AP Chemistry Unit 0 Packet **Name _____**
Due _____ **Date _____ Block _____**

The purpose of this packet is to help you review and set up the expectation of what you should already know before taking AP Chemistry. AP Chemistry is a fast-paced course and if many of these concepts have stumped you, this may require you to arrange to come in before/after school during the first two weeks of the semester.

This packet will be graded for **completion**, but you must do more than simply circle the correct answer. For every question, you must either **show your work** (if it's a calculation based question) or **annotate/explain** why the answer is correct (ex: write down the rule for rounding with sig figs).

The content in this packet serves as the majority of what will be covered on your first unit test. We will go over these concepts during the first two weeks of class, but since this is pre-requisite knowledge, please keep in mind it is not possible for me to reteach or go over every single one of these concepts in great detail.

Try going through this packet on your own first (minimal use of notes and a calculator). **Mark questions** you needed help with or look up how to do. Please also indicate which ones you needed to use a calculator (keep in mind you **may not** use a calculator on the multiple choice section of the AP exam).

A periodic table has been included for your reference (this is the same one you will be given on your tests and on the AP exam).

The topics covered in this packet are outlined below:

I. Matter and Measurement
   a. Significant Figures
   b. Measurement, Density
   c. Units, Scientific notation & Calculations
   d. Dimensional Analysis
II. Atoms, Molecules and Ions
   a. Atomic Structure and Theory
   b. Molecules and Ions
   c. Naming Compounds
   d. Periodic Properties
III. Stoichiometry
   a. The Mole, Molar Conversions
   b. Formula Weights
   c. Empirical and Molecular Formula
   d. Balancing Equations
   e. Stoichiometric Calculations
IV. Types of Chemical Reactions and Solution Stoichiometry
   a. Electrolytes
   b. Types of Reactions
   c. Molarity and Dilutions

PERIODIC TABLE OF THE ELEMENTS

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1 **H** 1.008																	2 **He** 4.00
3 **Li** 6.94	4 **Be** 9.01											5 **B** 10.81	6 **C** 12.01	7 **N** 14.01	8 **O** 16.00	9 **F** 19.00	10 **Ne** 20.18
11 **Na** 22.99	12 **Mg** 24.30											13 **Al** 26.98	14 **Si** 28.09	15 **P** 30.97	16 **S** 32.06	17 **Cl** 35.45	18 **Ar** 39.95
19 **K** 39.10	20 **Ca** 40.08	21 **Sc** 44.96	22 **Ti** 47.87	23 **V** 50.94	24 **Cr** 52.00	25 **Mn** 54.94	26 **Fe** 55.85	27 **Co** 58.93	28 **Ni** 58.69	29 **Cu** 63.55	30 **Zn** 65.38	31 **Ga** 69.72	32 **Ge** 72.63	33 **As** 74.92	34 **Se** 78.97	35 **Br** 79.90	36 **Kr** 83.80
37 **Rb** 85.47	38 **Sr** 87.62	39 **Y** 88.91	40 **Zr** 91.22	41 **Nb** 92.91	42 **Mo** 95.95	43 **Tc** (97)	44 **Ru** 101.1	45 **Rh** 102.91	46 **Pd** 106.42	47 **Ag** 107.87	48 **Cd** 112.41	49 **In** 114.82	50 **Sn** 118.71	51 **Sb** 121.76	52 **Te** 127.60	53 **I** 126.90	54 **Xe** 131.29
55 **Cs** 132.91	56 **Ba** 137.33	57 ***La** 138.91	72 **Hf** 178.49	73 **Ta** 180.95	74 **W** 183.84	75 **Re** 186.21	76 **Os** 190.2	77 **Ir** 192.2	78 **Pt** 195.08	79 **Au** 196.97	80 **Hg** 200.59	81 **Tl** 204.38	82 **Pb** 207.2	83 **Bi** 208.98	84 **Po** (209)	85 **At** (210)	86 **Rn** (222)
87 **Fr** (223)	88 **Ra** (226)	89 **†Ac** (227)	104 **Rf** (267)	105 **Db** (270)	106 **Sg** (271)	107 **Bh** (270)	108 **Hs** (277)	109 **Mt** (276)	110 **Ds** (281)	111 **Rg** (282)	112 **Cn** (285)	113 **Uut** (285)	114 **Fl** (289)	115 **Uup** (288)	116 **Lv** (293)	117 **Uus** (294)	118 **Uuo** (294)

