**Multiple Choice – Mathematics Questions**

**Format of Multiple Choice AP test:**

* 75 multiple choice questions
* 90 minutes on the section
* Average time is 72 seconds per question
* **NO CALCULATORS ARE TO BE USED**
* “Hard” questions are generally in the middle of the test.
  + This is designed to “separate the students out” – find a break between the fours and fives, the threes and the fours, etc.
* Choices go from the
  + lowest number to the highest number
  + they are generally lined up by decimal points, even though this does not make the number list “straight”
    - Allows you to see decimal points and significant figures easier.
* Look for the word approximate in the question, if there, you can use estimation to help arrive at the answer.

**Strategies on the multiple choice questions:**

* All multiple choice questions count the same amount…whether it took you 5 minutes or 15 seconds.
* Go through the test completely once, answering the questions that are easy for you to answer.
* When you run into a problem that you know you can do, but that will take you several minutes, put a star (★) next to the problem number and move on.
* When you run into a problem that you have no idea on, put a circle around the number and go on.
* When you have read through the entire test and have done all of the simple questions for you, go back and start working on the questions that you starred (★).
* If you have time after you did the starred (★) questions, go to the circle questions and look at them again…maybe a second time through will jog your memory.
* **REMEMBER every time you turn the page…make sure that you have bubbled the correct number on the answer sheet. This way if you get off track on bubbling, you only have to check a page to find your mistake.**

**The AP-style multiple-choice questions will be of four types:**

* Which of the following is set up correctly to solve this problem?
* Problems with A, B, C, D, and E at the top and three or four questions below it (remember the choices may be used more than once).
* Problems with Roman Numerals choices at the top and options for their combinations.
* Traditional multiple-choice question format with FIVE choices.

**Scoring:**

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ - (¼) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ = \_\_\_\_\_\_\_\_\_\_\_\_

(# of questions correct) – [(¼ x (# of questions wrong)] (raw score)

(Raw score) x 0.95 = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (weighted MC score)

The following statement is at the top of the multiple choice section…please be familiar with the symbols used on the test.

Note: For all questions, assume that the temperature is 298 K, the pressure is 1.00 atmospheres and solutions are aqueous unless otherwise specified.

Throughout the test the following symbols have the definitions specified unless otherwise noted.

*T* = temperature *M* = molar

*P* = pressure *m* = molal

*V* = volume L, mL = liter(s), milliliter(s)

*S* = entropy g = gram(s)

*H* = enthalpy nm = nanometers

*G* = free energy atm = atmosphere(s)

R = molar gas constant J, kJ = joule(s), kilojoule(s)

n = number of moles V = volt(s)

mol = mole(s)

**How to do the math**

You must remember the following fractions, their decimal equivalence and their percentages.



A common type of problem will require you to use scientific notation and to use the following exponent laws:



Example: A problem gives you the Keq value of 2.0 x 107 and would like the Keq value for the reverse reaction.

Answer:



Another way to do this problem is to rewrite 1 as 10 x 10-1. Doing this, you will have:



The other common mathematic problem is division by a fraction. Remember, find the main division bar and rewrite as a multiplication problem:



A common approach for a problem might be to have you solve the following problem, which can be done “long hand” or you can use the fraction information and division by a fraction to make the problem a little easier.



Another type of math problem that you will be expected to be able to do is simple logarithms. Remember a logarithm is just another way to write an exponent problem. Remember that logarithms are just a “circular” way of writing exponents. Take for example 2x = 8 can be written as log28.



2x = 8 🡺





Remember that, so when given a question that says “determine the approximate range that an indictor would be appropriate for?” – you are looking for the pKa value; you will need to know how to find the approximate answer. The exponent will always give you the characteristic of the number…unless the number in front of the “x” sign is 1, then your answer (when you take the log) will be (exponent – 1) – in this case B - 1.



Look at the following chart and look at the pattern of the numbers:

| **Number** | **log10 of number** |
| --- | --- |
| 1.00 x 10-5 | 5.00 |
| 1.78 x 10-5 | 4.75 |
| 3.16 x 10-5 | 4.50 |
| 5.62 x 10-5 | 4.25 |
| 10.0 x 10-5 | 4.00 |

The logarithmic scale is not linear. The half-way point for the log (a mantissa of “.5”) will be determined by

3.16 x 10-?? ; an easy way to remember this is π x 10-?? will give you the mantissa of “.5” and the exponent determines the characteristic of the your answer.

