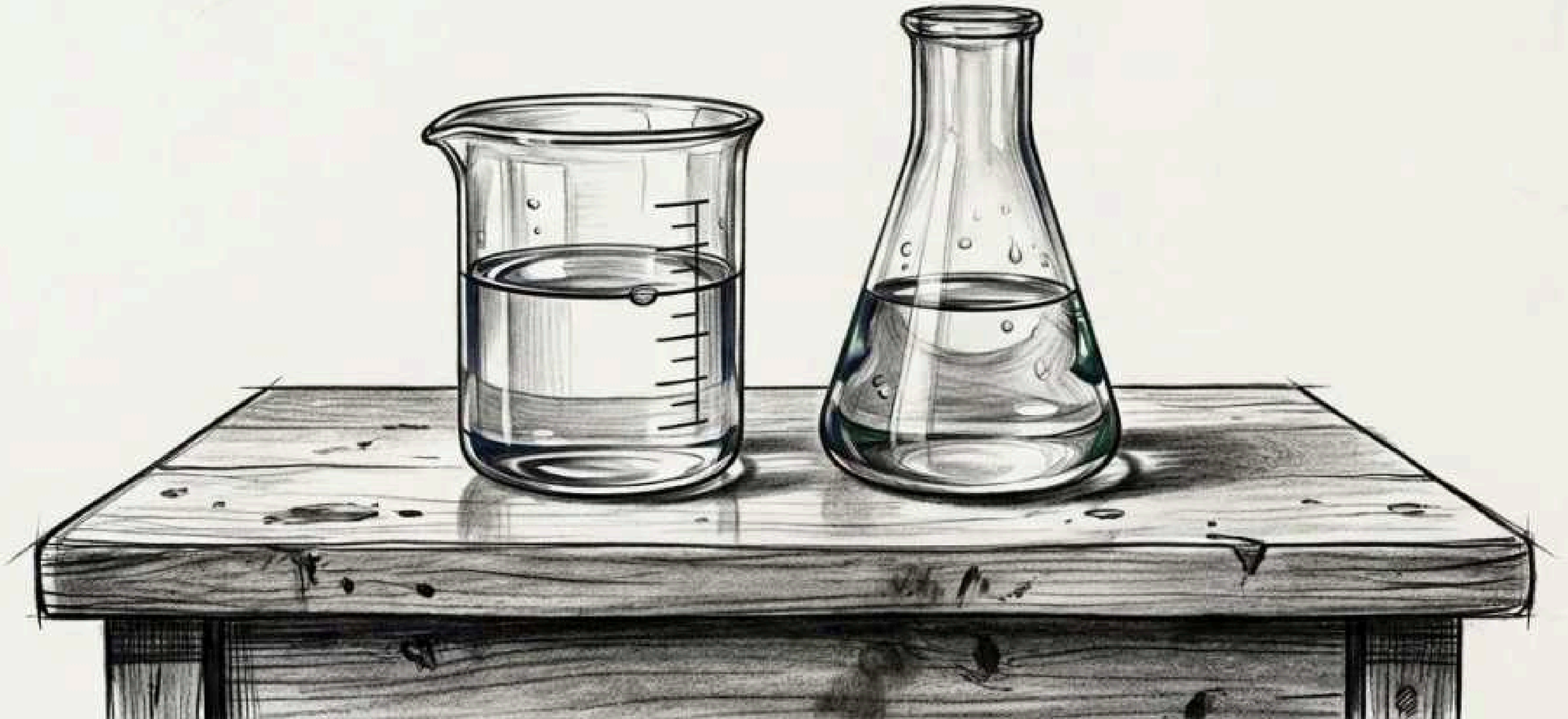
¶ 1.1

CHEM 101 B: Lecture 1

Matter, Measurement, and the Atom



What is everything made of?

