AP Chemistry Summer Review

2025-2026

Mrs. Bartsch

Welcome to AP Chemistry!

You have the unique distinction of being part of the first *ever* AP Chemistry class at Frassati Catholic High School. Thank you for your trust and your pioneering spirit. You are setting the standard for future AP Chemistry students, and I cannot think of a better group to take on this challenge.

AP Chemistry is a challenging course, equivalent in scope and rigor to two semesters of college-level general chemistry. There is a lot of material to cover so the pace of the course will be rapid. It is critical that you stay current with all assignments and seek help as soon as possible if you find yourself falling behind.

AP Chemistry presumes that you already have a solid grasp of foundational chemistry concepts and skills. This **required** summer packet is designed to help you review these concepts and skills so that you can begin the course as confidently as possible.

Timing is important. I encourage you to take a much needed break this summer. Do not start this packet too early in the summer lest you forget some concepts before school even starts. I recommend starting in late July and spreading out the assignment over the weeks leading up to the start of school on August 12. You will have the opportunity to ask questions about anything in the summer packet during the first week of school. **The completed packet is due by August 18 or 19, and you will have an assessment on August 21 or 22.**

A Google Classroom page called *Frassati Summer Science Review* has been created and the join code is **nq75bpsz.** Resources to help you with your summer assignment will be posted by June 1st.

I look forward to seeing you in August, and I am very excited to launch AP Chemistry with you!

In Christ,

Mrs. Bartsch

Summer Assignment Checklist

☐ **Part 1: Memorize the names of the elements and their corresponding symbols**
- Know elements 1-56, plus Pt, Au, Hg, Pb, Rn, Fr, Ra, U, Pu
- It's important to know these elements because the periodic table provided for AP Chemistry provided has only the symbols and not the names of the elements.
- Be familiar with the charts below of polyatomic ions and common molecules. Ideally, these should be memorized.

Common Polyatomic Ions

Name(s)	Formula	Name(s)	Formula
ammonium	NH_4^+	iodate	IO_3^-
acetate	CH_3COO^- $C_2H_3O_2^-$	nitrate	NO_3^-
		nitrite	NO_2^-
bromate	BrO_3^-		
		oxalate	$C_2O_4^{2-}$
carbonate	CO_3^{2-}		
		perchlorate	ClO_4^-
chlorate	ClO_3^-		
		periodate	IO_4^-
chlorite	ClO_2^-		
		permanganate	MnO_4^-
chromate	CrO_4^{2-}		
		peroxide	O_2^{2-}
cyanide	CN^-		
		phosphate	PO_4^{3-}
dichromate	$Cr_2O_7^{2-}$		
		phosphite	PO_3^{3-}
hydrogen carbonate bicarbonate	HCO_3^-	silicate	SiO_4^{4-}
hydrogen sulfate bisulfate	HSO_4^-	sulfate	SO_4^{2-}
		sulfite	SO_3^{2-}
hydrogen phosphate biphosphate	HPO_4^{2-}	thiocyanate	SCN^-
hydroxide	OH^-	thiosulfate	$S_2O_3^{2-}$
hypochlorite	ClO^-		

Formula	Common Name	Formula	Common Name
H_2O	Water	C_2H_2	Acetylene
H_2O_2	Hydrogen Peroxide	CH_4	Methane
NH_3	Ammonia	NO	Nitric Oxide
N_2H_4	Hydrazine	PH_3	Phosphine

☐ **Part 2: Complete the Summer Packet**
- ○ Show all pertinent work on separate paper if needed.

