Name and Index Number: ( )	Class:

SENG KANG SECONDARY SCHOOL
2024 PRELIMINARY EXAMINATION

CHEMISTRY 6092/01

Secondary 4 Express

27 August 2024

Paper 1 Multiple Choice

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 and index number on all the work you hand in.

There are **forty** questions in 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 Multiple Choice 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 16.
The use of an approved scientific calculator is expected, where appropriate.

Parent's / Guardian's Signature: ……...

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

Do not turn over the page until you are told to do so.

[Turn over

1 Which statement is correct?

A A filtrate is a substance that remains on the filter paper after filtration.

B A saturated solution has the maximum amount of solvent dissolved in the solute.

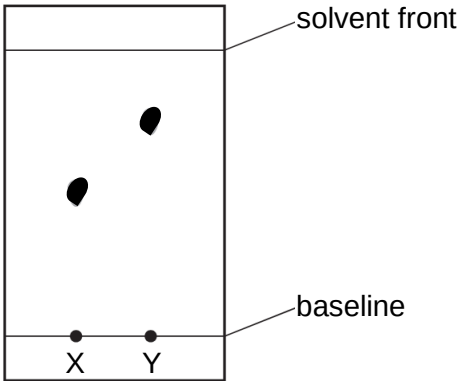
C A solution is a compound produced when a solute reacts with a solvent.

D A substance that remains in the heated flask after distillation is called a residue.

2 The results of a paper chromatography experiment are shown.

X is an aqueous solution of a salt of a Group 1 element.

Y is an aqueous solution of a salt of a transition element.



Which row is correct?

	larger R_f value	requires a locating agent
A	X	X
B	X	Y
C	Y	X
D	Y	Y

3 In which changes do the particles move further apart?

1 A gas is heated from 0 °C to 25 °C.

2 Pressure is applied to a gas at a constant temperature.

3 Steam condenses to form water.

4 Water evaporates at room temperature.

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

4 Data about two compounds is given. Both compounds have a simple molecular structure.

compound	melting point / °C	boiling point / °C
H_2S	−85	−61
PCl_3	−112	76

Two bottles are placed close together inside a large container at a temperature of 90 °C. One bottle contains 1.0 g of H_2S, the other bottle contains 1.0 g of PCl_3.

A detector is placed in the container 2.0 m away from the two bottles. The two bottles are opened at the same time.

Which row is correct?

	compound that reaches detector first	explanation
A	H_2S	gases diffuse faster than liquids
B	H_2S	H_2S has a lower M_r than PCl_3
C	PCl_3	gases diffuse faster than liquids
D	PCl_3	PCl_3 has a lower M_r than H_2S

5 The letters P, Q and R represent different atoms.

$^{40}_{19}P$ $^{39}_{19}Q$ $^{40}_{20}R$

Which statement is correct?

A P and Q are the same element.

B P and R are the same element.

C P has more protons than Q.

D R has more neutrons than Q.

6 Element Z, nucleon number 31, forms an ion Z^{3-}.

Where is Z found in the Periodic Table?

A Group 13 **B** Group 15 **C** Period 4 **D** Period 5

7 The electronic configurations of elements X and Y are as shown.

X: 2,8,3

Y: 2,6

Element X and element Y react together to form a compound.

Which row shows the electron transfer that takes place and the type of compound formed?

	element X	element Y	type of compound
A	2 atoms each loses 3 electrons	3 atoms each receives 2 electrons	covalent
B	2 atoms each loses 3 electrons	3 atoms each receives 2 electrons	ionic
C	2 atoms each receives 3 electrons	3 atoms each loses 2 electrons	covalent
D	2 atoms each receives 3 electrons	3 atoms each receives 2 electrons	ionic

8 Brass is an alloy of copper and zinc.

Which statement is correct?

A Brass can be represented by a chemical formula.

B Brass is formed by a chemical reaction between copper and zinc.

C Brass will react completely with dilute nitric acid.

