Chlorine Counts

Use particle models to distinguish atoms, ions, and isotopes.

CHE.1.b "Develop and use models of an element's subatomic particles to compare and contrast its atoms, ions, and isotopes."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline the proton, neutron, and electron counts in each chlorine model, then circle the words that explain which particle changes when an atom becomes an ion or a different isotope.

What Changes in the Water?

1. At a water treatment plant, a technician checks how chlorine ends up in the water. Start with a particle-count model: list the numbers of protons and neutrons in the nucleus, then the number of electrons outside it. Every chlorine atom has 17 protons. A neutral chlorine atom has 17 electrons, so its positive and negative charges balance. An atom with 17 protons and 18 neutrons is chlorine-35 because 17 + 18 = 35. Its model reads 17 protons, 18 neutrons, and 17 electrons. The mass number counts protons and neutrons, not electrons.

2. Chlorine also has a form called chlorine-37. A neutral chlorine-37 atom has 17 protons, 20 neutrons, and 17 electrons. Both neutral forms are isotopes of chlorine: they have the same proton count but different neutron counts. Their mass numbers are different, yet each is still chlorine because an element's identity depends on its protons. If a sample contains both isotopes, a model of each one makes the difference visible without changing its element name. Adding a neutron to a model changes its isotope, but does not give it an electric charge.

3. In water, chlorine can also appear as a chloride ion. A neutral chlorine-35 atom that gains one electron becomes a chlorine-35 chloride ion, Cl^-, with 17 protons, 18 neutrons, and 18 electrons. A chlorine-37 chloride ion has 17 protons, 20 neutrons, and 18 electrons. Each has a negative charge because it has one more electron than proton. Comparing these two ions reveals an isotope difference; comparing either ion with its matching neutral atom reveals an electron difference. For a two-negative ion, two extra electrons are present compared with a neutral atom of the same isotope.

2 ANSWER WITH EVIDENCE

Use the passage

1. Compare the particle-count models of neutral chlorine-35 and neutral chlorine-37. Which counts match, and which count differs?

2. Model a neutral chlorine-35 atom becoming a chlorine-35 chloride ion. Write both sets of particle counts and identify the change.

3. A technician models a chlorine-37 chloride ion with 17 protons, 18 neutrons, and 20 electrons. Correct the model and explain each correction.

4. Compare chlorine-35 and chlorine-37 chloride ions. Why are they different isotopes but ions with the same charge?

3 YOUR TURN

Your own words

Create three labeled particle-count models: a neutral oxygen-16 atom, a neutral oxygen-18 atom, and an oxygen-18 oxide ion, O^{2-}. Oxygen has 8 protons; show the proton, neutron, and electron counts in each panel, then write one sentence comparing the changes.

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PART 1 · READ AND MARK

Underline the proton, neutron, and electron counts in each chlorine model, then circle the words that explain which particle changes when an atom becomes an ion or a different isotope. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	Compare the particle-count models of neutral chlorine-35 and neutral chlorine-37. Which counts match, and which count differs?	**Both have 17 protons and 17 electrons. Chlorine-35 has 18 neutrons, while chlorine-37 has 20.**
2	Model a neutral chlorine-35 atom becoming a chlorine-35 chloride ion. Write both sets of particle counts and identify the change.	**Atom: 17 protons, 18 neutrons, 17 electrons. Ion: 17 protons, 18 neutrons, 18 electrons. It gains one electron.**
3	A technician models a chlorine-37 chloride ion with 17 protons, 18 neutrons, and 20 electrons. Correct the model and explain each correction.	**It needs 20 neutrons because 17 + 20 = 37. It needs 18 electrons because a chloride ion has one more electron than its 17 protons.**
4	Compare chlorine-35 and chlorine-37 chloride ions. Why are they different isotopes but ions with the same charge?	**They have different neutron counts, 18 and 20. Each has 17 protons and 18 electrons, so each has a charge of one negative.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

Panel 1, neutral oxygen-16: 8 protons, 8 neutrons, 8 electrons. Panel 2, neutral oxygen-18: 8 protons, 10 neutrons, 8 electrons. Panel 3, oxygen-18 oxide ion, O^{2-}: 8 protons, 10 neutrons, 10 electrons. Oxygen-16 and oxygen-18 differ in neutrons, while the oxide ion has two more electrons than the neutral oxygen-18 atom.

Accept particle-count models written as numbers or shown with labeled particle symbols. The isotope comparison must change neutrons, and the ion comparison must change electrons without changing protons.