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南洋女子中學校

Nanyang Girls' High School

**Preliminary Examination 2022
Secondary 4**

CHEMISTRY

6092/01

Paper 1 Multiple Choice

1 hour

Friday 26 August

1200 – 1300

Additional materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

Do not use staples, paper clips, glue, correction fluid or tape.

Write your name, register number and class in the spaces at the top of this page and on the Answer Sheet in the spaces provided.

There are **forty** questions on this paper. Answer **all** questions. For each question there are four possible answers, **A, B, C** and **D**.

Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.

Any rough working should be done in this booklet.

A copy of the Periodic Table is printed on page 15.

The use of an approved scientific calculator is expected, where appropriate.

This document consists of **15** printed pages and **1** blank page.

Setter(s): FKD

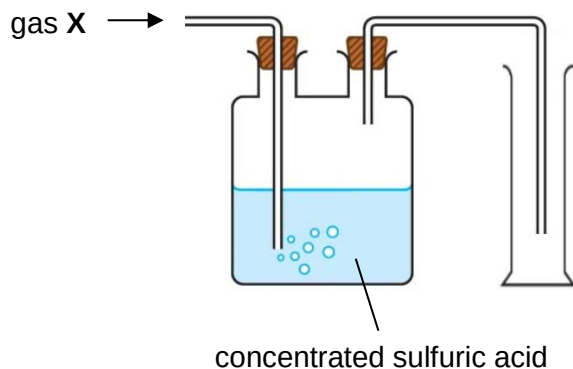
NANYANG GIRLS' HIGH SCHOOL

[Turn over

1 Which apparatus would be most suitable for measuring 24.5 cm^3 of a liquid?

- A burette
- B measuring cylinder
- C pipette
- D syringe

2 The diagram shows an experimental setup to produce and collect a dry sample of gas X.



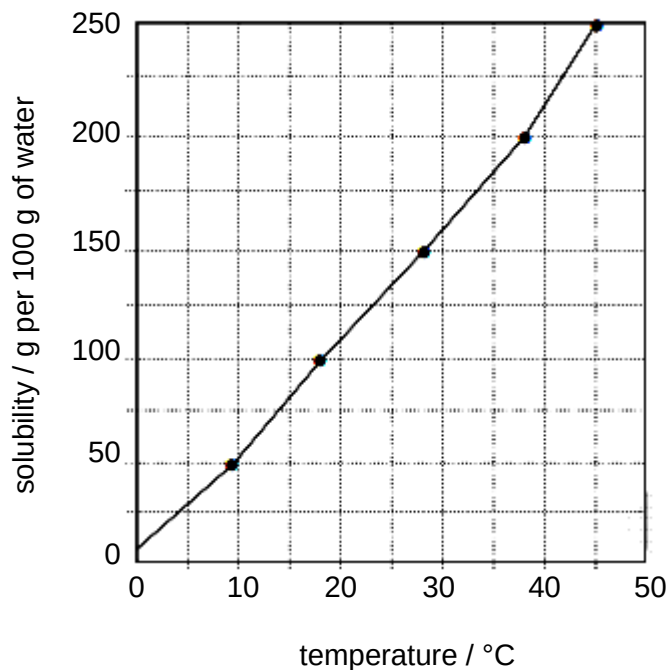
Which of the following is most likely to be gas X?

- A ammonia gas
- B hydrogen gas
- C hydrogen chloride gas
- D steam

3 Which is not correctly matched with the apparatus needed for each separation?

	separation	apparatus
A	oil from a mixture of oil and water	separating funnel
B	salt from a mixture of salt and sand	filter paper, filter funnel, evaporating dish, retort stand, Bunsen burner
C	blue dye from black ink	filter paper, beaker, lid
D	water from seawater	thermometer, fractionating column, condenser

- 4 The graph shows the solubility curve of potassium nitrate in water.



Potassium nitrate solid was dissolved in 400 g of water at 45°C to obtain a saturated solution.

Upon cooling the solution to room temperature (25°C), what is the maximum approximate mass of crystals that can be obtained?

