05 The Periodic Table

Set A Foundations

Name	Time 1 hour	Total 32 marks	Score ____ / 32

A Data Booklet may be used.

A From the lesson

10 MARKS

1 COMMON Arrange in order of increasing radius: Mg^{2+}, Na^{+}, F^{-}, O^{2-}. Explain.

[2]

/2

Source: Learners' Alley, The Periodic Table slides

2 How would barium react with cold water compared with calcium?

[2]

/2

Source: Learners' Alley, The Periodic Table slides

3 Why is Na^{+} smaller than Na?

[1]

/1

Source: Learners' Alley, The Periodic Table slides

4 COMMON Write the equation for $SiCl_4$ with water. What is the pH?

[2]

/2

Source: Learners' Alley, The Periodic Table slides

5 Why is $BaCO_3$ more thermally stable than $MgCO_3$?

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

/2

Source: Learners' Alley, The Periodic Table slides

6 Will Br_2 displace Cl^- from aqueous NaCl?

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

/1

Source: Learners' Alley, The Periodic Table slides

B Practice

22 MARKS

7 Element J is in Period 3 of the Periodic Table. The following three statements are properties of element J or its compounds.

- Adding NaOH(aq) to the solution resulting from the reaction of a chloride of J with water produces a white precipitate which is soluble in an excess of NaOH(aq).
- Element J is a solid at room temperature.
- The oxide of element J is soluble in hydrochloric acid.

What is the identity of element J?

A magnesium **B** aluminium **C** silicon **D** phosphorus

Answer [ ] **[1]**

/1

Source: IJC 2018 Prelim P1 Q29, via EJC 2022 The Periodic Table Topical Revision, Q4

8 COMMON What is the correct order of the pH of the resulting solutions when the oxides below are added to water, from lowest pH to 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

Answer [ ] **[1]**

/1

Source: HCI 2019 Prelim P1 Q27, via EJC 2022 The Periodic Table Topical Revision, Q9

9 COMMON The structures of Period 3 oxides can be simple or giant, and their bonding can be covalent or ionic. Use these terms to describe the structure and bonding in each of the oxides W, X, Y and Z. Explain your reasoning in each case.

oxide	melting point / °C	electrical conductivity when molten	reaction with H_2O	resulting pH
W	2850	good	very little	8
X	1720	poor	none	7
Y	1280	good	exothermic	14
Z	580	poor	exothermic	1

[4]

/4

Source: A Level 2007 and 2013 P3 (adapted), via EJC 2022 JC1 The Periodic Table Tutorial, Q1(a)

10 COMMON The pH values of 1.0 mol dm^{-3} solutions of three Period 3 chlorides are NaCl 7.0, $MgCl_2$ 6.5 and $AlCl_3$ 3.0.

(a) By using suitable data from the Data Booklet, suggest explanations for the pH values of the chloride solutions. Include appropriate equations in your answer.

[3]

(b) Describe the reactions, if any, of the chlorides $SiCl_4$ and PCl_5 with water. Include the approximate pH value of any resulting solutions, and write equations for any reactions that occur.

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/5

Source: A Level June 1997 (adapted), via EJC 2022 JC1 The Periodic Table Tutorial, Q4(a)(i) and (b)

11 The same amounts of $MgCO_3$ and $BaCO_3$ were heated separately, and the gas given off was bubbled through a solution X. The time taken for a white precipitate to be observed in X was 3 minutes for $MgCO_3$ and 9 minutes for $BaCO_3$.

(a) Write an equation, with state symbols, for the thermal decomposition of barium carbonate.

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

(b) State the identity of X and explain the above observations.

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

/4

Source: NJC 2011 P3 Q1(d) (modified), via EJC 2022 JC1 The Periodic Table Tutorial, Q6

12 CHALLENGE Explain each of the following observations in terms of structure and bonding.

(a) Beryllium chloride (boiling point 547 °C) is much more volatile than magnesium chloride (boiling point 1418 °C).

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(b) Beryllium oxide is amphoteric, but the oxides of all the other alkaline earth metals are basic.

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

/7

Source: RI(JC) H2 Chemistry Tutorial 22 (Group II), Q1(b) and (c)