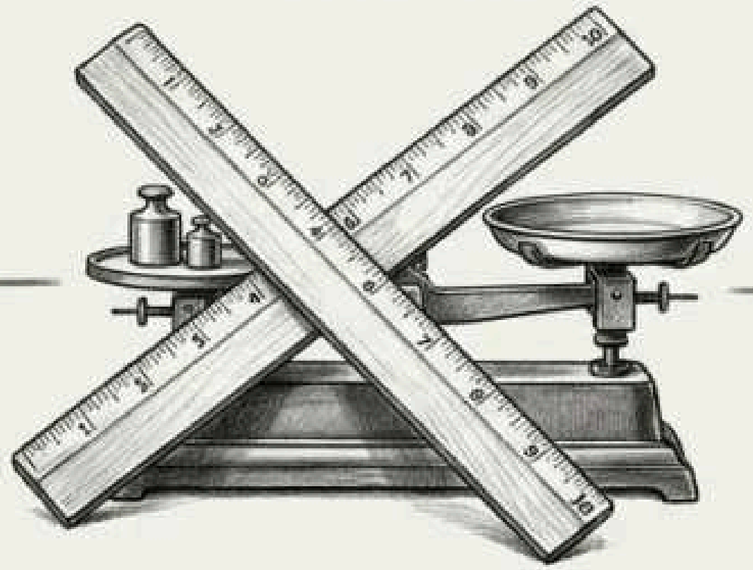
¶ 1.2

Zone 1



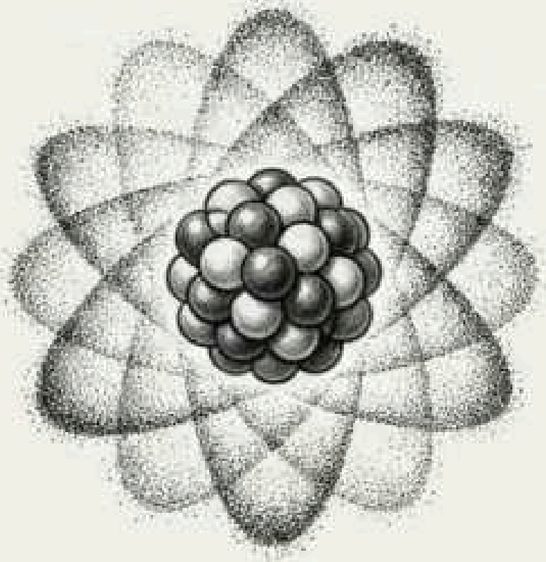
Sorting Matter

Zone 2



Measurement & Math

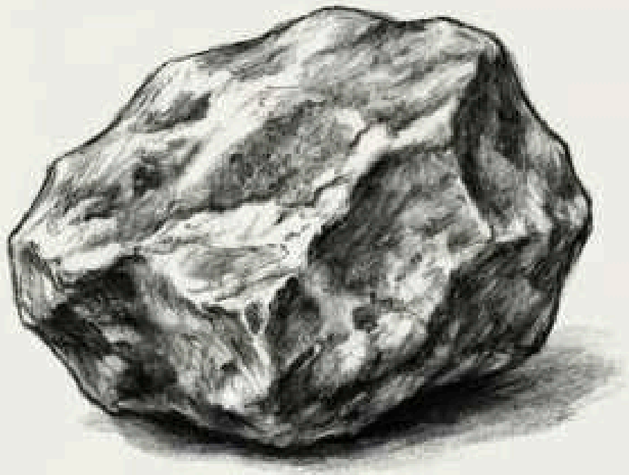
Zone 3



Inside the Atom

¶1.3

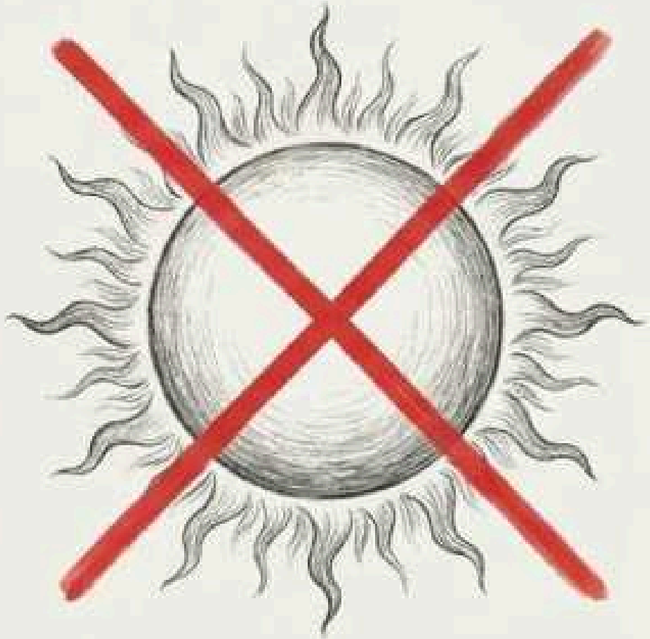
MATTER
(Mass + Volume)



Matter

Pure Substances
Fixed makeup

Mixtures
Blended, varying makeup



Not Matter

¶ 1.4

Element

Oxygen / Iron



Cannot be broken down by chemical means.

Compound

H_2O

Fixed ratio
2:1



Fixed ratio; properties are completely unlike the original elements.

¶ 1.5

Homogeneous (Solution)



