{232}Ac
- D) ^{228}Ac
- E) ^{228}Th

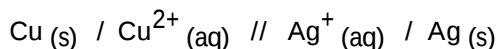
Answer: B

22) A concentration cell consists of two $\text{Ni} / \text{Ni}^{2+}$ electrodes. The electrolyte in half-cell A is 0.50 M and the electrolyte in half-cell B is 0.0025 M. Which combination below correctly pairs the anode and the cell voltage?

- A) B, + 0.14
- B) A, + 0.068
- C) B, + 0.068
- D) A, - 0.068
- E) A, + 0.14

Answer: C

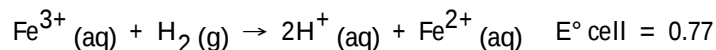
23) Write the net equation for the redox reaction that occurs in the voltaic cell.



- A) $\text{Cu}^{2+}(\text{aq}) + 2\text{Ag}(\text{s}) \rightarrow \text{Cu}(\text{s}) + 2\text{Ag}^+(\text{aq})$
- B) $\text{Cu}(\text{s}) + \text{Cu}^{2+}(\text{aq}) \rightarrow 2\text{Ag}^+(\text{aq}) + \text{Ag}(\text{s})$
- C) $\text{Cu}(\text{s}) + 2\text{Ag}^+(\text{aq}) \rightarrow \text{Cu}^{2+}(\text{aq}) + 2\text{Ag}(\text{s})$
- D) $2\text{Ag}^+(\text{aq}) + \text{Ag}(\text{s}) \rightarrow \text{Cu}(\text{s}) + \text{Cu}^{2+}(\text{aq})$

Answer: C

24) Given the following information:

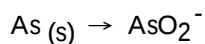


Determine E° for the reaction: $\text{e}^- + \text{Fe}^{3+}(\text{aq}) \rightarrow \text{Fe}^{2+}(\text{aq})$.

- A) -0.77
- B) 1.54
- C) 0.77
- D) 0.39
- E) additional information is required

Answer: C

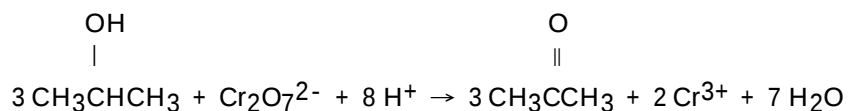
25) Balance the following half-reaction in a basic solution and indicate the number of electrons involved and whether the process is one of oxidation or reduction.



- A) 4 e^- , oxidation
- B) 2 e^- , oxidation
- C) 3 e^- , reduction
- D) 2 e^- , reduction
- E) 3 e^- , oxidation

Answer: E

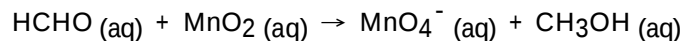
26) Which of the species in the following electrochemical reaction is reduced?



- A) $\begin{array}{c} \text{OH} \\ | \\ \text{CH}_3\text{CHCH}_3 \end{array}$
- B) H^+
- C) Cr^{3+}
- D) $\text{Cr}_2\text{O}_7^{2-}$
- E) H_2O

Answer: D

27) Which of the following species is reduced in the reaction shown below?



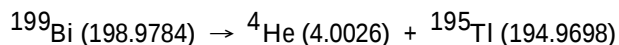
- A) $\text{CH}_3\text{OH}(\text{aq})$
- B) $\text{MnO}_2(\text{aq})$
- C) $\text{H}_2\text{O}(\text{l})$
- D) $\text{HCHO}(\text{aq})$
- E) $\text{MnO}_4^-(\text{aq})$

Answer: D

$$\begin{aligned}
 1 \text{ MeV} &= 1.602 \times 10^{-13} \text{ J} \\
 1 \text{ u} &= 931.5 \text{ MeV} \\
 1 \text{ u} &= 1.661 \times 10^{-27} \text{ kg} \\
 c &= 3.00 \times 10^8 \text{ m s}^{-1}
 \end{aligned}$$

Figure 19.1

28) (Refer to Figure 19.1.) Given the exact atomic masses:



calculate the energy associated with the α -decay of ^{199}Bi , in kJ/mol.

