

# The Nuclear Atom

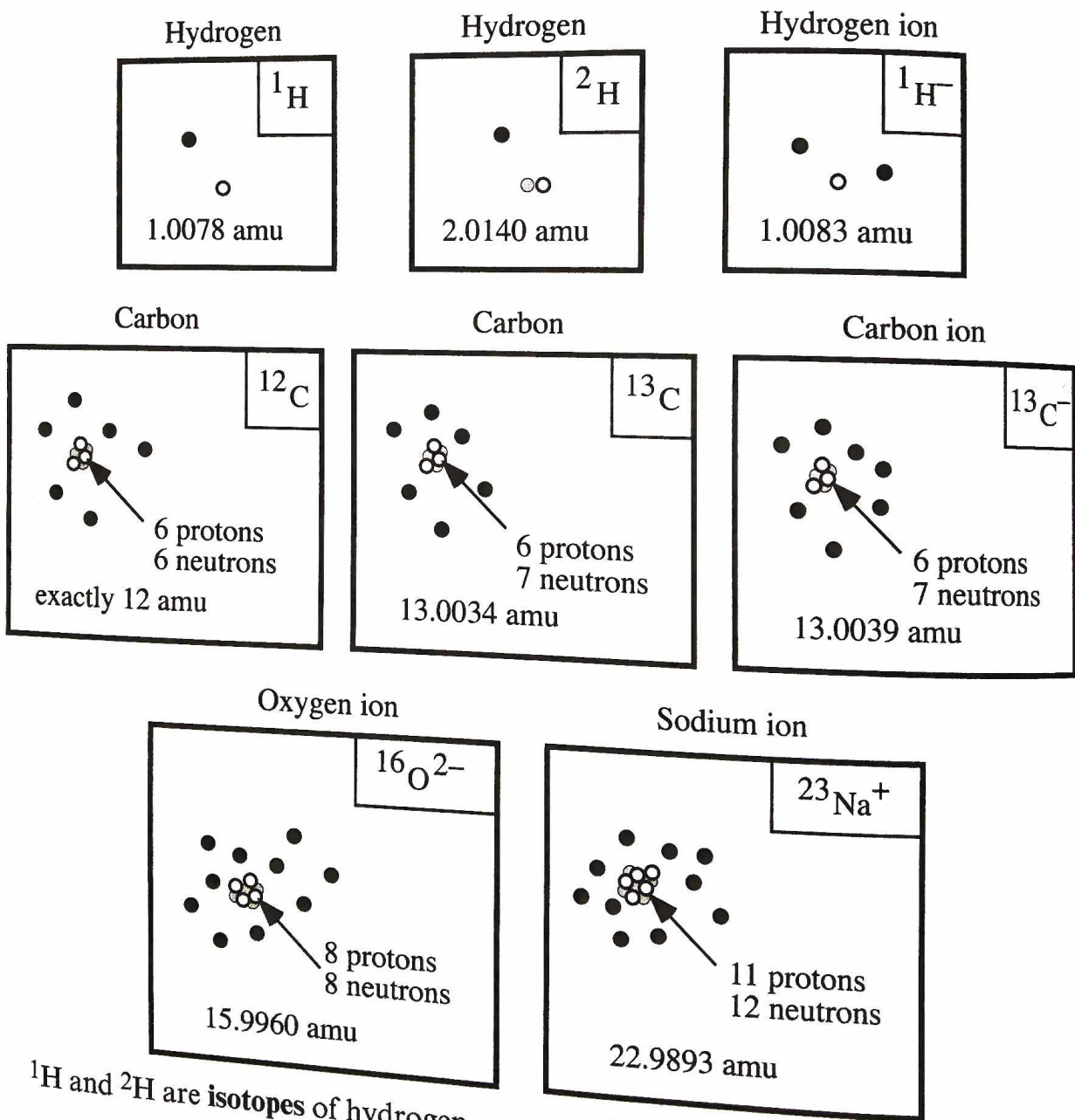
(What Is an Atom?)

## Model: Schematic Diagrams for Various Atoms and Ions.

- electron (-)
- proton (+)
- neutron (no charge)

$$1 \text{ amu} = 1.6606 \times 10^{-24} \text{ g}$$

The nucleus of an atom contains the protons and the neutrons.



$^1\text{H}$  and  $^2\text{H}$  are **isotopes** of hydrogen.

$^{12}\text{C}$  and  $^{13}\text{C}$  are **isotopes** of carbon.

### Critical Thinking Questions

- Write the symbols for the four ions in the Model.
- Write the symbols for the four uncharged atoms in the Model.
- Individually, complete the following table using information from the Model. Then discuss your answers as a team and reach a consensus on all of the entries.

	# of protons	# of neutrons	# of electrons	charge
$^{12}\text{C}$				0
$^{13}\text{C}$				0
$^{13}\text{C}^-$				-1

- How did your team determine the table entries for each of the following table columns from the Model?
  - number of protons
  - number of neutrons
  - number of electrons
- Based on the completed table in CTQ 3, what do all carbon atoms (and ions) have in common?
  - Explain how your team reached a conclusion for part a by specifically referring to information from the completed table in CTQ 3.
- Complete the following table using information from the Model.

	# of protons	# of neutrons	# of electrons	charge
$^1\text{H}$				
$^2\text{H}$				
$^1\text{H}^-$				

- Based on the model and the answers to part a above, what do all hydrogen atoms (and ions) have in common? Explain your reasoning.

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7. Locate the atomic symbols for carbon and hydrogen in a periodic table. There is a number above each symbol in the periodic table, called the **atomic number**. Based on your answers to CTQs 5a and 6b, what is the significance of the atomic number (often represented by the symbol  $Z$ ) above each atomic symbol in the periodic table?
8. Based on the answer to CTQ 7, what do all nickel (Ni) atoms have in common?
9. In terms of the numbers of protons, neutrons and electrons:
  - a) Why does the notation  $^{13}\text{C}^-$  have a negative sign in the upper right hand corner?
  - b) What feature distinguishes a neutral atom from an ion?
  - c) Provide an expression for calculating the charge on an ion.
10.
  - a) What are the two isotopes of carbon shown in the model?
  - b) Based on the information in the model, what structural feature is different in isotopes of a particular element?
11. The left-hand superscript next to the atomic symbol as shown in the Model is known as the **mass number**, often represented by the symbol  $A$ . Surprisingly, the mass number is *not* determined from the mass of the atom.
  - a) What is the mass number for the carbon ion in the Model?
  - b) Use the information in the completed tables from CTQs 3 and 6a to describe how the mass number is obtained in a grammatically correct sentence.

12. Determine the number of protons, neutrons, and electrons in one  ${}^1\text{H}^+$  ion. Describe the thinking used to determine each value.
13. Show that the mass number and charge given for  ${}^{16}\text{O}^{2-}$  and  ${}^{23}\text{Na}^+$  are correct in the Model.
14. Using information from the Model, where is most of the mass of an atom or ion: within the nucleus or outside of the nucleus? Explain your reasoning using grammatically correct sentences and including specific information from the Model.