**Chemistry**

**Higher level**

**Paper 2**

Practice paper

**Topic: Periodicity (Topic 3 and 13 Subset)**

**1.** The concept of periodicity is central to the organization of the periodic table.

(a) Write the equation for the SECOND ionization energy of Nitrogen. Include state symbols. **[1]**

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(b) Explain why the second ionization energy of any element is always greater than the first. **[2]**

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**2.** Electron affinity trends provide insight into atomic structure.

(a) Write the equation for the first electron affinity of Oxygen. **[1]**

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(b) Suggest why the first electron affinity of Fluorine is less exothermic than that of Chlorine, despite Fluorine being more electronegative. **[2]**

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**3.** Successive electron affinities:

(a) Write the equation for the SECOND electron affinity of Oxygen. **[1]**

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(b) Explain why this process ($O^- \rightarrow O^{2-}$) is endothermic. **[2]**

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**4.** Write balanced chemical equations for the following reactions of Period 3 oxides:

(a) Diphosphorus pentoxide ($P_4O_{10}$) with water. **[1]**

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(b) Magnesium oxide with water. **[1]**

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(c) Sulfur dioxide with water. **[1]**

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**5.** Melting points across Period 3 reach a maximum at Silicon and then decrease sharply.

(a) Describe the bonding in Silicon and Phosphorus. **[2]**

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(b) Explain why the melting point of Sulfur ($S_8$) is higher than that of Phosphorus ($P_4$). **[2]**

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**6.** Explain the significant increase in ionic radius from Silicon ($Si^{4+}$) to Phosphorus ($P^{3-}$). **[3]**

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**7.** Identify the elements in Period 2 that show an exception to the general increase in first ionization energy across the period. **[2]**

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**8.** $Al_2O_3$ is amphoteric.

(a) Deduce the species formed when $Al_2O_3$ reacts with excess Sodium Hydroxide. **[1]**

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**9.** An element Y has the following successive IEs (kJ $mol^{-1}$): 1012, 1907, 2914, 4963, 6273, 21267... Determine Y's group and block. **[2]**

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**10.** Define shielding effect and explain how it affects the first ionization energy down Group 1. **[3]**

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