Ionic Compounds – metal + nonmetal
OR polyatomic ions

$Fe^{2+}S^{2-}$

iron(II) sulfide – monatomic

magnesium nitrate → polyatomic

$Mg^{2+}(NO_3^-)_2$ $Mg(NO_3)_2$

Historical Models of the Atom

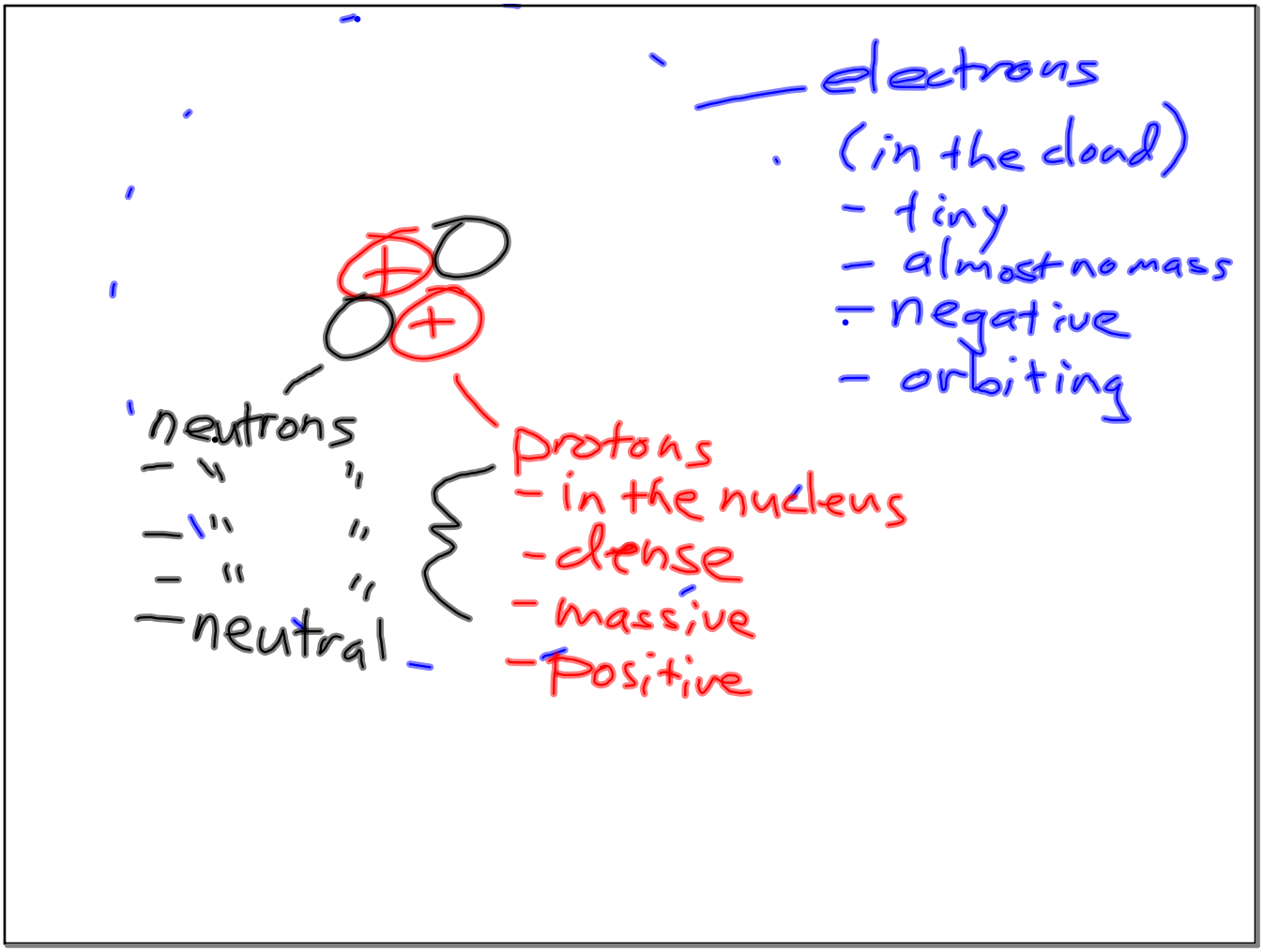
Dalton - first model, Atomic Theory, solid spheres, gasses

