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JURONGVILLE SECONDARY SCHOOL
PRELIMINARY EXAMINATION 2024
Secondary 4 Express

STUDENT NAME			
CLASS		INDEX NUMBER	

CHEMISTRY 6092/01

Paper 1 Multiple Choice **07 August 2024**

1 hour

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use staples, paper clips, highlighters, glue or correction fluid.
Write your name, class and index number in the spaces at the top of this page.

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 Multiple Choice Answer Sheet.

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.

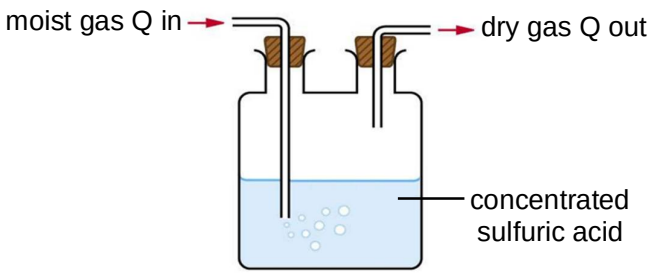
DO NOT OPEN THE BOOKLET UNTIL YOU ARE TOLD TO DO SO

For Examiner's Use
40

Setter: Ms Ethel Chng

This document consists of **15** printed pages.

1 The setup used to dry gas Q is shown.



What can be deduced about gas Q?

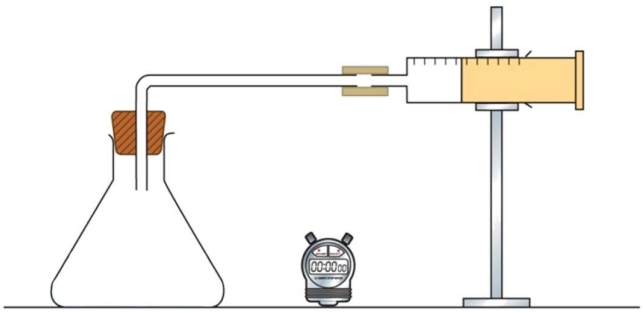
A Gas Q is denser than air.

B Gas Q is either acidic or neutral.

C Gas Q is insoluble in water.

D Gas Q is soluble in concentrated sulfuric acid.

2 The diagram shows a method of measuring the rate of reaction.



Which reaction is **not** suitable for using this method to measure its rate?

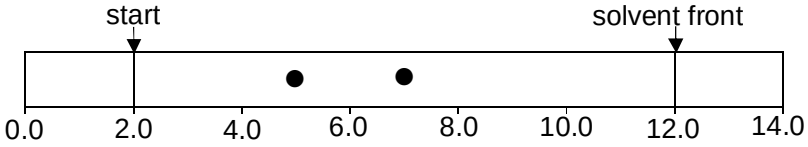
A $C_6H_{12}O_6 \rightarrow 2C_2H_5OH + 2CO_2$

B $CaCO_3 + 2HCl \rightarrow CaCl_2 + H_2O + CO_2$

C $Mg + 2HCl \rightarrow MgCl_2 + H_2$

D $NaOH + NH_4Cl \rightarrow NaCl + NH_3 + H_2O$

3 A food colouring is analysed by paper chromatography.



From its chromatogram, what is the R_f value of the least soluble dye?

A 0.25 **B** 0.30 **C** 0.35 **D** 0.40

4 From which mixture can the first substance be obtained by adding water, stirring and filtering?

A copper and copper(II) chloride

B iodine and magnesium carbonate

C silicon dioxide and zinc oxide

D sodium chloride and sodium sulfate

5 A chemist is given an unknown white powder.

What should the chemist do to determine the purity of the unknown substance?

A burn it in excess oxygen

B conduct a solubility test in water

C measure its melting point

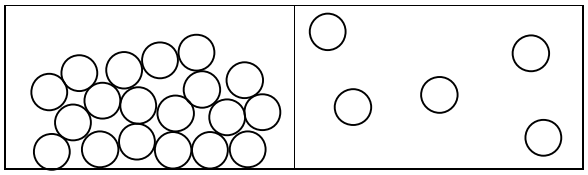
D pass electricity through it

6 An aqueous solution contains a mixture of Cl^-, CO_3^{2-} and SO_4^{2-} ions.

Which aqueous reagent can be added to remove only CO_3^{2-} ions from the mixture?

