

39 The results of flame tests on three metal salts, X, Y and Z, are shown.

metal salt	flame test colour
X	yellow
Y	lilac
Z	blue-green

Which row identifies the cations present in X, Y and Z?

	X	Y	Z
A	potassium	sodium	calcium
B	potassium	sodium	copper
C	sodium	potassium	calcium
D	sodium	potassium	copper

39 Substance X contains one cation.

Two tests are completed on aqueous X.

test 1 flame test

test 2 addition of aqueous sodium hydroxide dropwise and then in excess

Which row shows a possible combination of observations for the tests?

	observation for test 1	observation for test 2
A	yellow flame	white ppt., insoluble in excess
B	blue-green flame	light blue ppt., insoluble in excess
C	light green flame	green ppt., soluble in excess
D	red flame	red-brown ppt., insoluble in excess

3 A student tests two solids: solid **J** and solid **K**.

Tests on solid J

Solid **J** is lithium chloride.

Record the expected observations.

(a) The student carries out a flame test on solid **J**.

(i) State the colour the Bunsen burner flame becomes during the flame test.

..... [1]

(ii) The student uses a roaring Bunsen burner flame to carry out the flame test.

State why a yellow Bunsen burner flame is **not** suitable for a flame test.

.....
 [1]

(b) The student dissolves the remaining solid **J** in distilled water to form solution **J**.

The student divides solution **J** into two portions.

(i) To the first portion of solution **J**, the student adds about 1 cm³ of dilute nitric acid followed by a few drops of aqueous silver nitrate.

observations
 [1]

(ii) To the second portion of solution **J**, the student adds aqueous sodium hydroxide until it is in excess.

observations
 [1]

Tests on solid K

Table 3.1 shows the tests and the student's observations for solid **K**.

Table 3.1

tests	observations
test 1 Heat about half of solid K in a boiling tube until there is no further change. Hold anhydrous cobalt(II) chloride paper at the mouth of the boiling tube.	condensation forms at the top of the boiling tube the anhydrous cobalt(II) chloride paper changes colour from blue to pink
test 2 The remaining solid K is dissolved in distilled water to form solution K . Solution K is divided into three portions. To the first portion of solution K , add aqueous ammonia dropwise and then in excess.	a green precipitate forms the precipitate remains when excess aqueous ammonia is added
test 3 To the second portion of solution K , add 1 cm ³ of dilute nitric acid followed by a few drops of aqueous barium nitrate.	a white precipitate forms
test 4 To the third portion of solution K , add 3 cm ³ of aqueous sodium carbonate. Test any gas given off.	effervescence is seen and a green precipitate forms the gas turns limewater milky

(c) State the conclusion that can be made from the observations in **test 1**.

..... [1]

(d) Two different cations can give the observations in **test 2**.

(i) Identify the **two** possible cations that the observations in **test 2** show could be in solid **K**.

.....
..... [2]

- (ii) Describe an additional test that can be carried out on solution **K** to confirm which of the two cations you have identified in (d)(i) is in solid **K**.

Explain how the result of this test shows which of these two cations is in solid **K**.

test

.....

explanation

.....

[2]

- (e) Identify the gas given off in **test 4**.

..... [1]

- (f) Identify the anion in solid **K**.

..... [1]

[Total: 11]

3 A student tests two solids: solid **E** and solid **F**.

Tests on solid E

Solid **E** is ammonium sulfate.

Record the expected observations.

The student dissolves solid **E** in distilled water to form solution **E**. The student divides solution **E** into three approximately equal portions.

- (a) (i)** To the first portion of solution **E**, the student adds about 2 cm³ of aqueous sodium hydroxide. The student warms the mixture gently and tests any gas produced.

observations

..... [1]

- (ii)** Identify the gas given off in **(a)(i)**.

