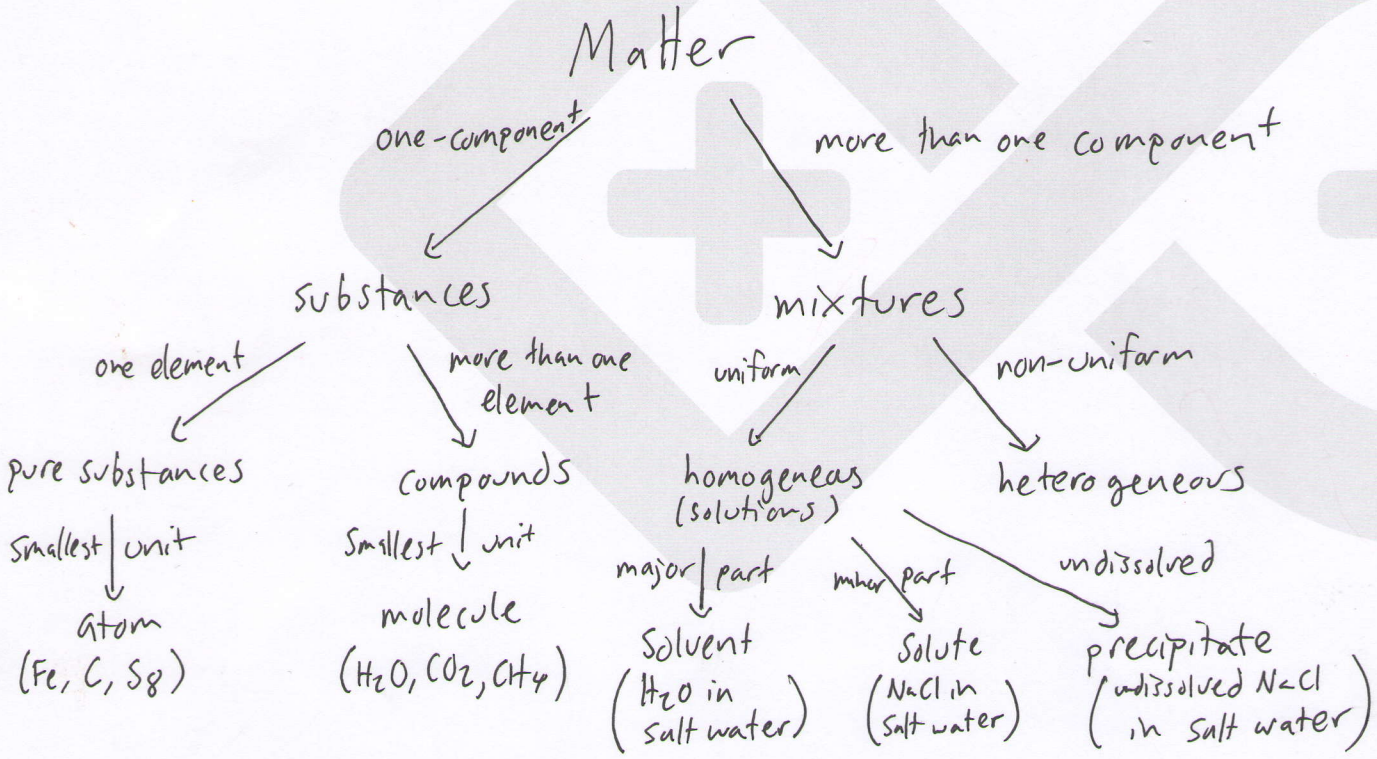
# Final Exam Review - Day 1

Chemistry = study of matter (lungs, $CO_2$, C) and change
- physical (no bonds broken or formed)
- chemical (bonds broken and/or formed)

matter ↓ has mass and volume

non-matter ↑ does not have (light, heat, life, death, etc.)