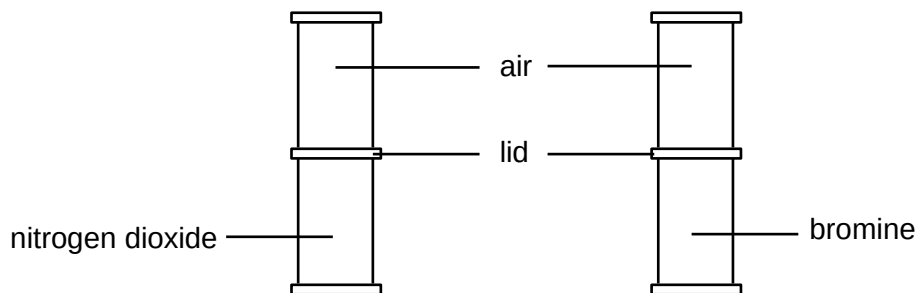
- A** 113 g **B** 138 g **C** 452 g **D** 552 g

- 5 Which of the following tests would be able to distinguish between sulfur dioxide and carbon dioxide gas?

- 1 Bubble the gas into a test tube containing aqueous acidified KMnO_4 .
- 2 Bubble the gas into a test tube containing limewater.
- 3 Place a damp blue litmus paper over the gas.
- 4 Place a lighted splint over the gas.

- A** 1 only **B** 1 and 2 **C** 1 and 3 **D** 2 and 4

- 6 A student carried out an experiment, at room temperature, involving two gas jars filled with equal volumes of nitrogen dioxide gas and bromine gas respectively. The gas jars are sealed with a lid and placed below another gas jar containing air.



The student removed the lids at the same time and observed that the gas jar containing nitrogen dioxide gas fills up the other gas jar more quickly than the gas jar containing bromine gas.

What could be the possible explanation to the difference in the rate of diffusion?

- A Bromine has a higher boiling point than nitrogen dioxide.
 - B Nitrogen dioxide has greater kinetic energy than bromine gas.
 - C Nitrogen dioxide has smaller molecular mass than bromine gas.
 - D There are more atoms in a molecule of nitrogen dioxide than in a bromine molecule.
- 7 An element from the Periodic Table has the following properties.
- It has x number of protons and $x+1$ number of neutrons.
 - It forms an ion with $x+3$ number of electrons.

Which element is this most likely to be?

- A aluminium
- B boron
- C nitrogen
- D phosphorus

8 Some properties of substance Y are listed.

- It has a high melting point.
- It does not conduct electricity in solid state.
- When fluorine gas is bubbled into its solution, a brown solution is obtained.

Which of the following is a possible identity of Y?

- A** calcium chloride
B graphite
C potassium iodide
D sodium

9 Epsom salts contain magnesium sulfate and are often used as a natural remedy for muscle aches, inflammation, and stress.

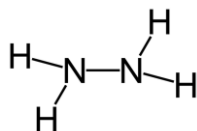
A student wrote down some statements about magnesium sulfate.

- 1 It is made up of a giant lattice structure.
- 2 Strong electrostatic forces of attraction exist between Mg^{2+} , S^{2-} and O^{2-} ions.
- 3 There is both ionic and covalent bonding present.
- 4 The ratio of positive to negative ions is 1:2.

Which of the above statements are correct?

- A** 1 and 2 **B** 1 and 3 **C** 2 and 4 **D** 1, 3 and 4

10 Dihydrogen tetrahydride has the following structure.



What is the total number of valence electrons not involved in bonding?

- A** 2
B 4
C 6
D 8

11 Which of the following enables a metal to conduct electricity?

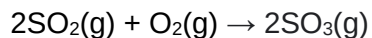
- A** atoms
- B** electrons
- C** ions
- D** protons

12 Vanillin is the main chemical compound present in vanilla bean extract. It contains 63.16 % of carbon, 5.26 % of hydrogen and 31.58 % of oxygen by mass.

What is the empirical formula of vanillin?

- A** $\text{C}_3\text{H}_3\text{O}$
- B** $\text{C}_5\text{H}_5\text{O}_2$
- C** $\text{C}_8\text{H}_8\text{O}_3$
- D** $\text{C}_8\text{H}_8\text{O}_6$

13 Four moles of sulfur dioxide reacted with three moles of oxygen gas according to the following equation at room temperature and pressure.