A $AgNO_3$ **B** $Ba(NO_3)_2$ **C** HNO_3 **D** NaOH

7 The diagrams represent the arrangement of particles in substance T at two different temperatures.

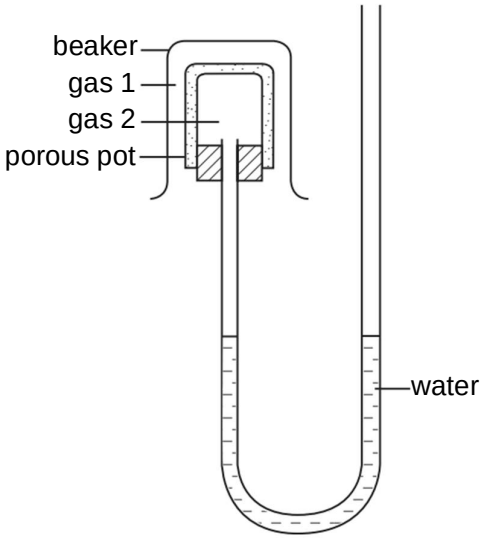


−110 °C 30 °C

What are the melting and boiling points of substance T?

	melting point / °C	boiling point / °C
A	−157	−152
B	−112	−108
C	−101	−35
D	−7	59

8 A beaker containing gas 1 is inverted over a porous pot containing gas 2 as shown.



Which two gases will cause no change in the water level?

A carbon monoxide and nitrogen

B carbon dioxide and nitrogen dioxide

C ethane and ethene

D ethane and propane

9 A particle, with a +4 charge, contains 48 particles in its nucleus and 18 electrons.

What are the numbers of neutrons and protons found in its nucleus?

	number of neutrons	number of protons
A	26	22
B	28	20
C	30	18
D	34	14

10 Which substance contains both covalent and ionic bonds?

A hydrogen chloride

B iron(II) sulfide

C manganese dioxide

D potassium nitrate

11 Phosphorus exists in several allotropes.

White phosphorus is a soft solid with a melting point of 44 °C, while red phosphorus is a hard solid with a melting point of 590 °C.

White phosphorus consists of discrete P_4 molecules, while red phosphorus consists of a network of P_4 units that have been linked.

Which statement is true of these two forms of phosphorus?

A Both forms are soluble in organic solvents and water.

B Both forms can conduct electricity.

C Both forms have a simple molecular structure.

D Both forms have strong covalent bonds between phosphorus atoms.

12 Metals have positive ions in a 'sea' of electrons.

Which statement(s) is/are correct?

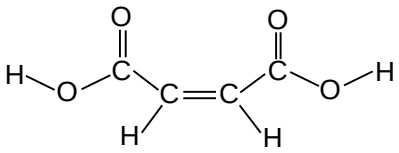
1 Aluminium provides more electrons for the 'sea' than magnesium.

2 The 'sea' of electrons allows metals to conduct electricity only in solid state.

3 The 'sea' of electrons cannot be found in alloys.

A 1, 2 and 3 **B** 1 and 3 only **C** 1 only **D** 2 and 3 only

13 A molecule of maleic acid has its structure shown.



How many valence electrons are **not** shared in this molecule?

A 8 **B** 14 **C** 16 **D** 28

14 How many hydrogen atoms are there in 17 g of phosphine, PH_3?

A 3.01×10^{23} **B** 6.02×10^{23} **C** 9.03×10^{23} **D** 1.20×10^{24}

15 On heating with carbon, the oxide of metal X is reduced.

$$2XO + C \rightarrow 2X + CO_2$$

When 120 g of XO is heated, 18 dm^3 of CO_2 is produced.

What is the relative atomic mass of X?

