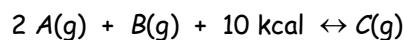


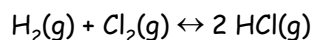
Chemistry Test: Acids & Bases, Equilibrium, Nuclear Chemistry

1. Given the equilibrium system:



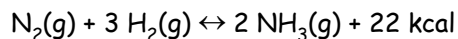
Which conditions would yield the most product?

- A) low temperature and low pressure
B) high temperature and high pressure
C) low temperature and high pressure
D) high temperature and low pressure
2. Given the reaction at STP and at equilibrium:



Which change will result in an increase in the concentration of $Cl_2(g)$?

- A) increasing the concentration of $HCl(g)$
B) decreasing the pressure of the system
C) decreasing the concentration of $HCl(g)$
D) increasing the concentration of $H_2(g)$
3. Which compound will conduct an electric current when dissolved in water?
- A) $NaOH$ C) $C_{12}H_{22}O_{11}$
B) C_2H_5OH D) $C_6H_{12}O_6$
4. Water containing dissolved electrolyte conducts electricity because the solution contains mobile
- A) molecules C) ions
B) atoms D) electrons
5. Which of the following particles has the greatest mass?
- A) a proton C) an alpha particle
B) an electron D) a beta particle
6. Given the reaction at equilibrium:



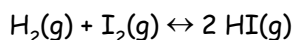
Which stress would cause the equilibrium to shift to the left?

- A) adding $H_2(g)$ to the system
B) increasing the pressure
C) increasing the temperature
D) adding $N_2(g)$ to the system
7. Which equation represents alpha decay?
- A) ${}_{90}^{234}\text{Th} \rightarrow {}_{91}^{234}\text{Pa} + X$ C) ${}_{19}^{38}\text{K} \rightarrow {}_{18}^{38}\text{Ar} + X$
B) ${}_{49}^{116}\text{In} \rightarrow {}_{50}^{116}\text{Sn} + X$ D) ${}_{86}^{222}\text{Rn} \rightarrow {}_{84}^{218}\text{Po} + X$

8. As an atom of a radioactive isotope emits an alpha particle, the mass number of the atom
- A) decreases C) remains the same
B) increases
9. Which reaction has a K_{eq} represented by the equilibrium expression below?

$$K_{eq} = \frac{[A]^2 [B]}{[C]^3}$$

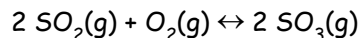
- A) $2 A + B \leftrightarrow 3 C$ C) $A^2 + B \leftrightarrow C^3$
B) $C^3 \leftrightarrow A^2 + B$ D) $3 C \leftrightarrow 2 A + B$
10. Given the reaction at equilibrium:
- $$2 SO_2(g) + O_2(g) \leftrightarrow 2 SO_3(g)$$
- As the pressure is increased at constant temperature, the number of moles of $SO_3(g)$ produced will
- A) decrease C) remain the same
B) increase
11. Which of the following is the best conductor of electricity?
- A) $C_6H_{12}O_6(s)$ C) $NaCl(aq)$
B) $C_6H_{12}O_6(aq)$ D) $NaCl(s)$
12. Which factors must be equal in a reversible chemical reaction at equilibrium?
- A) the activation energies of the forward and reverse reactions
B) the rates of reaction of the forward and reverse reactions
C) the concentrations of the reactants and products
D) the potential energies of the reactants and products
13. Given the equation:



Which statement is always true when this reaction has reached chemical equilibrium?

- A) $[H_2] \times [I_2] > [HI]$
B) $[H_2] \times [I_2] < [HI]$
C) $[H_2]$, $[I_2]$, and $[HI]$ are all equal.
D) $[H_2]$, $[I_2]$, and $[HI]$ remain constant.

14. Given the reaction at equilibrium:



Which is the correct equilibrium constant expression for the reaction?

