



CANDIDATE
NAME

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CENTRE
NUMBER

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CANDIDATE
NUMBER

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5070/32

October/November 2022

1 hour 30 minutes

You must answer on the question paper.

You will need: The materials and apparatus listed in the confidential instructions

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.
- You should show all your working and use appropriate units.

- The total mark for this paper is 40.
- The number of marks for each question or part question is shown in brackets [].
- Notes for use in qualitative analysis are provided in the question paper.

For Examiner's Use	
1	
2	
Total	

This document has **8** pages. Any blank pages are indicated.

- 1 **P** is a sample of dilute nitric acid.

P is prepared by adding 5.0 cm^3 of concentrated nitric acid to distilled water and making the total volume of the solution up to 250 cm^3 with distilled water.

Q is 0.316 mol/dm^3 sodium hydroxide.

- (a) Put **P** into the burette.

Pipette 25.0 cm^3 of **Q** into a flask and titrate with **P** using methyl orange indicator.

Record your results in the table, repeating the titration as many times as you consider necessary to achieve consistent results.

Results

Burette readings

titration number	1	2	
final reading/ cm^3			
initial reading/ cm^3			
volume of P used/ cm^3			
best titration results (✓)			

Summary

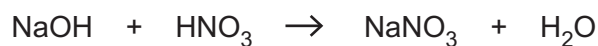
Tick (✓) the best titration results.

Using the best titration results the average volume of **P** required is cm^3 .

[12]

- (b) **Q** is 0.316 mol/dm^3 sodium hydroxide.

The equation for the reaction is shown.



Use your result from (a) to calculate the concentration, in mol/dm^3 , of nitric acid in **P**.

Give your answer to three significant figures.

..... mol/dm^3 [2]

- (c) **P** is prepared by adding 5.0 cm^3 of concentrated nitric acid to distilled water and making the total volume of the solution up to 250 cm^3 with distilled water.

Use your answer from (b) to calculate the number of moles of nitric acid in 5.0 cm^3 of concentrated nitric acid.

..... mol [1]

- (d) Use your answer from (c) to calculate the concentration, in mol/dm^3 , of concentrated nitric acid.

..... mol/dm^3 [1]

- (e) Use your answer from (d) to calculate the mass, in g, of nitric acid, HNO_3 , in 1 dm^3 of concentrated nitric acid.

[M_r : HNO_3 , 63]

..... g [1]

[Total: 17]

2 You are provided with two solutions, **R** and **S**.

(a) Do the following tests on **R** and record your observations in the table.

Test and name any gas evolved.

test no.	test	observations
1	(i) To 1 cm depth of R in a test-tube, add aqueous sodium hydroxide until a change is seen. (ii) To the mixture from (i), add excess aqueous sodium hydroxide.	
2	(i) To 1 cm depth of R in a test-tube, add aqueous ammonia until a change is seen. (ii) To the mixture from (i), add excess aqueous ammonia. (iii) Put 1 cm depth of aqueous hydrogen peroxide in a boiling tube. Add the mixture from (ii) to this boiling tube.	
3	(i) To 1 cm depth of R in a test-tube, add an equal volume of dilute nitric acid. (ii) Pour half of the mixture from (i) into a test-tube and add an equal volume of aqueous barium nitrate or barium chloride. (iii) To the other half of the mixture from (i), add an equal volume of aqueous silver nitrate.	

[11]

(b) **Conclusion**

A solid is used to prepare solution **R**.

The name of the solid is

[1]

(c) Do the following tests on **S** and record your observations in the table.

Test and name any gas evolved.

test no.	test	observations
1	(i) To 1 cm depth of S in a test-tube, add aqueous sodium hydroxide until a change is seen. (ii) To the mixture from (i), add excess aqueous sodium hydroxide.	
2	(i) To 1 cm depth of S in a test-tube, add aqueous ammonia until a change is seen. (ii) To the mixture from (i), add excess aqueous ammonia. (iii) Put 1 cm depth of aqueous hydrogen peroxide in a boiling tube. Add the mixture from (ii) to this boiling tube.	
3	(i) To 1 cm depth of S in a test-tube, add an equal volume of dilute nitric acid. (ii) Pour half of the mixture from (i) into a test-tube and add an equal volume of aqueous barium nitrate or barium chloride. (iii) To the other half of the mixture from (i), add an equal volume of aqueous silver nitrate.	

[10]

(d) **Conclusion**

A solid is used to prepare solution **S**.

The name of the solid is

[1]

[Total: 23]

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QUALITATIVE ANALYSIS NOTES

Tests for anions

<i>anion</i>	<i>test</i>	<i>test result</i>
carbonate (CO_3^{2-})	add dilute acid	effervescence, carbon dioxide produced
chloride (Cl^-) [in solution]	acidify with dilute nitric acid, then add aqueous silver nitrate	white ppt.
iodide (I^-) [in solution]	acidify with dilute nitric acid, then add aqueous silver nitrate	yellow ppt.
nitrate (NO_3^-) [in solution]	add aqueous sodium hydroxide then add aluminium foil; warm carefully	ammonia produced
sulfate (SO_4^{2-}) [in solution]	acidify with dilute nitric acid, then add aqueous barium nitrate	white ppt., insoluble in excess dilute nitric acid

Tests for aqueous cations

<i>cation</i>	<i>effect of aqueous sodium hydroxide</i>	<i>effect of aqueous ammonia</i>
aluminium (Al^{3+})	white ppt., soluble in excess giving a colourless solution	white ppt., insoluble in excess
ammonium (NH_4^+)	ammonia produced on warming	—
calcium (Ca^{2+})	white ppt., insoluble in excess	no ppt.
chromium(III) (Cr^{3+})	green ppt., soluble in excess giving a green solution	green ppt., insoluble in excess
copper(II) (Cu^{2+})	light blue ppt., insoluble in excess	light blue ppt., soluble in excess giving a dark blue solution
iron(II) (Fe^{2+})	green ppt., insoluble in excess	green ppt., insoluble in excess
iron(III) (Fe^{3+})	red-brown ppt., insoluble in excess	red-brown ppt., insoluble in excess
zinc (Zn^{2+})	white ppt., soluble in excess giving a colourless solution	white ppt., soluble in excess giving a colourless solution

Tests for gases

<i>gas</i>	<i>test and test result</i>
ammonia (NH_3)	turns damp red litmus paper blue
carbon dioxide (CO_2)	turns limewater milky
chlorine (Cl_2)	bleaches damp litmus paper
hydrogen (H_2)	'pops' with a lighted splint
oxygen (O_2)	relights a glowing splint

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