A 56 **B** 59 **C** 64 **D** 65

16 The industrial production of ammonia is carried out via the Haber process.

Suppose unreacted gases are not recycled, what volumes of nitrogen and hydrogen are required to produce 600 dm^3 of ammonia in a process that is only 15% efficient?

	volume of N_2 / dm^3	volume of H_2 / dm^3
A	45	135
B	255	765
C	300	900
D	2000	6000

17 On heating, sodium hydrogen carbonate decomposes.

$$2NaHCO_3(s) \rightarrow Na_2CO_3(s) + H_2O(l) + CO_2(g)$$

When all 105 g of sodium hydrogen carbonate undergoes thermal decomposition, what is the volume of 0.50 mol/dm^3 of hydrochloric acid required to exactly react with the residue formed?

A 0.40 dm^3 **B** 0.80 dm^3 **C** 1.25 dm^3 **D** 2.50 dm^3

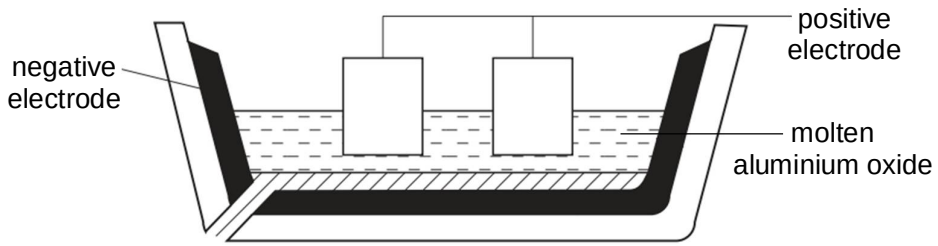
18 The table shows the results for the electrolytic purification of copper, using aqueous copper(II) sulfate as the electrolyte.

	initial mass / g	final mass / g
impure copper anode	110	10
pure copper cathode	10	90

What was the percentage impurity of the impure copper anode?

A 9.1% **B** 27.3% **C** 72.7% **D** 90.9%

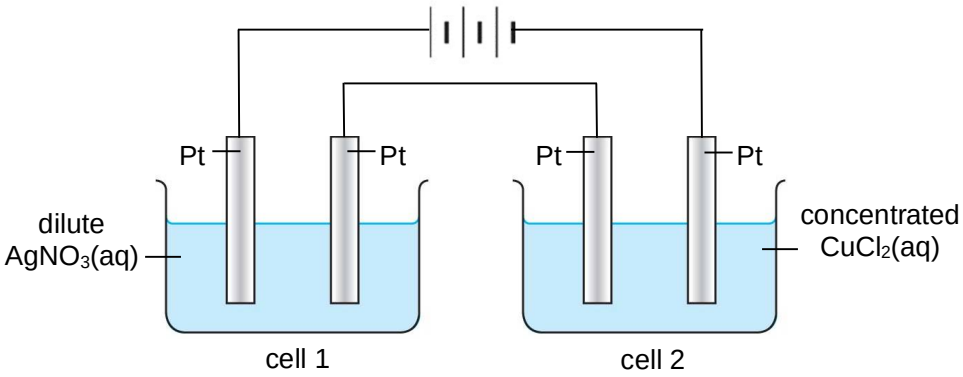
19 The diagram shows the electrolytic production of aluminium.



Which equations represent the reactions taking place at the inert electrodes?

	negative electrode	positive electrode
A	$Al^{3+} + 3e^- \rightarrow Al$	$2O^{2-} \rightarrow O_2 + 4e^-$
B	$Al^{3+} \rightarrow Al + 3e^-$	$2O^{2-} + 4e^- \rightarrow O_2$
C	$2O^{2-} \rightarrow O_2 + 4e^-$	$Al^{3+} + 3e^- \rightarrow Al$
D	$2O^{2-} + 4e^- \rightarrow O_2$	$Al^{3+} \rightarrow Al + 3e^-$

20 Two cells undergoing electrolysis are connected in series.



What are the substances formed at the platinum electrodes?

	cell 1		cell 2	
	anode	cathode	anode	cathode
A	nitrogen	hydrogen	chlorine	hydrogen
B	oxygen	hydrogen	oxygen	copper
C	oxygen	silver	chlorine	copper
D	oxygen	silver	oxygen	hydrogen

21 In combustion reactions, some substances release more energy than others.

The enthalpy change of combustion, ΔH_c, indicates the amount of energy released when one mole of a substance burns completely in oxygen.