A)
$$K_{eq} = \frac{[\text{SO}_3]^2}{[\text{SO}_2]^2[\text{O}_2]}$$

B)
$$K_{eq} = \frac{[\text{SO}_3]^2}{[\text{SO}_2]^2 + [\text{O}_2]}$$

C)
$$K_{eq} = \frac{[2\text{SO}_3]}{[2\text{SO}_2] + [\text{O}_2]}$$

D)
$$K_{eq} = \frac{[\text{SO}_3]}{[\text{SO}_2][\text{O}_2]}$$

15. Given the equilibrium reaction at constant pressure:



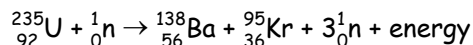
When the temperature is increased, the equilibrium will shift to the

- A) left, and the concentration of HBr(g) will increase
 B) left, and the concentration of HBr(g) will decrease
 C) right, and the concentration of HBr(g) will increase
 D) right, and the concentration of HBr(g) will decrease

16. An uncontrolled chain reaction takes place during the

- A) explosion of an atomic bomb
 B) operation of a fission nuclear reactor
 C) fusion of light nuclei into heavier nuclei
 D) production of energy by the Earth's Sun

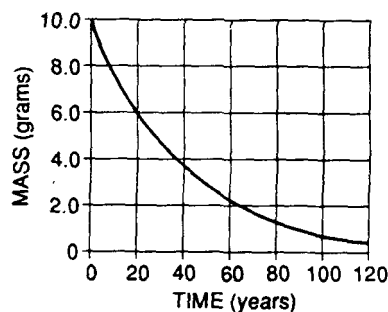
17. Given the nuclear reaction:



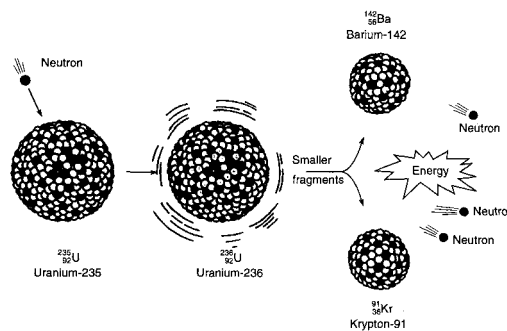
This equation can best be described as

- A) fission
 B) natural decay
 C) fusion
 D) endothermic

18. The graph below represents the decay curve of a radioactive isotope. The half-life of this isotope is



- A) 45 years
 B) 8 years
 C) 60 years
 D) 30 years
19. Which statement explains why nuclear waste materials may pose a problem?
- A) They frequently have long half-lives and remain radioactive for extended periods of time.
 B) They frequently have long half-lives and remain radioactive for brief periods of time.
 C) They frequently have short half-lives and remain radioactive for brief periods of time.
 D) They frequently have short half-lives and remain radioactive for extended periods of time.
20. The diagram below represents a nuclear reaction in which a neutron bombards a heavy nucleus.

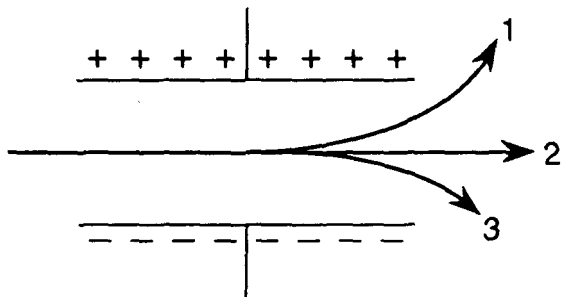


Which type of reaction does the diagram illustrate?

- A) alpha decay
 B) fusion
 C) beta decay
 D) fission
21. Which nuclear equation represents a fusion reaction?

- A) ${}_{92}^{238}\text{U} + {}_0^1\text{n} \rightarrow {}_{93}^{239}\text{Np} + {}_0^{-1}\text{e}$
 B) ${}_{6}^{14}\text{C} \rightarrow {}_{7}^{14}\text{N} + {}_0^{-1}\text{e}$
 C) ${}_{92}^{235}\text{U} + {}_0^1\text{n} \rightarrow {}_{36}^{92}\text{Kr} + {}_{56}^{141}\text{Ba} + 3{}_0^1\text{n}$
 D) ${}_1^1\text{H} + {}_1^2\text{H} \rightarrow {}_2^3\text{He}$

22. Which list of particles is in order of increasing mass?
- A) proton → electron → alpha particle
 B) alpha particle → electron → proton
 C) proton → alpha particle → electron
 D) electron → proton → alpha particle
23. A mixture of emanations from radioactive atoms is passed through electrically charged plates, as shown in the diagram below.

