08 The Periodic Table and Periodicity

Set B Competition Practice

Name | Time **45 minutes** | Total **24 marks** | Score ____ / 24

Marks by notes section For the marker: total each row. A score below the target means that section of the notes needs revising.

Notes section	Questions	Marks	Target	Score
2 Trends in Atomic Properties	1, 2, 3, 4	4	3	
3 The Period 3 Elements	5, 6	2	2	
4 Oxides and Chlorides of Period 3	7, 8, 9, 10, 11, 12, 13, 14, 15, 16	10	6	
6 Group 2	17, 18, 19	3	2	
7 Group 17: The Halogens	20, 21	2	2	
9 The Reactivity Series	22, 23	2	2	
10 Corrosion and Its Prevention	24	1	1	

A Competition questions

24 MARKS

1 The table gives the successive ionisation energies, in kJ mol^{-1}, of five elements in Period 3.

element	IE_1	IE_2	IE_3	IE_4	IE_5
V	787	1577	3231	4356	16091
W	738	1451	7733	10540	13630
X	1251	2297	3822	5158	6540
Y	496	4562	6912	9543	13353
Z	578	1817	2745	11575	14830

Based on this information, which of the following statements is false?

A W is an alkaline earth metal.

B Y is sodium.

C Z forms the largest cation.

D X has the smallest radius.

/1

Answer ☐ [1]

Source: 2023 SJChO P1 Q38

2 The first eight ionisation energies of an element Q in kJ mol^{-1} are 966, 1950, 2730, 4850, 6020, 12 300, 15 400 and 18 900. Which of the following statements about element Q is correct?

A It can form a basic oxide.

B It can form a chloride with the formula QCl_5.

C It has an even number of protons in its atom.

D It can form a chloride that is trigonal planar in shape.

/1

Answer ☐ [1]

Source: 2021 SAJC J2 Prelim P1 Q2

3 Which statement best explains why the second ionisation energy of sodium is higher than that of magnesium?

A Magnesium has more protons than sodium.

B Sodium has a complete octet but magnesium does not.

C The ionic radius of Na^+ is larger than that of Mg^+.

D The electron to be removed from sodium is closer to the nucleus.

/1

Answer ☐ [1]

2018 RVHS J1 Common Test P1 Q4

4 Rubidium and bromine form ions that are isoelectronic. Which statements are correct?

1 The ionic radius of rubidium is smaller than its atomic radius.
2 The ionic radius of bromine is larger than its atomic radius.
3 The ionic radius of bromine is smaller than that of rubidium.

A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

/1

Answer ☐ [1]

2022 NJC J2 Prelim P1 Q6

5 Which statement about the Period 3 elements and their oxides is **false**?

A The pH of the oxides in water decreases across the period.

B The melting points of the elements decrease across the period.

C The covalent character of the oxides increases across the period.

D The maximum oxidation state of the elements increases across the period.

/1

Answer ☐ [1]

2020 SAJC J2 Prelim P1 Q14

6 P, Q, R and S are elements in Period 3.

The oxide of P dissolves in water to give a solution with pH less than 7.
The oxide of Q has a giant covalent structure.
Element R is a metal which floats on water.
Element S is used to fill light bulbs.

Which arranges the four elements in order of increasing proton number?

A R, Q, P, S
B R, P, Q, S
C S, Q, P, R
D S, P, Q, R

/1

Answer [1]

2024 Woodlands O Prelim P1 Q23

7 What is the order of the pH of the solutions formed when these oxides are added to water?

	lowest pH			highest pH
A	SO_3	SiO_2	MgO	Na_2O
B	Na_2O	MgO	SiO_2	SO_3
C	MgO	SiO_2	SO_3	Na_2O
D	SO_3	Na_2O	MgO	SiO_2

A row A
B row B
C row C
D row D

/1

Answer [1]

2019 HCI J2 Prelim P1 Q27

8 Which statement does **not** describe the chemical properties of Period 3 compounds?

A SiO_2 is formed from the hydrolysis of $SiCl_4$.
B Al_2O_3 is soluble in both acid and base.
C Equal amounts of Na_2O and SO_3 can be mixed in water to give a neutral solution.
D The acidity of the Period 3 chlorides in water decreases from NaCl to PCl_5.

/1

Answer [1]

2019 NJC J2 Prelim P1 Q15

9 The oxides of four Period 3 elements W, X, Y and Z behave as follows.

The oxide of W is insoluble in water and in dilute HCl, but dissolves in concentrated NaOH.
The oxide of X is insoluble in water but dissolves in both dilute HCl and dilute NaOH.
The oxide of Y dissolves in dilute NaOH at room temperature.
The oxide of Z dissolves in water to form a solution of pH 13.

What is the order of increasing atomic number?

A Z, X, W, Y
B Y, W, X, Z
C W, X, Y, Z
D Z, Y, W, X

/1

Answer [1]

2019 NYJC J2 MYE P1-P3 Q16

10 X, Y and Z are in Period 3. The oxide of X gives a solution of pH less than 7. The oxide of Y reacts with both strong acids and strong alkalis. The oxide of Z gives a strongly alkaline solution. What is the order of increasing atomic radius?