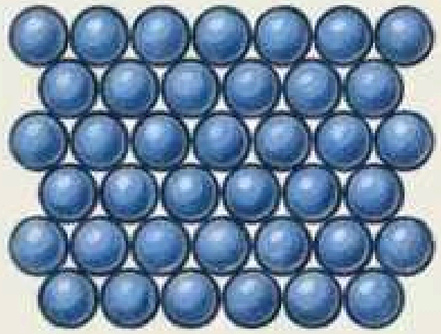
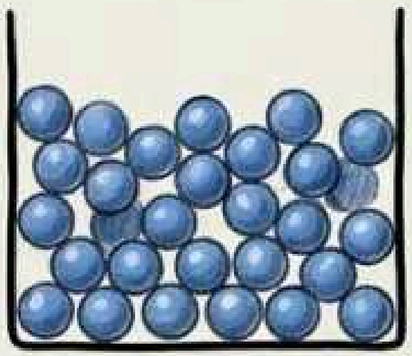
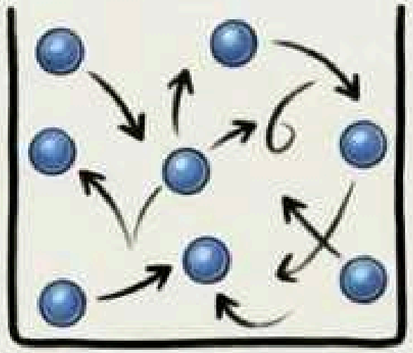
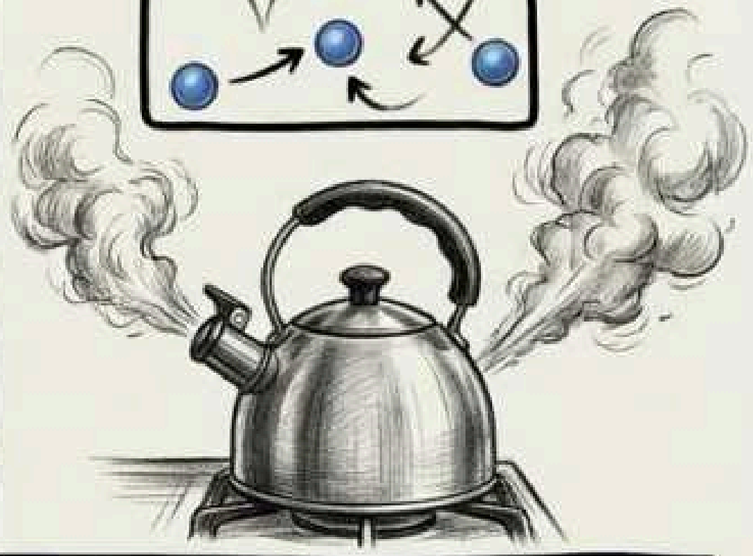
Heterogeneous



Separation Strategy

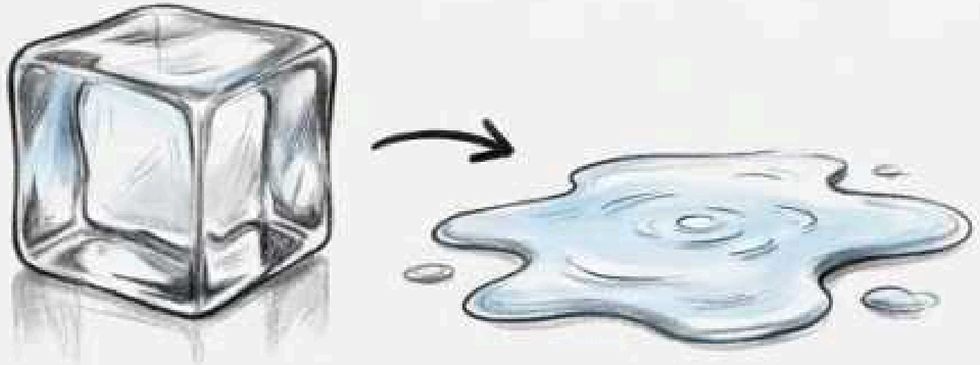
Can be separated by physical means (Filtering / Evaporating).

¶ 1.6

Solid	Liquid	Gas
 	 	 
Particle Spacing: Packed tightly Movement: Only vibrating Shape Behavior: Keeps shape	Particle Spacing: Touching but sliding Movement: Flowing past each other Shape Behavior: Takes container shape	Particle Spacing: Widely scattered Movement: Move freely Shape Behavior: Fills space

¶ 1.7

Physical Change



Form changes, substance remains

Chemical Change



4 Signs of Chemical Change:
1. Gas bubbling off
2. Colour change
3. Solid forming in liquid
4. Heat/Light released

¶ 1.8

SI Base Units
Length (metre)
Mass (kilogram)
Time (second)
Temperature (kelvin)
Amount (mole)

