1.1 Particles in the atom and atomic radius

Name: _____ Class: _____ Date: _____ **Total: 16 marks**

0 Vocabulary

Word	Example
proton /ˈprəʊtɒn/	A **proton** has a positive charge.
relative charge /ˈrelətɪv tʃɑːdʒ/	An electron has a **relative charge** of -1. -1
relative mass /ˈrelətɪv mæs/	A proton and a neutron both have a **relative mass** of 1. 1
neutral /ˈnjuːtrəl/	A **neutral** atom has the same number of protons and electrons.
atomic number /əˈtɒmɪk ˈnʌmbə/	Carbon has an **atomic number** of 6. 6
nucleon number /ˈnjuːklɪən ˈnʌmbə/	The **nucleon number** counts protons and neutrons.
mass number /mæs ˈnʌmbə/	Carbon-12 has a **mass number** of 12. Carbon-12 12
nucleon /ˈnjuːklɪən/	A proton or a neutron is a **nucleon**.
electric field /ɪˈlektrɪk fiːld/	A charged ball has an **electric field** around it.
deflection /dɪˈflekʃn/	The needle shows a large **deflection**.
atomic radius /əˈtɒmɪk ˈreɪdɪəs/	Sodium has a larger **atomic radius** than chlorine.

exercises.lol exercises.com.cn

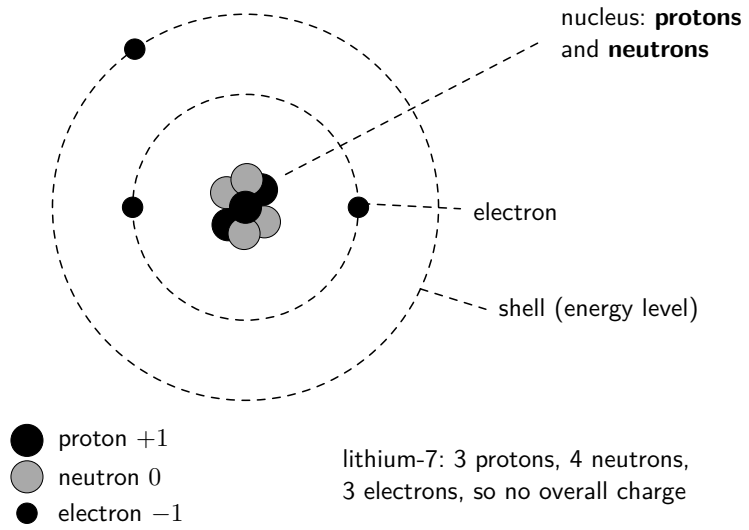
Word	Example
ionic radius /aɪˈɒnɪk ˈreɪdɪəs/	The Na+ ion has a smaller **ionic radius** than the sodium atom. Na+
cation /ˈkætaɪən/	Sodium loses one electron to form a **cation**.
anion /ˈænaɪən/	Chlorine gains one electron to form an **anion**.

1 Key knowledge and worked examples

The particles and the radius

particle	relative charge	relative mass	in an electric field
proton	+1	1	bends towards the − plate
neutron	0	1	not deflected
electron	−1	$\frac{1}{1836}$	bends towards the + plate, much more (tiny mass)

idea	statement
numbers	proton number Z; nucleon number A; neutrons $= A - Z$; electrons $= Z-$ charge
deflection	angle is proportional to $\frac{\text{charge}}{\text{mass}}$
atomic radius	decreases across a period (more protons, same shielding); increases down a group (more shells)
ionic radius	a cation is smaller than its atom (a shell lost); an anion is larger (more electron repulsion)



■ Worked example 1: counting particles

Find the protons, neutrons and electrons in $^{32}_{16}\mathrm{S}^{2-}$.

1. Known: $A = 32$, $Z = 16$, charge $2-$.
2. Rule: $n = A - Z$; electrons $= Z + 2$ for a $2-$ ion.
3. Numbers: 16; $32 - 16$; $16 + 2$.
4. Result: **16 p**, **16 n**, **18 e**.