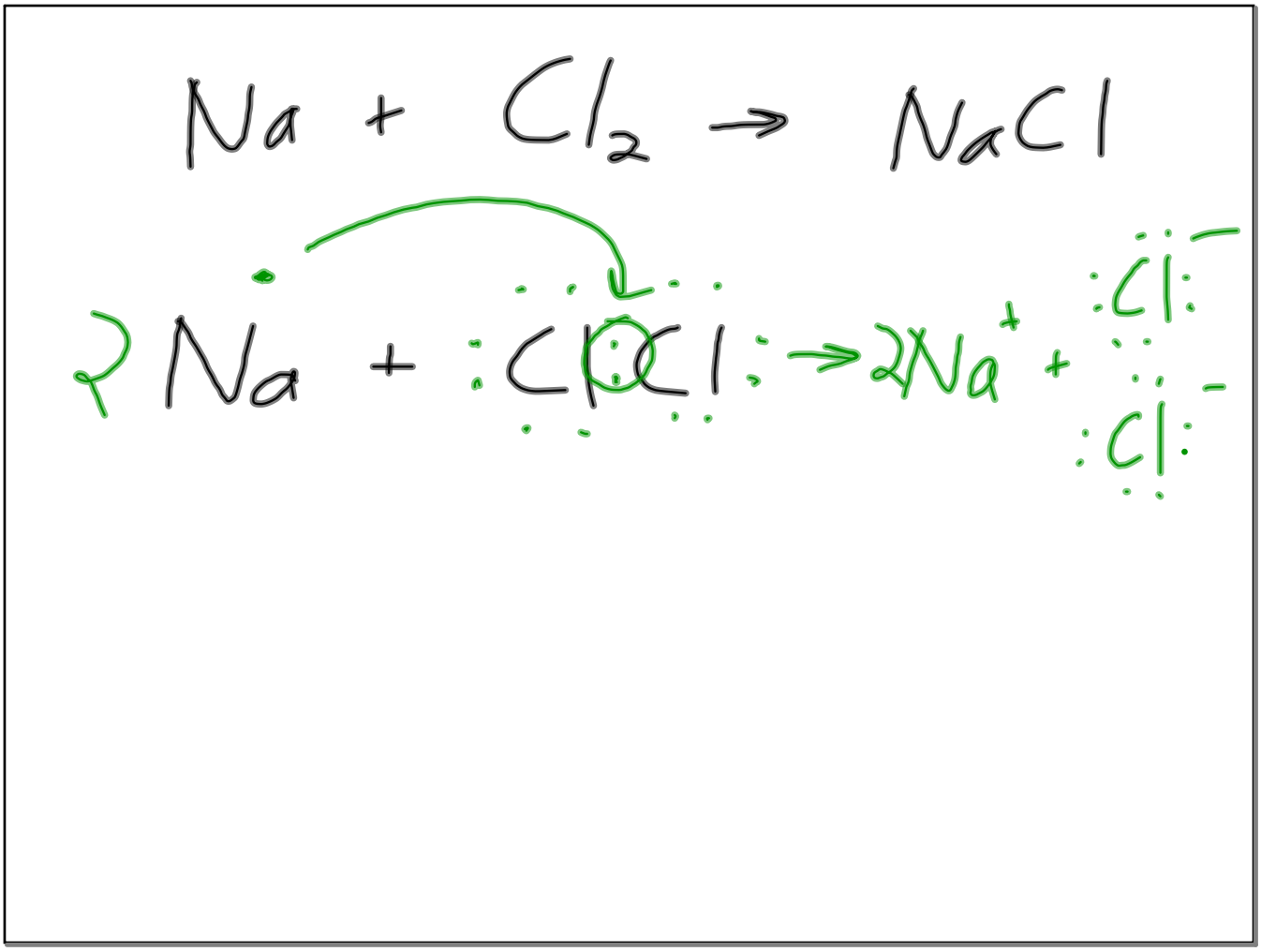
Thomson - electron, cathode ray tube, "plum pudding"