Some math tricks:

* If you don’t like to work with numbers like 0.025, move the decimal point three places to the right and think of the number as 25 – just remember to move the decimal point three places back to the left when done.
* If you are squaring a number that ends in 5, like 35. This is what you can do.
  + Take the number in front of the 5 – in this case it is 3.
  + Add one to the number – in this example that would be 1 + 3 = 4
  + Take this number and multiple by the original number; here we get 4 x 3 = 12.
  + Take this number and put 25 at the end. Here we would get 1225.

**Examples:**

**General Mole Relationships**

1. The atomic mass of copper is 63.55. Given that there are only two naturally occurring isotopes of copper, 63Cu and 65Cu, the natural abundance of the 65Cu isotope must be approximately
2. 90%
3. 70%
4. 50%
5. 25%
6. 10%
7. What is the mole fraction of ethanol, C2H5OH, in an aqueous solution that is 46 percent ethanol by mass? The molar mass of C2H5OH is 46 g, the molar mass of H2O is 18 g.
8. 0.25
9. 0.46
10. 0.54
11. 0.67
12. 0.75
13. Approximately what mass of CuSO4 ● 5 H2O (250 g mol-1) is required to prepare 250 mL of 0.10 M copper(II) sulfate solution?
14. 4.0 g
15. 6.2 g
16. 34 g
17. 85 g
18. 140 g
19. If 200. mL of 0.60 *M* MgCl2(aq) is added to 400. mL of distilled water, what is the concentration of Mg2+(aq) in the resulting solution? (Assume volumes are additive.)
20. 0.20 *M*
21. 0.30 *M*
22. 0.40 *M*
23. 0.60 *M*
24. 1.2 *M*

5. The weight of H2SO4 (molecular weight 98.1) in 50.0 milliliters of a 6.00-molar solution is

(a) 3.10 grams  
(b) 12.0 grams  
(c) 29.4 grams  
(d) 294 grams  
(e) 300. grams

6. How many grams of calcium nitrate, Ca(NO3)2, contains 24 grams of oxygen atoms?

(a) 41 grams  
(b) 50. grams  
(c) 62 grams  
(d) 96 grams  
(e) 164grams

7. The mass of element Q found in 1.00 mole of each of four different compounds is 38.0 grams, 57.0 grams, 76.0 grams, and 114 grams, respectively. A possible atomic weight of Q is

(a) 12.7  
(b) 19.0  
(c) 27.5  
(d) 38.0  
(e) 57.0

8. When 70. milliliter of 3.0-molar Na2CO3 is added to 30. milliliters of 1.0-molar NaHCO3 the resulting concentration of Na+ is

(a) 2.0 M

(b) 2.4 M

(c) 4.0 M  
(d) 4.5 M

(e) 7.0 M

9. What is the *approximate* mole fraction of ethanol, C2H5OH, in an aqueous solution in which the ethanol concentration is 11.0 molal?

(a) 0.0011

(b) 0.011

(c) 0.170  
(d) 0.200

(e) 0.600

10. Mass of an empty container = 3.0 grams  
Mass of the container plus the solid sample = 25.0 grams  
Volume of the solid sample = 11.0 cubic centimeters

The data above were gathered in order to determine the density of an unknown solid. The density of the sample should be reported as

(a) 0.5 g/cm3  
(b) 0.50 g/cm3  
(c) 2.0 g/cm3  
(d) 2.00 g/cm3  
(e) 2.27 g/cm3

11. If 87 grams of K2 SO4 (molar mass 174 grams) is dissolved in enough water to make 250 milliliters of solution, what are the concentrations of the potassium and the sulfate ions?

|  | [K+] | [SO42¯] |
| --- | --- | --- |
| (A) | 0.020 M | 0.020 M |
| (B) | 1.0 M | 2.0 M |
| (C) | 2.0 M | 1.0 M |
| (D) | 2.0 M | 2.0 M |
| (E) | 4.0 M | 2.0 M |

12. When a 1.25-gram sample of limestone was dissolved in acid, 0.44 gram of CO2 was generated. If the rock contained no carbonate other than CaCO3, what was the percent of CaCO3 by mass in the limestone?