What is the total volume of gas in the reaction mixture after the reaction is complete?

- A** 48.0 dm³ **B** 72.0 dm³ **C** 96.0 dm³ **D** 120 dm³

- 14** When 12.4 g of copper(II) carbonate, CuCO_3 , was heated, 20 cm^3 of carbon dioxide gas, measured at room temperature and pressure, was released.

What was the percentage yield of carbon dioxide?

- A** 0.833 % **B** 4.17% **C** 41.7 % **D** 83.3 %

- 15** Three electrochemical cells are set up using zinc metal and three other unknown metals P, Q and R as electrodes.

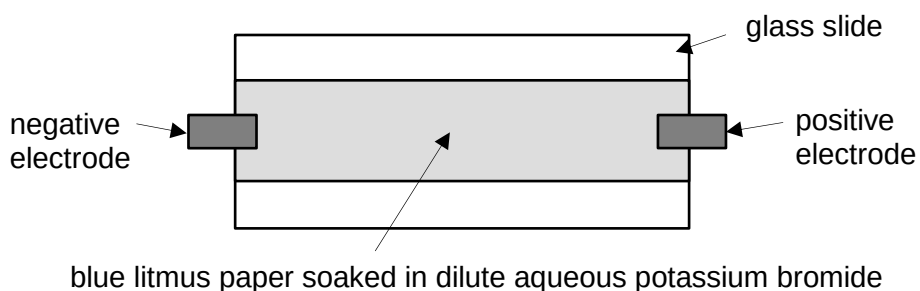
The results of the experiment are shown in the table below.

metal tested	voltmeter reading / V	direction of electron flow
P	0.200	zinc to metal P
Q	0.500	metal Q to zinc
R	1.100	zinc to metal R

Which of the following shows the three unknown metals in increasing order of reactivity?

- A** P, Q, R **B** Q, P, R **C** R, P, Q **D** R, Q, P

- 16** A piece of blue litmus paper was soaked in dilute aqueous potassium bromide and supported on a glass slide. The paper was connected to an electrical supply as shown in the diagram.



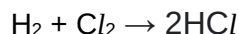
Which of the following shows the correct observations near each electrode after some time?

	negative electrode	positive electrode
A	remain blue	turn red
B	remain blue	turn red and then bleached
C	turn red	remain blue
D	turn red and then bleached	remain blue

17 Which of the following would involve overall energy being released?

- A action of light on silver bromide
- B conversion of water to steam
- C rusting of iron
- D thermal decomposition of calcium carbonate

18 When 17.75 g of Cl_2 is reacted with excess H_2 , 45.5 kJ of energy is given out according to the following equation.

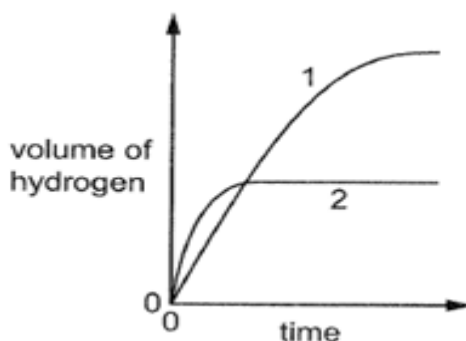
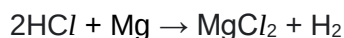


What is the enthalpy change, ΔH , for the reaction?

- A +91
- B -91
- C +182
- D -182

19 100 cm³ of 1 mol/dm³ dilute hydrochloric acid reacted with an excess of magnesium ribbon to produce hydrogen gas according to the equation below.

The volume of hydrogen gas produced was recorded against time in experiment 1.



What could be the quantities of acid and metal used in experiment 2?

	quantity of acid used	metal used
A	100 cm ³ of 1 mol/dm ³ HCl	Mg powder
B	100 cm ³ of 2 mol/dm ³ HCl	Mg ribbon
C	50 cm ³ of 1 mol/dm ³ HCl	Mg powder
D	50 cm ³ of 1 mol/dm ³ HCl	Mg ribbon

- 20** The rate of a reaction increases when the temperature is increased.

Which of the following statements best explain why this is so?