Percent Error, Sig Figs, Scientific Notation
1. Calculate the percent error for the following measurements.
   a. The density of an aluminum block determined in an experiment was 2.64 g/cm3. (Accepted value = 2.70 g/cm3)

   b. The experimental determination of iron in ore was 16.48%. (Accepted value was 16.12%)

2. How many significant figures are in each of the following?

a. 12	d. 2.001×10^3	g. 1000.
b.1098	e. 100	h. 22.04030
c. 2001	f. 0.0000101	i. 1.00×10^3

3. Round of each of the following numbers to two significant figures, and write the answers in scientific notation.
   a. 0.00031254   c. 35,900
   b. 31,254,000   d. 0.00000399

4. Use scientific notation to express the number 480 to
a. One significant figure   b. Two significant figures   c. Three significant figures

5. Perform the following mathematical operations, and express each result to the correct number of significant figures.
a. 97.381 + 4.2502+0.99195   c. 0.102 x 0.0821 x 273.5
b. 171.5 + 72.915 – 8.23   d. (9.04 – 8.23 + 21.954 + 81.0) / 3.1416

6. Convert the following Celsius temperatures to Kelvin and to Fahrenheit degrees.
   a.   The boiling-point temperature of ethyl alcohol, 78.1 C

   b.   A cold winter day, -25 C

   c.   The lowest possible temperature, -273 C

   d.   The melting-point temperature of sodium chloride, 801 C

Dimensional Analysis
7. Precious metals and gems are measured in troy weights in the English system:
   24 grains = 1 pennyweight
   20 pennyweights = 1 troy ounce 12
   troy ounces = 1 troy pound   1 grain = 0.0648 gram
                                       1 carat = 0.200 gram
   a. Diamonds are measured in carats. If a lucky girl receives a 5-carat diamond how many pennyweights is it?

   b. What is the mass of 2.3 troy ounces of gold in grams?

   c. The density of gold is 19.3 g/cm3. What is the volume of a troy pound of gold?

8. Apothecaries (druggists) use the following set of measures:
   20 grains ap = 1 scruple
   3 scruples = 1 dram ap
   8 dram ap = 1 oz. ap
   1 dram ap = 3.888 g

a. An aspirin table contains 5.00×10^2 mg of active ingredient. How many grains of active ingredient does it contain?

b. From (a) how many scruples?

c. What is the mass of 1.00 scruple in grams?

9. The world record for the hundred-meter dash is 9.79 s.
      a. At this speed how long would it take to run a mile (5,820 ft)?

10. You're planning to buy a new car. One model that you're considering gets 32 miles per gallon of gasoline in highway travel. The one that your spouse likes gets 14 kilometers to the liter. Which car has the better gas mileage? (1 gal = 4 qt., 1.057 qt = 1 L)

11. You pass a road sign saying "New York – 112 km".
      a. If you drive at a constant speed of 65 mi/hr., how long should it take you to reach New York?

      b. If your car gets 28 miles to the gallon, how many liters of gasoline are necessary to travel 112 km?

Classifying Matter Basics
12. What are some of the differences between a solid, a liquid, and a gas? Draw particle diagrams of each.

13. What is the difference between homogeneous and heterogeneous matter?

14. Classify each of the following as homogeneous or heterogeneous.
      a. soil   d. gasoline
      b. the atmosphere   e. gold
      c. a carbonated soft drink   f. a solution of ethanol and water

15. Classify each of the following as a mixture or a pure substance. Of the pure substances, which are elements and which are compounds?
      a. Water   d. Iron
      b. Blood   e. Brass
      c. The oceans   f. Uranium

16. Distinguish between physical and chemical changes.

19. List four indications that a chemical change (reaction) has occurred.

20. If you place a glass rod over a burning candle, the glass appears to turn black. What is happening to each of the following (physical change, chemical change, both, or neither) as the candle burns? Explain each answer
a. the wax   b. the wick   c. the glass rod

Periodic Table

21. Write the isotopic symbol for each of the isotopes below.
    a. Atomic number = 8, number of neutrons = 9

    b. The isotope of chlorine in which mass = 37

    c. Atomic number = 27, mass = 60

    d. Number of protons = 26, number of neutrons = 31

    e. The isotope of I with a mass number of 131

    f. Atomic number = 3, number of neutrons = 4

22. The element copper has naturally occurring isotopes with mass number of 63 and 65. The relative abundance of the isotopes are 69.2% for mass = 62.93 amu, and 30.8% for mass = 64.93 amu. Calculate the average atomic mass of copper.

