HL Paper 1

Which species has the electron configuration of $1s^2 2s^2 2p^6 3s^2 3p^6 3d^8$?

A. Ni

B. Ni^{2+}

C. Fe

D. Cu^{2+}

Markscheme

B

Examiners report

[N/A]

Which statements are correct for the alkali metals Li to Cs?

I. Melting point increases

II. First ionization energy decreases

III. Ionic radius increases

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

Markscheme

C

Examiners report

[N/A]

Which series is arranged in order of **increasing** radius?

A. $\mathrm{F} < \mathrm{Cl}^- < \mathrm{Cl}$

B. $\mathrm{Rb} < \mathrm{K} < \mathrm{Na}$

C. $\mathrm{Al}^{3+} < \mathrm{Mg}^{2+} < \mathrm{Na}^+$

D. $\mathrm{I}^- < \mathrm{Br}^- < \mathrm{Cl}^-$

Markscheme

C

Examiners report

[N/A]

What is the correct electron configuration of the Cu^+ ion?

A. $[\mathrm{Ar}]\ 3\mathrm{d}^9\ 4\mathrm{s}^1$

B. $[\mathrm{Ar}]\ 3\mathrm{d}^7\ 4\mathrm{s}^2$

C. $[\mathrm{Ar}]\ 3\mathrm{d}^{10}$

D. $[\mathrm{Ar}]\ 3\mathrm{d}^8\ 4\mathrm{s}^1$

Markscheme

C

Examiners report

One respondent stated that the question should not have been asked, as students are not supposed to know the Cu exception. In the teacher's notes of assessment statement 12.1.6 in the syllabus details it is clearly stated "exceptions to the principle for copper and chromium should be known". 56.49% of the candidates chose the correct answer C, with 30.78% choosing A which means that about one-third of the schools do not teach these two exceptions.

What is the definition of electronegativity?

A. The relative measure of the tendency of an atom when bonded in a molecule to attract a shared pair of electrons towards itself.

B. The minimum energy required to remove a mole of electrons from a mole of gaseous atoms.

C. The enthalpy change occurring in $\mathrm{kJ\ mol}^{-1}$ when a gaseous atom gains one electron to form a negative ion.

D. The strength of an atom measured in $\mathrm{kJ\ mol}^{-1}$ to attract an electron to itself when bonded in a molecule.

Markscheme

A

Examiners report

[N/A]

Which statements are correct for the oxides of period 3 going from Na to Cl?

I. The oxides become increasingly acidic.

II. The bonding of the oxides changes from ionic to covalent.

III. All the oxides dissolve readily in water.

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

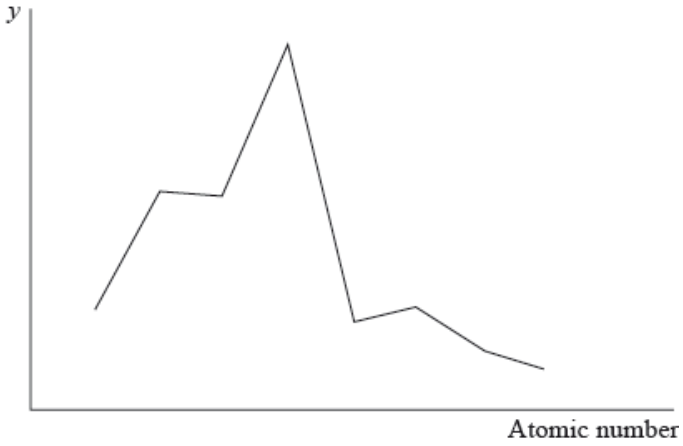
Markscheme

A

Examiners report

[N/A]

The *x*-axis of the graph below represents the atomic number of the elements in period 3.



Which variable could represent the *y*-axis?

A. Melting point

B. Electronegativity

C. Ionic radius

D. Atomic radius

Markscheme

A

Examiners report

[N/A]

Which species has the largest radius?

A. Cl^-

B. K

C. Na^+

D. K^+

Markscheme

B

Examiners report

Though students did not find this question on particle radius particularly difficult (Difficulty Index 68%), it proved to be a poor discriminator

(Discrimination Index 0.15) indicating that even good students find it difficult to apply a variety of trends simultaneously.

Which process is endothermic?

