| Centre Number | Candidate Number |
|---|---|
| | |

Candidate Name _____

**CAMBRIDGE INTERNATIONAL EXAMINATIONS**

**Joint Examination for the School Certificate and General Certificate of Education Ordinary Level**

# CHEMISTRY 5070/4

PAPER 4 Alternative to Practical

**OCTOBER/NOVEMBER SESSION 2002**

1 hour

Candidates answer on the question paper.
Additional materials:
Mathematical tables and/or calculator

**TIME** 1 hour

## INSTRUCTIONS TO CANDIDATES

Write your name, Centre number and candidate number in the spaces at the top of this page.
Answer **all** questions.
Write your answers in the spaces provided on the question paper.

## INFORMATION FOR CANDIDATES

The number of marks is given in brackets [ ] at the end of each question or part question.
You should use names, not symbols, when describing all reacting chemicals and the products formed.
Mathematical tables are available.

| FOR EXAMINER'S USE |
|---|
| |

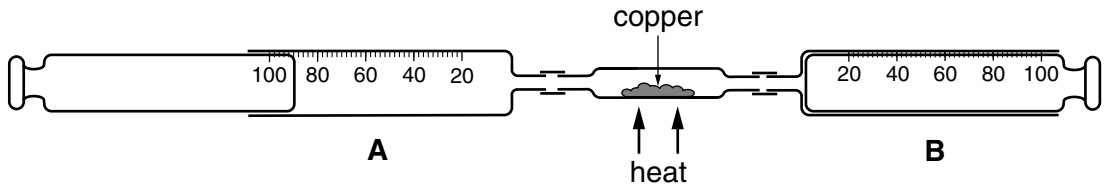
**This question paper consists of 14 printed pages and 2 blank pages.**

SP (SJF2133/PW) S09049/5


UNIVERSITY of CAMBRIDGE
Local Examinations Syndicate

**[Turn over**

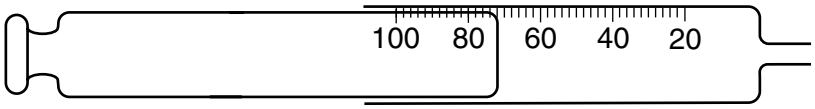
**1** A student found the composition of air using the apparatus shown below.




Syringe **A** contained 90 $cm^3$ of air. The air was forced over heated copper into syringe **B**. The air was then forced back into syringe **A**.

The process was repeated several times until the volume of gas forced back into syringe **A** was constant.

The diagram below shows the volume of gas in syringe **A** after the experiment had finished.




**(a) (i)** Name the main gas remaining in syringe **A**.

.....

**(ii)** What is the volume of gas remaining in syringe **A**?

.....

**(iii)** Calculate the percentage of this gas in the original sample of air.

.....

**(iv)** During the experiment copper formed a compound.

Give the name, formula and colour of this compound.

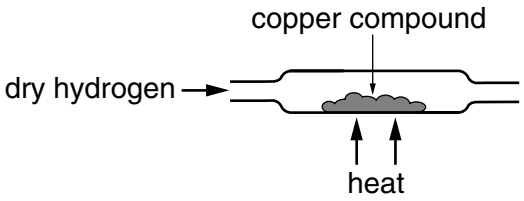
name .....

formula .....

colour .....

[6]

**(b)** The tube containing the copper compound was removed from the syringes. The copper compound was heated and dry hydrogen gas was passed over it.




**(i)** Name the two products of the reaction between hydrogen and the copper compound.

.....

**(ii)** What is the function of hydrogen in this reaction?

.....

**(iii)** Give a test and result to confirm the presence of hydrogen.

test .....

result .....

[4]

**2** Silver iodide may be made by the reaction between aqueous potassium iodide and aqueous silver nitrate.

A student added 50 $cm^3$ of 1.0 $mol/dm^3$ potassium iodide to 30 $cm^3$ of 2.0 $mol/dm^3$ silver nitrate.

$$KI(aq) + AgNO_3(aq) \longrightarrow KNO_3(aq) + AgI(s)$$

**(a) (i)** Describe what was seen during the reaction.

.....

**(ii)** How could the silver iodide be removed from the mixture?

..... [3]

**(b) (i)** Which of the reagents potassium iodide or silver nitrate was in excess? Explain your answer.

answer .....

explanation .....

.....

.....