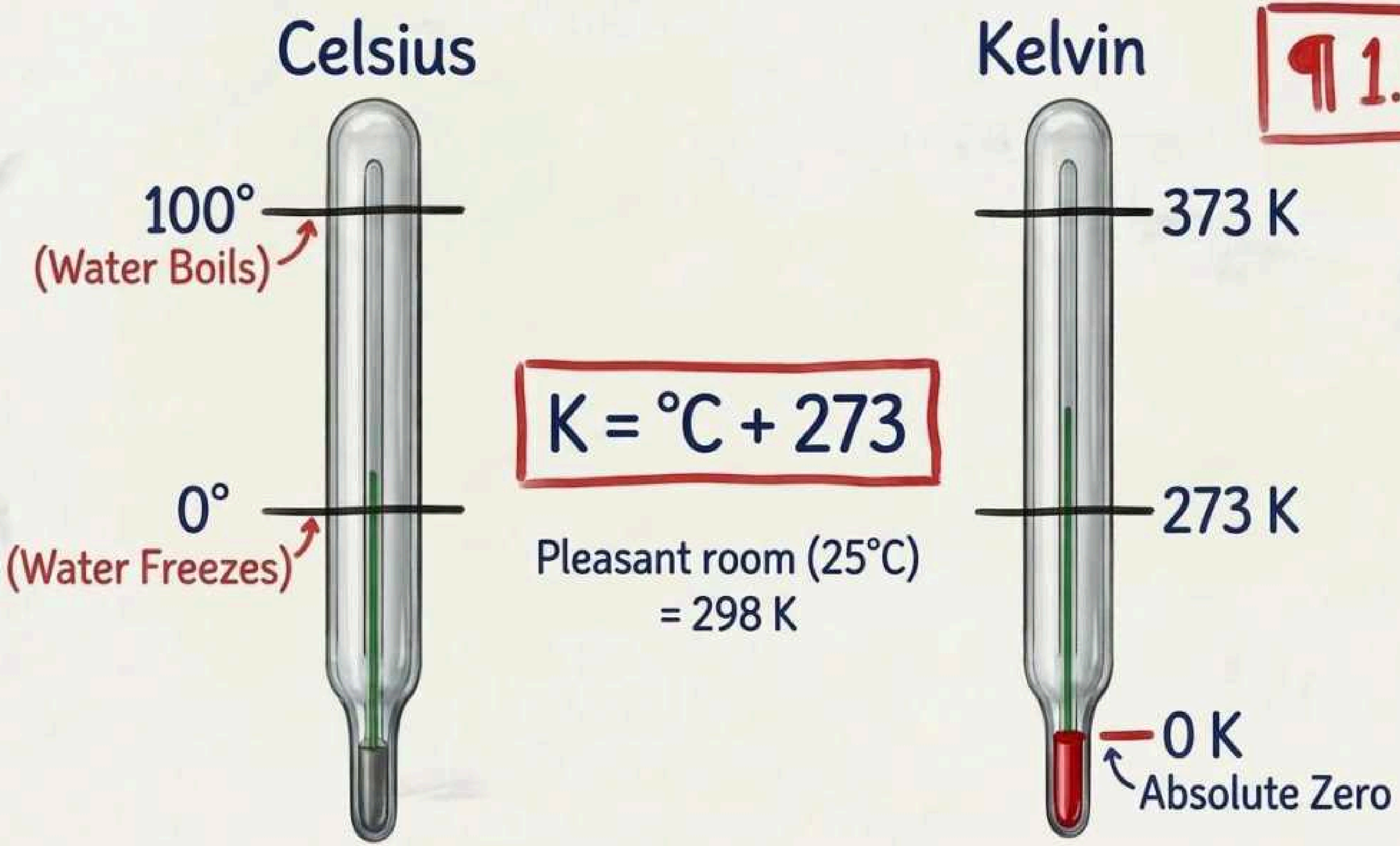
kilo- (1,000)
centi- (0.01)
milli- (0.001)

¶ 1.9

$$\left[\frac{72\ \cancel{km}}{1\ \cancel{h}}\right] \times \left[\frac{1000\ m}{1\ \cancel{km}}\right] \times \left[\frac{1\ \cancel{h}}{3600\ s}\right] = 20\ m/s$$

Conversion factors are fractions equal to ONE.
Always write the units, and cancel them.

¶ 1.10


Celsius
100°
(Water Boils)
0°
(Water Freezes)
K = °C + 273
Pleasant room (25°C)
= 298 K
Kelvin
373 K
273 K
0 K
Absolute Zero