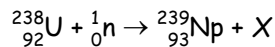


The nuclear emanations 1, 2, and 3 are called, respectively,

- A) alpha, beta, and gamma
 B) gamma, alpha, and beta
 C) beta, gamma, and alpha
 D) gamma, beta, and alpha
24. Which of these types of nuclear radiation has the greatest penetrating power?
- A) alpha C) gamma
 B) neutron D) beta
25. After 30 days, 5.0 grams of a radioactive isotope remains from an original 40.-gram sample. What is the half-life of this element?
- A) 20 days C) 10 days
 B) 5 days D) 15 days
26. The half-life of a radioactive isotope is 20.0 minutes. What is the total amount of a 1.00-gram sample of this isotope remaining after 1.00 hour?
- A) 0.250 g C) 0.500 g
 B) 0.333 g D) 0.125 g
27. An original sample of a radioisotope had a mass of 10 grams. After 2 days, 5 grams of the radioisotope remains unchanged. What is the half-life of this radioisotope?
- A) 1 day C) 5 days
 B) 2 days D) 4 days

28. A radioactive element has a half-life of 2 days. Which fraction represents the amount of an original sample of this element remaining after 6 days?
- A) $\frac{1}{8}$
 B) $\frac{1}{2}$
 C) $\frac{1}{3}$
 D) $\frac{1}{4}$

29. In the reaction:



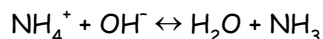
The species represented by X is

- A) ${}_{-1}^0\text{e}$ C) ${}_{1}^1\text{H}$
 B) ${}_{2}^4\text{He}$ D) ${}_{0}^1\text{n}$
30. As HCl(g) is added to water, the pH of the water solution
- A) decreases C) remains the same
 B) increases
31. Which relationship is present in a solution that has a pH of 7?
- A) $[\text{H}^+] < [\text{OH}^-]$ C) $[\text{H}^+] + [\text{OH}^-] = 7$
 B) $[\text{H}^+] > [\text{OH}^-]$ D) $[\text{H}^+] = [\text{OH}^-]$
32. As an acidic solution is added to a basic solution, the pH of the basic solution
- A) decreases C) remains the same
 B) increases
33. Which substance can be classified as an Arrhenius acid?
- A) KOH C) LiOH
 B) HCl D) NaCl
34. A solution of a base differs from a solution of an acid in that the solution of a base
- A) is able to cause an indicator color change
 B) has a greater $[\text{OH}^-]$
 C) has a greater $[\text{H}_3\text{O}^+]$
 D) is able to conduct electricity
35. According to the Arrhenius theory, a substance that is classified as an acid will always yield
- A) $\text{K}^+(\text{aq})$ C) $\text{I}^-(\text{aq})$
 B) $\text{H}^+(\text{aq})$ D) $\text{F}^-(\text{aq})$

36. Which substance is classified as an Arrhenius base?

- A) KHCO_3 C) NaOH
B) HCl D) LiNO_3

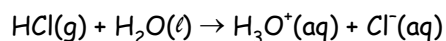
37. Given the reaction at equilibrium:



Which species is the proton donor in the forward reaction?

- A) H_2O C) OH^-
B) NH_4^+ D) NH_3

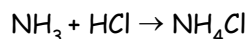
38. Given the reaction:



Which reactant acted as a Brønsted-Lowry acid?

- A) $\text{H}_2\text{O}(\ell)$, because it produced hydronium ions
B) $\text{HCl}(g)$, because it reacted with chloride ions
C) $\text{HCl}(g)$, because it donated protons
D) $\text{H}_2\text{O}(\ell)$, because it accepted protons

39. Given the reaction:



In this reaction ammonia molecules (NH_3) act as a base because they

- A) donate hydrogen ions (H^+)
B) donate hydroxide ions (OH^-)
C) accept hydroxide ions (OH^-)
D) accept hydrogen ions (H^+)

40. Which chemical equation represents the reaction of an Arrhenius acid and an Arrhenius base?

- A) $\text{Zn}(s) + 2 \text{HCl}(\text{aq}) \rightarrow \text{ZnCl}_2(\text{aq}) + \text{H}_2(g)$
B) $\text{BaCl}_2(\text{aq}) + \text{Na}_2\text{SO}_4(\text{aq}) \rightarrow \text{BaSO}_4(s) + 2 \text{NaCl}(\text{aq})$
C) $\text{C}_3\text{H}_8(g) + 5 \text{O}_2(g) \rightarrow 3 \text{CO}_2(g) + 4 \text{H}_2\text{O}(\ell)$
D) $\text{HC}_2\text{H}_3\text{O}_2(\text{aq}) + \text{NaOH}(\text{aq}) \rightarrow \text{NaC}_2\text{H}_3\text{O}_2(\text{aq}) + \text{H}_2\text{O}(\ell)$