(a) 35%  
(b) 44%  
(c) 67%  
(d) 80%  
(e) 100%

13. What mass of Au is produced when 0.0500 mol of Au2S3 is reduced completely with excess H2?

(a) 9.85 g  
(b) 19.7 g  
(c) 24.5 g  
(d) 39.4 g  
(e) 48.9 g

14. A 1.0 L sample of an aqueous solution contains 0.10 mol of NaCl and 0.10 mol of CaCl2. What is the minimum number of moles of AgNO3 that must be added to the solution in order to precipitate all of the Cl¯ as AgCl(s)? (Assume that AgCl is insoluble.)

(a) 0.10 mol  
(b) 0.20 mol  
(c) 0.30 mol  
(d) 0.40 mol  
(e) 0.60 mol

15. The volume of distilled water that should be **added** to 10.0 mL of 6.00 M HCl (aq) in order to prepare a 0.500 M HCl (aq) solution is approximately

(a) 50.0 mL  
(b) 60.0 mL  
(c) 100. mL  
(d) 110. mL  
(e) 120. mL

16. How many milliliters of 11.6-molar HCl must be diluted to obtain 1.0 liter of 3.0-molar HCl?

(a) 3.9 mL  
(b) 35 mL  
(c) 250 mL  
(d) 1,000 mL  
(e) 3,900 mL

17. A measured mass of an unreactive metal was dropped into a small graduated cylinder half filled with water. The following measurements were made.

Mass of metal = 19.611 grams  
Volume of water before addition of metal = 12.4 milliliters  
Volume of water after addition of metal = 14.9 milliliters

The density of the metal should be reported as

(a) 7.8444 grams per mL  
(b) 7.844 grams per mL  
(c) 7.84 grams per mL  
(d) 7.8 grams per mL  
(e) 8 grams per mL

18. A solution of toluene (molecular weight 92.1) in an organic solvent (molecular weight 55.6) is prepared. The mole fraction of toluene in the solution is 0.100. What is the molality of the solution?

(a) 0.100 *m*  
(b) 0.703 *m*  
(c) 0.921 *m*  
(d) 0.995 *m*  
(e) 0.200 *m*

19. How many moles of solid Ba(NO3)2 should be added to 300. milliliters of 0.20-molar Fe(NO3)3 to increase the concentration of the NO3¯ ion to 1.0-molar? (Assume that the volume of the solution remains constant.)

(a) 0.060 mole  
(b) 0.12 mole  
(c) 0.24 mole  
(d) 0.30 mole  
(e) 0.40 mole

20. In which of the following compounds is the mass ratio of chromium to oxygen closest to 1.6 to 1.0?

(a) CrO3  
(b) CrO2  
(c) CrO  
(d) Cr20  
(e) Cr2O3

**Gas Laws**

21. A gaseous mixture containing 7.0 moles of nitrogen, 2.5 moles of oxygen, and 0.50 mole of helium exerts a total pressure of 0.90 atmospheres. What is the partial pressure of the nitrogen?

(a) 0.13 atm  
(b) 0.27 atm  
(c) 0.63 atm  
(d) 0.90 atm  
(e) 6.3 atm

22. Hydrogen gas is collected over water at 24 °C. The total pressure of the sample is 755 millimeters of mercury.

At 24 °C, the vapor pressure of water is 22 millimeters of mercury. What is the partial pressure of the hydrogen gas?