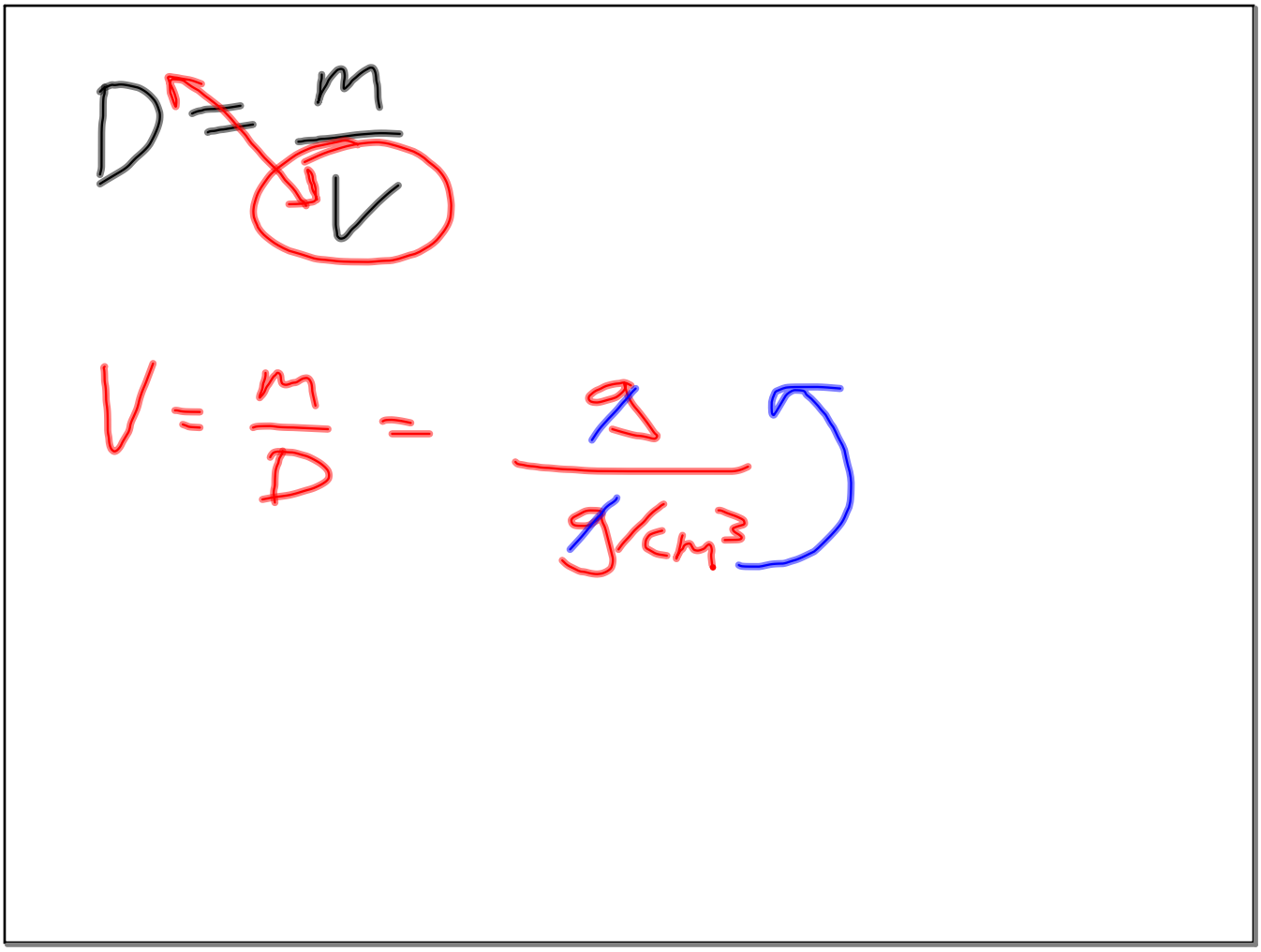
Rutherford - nucleus, gold foil, alpha particles

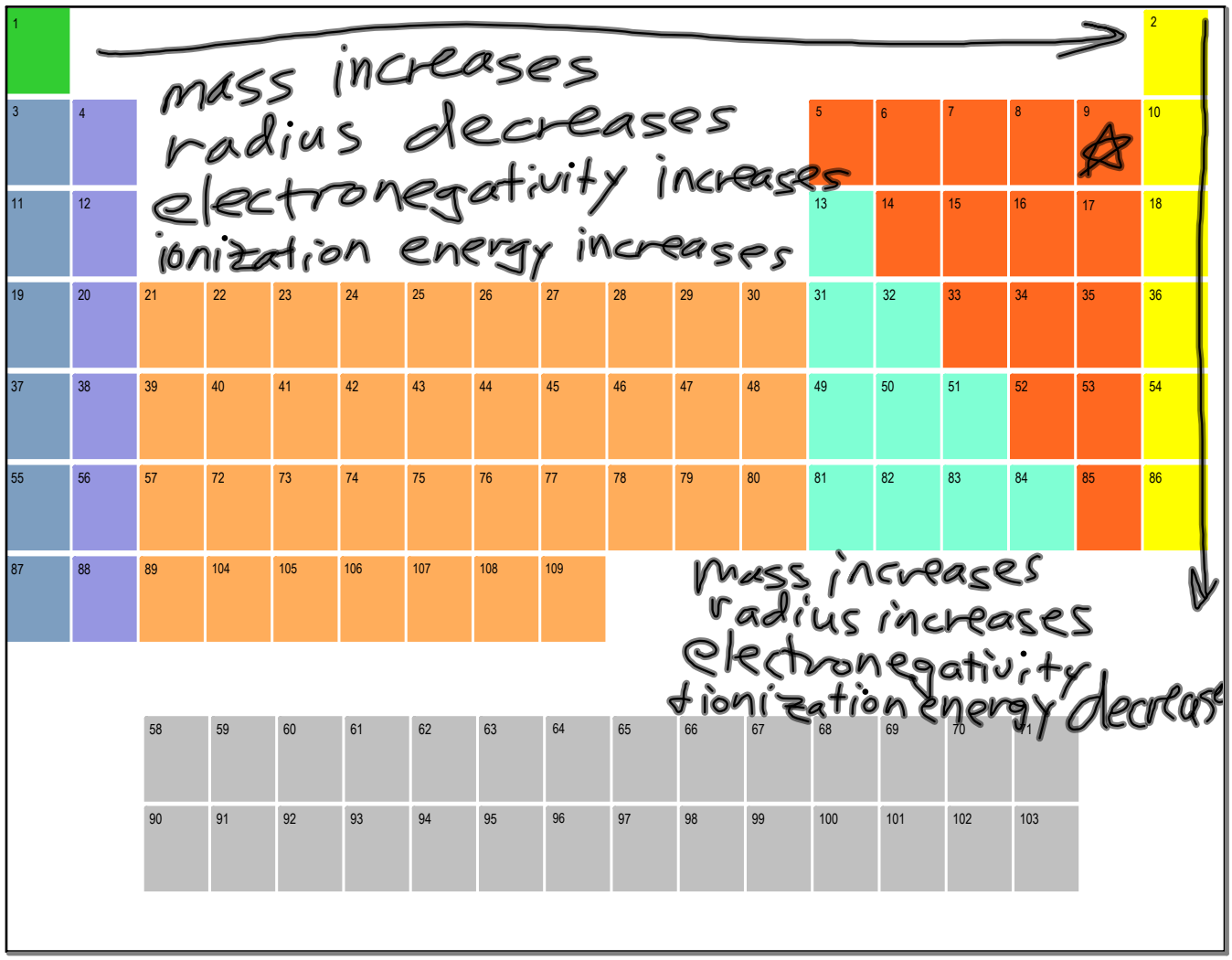
Bohr - energy levels, light emissions = line spectra, orbitals