A X < Y < Z **B** X < Z < Y **C** Y < Z < X **D** Z < Y < X

Answer [1]

/1

2019 SAJC J2 Prelim P1 Q19

11 Four elements with atomic numbers 11 to 17 have these properties.

The chloride of E dissolves in water and turns moist blue litmus red.
The oxide of F is amphoteric.
G has the lowest electronegativity of the four.
H has the smallest atomic radius.

What is the order of increasing atomic number?

A F, G, H, E **B** F, G, E, H **C** G, F, E, H **D** G, F, H, E

Answer [1]

/1

2019 CJC J2 Prelim P1 Q14

12 Element X is in Period 3. Three of these statements about X or its compounds are correct and one does not fit. Which statement does **not** fit?

A X is a solid at room temperature which conducts electricity.

B The chloride of X reacts with water to give an acidic solution.

C The oxide of X reacts with water to give an acidic solution.

D Adding NaOH(aq) to the solution from XCl_3 and water gives a white precipitate, soluble in excess NaOH(aq).

Answer [1]

/1

2021 CJC J2 Prelim P1 Q9

13 Element G is one of the first five elements in Period 3. Three of these statements about G or its compounds are correct and one is false. Which statement does not fit?

A The oxide of G dissolves in excess dilute NaOH(aq).

B G has only one oxidation number in its chloride, which is not a solid at room temperature.

C The oxide of G has a very high melting point.

D The chloride of G reacts with water to give an acidic solution of pH 2.

Answer [1]

/1

2021 TMJC J2 Prelim P1 Q6

14 Element Z is in Period 3. Its oxide has a giant molecular structure and its chloride is a simple molecule. Which statements are correct?

1 Element Z is a solid at room temperature.
2 The oxide of Z reacts with water to give an acidic solution.
3 Z forms two chlorides with different oxidation states.

A 1 only **B** 1 and 3 only **C** 2 and 3 only **D** 1, 2 and 3

/1

Answer [1]

2021 YIJC J2 Prelim P1 Q29

15 Element Y in Period 3 is a metalloid and semiconductor, and its chloride reacts with water to form an acidic solution. Element X has an atomic number one less than Y. What is a property of the oxide of X?

A It is covalent. **B** It is amphoteric. **C** Its formula is XO_2. **D** It is a gas at room temperature.

/1

Answer [1]

2023 HCI J2 Prelim P1 Q27

16 M, N and O are in the same period. The oxide of M reacts with water to form a solution of pH less than 7. The oxide of N reacts with water to form a solution that turns damp red litmus blue. The oxide of O dissolves in both hydrochloric acid and aqueous sodium hydroxide. What is the order of increasing proton number?

A M, N, O **B** M, O, N **C** N, O, M **D** O, N, M

/1

Answer [1]

2024 BBSS O Prelim P1 Q20

17 Which statement is **not** true of the trends of the Group 2 elements and their compounds?

A Their melting points generally decrease down the group.
B The reducing power of the elements decreases down the group.
C They react with water to give solutions that are increasingly alkaline.
D Heating their nitrates and carbonates strongly produces a white solid and an acidic gas.

/1

Answer [1]

2018 NYJC J2 MYE P1-P3 Q17

18 Which property generally increases down Group 2?

A charge density of the M^{2+} ion **B** electronegativity **C** melting point **D** thermal stability of the carbonate

/1

Answer [1]

2021 CJC J2 Prelim P1 Q10

19 The Group 2 metals have higher melting points than the Group 1 metals. Which factors could contribute?

1 There are smaller distances between atoms in the metallic lattices of the Group 2 metals.
2 Two valence electrons from each Group 2 atom are available for bonding in the lattice.
3 The Group 2 metals have the higher first ionisation energy.

A 1, 2 and 3 **B** 1 and 2 only **C** 2 and 3 only **D** 1 only

/1

Answer [1]

2023 ACJC J2 Prelim P1 Q4

20 Which statement about the Group 17 elements and their compounds is **incorrect**?

A When aqueous sodium chloride is added to aqueous bromine, the orange solution is decolourised.

B When aqueous silver nitrate is added to aqueous sodium chloride followed by nitric acid, a white precipitate remains.

C When aqueous chlorine is added to excess sodium thiosulfate, followed by barium nitrate, a white precipitate forms.

D When chlorine gas is bubbled through potassium iodide, the solution turns brown.

/1

Answer [1]

2022 TJC J2 Prelim P1 Q9

21 X is a Group 1 metal more reactive than sodium. Y and Z are Group 17 elements. X reacts with Y to form a salt. A solution of this salt reacts with Z to form a different salt. What are X, Y and Z?

	X	Y	Z
A	K	Cl_2	I_2
B	Li	Cl_2	Br_2
C	Li	Br_2	Cl_2
D	K	I_2	Cl_2

A row A **B** row B **C** row C **D** row D

/1

Answer [1]

2024 Greendale O Prelim P1 Q23

22 Metals Q, R, S and T form cations Q^{2+}, R^{2+}, S^{+} and T^{2+}. Solid Q placed in a solution of T^{2+} becomes coated with T. Solid Q does not react with a solution of R^{2+}. Only the carbonate of S does not decompose on heating. T reacts with hydrochloric acid to give hydrogen. What is the order of decreasing reactivity?