*Lanthanoid Series	58 **Ce** 140.12	59 **Pr** 140.91	60 **Nd** 144.24	61 **Pm** (145)	62 **Sm** 150.4	63 **Eu** 151.97	64 **Gd** 157.25	65 **Tb** 158.93	66 **Dy** 162.50	67 **Ho** 164.93	68 **Er** 167.26	69 **Tm** 168.93	70 **Yb** 173.05	71 **Lu** 174.97
†Actinoid Series	90 **Th** 232.04	91 **Pa** 231.04	92 **U** 238.03	93 **Np** (237)	94 **Pu** (244)	95 **Am** (243)	96 **Cm** (247)	97 **Bk** (247)	98 **Cf** (251)	99 **Es** (252)	100 **Fm** (257)	101 **Md** (258)	102 **No** (259)	103 **Lr** (262)

AP Chem Unit 0 Review

Name: _____ **Date:** _____

1. Which milligram quantity contains a total of four significant figures?

   A. 0.3010 mg B. 3010 mg

   C. 3100 mg D. 30001 mg

2. Which mass measurement contains four significant figures?

   A. 0.086 g B. 0.431 g

   C. 1003 g D. 3870 g

3. Which measurement contains a total of three significant figures?

   A. 0.12 B. 012 C. 120 D. 120.

4. The following weighings were made during a laboratory exercise:

   Mass of evaporating dish . . . . . 59.260 g
   Mass of sugar sample . . . . . 1.61 g

   What is the total mass of the evaporating dish plus the sample, expressed to the proper number of significant figures?

   A. 60.870 g B. 60.87 g

   C. 60.9 g D. 61 g

5. In a laboratory exercise to determine the density of a substance, a student found the mass of the substance to be 6.00 grams and the volume to be 2.0 milliliters. Expressed to the correct number of significant figures, the density of the substance is

   A. 3.000 g/mL B. 3.00 g/mL

   C. 3.0 g/mL D. 3 g/mL

6. When 1.255 grams of X reacts completely with 3.2 grams of Y, Z is the only product of the reaction. What is the total mass of Z, expressed to the proper number of significant figures?

A. 4.455 g B. 4.46 g

C. 4.5 g D. 5 g

7. The volume of a gas sample is 22.4 liters at STP. The density of the gas is 1.34 grams per liter. What is the mass of the gas sample, expressed to the correct number of significant figures?

A. 16.7 g B. 17 g

C. 30 g D. 30.0 g

8. In the laboratory a student determined the atomic mass of an element to be 28.02. The accepted value is 28.086. The difference between the student's observed value and the accepted value, expressed to the correct number of significant figures, is

A. 0.1 B. 0.10 C. 0.066 D. 0.07

9. Expressed to the correct number of significant figures, the sum of two masses is 445.2 grams. Which two masses produce this answer?