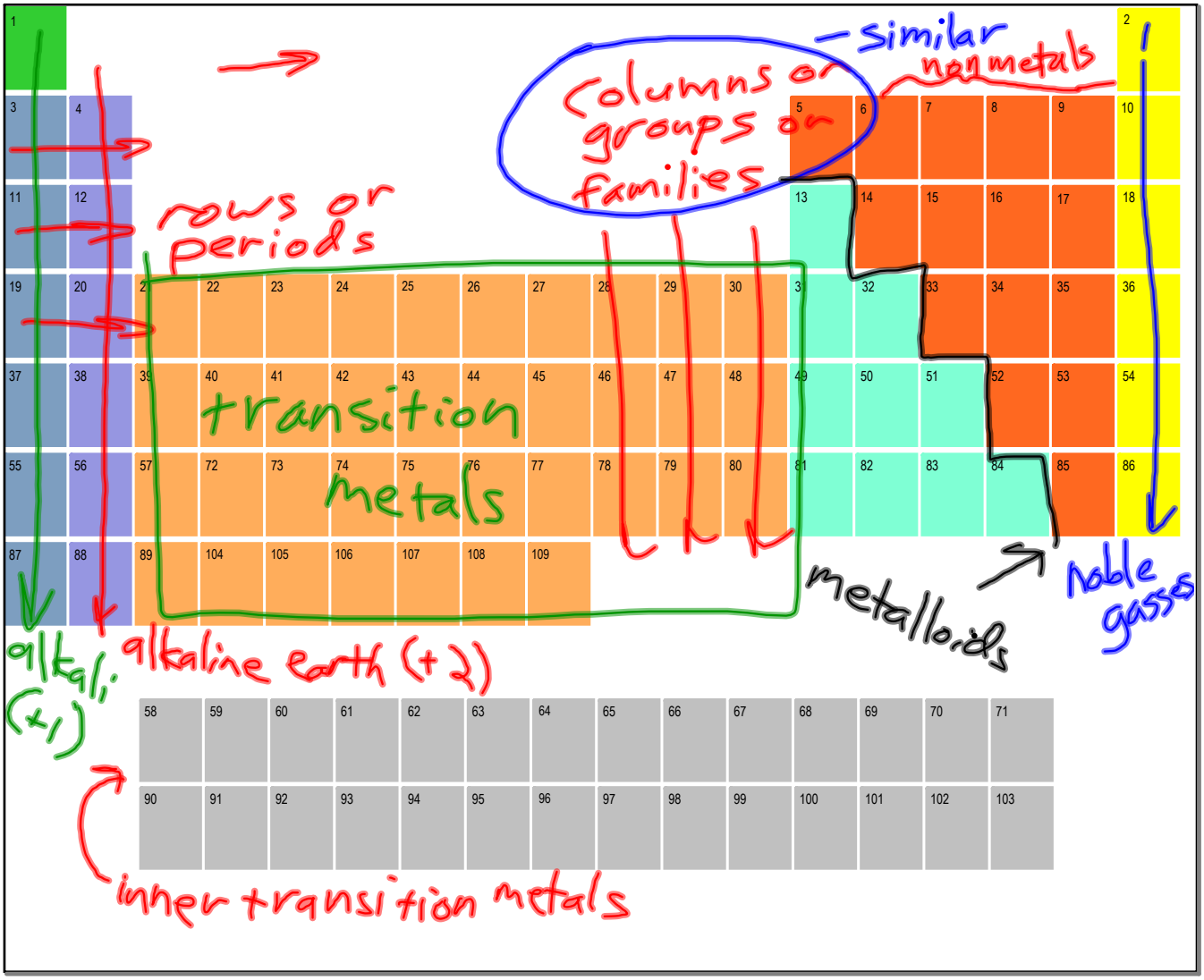
Quantum mechanical - uncertainty, electron cloud


electrons
(in the cloud)
- tiny
- almost no mass
- negative
- orbiting
neutrons
- " "
- " "
- " "
- neutral
protons
- in the nucleus
- dense
- massive
- positive