41. The pH of 0.001M HCl is

- A) 1 C) 3
B) 2 D) 4

42. Which pH value indicates the most basic solution?

- A) 7 C) 3
B) 8 D) 11

43. Given the reaction at equilibrium:



The equilibrium will shift to the right when the

- A) concentration of $\text{A}(g)$ is decreased
B) concentration of $\text{C}(g)$ is increased
C) pressure is decreased
D) temperature is increased

44. What is the hydroxide ion concentration of a solution with a pH of 4?

- A) 1×10^{-14} C) 1×10^{-4}
B) 1×10^{-10} D) 1×10^{-7}

45. Given the following solutions:

- Solution A: pH of 10
Solution B: pH of 7
Solution C: pH of 5

Which list has the solutions placed in order of increasing H^+ concentration?

- A) C, A, B C) B, A, C
B) C, B, A D) A, B, C

46. What is the hydrogen ion concentration of a solution at 298 K whose hydroxide ion concentration is 1×10^{-8} ?

- A) 1×10^{-14} C) 1×10^{-7}
B) 1×10^{-6} D) 1×10^{-8}

47. For a given system at equilibrium, lowering the temperature will always

- A) favor the exothermic reaction
B) increase the rate of reaction
C) increase the concentration of products
D) favor the endothermic reaction

48. What is the K_w of water at 1 atm and 298 K?

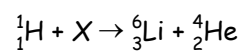
- A) 1.0×10^{-7} C) 1.0×10^{-14}
B) 1.0×10^{14} D) 1.0×10^7

49. If a solution has a hydrogen ion concentration of 1×10^{-9} M, the solution is

- A) basic and has a pH of 9
B) acidic and has a pH of 9
C) acidic and has a pH of 5
D) basic and has a pH of 5

50. According to the Arrhenius theory, when a base is dissolved in water it produces a solution containing only one kind of negative ion. What is the name of this negative ion?
- hydroxide ion
 - hydrogen sulfate ion
 - hydrogen carbonate ion
 - hydride ion
51. When the pH of a solution is 8, what is the OH^- ion concentration in moles per liter?
- 1×10^{-8}
 - 1×10^{-14}
 - 1×10^{-7}
 - 1×10^{-6}
52. What is the OH^- ion concentration of an aqueous solution with a pH of 5?
- $1 \times 10^{-5} \text{ M}$
 - $1 \times 10^{-7} \text{ M}$
 - $1 \times 10^{-14} \text{ M}$
 - $1 \times 10^{-9} \text{ M}$
53. What is the pH of a 0.01 M solution of KOH?
- 1
 - 2
 - 12
 - 13
54. As an aqueous solution becomes more acidic, the hydroxide ion concentration
- decreases
 - increases
 - remains the same
55. Which concentration indicates a basic solution at 298 K?
- $[\text{OH}^-] > 1.0 \times 10^{-7}$
 - $[\text{OH}^-] = 1.0 \times 10^{-7}$
 - $[\text{H}_3\text{O}^+] > 1.0 \times 10^{-7}$
 - $[\text{H}_3\text{O}^+] = 1.0 \times 10^{-7}$
56. Given the equilibrium constant for water:
- $$K_w = [\text{H}^+][\text{OH}^-] = 1 \times 10^{-14} \text{ at } 298 \text{ K}$$
- As the $[\text{H}^+]$ increases, the $[\text{OH}^-]$
- decreases
 - increases
 - remains the same
57. A student tested a 0.1 M aqueous solution and made the following observations:
- conducts electricity
 - turns blue litmus to red
 - reacts with Zn(s) to produce gas bubbles
- Which compound could be the solute in this solution?
- LiBr
 - HBr
 - LiOH
 - CH_4
58. An aqueous solution with a pH of 4 would have a hydroxide ion concentration of
- $1 \times 10^{-7} \text{ mol/L}$
 - $1 \times 10^{-10} \text{ mol/L}$
 - $1 \times 10^{-4} \text{ mol/L}$
 - $1 \times 10^{-14} \text{ mol/L}$
59. What is the H^+ ion concentration of an aqueous solution that has a pH of 11?
- $1.0 \times 10^{-11} \text{ mol/L}$
 - $3.0 \times 10^{-1} \text{ mol/L}$
 - $11 \times 10^{-1} \text{ mol/L}$
 - $1.0 \times 10^{-3} \text{ mol/L}$
60. A solution has a hydroxide ion concentration of $1 \times 10^{-5} \text{ M}$. What is the hydrogen ion concentration of the solution?
- $1 \times 10^{-1} \text{ M}$
 - $1 \times 10^{-9} \text{ M}$
 - $1 \times 10^{-5} \text{ M}$
 - $1 \times 10^{-14} \text{ M}$
61. What is the pH of a solution with a hydroxide ion concentration of 0.001 mole per liter?
- 1
 - 7
 - 3
 - 11
62. Which aqueous solution would turn blue litmus red?
- NaOH(aq)
 - NaCl(aq)
 - HCl(aq)
 - $\text{K}_2\text{CO}_3(\text{aq})$
63. If 25. milliliters of 0.80 M HCl is used to completely neutralize 40. milliliters of NaOH solution, what is the molarity of the base?
- 0.50 M
 50. M
 - 0.050 M
 - 5.0 M
64. Which equation represents a neutralization reaction?
- $\text{AgNO}_3 + \text{NaCl} \rightarrow \text{AgCl} + \text{NaNO}_3$
 - $\text{Zn} + \text{CuSO}_4 \rightarrow \text{ZnSO}_4 + \text{Cu}$
 - $\text{NaOH} + \text{HCl} \rightarrow \text{NaCl} + \text{H}_2\text{O}$
 - $2 \text{Na} + 2 \text{H}_2\text{O} \rightarrow 2 \text{NaOH} + \text{H}_2$
65. Which products are formed when an acid reacts with a base?
- a salt and water
 - an alcohol and carbon dioxide
 - a soap and glycerine
 - an ester and water
66. An alpha particle has the same composition as a
- deuterium nucleus
 - helium nucleus
 - beryllium nucleus
 - hydrogen nucleus

