BioMedical Admissions Test (BMAT)

Section 2: Chemistry

Questions by Topic

C16 - Chemical Tests

This work by PMT Education is licensed under CC BY-NC-ND 4.0

C16: Chemical Tests - Question by Topic

(Mark Scheme and explanations at the end)

1 Which of the reactions below will produce a white, **insoluble** precipitate if sodium hydroxide (NaOH) is added **after** the reaction is completed?

A $Ca + Na_2O$
B $Al + CuCl_2$
C $Ca + K_2CO_3$
D $Cu + Ag(NO_3)_2$
E $Ca + CuCl_2$

2 A compound X has the formula C_6H_{10}. Aqueous bromine is shaken with compound X, and the solution changes from brown to colourless.

Which of the following compounds could X be?

1 2,3-dimethyl-1,3-butadiene
2 1,3,6-hexatriene
3 Hexa-2,3-diene
4 Hexene
5 3-chlorohex-5-ene

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

CC BY NC ND

3 An unknown hydrocarbon compound XA, where X represents the carbon chain and A represents a single other atom on the carbon chain, has the atomic mass 121 g/mol. It contains six carbon atoms.

What observation is seen when Y is warmed with aqueous silver nitrate?

(Molecular weights: C = 12, H = 1, Na = 23, Br = 80, I = 127, Cl = 35, O = 16, N = 14)

A White precipitate forms
B Yellow precipitate forms
C Green precipitate forms
D Red-brown precipitate forms
E Cream precipitate forms

4 Examine the following four lists of compounds. All these compounds are in aqueous form. Which list contains only compounds that will:

a) react readily with NaOH to form a green, blue or white precipitate
b) have a molar mass of over 120 g/mol

A $Fe_{2(}SO_4)_3$, Al_2O_3, $CaCO_3$, Na_2CO_3
B $A_{l2}(CO_3)_3$, $FeSO_4$, $CaCl_2$, $Ca(NO_3)_2$
C Al_2O_3, $Fe_2(SO_4)_3$, $CaCl_2$, $Ca(NO_3)_2$
D NaI, CH_4, NaBr, $CaCl_2$
E $FeSO_4$, $Ca(NO_3)_2$, $Al_2(CO_3)_3$, $Ca_3(PO_4)_2$

5 Compound X has a white, powdered appearance and reacts readily with hydrochloric acid. It has an atomic mass of 100 g/mol.

Which **non-metal** ion does Compound X contain, and what would be observed if it was placed in a flame?

A Li^+, brick red flame
B CO_3^{2-}, orange-red flame
C SO_4^{3-}, yellow flame
D Ca^{2+}, lilac flame
E CO_3^{2-}, yellow flame
F CO_3^{2-}, green flame
G SO_4^{3-}, yellow flame

CC BY NC ND

6 An unknown compound R, white and crumbly in appearance, and with a molar mass of 125 g/mol, is heated strongly. Placing a lighted splint into the reaction container causes the splint to be extinguished.

What is the molar mass of the metal ion that compound R contains?

A 31
B 20
C 13
D 30
E 28

7 Silver nitrate is used to test for halide ions. The silver nitrate must be acidified for the test to work (mixed with nitric acid). The expected observations are:

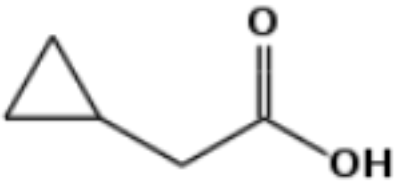
F- = no precipitate
Cl- = white precipitate
Br- = cream precipitate
I- = yellow precipitate

Which of the following ions could be added to the silver nitrate beforehand, without affecting the results?

A Au^{+}
B Cu^{2+}
C OH^{-} (aq)
D Zn^{2+}
E K^{+}

CC BY NC ND

8 Consider the organic compound X, shown below.



A particular carbonate has the same molar mass as compound X.

When a sample of the metal in this carbonate is held to a flame, what colour will be observed?

A Blue
B Green
C White
D Orange-Red
E Purple

9 A chemist is given three colourless solutions and asked to identify them.She mixes each of the solutions with 2 mol dm^{-3} aqueous NaOH and observes the formation of blue, green and brown precipitates respectively.

What could the solutions be, ordered as above?

A Calcium chloride, iron (III) chloride, magnesium chloride
B Magnesium sulfate, copper (II) sulfate, calcium chloride
C Copper (II) sulfate, iron (II) chloride, iron (III) sulfate
D Magnesium iodide, iron (II) chloride, copper iodide
E Copper (II) sulfate, iron (III) chloride, iron (II) sulfate

CC BY NC ND

10 Three particular metal hydroxides have relative atomic masses of 90, 78 and 58 g/mol respectively.

When combined with concentrated sulfuric acid, and then aqueous NaOH, what will be seen?