..... [1]

- (b)** To the second portion of solution **E**, the student adds about 1 cm³ of dilute nitric acid followed by a few drops of aqueous barium nitrate.

observations

..... [1]

- (c)** To the third portion of solution **E**, the student adds a few drops of acidified aqueous potassium manganate(VII).

observations

..... [1]

Tests on solid F

Table 3.1 shows the tests and the student's observations for solid **F**.

Table 3.1

tests	observations
test 1 Carry out a flame test on solid F .	yellow flame
test 2 Dissolve the remaining solid F in distilled water to form solution F . Divide solution F into three portions. To the first portion of solution F , add about 1 cm ³ of dilute nitric acid followed by a few drops of aqueous silver nitrate.	yellow precipitate forms
test 3 To the second portion of solution F , add aqueous sodium hydroxide dropwise until in excess.	white precipitate forms the precipitate dissolves in excess aqueous sodium hydroxide to form a colourless solution
test 4 To the third portion of solution F , add aqueous ammonia dropwise until in excess.	white precipitate forms the precipitate dissolves in excess aqueous ammonia to form a colourless solution

(d) Identify the **three** ions in solid **F**.

.....

.....

..... [3]

[Total: 7]

3 A student tests two substances: solution **A** and solid **B**.

Tests on solution A

Solution **A** is aqueous iron(III) nitrate.

Record the expected observations.

The student divides solution **A** into three approximately equal portions.

(a) To the first portion of solution **A**, the student adds aqueous ammonia dropwise and then in excess.

observations when added dropwise

observations in excess

[2]

(b) (i) To the second portion of solution **A**, the student adds excess aqueous sodium hydroxide.

observations

..... [1]

(ii) To the product from **(b)(i)**, the student adds a small piece of aluminium foil. The student gently warms the mixture formed and tests any gas produced.

observations

..... [1]

(iii) Identify the gas produced in **(b)(ii)**.

..... [1]

(c) To the third portion of solution **A**, the student adds about 1 cm³ of dilute nitric acid followed by a few drops of aqueous barium nitrate.

observations

..... [1]

Tests on solid B

Table 3.1 shows the tests and the student's observations for solid **B**.

Table 3.1

tests	observations
test 1 Do a flame test on solid B .	light green flame colour
test 2 Add the remaining solid B to dilute hydrochloric acid. Test any gas produced.	effervescence and a colourless solution forms limewater turns milky

(d) Identify the gas produced in **test 2**.

..... [1]

(e) Identify solid **B**.

.....

..... [2]

[Total: 9]

3 A student tests two solids: solid **F** and solid **G**.

Tests on solid F

Solid **F** is calcium carbonate.

- (a)** The student adds about 15 cm³ of dilute hydrochloric acid to the sample of solid **F** in a boiling tube and tests any gas produced.

observations

 [2]

- (b)** The student filters the product from **(a)** to obtain solution **H** as the filtrate.
 The student divides solution **H** into three approximately equal portions in three test-tubes.

- (i)** To the first portion of solution **H**, the student adds about 1 cm depth of dilute nitric acid followed by a few drops of aqueous barium nitrate.

observations
 [1]

- (ii)** To the second portion of solution **H**, the student adds aqueous sodium hydroxide dropwise and then in excess.

observations when added dropwise
 observations in excess [2]

- (iii)** To the third portion of solution **H**, the student adds about 1 cm depth of dilute nitric acid followed by a few drops of aqueous silver nitrate.

observations
 [1]

Tests on solid G

Table 3.1 shows the tests and the student's observations for solid **G**.

Table 3.1

tests	observations
test 1 Do a flame test on solid G .	 lilac coloured flame
test 2 Dissolve the remaining solid G in water to form solution G . Divide solution G into three portions. To the first portion of solution G , add about 1 cm ³ of aqueous chlorine.	 orange solution forms
test 3 To the second portion of solution G , add about 1 cm ³ of aqueous sodium hydroxide.	 remains colourless
test 4 To the third portion of solution G , add about 1 cm ³ of dilute nitric acid followed by a few drops of aqueous silver nitrate.	 cream precipitate forms

(c) Identify solid **G**.

