BioMedical Admissions Test (BMAT)

Section 2: Chemistry

Questions by Topic

C7 - Group Chemistry

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(Mark Scheme and explanations at the end)

1 The following statements relate to the Group 1 metals (alkali metals).

1 They react violently with water.
2 Francium has the lowest melting point of the Group 1 metals.
3 If magnesium is reacted with water, the resultant compound will turn litmus paper red.
4 Given that francium (Fr) and Astatine (At) do **not** form metal halides (formed by reaction of a Group 1 metal with a halogen), the highest possible relative atomic mass of a metal halide is 251 g/mol.
5 Magnesium does not react with potassium chloride.

Which of these statements about the Group 1 metals are **not** correct?

A 1 and 5 only
B 1, 3 and 5 only
C 2, 4 and 5 only
D 2 and 4 only
E 3 and 4 only
F 3 only
G 1 only

2 A metal carbonate with an atomic mass of 197 g/mol is reacted with hydrochloric acid to form a chloride. The resulting chloride is reacted with potassium to obtain a metal.

When this metal is placed in a flame, what colour is observed?

A Brick red
B Blue
C Lilac
D Green
E Yellow

3 An element Z has an outer shell containing a single electron.

Which of the following statements about this element are true?

1 The element is in Group 3 of the Periodic Table.
2 The element reacts with water.
3 Ions of the element react with ions of the Group 7 elements in a 1:1 ratio.
4 Oxides of the element have a pH greater than 7.
5 Atoms of the element form both ionic and covalent bonds.

A 2 and 3 only
B 2 and 4 only
C 1, 2 3 and 5 only
D 2 only
E 2, 3 and 4 only
F 2, 3, 4 and 5 only
G 5 only

4 An element X has 7 electrons in its outer shell.

Which of the following statements about this element are true?

1 The element forms coloured ions and is commonly used as a catalyst.
2 The element reacts with the alkali metals.
3 In the element's group, melting point decreases as you move down the group.
4 The element exists as monatomic molecules.

A 1, 2, 3 and 4 only
B 2 and 4 only
C 1 and 4 only
D 2 only
E 1 and 2 only
F 2, 3, and 4 only
G 2 and 3 only

5 Hydrogen bromide decomposes to form hydrogen and bromine gas. Using the bond energy values given below, determine the energy change of this reaction, ΔH, and suggest the colour of the reaction mixture.

H-Br	Br - Br	H - H
366kJ/mol	193kJ/mol	432kJ/mol

A +108kJ/mol, yellow
B +108kJ/mol, brown
C +97kJ/mol, yellow
D +97kJ/mol, blue
E -97 kJ/mol, brown
F -92 kJ/mol, yellow
G -92 kJ/mol, green

Answers and Explanations

1 **The answer is E**

Magnesium will form magnesium hydroxide on reaction with water. All hydroxides are alkaline bases, so this compound will turn litmus paper **blue.** The highest possible atomic mass of a metal halide is caesium iodide (CsI), which has a relative atomic mass of 260g/mol, not 251 g/mol. Remember - all metal ions react with halide ions in a one-to-one ratio.

2 **The answer is D**

The carbonate with atomic mass 197 g/mol is barium carbonate ($BaCO_3$). This can be obtained by noting the atomic mass of the carbonate ion (60 g/mol) and working backwards to find the metal with atomic mass 137 (barium). Barium burns in a green flame, so the answer is D.

3 **The answer is E**

The element is in Group 1 of the Periodic Table (the alkali metals). Therefore it **does** react with water, its ions **do** react with Group 7 elements in a 1:1 ratio, its oxides **are** alkaline, but it does **not** form covalent bonds, only metallic and ionic bonds. Therefore, statements **2, 3 and 4 are true**.

4 **The answer is D**

The element is in Group 7 of the Periodic Table (the halogens). Therefore it **does not** act as a catalyst and form coloured ions (these are properties of the transition metals), it **does** react with alkali metals (to form metal halides), melting point **increases** down the group rather than decreases (Iodine is a solid at room temperature), and it forms **diatomic** molecules, not monatomic. Hence, the only correct statement is Statement 2.

5 **The answer is B**

The bonds being broken are 2 H-Br bonds (2 x 366 = 732 kJ/mol).
The bonds being formed are 1 H-H bond and 1 Br-Br bond (193 + 432 = 625kJ/mol).
Overall energy change = 732 - 625 = **+108 kJ/mol.**
The solution will be brown due to the bromine.