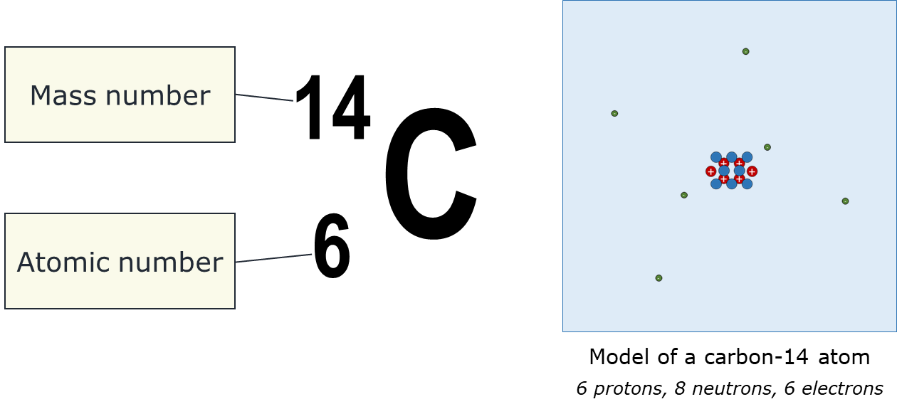
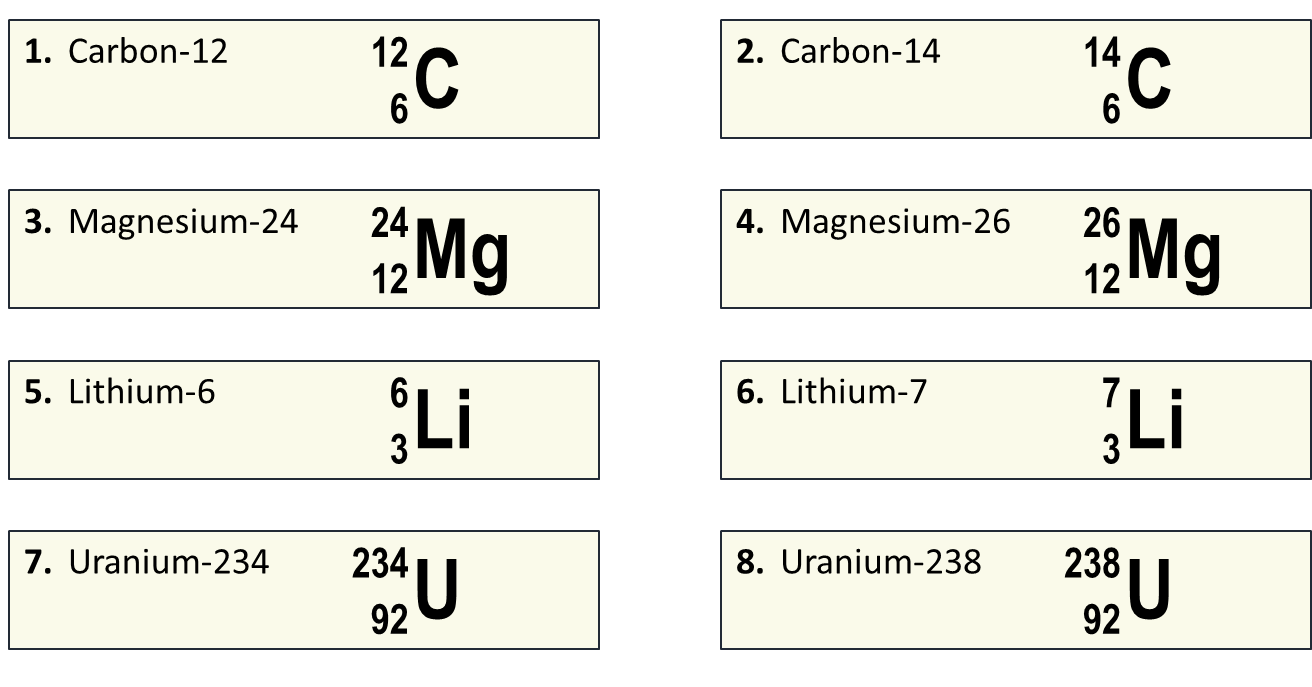
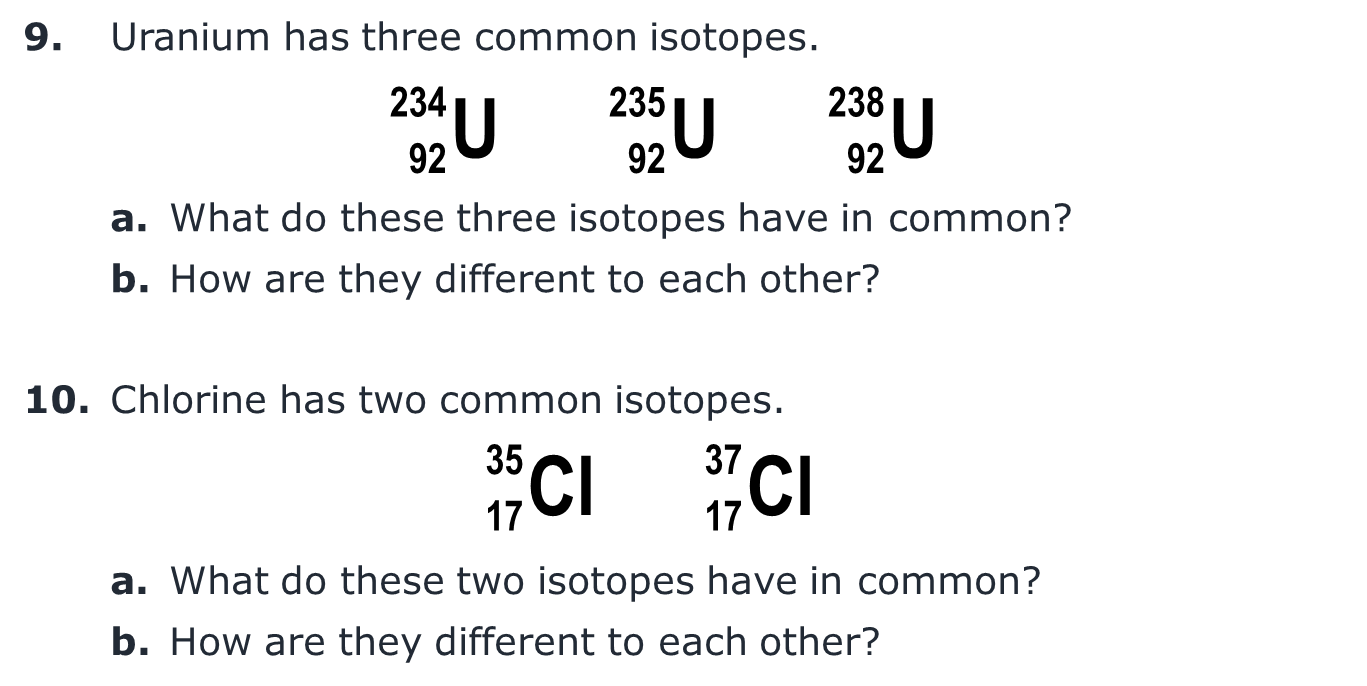
**Accounting for atoms**