.....
..... [2]

[Total: 8]

3 A student tests two solids: solid **J** and solid **K**.

Tests on solid J

Solid **J** is iron(II) iodide.

The student dissolves solid **J** in water to form solution **J**. Solution **J** is divided into four portions.

(a) To the first portion of solution **J**, the student adds aqueous sodium hydroxide dropwise and then in excess.

observations when added dropwise

observations when added in excess

[2]

(b) To the second portion of solution **J**, the student adds 1 cm³ of dilute nitric acid followed by a few drops of aqueous barium nitrate.

observations

..... [1]

(c) To the third portion of solution **J**, the student adds 1 cm³ of dilute nitric acid followed by a few drops of aqueous silver nitrate.

observations

..... [1]

(d) To the fourth portion of solution **J**, the student adds 1 cm³ of aqueous chlorine.

observations

..... [1]

Tests on solid K

Table 3.1 shows the tests and the student's observations for solid **K**.

Table 3.1

tests	observations
test 1 Carry out a flame test on solid K .	 lilac coloured flame
test 2 The remaining solid K is dissolved in water to form solution K . Solution K is divided into two portions. To the first portion of solution K in a boiling tube, add 1 cm ³ aqueous sodium hydroxide. Warm the product and hold damp red litmus paper at the mouth of the boiling tube.	 the damp red litmus paper remains red
test 3 To the second portion of solution K in a boiling tube, add about 1 cm ³ of aqueous sodium hydroxide and a piece of aluminium foil. Warm the mixture and test any gas given off.	 effervescence is seen damp red litmus paper turns blue

(e) State the conclusion about solid **K** that can be made from the observations in **test 2**.

..... [1]

(f) Identify the gas given off in **test 3**.

..... [1]

(g) Identify solid **K**.

.....
..... [2]

[Total: 9]

3 A student tests two solids: solid **L** and solid **M**.

Tests on solid L

Solid **L** is hydrated aluminium chloride.

The student dissolves solid **L** in distilled water to form solution **L**. Solution **L** is divided into four approximately equal portions.

- (a)** To the first portion of solution **L**, the student adds aqueous sodium hydroxide dropwise and then in excess.

observations when added dropwise

observations in excess [2]

- (b)** To the second portion of solution **L**, the student adds aqueous ammonia dropwise and then in excess.

observations when added dropwise

observations in excess [2]

- (c)** To the third portion of solution **L**, the student adds about 1 cm³ of dilute nitric acid followed by a few drops of aqueous silver nitrate.

observations

..... [1]

- (d)** To the fourth portion of solution **L**, the student adds about 1 cm³ of dilute nitric acid followed by a few drops of aqueous barium nitrate.

observations

..... [1]

Tests on solid M

Table 3.1 shows the tests and the student's observations for solid **M**.

Table 3.1

tests	observations
test 1 Do a flame test on solid M .	light green coloured flame
test 2 Dissolve the remaining solid M in water to form solution M . Divide solution M into three portions. To the first portion of solution M , add about 1 cm ³ of aqueous sodium hydroxide.	no visible change
test 3 To the second portion of solution M , add about 1 cm ³ of aqueous sodium hydroxide and a piece of aluminium foil. Warm the mixture and test any gas given off.	effervescence is seen; damp red litmus paper turns blue
test 4 To the third portion of solution M , add about 1 cm ³ of dilute sulfuric acid.	white precipitate forms

(e) Identify the gas given off in **test 3**.

..... [1]

(f) Identify solid **M**.

.....
..... [2]

[Total: 9]

39 Which ion forms a green precipitate with aqueous sodium hydroxide that dissolves in an excess of aqueous sodium hydroxide?

A Ca²⁺

B Cr³⁺

C Cu²⁺

D Fe²⁺