A. 210.10 g + 235.100 g

B. 210.100 g + 235.10 g

C. 210.1 g + 235.1 g

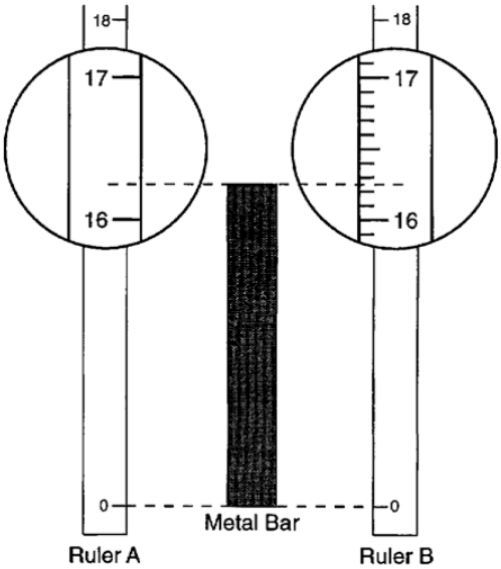
D. 210.10 g + 235.10 g

10. Which kelvin temperature is equal to 56° C?

A. −329 K B. −217 K

C. 217 K D. 329 K

11. The diagram represents a metal bar and two centimeter rulers, *A* and *B*. Portions of the rulers have been enlarged to show detail. What is the greatest degree of precision to which the metal bar can be measured by ruler *A* and by ruler *B*?



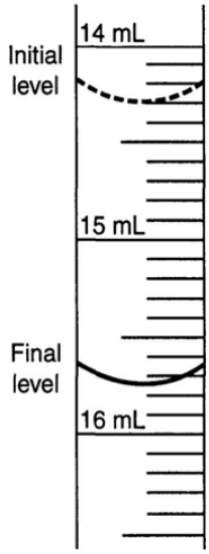
A. to the nearest tenth by both rulers

B. to the nearest hundredth by both rulers

C. to the nearest tenth by ruler *A* and to the nearest hundredth by ruler *B*

D. to the nearest hundredth by ruler *A* and to the nearest tenth by ruler *B*

12. The accompanying diagram represents a section of a buret containing acid used in an acid-base titration.



What is the total volume of acid that was used?