23. An element consists of 1.40% of an isotope with mass 203.973 amu, 24.10% of an isotope with mass 205.9745 amu, 22.10% of an isotope with mass 206.9759 amu, and 52.40% of an isotope with mass 207.9766 amu. Calculate the average atomic mass and identify the element.

24. In the periodic table, what is the name of the following groups
a. Group (1)   c. Group (3-12)   e. Group (18)
b. Group (2)   d. Group (17)

25. An ion contains 50 protons, 68 neutrons, and 48 electrons. What is its symbol and charge (Write the ion notation)?

26. Which of the following sets of elements are all in the same group in the periodic table?
    a. N, P, O   b. C, Si, Ge   c. Rb, Sn   d. Mg, Ca

27. Identify each of the following elements:
    a. A member of the same family as oxygen whose most stable ion contains 54 electrons

    b. A member of the alkali metal family whose most stable ion contains 36 electrons

    c. A noble gas with 18 protons in the nucleus

    d. A halogen with 85 protons and 85 electrons

28. Would you expect each of the following atoms to gain or lose electrons when forming ions? What ion is the most likely in each case?
    a. Na   b. Sr   c. P   d. Ba   e. I   f. O   g. Al

    h. S   i. Al   j. S

29. For each of the following ions, indicate the total number of protons and electrons in the ion. For the positive ions, predict the formula of the simplest compound formed between itself and oxide. For the negative ions predict the simplest compound formed between itself and aluminum.
a. Fe^{+2} e. S^{-2} i. Br^{-1}

b. Fe^{+3} f. P^{-3} j. N^{-3}

c. Ba^{+2} g. Br^{-1}

d. Cs^{+1} h. N^{-3}

30. An element's most stable ion forms an ionic compound with bromine, having the formula XBr_2. If the ion of element X has a mass number of 230 and 86 electrons, what is the identity of the element, and how many neutrons does it have?

Electrons Electron Wave Equations Helpful Links for electrons
       Speed of Light Equation $c = \lambda v$
           $c = speed\ of\ light\ constant\ 3.0 \times 10^8\ m/s$ $\lambda = wavelength\ (m)$ $v = frequency\ (s-1)$

       Energy of Wave equation $E = hv$
           $E = energy\ (J)$ $h = Planck's\ Constant\ 6.626 \times 10{-34}\ J \cdot s$ $v = frequency\ (s-1)$

31. What is the wavelength of a wave having a frequency of $3.76 \times 10\ 14\ s\ -1$? What is its energy?

32. What is the frequency of a $6.9 \times 10\ -10$ cm wave?

33. What is the wavelength of a wave carrying $8.35 \times 10\ -18$ J of energy?

34. Below is the hydrogen atomic emission spectrum. Calculate the energy for the blue-green light wave given the wavelength in nanometers below:

(Speed of light c = 3.0 x 10⁸ m/s   Planck's Constant h = 6.63 x 10⁻³⁴ Js)
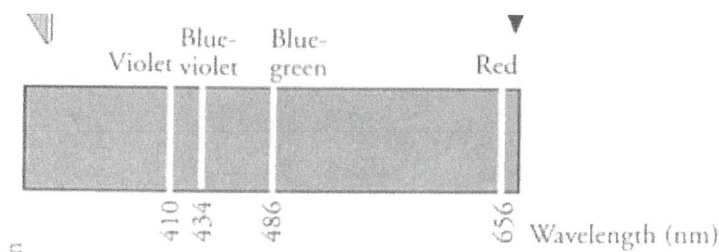
35. Write the full electron configuration of the following elements or ions:
       a. Iron, Fe _____
       b. Oxide ion, O^{-2} _____
       c. Sodium ion, Na + _____