D The zinc in brass will react completely with dilute nitric acid.

9 Which statements about the relative atomic mass and relative molecular mass are correct?

1 The mass of the different isotopes does not affect relative atomic masses.

2 Only covalent compounds have a relative molecular mass.

3 Relative atomic masses are compared to $\frac{1}{12}$ of the mass of one atom of ^{12}C.

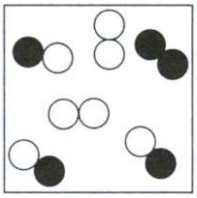
A 1 and 2 only **B** 1 and 3 only **C** 2 and 3 only **D** 1, 2 and 3

10 Hydrogen reacts with bromine to form hydrogen bromide.

Which diagram represents a reaction between hydrogen and bromine that is **not** yet completed?

A

B



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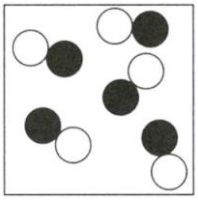

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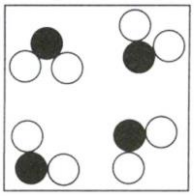


11 Three compounds are listed.

copper(II) nitrate, $Cu(NO_3)_2$

zinc sulfate, $ZnSO_4$

sodium thiosulfate, $Na_2S_2O_3$

Which row shows the element that is present in the greatest percentage by mass in each compound?

[relative formula masses, M_r: $Cu(NO_3)_2$, 188; $ZnSO_4$, 161; $Na_2S_2O_3$, 158]

	copper(II) nitrate	zinc sulfate	sodium thiosulfate
A	copper	oxygen	oxygen
B	copper	oxygen	sulfur
C	oxygen	zinc	sodium
D	oxygen	zinc	sulfur

12 Compound T is the only substance formed when 500 cm^3 of ammonia reacts with 250 cm^3 of carbon dioxide. All measurements are at room temperature and pressure.

What is the formula of T?

A $(NH_2)_2CO$ **B** $(NH_4)_2CO_3$ **C** NH_2COONH_4 **D** NH_4COONH_4

13 The equation shows the production of iron from its ore, iron(III) oxide.

$$Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$$

80 tonnes of iron(III) oxide produces 50 tonnes of iron.

What is the percentage yield?

A 45% **B** 63% **C** 68% **D** 89%

14 Which statement about hydrochloric acid is correct?

A Hydrochloric acid is formed when hydrogen chloride gas dissolves in water.

B Hydrochloric acid reacts with magnesium to form magnesium chloride and water.

C When hydrochloric acid is added to acidified silver nitrate, yellow precipitate is observed.

D When hydrochloric acid is warmed with aqueous ammonium chloride, ammonia gas is evolved.

15 An excess of substance E is added to the acid that is spilled onto the laboratory bench. The solution produced as a result is neutral.

What is substance E?

A aqueous ammonia

B aqueous sodium hydroxide

C calcium carbonate powder

D water

16 Compound G is a gas at room temperature. G dissolves in water to give a solution with a pH of 4.

Which statement about compound G is correct?

A An aqueous solution of G will not conduct electricity.

B Atoms of a metallic element are present in G.

C Atoms of hydrogen are present in G.

D G is ionically bonded.

17 The table shows the pH values of four substances that can be consumed by humans.

substance	pH value
P	6.6
Q	3.1
R	10.4
S	7.8

Which statement about these substances is correct?

A P is alkaline.

B Q has the lowest concentration of hydrogen ions.

C R can neutralise excess stomach acid.

D S has a pH value closest to neutral.

18 The addition of calcium hydroxide to soil reduces its acidity but also reduces the efficiency of fertilisers.

Which two equations explain this?