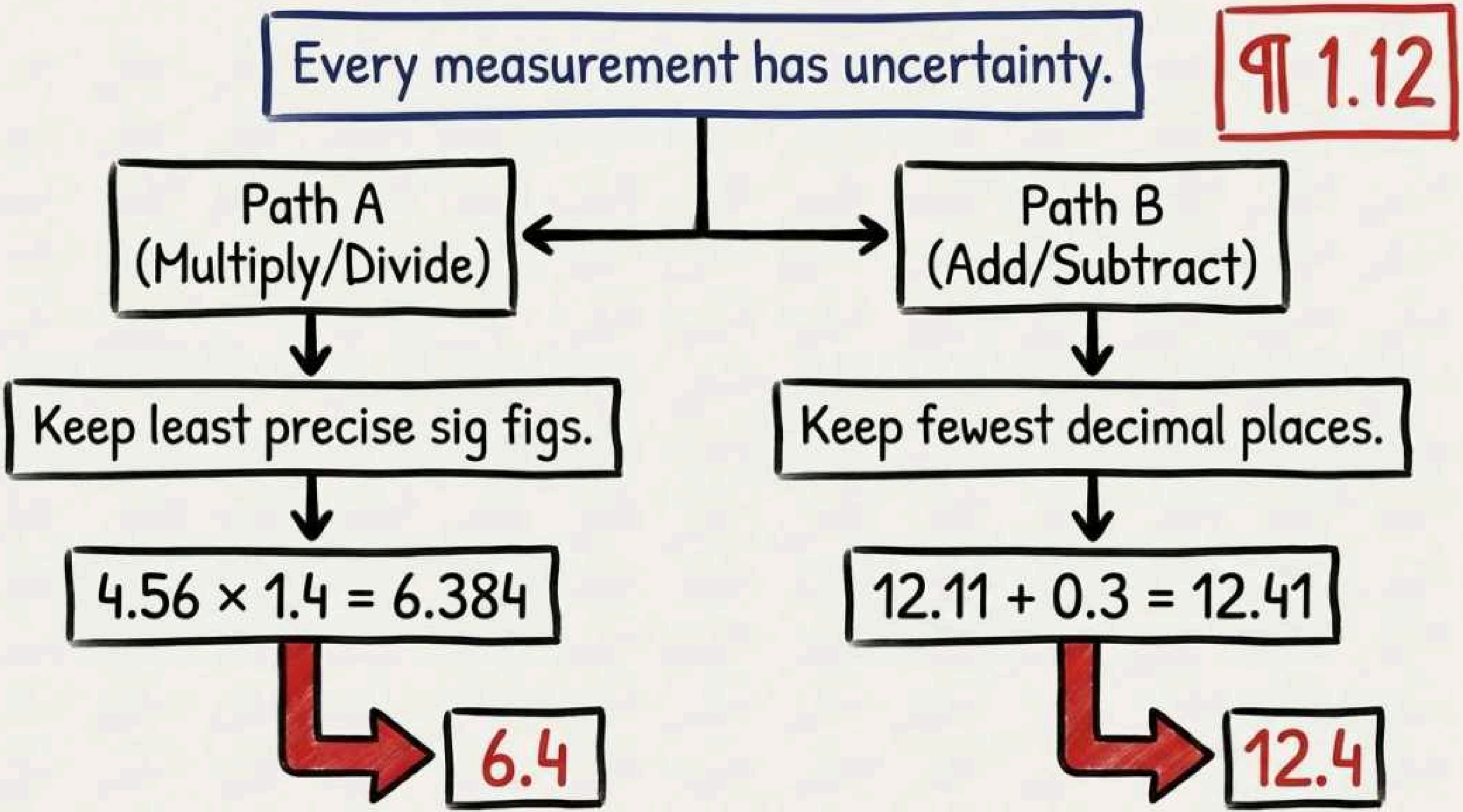
¶ 1.11



$$d = \frac{m}{V}$$

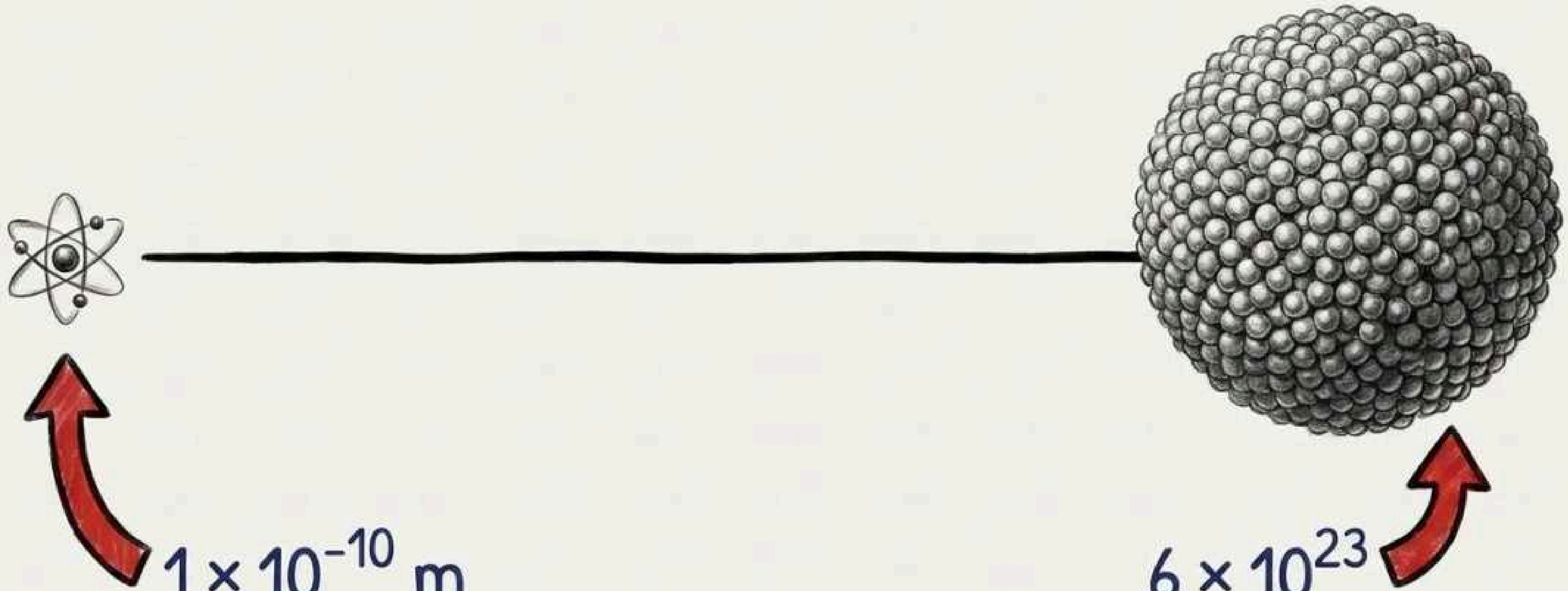
$$\frac{54\,g}{20\,cm^3} = 2.7\,g/cm^3 \text{ (Aluminium)}$$

Water density $\approx 1.0\,g/cm^3$. Denser objects sink.