A R, Q, T, S **B** S, R, Q, T

C S, T, Q, R **D** T, Q, R, S

/1

Answer [1]

2024 Zhonghua O Prelim P1 Q28

23 The table shows three metals and how each is extracted.

metal	method of extraction
P	reduction of the ore by carbon
Q	electrolysis
R	mined from the ground as the metal

Which statement is true?

A Metal Q is high up in the reactivity series.

B Metal R is most likely above hydrogen in the reactivity series.

C Metal R is the most reactive of the three metals.

D The oxide of P is the most stable of the three oxides.

/1

Answer ☐ [1]

2024 QTSS O Prelim P1 Q25

24 A warship had its hull plated with copper. After two years at sea, the iron parts in contact with the copper plates were more corroded than normal. What is the best explanation?

A Copper acts as a catalyst to speed up corrosion.

B Copper reacts with the iron to increase corrosion.

C Iron displaces copper to form iron(III) oxide.

D Iron is more reactive and corrodes in place of copper.

/1

Answer ☐ [1]

2024 VS O Prelim P1 Q29

10 The Periodic Table of Elements

Group																	
1	2											13	14	15	16	17	18
							1 H hydrogen 1.0										2 He helium 4.0
3 Li lithium 6.9	4 Be beryllium 9.0		**Key** atomic number atomic symbol name relative atomic mass									5 B boron 10.8	6 C carbon 12.0	7 N nitrogen 14.0	8 O oxygen 16.0	9 F fluorine 19.0	10 Ne neon 20.2
11 Na sodium 23.0	12 Mg magnesium 24.3	3	4	5	6	7	8	9	10	11	12	13 Al aluminium 27.0	14 Si silicon 28.1	15 P phosphorus 31.0	16 S sulfur 32.1	17 Cl chlorine 35.5	18 Ar argon 39.9
19 K potassium 39.1	20 Ca calcium 40.1	21 Sc scandium 45.0	22 Ti titanium 47.9	23 V vanadium 50.9	24 Cr chromium 52.0	25 Mn manganese 54.9	26 Fe iron 55.8	27 Co cobalt 58.9	28 Ni nickel 58.7	29 Cu copper 63.5	30 Zn zinc 65.4	31 Ga gallium 69.7	32 Ge germanium 72.6	33 As arsenic 74.9	34 Se selenium 79.0	35 Br bromine 79.9	36 Kr krypton 83.8
37 Rb rubidium 85.5	38 Sr strontium 87.6	39 Y yttrium 88.9	40 Zr zirconium 91.2	41 Nb niobium 92.9	42 Mo molybdenum 95.9	43 Tc technetium –	44 Ru ruthenium 101.1	45 Rh rhodium 102.9	46 Pd palladium 106.4	47 Ag silver 107.9	48 Cd cadmium 112.4	49 In indium 114.8	50 Sn tin 118.7	51 Sb antimony 121.8	52 Te tellurium 127.6	53 I iodine 126.9	54 Xe xenon 131.3
55 Cs caesium 132.9	56 Ba barium 137.3	57–71 lanthanoids	72 Hf hafnium 178.5	73 Ta tantalum 180.9	74 W tungsten 183.8	75 Re rhenium 186.2	76 Os osmium 190.2	77 Ir iridium 192.2	78 Pt platinum 195.1	79 Au gold 197.0	80 Hg mercury 200.6	81 Tl thallium 204.4	82 Pb lead 207.2	83 Bi bismuth 209.0	84 Po polonium –	85 At astatine –	86 Rn radon –
87 Fr francium –	88 Ra radium –	89–103 actinoids	104 Rf rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 Ds darmstadtium –	111 Rg roentgenium –	112 Cn copernicium –	113 Nh nihonium –	114 Fl flerovium –	115 Mc moscovium –	116 Lv livermorium –	117 Ts tennessine –	118 Og oganesson –

lanthanoids	57 La lanthanum 138.9	58 Ce cerium 140.1	59 Pr praseodymium 140.9	60 Nd neodymium 144.2	61 Pm promethium –	62 Sm samarium 150.4	63 Eu europium 152.0	64 Gd gadolinium 157.3	65 Tb terbium 158.9	66 Dy dysprosium 162.5	67 Ho holmium 164.9	68 Er erbium 167.3	69 Tm thulium 168.9	70 Yb ytterbium 173.1	71 Lu lutetium 175.0
actinoids	89 Ac actinium –	90 Th thorium 232.0	91 Pa protactinium 231.0	92 U uranium 238.0	93 Np neptunium –	94 Pu plutonium –	95 Am americium –	96 Cm curium –	97 Bk berkelium –	98 Cf californium –	99 Es einsteinium –	100 Fm fermium –	101 Md mendelevium –	102 No nobelium –	103 Lr lawrencium –