(a) 22 mm Hg  
(b) 733 mm Hg  
(c) 755 mm Hg  
(d) 760 mm Hg  
(e) 777 mm Hg

23. A 2.00-liter sample of nitrogen gas at 27 °C and 600. millimeters of mercury is heated until it occupies a volume of 5.00 liters. If the pressure remains unchanged, the final temperature of the gas is

(a) 68 °C  
(b) 120 °C  
(c) 477 °C  
(d) 677 °C  
(e) 950. °C

24. The density of an unknown gas is 2.00 grams per liter at 3.00 atmospheres pressure and 127 °C. What is the molecular weight of this gas? (R = 0.0821 liter-atm / mole-K)

(a) 254/3 R  
(b) 188 R  
(c) 800/3 R  
(d) 600 R  
(e) 800 R

25. At 20. °C, the vapor pressure of toluene is 25 millimeters of mercury and that of benzene is 75 millimeters of mercury. An ideal solution, equimolar in toluene and benzene, is prepared. At 20. °C, what is the mole fraction of benzene in the vapor in equilibrium with this solution?

(a) 0.25

(b) 0.33

(c) 0.50  
(d) 0.75

(e) 0.83

26. A sample of 0.010 mole of oxygen gas is confined at 127 °C and 0.80 atmospheres. What would be the pressure of this sample at 27 °C and the same volume?

(a) 0.10 atm  
(b) 0.20 atm  
(c) 0.60 atm  
(d) 0.80 atm  
(e) 1.1 atm

27. A sample of 9.00 grams of aluminum metal is added to an excess of hydrochloric acid. The volume of hydrogen gas produced at standard temperature and pressure is

(a) 22.4 liters

(b) 11.2 liters  
(c) 7.46 liters

(d) 5.60 liters  
(e) 3.74 liters

28. A flask contains 0.25 moles of SO2(*g*), 0.50 moles of CH4(*g*), and 0.50 mole of O2(*g*). The total pressure of the gases in the flask is 800 mm Hg. What is the partial pressure of the SO2(*g*) in the flask?

(a) 800 mm Hg

(b) 600 mm Hg

(c) 250 mm Hg

(d) 200 mm Hg

(e) 160 mm Hg

29. CS2(*l*) + 3 O2(*g*) 🡪 CO2(*g*) + 2 SO2(*g*)

What volume of O2(*g*) is required to react with excess CS2(*l*) to produce 4.0 liters of CO2(*g*)? (Assume all gases are measured at 0oC and 1 atm.)

(a) 12 L

(b) 22.4 L

(c) 1/3 x 22.4 L

(d) 2 x 22.4 L

(e) 3 x 22.4 L

30. A 2 L container will hold about 4 g of which of the following gases at 0oC and 1 atm?

(a) SO2

(b) N2

(c) CO2

(d) C4H8

(e) NH3

31. An excess of Mg(s) is added to 100. mL of 0.400 M HCl. At 0oC and 1 atm pressure, what volume of H2 gas can be obtained?

1. 22.4 mL
2. 44.8 mL
3. 224 mL
4. 448 mL
5. 896 mL

**Empirical and molecular formulas**

32. A compound contains 1.10 mol of K, 0.55 mol of Te, and 1.65 mol of O. What is the simplest formula of this compound?

(a) KTeO

(b) KTe2O

(c) K2TeO3

(d) K2TeO6

(e) K4TeO6

33. The simplest formula for an oxide of element X (MM = 76.0) that is 24.0 percent oxygen by weight is

(a) X2O  
(b) XO

(c) XO2  
(d) X2O3  
(e) X2O5

34. A 27.0-gram sample of an unknown hydrocarbon was burned in excess oxygen to form 88.0 grams of carbon dioxide and 27.0 grams of water. What is a possible molecular formula of the hydrocarbon?

(a) CH4

(b) C2H2

(c) C4H3  
(d) C4H6

(e) C4H10

35. When a hydrate of X2CO3 (MM = 153) is heated until all the water is removed, it loses 54 percent of its mass. The formula of the hydrate is

(a) X2CO3 ∙ 10 H2O  
(b) X2CO3 ∙ 7 H2O  
(c) X2CO3 ∙ 5 H2O  
(d) X2CO3 ∙ 3 H2O  
(e) X2CO3 ∙ H2O

**Stoichiometry**

36.

2 N2H4(*g*) + N2O4(*g*) 🡪 3 N2(*g*) + 4 H2O(*g*)

When 8.0 g of N2H4 (32 g mol-1) and 92 g of N2O4 (92 g mol-1) are mixed together and react according to the equation above, what is the maximum mass of H2O that can be produced?