Every measurement has uncertainty.
¶ 1.12
Path A
(Multiply/Divide)
Path B
(Add/Subtract)
Keep least precise sig figs.
Keep fewest decimal places.
4.56 × 1.4 = 6.384
12.11 + 0.3 = 12.41
6.4
12.4

Value between 1 and 10×10^{n}

¶ 1.13



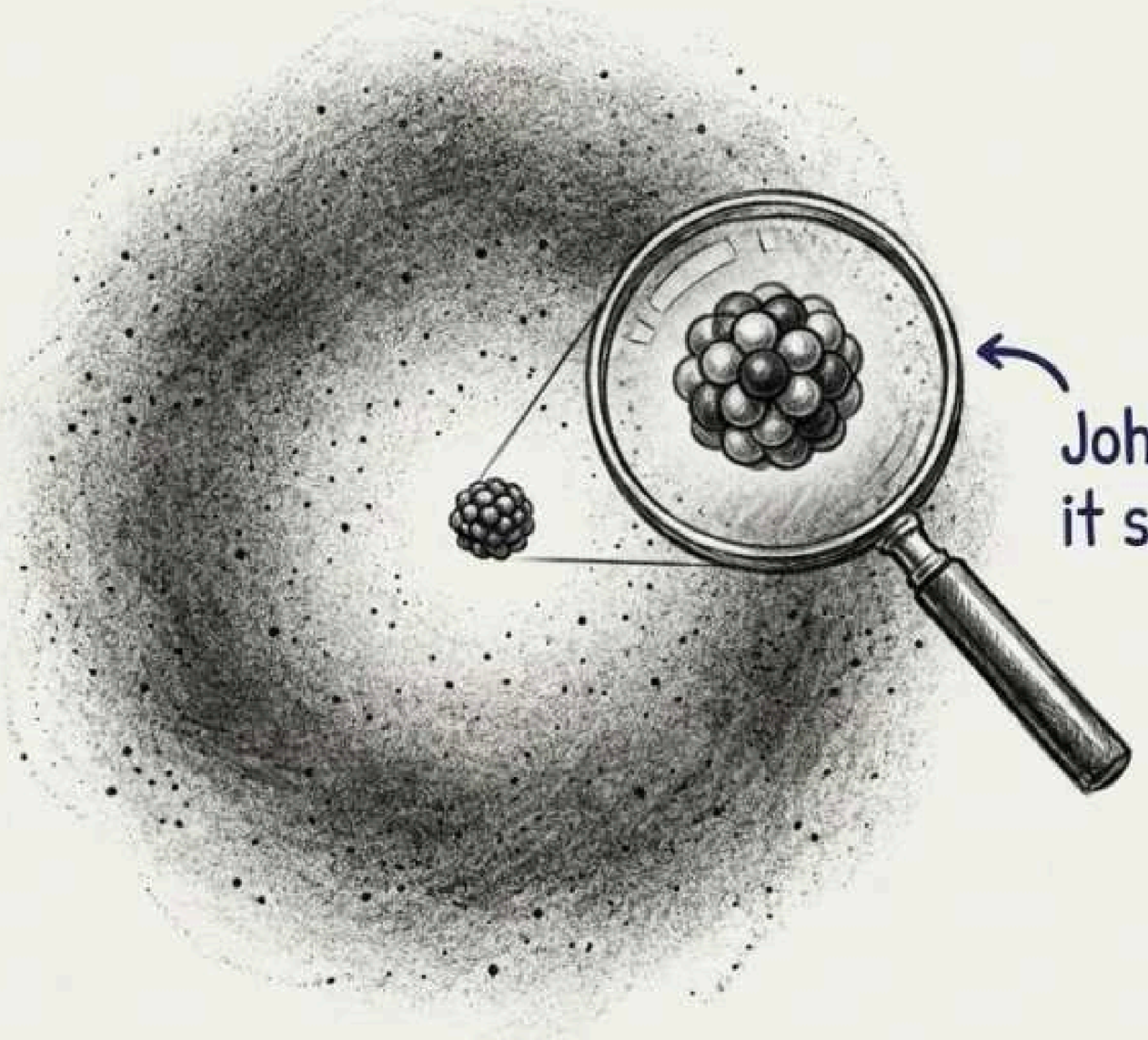
1×10^{-10} m

(a tenth of a billionth of a metre)

6×10^{23}

(Avogadro's number - Lecture 4)

¶ 1.14



John Dalton made it scientific in 1803.

The nucleus is 100,000x smaller than the atom — it is mostly empty space.

