

ChemQuest 18

Forming Ions

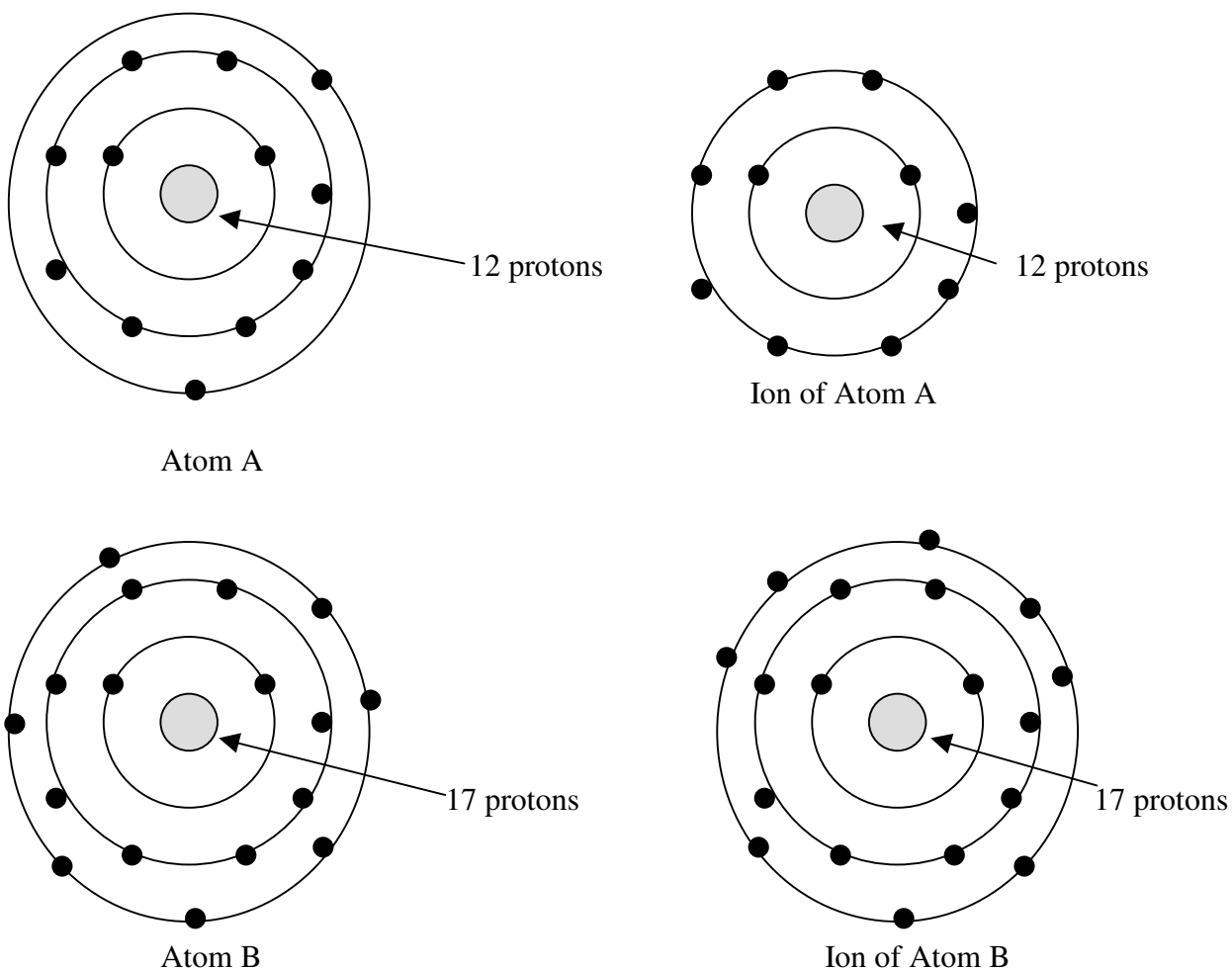
Name: _____

Date: _____

Hour: _____

Information: Ions

Figure 1: Below are four Bohr diagrams of atoms and ions. The two diagrams on the left are atoms; the two on the right are ions.



Critical Thinking Questions

- Prove that both Atom A and Atom B are neutral (have a charge of zero).
Both atoms have an equal number of protons and electrons.
- What is the identity of Atom A and of Atom B?
The atom with 12 protons and 12 electrons is magnesium.

3. Given the above diagrams, how does an atom become an ion?
An atom can become an ion by either gaining or losing electrons.
4. What is the charge on Ion A? What is the charge on Ion B?
Atom A = 12 protons and 10 electrons = +2 charge
Atom B = 17 protons and 18 electrons = -1 charge
5. Write the electron configuration (ex: $1s^22s^22p^6 \dots$) for each ion and atom shown in the Bohr diagrams.
 Atom A: $1s^22s^22p^63s^2$ Ion A: $1s^22s^22p^6$
 Atom B: $1s^22s^22p^63s^23p^5$ Ion B: $1s^22s^22p^63s^23p^6$
6. Consider the electron configuration that you wrote for Ion A. What atom has the same electron configuration as this ion?
Neon
7. Consider the electron configuration that you wrote for Ion B. What atom has the same electron configuration as this ion?
Argon
8. Bromine atoms always gain one electron when they become an ion. Which atom has the same number of electrons as a bromine ion?
Krypton
9. Cesium atoms always lose one electron to become an ion. Which atom has the same number of electrons as a cesium ion?
Xenon
10. Consider your answers to questions 6-9. What do all of the atoms you named have in common?
They are all noble gases with eight outer-level electrons.
11. Knowing what you know about the atoms that you named in questions 6-9, why do you think atoms want to form ions the way they do?
The noble gases have very stable electron configurations and so atoms want to gain or lose electrons so that their electron configuration is the same as a noble gas and more stable.

Information: Ions

As you know, all of the noble gases are very stable. Ions form in such a way so that the ion will have the same number of electrons as a noble gas. Take oxygen, for example. Oxygen has 8 electrons. To become like a noble gas it could either gain two to become like neon or it could lose six to become like helium. So what will oxygen do—gain two or lose six? As a general rule, atoms will gain or lose the fewest number of electrons possible.

Critical Thinking Questions

12. What does an oxygen atom do when becoming an ion? (Does it gain or lose electrons and how many?)

It will gain 2 electrons rather than losing 6.

13. An oxygen atom has an overall neutral charge because it has an even number of protons and electrons. What is the overall charge on an oxygen ion? *After gaining 2 negative electrons the charge will be -2.*

14. Consider an aluminum atom.

a) To become like argon, would aluminum have to gain or lose electrons? How many?

Aluminum would have to gain 5 electrons.

b) To become like neon, would aluminum have to gain or lose electrons? How many?

Aluminum would have to lose 3 electrons.

c) Considering your answers to parts a and b, what does an aluminum atom do to become an ion?

Since aluminum wants to gain or lose the fewest number of electrons possible, aluminum will lose 3 electrons.

d) What is the charge on an aluminum ion?

After losing 3 electrons, the charge will be a net +3.

15. When each of the following atoms becomes an ion, what will the charge be?

a) Ca
+2

b) Cl
-1

c) N
-3

d) K
+1

e) S
-2

f) B
+3

g) P
-3