

IB Chemistry HL - S1.2

The nuclear atom

Exercises + Practice questions

Official answers appended at the end

Exercise

- Q1.** Explain why the relative atomic mass of tellurium is greater than the relative atomic mass of iodine, even though iodine has a greater atomic number.
- Q2.** Use the periodic table to identify the subatomic particles present in the following species.

	Species	No. of protons	No. of neutrons	No. of electrons
(a)	${}^7\text{Li}$			
(b)	${}^1\text{H}$			
(c)	${}^{14}\text{C}$			
(d)	${}^{19}\text{F}^-$			
(e)	${}^{56}\text{Fe}^{3+}$			

- Q3.** Isoelectronic species have the same number of electrons. Identify the following isoelectronic species by giving the correct symbol and charge. You will need a periodic table.

The first one has been done as an example.

	Species	No. of protons	No. of neutrons	No. of electrons
	${}^{40}\text{Ca}^{2+}$	20	20	18
(a)		18	22	18
(b)		19	20	18
(c)		17	18	18

- Q4.** What is the difference between two neutral atoms represented by the symbols ${}^{14}_6\text{C}$ and ${}^{14}_7\text{N}$?

- I. the number of neutrons II. the number of protons
 III. the number of electrons

A I and II only **B** I and III only **C** II and III only **D** I, II and III

Exercise

- Q5.** State two physical properties other than boiling point and melting point that would differ for the two isotopes of chlorine.
- Q6.** Identify the particles which account for the existence of isotopes.
A electrons **B** nucleons **C** neutrons **D** protons
- Q7.** Which of the following species contains more electrons than neutrons?
A ${}^2_1\text{H}$ **B** ${}^{11}_5\text{B}$ **C** ${}^{16}_8\text{O}^{2-}$ **D** ${}^{19}_9\text{F}^-$
- Q8.** Which of the following gives the correct composition of the ${}^{71}\text{Ga}^+$ ion?

	Protons	Neutrons	Electrons
A	31	71	30
B	31	40	30
C	31	40	32
D	32	40	31

Q9. Chromium has an atomic number of 24. The mass numbers of its four stable isotopes are 50, 52, 53 and 54.

Identify the correct statements about the isotopes.

- I. All the isotopes have the same chemical properties.
- II. All the isotopes have nuclei containing 24 protons.
- III. One of the isotopes has 54 neutrons.

A I and II only **B** I and III only **C** II and III only **D** I, II and III

Q10. Identify the atoms which are isotopes.

	Mass number	Atomic number
W	52	24
X	53	25
Y	53	24
Z	52	25

A W and Z **B** X and Y **C** W and Y **D** Y and Z

Q11. The relative atomic mass of silicon is 28.09. Comment on the claim that no atom of silicon exists with this relative mass.

Q12. Deduce the composition of a nucleus of boron-11, $^{11}_5\text{B}$.

	Protons	Neutrons
A	5	11
B	11	5
C	6	5
D	5	6

Q13. What is the same for an atom of phosphorus-26 and an atom of phosphorus-27?

- A** atomic number and mass number
- B** number of protons and electrons
- C** number of neutrons and electrons
- D** number of protons and neutrons

Exercise

Q14. A sample of chromium has the following isotopic composition by mass.

Isotope	^{50}Cr	^{52}Cr	^{53}Cr	^{54}Cr
Relative abundance / %	4.31	83.76	9.55	2.38

Calculate the relative atomic mass of chromium based on these data, giving your answer to two decimal places.

Q15. Use the periodic table to find the percentage abundance of neon-20, if neon has only one other isotope, neon-22.

Q16. Magnesium has three stable isotopes: ^{24}Mg , ^{25}Mg , and ^{26}Mg . The lightest isotope has an abundance of 78.90%. Calculate the percentage abundance of the other isotopes.

Q17. The relative abundances of the two isotopes of chlorine are shown in this table:

Isotope	Relative abundance
^{35}Cl	75%
^{37}Cl	25%

Use this information to deduce the mass spectrum of chlorine gas, Cl_2 .

Practice questions

- Which statements about the isotopes of chlorine, $^{35}_{17}\text{Cl}$ and $^{37}_{17}\text{Cl}$, are correct?
 - They have the same chemical properties.
 - They have the same atomic number.
 - They have the same physical properties.

A I and II only **B** I and III only
C II and III only **D** I, II and III
- Which statement about the numbers of protons, electrons and neutrons in an atom is always correct?

A The number of neutrons minus the number of electrons is zero.
B The number of protons plus the number of neutrons equals the number of electrons.
C The number of protons equals the number of electrons.
D The number of neutrons equals the number of protons.
- Which quantities are the same for all atoms of chlorine?
 - number of protons
 - number of neutrons
 - number of electrons

A I and II only **B** I and III only
C II and III only **D** I, II and III
- How many electrons does the ion $^{31}_{15}\text{P}^{3-}$ contain?

A 12 **B** 15 **C** 16 **D** 18
- Deduce the number of elementary particles present in the $^{55}_{25}\text{Mn}^{2+}$ ion. (3)
 (Total 3 marks)
- A sample of iron has the following isotopic composition by mass.

Isotope	^{54}Fe	^{56}Fe	^{57}Fe
Relative abundance / %	5.95	91.88	2.17

Calculate the relative atomic mass of iron based on these data, giving your answer to two decimal places. (2)
 (Total 2 marks)

- Explain why the relative atomic mass of cobalt is greater than the relative atomic mass of nickel, even though the atomic number of nickel is greater than the atomic number of cobalt. (1)
 - Deduce the numbers of protons and electrons in the Co^{2+} ion. (1)

(Total 2 marks)