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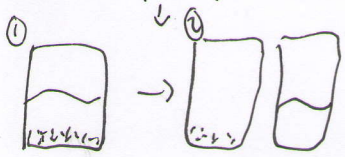
# Separation Techniques

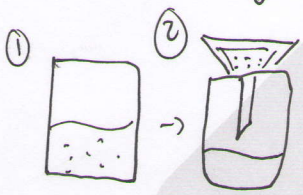
## Decantation

pour off solution
leave precipitate



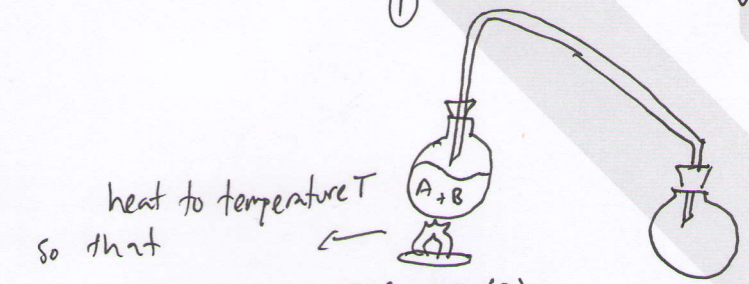
## Filtration

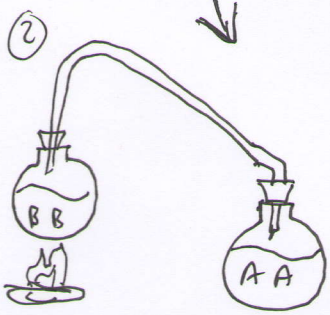
pour solution into filter paper
↓
separate based on size



