



IB Chemistry – SL

Topic 2 Questions

1. Consider the composition of the species W, X, Y and Z below. Which species is an anion?

Species	Number of protons	Number of neutrons	Number of electrons
W	9	10	10
X	11	12	11
Y	12	12	12
Z	13	14	10

- A. W
- B. X
- C. Y
- D. Z

(Total 1 mark)

2. Energy levels for an electron in a hydrogen atom are

- A. evenly spaced.
- B. farther apart near the nucleus.
- C. closer together near the nucleus.
- D. arranged randomly.

(Total 1 mark)

3. Which is related to the number of electrons in the outer main energy level of the elements from the alkali metals to the halogens?

- I. Group number
 - II. Period number
- A. I only
 - B. II only
 - C. Both I and II
 - D. Neither I nor II

(Total 1 mark)



4. How do bond length and bond strength change as the number of bonds between two atoms increases?

	Bond length	Bond strength
A.	Increases	increases
B.	Increases	decreases
C.	Decreases	increases
D.	Decreases	decreases

(Total 1 mark)

5. Which of the following is true for CO₂?

	C—O bond	CO₂ molecule
A.	Polar	non-polar
B.	non-polar	polar
C.	Polar	polar
D.	non-polar	non-polar

(Total 1 mark)

6. The molar masses of C₂H₆, CH₃OH and CH₃F are very similar. How do their boiling points compare?

- A. C₂H₆ < CH₃OH < CH₃F
B. CH₃F < CH₃OH < C₂H₆
C. CH₃OH < CH₃F < C₂H₆
D. C₂H₆ < CH₃F < CH₃OH

(Total 1 mark)

7. What is the correct number of each particle in a fluoride ion, ¹⁹F⁻?

	protons	neutrons	electrons
A.	9	10	8
B.	9	10	9
C.	9	10	10
D.	9	19	10

(Total 1 mark)

8. Which statement is correct for the emission spectrum of the hydrogen atom?

- A. The lines converge at lower energies.
B. The lines are produced when electrons move from lower to higher energy levels.



- C. The lines in the visible region involve electron transitions into the energy level closest to the nucleus.
- D. The line corresponding to the greatest emission of energy is in the ultraviolet region.

9. Which is the correct description of polarity in F_2 and HF molecules?

- A. Both molecules contain a polar bond.
- B. Neither molecule contains a polar bond.
- C. Both molecules are polar.
- D. Only one of the molecules is polar.

(Total 1 mark)

10. Which types of bonding are present in CH_3CHO in the liquid state?

- I. Single covalent bonding
 - II. Double covalent bonding
 - III. Hydrogen bonding
- A. I and II only
 - B. I and III only
 - C. II and III only
 - D. I, II and III

(Total 1 mark)

11. Which statement(s) is/are generally true about the melting points of substances?

- I. Melting points are higher for compounds containing ions than for compounds containing molecules.
 - II. A compound with a low melting point is less volatile than a compound with a high melting point.
 - III. The melting point of a compound is decreased by the presence of impurities.
- A. I only
 - B. I and III only
 - C. II and III only
 - D. I, II and III

(Total 1 mark)

12. How many valence electrons are present in an atom of an element with atomic number 16?



- A. 2
- B. 4
- C. 6
- D. 8

(Total 1 mark)

13. A certain sample of element Z contains 60% of ^{69}Z and 40% of ^{71}Z . What is the relative atomic mass of element Z in this sample?

- A. 69.2
- B. 69.8
- C. 70.0
- D. 70.2

(Total 1 mark)

14. What is the difference between two neutral atoms represented by the symbols $^{59}_{27}\text{Co}$ and $^{59}_{28}\text{Ni}$?

- A. The number of neutrons only.
- B. The number of protons and electrons only.
- C. The number of protons and neutrons only.
- D. The number of protons, neutrons and electrons.

(Total 1 mark)

15. How many electrons are there in one $^{24}_{12}\text{Mg}^{+2}$ ion?

- A. 10
- B. 12
- C. 14
- D. 22

(Total 1 mark)

16. The electron arrangement of sodium is 2.8.1. How many occupied main electron energy levels are there in an atom of sodium?

- A. 1
- B. 3
- C. 10
- D. 11



(Total 1 mark)

17. Information is given about four different atoms:

Atom	neutrons	protons
W	22	18
X	18	20
Y	22	16
Z	20	18

Which **two** atoms are isotopes?