36. Write the noble gas core configuration of the following elements or ions:
       a. Cesium, Cs _____
       b. Gallium, Ga _____
       c. Xenon, Xe _____

Periodicity
37. Atomic Radius
a.   Define Atomic Radius –

b.   What happens to the attractive forces between two oppositely charged particles as the distance between the particles increases?

c. What happens to the attractive forces between outer valence electrons and the nucleus as more protons are added to the nucleus?

d. Which atom has the largest atomic radius, Li, Na, or K? Explain.

e. Which atom has the smallest radius, Ca, Cu, or As? Explain.

f. A student claims that F has the smallest radius of O, F, and Cl. Do you agree or disagree? Explain why or why not.

38. Ionization Energy
a. Define Ionization Energy –

b. Which atom has the smallest ionization energy, Beryllium Be, Magnesium Mg, or Calcium Ca? Explain.

c. Which atom has the largest ionization energy, Phosphorus P, Sulfur S or Chlorine Cl? Explain.

d. A student claims Nitrogen will have the smallest ionization energy of C, N, and P. Do you agree or disagree? Explain why or why not.

39. Electronegativity
a. Define electronegativity –

b. Which atom has the largest electronegativity nitrogen, oxygen, or fluorine? Explain.

c. Which atom has the smallest electronegativity Lithium. sodium, or potassium? Explain.

d. Which atom O, F, or Cl has the largest electronegativity? Explain

Writing Formulas and Naming Compounds – On the AP Exam you won't have an ion chart – so you will have to know all ions by heart! I don't think it's worth memorizing them up front (unless you want to), over the course of the year you will use them so much that I think you will know them by heart by then anyway! For now, use the periodic table from regular chem to help you.

40. Name each of the following compounds:

a. $NaCl$

b. Rb_2O

c. $FeBr_3$

d. Cr_2O_3

e. $CaBr_2$

f. CsF

g. CaS

h. AlI_3

i. Al_2O_3

j. $ZnCl_2$

k. Li_3N

l. Ag_2S

m. $KClO_4$

n. $Al_2(SO_4)_3$

o. $BaSO_3$

p. $KMnO_4$

q. Sr_3P_2

r. $Ca_3(PO_4)_2$

s. $Pb(NO_3)_2$

t. $NaNO_2$

u. $K_2Cr_2O_7$

41. Name each of the following molecules:

a. NI_3

b. PCl_3

c. SO_2

d. N_2O_4

e. ICl_3

f. SF_2

g. N_2F_4

h. P_2S_5

i. SiO_2

j. XeF_6

k. CH_4

l. NH_3

m. O_2

n. N_2

0. C_2H_2

p. C_2H_4

42. Name each of the following acids or bases:

a. HCl

b. H_3PO_4

c. H_2SO_3

d. $HC_2H_3O_2$

e. H_2SO_4

f. $CaCO_3$

g. $Al(OH)_3$

h. NaOH

i. $NaHCO_3$

k. NH_3

43. Write the formula for each of the following compounds/molecules and acids:

a. Cesium bromide

b. Barium sulfate

c. Chlorine trifluoride

d. Ammonium chloride

e. Beryllium oxide

f. Chlorine monoxide

g. Magnesium fluoride

h. sodium oxide

i. Sodium peroxide

j. Potassium cyanide

k. Copper (II) nitrate

l. Silicon tetrafluoride

m. Lead (II) sulfide

n. Sulfur difluoride

o. Sulfur hexafluoride

p. Sodium dihydrogen phosphate

q. Silicon tetrachloride

r. Lithium nitride

s. Chromium (III) carbonate

t. Tin (II) fluoride

u. Ammonium acetate

v. Ammonium hydrogen sulfate

w. Cobalt (III) nitrate

x. Copper (I) sulfide

y. Potassium chlorate

z. Lithium borate

aa. Lead (IV) sulfide

bb. Copper (I) chloride

cc. Cadmium selenide

dd. Zinc sulfide

ee. Ammonium hydrogen phosphate

ff. Hydrobromic acid

gg. Bromous acid

hh. Perchloric acid

ii. Silicon dioxide

jj. Sodium sulfate

kk. Aluminum hydrogen sulfate

States in Reactions:
- (s): solid
- (l): liquid
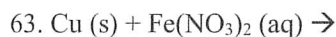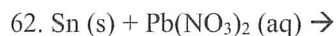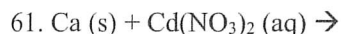- (g): gas
- (aq): aqueous or hydrated or in water