¶ 1.15

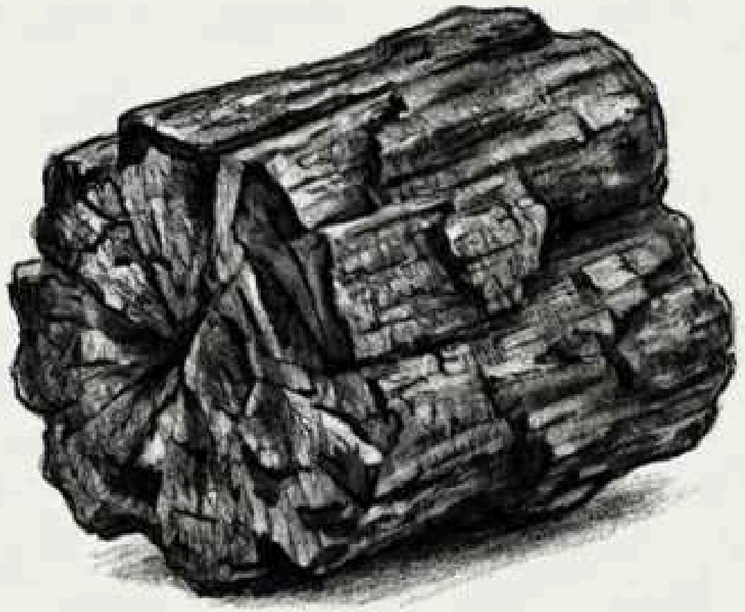
	Charge	Mass (amu)	Role
Proton	(+)	1	Defines Identity
Neutron	(0)	1	Adds Mass
Electron	(-)	~2000x lighter	Controls Chemistry

Atomic Number (Protons) = Element Identity

(e.g., 6 Protons ALWAYS = Carbon)

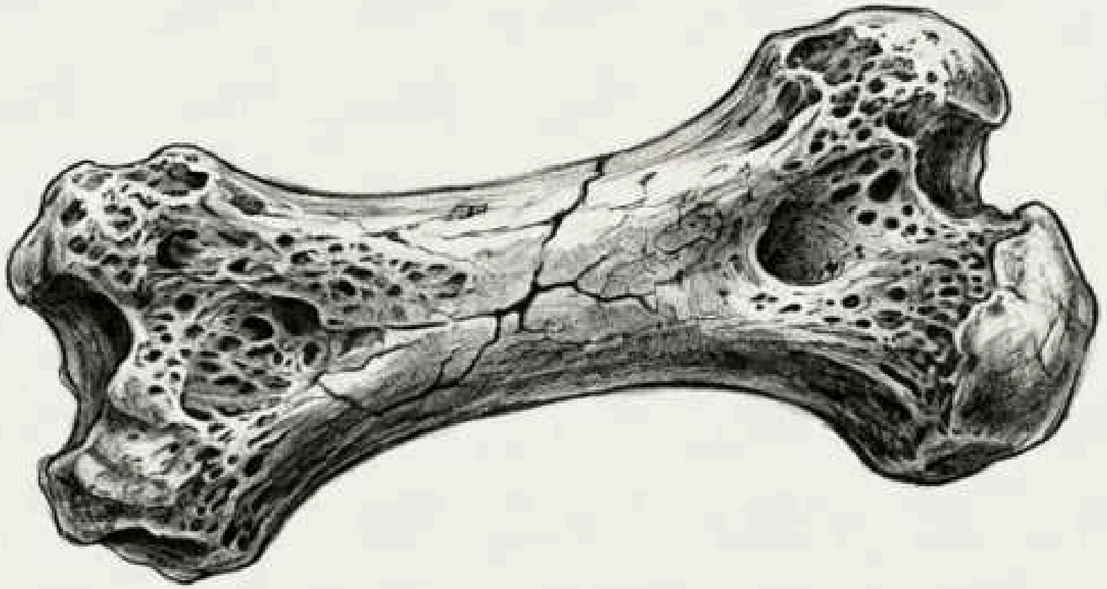
¶ 1.16

Carbon-12



6 Protons, 6 Neutrons

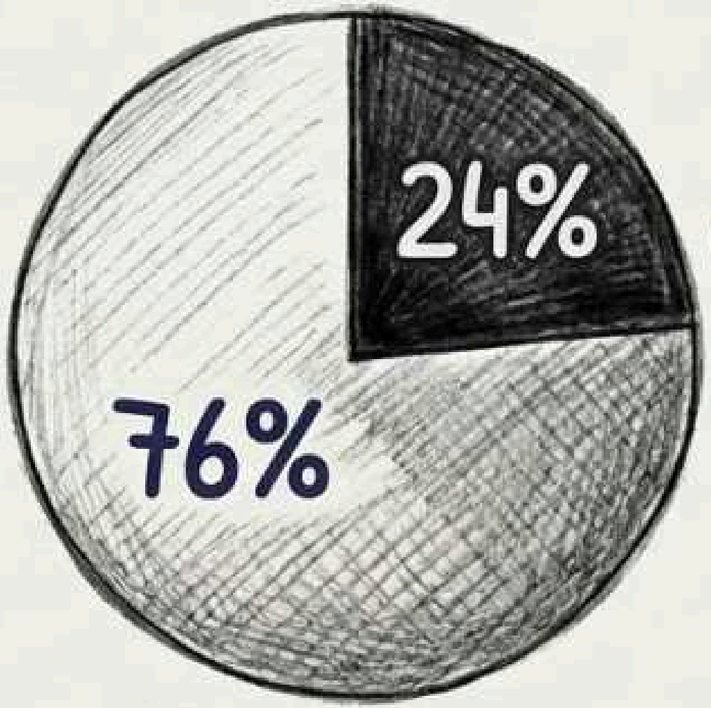
Carbon-14



6 Protons, 8 Neutrons
(Radioactive decay used for dating)

Chemically identical: chemistry is controlled by electrons.