- A. W and Y
- B. W and Z
- C. X and Z
- D. X and Y

(Total 1 mark)

18. Which statement is correct about a line emission spectrum?

- A. Electrons absorb energy as they move from low to high energy levels.
- B. Electrons absorb energy as they move from high to low energy levels.
- C. Electrons release energy as they move from low to high energy levels.
- D. Electrons release energy as they move from high to low energy levels.

(Total 1 mark)

19. How many neutrons are there in the ion $^{18}\text{O}^{2-}$?

- A. 8
- B. 10
- C. 16



D. 20

(Total 1 mark)

20. What is the electron arrangement of silicon?

A. 2.4

B. 2.8

C. 2.8.4

D. 2.8.8

(Total 1 mark)

21. Which statement is correct about the isotopes of an element?

A. They have the same mass number

B. They have the same electron arrangement

C. They have more protons than neutrons

D. They have the same numbers of protons and neutrons

(Total 1 mark)

22. What is the difference between two neutral atoms represented by the symbols ${}^{210}_{84}\text{Po}$ and ${}^{210}_{85}\text{At}$?

A. The number of neutrons only.

B. The number of protons and electrons only.

C. The number of protons and neutrons only.

D. The number of protons, neutrons and electrons.

(Total 1 mark)

23. Which statements are correct for the emission spectrum of the hydrogen atom?

I. The lines converge at lower energies.

II. Electron transition to $n=1$ are responsible for lines in the UV region.

III. Lines are produced when electrons move from higher to lower energy levels.

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

(Total 1 mark)



24. What is the symbol for a species that contains 15 protons, 16 neutrons and 18 electrons?

- A. ${}_{16}^{31}\text{S}$
- B. ${}_{16}^{31}\text{S}^{3-}$
- C. ${}_{15}^{31}\text{P}^{-}$
- D. ${}_{15}^{31}\text{P}^{3-}$

(Total 1 mark)

25. What is the electron arrangement of an Al^{3+} ion?

- A. 2, 8
- B. 2, 3
- C. 2, 8, 3
- D. 2, 8, 8

(Total 1 mark)

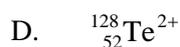
26. What will happen to the volume of a fixed mass of gas if the pressure and the Kelvin temperature are both doubled?

- A. It will remain the same.
- B. It will be double its initial volume.
- C. It will be one-half its initial volume.
- D. It will be four times its initial volume.

(Total 1 mark)

27. Which species has 54 electrons and 52 protons?

- A. ${}_{52}^{128}\text{Te}^{2-}$
- B. ${}_{54}^{132}\text{Xe}^{2+}$
- C. ${}_{54}^{132}\text{Xe}^{2-}$



(Total 1 mark)

28. What is the correct sequence for the processes occurring in a mass spectrometer?

- A. vaporization, ionization, acceleration, deflection
- B. vaporization, acceleration, ionization, deflection
- C. ionization, vaporization, acceleration, deflection
- D. ionization, vaporization, deflection, acceleration

(Total 1 mark)

29. The percentage composition by mass of a hydrocarbon is C = 85.6% and H = 14.4%.

(a) Calculate the empirical formula of the hydrocarbon.

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(2)

(b) A 1.00 g sample of the hydrocarbon at a temperature of 273 K and a pressure of 1.01×10^5 Pa (1.00 atm) has a volume of 0.399 dm^3 .

(i) Calculate the molar mass of the hydrocarbon.

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.....
.....
.....

(2)

(ii) Deduce the molecular formula of the hydrocarbon.

(1)
(Total 5 marks)

30. State the number of protons, electrons and neutrons in the ion ${}_{7}^{15}\text{N}^{3-}$.

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.....

(Total 2 marks)

31. A sample of germanium is analysed in a mass spectrometer. The first and last processes in mass spectrometry are vaporization and detection.

(a) (i) State the names of the other three processes in the order in which they occur in a mass spectrometer.

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(2)

(ii) For each of the processes named in (a) (i), outline how the process occurs.

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(3)

(b) The sample of germanium is found to have the following composition:

Isotope	^{70}Ge	^{72}Ge	^{74}Ge	^{76}Ge
Relative abundance / %	22.60	25.45	36.73	15.22

(i) Define the term *relative atomic mass*.

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(2)

(ii) Calculate the relative atomic mass of this sample of germanium, giving your answer to two decimal places.

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.....
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(2)
(Total 9 marks)

32. Define the following terms.

(i) *atomic number*

.....
.....

(1)

(ii) *mass number*

.....
.....

(1)
(Total 2 marks)

33. State the electron arrangements of the following species:

Si

P^{3-}

(Total 2 marks)

34. Identify the numbers of protons, neutrons and electrons in the species $^{33}_{16}S^{2-}$.

.....
.....