Practice: In the following reactions, identify the precipitate and write the complete and net ionic equations including states.

57. Lead (II) nitrate reacts with potassium iodide

58. hydrochloric acid reacts with sodium hydroxide

59. Silver (I) nitrate reacts with lithium chloride.

For the following reactions, use the **Activity Series of Metals** to determine if a reaction will occur and if so, what the products will be. If no reaction will occur, write NR for the product. **Balance the equations if applicable**.

60. $Zn \ (s) + KNO_3 \ (aq) \rightarrow$

61. $Ca \ (s) + Cd(NO_3)_2 \ (aq) \rightarrow$

62. $Sn \ (s) + Pb(NO_3)_2 \ (aq) \rightarrow$

63. $Cu \ (s) + Fe(NO_3)_2 \ (aq) \rightarrow$

64. $Mg \ (s) + HNO_3 \ (aq) \rightarrow$

65. $Ag \ (s) + HNO_3 \ (aq) \rightarrow$

F. Mole Conversions – use dimensional analysis to solve.

66. The molecular formula of aspartame, the artificial sweetener marketed as NutraSweet, is $C_{14}H_{18}N_2O_5$.
    a. What is the molar mass of aspartame?

    b. How many moles of aspartame are present in 3769.4 grams of aspartame?

    c. How many molecules of aspartame are present in 345.9 grams of aspartame?

    d. How many oxygen atoms are present in 23.6 grams of aspartame?

67. How many moles of ammonium ions are in 0.557 g of ammonium carbonate?

68. What is the mass, in grams, of 0.0438 moles of iron (III) phosphate?

Most Reactive

POTASSIUM	19 K
SODIUM	11 Na
CALCIUM	20 Ca
MAGNESIUM	12 Mg
ALUMINUM	13 Al
CARBON	6 C
ZINC	30 Zn
IRON	26 Fe
TIN	50 Sn
LEAD	82 Pb
HYDROGEN	1 H
COPPER	29 Cu
SILVER	47 Ag
GOLD	79 Au
PLATINUM	78 Pt

Least Reactive

69. What is the mass, in grams, of 2.69×10^{23} molecules of aspirin, $C_9H_8O_4$?

70. What is the molar mass of diazepam (Valium) if 0.05570 mol has a mass of 15.86 g?

Mole Conversions – use dimensional analysis to solve.

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Limiting Reactant & Percent Yield

76. Determine the grams of sodium chloride produced when 10.0 g of sodium react with 10.0 g of chlorine gas.
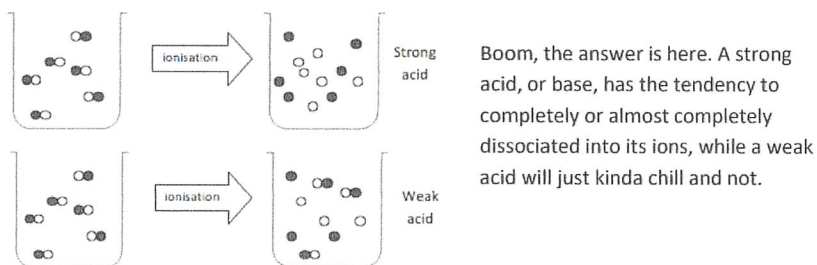
77. Determine the mass of lithium hydroxide produced when 50.0g of lithium are reacted with 45.0g of water.