A. 1.10 mL B. 1.30 mL

C. 1.40 mL D. 1.45 mL

13. Which expression represents the number 0.00017 written in scientific notation?

A. 1.7×10^{-4} B. 1.7×10^{4}

C. 1.7×10^{-3} D. 1.7×10^{3}

14. Which number is equal to 3.6×10^5?

A. 360,000 B. 3,600,000

C. 0.000036 D. 0.0000036

15. The expression $3^2 \cdot 3^3 \cdot 3^4$ is equivalent to

A. 27^9 B. 27^{24} C. 3^9 D. 3^{24}

16. Which expression is equivalent to $(3x^2)^3$?

A. $9x^5$ B. $9x^6$ C. $27x^5$ D. $27x^6$

17. What is half of 2^6?

A. 1^3 B. 1^6 C. 2^3 D. 2^5

18. The expression $\frac{6 \times 10^{-7}}{3 \times 10^{-3}}$ is equivalent to

A. 2×10^4 B. 2×10^{10}

C. 2×10^{-4} D. 2×10^{-10}

19. Which expression is equivalent to 6.02×10^{23} ?

A. 0.602×10^{21} B. 60.2×10^{21}

C. 602×10^{21} D. 6020×10^{21}

20. If the number of molecules in 1 mole of a substance is 6.02×10^{23}, then the number of molecules in 100 moles is

A. 6.02×10^{21} B. 6.02×10^{22}

C. 6.02×10^{24} D. 6.02×10^{25}

21. What is the value of $\frac{6.3 \times 10^8}{3 \times 10^4}$ in scientific notation?

A. 2.1×10^{-2} B. 2.1×10^2

C. 2.1×10^{-4} D. 2.1×10^4

22. If the mass of a proton is 1.67×10^{-24} gram, what is the mass of 1,000 protons?

A. 1.67×10^{-27} g B. 1.67×10^{-23} g

C. 1.67×10^{-22} g D. 1.67×10^{-21} g

23. The quotient of (9.2×10^6) and (2.3×10^2) expressed in scientific notation is

A. 4,000 B. 40,000

C. 4×10^3 D. 4×10^4

24. Which expression could be used to change 8 kilometers per hour to meters per minute?

A. $\frac{8\text{ km}}{\text{hr}} \cdot \frac{\text{km}}{1000\text{ m}} \cdot \frac{\text{hr}}{60\text{ min}}$

B. $\frac{8\text{ km}}{\text{hr}} \cdot \frac{1000\text{ m}}{\text{km}} \cdot \frac{60\text{ min}}{\text{hr}}$

C. $\frac{8\text{ km}}{\text{hr}} \cdot \frac{1000\text{ m}}{\text{km}} \cdot \frac{\text{hr}}{60\text{ min}}$

D. $\frac{8\text{ km}}{\text{hr}} \cdot \frac{\text{km}}{1000\text{ m}} \cdot \frac{60\text{ min}}{\text{hr}}$

25. There are 12 players on a basketball team. Before a game, both ankles of each player are taped. Each roll of tape will tape three ankles. Which product can be used to determine the number of rolls of tape needed to tape the players' ankles?

A. $12\text{ players} \cdot \frac{1\text{ player}}{2\text{ ankles}} \cdot \frac{3\text{ ankles}}{1\text{ roll}}$

B. $12\text{ players} \cdot 2\text{ ankles} \cdot \frac{3\text{ rolls}}{1\text{ ankle}}$

C. $12\text{ players} \cdot \frac{2\text{ ankles}}{1\text{ player}} \cdot \frac{1\text{ roll}}{3\text{ ankles}}$

D. $12\text{ players} \cdot \frac{1\text{ roll}}{3\text{ ankles}}$

26. If the instructions for cooking a turkey state "Roast turkey at 325° for 20 minutes per pound," how many *hours* will it take to roast a 20-pound turkey at 325°?

27. Roberta needs ribbon for a craft project. The ribbon sells for \$3.75 per yard. Find the cost, in dollars, for 48 inches of the ribbon.

28. The atomic number of an atom is always equal to the total number of

A. neutrons in the nucleus

B. protons in the nucleus

C. neutrons plus protons in the atom

D. protons plus electrons in the atom

29. An atom of an element contains 20 protons, 20 neutrons, and 20 electrons. This element is

A. an alkali metal

B. an alkaline earth metal

C. a halogen

D. a noble gas

30. Which is the atomic number of an atom with six valence electrons?

A. 6 B. 8 C. 10 D. 12

31. A particle of matter contains 6 protons, 7 neutrons, and 6 electrons. This particle must be a

A. neutral carbon atom

B. neutral nitrogen atom

C. positively charged carbon ion

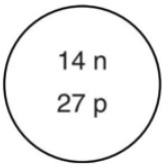
D. positively charged nitrogen ion

32. Which notation represents an atom of sodium with an atomic number of 11 and a mass number of 24?

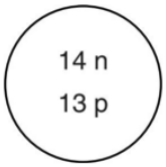
A. $^{24}_{11}Na$ B. $^{11}_{24}Na$ C. $^{13}_{11}Na$ D. $^{35}_{11}Na$

33. Which diagram represents the nucleus of an atom of $^{27}_{13}Al$?

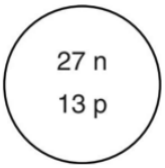
A.



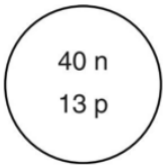
B.



C.



D.



34. The most common isotope of chromium has a mass number of 52. Which notation represents a different isotope of chromium?

A. $^{52}_{24}Cr$ B. $^{54}_{24}Cr$ C. $^{24}_{52}Cr$ D. $^{24}_{54}Cr$

35. A sample of element X contains 90 percent ^{35}X atoms, 8.0 percent ^{37}X atoms, and 2.0 percent ^{38}X atoms. The average isotopic mass is closest to

A. 32 B. 35 C. 37 D. 38

36. Naturally occurring boron is composed of two isotopes. The percent abundance and the mass of each isotope are listed below.