The structure of an atom can be described using just two numbers.



How many protons, neutrons and electrons in these atoms?





*Physics > Big idea PMA: Matter > Topic PMA5: Nuclear physics > Key concept PMA5.1: Atomic nuclei*

|  |
| --- |
| **Response activity** |
| **Accounting for atoms** |

**Overview**

|  |  |
| --- | --- |
| Learning focus: | There is a fixed number of positively charged protons in the nucleus of each atom of an element, but the number of neutrons can vary to make isotopes that are either stable or unstable. |
| Observable learning outcome: | Determine the structure of an atom from its mass number and atomic number.  Explain what isotopes of an element are. |
| Activity type: | Application and practice |
| Key words: | Isotope, element, atom, nucleus, proton, neutron, electron, mass number, atomic number |

This activity can help develop students’ understanding by addressing the sticking-points revealed by the following diagnostic questions:

* Diagnostic question: Numbering nucleons
* Diagnostic question: Different but the same

**What does the research say?**

To develop a deeper understanding of the structure of nuclei, Brock, Manning and Walsh (2021) suggest starting by reinforcing understanding of the structure and scale of an atom by modelling Rutherford’s scattering experiment. Their next step is to introduce the proton and neutron, and to use nomenclature to give students opportunity to explore the numbers of protons, neutrons and electrons in different atoms. This introduces students to ideas about isotopes and about what makes some nuclei stable and others unstable (radioactive).

**Ways to use this activity**

This activity gives students the opportunity to practise applying their understanding and to clarify their thinking through discussion. To support this, students should answer the questions in pairs or small groups.

Listening to individual groups as they work often highlights any difficulties they might have. These can often be overcome, through a whole class clarification or redirection part way through the activity.

Asking students to share their answer is a useful check. After a group has fed back, it might be helpful to model an even better answer. You could do this, for example, by asking another group to add to, or clarify, the first observation. Then ask another group to sum up the important part of the observation, and so on.

*Differentiation*

If some students are working with a teaching assistant, then a list of prompt questions for the TA could help to make this activity more purposeful.

**Expected answers**

1. 6p, 6n, 6e
2. 6p, 8n, 6e
3. 12p, 12n, 12e
4. 12p, 14n, 12e
5. 3p, 3n, 3e
6. 3p, 4n, 3e
7. 92p, 142n, 92e
8. 92p, 146n, 92e
9. a.Same number of protons, same number of electrons, same element, interact chemically in the same way.

b. Different number of neutrons in the nucleus

1. a.Same number of protons, same number of electrons, same element, interact chemically in the same way.

b. Different number of neutrons in the nucleus

**Acknowledgments**

Developed by Peter Fairhurst (UYSEG).

Images: Peter Fairhurst (UYSEG).

**References**

Brock, R., Manning, A. and Walsh, K. (2021). Atomic physics. In de Winter, J. & Hardman, M. (eds.) *Teaching Secondary Physics.* 3rd ed. London: Hodder Education.