

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

1) Which of the following statements is not correct?

- A) The density of the sulfuric acid solution decreases in a lead storage battery as the battery discharges.
- B) Oxidation occurs at the cathode.
- C) Oxidation must always accompany a corresponding reduction.
- D) A free metal can displace from solution the ions of a metal that lie below the free metal in the activity series.
- E) A sacrificial electrode hinders corrosion of attached metals.

Answer: B

2) What is the final nuclide obtained when indium-123 decays by electron capture ?

- A) In 124
- B) In 123
- C) Cd 123
- D) Cd 124
- E) Sn 124

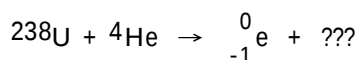
Answer: C

3) Would a precipitate be observed if equal volumes of a 0.040 M AgNO_3 solution and a 0.030 M NaNO_2 solution are mixed? ($K_{\text{sp}} \text{AgNO}_2 = 6.0 \times 10^{-4}$)

- A) Yes, because $Q_{\text{ip}} < K_{\text{sp}}$.
- B) No, because $Q_{\text{ip}} < K_{\text{sp}}$.
- C) Yes, because $Q_{\text{ip}} > K_{\text{sp}}$.
- D) No, because $Q_{\text{ip}} = K_{\text{sp}}$.
- E) No, because $Q_{\text{ip}} > K_{\text{sp}}$.

Answer: B

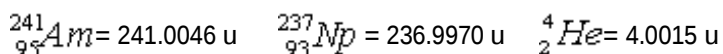
4) What is the identity of the missing species in the following reaction?



- A) $^{242}_{96}\text{Am}$
- B) $^{234}_{94}\text{Am}$
- C) $^{234}_{94}\text{Pu}$
- D) $^{241}_{96}\text{Pu}$
- E) $^{242}_{97}\text{Np}$

Answer: A

5) Give the nuclear masses



Calculate the energy associated with the α decay of americium -241, in MeV .

- A) -1.3 MeV
- B) -10.3 MeV
- C) -7.2 MeV
- D) -3.2 MeV
- E) -5.7 MeV

Answer: E

6) Predict the products from the electrolysis of aqueous MgSO_4 .

- A) Mg (s) , $\text{O}_2 \text{ (g)}$
- B) $\text{H}_2 \text{ (g)}$, $\text{O}_2 \text{ (g)}$
- C) $\text{H}_2 \text{ (g)}$, S (s)
- D) Mg (s) , S (s)
- E) $\text{H}_2 \text{ (g)}$, Mg (s)

Answer: B

7) The half-life of sodium-24 is 15.0 h. How many hours will it take for an initially observed activity to decrease to 75% of its initial value?

- A) 5.0 B) 6.2 C) 7.5 D) 11.3 E) 30

Answer: B

8) A nuclide with a long half-life

- A) decays at a faster rate than a nuclide with a small half-life.
B) has fewer atoms left after one hour than a nuclide with a small half-life.
C) is a non-radioactive nuclide.
D) undergoes radioactive decay by second order kinetics.
E) has a smaller decay constant than a nuclide with a short half-life.

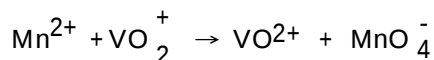
Answer: E

9) By what method are the transuranium elements formed?

- A) neutron bombardment of uranium-238
B) positron emission from phosphorus-30
C) α -particle bombardment of uranium-235
D) electron capture by uranium-238
E) the transuranium elements occur naturally

Answer: A

10) What is the coefficient for water and on which side of the equation will it reside in the following redox reaction? Balance the equation using the half-reaction method.



- A) 4, left B) 5, right C) 1, left D) 3, left E) 1, right

Answer: E

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

- A) Na (s), O₂ (g)
B) H₂ (g), Cl₂ (g)
C) H₂ (g), O₂ (g)
D) Na (s), Cl₂ (g)
E) Na⁺ (aq), Cl₂ (g)

Answer: B

12) A half-reaction is incomplete because

- A) they only show the reactants of a reaction.
B) half-reactions only show the products of a reaction.
C) half-reactions only show the oxidation or reduction portion of a reaction.
D) they are not balanced.
E) they don't illustrate exactly what is happening in a reaction.

Answer: C

13) Given the following cell potentials (E_{cell}), which would be predicted to have been found in a spontaneous reaction?