## Distillation (Evaporation)

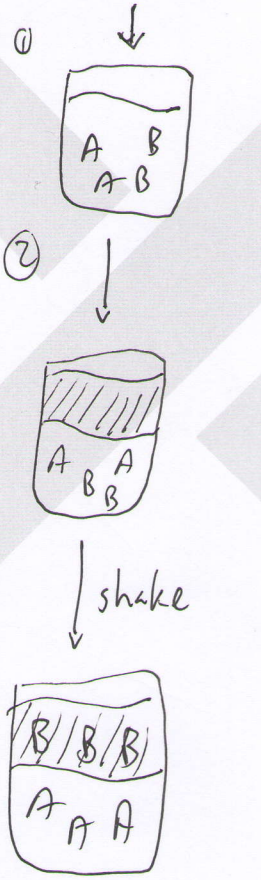
separate based on boiling points




## Extraction

separate based on solubility in different solvents




## Recrystallization

separate based on solubility in same solvent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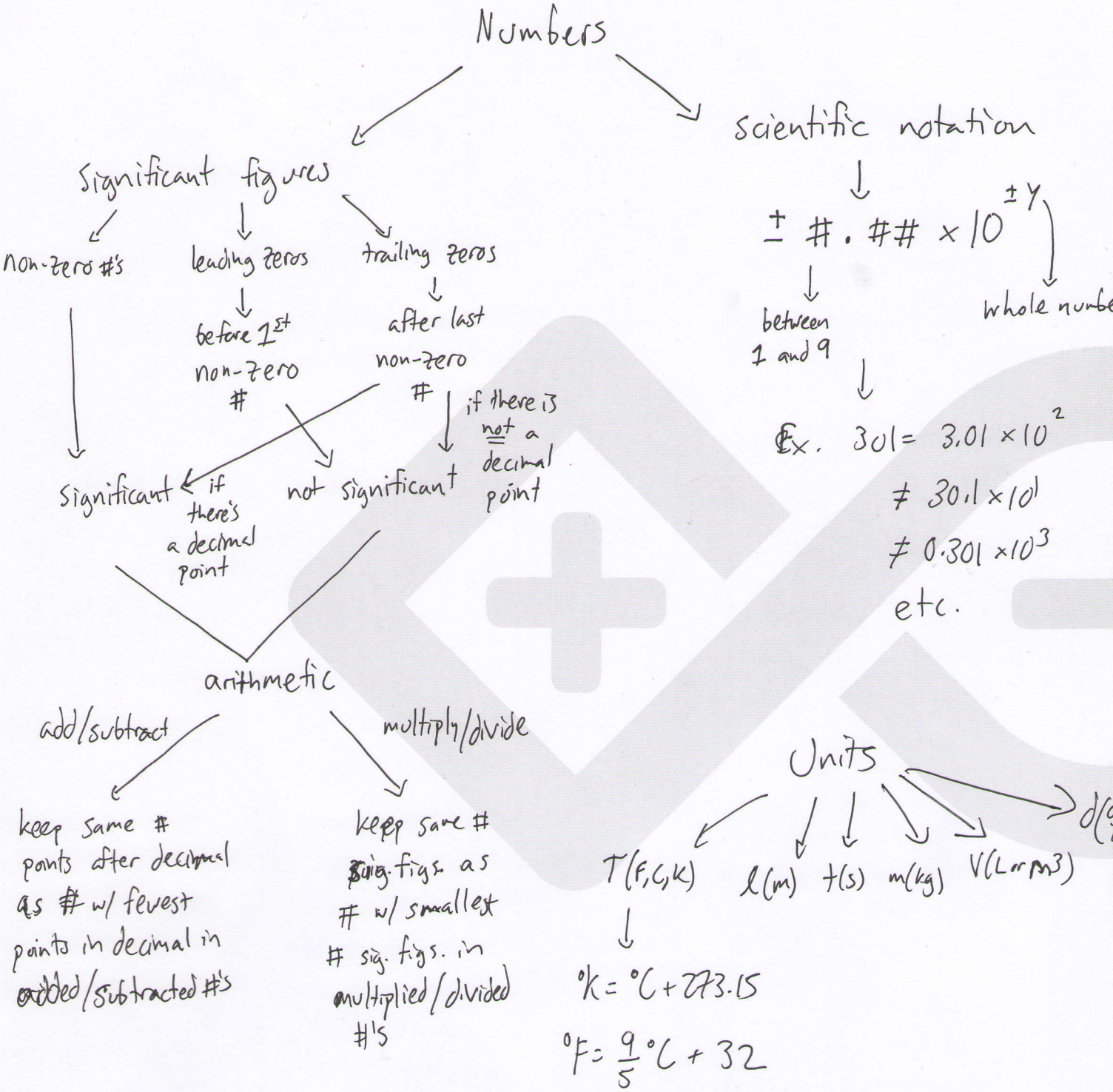