- 1 The activation energy decreases.
- 2 There are more particles with energy equal to or greater than the activation energy.
- 3 The frequency of effective collisions between particles increases.
- 4 The particles in the reaction mixture expand and have a greater surface area to collide.

A 1 and 3 **B** 1 and 4 **C** 2 and 3 **D** 2 and 4

- 21** Which of the following will **not** have their rate of reaction affected by a change in pressure?

- A** $\text{H}_2(\text{g}) + \text{O}_2(\text{g}) \rightarrow \text{H}_2\text{O}_2(\text{l})$
B $\text{I}_2(\text{s}) + \text{Cl}_2(\text{g}) \rightarrow 2\text{ICl}(\text{l})$
C $\text{N}_2\text{H}_4(\text{l}) + \text{O}_2(\text{g}) \rightarrow \text{N}_2(\text{g}) + 2\text{H}_2\text{O}(\text{l})$
D $\text{Na}_2\text{CO}_3(\text{aq}) + \text{H}_2\text{SO}_4(\text{aq}) \rightarrow \text{Na}_2\text{SO}_4(\text{aq}) + \text{H}_2\text{O}(\text{l}) + \text{CO}_2(\text{g})$

- 22** Small portions of aqueous acidified potassium manganate(VII) and aqueous potassium iodide were added separately to four solutions **A** to **D**. The original colour of these solutions was colourless.

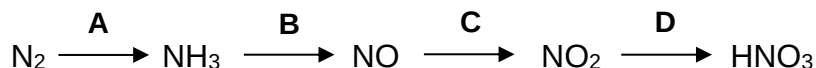
The final colours of the solutions are shown in the table below.

Which solution acts as both an oxidising and a reducing agent?

	aqueous acidified potassium manganate(VII)	aqueous potassium iodide
A	colourless	colourless
B	colourless	brown
C	purple	colourless
D	purple	brown

- 23** The Ostwald process involves the manufacture of nitric acid. Ammonia is first manufactured from nitrogen gas before being used as a raw material for the Ostwald process.

A summary of the manufacturing process is shown below.



Which stage above shows the greatest change in the oxidation state of nitrogen?

- 24** In which row are the oxides correctly identified?

	acidic	amphoteric
A	nitrogen monoxide, carbon monoxide	phosphorus oxide, selenium oxide
B	nitrogen dioxide, silicon dioxide	aluminium oxide, calcium oxide
C	phosphorus oxide, carbon dioxide	lead(II) oxide, zinc oxide
D	sulfur dioxide, manganese oxide	nitrogen monoxide, lithium oxide

- 25** When excess calcium carbonate was reacted with dilute hydrochloric acid, the reaction gradually became slower and eventually stopped.

Which statement best explains this observation?

- A** An insoluble layer of calcium chloride is formed.
- B** As carbon dioxide is produced, it forms a white precipitate with calcium carbonate.
- C** Calcium carbonate was used up completely.
- D** There were no more hydrogen ions present in the reaction mixture.

- 26** Which substances produce an insoluble salt when aqueous solutions of them are mixed?

- A** barium chloride and aluminium nitrate
- B** calcium nitrate and potassium chloride
- C** lead(II) nitrate and zinc chloride
- D** sodium carbonate and ammonium sulfate

27 Which statement about the Haber process is correct?

- A Hydrogen used is obtained from fractional distillation of air.
- B Iron is used as a catalyst.
- C Nitrogen used is obtained from nitrates in the soil.
- D The reaction takes place at room temperature and pressure.

28 T and U are two elements located in Period 4 of the Periodic Table.

Which statement best proves that element U is located on the right side of element T?

- A T is less reactive than U.
- B T loses electrons more easily than U.
- C T forms an acidic oxide while U forms a basic oxide.
- D T has two unpaired valence electrons while U has four unpaired valence electrons.

29 Which statements about rubidium is correct?

- A It reacts with water to form an oxide.
- B It reacts with water to produce a colourless and pungent gas that turns red litmus blue.
- C It reacts with chlorine explosively to form a giant molecular structure.
- D It is a stronger reducing agent than potassium.