1. 9.0 g
2. 18 g
3. 36 g
4. 72 g
5. 144 g

37.

2 H2O(*l*) + 4 MnO4—(*aq*) + 3 ClO2—(*aq*) 🡪 4 MnO2(*s*) + 3 ClO4–(*aq*) + 4 OH—(*aq*)

According to the balance equation above, how many moles of ClO2—(*aq*) are needed to react completely with 20. mL of 0.20 *M* KMnO4 solution?

1. 0.0030 mol
2. 0.0053 mol
3. 0.0075 mol
4. 0.013 mol
5. 0.030 mol

38.

3 Ag(s) + 4 HNO3 🡸🡺3 AgNO3 + NO(g) + 2 H2O

The reaction of silver metal and dilute nitric acid proceeds according to the equation above. If 0.10 mole of powdered silver is added to 10. milliliters of 6.0-molar nitric acid, the number of moles of NO gas that can be formed is

(a) 0.015 mole  
(b) 0.020 mole  
(c) 0.030 mole  
(d) 0.045 mole  
(e) 0.090 mole

39. A 20.0-milliliter sample of 0.200-molar K2CO3 solution is added to 30.0 milliliters of 0.400-molar Ba(NO3)2 solution. Barium carbonate precipitates. The concentration of barium ion, Ba2+, in solution **after** reaction is

(a) 0.150 M  
(b) 0.160 M  
(c) 0.200 M  
(d) 0.240 M  
(e) 0.267 M

40. What number of moles of O2 is needed to produce 142 grams of P4O10 from P? (Molecular weight P4O10 = 284)

(a) 0.500 mole  
(b) 0.625 mole  
(c) 1.25 mole  
(d) 2.50 mole  
(e) 5.00 mole

41.

BrO3¯ + 5 Br¯ + 6 H+ 🡸🡺 3 Br2 + 3 H2O

If 25.0 milliliters of 0.200-molar BrO3¯ is mixed with 30.0 milliliters of 0.450-molar Br¯ solution that contains a large excess of H+, the amount of Br2 formed, according to the equation above, is

(a) 5.00 x 10-3 mole  
(b) 8.10 x 10-3 mole  
(c) 1.35 x 10-2 mole  
(d) 1.50 x 10-2 mole  
(e) 1.62 x 10-2 mole

42. Commercial vinegar was titrated with NaOH solution to determine the content of acetic acid, HC2H3O2. For 20.0 milliliters of the vinegar 26.7 milliliters of 0.600-molar NaOH solution was required. What was the concentration of acetic acid in the vinegar if no other acid was present?

(a) 1.60 M  
(b) 0.800 M  
(c) 0.600 M  
(d) 0.450 M  
(e) 0.200 M

43. What volume of 0.150-molar HCl is required to neutralize 25.0 millilters of 0.120-molar Ba(OH)2?

(a) 20.0 mL  
(b) 30 0 mL  
(c) 40.0 mL  
(d) 60.0 mL  
(e) 80.0 mL

44. It is suggested that SO2 (molar mass 64 grams), which contributes to acid rain, could be removed from a stream of waste gases by bubbling the gases through 0.25-molar KOH, thereby producing K2SO3. What is the maximum mass of SO2 that could be removed by 1,000. liters of the KOH solution?

(a) 4.0 kg  
(b) 8.0 kg  
(c) 16 kg  
(d) 20. kg  
(e) 40. kg

45. Commercial vinegar was titrated with NaOH solution to determine the content of acetic acid, HC2H3O2. For 20.0 milliliters of the vinegar, 32.0 milliliters of 0.500-molar NaOH solution was required. What was the concentration of acetic acid in the vinegar if no other acid was present?

(a) 1.60 M  
(b) 0.800 M  
(c) 0.640 M  
(d) 0.600 M  
(e) 0.400 M

46. What is the final concentration of barium ions, [Ba2+], in solution when 100. mL of 0.10 M BaCl2(aq) is mixed with 100. mL of 0.050 M H2SO4(aq)?

(a) 0.00 M  
(b) 0.012 M  
(c) 0.025 M  
(d) 0.075 M  
(e) 0.10 M

**Nuclear**

47. 98251Cf 🡪 2 *n* + 54131Xe + \_\_

What is the missing product in the nuclear reaction represented above?