Na + Cl2 → NaCl
2 Na + :Cl:Cl: → 2Na+ + :Cl:- :Cl:-

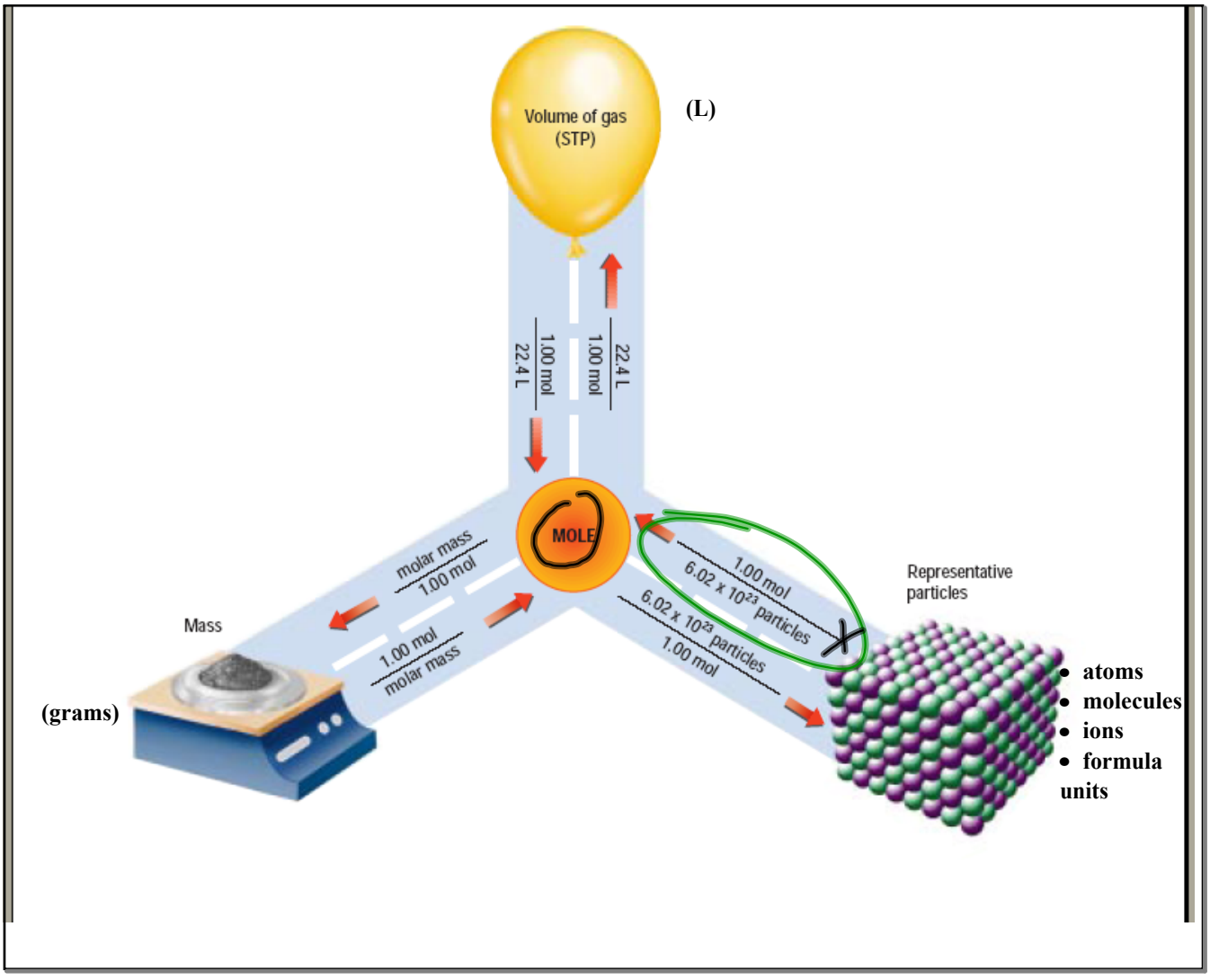

D = m/V
V = m/D = g / g/cm³


mass increases
radius decreases
electronegativity increases
ionization energy increases
mass increases
radius increases
electronegativity
ionization energy decreases


columns or groups or families
similar nonmetals
rows or periods
transition metals
metalloids
noble gasses
alkali (+1)
alkaline earth (+2)
inner transition metals

Reaction Types:

1. Combination: $A + B \rightarrow AB$
   - one on right
2. Decomposition: $AB \xrightarrow{\Delta} A + B$
   - one on left
3. Single Replacement: $A + BC \rightarrow B + AC$
   - cutting in; element on either side
4. Double Replacement: $AB + CD \rightarrow CB + AD$
   - two ionic compounds
5. Combustion: $C_xH_y + O_2 \rightarrow CO_2 + H_2O$
   - oxygen on the left


Volume of gas (STP)
(L)
22.4 L / 1.00 mol
1.00 mol / 22.4 L
MOLE
molar mass / 1.00 mol
1.00 mol / molar mass
Mass
(grams)
1.00 mol / 6.02 x 10^23 particles
6.02 x 10^23 particles / 1.00 mol
Representative particles
atoms
molecules
ions
formula units

70, 89?