- 19.9% of the boron atoms have a mass of 10.013 atomic mass units.
- 80.1% of the boron atoms have a mass of 11.009 atomic mass units.

Calculate the atomic mass of boron. Your response must include both a correct numerical setup and the calculated result.

37. What is the total number of electrons in a Mg^{2+} ion?

A. 10 B. 2 C. 12 D. 24

38. Potassium forms an ion with a charge of

A. 1^+ by losing one electron

B. 1^- by losing one electron

C. 1^+ by gaining one electron

D. 1^- by gaining one electron

39. When metals form ions, they tend to do so by

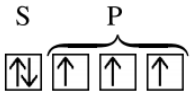
A. losing electrons and forming positive ions

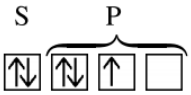
B. losing electrons and forming negative ions

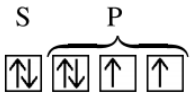
C. gaining electrons and forming positive ions

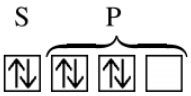
D. gaining electrons and forming negative ions

40. Which orbital notation correctly represents the outermost principal energy level of a nitrogen atom in the ground state?

A. 

B. 

C. 

D. 

41. An atom has the electron configuration $1s^2 2s^2 2p^6 3s^2 3p^5$. The electron dot symbol for this element is

A. X: B. X: C. ·X: D. :X:

42. Which statement describes how an atom in the ground state becomes excited?

A. The atom absorbs energy, and one or more electrons move to a higher electron shell.

B. The atom absorbs energy, and one or more electrons move to a lower electron shell.

C. The atom releases energy, and one or more electrons move to a higher electron shell.

D. The atom releases energy, and one or more electrons move to a lower electron shell.

43. The light emitted from a flame is produced when electrons in an excited state

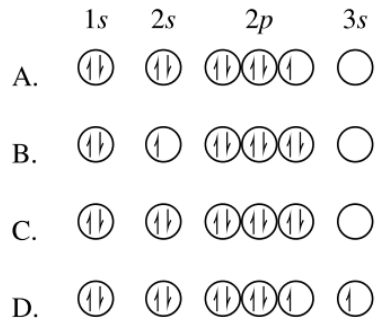
A. absorb energy as they move to lower energy states

B. absorb energy as they move to higher energy states

C. release energy as they move to lower energy states

D. release energy as they move to higher energy states

44. Which diagram correctly represents an atom of fluorine in an excited state?



45. Which element in Period 3 has the greatest tendency to gain electrons?

A. Na B. Si C. Cl D. Ar

46. Which element within any given period of the Periodic Table would always have the *lowest* first ionization energy?

A. an alkali metal

B. a halogen

C. an alkaline earth metal

D. a noble gas

47. As the Group 1 (IA) elements of the Periodic Table are considered from top to bottom, the first ionization energy of each successive element decreases. One reason for this is that the

A. nuclear charge is decreasing

B. number of neutrons is increasing

C. number of principal energy levels is decreasing

D. distance between the valence electron and the nucleus is increasing

48. Atoms of elements in a group on the Periodic Table have similar chemical properties. This similarity is most closely related to the atoms'

A. number of principal energy levels

B. number of valence electrons

C. atomic numbers

D. atomic masses

49. What occurs as the atomic number of the elements in Period 2 increases?

A. The nuclear charge of each successive atom decreases, and the covalent radius decreases.

B. The nuclear charge of each successive atom decreases, and the covalent radius increases.

C. The nuclear charge of each successive atom increases, and the covalent radius decreases.

D. The nuclear charge of each successive atom increases, and the covalent radius increases.

50. As the elements in Group IA are considered in order of increasing atomic number, the atomic radius of each successive element increases. This is primarily due to an increase in the number of