1 $Ca(OH)_2(s) + CO_2(g) \rightarrow CaCO_3(s) + H_2O(l)$

2 $Ca(OH)_2(s) + 2H^+(aq) \rightarrow Ca^{2+}(aq) + 2H_2O(l)$

3 $Ca(OH)_2(s) + 2NH_4NO_3(aq) \rightarrow Ca(NO_3)_2(aq) + 2NH_3(g) + 2H_2O(l)$

4 $Ca(OH)_2(s) + Cu^{2+}(aq) \rightarrow Cu(OH)_2(s) + Ca^{2+}(aq)$

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

19 A pure sample of a salt is obtained by filtration followed by evaporation of the filtrate.

Which pair of reagents would produce the salt?

A aqueous silver nitrate and hydrochloric acid

B aqueous sodium hydroxide and hydrochloric acid

C excess copper(II) oxide and hydrochloric acid

D platinum and hydrochloric acid

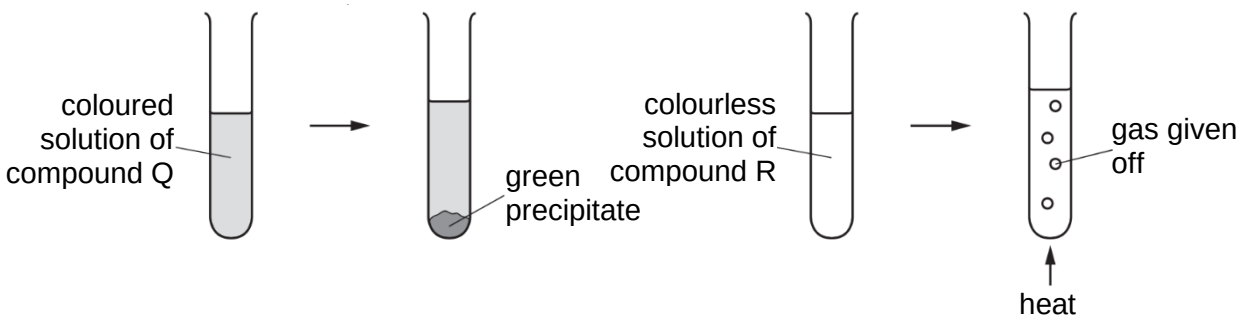
20 A solution of sodium carbonate is added to tap water. A white precipitate forms.

Which ion present in the tap water causes the precipitate to form?

A chloride **B** magnesium **C** potassium **D** sulfate

21 Aqueous sodium hydroxide is used to identify the ions present in aqueous solutions of compounds Q and R.

The results are shown.



before addition of aqueous sodium hydroxide	after addition of a few drops of aqueous sodium hydroxide	before addition of aqueous sodium hydroxide	after addition of aqueous sodium hydroxide

Which row is correct?

	ion in compound Q	ion in compound R
A	Fe^{2+}	NH_4^+
B	Fe^{2+}	NO_3^-
C	Fe^{3+}	NH_4^+
D	Fe^{3+}	NO_3^-

22 Which reagent and observation describes the test for an oxidising agent?

	reagent	colour change
A	acidified aqueous potassium manganate(VII)	colourless to purple
B	acidified aqueous potassium manganate(VII)	purple to colourless
C	aqueous potassium iodide	brown to colourless
D	aqueous potassium iodide	colourless to brown

23 Aqueous copper(II) sulfate is electrolysed with copper electrodes.

What is the equation for the reaction occurring at the anode?

A $Cu \rightarrow Cu^{2+} + 2e^-$

B $Cu^{2+} + 2e^- \rightarrow Cu$

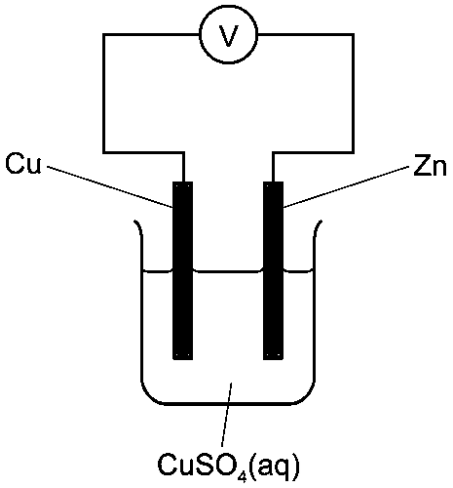
C $4OH^- \rightarrow O_2 + 2H_2O + 4e^-$