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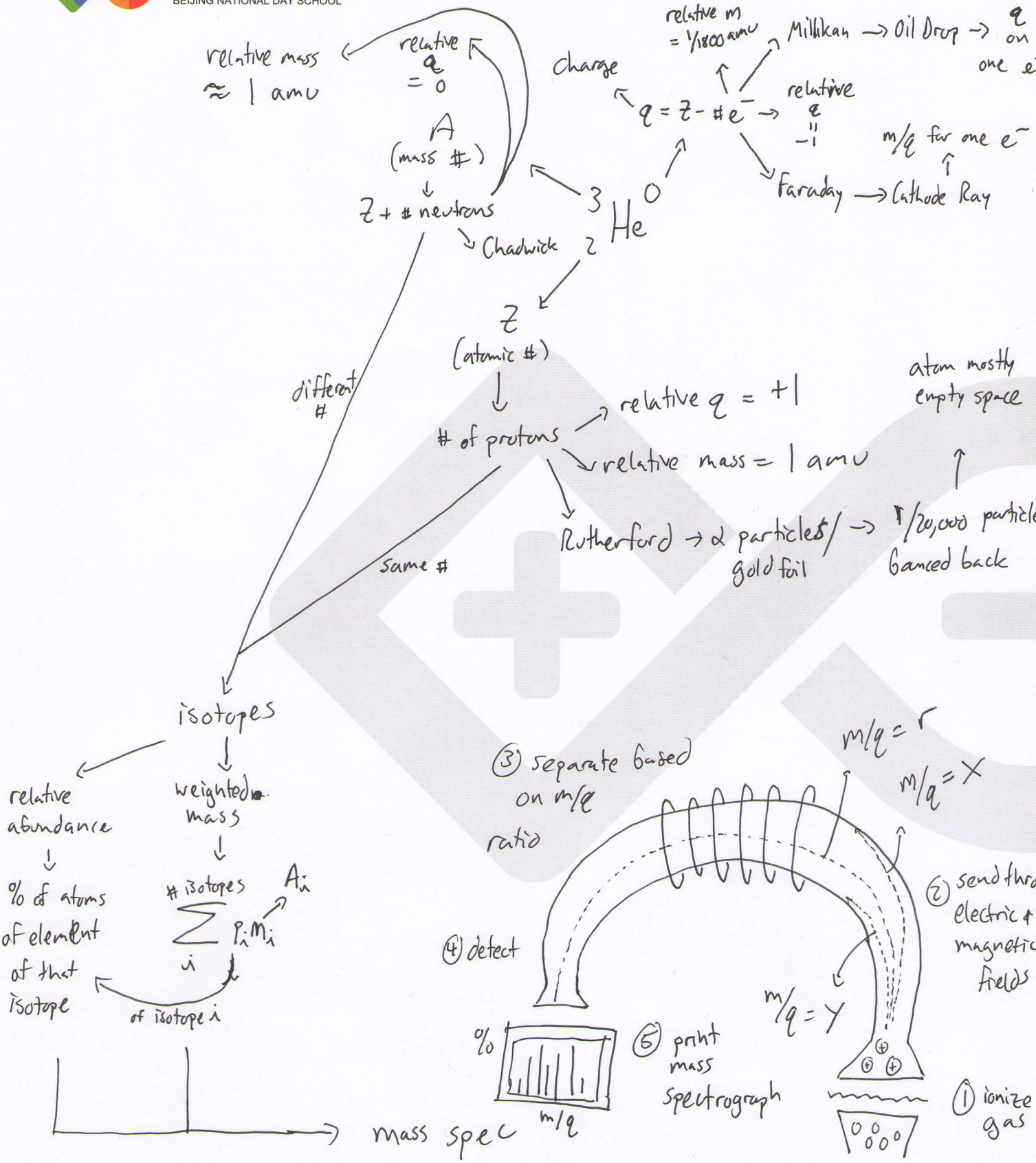


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# Final Exam Review Problems – Day 1

## Chapter 1:

5. a) The following are examples of matter (anything that has mass and volume):
   - * an elephant
   - * a hair
   - * a cell
   - * sugar
   - * a carbon atom
   - * an electron

   These can be compared to non-matter, which includes, for example:
   - * light
   - * heat
   - * energy
   - * success
   - * suffering
   - * the Christmas spirit

   b) A substance has a uniform composition of only one comonet. Examples include pure substances – made from only one element – such as iron (Fe), oxygen gas, and graphite (C). In addition, there are compounds made of more than one element, such as water, $CO_2$, and polyester. The smallest unit of a pure substance is an atom; the smallest unit of a compound is a molecule.

   c) Mixtures can be uniform (homogeneous) or non-uniform (heterogeneous), though they all contain more than one component. Homogeneous mixtures (or solutions) include salt water and air. Heterogeneous mixtures include sand in water, rocks in your shoes, oil and vinegar, or salt in water that is already saturated.

7. A physical property is something that can be measured and changed without breaking or forming any chemical bonds. An example is melting or boiling a substance, which only interrupts intermolecular forces but does not break bonds. A chemical property is measured only through a chemical reaction – breaking and making bonds, rearranging atoms in molecules. An example is a combustion reaction.

