ICSE CLASS 10 CHEMISTRY – PRACTICE PAPER

STEP-BY-STEP SOLUTIONS AND MARKING SCHEME

Chapter 1: Periodic Table, Periodic Properties and Variations of Properties | Maximum Marks: 40

SECTION A (20 Marks)

Question 1 [8 × 1 = 8]

Part	Ans	Step-by-step reasoning
(i)	(b)	Configuration 2, 8, 3 has **3 shells** → Period 3. It has **3 valence electrons** → Group 13 (old notation IIIA). It loses 3 electrons to form a positive ion, so it is a metal (aluminium).
(ii)	(a)	Across a period atomic size decreases as nuclear charge increases, so Na > Mg > Al > Si. In (b) and (c) the order is reversed. In (d) size increases down a group, so Li < Na < K < Rb.
(iii)	(c)	Atomic number 9 is 2, 7 and atomic number 17 is 2, 8, 7. Both have **7 valence electrons** (group 17, halogens), hence similar properties.
(iv)	(d)	Atomic radius falls from W (112 pm) to Z (70 pm), so Z is the right-most element, with the greatest nuclear charge and the smallest size. Electronegativity increases across a period, so Z has the highest.
(v)	(b)	Na, Mg and Cl are in period 3, and ionisation energy increases from left to right, so Cl > Mg > Na. K is below Na in group 1, so its I.E. is lower than that of Na. Hence Cl is highest.
(vi)	(a)	(A) is true: nuclear charge increases while the number of shells stays the same, so the outer shell is pulled in. (R) is false: the number of shells remains the same across a period.
(vii)	(d)	2, 8, 8, 2 has **4 shells** → Period 4 and **2 valence electrons** → Group 2 (calcium). It is below magnesium in group 2, so it is larger and loses electrons more easily, i.e. more reactive.
(viii)	(c)	Li 1, Be 2, B 3, C 4, N 8−5 = 3, O 8−6 = 2, F 8−7 = 1, Ne 0. Valency rises to 4 at group 14 and then falls to 0: 1, 2, 3, 4, 3, 2, 1, 0.

Question 2 [3 + 3 = 6]

(i) **[3 × 1]**

(a) **shells** – the number of shells present in an atom determines its period (e.g. sodium 2, 8, 1 has three shells, so it is in period 3).

(b) **increases** – nuclear charge increases and atomic size decreases across a period, so the atom attracts the shared pair more strongly.

(c) **amphoteric** – Al_2O_3 reacts with both acids and bases. Across period 3 the oxides change from basic (Na_2O, MgO) through amphoteric (Al_2O_3) to acidic.

(ii) **[3 × 1]**

(a) energy released on gaining an electron = **2. Electron affinity**

(b) tendency to attract the shared pair of electrons = **1. Electronegativity**

(c) energy needed to remove an electron = **3. Ionisation potential**

Atomic radius (4) is the extra option and is not matched.

Question 3 [3 + 3 = 6]

(i) **[3 × 1]**

(a) X has 12 protons, so 12 electrons arranged as 2, 8, 2. It has **3 shells** and **2 valence electrons**. Answer: **Group 2, Period 3** (this is magnesium).

(b) Mass number = protons + neutrons = 9 + 10 = **19** (Y has the configuration 2, 7, so it is fluorine).

(c) X loses 2 electrons and forms X^{2+} (valency 2). Y has 7 valence electrons and gains 1 electron to form Y^{-} (valency 1). Cross-multiplying the valencies gives the formula $\mathbf{XY_2}$.

(ii) **[3 × 1]**

(a) An anion is formed by the **gain** of electrons, so the number of electrons becomes more than the number of protons. The effective nuclear pull on each electron decreases and the electron–electron repulsion increases, so the electron cloud expands. Example: Cl (2, 8, 7) + e^{-} → Cl^{-} (2, 8, 8); Cl^{-} is larger than Cl.

(b) Alkali metals have **one** valence electron and a large atomic size, so they lose it very easily. A substance that loses electrons readily is a strong reducing agent.

(c) Valency is the number of electrons an atom loses, gains or shares. Group 1 atoms have 1 valence electron, so they **lose 1 electron** (valency 1). Group 17 atoms have 7 valence electrons, so they **gain 1 electron** (valency 8 − 7 = 1).

SECTION B (20 Marks)

Question 4 [4 + 3 + 3 = 10]

Decoding the table: Period 2 is Li–Ne and Period 3 is Na–Ar, so A = group 1, B = group 2, C = group 13, D = 14, E = 15, F = 16, G = 17, H = 18 (period 2), and I–P are the same groups in period 3. Q is group 1, period 4.