D $2SO_4^{2-} + 2H_2O \rightarrow 2H_2SO_4 + O_2 + 4e^-$

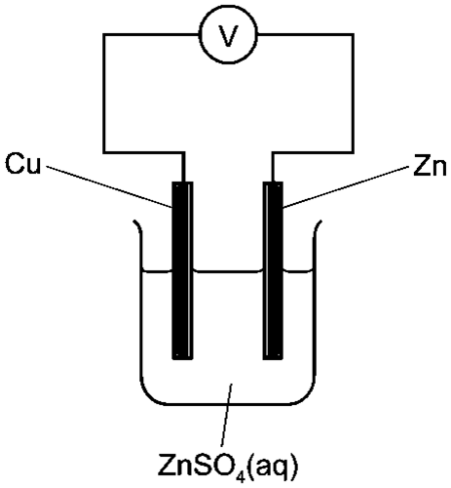
24 Students proposed four cells to produce electricity in a school laboratory.

Which cell would produce the largest voltage in a safe way?

A



B



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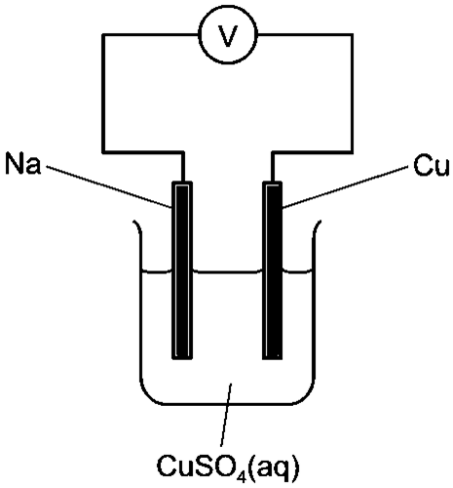

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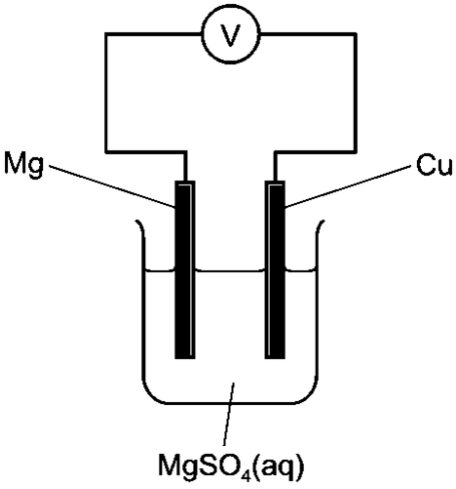


25 Many properties of an element and its compounds can be predicted from the position of the element in the Periodic Table.

What property could **not** be predicted in this way?

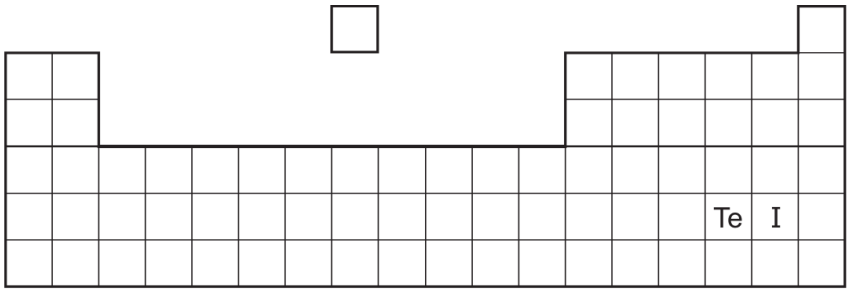
A its metallic or non-metallic properties

B the acidic or basic nature of its oxide

C the formula of its oxide

D the number of isotopes it has

26 Iodine, I, has a lower relative atomic mass than tellurium, Te, but is placed after it in the Periodic Table.



Which statement explains why iodine is placed after tellurium in the Periodic Table?

