Past-paper walk-through

Identification of ions and gases ▪ 12.5

eXercise

Questions in this set

- 0620/21 N25 Q39 ▪ 1 mark
- 0620/23 N25 Q39 ▪ 1 mark
- 0620/61 N25 Q3 ▪ 11 marks
- 0620/62 N25 Q3 ▪ 7 marks
- 0620/63 N25 Q3 ▪ 9 marks
- 0620/61 J25 Q3 ▪ 8 marks
- 0620/62 J25 Q3 ▪ 9 marks
- 0620/63 J25 Q3 ▪ 9 marks
- 0620/22 M25 Q39 ▪ 1 mark

Reading the mark scheme

- **B1** a mark that stands on its own – the point is either made or not.
- **M1** a *method* mark: the right approach, even if the number is wrong.
- **A1** an *answer* mark, and it usually needs its M mark first.
- **C1** a working mark on the way to the answer.
- // separates answers the examiner accepts equally.
- **ecf** = error carried forward: a later part is marked on your own earlier answer.
- **owtte** = "or words to that effect" – the wording need not match.

Question 39

0620/21 N25 ▪ Q39 ▪ 1 mark

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

Question 39

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

Solution 39

Answer: **D**

Why

- Learn the flame colours: sodium yellow, potassium lilac, calcium red, copper(II) blue-green.
- So X is sodium and Y is potassium – those two are the easiest pair to swap by mistake.
- The blue-green of Z is copper(II).

Question 39

0620/23 N25 ▪ Q39 ▪ 1 mark

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

Question 39

C	light green flame	green ppt., soluble in excess
D	red flame	red-brown ppt., insoluble in excess

Solution 39

Answer: **B**

Why

- The flame colour identifies the metal: yellow sodium, lilac potassium, red calcium, blue-green copper.
- Adding sodium hydroxide dropwise and then in excess separates the precipitates – Al^{3+} and Zn^{2+} redissolve, Cu^{2+} and Fe^{3+} do not.
- Both tests must point at the *same* cation, so use each to check the other.

Question 3

0620/61 N25 ▪ Q3 ▪ 11 marks

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.

Question 3

(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.

Question 3

(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 cm^3 of dilute nitric acid followed by a few drops of aqueous silver nitrate.

Question 3

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

Question 3

Question 3

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	

Question 3

Question 3

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.	effervescence is seen and a green precipitate forms

Question 3

Question 3

Test any gas given off.	the gas turns limewater milky

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

Question 3

(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**.

Question 3

(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**.

Question 3

Question 3

Question 3

[2]

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

Question 3

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

Question 3

[Total: 11]

Solution 3

(a)(i)

Mark scheme

- red
- 1

(a)(ii)

Mark scheme

- (yellow flame) not hot enough
- 1

Solution 3

(b)(i)

Mark scheme

- white precipitate
- 1

(b)(ii)

Mark scheme

- no change
- 1

Solution 3

(c)

Mark scheme

- (solid K is) hydrated
- 1

Solution 3

(d)(i)

Mark scheme

- M1 Fe2+ / iron(II)
- 1 M2
- Cr3+ / chromium(III)
- 1
- 0620/61
- October/November 2025

Solution 3

(d)(ii) Mark scheme

- M1 add excess aqueous sodium hydroxide M2
- chromium and forms a solution / (green) precipitate dissolves
- OR M1
- add excess aqueous sodium hydroxide M2
- iron(II) and forms a (green) precipitate which doesn't dissolve
- OR M1
- add aqueous sodium hydroxide and leave to stand M2
- iron(II) and (green) precipitate becomes brown

Solution 3

- OR M1
- add aqueous sodium hydroxide and leave to stand M2
- chromium and (green) precipitate does not turn brown
- 2

Solution 3

(e)

Mark scheme

- carbon dioxide / CO2
- 1

Solution 3

(f) Mark scheme

- sulfate / SO42–
- 1
- 0620/61
- October/November 2025
- 4
- any six from:
- MP1 use a specified/known volume of aqueous copper(II) sulfate

Solution 3

- MP2 use of a (volumetric) pipette / measuring cylinder / burette to measure volume of solution
- MP3 measure initial temperature of aqueous copper(II) sulfate
- MP4 known / specified mass of one of the metals
- MP5 add metal to aqueous copper(II) sulfate and stir / mix
- MP6 measure highest temperature (reached)
- MP7 biggest temperature rise is most reactive / lowest temperature rise is least reactive
- 6

Question 3

0620/62 N25 ▪ Q3 ▪ 7 marks

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 $2\,cm^3$ of aqueous sodium hydroxide. The student warms the mixture gently and tests any gas produced.