A. neutrons in the nucleus

B. electrons in the outermost shell

C. unpaired electrons

D. principal energy levels

51. In which compound is the ratio of metal ions to nonmetal ions 1 to 2?

A. calcium bromide

B. calcium oxide

C. calcium phosphide

D. calcium sulfide

52. Which formula represents an ionic compound?

A. $H_2O(\ell)$ B. $NaCl(s)$

C. $NH_3(g)$ D. $CCl_4(\ell)$

53. When oxygen combines with any alkali metal, M, the formula of the compound produced usually is

A. M_2O_3 B. MO_2

C. M_2O D. M_3O_2

54. Which formula correctly represents iron (III) oxide?

A. Fe_2O_3 B. Fe_3O_2

C. FeO_3 D. Fe_3O

55. Which formula correctly represents the compound calcium hydroxide?

A. $CaOH$ B. Ca_2OH

C. $CaOH_2$ D. $Ca(OH)_2$

56. What is the correct formula for ammonium carbonate?

A. $NH_4(CO_3)_2$ B. NH_4CO_3

C. $(NH_4)_2(CO_3)_2$ D. $(NH_4)_2CO_3$

57. Which formula represents lead (II) phosphate?

A. $PbPO_4$ B. Pb_4PO_4

C. $Pb_3(PO_4)_2$ D. $Pb_2(PO_4)_3$

58. Which polyatomic ion contains the greatest number of oxygen atoms?

A. acetate B. carbonate

C. hydroxide D. peroxide

59. Which formula represents a polar molecule?

A. CH_4 B. Cl_2 C. NH_3 D. N_2

60. Which formula represents a nonpolar molecule containing polar covalent bonds?

A. H_2O B. CCl_4 C. NH_3 D. H_2

61. When a reaction occurs between atoms with ground state electron configurations $1s^2 2s^1$ and $1s^2 2s^2 2p^5$ the predominant type of bond formed is

A. polar covalent B. nonpolar covalent

C. ionic D. metallic

62. What is the gram-formula mass of $Ca_3(PO_4)_2$?

A. 248 g/mol B. 263 g/mol

C. 279 g/mol D. 310. g/mol

63. Which quantity is equivalent to 39 grams of LiF?

A. 1.0 mole B. 2.0 moles

C. 0.50 mole D. 1.5 moles

64. What is the total mass in grams of 0.75 mole of SO_2?

A. 16 g B. 24 g C. 32 g D. 48 g

65. What is the total mass of 3.01×10^{23} atoms of helium gas?

A. 8.00 g B. 2.00 g

C. 3.50 g D. 4.00 g

66. The percent by mass of oxygen in CO is approximately

A. 73% B. 57% C. 43% D. 17%

67. The percent by mass of water in $BaCl \cdot 2H_2O$ (formula mass = 243) is equal to

A. $\frac{18}{243} \times 100$ B. $\frac{36}{243} \times 100$

C. $\frac{243}{18} \times 100$ D. $\frac{243}{36} \times 100$

68. A compound has an empirical formula of CH_2 and a molecular mass of 56. Its molecular formula is

A. C_2H_4 B. C_3H_6

C. C_4H_8 D. C_5H_{10}

69. A compound contains 40% calcium, 12% carbon, and 48% oxygen by mass. What is the empirical formula of this compound?

A. $CaCO_3$ B. CaC_2O_4

C. CaC_3O_6 D. $CaCO_2$

70. A compound consists of 85.7% carbon and 14.3% hydrogen by mass. Its empirical formula is

A. CH B. CH_2 C. CH_3 D. CH_4

71. Given the unbalanced equation:

$$\_\_\_\_C_3H_8(g) + \_\_\_\_O_2(g) \rightarrow \_\_\_\_H_2O(g) + \_\_\_\_CO_2(g)$$

When the equation is completely balanced using smallest whole numbers, the coefficient of O_2 is

A. 5 B. 2 C. 3 D. 10

72. Given the reaction:

$$\_\_\_\_Cu(s) + \_\_\_\_HNO_3(aq) \rightarrow \_\_\_\_Cu(NO_3)_2(aq) + \_\_\_\_NO_2(g) + \_\_\_\_H_2O(\ell)$$

When the reaction is completely balanced using smallest whole numbers, the coefficient of $HNO_3(aq)$ will be

A. 1 B. 2 C. 3 D. 4

73. Given the balanced equation representing the reaction between propane and oxygen:

$$C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$$

According to this equation, which ratio of oxygen to propane is correct?