30 Which of the following show a decreasing trend down the group VII elements?

- A atomic radius
- B colour intensity
- C melting and boiling point
- D reactivity

31 Some properties of silver and its compounds are stated below.

- 1 Silver can form compounds like Ag_2O and AgF_2 .
- 2 Silver has a high melting point of 962°C .
- 3 Silver is an important catalyst in the production of formaldehyde.
- 4 Silver reacts with chlorine to form a white crystalline solid of silver chloride.

Which of the above statements do not agree with the typical properties of transition metals?

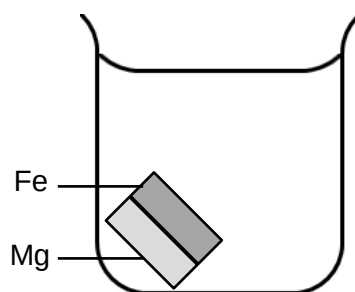
- A 2 only
- B 4 only
- C 1 and 3
- D 2 and 4

32 Four beakers of dilute sodium chloride solution were set up as shown.

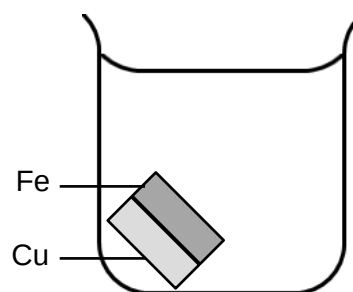
In each beaker, a piece of iron was attached on one side by another piece of metal.

In which beaker would the iron take the shortest time to rust?

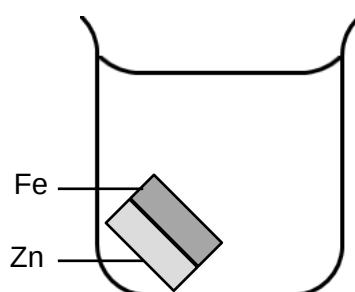
A



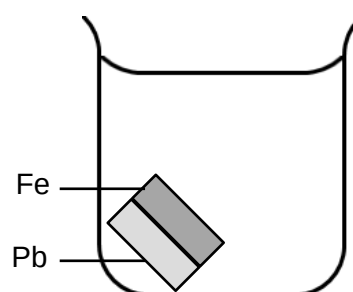
B



C



D



33 When heated strongly, metal X turns red hot and reacts slowly with steam. Metal Y reacts slowly with dilute sulfuric acid and stops reacting halfway through the reaction. Metal Z reacts very slowly with cold water but reacts violently with steam.

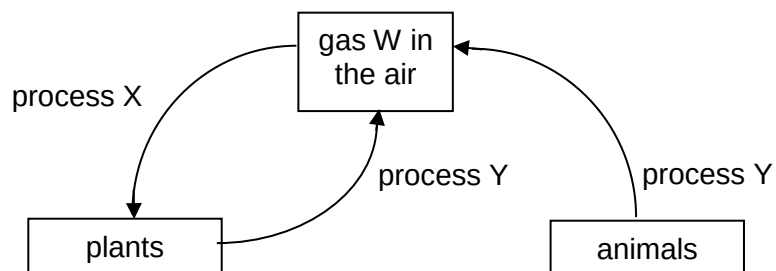
Which method of metal extraction from its ores is most likely to be used?

	electrolysis of molten ore	reduction by carbon
A	Z	X and Y
B	Y	X and Z
C	X and Z	Y
D	Y and Z	X

34 Which statements about the extraction of iron from haematite is correct?

- A** At the bottom of the furnace, molten slag floats on top of molten iron.
- B** At the top of the furnace, hot waste gases such as oxygen escape.
- C** Carbon monoxide acts as the oxidising agent in the process.
- D** The other raw materials used are coke and quicklime.

- 35 The diagram below shows part of the carbon cycle.



What is the correct combination of the identity of gas W and processes X and Y?

	gas W	process X	process Y
A	carbon dioxide	photosynthesis	respiration
B	carbon dioxide	respiration	photosynthesis
C	carbon monoxide	photosynthesis	respiration
D	carbon monoxide	respiration	photosynthesis

- 36 When fossil fuels are burnt incompletely in a motor car, which gases can be found in its exhaust gases?

- I** carbon monoxide
- II** carbon dioxide
- III** sulfur dioxide
- IV** nitrogen

- A** I only **B** I and II **C** I, II and III **D** all of the above

- 37 Which formula below best represents a straight-chain hydrocarbon that contains only single covalent bonds?