70. When the following equation is balanced, the coefficient of Al is _____.

$$2\ Al\ (s) + H_2O\ (l) \rightarrow Al(OH)_3\ (s) + 3H_2$$

A. 1
B. 2
C. 3
D. 5
E. 4

71. When the following equation is balanced, the coefficient of H_2O is _____.

$$Ca\ (s) + H_2O\ (l) \rightarrow Ca(OH)_2\ (aq) + H_2\ (g)$$

A. 1
B. 2
C. 3
D. 5
E. 4

72. When the following equation is balanced, the coefficient of Al_2O_3 is _____.

$$Al_2O_3\ (s) + C\ (s) + Cl_2\ (g) \rightarrow Al Cl_3\ (s) + CO\ (g)$$

A. 1
B. 2
C. 3
D. 4
E. 5

73. Of the reactions below, which one is not a combination reaction?

A. $C + O_2 \rightarrow CO_2$
B. $2Mg + O_2 \rightarrow 2MgO$
C. $2N_2 + 3H_2 \rightarrow 2NH_3$
D. $CaO + H_2O \rightarrow Ca(OH)_2$
E. $2CH_4 + 4O_2 \rightarrow 2CO_2 + 4H_2O$

74. Of the reactions below, which one is a decomposition reaction?

A. $NH_4Cl \rightarrow NH_3 + HCl$
B. $2Mg + O_2 \rightarrow 2MgO$
C. $2N_2 + 3H_2 \rightarrow 2NH_3$
D. $2CH_4 + 4O_2 \rightarrow 2CO_2 + 4H_2O$
E. $Cd(NO_3)_2 + Na_2S \rightarrow CdS + 2NaNO_3$

75. Which of the following are combustion reactions?

1) $CH_4\ (g) + O_2\ (g) \rightarrow CO_2\ (g) + H_2O\ (l)$
2) $CaO\ (s) + CO_2\ (g) \rightarrow CaCO_3\ (s)$
3) $PbCO_3\ (s) \rightarrow PbO\ (s) + CO_2\ (g)$
4) $CH_3OH\ (l) + O_2\ (g) \rightarrow CO_2\ (g) + H_2O$ (l)

A. 1 and 4
B. 1, 2, 3, and 4
C. 1, 3, and 4
D. 2, 3, and 4
E. 3 and 4

76. The formula of nitrobenzene is $C_6H_5NO_2$. The molecular weight of this compound is _____ amu.

A. 107.11
B. 43.03
C. 109.10
D. 123.11
E. 3.06

77. The formula weight of potassium dichromate ($K_2Cr_2O_7$) is _____ amu.

A. 107.09
B. 255.08
C. 242.18
D. 294.18
E. 333.08

78. The formula weight of aluminum sulfate (($Al_2 SO_4)_3$) is _____ amu.

A. 342.14
B. 123.04
C. 59.04
D. 150.14
E. 273.06

79. The molecular weight of the acetic acid (CH_3CO_2H) is _____ amu.
    A. 60
    B. 48
    C. 44
    D. 32

80. What is the mass % of carbon in dimethylsulfoxide (C_2H_6SO)?
    A. 60.0
    B. 20.6
    C. 30.7
    D. 7.74
    E. 79.8

81. The mass % of H in methane (CH_4) is _____.
    A. 25.13
    B. 4.032
    C. 74.87
    D. 92.26
    E. 7.743

82. How many molecules of CH_4 are in 48.2 g of this compound?
    A. 5.00×10^{-24}
    B. 3.00
    C. 2.90×10^{25}
    D. 1.81×10^{24}
    E. 4.00