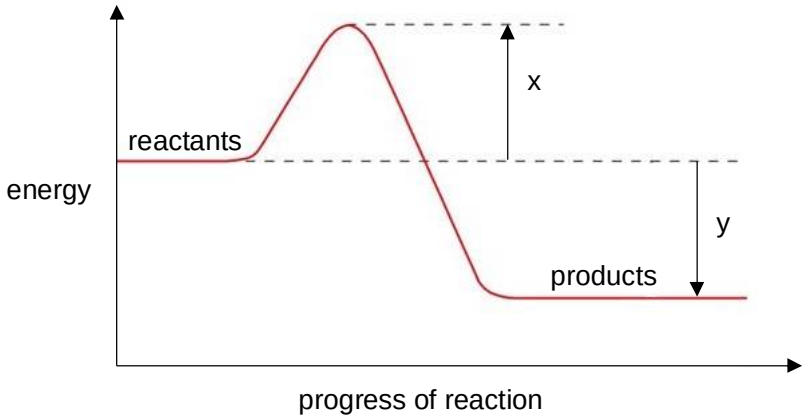
The table shows the ΔH_c of four substances.

substance	formula	state	ΔH_c in kJ/mol
ethanol	C_2H_5OH	liquid	−1367
hydrogen	H_2	gas	−286
octane	C_8H_{18}	liquid	−5470
propane	C_3H_8	gas	−2220

Which substance will release the most energy when 1 g of it is completely combusted?

A ethanol **B** hydrogen **C** octane **D** propane

22 The energy profile diagram for a reversible reaction is shown.



Which statements about the reaction are true?

1 The activation energy of the forward reaction is x.
2 The activation energy of the reverse reaction is x + y.
3 The enthalpy change of the forward reaction has a positive value.
4 The products of the reverse reaction have less energy than reactants.

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

23 What condition(s) used in the Haber process can increase both the reaction rate and yield?

1 operating at a high pressure
2 operating at a high temperature
3 using a finely divided catalyst

A 1, 2 and 3 **B** 1 and 2 only **C** 1 only **D** 2 and 3 only

24 The formula of bromate ion is BrO_3^-.

Which row shows the oxidation states of each element in bromate ion?

	Br	O
A	−1	−6
B	−1	−2
C	+5	−2
D	+5	−6

25 When acidified potassium iodide solution is added to aqueous hydrogen peroxide, a colour change is observed.

Which row shows the colour change and its explanation?

	colour change	explanation
A	brown to colourless	iodide ions gain electrons and are reduced
B	brown to colourless	iodide ions lose electrons and are oxidised
C	colourless to brown	iodide ions gain electrons and are reduced
D	colourless to brown	iodide ions lose electrons and are oxidised

26 When an effervescent tablet is dissolved in water, it produces a fizzing effect due to a chemical reaction involving an acid in the tablet.

Which pair could be involved in the reaction?

A citric acid and sodium bicarbonate
B ethanoic acid and magnesium hydroxide
C hydrochloric acid and potassium
D nitric acid and silver nitrate

27 Fertilisers are usually salts containing nitrogen, phosphorus and potassium.

An ammonium salt is formed when ammonia reacts with an acid.

Which equation representing the formation of ammonium salt is **not** correct?

A $NH_3(g) + CH_3COOH(aq) \rightarrow CH_3COONH_4(aq)$

B $NH_3(g) + HCl(aq) \rightarrow NH_4Cl(aq)$

C $NH_3(g) + HNO_3(aq) \rightarrow NH_4NO_3(aq)$

D $NH_3(g) + H_2SO_4(aq) \rightarrow NH_4SO_4(aq)$

28 When dissolved in water, iron(III) chloride hydrolyses to form iron(III) hydroxide and hydrochloric acid.

Due to the formation of hydrochloric acid, the resulting solution is acidic.