A. $\frac{5 \text{ grams } O_2}{1 \text{ gram } C_3H_8}$ B. $\frac{5 \text{ moles } O_2}{1 \text{ mole } C_3H_8}$

C. $\frac{10 \text{ grams } O_2}{11 \text{ grams } C_3H_8}$ D. $\frac{10 \text{ moles } O_2}{11 \text{ moles } C_3H_8}$

74. Given the reaction:

$$4Al(s) + 3O_2(g) \rightarrow 2Al_2O_3(s)$$

What is the minimum number of grams of oxygen gas required to produce 1.00 mole of aluminum oxide?

A. 32.0 g
B. 48.0 g
C. 96.0 g
D. 192 g

75. In a laboratory experiment, a student reacted 2.8 grams of Fe(s) (steel wool) in excess $CuSO_4(aq)$, according to the following balanced equation:

$$Fe(s) + CuSO_4(aq) \rightarrow FeSO_4(aq) + Cu(s)$$

When the Fe(s) was completely consumed, the precipitated Cu(s) had a mass of 3.2 grams. Did the student's result in this experiment verify the mole ratio of Fe(s) to Cu(s) as predicted by the equation?

A. Yes, because the experimental result was 2 : 1.
B. No, because the experimental result was 2 : 1.
C. Yes, because the experimental result was 1 : 1.
D. No, because the experimental result was 1 : 1.

76. A sample of $H_2(g)$ at STP contains 9.03×10^{23} molecules. The volume of the sample is

A. 11.2 ℓ
B. 22.4 ℓ
C. 33.6 ℓ
D. 44.8 ℓ

77. Which equation represents a decomposition reaction?

A. $CaCO_3(s) \rightarrow CaO(s) + CO_2(g)$
B. $Cu(s) + 2AgNO_3(aq) \rightarrow 2Ag(s) + Cu(NO_3)_2(aq)$
C. $2H_2(g) + O_2(g) \rightarrow 2H_2O(\ell)$
D. $KOH(aq) + HCl(aq) \rightarrow KCl(aq) + H_2O(\ell)$

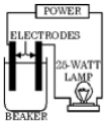
78. Which balanced equation represents a single-replacement reaction?

A. $Mg + 2AgNO_3 \rightarrow Mg(NO_3)_2 + 2Ag$
B. $2Mg + O_2 \rightarrow 2MgO$
C. $MgCO_3 \rightarrow MgO + CO_2$
D. $MgCl_2 + 2AgNO_3 \rightarrow 2AgCl + Mg(NO_3)_2$

79. Which of the following, if placed in the beaker shown in the diagram, would cause the lamp bulb to glow brightly?

A. $CH_3OH(\ell)$ B. $CH_3OH(aq)$

C. NaOH(s) D. NaOH(aq)



80. Which of the following is the best conductor of electricity?

A. NaCl(s) B. NaCl(aq)

C. $C_6H_{12}O_6(s)$ D. $C_6H_{12}O_6(aq)$

81. What is the molarity of a solution that contains 0.25 mole of solute in 250 milliliters of solution?

A. 1.0 M B. 0.025 M

C. 0.50 M D. 0.75 M

82. How many grams of KOH are needed to prepare 250 milliliters of a 2.00 M solution of KOH (formula mass = 56.0)?

A. 1.00 B. 2.00 C. 28.0 D. 112

83. If 0.50 liter of a 12-molar solution is diluted to 1.0 liter, the molarity of the new solution is

A. 2.4 B. 6.0 C. 12 D. 24