■ Worked example 2: comparing deflections

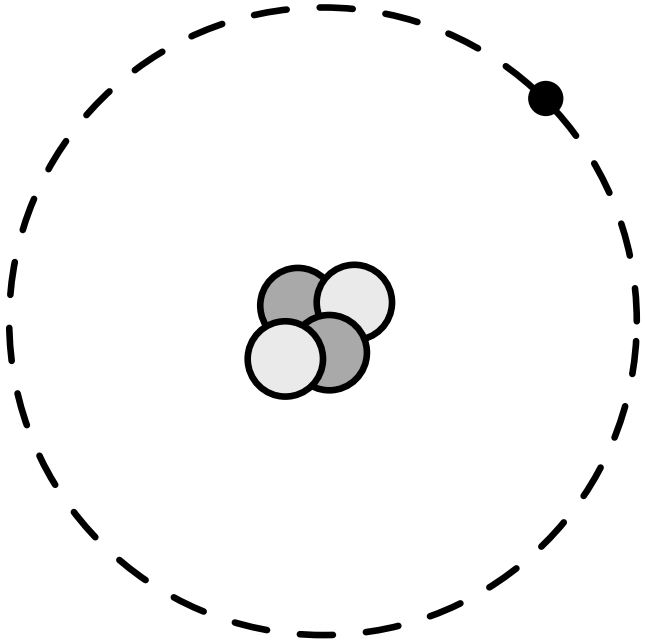
Compare the deflection of $^{1}\mathrm{H}^{+}$ and $^{2}\mathrm{H}^{+}$ beams at the same speed.

1. Known: same charge; masses 1 and 2.
2. Rule: angle $\propto \dfrac{\text{charge}}{\text{mass}}$.
3. Numbers: $\dfrac{1}{1}$ against $\dfrac{1}{2}$.
4. Result: $^{1}\mathrm{H}^{+}$ is deflected **twice as much**, the same way.

Answer shapes: in radius answers name nuclear charge, shielding and the number of shells.

2 Practice

2.1 State the relative charge and relative mass of a neutron and of an electron. [2]



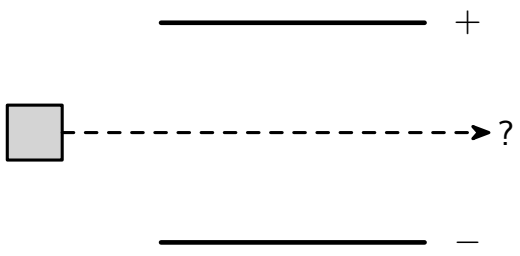
2.2 Give the numbers of protons, neutrons and electrons in $^{40}_{20}Ca^{2+}$. [2]

$^{40}_{20}Ca^{2+}$

exercises.lol exercises.com.cn

3 Exam-style questions

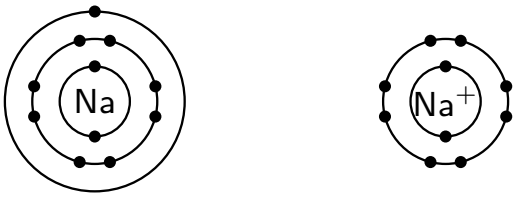
3.1 Beams of protons, neutrons and electrons, all at the same speed, pass between two charged plates.



(a) State which beam is not deflected. [1]

(b) Explain why the electron beam is deflected in the opposite direction to the proton beam and by a much larger angle. [2]

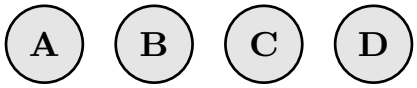
3.2 Explain why a sodium ion, Na^+, is smaller than a sodium atom. [2]



exercises.lol exercises.com.cn

3.3 The table shows the particles in four species, **A** to **D**.

species	protons	neutrons	electrons
A	12	12	12
B	12	14	12
C	12	12	10
D	9	10	10



(a) State which two species are isotopes of the same element. [1]

(b) Identify **C** and **D**, including their charges. [2]

(c) **C** and **D** have the same number of electrons. Explain which is smaller. [2]

(d) A beam of **C** and a beam of $^{24}Mg^{+}$ ions enter the same electric field at the same speed. Compare their deflections. [2]

exercises.lol exercises.com.cn