HL Topics 3 and 13: Periodicity (2)

For each question choose the answer you consider to be the best.

1. An element is in period 3 and group 5 of the periodic table. How many electrons are present in the highest occupied energy level of this element?
   A. 3
   B. 5
   C. 13
   D. 15

2. Which best describes the trends of electronegativity values within the periodic table?
   A. The values increase across a period (from left to right) and decrease down a group.
   B. The values increase across a period (from left to right) and increase down a group.
   C. The values decrease across a period (from left to right) and decrease down a group.
   D. The values decrease across a period (from left to right) and increase down a group.

3. Which is the correct trend for the elements moving from left to right across Period 3?
   A. The oxides become less acidic
   B. The bonding of the chlorides changes from ionic to covalent
   C. The atomic radii increase
   D. The melting points of the elements increases
4. The first ionization energies for three consecutive elements in the periodic table are 1251, 1521 and 419 kJ mol\(^{-1}\) respectively. Which elements have these values?

A. carbon, nitrogen, oxygen

B. neon, sodium, magnesium

C. sodium, magnesium, aluminium

D. chlorine, argon, potassium

5. Which factors lead to an element having a high first ionization energy?

I. Completely filled outer energy level

II. Small atomic radius

III. High number of completely filled inner energy levels

A. I and II only

B. I and III only

C. II and III only

D. I, II and III
6. Which equation represents the first ionization energy of carbon?

A. \( \text{C(s)} \rightarrow \text{C}^+(g) + e^- \)
B. \( \text{C(g)} + e^- \rightarrow \text{C}^-(g) \)
C. \( \text{C(s)} + e^- \rightarrow \text{C}^-(g) \)
D. \( \text{C(g)} \rightarrow \text{C}^+(g) + e^- \)

7. Which is a correct statement about the halogens or their ions?

A. Halide ions are all oxidising agents with the fluoride ion being the strongest
B. Bromine can oxidise iodide ions.
C. Iodine can oxidise chloride ions.
D. Fluorine is a stronger reducing agent than iodine.

8. Which are the correct products when chlorine gas reacts with water?

A. \( \text{H}_2 \) and \( \text{Cl}_2\text{O} \)
B. \( \text{H}_2, \text{O}_2 \) and \( \text{HClO} \)
C. \( \text{H}_2, \text{Cl}_2 \) and \( \text{HClO} \)
D. \( \text{HClO} + \text{H}^+ + \text{Cl}^- \)
9. Which is a correct statement about the nature of the chlorides of period 3?

A. They change from basic to acidic from left to right across the period.

B. They change from acidic to basic from left to right across the period.

C. They change from neutral to acidic from left to right across the period.

D. They change from neutral to basic from left to right across the period.

10. Which reaction produces a coloured substance.

A. The addition of sodium metal to water.

B. The addition of sulfur dioxide gas to water.

C. Burning sodium metal in chlorine gas.

D. The addition of chlorine gas to a solution of potassium iodide.

11. Which is a correct statement about all the elements in the same period?

A. They all contain the same number of electrons in their outer energy level.

B. Their boiling points increase (going from left to right).

C. They have the same number of occupied energy levels.

D. Their atomic radii decrease (going from left to right).
12. Which support the statement that aluminium oxide is amphoteric.

I. \( \text{Al}_2\text{O}_3 \) can react with strong acids and bases.
II. \( \text{Al}_2\text{O}_3 \) dissolves in water to give a neutral solution.
III. \( \text{Al}_2\text{O}_3 \) can react to form a salt with sodium hydroxide and with hydrochloric acid.

A. I and II only
B. I and III only
C. II and III only
D. I, II and III

13. Which element is a transition metal?

A. lead, Pb
B. gallium, Ga
C. strontium, Sr
D. iron, Fe

14. What must all ligands contain?

A. An unpaired electron
B. A negative charge
C. A non-bonding pair of electrons
D. Two or more atoms or ions
15. Which species can act as ligands?

I. NH$_3$
II. Cl$^-$
III. SiCl$_4$

A. I and II only
B. I and III only
C. II and III only
D. I, II and III

16. The compounds [Cr(H$_2$O)$_4$Cl$_2$]Cl and [Cr(H$_2$O)$_5$Cl]Cl$_2$ are isomers. What is the oxidation state of chromium in these two compounds?

<table>
<thead>
<tr>
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<th>[Cr(H$_2$O)$_4$Cl$_2$]Cl</th>
<th>[Cr(H$_2$O)$_5$Cl]Cl$_2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.</td>
<td>+3</td>
<td>+3</td>
</tr>
<tr>
<td>B.</td>
<td>+2</td>
<td>+1</td>
</tr>
<tr>
<td>C.</td>
<td>+4</td>
<td>+5</td>
</tr>
<tr>
<td>D.</td>
<td>+6</td>
<td>+6</td>
</tr>
</tbody>
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17. Which is used as a catalyst during the manufacture of sulfuric acid?

A. Ni
B. V$_2$O$_5$
C. MnO$_2$
D. Fe
18. In the following reaction:

\[ [\text{Cu}(\text{H}_2\text{O})_6]^{2+}(aq) + 4\text{NH}_3(aq) \rightarrow [\text{Cu}({\text{NH}_3})_4(\text{H}_2\text{O})_2]^{2+}(aq) + 4\text{H}_2\text{O}(l) \]

Which are correct statements?

I. The Cu\(^{2+}\) ion is acting as a Lewis base
II. \([\text{Cu}(\text{H}_2\text{O})_6]^{2+}\) has an octahedral shape
III. The oxidation state of copper remains unchanged

A. I and II only
B. I and III only
C. II and III only
D. I, II and III

19. In which complex ion does the metal have an oxidation state of +2?

A. \([\text{Co}(\text{H}_2\text{O})_6]^{3+}\)
B. \([\text{Ag}({\text{NH}_3})_2]^{+}\)
C. \([\text{CuCl}_4]^{2-}\)
D. \([\text{Fe}({\text{CN}})_6]^{3-}\)

20. Which species will not be coloured?

A. \(\text{Cu}_2\text{SO}_4\)
B. \(\text{Mn}_2\text{O}_3\)
C. \([\text{Fe}(\text{H}_2\text{O})_6]^{3+}\)
D. \(\text{Pt}({\text{NH}_3})_2\text{Cl}_2\)