(i) **[4 × 1]**

(a) Electronegativity increases across a period and decreases down a group, so it is highest at the top right (excluding the inert gases): **G** (group 17, period 2).

(b) Ionisation energy is lowest for the group 1 element, which has the largest size in the period: **I**.

(c) Group 15 elements are E (period 2) and M (period 3). Three shells means period 3, so **M**.

(d) The element of group 13 in period 3, aluminium, forms the amphoteric oxide Al_2O_3: **K**.

(ii) **[3]**

(a) I is in group 1 (valency 1, loses 1 electron) and O is in group 17 (valency 1, gains 1 electron). Formula: **IO**. Type of bond: **ionic (electrovalent) bond**, as I^+ and O^- are formed. [2]

(b) A (period 2, group 1) and B (period 2, group 2): metallic character decreases from left to right, so A is more metallic than B. I is in the same group as A but below it, and metallic character increases down a group. Order: **B < A < I**. [1]

(iii) **[3]**

(a) **Q** reacts more vigorously. Q and I are both in group 1, but Q is below I, so Q has a larger atomic size. Its valence electron is farther from the nucleus and is lost more easily (lower ionisation energy), which makes Q more reactive. [2]

(b) N is in group 16, so it has **6 valence electrons**. Valency = 8 − 6 = **2**. [1]

Question 5 [4 + 3 + 3 = 10]

(i) **[4]**

(a) The highest point of the graph is at atomic number 10 (about 2080 kJ mol^{-1}): **neon**. [1]

(b) In period 3 (atomic numbers 11–18) the lowest point is at atomic number 11 (about 496 kJ mol^{-1}): **sodium**. [1]

(c) Neon (2, 8) is the last element of period 2, and sodium (2, 8, 1) starts a **new shell**. The outermost electron of sodium is much farther from the nucleus, so the atomic size is larger and the nuclear pull on this electron is much smaller. Less energy is needed to remove it, so the I.E. falls sharply. [2]

(ii) **[3 × 1]**

(a) The energy required to remove an electron from a neutral isolated gaseous atom and convert it into a positively charged gaseous ion.

(b) $Na(g) + I.E. \rightarrow Na^+(g) + e^-$

(c) kilojoule per mole (kJ mol^{-1}). It is also written as electron volt per atom (eV/atom).

(iii) **[3]**

(a) Reading the values from the graph: Na ≈ 496, Si ≈ 786, Cl ≈ 1256, Ar ≈ 1520 kJ mol^{-1}. Increasing order: **Na < Si < Cl < Ar**. [1]

(b) **Atomic size** – the larger the atomic size, the lower the ionisation energy, since the outer electrons are farther from the nucleus and held less firmly. **Nuclear charge** – the greater the nuclear charge, the higher the ionisation energy, since the outer electrons are held more firmly. [2]

Question 6 [4 + 3 + 3 = 10]

(i) **[4 × 1]**

(a) X (atomic number 19) = **2, 8, 8, 1**; Y (atomic number 35) = **2, 8, 18, 7**.

(b) X has 4 shells and 1 valence electron: **Group 1, Period 4**. Y has 4 shells and 7 valence electrons: **Group 17, Period 4**.

(c) X loses 1 electron to form X^+, and Y gains 1 electron to form Y^-. Formula: **XY** (potassium bromide, KBr). The bond is **ionic (electrovalent)**.

(d) **X** has the larger atomic size. Both are in the same period (4 shells), but the nuclear charge increases from left to right (19 for X, 35 for Y), so the outer shell of Y is pulled closer to the nucleus.

(ii) **[3 × 1]**

From the diagram: electrons = 2 + 8 + 1 = 11, three shells, and the nucleus contains 12 neutrons.

(a) For a neutral atom, atomic number = number of protons = number of electrons = **11**.

(b) Mass number = protons + neutrons = 11 + 12 = **23**.

(c) Three shells → **Period 3**; one valence electron → **Group 1** (A is sodium, an alkali metal).

(iii) **[3 × 1]**

Write one difference for each point:

Point	Alkali metals (group 1)	Halogens (group 17)
(a) Nature	Metals	Non-metals
(b) Tendency and behaviour	Lose their 1 valence electron to form M^+; strong **reducing** agents	Gain 1 electron to form X^-; strong **oxidising** agents
(c) Reactivity down the group	Increases (e.g. Cs is more reactive than Li)	Decreases (e.g. F is more reactive than I)

Marks summary	Section A: Q1 = 8, Q2 = 6, Q3 = 6 → **20** | Section B: any two of Q4, Q5, Q6 at 10 each → **20** | Total = **40**