Question 3

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

Question 3

(b) To the second portion of solution **E**, the student adds about 1 cm^3 of dilute nitric acid followed by a few drops of aqueous barium nitrate.

Question 3

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

Question 3

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.	

Question 3

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

Question 3

aqueous ammonia to form a colourless solution

Question 3

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

Question 3

[Total: 7]

Solution 3

(a)(i)

Mark scheme

- (damp red) litmus (paper) turns blue
- 1

(a)(ii)

Mark scheme

- ammonia / NH3
- 1

Solution 3

(b)

Mark scheme

- white precipitate
- 1

Solution 3

(c)

Mark scheme

- (solution) becomes pink
- 1

Solution 3

(d) Mark scheme

- M1 sodium / Na+ M2
- zinc / Zn2+ M3
- iodide / I–
- 3
- 0620/62
- October/November 2025
- 4

Solution 3

- There are two valid approaches, either measuring time for a set temperature increase OR measuring temperature increase
- in a set time.
- any 6 from:
- MP1 specified/set/measured volume water
- MP2 measure (start/initial) temperature (of water)
- MP3 volume of water measured using a measuring cylinder or burette or (volumetric) pipette
- AND
- HEAT TO SET TEMPERATURE (change)
- MP4 start timing when heating started / burner put under tube

Solution 3

- MP5 heat to set temperature / set temperature rise
- MP6 record/measure time taken to heat water
- MP7 shortest time is fuel that heats fastest
- OR
- HEAT FOR A SET TIME
- MP4 heat water for a specified time
- MP5 measure final temp of water
- MP6 calculate temperature rise
- MP7 highest temperature (rise) is fuel that heats fastest
- 6

Question 3

0620/63 N25 ▪ Q3 ▪ 9 marks

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.

Question 3

[2]

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

Question 3

(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.

Question 3

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

Question 3

(c) To the third portion of solution **A**, the student adds about 1 cm^3 of dilute nitric acid followed by a few drops of aqueous barium nitrate.

Question 3

Question 3

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.	effervescence and a colourless solution forms

Question 3

Test any gas produced.	limewater turns milky

Question 3

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

Question 3

(e) Identify solid **B**.

Question 3

[Total: 9]

Solution 3

(a)

Mark scheme

- M1 dropwise: red-brown precipitate **M2**
- excess: no further change / precipitate remains / red-brown precipitate
- 2

Solution 3

(b)(i)

Mark scheme

- red-brown precipitate
- 1

(b)(ii)

Mark scheme

- (damp red) litmus (paper) turns blue
- 1

Solution 3

(b)(iii)

Mark scheme

- ammonia / NH3
- 1

Solution 3

(c)

Mark scheme

- no change
- 1

Solution 3

(d)

Mark scheme

- carbon dioxide / CO_2
- 1

Solution 3

(e) Mark scheme

- M1 barium / Ba2+ M2
- carbonate / CO3 2–
- 1
- 4
- any 6 from:
- MP1 find mass of duralumin
- MP2 add (dilute) nitric acid
- MP3 acid in excess

Solution 3

- MP4 heat/warm
- MP5 filter
- MP6 wash (the residue/solid/aluminium with distilled water) and dry the residue and then find the mass (of the aluminium)
- MP7 percentage aluminium $=$ (mass of aluminium $\div$ mass alloy) $\times$ 100
- 6

Question 3

0620/61 J25 ▪ Q3 ▪ 8 marks

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 cm^3 of dilute hydrochloric acid to the sample of solid **F** in a boiling tube and tests any gas produced.

Question 3

(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.

Question 3

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

Question 3

[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.

Question 3

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	orange solution forms

Question 3

of aqueous chlorine.

Question 3

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**.

Question 3

[Total: 8]

Solution 3

(a)

Mark scheme

- M1 limewater becomes milky
- 1 M2
- effervescence / fizzing / bubbling
- 1

Solution 3

(b)(i)

Mark scheme

- no change
- 1

Solution 3

(b)(ii)

Mark scheme

- dropwise: white precipitate
- 1
- excess: no (further) change / precipitate remains / white precipitate / insoluble
- 1

Solution 3

(b)(iii)

Mark scheme

- white precipitate
- 1
- 0620/61
- May/June 2025

Solution 3

(c) Mark scheme

- M1 potassium / K+ M2
- bromide / Br–
- 1
- KBr = 2/1
- 4
- any 6 from
- MP1 known / specified mass of sodium hydrogencarbonate

Solution 3

- MP2 known / specified volume (and concentration) of hydrochloric or ethanoic acid
- MP3 use of a named suitable container for the reaction and named suitable apparatus to measure volume of acid
- MP4 measure temperature of acid before mixing
- MP5 add reagents together and mix / stir
- MP6 measure temperature of mixture / acid after mixing / reaction
- MP7 biggest temperature decrease is most endothermic
- max 6/6

Question 3

0620/62 J25 ▪ Q3 ▪ 9 marks

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.