**(ii)** Calculate the mass of silver iodide formed ($A_r$: Ag, 108; I, 127.)

..... [5]

**(c)** The student did another experiment to make silver chloride by adding 50 $cm^3$ of 1.0 $mol/dm^3$ potassium chloride to 30 $cm^3$ of 2.0 $mol/dm^3$ silver nitrate,

**(i)** Describe the appearance of the silver chloride

on forming, .....

on standing for a few minutes. .....

.....

**(ii)** Was the mass of silver chloride more than, the same or less than the mass of silver iodide in **(b)(ii)**? Explain your answer. ($A_r$: Ag, 108; C*l*, 35.5.)

answer .....

explanation .....

.....

..... [4]

For questions **3** - **6** inclusive, place a tick against the best answer.

**3** A student did some experiments involving carbon dioxide.

Which of the following statements is **not** correct?

**(a)** Carbon dioxide was produced by the reaction between calcium carbonate and dilute hydrochloric acid. ☐

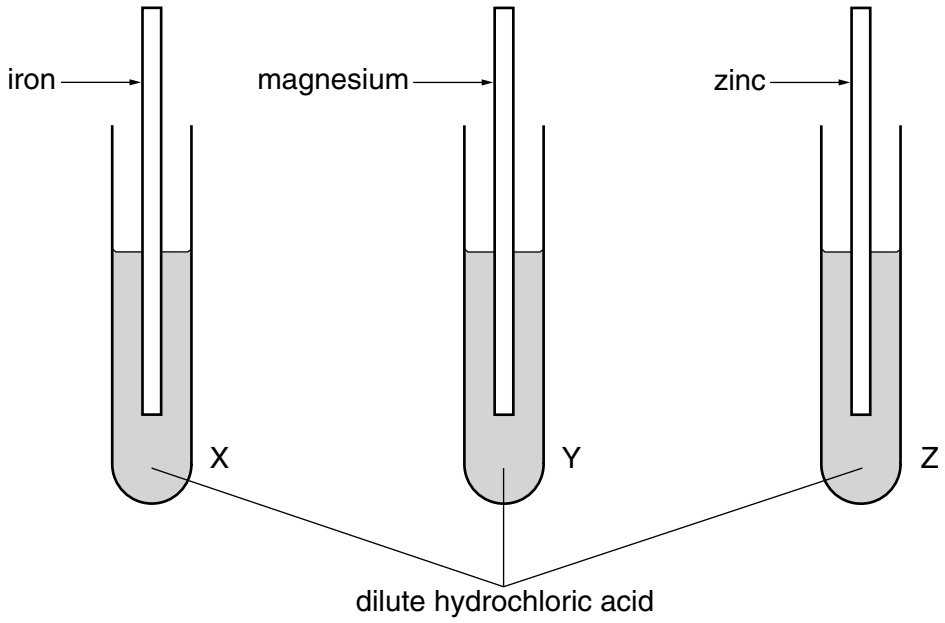
**(b)** The production of carbon dioxide in a solution was indicated by effervescence. ☐

**(c)** A solution of carbon dioxide in water turned red litmus blue. ☐

**(d)** Carbon dioxide turned lime water milky. ☐

[1]

**4** A student placed each of three metals in tubes containing dilute hydrochloric acid.




In which tubes was hydrogen produced?