67. Given the nuclear equation:



The particle represented by X is

- A) ${}^9_4\text{Be}$ C) ${}^{10}_6\text{C}$
B) ${}^{10}_5\text{Be}$ D) ${}^9_4\text{Li}$

Answer Key
[New Exam]

- | | | |
|------------------|------------------|------------------|
| 1. <u> B </u> | 26. <u> D </u> | 51. <u> D </u> |
| 2. <u> A </u> | 27. <u> B </u> | 52. <u> D </u> |
| 3. <u> A </u> | 28. <u> A </u> | 53. <u> C </u> |
| 4. <u> C </u> | 29. <u> A </u> | 54. <u> A </u> |
| 5. <u> C </u> | 30. <u> A </u> | 55. <u> A </u> |
| 6. <u> C </u> | 31. <u> D </u> | 56. <u> A </u> |
| 7. <u> D </u> | 32. <u> A </u> | 57. <u> B </u> |
| 8. <u> A </u> | 33. <u> B </u> | 58. <u> B </u> |
| 9. <u> D </u> | 34. <u> B </u> | 59. <u> A </u> |
| 10. <u> B </u> | 35. <u> B </u> | 60. <u> B </u> |
| 11. <u> C </u> | 36. <u> C </u> | 61. <u> D </u> |
| 12. <u> B </u> | 37. <u> B </u> | 62. <u> C </u> |
| 13. <u> D </u> | 38. <u> C </u> | 63. <u> A </u> |
| 14. <u> A </u> | 39. <u> D </u> | 64. <u> C </u> |
| 15. <u> D </u> | 40. <u> D </u> | 65. <u> A </u> |
| 16. <u> A </u> | 41. <u> C </u> | 66. <u> B </u> |
| 17. <u> A </u> | 42. <u> D </u> | 67. <u> A </u> |
| 18. <u> D </u> | 43. <u> D </u> | |
| 19. <u> A </u> | 44. <u> B </u> | |
| 20. <u> D </u> | 45. <u> D </u> | |
| 21. <u> D </u> | 46. <u> B </u> | |
| 22. <u> D </u> | 47. <u> A </u> | |
| 23. <u> C </u> | 48. <u> C </u> | |
| 24. <u> C </u> | 49. <u> A </u> | |
| 25. <u> C </u> | 50. <u> A </u> | |