- A) 0.00 V
- B) -0.34 V
- C) +0.34 V
- D) -1.50 V
- E) More information is needed to answer this question.

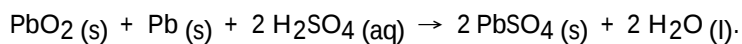
Answer: C

14) What is the product formed from ^{207}Po by positron emission?

- A) $^{207}_{83}\text{Bi}$
- B) $^{206}_{84}\text{Po}$
- C) $^{208}_{84}\text{Po}$
- D) $^{207}_{85}\text{At}$
- E) $^{208}_{85}\text{At}$

Answer: A

15) The overall cell reaction during discharge of the lead-acid battery is

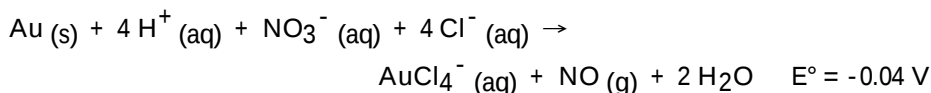


Which statement is incorrect?

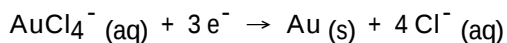
- A) The lead serves as the anode.
- B) The PbO_2 electrode would be positive during discharge.
- C) Upon recharging, the above reaction occurs in reverse.
- D) Upon recharging, the density of the electrolyte will increase.
- E) Upon recharging the lead electrode is negative.

Answer: E

16) For the reaction:



If the standard potential for the reduction of $\text{NO}_3^- (\text{aq})$ to $\text{NO} (\text{g})$ is +0.96 V, determine the value of E° for the following half-reaction.



- A) 1.00
- B) +0.92
- C) -0.92
- D) -1.00
- E) none of these

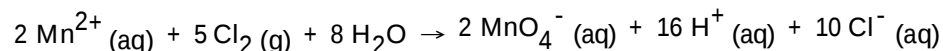
Answer: A

17) Consider a cell made up of two half cells consisting of the same metal in solutions of the metal ion of different concentrations. Which statement is incorrect?

- A) The E°_{cell} is zero.
- B) The cell containing more concentrated electrolyte is the anode.
- C) The spontaneous reaction will proceed until the concentrations become equal.
- D) Reduction occurs in the more concentrated solution.
- E) The greater the ratio in concentrations between the two cells, the greater is the initial voltage.

Answer: B

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



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

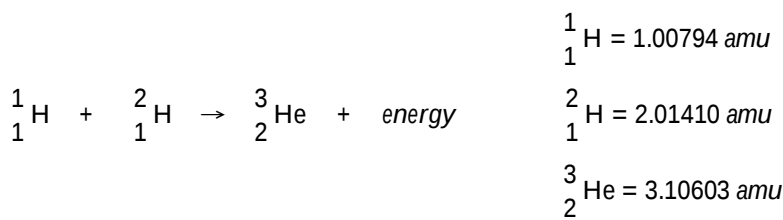
Answer: D

19) Why is α -particle emission less hazardous than γ -ray or X-ray emission as long as it is outside the body?

- A) Less α -particle emission occurs naturally than γ -ray or X-ray emission.
- B) α -particles are very high in energy and can pass through living tissue without harming it.
- C) γ -rays and X-rays are hazardous because the rays are highly penetrating, causing damage inside the body quite easily.
- D) α -particles are less hazardous because they are electrons, while γ -rays and X-rays have much more mass.
- E) None of these are hazardous to living creatures— β -particles are hazardous.

Answer: C

20) Calculate the amount of energy released (in MeV) during the fusion of hydrogen with deuterium, given the following information:



- A) 0.00601 MeV
- B) 6.772 MeV
- C) 0 MeV
- D) 2809 MeV
- E) 78.2 MeV

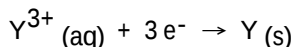
Answer: E

21) 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) 8.80
- B) 0.163
- C) 17.6
- D) 0.293
- E) 438

Answer: C

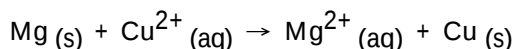
- 22) A voltaic cell consisting of a yttrium electrode in a solution of 1 M $\text{Y}_2(\text{SO}_4)_3$ and a copper electrode in 1 M CuSO_4 has a standard potential of +2.71 V. If E° for $\text{Cu}^{2+} / \text{Cu} = +0.337$ V, calculate the potential, in volts, for the following reaction:



- A) +2.71 B) -2.71 C) +2.37 D) +3.05 E) -2.37

Answer: E

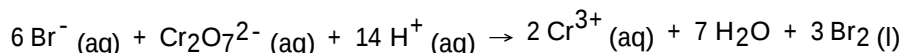
- 23) Which of the species in the following electrochemical reaction is oxidized?