A. $2C_4H_{10}(g) + 13O_2(g) \rightarrow 8CO_2(g) + 10H_2O(g)$

B. $Na(g) \rightarrow Na^+(g) + e^-$

C. $H_2SO_4(aq) + 2KOH(aq) \rightarrow K_2SO_4(aq) + 2H_2O(l)$

D. $NH_3(g) \rightarrow NH_3(l)$

Markscheme

B

Examiners report

[N/A]

Which property increases down group 17, the halogens?

A. Electron affinity

B. Boiling point

C. First ionization energy

D. Reactivity

Markscheme

B

Examiners report

[N/A]

What is the order of decreasing ionic radius?

A. $S^{2-} > Cl^{-} > Al^{3+} > Mg^{2+}$

B. $Cl^{-} > S^{2-} > Al^{3+} > Mg^{2+}$

C. $S^{2-} > Cl^{-} > Mg^{2+} > Al^{3+}$

D. $Mg^{2+} > Al^{3+} > Cl^{-} > S^{2-}$

Markscheme

C

Examiners report

[N/A]

Which compounds have an ionic lattice structure in the solid state?

I. Silicon dioxide

II. Sodium fluoride

III. Ammonium nitrate

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

Markscheme

C

Examiners report

[N/A]

Which equation best represents the first ionization energy of magnesium?

A. $\mathrm{Mg(s)} \rightarrow \mathrm{Mg^{+}(s)} + \mathrm{e^{-}}$

B. $\mathrm{Mg(g)} \rightarrow \mathrm{Mg^{2+}(g)} + 2\mathrm{e^{-}}$

C. $\mathrm{Mg(g)} \rightarrow \mathrm{Mg^{+}(g)} + \mathrm{e^{-}}$

D. $\mathrm{Mg(s)} \rightarrow \mathrm{Mg^{+}(g)} + \mathrm{e^{-}}$

Markscheme

C

Examiners report

[N/A]

Which statements about reactivity are correct?

I. Potassium reacts more vigorously than sodium with chlorine.

II. Lithium reacts more vigorously than potassium with water.

III. Fluorine reacts more vigorously than bromine with a potassium iodide solution.

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

Markscheme

B

Examiners report

[N/A]

The elements argon, potassium, and calcium are consecutive in the periodic table. Which gives the correct order of **increasing** first ionization energies?

A. $\mathrm{Ar} < \mathrm{Ca} < \mathrm{K}$

B. $\mathrm{K} < \mathrm{Ar} < \mathrm{Ca}$

C. $\mathrm{Ca} < \mathrm{K} < \mathrm{Ar}$

D. $\mathrm{K} < \mathrm{Ca} < \mathrm{Ar}$

Markscheme

D

Examiners report

The most common wrong answer was C.

Which metals are considered to be transition elements?

I. Ti

II. Zn

III. Fe

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

Markscheme

B

Examiners report

[N/A]

Which electron configuration is that of a transition metal atom in the ground state?

A. $[Ne]3s^2 3p^6 4s^1$

B. [Ar]$3d^9$

C. $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^2$

D. $[Ar] 4s^1 3d^5$

Markscheme

D

Examiners report

[N/A]

Each of the following oxides is added to separate equal volumes of distilled water. Which of the following is the most acidic oxide?

A. P_4O_{10}

B. SO_3

C. Cl_2O_7

D. SiO_2

Markscheme

C

Examiners report

[N/A]

Which statement about the elements in group 7 is correct?

A. Br_2 will oxidize Cl^-.

B. F_2 has the least tendency to be reduced.

C. Cl_2 will oxidize I^-.

D. I_2 is a stronger oxidizing agent than F_2.

Markscheme

C

Examiners report

[N/A]

Which correctly describes the reaction between potassium and excess water?

A. The reaction is endothermic.

B. The final products of the reaction are potassium oxide and hydrogen.

C. The final products of the reaction are potassium hydroxide and hydrogen.

D. The final pH of the solution is 7.

Markscheme

C

Examiners report

[N/A]

Which oxides form acidic solutions when added to water?

A. $P_4O_{10}(s)$ and $SO_3(g)$

B. $Na_2O(s)$ and $MgO(s)$

C. $Al_2O_3(s)$ and $SiO_2(s)$

D. $MgO(s)$ and $Al_2O_3(s)$

Markscheme

A

Examiners report

[N/A]

X, Y and Z represent the successive elements, Ne, Na and Mg, but not necessarily in that order.

	First ionization energy / kJ mol^{-1}
X	2081
Y	496
Z	738

What is the order of increasing atomic number?

A. X < Y < Z

B. X < Z < Y

C. Y < Z < X

D. $Y < X < Z$

Markscheme

A

Examiners report

[N/A]