6. See 5(c).

9. See 5(b).

33. a) 48 mi — 4 sig figs

b) 56 mL — 2 sig figs

c) 60,104 ton — 5 sig figs

d) 2900 g = $2.9 \times 10^3$ g — do not include trailing zeros if no decimal point; 2 sig figs

e) 0.2 g/cm$^3$ — 3 sig figs

f) 0.0000003 cm = $3 \times 10^{-7}$ cm — never include leading zeros; 1 sig fig

g) 0.7 min = $7 \times 10^{-1}$ min — 1 sig fig

h) $4.6 \times 10^{19}$ atoms — 2 sig figs

35. a) $5.6792_m + 0.6\ m + 4.33\ m = 10.6\ m$ $(1 < 2 < 4)$

4 #'s after decimal; 1 # after decimal; 2 #'s after decimal; 1 # after decimal

b) $3.70\ g - 2.9133\ g = 0.78\ g$ $(2 < 4)$

2 #'s after decimal; 4 #'s after decimal; 2 #'s after decimal

c) $4.51\ cm \times 3.6666\ cm = 16.5\ cm$ $(3 < 5)$

3 sig figs; 5 sig figs; 3 sig figs

d) $$\frac{3 \times 10^4\ g + 6.827\ g}{0.043\ cm^3 - 0.021\ cm^3} = \frac{30,007\ g}{0.022\ cm^3} = 1,400,000 = 1.4 \times 10^6\ g/cm^3$$

0 #'s after decimal; 3 places after decimal; 5 sig figs

3 places after decimal; 3 places after decimal; 2 sig figs

18. a) mega = $10^6$ b) kilo = $10^3$ c) deci = $10^{-1}$ d) centi = $10^{-2}$

e) milli = $10^{-3}$ f) micro = $10^{-6}$ g) nano = $10^{-9}$ h) pico = $10^{-12}$

Chapter 2:

5. J.J. Thomson - Cathode Ray Tube Experiment, discovery of the mass-to-charge ratio of the electron

R.A. Millikan - Oil Drop Experiment, discovery of the charge of the electron

Ernest Rutherford - Alpha-Particle/Gold Foil Scattering Experiment, discovery of the nucleus and protons

James Chadwick - discovery of the neutron

6. In Rutherford's scattering experiments, only 1/20,000 alpha particles shot at the gold foil bounced back after colliding with a nucleus. 19,999/20,000 passed through gold foil undeflected, indicating that atoms are mostly empty space.

9. $^4_2He$

Atomic # = Z = # of protons = 2

Mass # = sum of protons and neutrons = mass of nucleus = 2+2 = 4

In a neutral atom, the number of electrons equals the number of protons since protons and electrons have equal but opposite relative charges.

15.

| | Protons | Neutrons |
|---|---|---|
| $^3_2He$ | 2 | 3-2 = 1 |
| $^4_2He$ | 2 | 4-2 = 2 |
| $^{24}_{12}Mg$ | 12 | 24-12 = 12 |
| $^{25}_{12}Mg$ | 12 | 25-12 = 13 |

| | Protons | Neutrons |
|---|---|---|
| $^{48}_{22}Ti$ | 22 | 48-22 = 26 |
| $^{79}_{35}Br$ | 35 | 79-35 = 44 |
| $^{195}_{78}Pt$ | 78 | 195-78 = 117 |

35.

| | Protons | Electrons |
|---|---|---|
| $Na^{+}$ | 11 | $11-1=10$ |
| $Ca^{+}$ | 20 | $20-1=19$ |
| $Al^{3+}$ | 13 | $13-3=10$ |
| $Fe^{2+}$ | 26 | $26-2=24$ |
| $I^{-}$ | 53 | $53-(-1)=54$ |

| | Protons | Electrons |
|---|---|---|
| $F^{-}$ | 9 | $9-(-1)=10$ |
| $S^{2-}$ | 16 | $16-(-2)=18$ |
| $O^{2-}$ | 8 | $8-(-2)=10$ |
| $N^{3-}$ | 7 | $7-(-3)=10$ |