Question 3

[2]

(b) To the second portion of solution **J**, the student adds 1 cm^3 of dilute nitric acid followed by a few drops of aqueous barium nitrate.

Question 3

(c) To the third portion of solution **J**, the student adds 1 cm^3 of dilute nitric acid followed by a few drops of aqueous silver nitrate.

Question 3

(d) To the fourth portion of solution **J**, the student adds 1 cm^3 of aqueous chlorine.

Question 3

Question 3

Question 3

Solution 3

(a)

Mark scheme

- dropwise: green precipitate
- 1
- excess: no (further) change / precipitate remains / green precipitate / insoluble
- 1

Solution 3

(b)

Mark scheme

- no change
- 1

Solution 3

(c)

Mark scheme

- yellow precipitate
- 1

Solution 3

(d)

Mark scheme

- (solution / liquid becomes) yellow / orange / brown
- 1

Solution 3

(e)

Mark scheme

- does not contain ammonium / NH4+ ions / not ammonium / NH4+
- 1

Solution 3

(f)

Mark scheme

- ammonia / NH3
- 1

Solution 3

(g) Mark scheme

- potassium / K+
- 1
- nitrate / NO3–
- KNO3 = 2/1
- 4
- 1 mark for any 6 of:
- ▪

Solution 3

- 100 cm3 of water measured using suitable apparatus and placed into a suitable container
- ▪
- water is heated to 50 °C
- ▪
- water is maintained at this temperature
- ▪
- magnesium sulfate is added in excess or in portions until no more dissolves
- ▪
- the mixture is stirred

Solution 3

- ▪
- the solution is filtered to remove undissolved magnesium sulfate or the mass used is known
- ▪
- the use of appropriate measurements to calculate the solubility.
- 6

Question 3

0620/63 J25 ▪ Q3 ▪ 9 marks

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.

Question 3

[2]

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

Question 3

[2]

(c) To the third portion of solution **L**, the student adds about 1 cm^3 of dilute nitric acid followed by a few drops of aqueous silver nitrate.

Question 3

(d) To the fourth portion of solution **L**, the student adds about 1 cm^3 of dilute nitric acid followed by a few drops of aqueous barium nitrate.

Question 3

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 dilute	

Question 3

To the first portion of solution **M**, add about	no visible change

Question 3

1 cm^3 of aqueous sodium hydroxide.	
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**.

Question 3

(f) Identify solid **M**.

Question 3

[Total: 9]

Solution 3

(a)

Mark scheme

- M1 dropwise: white precipitate
- 1 M2
- excess: precipitate dissolves
- 1

Solution 3

(b)

Mark scheme

- M1 dropwise: white precipitate
- 1 M2
- excess: precipitate remains / no change
- 1

Solution 3

(c)

Mark scheme

- white precipitate
- 1

Solution 3

(d)

Mark scheme

- no change
- 1

Solution 3

(e)

Mark scheme

- ammonia / NH3
- 1

Solution 3

(f) Mark scheme

- M1 barium / Ba2+
- 1 M2
- nitrate / NO3–
- Ba(NO3)2 = 2/1 0620/63
- May/June 2025
- 4
- any 6 points from:
- ▪

Solution 3

- add sodium chloride / lead nitrate to water
- ▪
- stir / mix / shake (to dissolve)
- ▪
- add / combine / mix the two reactants together
- ▪
- use of a suitable container
- ▪
- filter (to obtain lead(II) chloride as residue)
- ▪

Solution 3

- pour water over the residue (in the funnel)
- ▪
- description of how to dry the solid
- 6

Question 39

0620/22 M25 ▪ Q39 ▪ 1 mark

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

A Ca^{2+} **B** Cr^{3+} **C** Cu^{2+} **D** Fe^{2+}

Solution 39

Answer: **B**

Why

- Cu^{2+} gives a light blue precipitate and Fe^{2+} a green one that does *not* redissolve.
- Ca^{2+} gives a white precipitate.
- Cr^{3+} gives a green precipitate that does dissolve in excess alkali.