Atoms, ions and isotopes

Pearson Edexcel 1CH0 Separate Chemistry · Foundation and Higher

Show your working where needed. Check the worked answers when you finish.

Name _____ Date _____

1. Charge and position

Name the three particles in an atom. For each particle, give its relative charge and say whether it is in the nucleus or outside it.

2. Count the particles

A neutral sulfur atom has atomic number 16 and mass number 34. Find its numbers of protons, neutrons and electrons.

3. Draw the shells

A neutral aluminium atom has atomic number 13. Write its electronic configuration in numbers, then draw it using electron shells.

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4. An oxide ion

Oxygen has atomic number 8. Give the numbers of protons, neutrons and electrons in an O^{2-} ion with mass number 16. Explain how it acquired its charge.

5. Spot the isotopes

Atom P has 17 protons and 18 neutrons. Atom Q has 17 protons and 20 neutrons. Atom R has 18 protons and 20 neutrons. Which pair are isotopes of the same element? Explain.

6. A change to the Dalton model

In Dalton’s model, atoms are solid particles with no internal structure. Later experiments show that an atom contains negatively charged electrons. Explain why this discovery led to a change in the model, and how a current model accounts for the net charge of a neutral atom.

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7. Relative atomic mass (Higher)

In a magnesium sample, 80% of the atoms have relative isotopic mass 24, 10% have mass 25 and 10% have mass 26. Calculate the relative atomic mass of magnesium in this sample.

8. Compare two samples (Higher)

Sample A of bromine contains 60% bromine-79 and 40% bromine-81. Sample B contains 40% bromine-79 and 60% bromine-81.

Calculate the relative atomic mass in each sample. Explain how the abundances account for the difference. Use 79 and 81 for the relative isotopic masses.

9. Extra challenge · Three unidentified particles

P has 12 protons, 12 neutrons and 10 electrons. Q has 12 protons, 13 neutrons and 12 electrons. R has 13 protons, 12 neutrons and 10 electrons. Which pair belongs to the same element? Give both mass numbers and state which particle has charge 3+. Explain your choices.

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Worked answers

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1. Charge and position

The nucleus contains protons, with relative charge +1, and neutrons, with relative charge 0. Electrons, with relative charge −1, occupy shells outside the nucleus.

2. Count the particles

There are 16 protons. Neutrons = 34 − 16 = 18. A neutral atom has the same number of electrons as protons, so it has 16 electrons.

3. Draw the shells

2,8,3. Draw three occupied shells with 2 electrons in the first, 8 in the second and 3 in the third.

4. An oxide ion

There are 8 protons, 16 − 8 = 8 neutrons and 10 electrons. The neutral oxygen atom gained two electrons, giving it two more electrons than protons.

5. Spot the isotopes

P and Q. Both have 17 protons, so they are atoms of the same element. Their numbers of neutrons differ.

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Worked answers

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6. A change to the Dalton model

Electrons are smaller parts inside atoms, so the atom could not be a solid particle without internal structure. The current model has negative electrons outside the positive nucleus.

In a neutral atom the number of electrons equals the number of protons, so their charges cancel.

7. Relative atomic mass (Higher)

Use the abundances as weights. (24 × 80 + 25 × 10 + 26 × 10) ÷ 100 = 24.3. Relative atomic mass has no units.

8. Compare two samples (Higher)

A = (79 × 60 + 81 × 40) ÷ 100 = 79.8. B = (79 × 40 + 81 × 60) ÷ 100 = 80.2.

The heavier isotope is more abundant in sample B, so it has a greater effect on that sample’s average.

9. Extra challenge · Three unidentified particles

P and Q belong to the same element because both have 12 protons. Their mass numbers are 12 + 12 = 24 and 12 + 13 = 25, so they represent different isotopes.

R has charge 3+ because it has 13 protons and only 10 electrons. P and R have the same electron count, but their proton counts differ.

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