(Molecular weights: Al = 27, Ca = 40, Mg = 24, Cu = 63, Fe = 56, O = 16, H = 1)

A Effervescence only.
B Effervescence, then the formation of green, white and white precipitates.
C Effervescence, then the formation of green, white and brown precipitates.
D Effervescence, then the formation of blue, white and brown precipitates.
E The formation of white precipitates only.

11 A chemist is working with lithium metal, which is usually stored under oil. One night, the chemist forgets to store the metal under oil and comes back the next morning to find that the lithium has formed a white solid.

When an excess of this solid is placed in a small volume of water and a drop of universal indicator is placed inside, which colour will be observed?

A White
B Red
C Purple
D Light Blue
E Green

CC BY NC ND

Answers and Explanations

1 **The answer is E**

A white insoluble precipitate forms when NaOH is mixed with Ca^{2+} ions - not elemental calcium (Ca). Ca^{2+} ions exist in **compounds** that contain calcium.

A Calcium cannot displace sodium as it is lower down in the reactivity series.

B Aluminium displaces copper to form $AlCl_3$, aluminium chloride. The Al^{3+} ions in this solution react with NaOH to produce a white, **soluble** precipitate.

C Calcium cannot displace potassium as it is lower down in the reactivity series.

D Copper displaces silver to form $Cu(NO_3)2$, copper nitrate. The Cu^{2+} ions in this solution react with NaOH to produce a pale blue precipitate.

E Calcium displaces copper to form $CaCl_2$, calcium chloride. The Ca^{2+} ions in this solution react with NaOH to form a white, insoluble precipitate.

2 **The answer is B** - 1 and 3.

Only 1 and 3 have the formula C_6H_{10}, which can be noticed if the compounds are drawn out carefully. The question suggests that the compound is unsaturated (contains double bonds) however this is not needed to retrieve the answer, as no saturated isomers of C_6H_{10} exist!

3 **The answer is A** **-** a white precipitate forms**.**

The compound has six carbon atoms, so the chain must be CH_3-CH_2-CH_2-CH_2-CH_2-CH_3.
The identity of A can be determined by subtracting the atomic mass of the carbon chain from 121.
The atomic mass of the carbon chain is 86 - subtracting this from 121 gives 35, so A is chlorine (Cl).
When warmed with aqueous silver nitrate, this produces a **white** precipitate.

4 **The answer is E**

To form the precipitates in the colours stated with NaOH, the compounds must contain either Al^{3+} or Ca^{2+} ions (white), Fe^{2+} ions (green) or Cu^{2+} ions (blue). This excludes Options A and C ($Fe_2(SO_4)_3$contains Fe^{3+} ions), and D. Both lists B and E contain the necessary ions, however $CaCl_2$ has a molar mass of 111 g/mol, which is less than 120. Therefore, the correct answer is E.

5 **The answer is B**

The first two statements suggest that this is a carbonate. The carbonate with an atomic mass of 100 g/mol is calcium carbonate ($CaCO_3$). When held to a flame, the calcium ions in this compound will burn with an orange / red flame.

6 **The answer is D**

The metal ion is zinc, and compound R is zinc carbonate (molar mass 125). The lighted splint indicates that CO_2 is formed on heating (thermal decomposition), and along with the visual information given in the question, this should be enough to identify that R is a metal carbonate. The only metal carbonate with the molar mass 125 is zinc carbonate, $ZnCO_3$.

7 **The answer is A**

Of the metal ions listed, only gold (Au^+) is below silver in the reactivity series and would not displace it from the nitrate. The OH^- ions would neutralise the acidity in the acidified silver nitrate mixture, rendering it unable to perform the test.

8 **The answer is D**

This compound has a molar mass of 100 g/mol. The carbonate with this molar mass is **calcium carbonate.** When calcium is held to a flame, an orange-red colour is observed.

9 **The answer is C**

The colours blue, green and brown correspond to copper (II) ions, iron (II) ions and iron (III) ions respectively.

CC BY NC ND

10 **The answer is B**

The metal hydroxides in question can be identified using the molecular weights given as: iron (II) hydroxide, aluminium hydroxide and magnesium hydroxide. Effervescence will be seen when the metal hydroxides are neutralised by the concentrated sulfuric acid. Following this, the Fe^{2+}, Al^{3+} and Mg^{2+} ions will form green, white and white precipitates respectively.

11 **The answer is C**

The indicator will turn purple. Lithium oxide, the white solid, is a base, which is always alkaline in solution. The question states that an excess of the solid is placed in a small volume of water, therefore a strongly alkaline solution is produced, which turns the universal indicator purple.