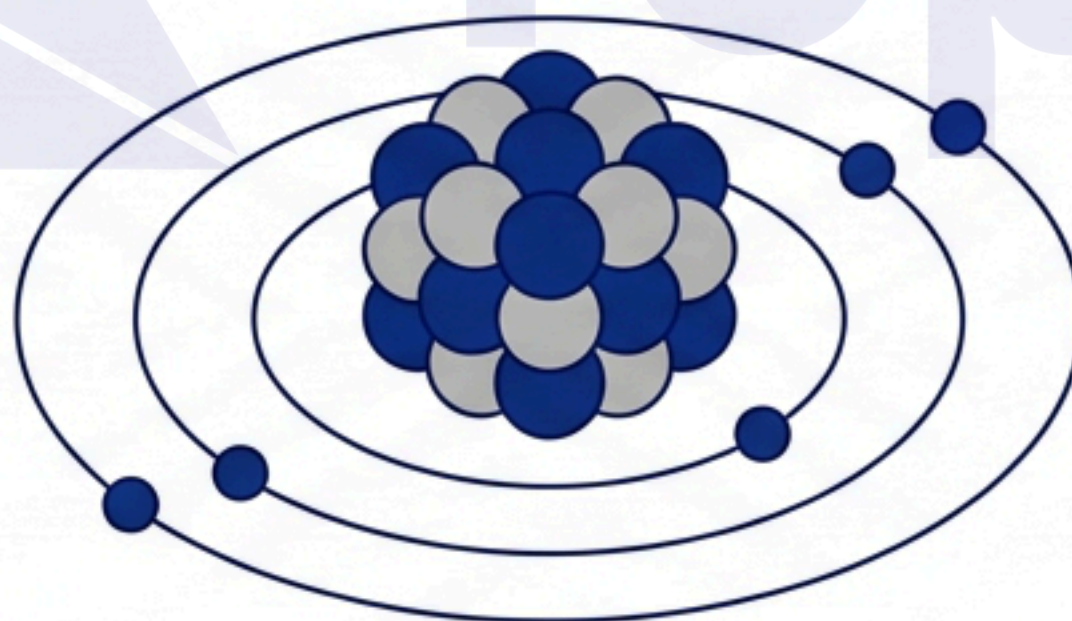


# Isobars and Isotopes

A structural comparison of atomic mass and atomic number variations.



## FOUNDATION

# Symbol Representation of an Atom

The composition of any atom is represented by a standard notation that isolates the total mass from the nuclear charge.



### **A : Mass Number**

(Superscript, top left) – Total number of nucleons.

$$A = \text{protons (p)} + \text{neutrons (n)}$$

### **X : Element Symbol**

Normal chemical symbol of the element.

### **Z : Atomic Number**

(Subscript, bottom left) – Number of protons in the nucleus. (Equal to electrons in a neutral atom).



$$\text{Mass Number (A)} = \text{Atomic Number (Z)} + \text{Number of Neutrons (n)}$$

## CONCEPT 1



# What Isotopes Are

Atoms with identical atomic numbers (Z) but different mass numbers (A). The difference is caused entirely by a varying number of neutrons in the nucleus.

### Chlorine-35



$$Z = 17$$

$$A = 35$$

Protons (p) = 17  
Neutrons (n) = 18

### Chlorine-37



$$Z = 17$$

$$A = 37$$

Protons (p) = 17  
Neutrons (n) = 20

### Chemical Properties Stay the Same

Because isotopes have the same number of protons (and thus electrons), their chemical behavior is identical. Neutrons have minimal effect on chemistry.



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$$E=mc^2$$



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## CONCEPT 2

# What Isobars Are

Atoms with the same mass number (A) but different atomic numbers (Z). These are completely different elements that just happen to weigh the same.

### Carbon-14

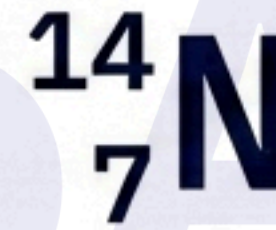


$$Z = 6$$

$$A = 14$$

Protons (p) = 6  
Neutrons (n) = 8

### Nitrogen-14



$$Z = 7$$

$$A = 14$$

Protons (p) = 7  
Neutrons (n) = 7

### Chemical Properties Are Different

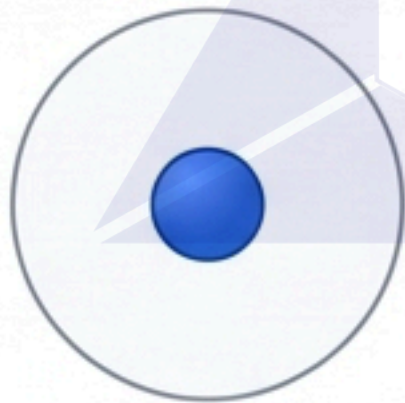
Because the atomic number (Z) changes, the element itself changes. Isobars share no chemical similarities, only a total nucleon count.

## VISUAL CASE STUDY

# The Isotopes of Hydrogen

Hydrogen is the most distinct example of isotopic variation, with 99.985% of atoms containing no neutrons at all.

### Protium

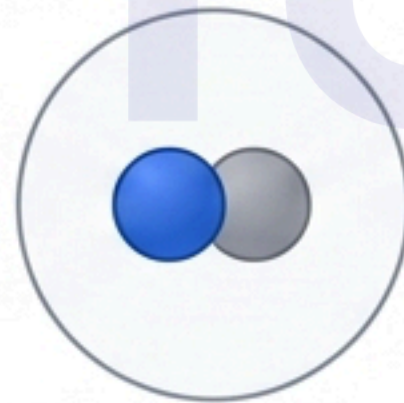


1 Proton

0 Neutrons

99.985% Abundance

### Deuterium

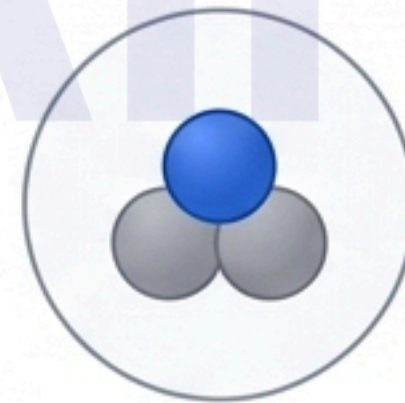
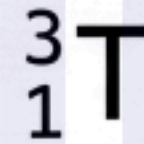


1 Proton

1 Neutron

0.015% Abundance

### Tritium



1 Proton

2 Neutrons

Trace Amounts on Earth

# Final Recap: Isotopes vs. Isobars

| Feature             | Isotopes            | Isobars             |
|---------------------|---------------------|---------------------|
| Condition           | Same Z, Different A | Same A, Different Z |
| Atomic Number (Z)   | <b>SAME</b>         | <b>DIFFERENT</b>    |
| Mass Number (A)     | <b>DIFFERENT</b>    | <b>SAME</b>         |
| Protons (p)         | SAME                | DIFFERENT           |
| Neutrons (n)        | DIFFERENT           | DIFFERENT           |
| Element Identity    | Same Element        | Different Elements  |
| Chemical Properties | Identical           | Distinct            |

Exam Tip: Remember the prefixes. Iso-topes = same 'p' (protons).



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