05 The Periodic Table

Set B Exam practice

Name | Time 1 hour | Total 33 marks | Score ____ / 33

A Data Booklet may be used.

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 Atomic and Ionic Radius	8	2	2	
4 First Ionisation Energy	9(a)	3	2	
5 Melting Point across Period 3	9(b)	2	2	
7 Group 2 Elements	10	5	3	
8 Oxides of Period 3	5(a)(ii), 5(a)(iii), 5(b)	8	5	
9 Chlorides of Period 3	3, 4	4	3	
10 Group 17: The Halogens	6	3	2	
11 Hydrogen Halides	7	3	2	
12 Deducing and Predicting	1, 2, 5(a)(i)	3	2	

A Multiple choice

3 MARKS

1 W, X, Y and Z are four consecutive elements in Period 3, but not necessarily in the order presented.

- The chloride of W dissolves in water and turns blue litmus red.
- X is a good conductor of electricity but is insoluble in water.
- The oxide of Y has the highest melting point.
- Z has the highest first ionisation energy and largest ionic radius.

Which of the following is the correct sequence of the four elements in order of increasing atomic number?

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

Answer ☐ [1]

/1

Source: NYJC 2018 Prelim P1 Q14, via EJC 2022 The Periodic Table Topical Revision, Q5

2 COMMON Four elements with atomic numbers from 11 to 17 inclusive have the following 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 among these four elements.
- H has the smallest atomic radius.

Which of the following is the correct sequence of the four elements in 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

Source: CJC 2019 Prelim P1 Q14, via EJC 2022 The Periodic Table Topical Revision, Q7

3 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 Equimolar amounts of Na_2O and SO_3 can be mixed in water to give a pH neutral solution.

D The acidity of Period 3 chlorides in water decreases from NaCl to PCl_5.

Answer [1]

/1

Source: NJC 2019 Prelim P1 Q15, via EJC 2022 The Periodic Table Topical Revision, Q11

B Structured questions

30 MARKS

4 COMMON Describe the reactions, if any, of the chlorides NaCl, $AlCl_3$ and PCl_5 with water. Write an equation for any reaction and state the pH of the resultant mixtures.

[3]

/3

Source: 2024 DHS J2 Prelim P3 Q2(a)

5 Elements E and F are Period 3 elements.

(a)(i) E is a white solid with a melting point of 317 K. When exposed to air, it reacts spontaneously, producing a white powder of empirical formula E_2O_5. E_2O_5 readily undergoes neutralisation with aqueous NaOH to form a salt and water. From these observations, deduce the identity of E.

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..... **[1]**

(ii) Based on your deduced identity of E, describe the above reactions using only equations with state symbols.

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..... **[2]**

(iii) With the aid of an equation, suggest and account for a pH value for the resultant solution when the oxide of E dissolves in water.

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..... **[2]**

(b) Element F forms an oxide readily in air. The oxide formed has an acid–base behaviour similar to that of magnesium oxide, MgO, on one hand, and phosphorus(V) oxide, P_4O_{10}, on the other. Describe what these similarities are and explain why the oxide of F occupies the in-between position. Write equations for all the reactions you choose to illustrate your answer.

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..... **[4]**

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Source: SRJC 2011 P2 Q5(a) and (b) (modified), via EJC 2022 JC1 The Periodic Table Tutorial, Q2

6 When chromium is made to react with chlorine, the main product of the reaction is $CrCl_3$. However, when chromium is made to react separately with fluorine and with iodine, the main products are CrF_4 and CrI_2. By reference to the Data Booklet, what can you conclude about the relative oxidising ability of the halogens?

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Source: VJC 2016 Prelim P3, via EJC 2022 JC1 The Periodic Table Tutorial, Q8

7 Hydrogen halides can be unstable to heat.

(a) Write an equation, including state symbols, for the reaction undergone on heating hydrogen iodide, HI.

..... **[1]**

(b) In an experiment, four glass jars were filled with different hydrogen halide gases. A red hot wire was inserted into each jar for a fixed period of time. The observations were recorded in the table.

gas in glass jar	observations
hydrogen chloride	no observable change
hydrogen bromide	reddish brown vapour formed slowly
hydrogen iodide	purple fumes evolved vigorously
hydrogen astatide	?

Based on the data, predict the observations for hydrogen astatide and explain the trend observed.

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..... **[2]**

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Source: ACJC 2018 Prelim P3 (modified), via EJC 2022 JC1 The Periodic Table Tutorial, Q9

8 The atomic radius of potassium is 0.243 nm and that of calcium is 0.197 nm. Explain why the atomic radius of calcium is less than that of potassium.

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..... **[2]**

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Source: 2023 SAJC J2 Prelim P2 Q2(a)(i)

9 This question is about phosphorus.

(a) COMMON With reference to relevant electronic configurations where necessary, explain why the first ionisation energy of phosphorus is higher than those of the elements that come immediately before and after it in Period 3.

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..... **[3]**

(b) COMMON With reference to structure and bonding, explain why the melting point of phosphorus is lower than those of the elements that come immediately before and after it in Period 3.

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Source: 2024 CJC J2 Prelim P2 Q2(a) and (b)

10 CHALLENGE Magnesium nitrate and barium nitrate decompose similarly on heating.

(a) Write a balanced equation for the decomposition of magnesium nitrate.

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(b) There is a noticeable difference in the temperature for decomposition of these two nitrates. Which of these nitrates decomposes at a lower temperature? Explain your answer.

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Source: RI(JC) H2 Chemistry Tutorial 22 (Group II), Q4(a) and (b)