(Total 1 mark)

35. State the electron arrangement for atoms of aluminium, nitrogen and fluorine.

(Total 2 marks)

36. The relative atomic mass of chlorine is 35.45. Calculate the percentage abundance of the two isotopes of chlorine, ^{35}Cl and ^{37}Cl in a sample of chlorine gas.

(Total 2 marks)



37. (a) Describe the following stages in the operation of the mass spectrometer.
- (i) ionization (2)
 - (ii) deflection (2)
 - (iii) acceleration (1)
- (b) (i) State the meaning of the term *isotopes* of an element. (1)
- (ii) Calculate the percentage abundance of the two isotopes of rubidium ^{85}Rb and ^{87}Rb . (2)
- (iii) State **two** physical properties that would differ for each of the rubidium isotopes. (1)
- (iv) Determine the full electron configuration of an atom of Si, an Fe^{3+} ion and a P^{3-} ion. (3)
- (Total 12 marks)**

38. Naturally occurring copper has a relative atomic mass, (A_r), of 63.55 and consists of two isotopes ^{63}Cu and ^{65}Cu .
- (i) Define the term *relative atomic mass*, A_r .
-
-
- (1)
- (ii) State and explain which is the more abundant isotope.
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- (1)
- (Total 2 marks)**

39. The element vanadium has two isotopes, $^{50}_{23}\text{V}$ and $^{51}_{23}\text{V}$, and a relative atomic mass of 50.94.



(a) Define the term *isotope*.

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.....

(1)

(b) State the number of protons, electrons and neutrons in ${}_{23}^{50}\text{V}$.

.....
.....

(2)

(c) State and explain which is the more abundant isotope.

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(1)

(d) State the name and the mass number of the isotope relative to which **all** atomic masses are measured.

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(1)

(Total 5 marks)

40. (a) State a physical property that is different for isotopes of an element.

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(1)

(b) Chlorine exists as two isotopes, ${}^{35}\text{Cl}$ and ${}^{37}\text{Cl}$. The relative atomic mass of chlorine is 35.45. Calculate the percentage abundance of each isotope.

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(2)

(Total 3 marks)

41. (a) Define the term *isotope*.

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(2)



(b) A sample of argon exists as a mixture of three isotopes.

- mass number 36, relative abundance 0.337%
- mass number 38, relative abundance 0.0630%
- mass number 40, relative abundance 99.6%

Calculate the relative atomic mass of argon.

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(2)

(c) State the number of electrons, protons and neutrons in the ion $^{56}\text{Fe}^{3+}$.

electrons: protons: neutrons:

(2)

(Total 6 marks)

42. The element bromine exists as the isotopes ^{79}Br and ^{81}Br , and has a relative atomic mass of 79.90.

(a) Complete the following table to show the numbers of sub-atomic particles in the species shown.

	an atom of ^{79}Br	an ion of $^{81}\text{Br}^-$
protons		
neutrons		
electrons		

(3)

(b) State and explain which of the two isotopes ^{79}Br and ^{81}Br is more common in the element bromine.

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(1)

(c) The element calcium is in the same period of the Periodic Table as bromine.

(i) Write the electron arrangement for an atom of calcium.



..... (1)

(ii) Deduce the formula of the compound calcium bromide.

..... (1)

(Total 6 marks)

43. Some vaporized magnesium is introduced into a mass spectrometer. One of the ions that reaches the detector is $^{25}\text{Mg}^+$.

(a) Identify the number of protons, neutrons and electrons in the $^{25}\text{Mg}^+$ ion.

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..... (1)

(b) State how this ion is accelerated in the mass spectrometer.

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..... (1)

(c) The $^{25}\text{Mg}^{2+}$ ion is also detected in this mass spectrometer by changing the magnetic field. Deduce and explain, by reference to the m/z values of these two ions of magnesium, which of the ions $^{25}\text{Mg}^{2+}$ and $^{25}\text{Mg}^+$ is detected using a stronger magnetic field.

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..... (2)
(Total 4 marks)

44. (a) List the following types of electromagnetic radiation in order of **increasing** wavelength (shortest first).

I. Yellow light

II. Red light

III. Infrared radiation

IV. Ultraviolet radiation

..... (1)



(b) Distinguish between a continuous spectrum and a line spectrum.

.....
.....
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(1)

(c) The thinning of the ozone layer increases the amount of UV-B radiation that reaches the Earth's surface.

Type of Radiation	Wavelength / nm
UV-A	320–380
UV-B	290–320

Based on the information in the table above explain why UV-B rays are more dangerous than UV-A.

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(3)

(Total 5 marks)