- A) 5.4×10^8 kJ/mol
- B) 1.8×10^{-8} kJ/mol
- C) 1.8 kJ/mol
- D) 6.3 kJ/mol
- E) 8.2×10^6 kJ/mol

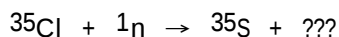
Answer: A

29) Which of the following emissions is common in carbon-14?

- A) α -emission
- B) λ -ray emission
- C) β -emission
- D) positron emission
- E) electron capture

Answer: C

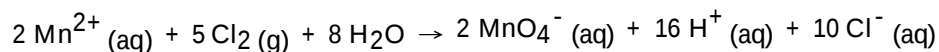
30) What is the identity of the missing species in the following reaction?



- A) ^1_1H
- B) ^1_0n
- C) $^0_{-1}\text{e}$
- D) ^1_1H
- E) ^1_1H

Answer: E

31) Determine the number of electrons transferred in the following reaction.



- A) 5
- B) 2
- C) 16
- D) 10
- E) 7

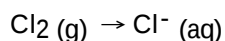
Answer: D

32) It has been estimated that carbon-14 dating is not useful for objects that are older than 50,000 years. Assuming that the half-life for carbon-14 is 5730 years and that there are 15 disintegrations per minute in living organisms, how many disintegrations per minute will there be in an object that is 50,000 years old?

- A) 3.339
- B) 0.0355
- C) 15
- D) 1.209×10^{-4}
- E) 0

Answer: B

- 33) When the following half-reaction is balanced, the number of electrons and the type of process (oxidation or reduction) is



- A) 3, reduction. B) 1, reduction. C) 1, oxidation. D) 2, oxidation. E) 2, reduction.

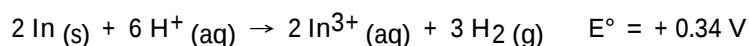
Answer: E

- 34) Identify the nuclide that would be formed from the γ -ray emission of fermium-250.

- A) $^{250}_{100}\text{Fm}$ B) $^{250m}_{100}\text{Fm}$ C) $^{250}_{99}\text{Es}$ D) $^{251}_{100}\text{Fm}$ E) $^{230}_{90}\text{Th}$

Answer: A

- 35) For the reaction:

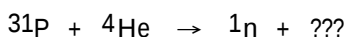


Determine the value of E° for the half reaction: $\text{In}^{3+} (\text{aq}) + 3 \text{e}^- \rightarrow \text{In} (\text{s})$.

- A) -0.34
B) 0.34
C) 0.17
D) -0.17
E) none of these

Answer: A

- 36) What is the identity of the missing species in the following reaction?



- A) $^{17}_{14}\text{Si}$ B) $^{27}_{13}\text{Al}$ C) $^{34}_{17}\text{Cl}$ D) $^{35}_{17}\text{Cl}$ E) $^{34}_{16}\text{S}$

Answer: C

- 37) Which of the following nuclides would be most likely to decay by positron emission?

- A) $^{32}_{11}\text{P}$ B) $^{26}_{11}\text{Na}$ C) $^{28}_{11}\text{P}$ D) $^{27}_{12}\text{Mg}$ E) $^{22}_{9}\text{F}$

Answer: C

- 38) Which of the following aqueous solutions will yield the greatest mass of metal (at STP) at a platinum anode when the same amount of electric charge is passed through each of them?

- A) NaCl B) Cu^{2+} C) AgNO_3 D) $\text{Pb}(\text{NO}_2)_2$ E) Fe^{3+}

Answer: C

- 39) How many grams of silver are deposited from a solution of Ag^+ on a tin cathode in 1.25 h by a current of 3.50 A?