Which row explains the pH of a sample of iron(III) chloride in water?

	pH	explanation
A	3	concentration of H^+ is less than that of OH^-
B	3	concentration of H^+ is more than that of OH^-
C	11	concentration of H^+ is less than that of OH^-
D	11	concentration of H^+ is more than that of OH^-

29 How many soluble salts can be made using only barium chloride, copper(II) oxide, lead and sulfuric acid?

A 0 **B** 1 **C** 2 **D** 3

30 Three elements X, Y and Z have consecutive increasing atomic numbers.

If element X is a noble gas, what will be the formulae of the oxides of Y and Z?

A YO and Z_2O

B Y_2O and ZO

C Y_2O_3 and ZO_2

D YO_2 and Z_2O_3

31 Element J is in the same group as bromine but has a lower boiling point.

Which statement about element J is **not** correct?

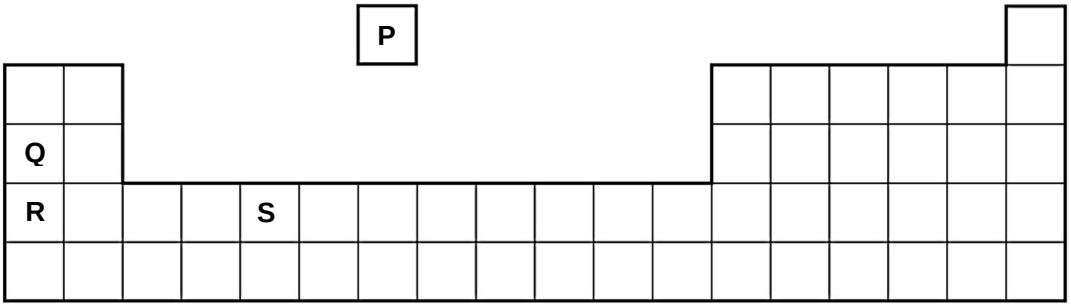
A It can displace bromine from aqueous potassium bromide.

B It has a darker colour than bromine.

C It is a gas at room temperature.

D It is a more powerful oxidising agent than bromine.

32 Part of the Periodic Table is shown.



Which statement about the elements P, Q, R and S is correct?

A P is monatomic.

B P loses an electron when it reacts with Q.

C Q has a lower melting point than R.

D R has a lower density than S.

33 The reactions of metal G and its compounds are shown.

$$G + 2HCl \rightarrow GCl_2 + H_2$$
$$G + Fe(NO_3)_2 \rightarrow G(NO_3)_2 + Fe$$
$$GCO_3 \rightarrow GO + CO_2$$
$$2GO + C \rightarrow 2G + CO_2$$

What could be the identity of G?

A Cu **B** Mg **C** Pb **D** Zn

34 The table shows the reactions of manganese.

reaction with	observation
cold water	no visible change
dilute acid	effervescence
steam	effervescence

Which property of manganese can be determined from these reactions?

A It can be extracted by heating its oxide with carbon.

B It can reduce an oxide of chromium.

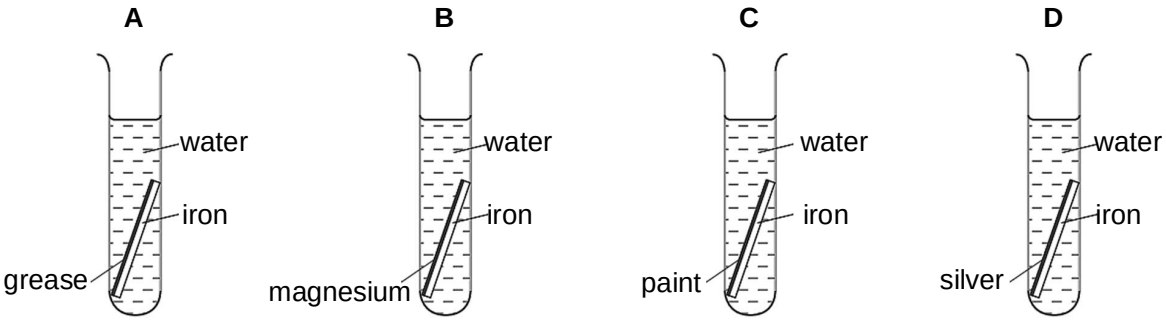
C It reacts with oxygen to form various oxides.