**(a)** X and Y only, ☐

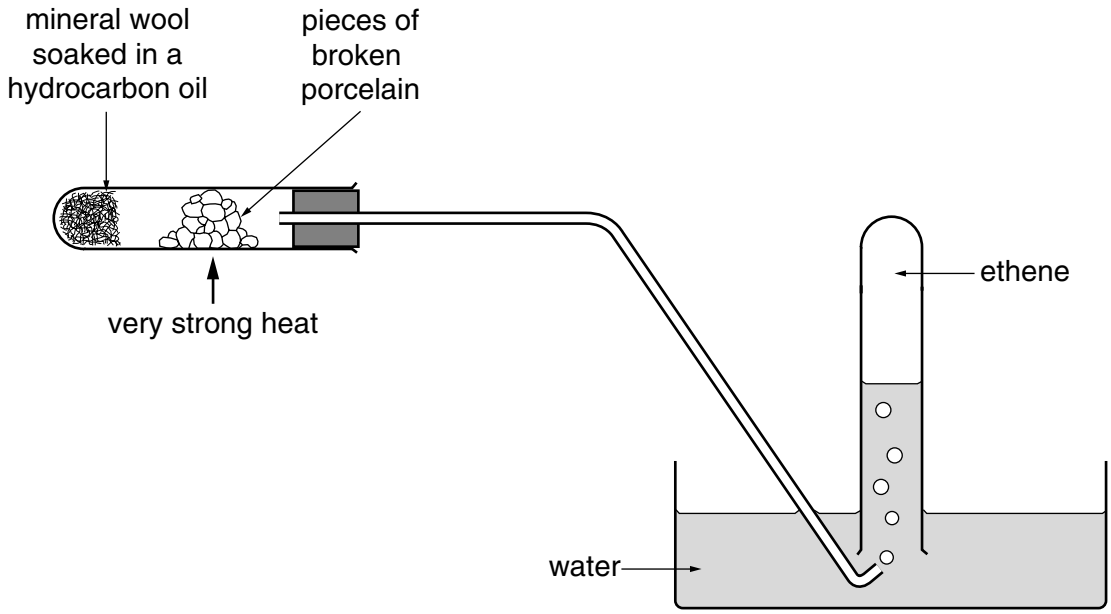
**(b)** X and Z only, ☐

**(c)** Y and Z only, ☐

**(d)** X and Y and Z. ☐

[1]

**5** A student prepared ethene from a hydrocarbon oil using the apparatus shown below.




The reaction is an example of

**(a)** cracking, ☐

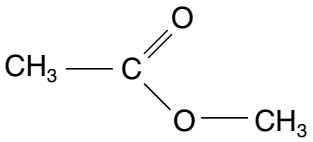
**(b)** oxidation, ☐

**(c)** polymerisation, ☐

**(d)** saturation. ☐

[1]

**6** An ester has the structural formula shown below.




It can be prepared by the reaction between:

**(a)** methanol and methanoic acid. ☐

**(b)** methanol and ethanoic acid. ☐

**(c)** ethanol and methanoic acid. ☐

**(d)** ethanol and ethanoic acid. ☐

[1]

**7** Substance **F** is a fertiliser containing ammonium sulphate.

A student determined the mass of ammonia produced from a sample of **F**.

He added the sample to a previously weighed container which he re-weighed.

| | | |
|---|---|---|
| Mass of container and **F** | = | 10.44 g |
| Mass of container | = | 8.68 g |
| Mass of **F** | = | |

**(a)** Calculate the mass of **F** used in the experiment.

..... g [1]

The sample was placed in a beaker and 50.0 $cm^3$ of 1.00 $mol/dm^3$ sodium hydroxide (an excess) was added.

The mixture was heated until the following reaction was complete.

$$(NH_4)_2SO_4(aq) + 2NaOH(aq) \longrightarrow Na_2SO_4(aq) + 2H_2O(l) + 2NH_3(g)$$

The reaction was complete when all the ammonia was evolved.

**(b)** Describe a chemical test for ammonia.

test .....

result ..... [1]

The remaining mixture, which contained excess sodium hydroxide, was transferred to a graduated flask and made up of 250 $cm^3$ with distilled water. This was solution **G**.

25.0 $cm^3$ of **G** was transferred to a titration flask and a few drops of phenolphthalein indicator was added.

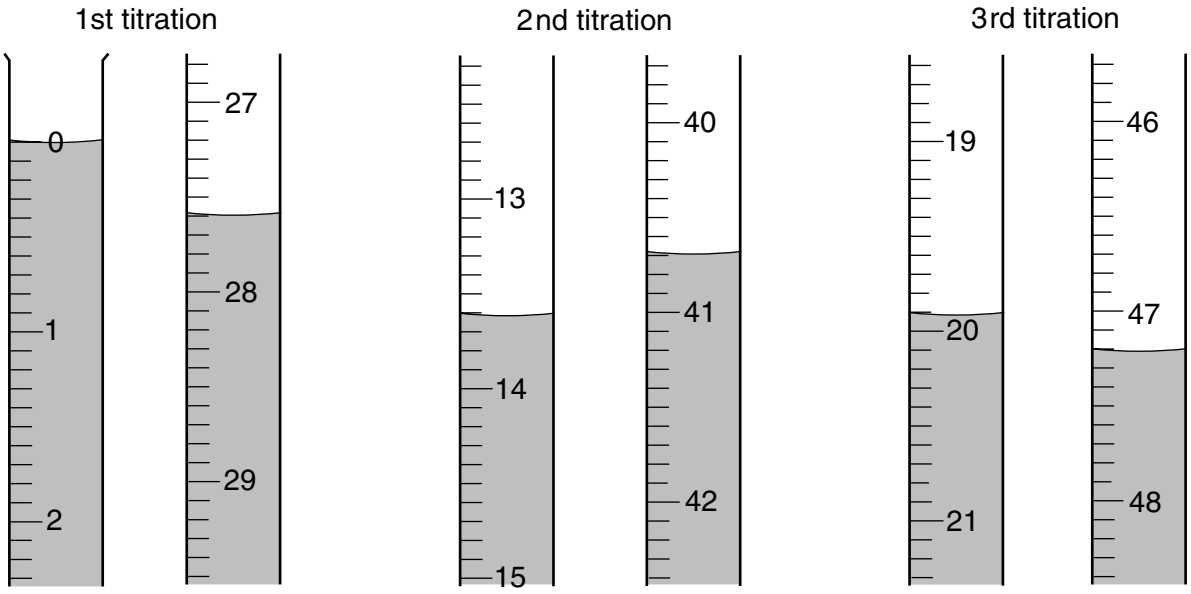
0.100 $mol/dm^3$ hydrochloric acid was added to **G** until an end-point was reached.