¶ 1.17



Cl-37
(mass 36.97)

Cl-35
(mass 34.97)

$$(0.76 \times 34.97) + (0.24 \times 36.97) = 35.45 \text{ amu}$$

The average atomic mass you see on the periodic table.

¶ 1.18

Protons = Electrons = Neutral

Neutral Na atom —(loses electron)→ $Na^+ + e^-$

Neutral Cl atom + gains electron (e^-) ⟶ Cl^-

Remember this: Ions are the key to the next two lectures.

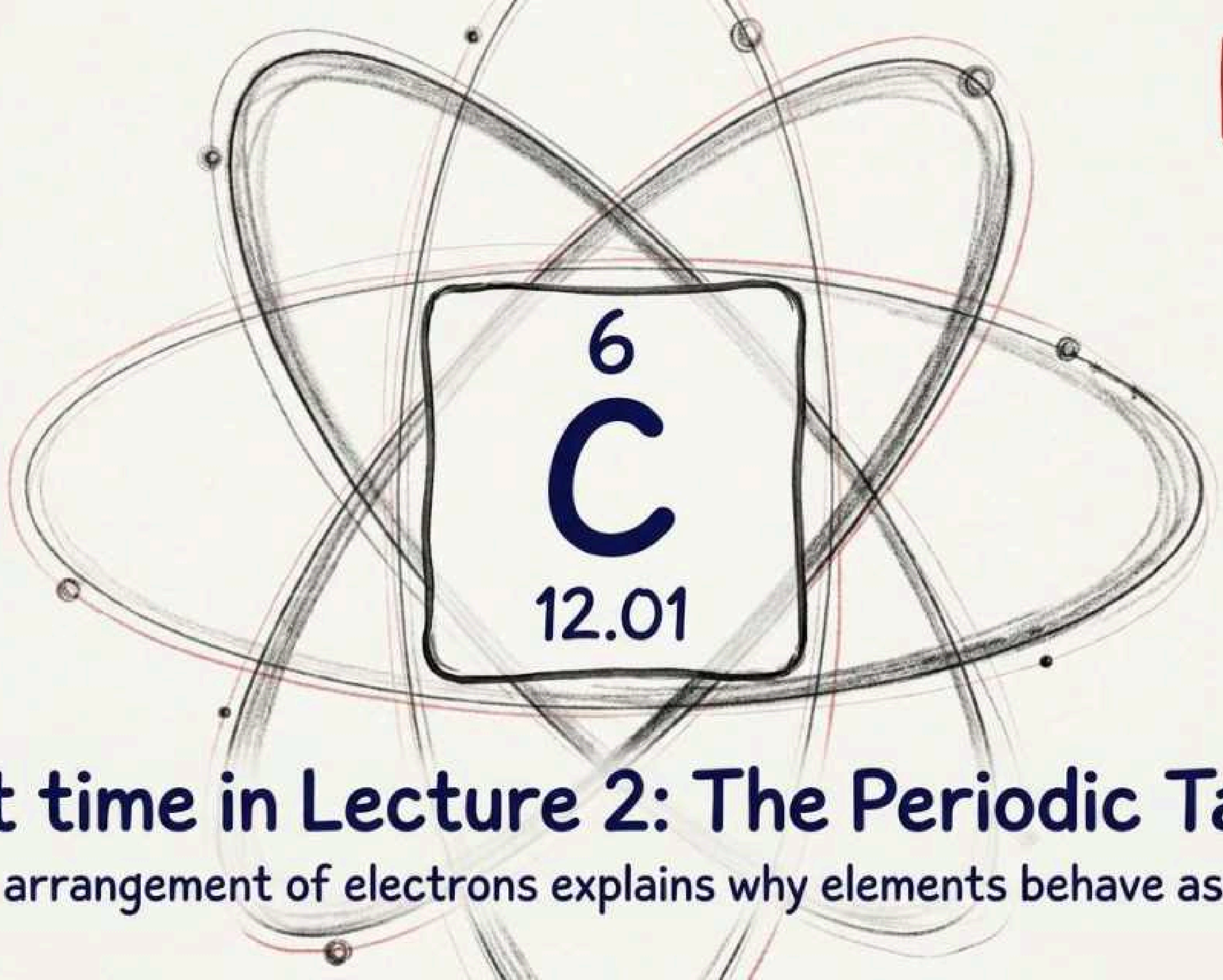
¶ 1.19





Is it an element, a compound, or a mixture? How do you know?

¶ 1.20



Next time in Lecture 2: The Periodic Table.

How the arrangement of electrons explains why elements behave as they do.