D Its oxides are used as catalysts in various reactions.

35 Four test-tubes were set up as shown.

Each piece of iron was protected on one side by a different coating.

In which test-tube is the iron least likely to rust?



36 Which statement about biofuels is correct?

A Biofuels are carbon-neutral and do not release any carbon dioxide when burnt.

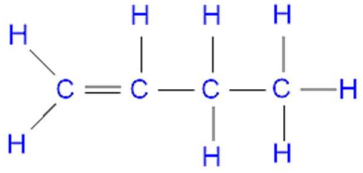
B Biofuels can be mixed with petrol as fuel for motor cars.

C Biofuels can be produced and used with no impact on the environment.

D Biofuels can only be produced from food crops like corn and sugarcane.

37 The figures show two isomers of butene.

1



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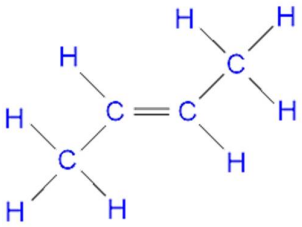


Which statement about these isomers is correct?

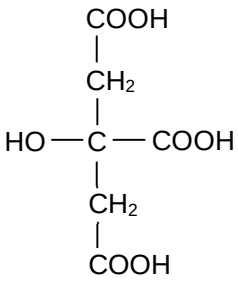
A They are the only two isomers of butene.

B They burn in excess oxygen to produce soot.

C They have slightly different boiling points.

D They react with steam to produce butan-1-ol.

38 The structure of citric acid is shown.



Which statements describe citric acid?

1 It decolourises aqueous bromine.

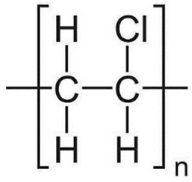
2 It reacts with aqueous sodium carbonate.

3 Its pH can be estimated using Universal Indicator.

4 Its reaction with aqueous sodium hydroxide takes in heat from the surroundings.

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

39 The structure of polyvinylchloride, PVC, is shown.



Which row shows the molecular formula of monomer and type of reaction to synthesize PVC?

	monomer	reaction
A	CH_3Cl	addition polymerisation
B	C_2H_3Cl	condensation polymerisation
C	C_2H_3Cl	addition polymerisation
D	C_2H_5Cl	condensation polymerisation

40 Some polymers undergo depolymerisation through acid hydrolysis.

Which row shows a polymer and its product(s) formed from hydrolysis?

	polymer	product(s)
A	nylon	dicarboxylic acid and diol
B	poly(ethene)	alkene
C	Teflon	alkene
D	Terylene	dicarboxylic acid and diol

End of Paper

The Periodic Table of Elements

Group																	
1	2											13	14	15	16	17	18
							1 **H** hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9		**Key** proton (atomic) numbers atomic symbol name relative atomic mass									5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24	3	4	5	6	7	8	9	10	11	12	13 A*l* aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 C*l* 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 T*l* thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium 209	85 At astatine 210	86 Rn radon 222
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 –	113 Nh nihonium –	114 F*l* flerovium –	115 Mc moscovium –	116 Lv livermorium –	117 Ts tennessine –	118 Og oganesson –

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 162	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175
actinoids	89 Ac actinum –	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 –	101 Md mendelevium –	102 No nobelium –	103 Lr lawrencium –

The volume of any gas is 24 dm^3 at room temperature and pressure (r.t.p.)
The Avogadro constant, $L = 6.02 \times 10^{23}$ mol^{-1}.