(a) 42118Mo  
(b) 44118Ru  
(c) 42120Mo  
(d) 44120Ru  
(e) 46122Pd

48. The half-life for radioactive element X is 10.0 min. What weight of X was originally present in a sample if 40. grams is left after 60. minutes?

(a) 320. grams  
(b) 640. grams  
(c) 1,280. grams  
(d) 2,400 grams  
(e) 2,560 grams

49. If 87.5 percent of a sample of pure 131I decays in 24 days, what is the half-life of 131I?

(a) 6 days  
(b) 8 days  
(c) 12 days  
(d) 14 days  
(e) 21 days

**Enthalpy**

50.

3 C2H2(*g*) 🡪 C6H6

What is the standard enthalpy change, **Δ**Ho, for the reaction represented above?

**Δ**Hf of C2H2(*g*) is 230 kJ mol-1

**Δ**Hf of C6H6(*g*) is 83 kJ mol-1

1. -607 kJ
2. -147 kJ
3. -19 kJ
4. +19 kJ
5. +773 kJ

51.

CH4(g) + 2 O2(g) 🡪 CO2(g) + 2 H2O(l); ΔΗ = - 889.1 kJ

ΔHf° H2O(l) = - 285.8 kJ / mole

ΔHf° CO2(g) = - 393.3 kJ / mole

What is the standard heat of formation of methane, ΔHf° CH4(g), as calculated from the data above?

(a) -210.0 kJ/mole

(b) -107.5 kJ/mole  
(c) -75.8 kJ/mole  
(d) 75.8 kJ/mole  
(e) 210.0 kJ/mole

52.

I2(g) + 3 Cl2(g) 🡪 2 ICl3(g)

According to the data in the table below, what is the value of ΔH° for the reaction represented above?

| Bond | Average Bond Energy (kilojoules / mole) |
| --- | --- |
| I---I | 150 |
| Cl---Cl | 240 |
| I---Cl | 210 |

(a) - 870 kJ  
(b) - 390 kJ  
(c) + 180 kJ  
(d) + 450 kJ  
(e) + 1,260 kJ

**Equilibrium**

53. At 25OC, aqueous solutions with a pH of 8 have hydroxide ion concentration, [OH— ], of

1. 1 x 10-14 M
2. 1 x 10-8 M
3. 1 x 10-6 M
4. 1 M
5. 8 M

54.

H2(*g*) + Br2(*g)* ↔ 2 HBr(*g*)

At a certain temperature, the value of the equilibrium constant, K, for the reaction represented above is 2.0 x 105. What is the value of K for the reverse reaction at the same temperature?

1. -2.0 x 10-5
2. 5.0 x 10-6
3. 2.0 x 10-5
4. 5.0 x 10-5
5. 5.0 x 10-4

55. In a saturated solution of Zn(OH)2 at 25oC, the value of [OH—] is 2.0 x 10-6 M. What is the value of the solubility-product constant, Ksp, for Zn(OH)2 at 25oC?

1. 4.0 x 10-18
2. 8.0 x 10-18
3. 1.6 x 10-17
4. 4.0 x 10-12
5. 2.0 x 10-6

56.

2 K + 2 H2O 🡪 2 K+ + 2 OH¯ + H2

When 0.400 mole of potassium reacts with excess water at standard temperature and pressure as shown in the equation above, the volume of hydrogen gas produced is

(a) 1.12 liters  
(b) 2.24 liters  
(c) 3.36 liters  
(d) 4.48 liters  
(e) 6.72 liters

57. A 0.20-molar solution of a weak monoprotic acid, HA, has a pH of 3.00. The ionization constant of this acid is

(a) 5.0 x 10-7  
 (b) 2.0 x 10-7  
 (c) 5.0 x 10-6  
 (d) 5.0 x 10-3  
 (e) 2.0 x 10-3

58. The solubility of CuI is 2 x 10-6 molar. What is the solubility product constant, Ksp, for CuI?

(a) 1.4 x 10-3  
(b) 2 x 10-6  
(c) 4 x 10-12  
(d) 2 x 10-12  
(e) 8 x 10-18

59. MnS(s) + 2 H+ 🡸🡺 Mn2+ + H2S(g)

At 25 °C the solubility product constant, Ksp, for MnS in 5 x 10-15 and the acid dissociation constants K1 and K2 for H2S are 1 x 10-7 and 1 x 10-13, respectively. What is the equilibrium constant for the reaction represented by the equation above at 25 °C?