A Iodine has fewer neutrons than tellurium.

B Iodine has fewer protons than tellurium.

C Iodine has more neutrons than tellurium.

D Iodine has more protons than tellurium.

27 Elements in Group 1 of the Periodic Table react with water.

Which row describes the products made in the reaction and the trend in reactivity of the elements?

	products	trend in reactivity
A	metal hydroxide and hydrogen	less reactive down the group
B	metal hydroxide and hydrogen	more reactive down the group
C	metal oxide and hydrogen	less reactive down the group
D	metal oxide and hydrogen	more reactive down the group

28 Which statement about the Group 17 halogens is correct?

A Bromine consists of Br_2 molecules at room temperature and pressure.

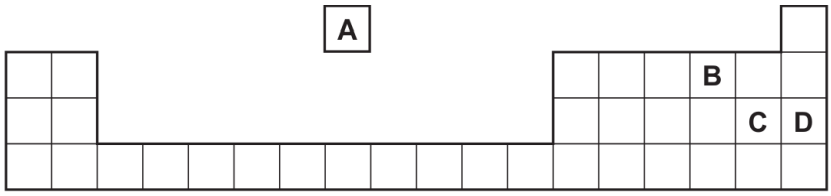
B Iodine will displace bromine from aqueous potassium bromide.

C The halogens become darker in colour as the relative molecular mass decreases.

D The halogens become more volatile as the relative molecular mass increases.

29 Part of the Periodic Table is shown.

Which substance is an unreactive gas found in the atmosphere?



30 Which statement about corrosion of metals is correct?

A A barrier method is needed to prevent the corrosion of stainless steel.

B Iron corrodes to produce hydrated iron(I) oxide.

C Sacrificial protection uses a less reactive metal attached to the metal object that is being protected.

D When corrosion occurs, the metal loses electrons to become positive ions.

31 Some metals and the compounds in their ores are shown.

metal	A*l*	Ca	Pb	Na	Fe	Mg
compound in ore	Al_2O_3	$CaCO_3$	PbS	Na*Cl*	Fe_2O_3	$MgCO_3$

Which type of reaction occurs in the extraction of each metal from its ore?

A electrolysis

B precipitation

C reduction

D thermal decomposition

32 Two reactions are done.

Reaction 1: Hydrated cobalt(II) chloride is heated. It changes colour.

Reaction 2: Water is added to the product of reaction 1. It becomes hotter. The original colour is produced.

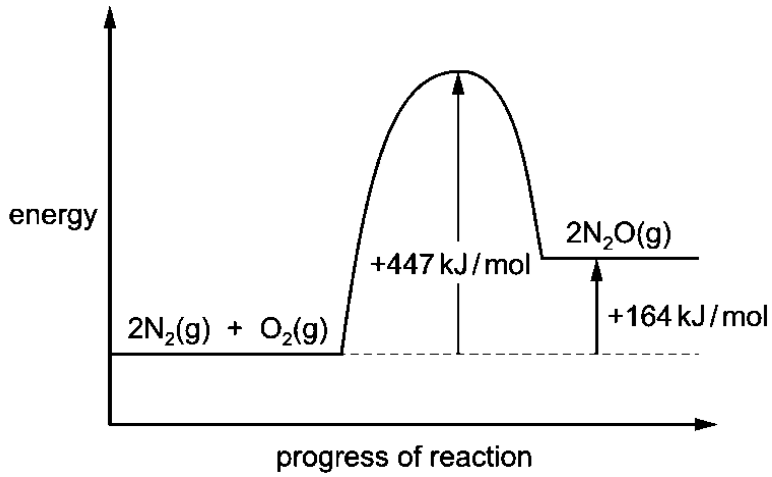
Which types of reaction have occurred in reactions 1 and 2?

	endothermic	exothermic	neutralisation	reversible
A	✓	✓	✓	✓
B	✓	✓	✓	×
C	✓	✓	×	✓
D	✓	×	×	✓

33 Under certain conditions, nitrogen reacts with oxygen to form N_2O.

$$2N_2(g) + O_2(g) \rightleftharpoons 2N_2O(g)$$

The reaction pathway diagram is shown.