Phenolphthalein is colourless in acid and red in alkali.

**(c)** What was the colour change of the indicator at the end-point?

The colour changed from ..... to ..... [1]

Three titrations were done. The diagrams below show parts of the burette at the beginning and end of each titration.




**(d)** Use the diagrams to complete the following table.

| titration number | 1 | 2 | 3 |
|---|---|---|---|
| final reading / $cm^3$ | | | |
| initial reading / $cm^3$ | | | |
| volume of hydrochloric acid used / $cm^3$ | | | |
| best titration results (✓) | | | |

Summary:
Tick (✓) the best titration results. Using these results, the average volume of hydrochloric acid required was …… $cm^3$. [4]

**(e)** Calculate the number of moles of hydrochloric acid in the average volume of 0.100 mol/$dm^3$ hydrochloric acid in **(d)**.

..... [1]

**(f)** Using the equation

$$HCl + NaOH \longrightarrow NaCl + H_2O$$

Deduce the number of moles of sodium hydroxide in 25.0 $cm^3$ of solution **G**.

..... [1]

**(g)** Using your answer in **(f)** calculate the number of moles of sodium hydroxide in 250 $cm^3$ of solution **G**.

..... [1]

**(h)** Calculate the number of moles of sodium hydroxide in 50.0 $cm^3$ of 1.00 $mol/dm^3$ sodium hydroxide.

..... [1]

**(i)** By subtracting your answer in **(g)** from your answer in **(h)** calculate the number of moles of sodium hydroxide which reacted with the sample of **F**.

..... [1]

**(j)** Given that 1 mole of sodium hydroxide produces 17 g of ammonia.

Calculate

**(i)** the mass of ammonia produced from the original sample,

..... g $NH_3$

**(ii)** the mass of ammonia produced from 100 g fertiliser.

..... g $NH_3$ / 100 g fertiliser **F**
[2]



**[Turn over**

**8** The following table shows the tests a student did on substance **S** and the conclusions made from the observations.

Complete the table by describing these observations and suggest the test and observation which led to the conclusion from test 4.

| *Test* | *Observation* | *Conclusion* |
|---|---|---|
| **1** S was dissolved in water and the solution divided into three parts for tests 2, 3 and 4. | | **S** is not a compound of a transition metal. |
| **2** **(a)** To the first part, aqueous sodium hydroxide was added until a change was seen.<br><br>**(b)** An excess of aqueous sodium hydroxide was added to the mixture from **(a)**. | | **S** may contain $Al^{3+}$ or $Zn^{2+}$ ions. |
| **3** **(a)** To the second part, aqueous ammonia was added until a change was seen.<br><br>**(b)** An excess of ammonia was added to the mixture from **(a)**. | | **S** contains $Zn^{2+}$ ions |
| **4** | | **S** contains $Cl^{-}$ ions |

Conclusion: The formula for the compound **S** is ..... [9]

**9** The reaction between aqueous barium chloride and dilute sulphuric acid produces a white precipitate.

**(a)** Name and state the formula of this precipitate.

name .....

formula ..... [1]

A series of experiments was done to find the mass of precipitate produced.

Solution **J** is 1.00 mol/dm$^3$ barium chloride
Solution **K** is 1.00 mol/dm$^3$ sulphuric acid

10.0 cm$^3$ of **J** was put into each of six test tubes. Increasing volumes of **K** were added to each test tube. The mixtures were filtered and the precipitates were washed with water, dried and placed in a weighed container which was reweighed.