(a) 1 x 10-13 / 5 x 10-15  
(b) 5 x 10-15 / 1 x 10-7  
(c) 1 x 10-7 / 5 x 10-20  
(d) 5 x 10-15 / 1 x 10-20  
(e) 1 x 10-20 / 5 x 10-15

60. How many moles of NaF must be dissolved in 1.00 liter of a saturated solution of PbF2 at 25 °C to reduce the [Pb2+] to 1 x 10-6 molar? (Ksp of PbF2 at 25 °C = 4.0 x 10-8)

(a) 0.020 mole

(b) 0.040 mole  
(c) 0.10 mole

(d) 0.20 mole  
(e) 0.40 mole

61. If the acid dissociation constant, Ka, for an acid HA is 8 x 10-4 at 25 °C, what percent of the acid is dissociated in a 0.50-molar solution of HA at 25 °C?

(a) 0.08%

(b) 0.2%

(c) 1%  
(d) 2%

(e) 4%

62.

5 Fe2+ + MnO4¯ + 8 H+ 🡸🡺 5 Fe3+ + Mn2+ + 4 H2O

In a titration experiment based on the equation above, 100.0 milliliters of an acidified Fe2+ solution requires 14.0 milliliters of standard 0.050-molar MnO4¯ solution to reach the equivalence point. The concentration of Fe2+ in the original solution is

(a) 0.0035 M  
(b) 0.0070 M  
(c) 0.035 M  
(d) 0.070 M  
(e) 0.14 M

63.

H2C2O4 + 2 H2O 🡨🡪 2 H3O+ + C2O42¯

Oxalic acid, H2C2O4, is a diprotic acid with K1 = 5 x 10-2 and K2 = 5 x 10-5. Which of the following is equal to the equilibrium constant for the reaction represented above?

(a) 5 x 10-2  
(b) 5 x 10-5  
(c) 2.5 x 10-6  
(d) 5 x 10-7  
(e) 2.5 x 10-8

64. What is the H+(aq) concentration in 0.05 M HCN (aq) ? (The Ka for HCN is 5.0 x 10-10)

(a) 2.5 x 10-11  
(b) 2.5 x 10-10  
(c) 5.0 x 10-10  
(d) 5.0 x 10-6  
(e) 5.0 x 10-4

65. What is the molar solubility in water of Ag2CrO4? (The Ksp for Ag2CrO4 is 8 x 10-12.)

(a) 8 x 10-12 M  
(b) 2 x 10-12 M  
(c) (4 x 10-12 M)1/2  
(d) (4 x 10-12 M)1/3  
(e) (2 x 10-12 M)1/3

**Kinetics**

Rate = *k*[M][N]2

66. The rate of a certain chemical reaction between substances M and N obeys the rate law above. The reaction is first studied with [M] and [N] each 1 x 10-3 molar. If a new experiment is conducted with [M] and [N] each 2 x 10-3 molar, the reaction rate will increase by a factor of

1. 2
2. 4
3. 6
4. 8
5. 16

**Electrochemistry**

67. In the electroplating of nickel, 0.200 faraday of electrical charge is passed through a solution of NiSO4. What mass of nickel is deposited?

1. 2.94 g
2. 5.87 g
3. 11.7 g
4. 58.7 g
5. 294 g

68. If 0.060 faraday is passed through an electrolytic cell containing a solution of In3+ ions, the maximum number of moles of In that could be deposited at the cathode is

(a) 0.010 mole  
(b) 0.020 mole  
(c) 0.030 mole  
(d) 0.060 mole  
(e) 0.18 mole

**Answers**

**Your answers Correct answers**

1. \_\_\_\_\_\_\_\_
2. \_\_\_\_\_\_\_\_
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51.\_\_\_\_\_\_\_\_

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