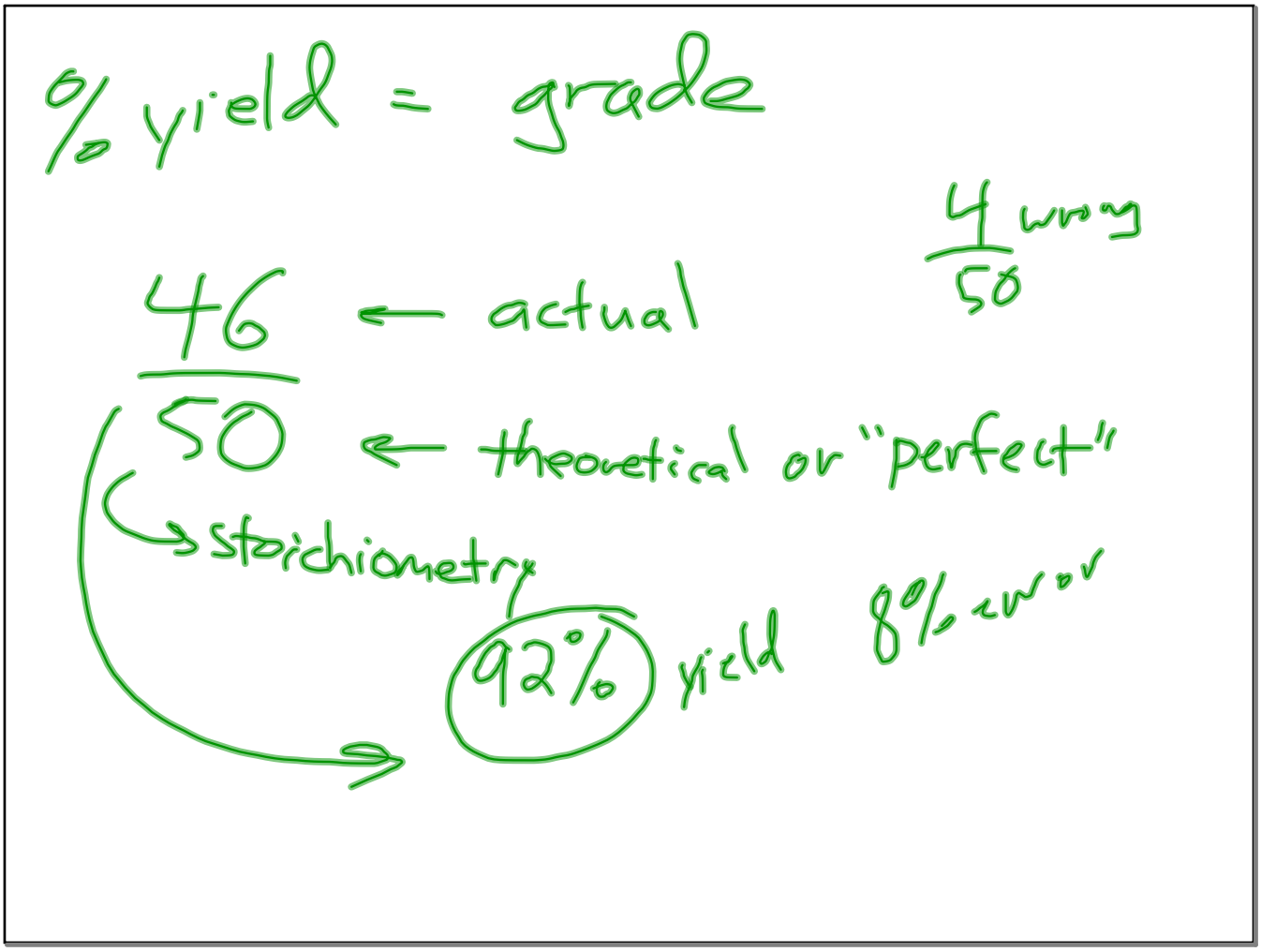
83. What is the mass in grams of 9.76×10^{12} atoms of naturally occurring sodium?
    A. 22.99
    B. 1.62×10^{-11}
    C. 3.73×10^{-10}
    D. 7.05×10^{-13}
    E. 2.24×10^{14}

84. How many moles of carbon dioxide are there in 52.06 g of carbon dioxide?
    A. 0.8452
    B. 1.183
    C. 6.022×10^{23}
    D. 8.648×10^{23}
    E. 3.134×10^{25}

85. How many moles of sodium carbonate contain 1.773×10^{17} carbon atoms?
    A. 5.890×10^{-7}
    B. 2.945×10^{-7}
    C. 1.473×10^{-7}
    D. 8.836×10^{-7}
    E. 9.817×10^{-8}

86. A 2.25-g sample of magnesium nitrate, $Mg(NO_3)_2$, contains _____ mol of this compound.
    A. 38.4
    B. 65.8
    C. 148.3
    D. 0.0261
    E. 0.0152

87. The molecular formula of aspartame, the generic name of NutraSweetä, is $C_{14}H_{18}N_2O_5$. The molar mass of aspartame is _____ g.
    A. 24
    B. 156
    C. 294
    D. 43
    E. 39


% yield = grade
4 wrong
50
46 ← actual
50 ← theoretical or "perfect"
stoichiometry
92% yield
8% error

88. Magnesium and nitrogen react in a combination reaction to produce magnesium nitride:

$3\ Mg + N_2 \rightarrow Mg_3N_2$

In a particular experiment, a 9.27-g sample of N_2 reacts completely. The mass of Mg consumed is _____ g.

A. 8.04
B. 24.1
C. 16.1
D. 0.92
E. 13.9

89. The combustion of ammonia in the presence of excess oxygen yields NO_2 and H_2O:

$4\ NH_3\ (g) + 7\ O_2\ (g) \rightarrow 4\ NO_2\ (g) + 6\ H_2O\ (g)$

The combustion of 28.8 g of ammonia consumers _____ g of oxygen.

A. 94.9
B. 54.1
C. 108
D. 15.3
E. 28.8

90. The combustion of propane (C_3H_8) produces CO_2 and H_2O:

$C_3H_8\ (g) + 5O_2\ (g) \rightarrow 3CO_2\ (g) + 4H_2O$

The reaction of 2.5 mol of O_2 will produce _____ mol of H_2O.

A. 4.0
B. 3.0
C. 2.5
D. 2.0
E. 1.0

91. Calcium carbide (CaC_2) reacts with water to produce acetylene (C_2H_2):

$CaC_2\ (s) + 2H_2O\ (g) \rightarrow Ca(OH)_2\ (s) + C_2H_2\ (g)$

Production of 13g of C_2H_2 requires consumption of _____ g of H_2O.