What is the activation energy of the reverse reaction?

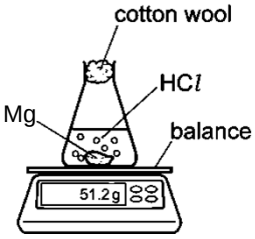
A −447 kJ/mol **B** −283 kJ/mol **C** +141.5 kJ/mol **D** +283 kJ/mol

34 A student plans to investigate how the rate of the reaction changes when hydrochloric acid and magnesium react.

$$Mg(s) + 2HCl(aq) \rightarrow MgCl_2(aq) + H_2(g)$$

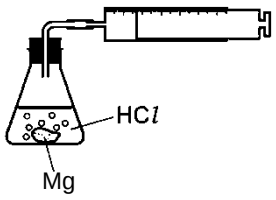
Three methods are described.

1



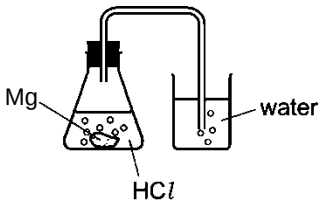
Record the mass of the flask and contents every 30 seconds for 5 minutes.

2



Measure and record the volume of gas in the syringe after 30 seconds.

3



Count and record the total number of bubbles of gas in the water every 30 seconds for 5 minutes.

Which methods could be used to measure how the rate of reaction changes?

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

35 In which reaction is the pressure **least** likely to affect the rate of reaction?

A $C(s) + CO_2(g) \rightarrow 2CO(g)$

B $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$

C $NaOH(aq) + HCl(aq) \rightarrow NaCl(aq) + H_2O(l)$

D $2SO_2(g) + O_2(g) \rightarrow 2SO_2(g)$

36 Hydrogen is used as a reactant both in the Haber process and in its addition to alkenes.

Which row is correct?

	catalyst in the Haber process	product of addition of hydrogen to an alkene
A	iron	alcohol
B	iron	alkane
C	nickel	alcohol
D	nickel	alkane

37 In the fractional distillation of petroleum, different fractions are obtained at the top and bottom of the fractionating column.

Which properties does the fraction obtained at the top of the fractionating column have, compared with the fraction obtained at the bottom?

1 higher viscosity

2 lower boiling point

3 lower volatility

4 shorter chain length

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

38 Which statement about organic compounds is correct?

A Each molecule of propan-1-ol has one –OH group and each molecule of propan-2-ol has two –OH groups.

B Octane and decane are in a homologous series with the general formula C_nH_{2n}.

C The ester butyl butanoate has eight carbon atoms in each molecule.

D The structure of the functional group in a carboxylic acid is –C–O–O–H.

39 A chlorine atom can replace a hydrogen atom in a molecule of butane, $CH_3CH_2CH_2CH_3$, to form chlorobutane.

How many different structural isomers of chlorobutane can be formed?

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

40 Different strategies to reduce the effects of environmental issues have been suggested.

Which row is correct?

	strategy to reduce the effects of climate change	strategy to reduce the effects of acid rain
A	reduction in livestock farming	planting trees
B	reduction in livestock farming	using low-sulfur fuels
C	reduction in use of renewable energy	planting trees
D	reduction in use of renewable energy	using low-sulfur fuels

END OF PAPER

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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) number 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 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 –	113 Nh nihonium –	114 Fl 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 163	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175
actinoids	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 –	101 Md mendelevium –	102 No nobelium –	103 Lr lawrencium –

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