- A** C_6H_6 **B** C_6H_{12} **C** C_6H_{14} **D** C_6H_5OH

- 38 Catalytic cracking is a process where long chain alkanes are broken into smaller, more useful molecules.

Which of the following equations correctly represents catalytic cracking?

- A** $C_{16}H_{32} \rightarrow 2C_3H_6 + 2C_5H_{10}$
B $C_{16}H_{32} \rightarrow 16C + 16H_2$
C $C_{16}H_{34} \rightarrow 4C_4H_8 + H_2$
D $C_{16}H_{34} \rightarrow 2C_2H_4 + 2C_6H_6 + 7H_2$

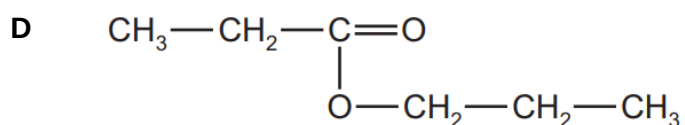
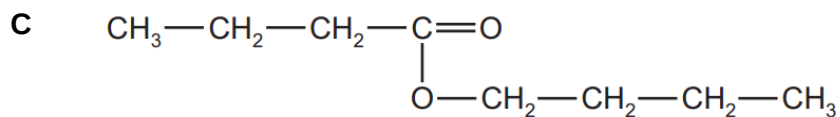
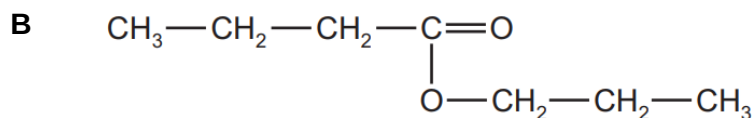
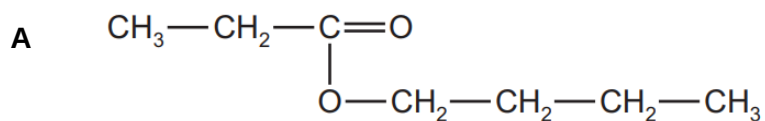
39 Which statements about alcohols are correct?

- 1 Alcohols decolourise aqueous acidified potassium manganate(VII).
- 2 All alcohols contain the hydroxide ion, OH^- .
- 3 Ethanol can be formed from ethene using a reaction catalysed by yeast.
- 4 Propanol can be oxidised to propanoic acid.

A 1 and 2 **B** 1 and 4 **C** 2 and 3 **D** 3 and 4

40 A carboxylic acid of molecular formula $\text{C}_4\text{H}_8\text{O}_2$ reacts with an alcohol of molecular formula $\text{C}_3\text{H}_8\text{O}$ to form an ester.

What could be the formula of the ester formed?



End of paper

The Periodic Table of Elements

Group																																	
I	II											III	IV	V	VI	VII	0																
Key proton (atomic) number atomic symbol relative atomic mass																	1 H hydrogen 1																
3 Li lithium 7	4 Be beryllium 9																5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	2 He helium 4											
11 Na sodium 23	12 Mg magnesium 24																13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40											
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84																
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium -	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131																
55 Cs caesium 133	56 Ba barium 137	57 – 71 lanthanoids		72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium -	85 At astatine -	86 Rn radon -															
87 Fr francium -	88 Ra radium -	89 – 103 actinoids		104 Rf Rutherfordium -	105 Db dubnium -	106 Sg seaborgium -	107 Bh bohrium -	108 Hs hassium -	109 Mt meitnerium -	110 Ds darmstadtium -	111 Rg roentgenium -	112 Cn copernicium -		114 Fl flerovium -		116 Lv livermorium -																	

lanthanoids

57 La lanthanum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium -	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167	71 Lu lutetium 175
89 Ac actinium -	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	93 Np neptunium -	94 Pu plutonium -	95 Am americium -	96 Cm curium -	97 Bk berkelium -	98 Cf californium -	99 Es einsteinium -	100 Fm fermium -	103 Lr lawrencium -

actinoids

The volume of one mole of any gas is 24 dm³ at room temperature and pressure (r.t.p.).