- A) 17.6 B) 438 C) 0.293 D) 0.163 E) 8.80

Answer: A

40) For a certain reaction, the standard free energy change is -80.0 kJ at 300 K and -40.0 kJ at 600 K. For this reaction

- A) ΔH is negative, and ΔS is negative.
- B) ΔH is positive, and ΔS is positive.
- C) ΔH is negative, and ΔS is positive.
- D) ΔH is positive, and ΔS is negative.
- E) impossible to tell

Answer: A

41) When ^9Be is bombarded with α -particles, ^{14}C is formed. What other particle is involved?

- A) α
- B) β^-
- C) n
- D) p^+
- E) β^+

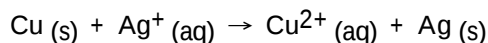
Answer: C

42) A sample of radioactive radon-222 was found to have a half-life of 3.823 d. What fraction of the sample will still be radon-222 after 1 week?

- A) 18%
- B) 28%
- C) 14%
- D) 7%
- E) Not enough information is given to answer this question.

Answer: B

43) Which of the following species is reduced in the reaction shown below?



- A) Cu (s)
- B) Ag (s)
- C) $\text{Ag}^+ (\text{aq})$
- D) $\text{H}_2\text{O (l)}$
- E) $\text{Cu}^{2+} (\text{aq})$

Answer: C

44) [more than one answer] Which of the following would you expect to be radioactive:

- A) None of above
- B) $^{118}_{50}\text{Sn}$
- C) $^{243}_{91}\text{Pa}$
- D) $^{54}_{25}\text{Mn}$

Answer: C, D

45) The value of E_{cell}^0 for the oxidation — reduction reaction $\text{Zn(s)} + \text{Pb}^{2+} (1.0\text{M}) \rightarrow \text{Zn}^{2+} (1.0\text{M}) + \text{Pb(s)}$ is + 0.66

V. What is E_{cell} for the reaction $\text{Zn(s)} + \text{Pb}^{2+} (0.01\text{M}) \rightarrow \text{Zn}^{2+} (0.1\text{M}) + \text{Pb(s)}$?

- A) +0.66V
- B) +0.72V
- C) +0.69V
- D) +0.63V

Answer: D

46) Which of the following half-reactions is not correct?

- A) $\text{Cu}^+ + e^- \rightarrow \text{Cu}$
- B) $\text{Fe}^{3+} + 2e^- \rightarrow \text{Fe}^+$
- C) $\text{Mg} \rightarrow \text{Mg}^{2+} + 2e^-$
- D) $\text{Ag} \rightarrow \text{Ag}^+ + e^-$
- E) $\text{Pb}^{2+} + e^- \rightarrow \text{Pb}^{3+}$

Answer: E

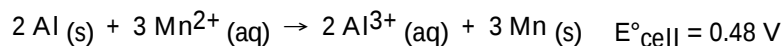
- 47) Calculate the mass defect in the creation of a nucleus of cobalt-59 from the nucleons it contains. The nuclear mass of cobalt-59 is 58.9332 u. Use 1.0073 u as the mass of a proton and 1.0087 u as the mass of a neutron.
- A) 0.5423 u B) 0.4975 u C) 0.5801 u D) 0.0668 u E) 0.5353 u

Answer: A

- 48) The half-life of a radioactive nuclide is 14 hours. Without doing calculations, estimate how long would it take for a sample to decay to 12% of its present activity?
- A) 56 hours B) 14 hours C) 42 hours D) 3 hours E) 28 hours

Answer: C

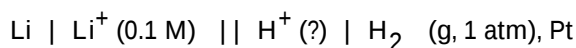
- 49) The following redox reaction is conducted with $[Al^{3+}] = 0.01\text{ M}$ and $[Mn^{2+}] = 3.0\text{ M}$. What is the new E_{cell} ?



- A) 0.53 V B) 0.32 V C) 0.60 V D) 0.43 V E) 0.16 V

Answer: A

- 50) What should be the pH of a solution in the cathode half-cell if the following voltaic cell is to have $E_{\text{cell}} = 3.000\text{ V}$?



- A) 0.0668 B) 1.676 C) 2.351 D) 0.116 E) 0.040

Answer: B