A. 4.5
B. 9.0
C. 18
D. 4.8×10^2
E. 4.8×10^{-2}

92. The combustion of propane (C_3H_8) in the presence of excess oxygen yields CO_2 and H_2O:

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

When 7.3 g of C_3H_8 burns in the presence of excess O_2, _____ g of CO_2 is produced.

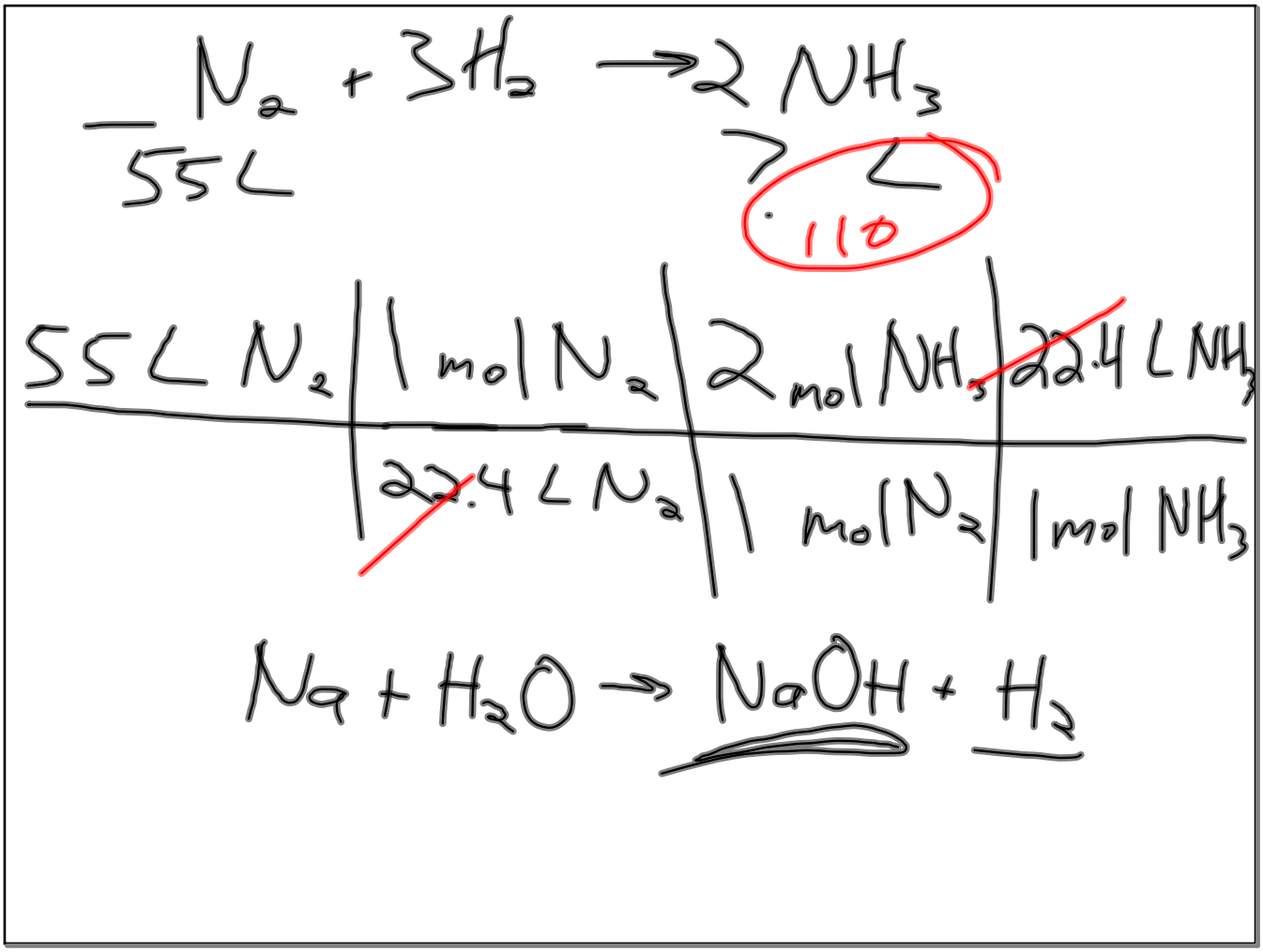
A. 22
B. 7.3
C. 8.0×10^2
D. 2.4
E. 0.61

93. Under appropriate conditions, nitrogen and hydrogen undergo a combination reaction to yield ammonia:

$N_2\ (g) + 3H_2\ (g) \rightarrow 2NH_3\ (g)$

A 9.3-g sample of hydrogen requires _____ g of N_2 for a complete reaction.

A. 1.3×10^2
B. 2.0
C. 43
D. 3.9×10^2
E. 4.6


$N_2 + 3H_2 \rightarrow 2NH_3$
55 L
? L
110
$55\,L\ N_2 \left| \frac{1\ mol\ N_2}{22.4\ L\ N_2} \right| \frac{2\ mol\ NH_3}{1\ mol\ N_2} \left| \frac{22.4\ L\ NH_3}{1\ mol\ NH_3} \right.$
$Na + H_2O \rightarrow NaOH + H_2$