The table overleaf shows the results of these experiments.



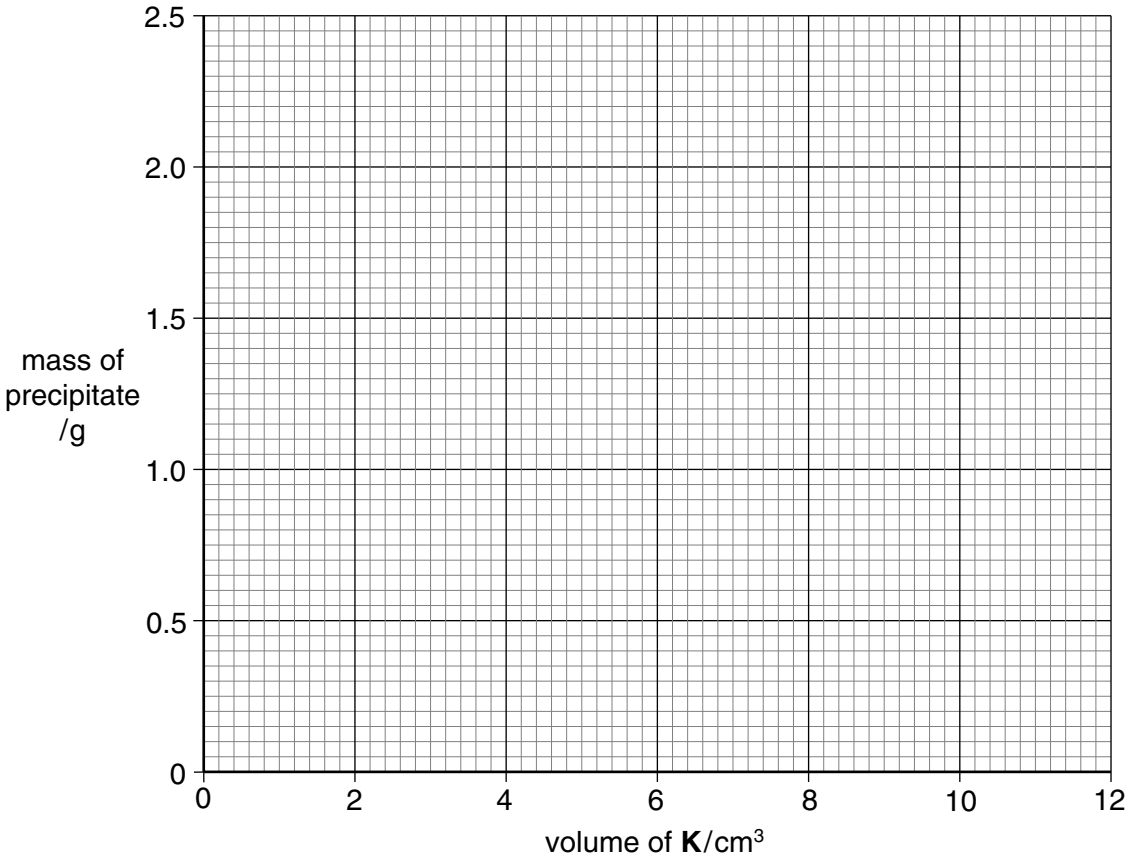
[Turn over

**(b)** Complete the final column to give the mass of the precipitate.

| volume of **J** / $cm^3$ | volume of **K** / $cm^3$ | mass of empty container / g | mass of container and precipitate / g | mass of precipitate / g |
|---|---|---|---|---|
| 10.0 | 2.0 | 3.50 | 3.97 | 0.47 |
| 10.0 | 4.0 | 3.50 | 4.43 | |
| 10.0 | 6.0 | 3.50 | 4.70 | |
| 10.0 | 8.0 | 3.50 | 5.36 | |
| 10.0 | 10.0 | 3.50 | 5.83 | |
| 10.0 | 12.0 | 3.50 | 5.83 | |

[2]

**(c)** Using the grid below, plot the mass of precipitate on the y-axis against the volume of **K** on the x-axis. Join the points with two straight lines.




[3]

**(d)** One of the results is incorrect. Circle the result on your graph and suggest what the correct mass of precipitate should be.

..... g [1]

**(e)** What volume of **K** would produce 1.60 g of precipitate?

..... $cm^3$ [1]

**(f)** Why was the mass of precipitate the same in the last two experiments?

.....