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

Answer: C

- 24) How many electrons are transferred in the following reaction?



- A) 1 B) 2 C) 3 D) 6 E) 14

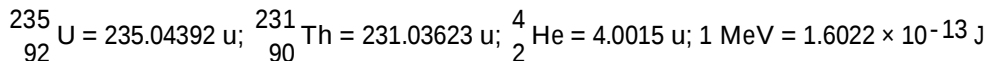
Answer: D

- 25) In 1998, archaeologists uncover a wooden coffin believed by local residents to be that of an early American colonist. A piece of the coffin is analyzed by radiocarbon dating to determine the actual age of the coffin. The decay rate for carbon-14 in the sample is $12.5 \text{ dis min}^{-1}$ per gram carbon. In what year was the coffin most likely made? (Assume the half-life of carbon-14 is 5730 years and that the decay rate for carbon-14 in living organisms is 15 dis min^{-1} per gram carbon.)

- A) 1606 B) 1901 C) 1506 D) 1774 E) 1945

Answer: C

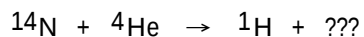
- 26) $^{235}_{92}\text{U}$ decaying by alpha-particle emission is used in nuclear reactors to provide electricity. If 1.00 mol of $^{235}_{92}\text{U}$ is placed in the reactor, what quantity of energy (in J/mol) is liberated by this decay?



- A) $9.24 \times 10^{-13} \text{ kJ}$
 B) $5.56 \times 10^8 \text{ kJ}$
 C) 5.77 kJ
 D) $9.24 \times 10^{16} \text{ kJ}$
 E) $3.60 \times 10^{14} \text{ kJ}$

Answer: B

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



A) ^{17}O

B) ^{17}N

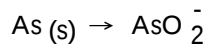
C) ^{19}O

D) ^{19}F

E) ^{18}O

Answer: A

28) 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) 2e^- , reduction

B) 2e^- , oxidation

C) 3e^- , oxidation

D) 3e^- , reduction

E) 4e^- , oxidation

Answer: C

29) 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) 7%

B) 14%

C) 18%

D) 28%

E) Not enough information is given to answer this question.

Answer: D

30) The half-life of plutonium-239 is 2.411×10^4 years. How long it would take to decay to 25% of its present activity?

A) 239 years

B) 6.03×10^3 years

C) 2.411×10^4 years

D) 4.822×10^4 years

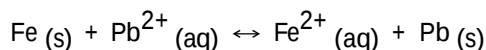
E) 7.233×10^4 years

Answer: D

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
$\text{Fe}^{3+}(\text{aq}) + \text{e}^- \rightarrow \text{Fe}^{2+}(\text{aq})$	+0.771
$\text{Ag}^+(\text{aq}) + \text{e}^- \rightarrow \text{Ag}(\text{s})$	+0.800
$\text{O}_2(\text{g}) + 4\text{H}^+(\text{aq}) + 2\text{e}^- \rightarrow 2\text{H}_2\text{O}(\text{l})$	+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

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

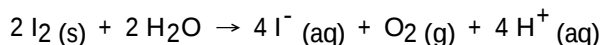


A) 24.5

B) 4.8×10^{-6} C) 4.4×10^{10} D) 2.3×10^{-11} E) 2.1×10^5

Answer: C

32) (Refer to Table 18.1) Will the following reaction occur spontaneously as written at standard state?



A) yes

B) no

C) impossible to tell

Answer: B

33) (Refer to Table 18.1) Will magnesium metal displace Cu^{2+} ion from aqueous solution?

A) yes

B) no

C) impossible to tell

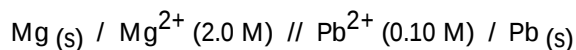
Answer: A

34) (Refer to Table 18.1) Which is the best oxidizing agent?

A) Cl_2 B) Mg^{2+} C) F^- D) Cu^{2+} E) Fe^{3+}

Answer: A

35) (Refer to Table 18.1) Use the Nernst equation to determine E_{cell} at 25° C for the following voltaic cell.