78. Determine the percent yield of water produced when 68.3 g of hydrogen reacts with 85.4g of oxygen and 86.4g of water are collected.

Molarity

79. How many moles HCl is in a 10 mL solution of of .6 M HCl?

80. What is the molarity of a 15 mL solution with 0.01 moles of KOH?

81. What is the volume needed to make 4 M HNO3 with 2 moles of acid?

82. You're titrating HCl with 0.1 M NaOH. What is the concentration of HCl if the equivalence point is at 10 mL?

83. How much 0.25 M NaOH is necessary to neutralize 75 mL of .7987 M HI?

Acids/Bases

Strong acid

Weak acid

Boom, the answer is here. A strong acid, or base, has the tendency to completely or almost completely dissociated into its ions, while a weak acid will just kinda chill and not.

Brønsted-Lowry Acids and Bases: Danish Chemist, Johannes Bronsted, and English Chemist, Thomas Lowry have given us a more general definition of what acids and bases are. According to them, an acid is a hydrogen donor, while a base is a hydrogen receiver.

Example: adding Hydrochloric Acid (HCl) to water will cause the HCl to donate its proton (H+) to water, making it a Brønsted-Lowry Acid.

Characteristics of Acids and Bases:
Acids: 1 - 6.9999 pH, they taste sour, they increase H+ in water.
Bases: 7.0001 - 14 pH, bitter, increases OH

Identify each acid, base, conjugate acid, and conjugate base.

84. HNO_2 + H_2O ↔ H_3O^+ + NO_2^-

85. $HBrO_4$ + H_2O ↔ H_3O^+ + BrO_4^-

86. H_2O + S^{2-} ↔ HS^- + OH^-

87. HSO_4^- + $C_2O_4^{2-}$ ↔ SO_4^{2-} + $HC_2O_4^-$

88. CN^- + $HC_2H_3O_2$ ↔ HCN + $C_2H_3O_2^-$
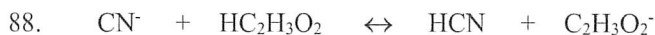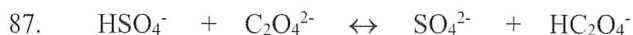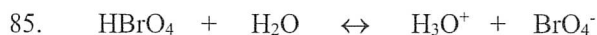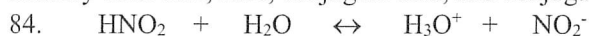
Complete the equation for each of the following acid-base reactions.

89. HF + CH_3COO^- →

90. H_2S + CO_3^{2-} →

91. NH_4^+ + F^- →

PERIODIC TABLE OF THE ELEMENTS

1																	18
1 **H** 1.008	**2**											**13**	**14**	**15**	**16**	**17**	**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	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**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**	**44** **Ru** 101.07	**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	**57-71** *	**72** **Hf** 178.49	**73** **Ta** 180.95	**74** **W** 183.84	**75** **Re** 186.21	**76** **Os** 190.23	**77** **Ir** 192.22	**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**	**85** **At**	**86** **Rn**
87 **Fr**	**88** **Ra**	**89-103** †	**104** **Rf**	**105** **Db**	**106** **Sg**	**107** **Bh**	**108** **Hs**	**109** **Mt**	**110** **Ds**	**111** **Rg**	**112** **Cn**	**113** **Nh**	**114** **Fl**	**115** **Mc**	**116** **Lv**	**117** **Ts**	**118** **Og**

*Lanthanoids	**57** **La** 138.91	**58** **Ce** 140.12	**59** **Pr** 140.91	**60** **Nd** 144.24	**61** **Pm**	**62** **Sm** 150.36	**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
†Actinoids	**89** **Ac**	**90** **Th** 232.04	**91** **Pa** 231.04	**92** **U** 238.03	**93** **Np**	**94** **Pu**	**95** **Am**	**96** **Cm**	**97** **Bk**	**98** **Cf**	**99** **Es**	**100** **Fm**	**101** **Md**	**102** **No**	**103** **Lr**