..... [1]

**(g)** The experiment was repeated using the volumes of **J** and **K** as shown in the table below. Using your results from the first experiment, complete the final column showing the mass of precipitate produced in each case.

| volume of **J** / $cm^3$ | volume of **K** / $cm^3$ | mass of precipitate / g |
|---|---|---|
| 2.0 | 2.0 | |
| 2.0 | 4.0 | |
| 2.0 | 6.0 | |

[2]

**BLANK PAGE**

**BLANK PAGE**

# DATA SHEET
## The Periodic Table of the Elements

| Group | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| I | II | | | | | | | | | | III | IV | V | VI | VII | 0 |
| | | | | | | | 1 H Hydrogen 1 | | | | | | | | | 4 He Helium 2 |
| 7 Li Lithium 3 | 9 Be Beryllium 4 | | | | | | | | | | 11 B Boron 5 | 12 C Carbon 6 | 14 N Nitrogen 7 | 16 O Oxygen 8 | 19 F Fluorine 9 | 20 Ne Neon 10 |
| 23 Na Sodium 11 | 24 Mg Magnesium 12 | | | | | | | | | | 27 Al Aluminium 13 | 28 Si Silicon 14 | 31 P Phosphorus 15 | 32 S Sulphur 16 | 35.5 Cl Chlorine 17 | 40 Ar Argon 18 |
| 39 K Potassium 19 | 40 Ca Calcium 20 | 45 Sc Scandium 21 | 48 Ti Titanium 22 | 51 V Vanadium 23 | 52 Cr Chromium 24 | 55 Mn Manganese 25 | 56 Fe Iron 26 | 59 Co Cobalt 27 | 59 Ni Nickel 28 | 64 Cu Copper 29 | 65 Zn Zinc 30 | 70 Ga Gallium 31 | 73 Ge Germanium 32 | 75 As Arsenic 33 | 79 Se Selenium 34 | 80 Br Bromine 35 | 84 Kr Krypton 36 |
| 85 Rb Rubidium 37 | 88 Sr Strontium 38 | 89 Y Yttrium 39 | 91 Zr Zirconium 40 | 93 Nb Niobium 41 | 96 Mo Molybdenum 42 | Tc Technetium 43 | 101 Ru Ruthenium 44 | 103 Rh Rhodium 45 | 106 Pd Palladium 46 | 108 Ag Silver 47 | 112 Cd Cadmium 48 | 115 In Indium 49 | 119 Sn Tin 50 | 122 Sb Antimony 51 | 128 Te Tellurium 52 | 127 I Iodine 53 | 131 Xe Xenon 54 |
| 133 Cs Caesium 55 | 137 Ba Barium 56 | 139 La Lanthanum 57 * | 178 Hf Hafnium 72 | 181 Ta Tantalum 73 | 184 W Tungsten 74 | 186 Re Rhenium 75 | 190 Os Osmium 76 | 192 Ir Iridium 77 | 195 Pt Platinum 78 | 197 Au Gold 79 | 201 Hg Mercury 80 | 204 Tl Thallium 81 | 207 Pb Lead 82 | 209 Bi Bismuth 83 | Po Polonium 84 | At Astatine 85 | Rn Radon 86 |
| Fr Francium 87 | 226 Ra Radium 88 | 227 Ac Actinium 89 † | | | | | | | | | | | | | | | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 140 Ce Cerium 58 | 141 Pr Praseodymium 59 | 144 Nd Neodymium 60 | Pm Promethium 61 | 150 Sm Samarium 62 | 152 Eu Europium 63 | 157 Gd Gadolinium 64 | 159 Tb Terbium 65 | 162 Dy Dysprosium 66 | 165 Ho Holmium 67 | 167 Er Erbium 68 | 169 Tm Thulium 69 | 173 Yb Ytterbium 70 | 175 Lu Lutetium 71 |
| 232 Th Thorium 90 | Pa Protactinium 91 | 238 U Uranium 92 | Np Neptunium 93 | Pu Plutonium 94 | Am Americium 95 | Cm Curium 96 | Bk Berkelium 97 | Cf Californium 98 | Es Einsteinium 99 | Fm Fermium 100 | Md Mendelevium 101 | No Nobelium 102 | Lr Lawrencium 103 |

*58-71 Lanthanoid series
†90-103 Actinoid series

Key

| | |
|---|---|
| a | a = relative atomic mass |
| X | X = atomic symbol |
| b | b = proton (atomic) number |

The volume of one mole of any gas is 24 $dm^3$ at room temperature and pressure (r.t.p.).