A) 1.23

B) 2.19

C) 2.27

D) 2.23

E) 1.27

Answer: B

- 36) 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) 0.5353 u B) 0.5423 u C) 0.0668 u D) 0.5801 u E) 0.4975 u

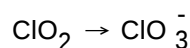
Answer: B

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

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

Answer: A

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



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

Answer: A

- 39) In an electrochemical cell that functions as a voltaic cell, which of the following is true?

A) Electrons move from the cathode to the anode.
B) Electrons move through a salt bridge.
C) Electrons can move either from the cathode to the anode or from the anode to the cathode.
D) Reduction occurs at the cathode.

Answer: D

- 40) Cu metal displaces Ag^+ (aq) from an aqueous solution. Which of the following is correct?

A) Ag is easier to oxidize than Cu. B) Ag^+ is easier to reduce than Cu^{2+} .
C) Ag is a better reducing agent than Cu. D) Cu^{2+} is a better oxidizing agent than Ag^+ .

Answer: B

- 41) For which of the following processes would the entropy change be positive?

A) $\text{He (g) (1 atm)} \rightarrow \text{He (g) (10 atm)}$
B) $\text{Hg (l) (45}^\circ\text{C)} \rightarrow \text{Hg (l) (25}^\circ\text{C)}$
C) $\text{Ag}^+ \text{ (aq)} + \text{Br}^- \text{ (aq)} \rightarrow \text{AgBr (s)}$
D) $\text{I}_2 \text{ (s)} \rightarrow \text{I}_2 \text{ (aq)}$
E) $\text{H}_2\text{O (l)} \rightarrow \text{H}_2\text{O (s)}$

Answer: D

- 42) A concentration cell consists of two Ni / 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) A, + 0.068 B) A, + 0.14 C) B, + 0.068 D) B, + 0.14 E) A, - 0.068

Answer: C

43) What is the maximum molar concentration of magnesium ion in a solution of pH = 11.00?

($K_{sp} \text{ Mg(OH)}_2 = 1.8 \times 10^{-11}$)

A) 1.7×10^{-4}

B) 1.8×10^{-5}

C) 1.8×10^{-11}

D) 1.8×10^{-8}

E) 2.6×10^{-4}

Answer: B

44) When a uranium-235 nucleus is struck by a thermal neutron, fission occurs often with the release of neutrons. If the fission fragments are ^{89}Sr and ^{144}Xe , how many neutrons are released?

A) 0

B) 1

C) 2

D) 3

E) 4

Answer: C

45) The total mass-energy of the products of a nuclear reaction are equal to the total mass-energy of the reactants.

This suggests that:

A) any mass lost in the reaction must be replaced by potential energy in the products.

B) the kinetic energy of the products must equal the kinetic energy of the reactants.

C) the mass lost in a reaction escapes from the isolated system.

D) the increase in kinetic energy of the products must come from the mass lost from the reactants.

E) none of the above is true.

Answer: D

$$1 \text{ MeV} = 1.602 \times 10^{-13} \text{ J}$$

$$1 \text{ u} = 931.5 \text{ MeV}$$

$$1 \text{ u} = 1.661 \times 10^{-27} \text{ kg}$$

$$c = 3.00 \times 10^8 \text{ m s}^{-1}$$

Figure 19.1

46) (Refer to Figure 19.1.) ^{223}Fr decays by β -emission with a decay energy of 1.15 MeV. What is the mass equivalent, in u, of the energy?

A) $6.23 \times 10^{23} \text{ u}$

B) 8.38 u

C) $1.23 \times 10^{-3} \text{ u}$

D) 2.46 u

E) $1.97 \times 10^3 \text{ u}$

Answer: C

47) Which combination of number of protons and number of neutrons is most common among the naturally occurring nonradioactive nuclides?

A) even protons; odd neutrons

B) odd protons; even neutrons

C) odd protons; odd neutrons

D) The combinations are found equally.

E) even protons; even neutrons

Answer: E

48) What is the product formed from ^{185}Ir by electron capture?

A) ^{184}Os

B) ^{185}Pt

C) ^{185}Os

D) ^{184}Os

E) ^{186}Ir

Answer: C

49) What kind of radioactive decay would you expect the nuclide ${}_{40}^{84}\text{Zr}$ to undergo?

- A) β^- emission
- B) Positron emission or electron capture
- C) None of above
- D) α emission
- E) β^- emission α emission

Answer: B

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

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

Answer: B