

Atomic structure: teacher guidance

These Knowledge check worksheets provide a series of questions to assess learners' knowledge and understanding of this topic at the end of a period of teaching or as revision. They are available at Foundation and Higher level and as fully editable versions so you can adapt them to suit learners' needs. Use for individual student work in class or at home. Find the full set of answers below.

Also available to assess this topic:

- **Review my learning worksheets:** available with three levels of scaffolded support to help build confidence in every learner. Use before, during or after teaching the relevant topic, to understand progress and identify misconceptions, rsc.li/44igB7V.
- **Stretch and challenge worksheets** ask learners to apply their knowledge to an unfamiliar context, helping them develop their skills and prepare for examination, <https://rsc.li/3RpZ4Wq>.

Answers

Foundation

- 1 (a) An atom consists of a nucleus surrounded by **electrons** in shells. The nucleus of most atoms contains **protons/neutrons** and **neutrons/protons**. All atoms of the same element have the same numbers of **protons/electrons** and **electrons/protons**. [3 marks]
- (b) atomic number = 4 [1 mark]
- (c) mass number = 9 [1 mark]
- (c) ${}^9_4\text{Be}$ [1 mark]
- (d) [1 mark per correct row: 2 marks]

Sub-atomic particle	Relative mass	Relative charge
proton	1	+1
neutron	1	0
electron	very small/0	-1

- (e) An atom of beryllium has equal numbers of positive charges (protons) and negative charges (electrons). [1 mark]

2 (a) Most of the mass is in the nucleus. [1 mark]

(b) **B.** 1×10^{-10} m [1 mark]

3 (a) **B.** number of neutrons = mass number – atomic number [1 mark]

(b) [1 mark per correct row: 3 marks]

Atom	Atomic number	Mass number	Number of protons	Number of neutrons	Number of electrons
aluminium	13	27	13	14	13
phosphorus	15	31	15	16	15
scandium	21	45	21	24	21

4 (a) Isotopes of an element have the same number of **protons/electrons** [1] and **electrons/protons** [1], but different numbers of **neutrons** [1]. They have the same **atomic** [1] number but different **mass** [1] numbers. [5 marks]

(b) i. carbon-13 $^{13}_6\text{C}$ [1 mark]

ii. carbon-14 $^{14}_6\text{C}$ [1 mark]

(c) i. 18 neutrons [1 mark]

ii. 20 neutrons [1 mark]

[Total: 24 marks]

Higher

- 1 (a) atomic number is 4 [1 mark]
- (b) mass number is 9 [1 mark]
- (c) in the nucleus [1 mark]
- (d) i. four [1 mark]
- ii. four [1 mark]
- iii. five [1 mark]
- (e) ${}^9_4\text{Be}$ [1 mark]
- (f) **C.** 0.112 nm [1 mark]
- 2 (a) number of neutrons = mass number – atomic number [1 mark]
- (b) [1 mark per correct row: 4 marks]

Atom or ion	Number of protons	Number of neutrons	Number of electrons
${}^{27}_{13}\text{Al}$	13	14	13
${}^{45}_{21}\text{Sc}$	21	24	21
${}^{39}_{19}\text{K}^+$	19	20	18
${}^{31}_{15}\text{P}^{3-}$	15	16	18

- 3 (a) Isotopes are atoms of the same element that have the same atomic number, [1] but different mass numbers [1].

OR

Isotopes are atoms of the same element that have the same number of protons, [1] but different numbers of neutrons [1]. [2 marks]

- (b) i. $^{12}_6\text{C}$ [1 mark]
- ii. $^{13}_6\text{C}$ [1 mark]
- iii. $^{14}_6\text{C}$ [1 mark]
- (c) The electrical charge is determined by the number of positive (protons) and negative (electrons) sub-atomic particles [1]. Isotopes of an element have equal numbers of positive and negative charges [1]. [2 marks]
- (d) The relative atomic mass of an element is the (weighted or taking abundance into account) average of all isotopes [1]. The relative atomic mass of 12.011 takes carbon-13 and carbon-14 into account [1]. [2 marks]
- (e) $^{35}_{17}\text{Cl}$ is more common. [1 mark]
- 4 (a) Atomic models changed as new sub-atomic particles were discovered. [1 mark]
- (b)

Scientist	Contribution to atomic structure model
John Dalton	identified atoms as discrete spheres.
J J Thomson	discovered the negatively charged electrons and reasoned that they were in a positive field.
Ernest Rutherford	discovered that the positive charge was concentrated in a central nucleus.
Niels Bohr	discovered that electrons orbit the central nucleus in shells/energy levels.

[4 marks]

[Total: 28 marks]