E

GAN ENG SENG SCHOOL
End-of-Year Examination 2023

CANDIDATE NAME			
CLASS		**INDEX NUMBER**	

CHEMISTRY
Paper 1 Multiple Choice

6092/01

11 October 2023
1 hour

Sec 3 Express

Additional Materials: OTAS

Calculators are allowed in the examination.

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 on the OTAS.

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 separate OTAS.

Read the instructions on the OTAS 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.

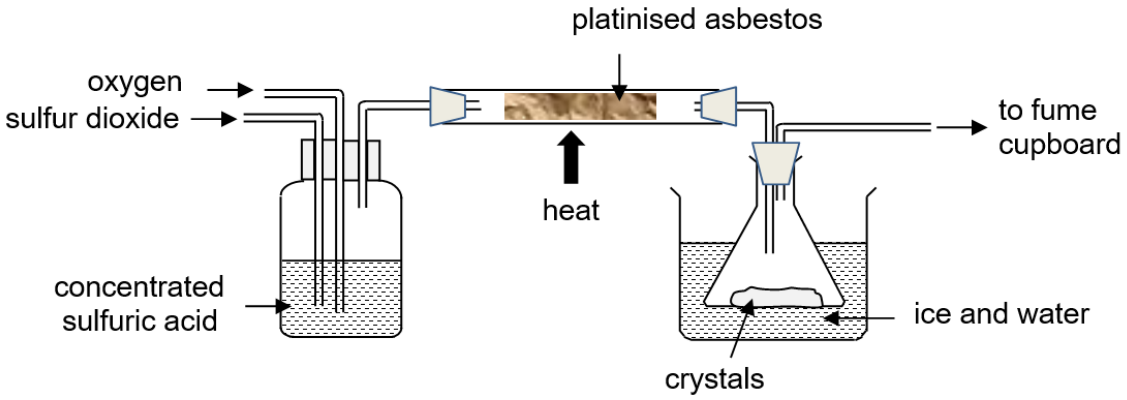
A copy of the Periodic Table is found on page 14.

Total Marks
40

1 Which apparatus is most suitable for measuring 22.15 cm^3 of sodium hydroxide?

A beaker
B burette
C measuring cylinder
D pipette

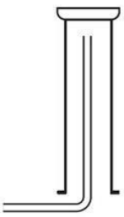
2 In the experimental set-up shown below, sulfur dioxide was reacted with oxygen to form sulfur trioxide by passing the mixture through heated platinised asbestos (a substance that speeds up the reaction).



What is the function of concentrated sulfuric acid?

A to acidify the mixture
B to act as a drying agent
C to act as a medium for the two reactant gases to mix
D to remove impurities

3 The apparatus below shows the method to collect gas **X**.

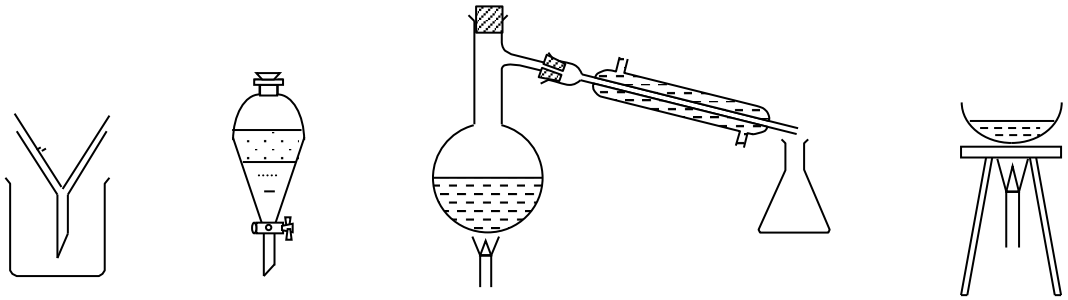


Which properties of gas **X** can be deduced?

A denser than air
B insoluble in water and denser than air
C less dense than air
D soluble in water and less dense than air

4 A mixture contains solid **Y** mixed with ethanol. Solid **Y** is insoluble in ethanol. Ethanol is an alcohol that has a boiling point of 78 ºC and **Y** has a boiling point of 103 ºC.

Which of the following apparatus represents the best method used to obtain both solid **Y** and ethanol?



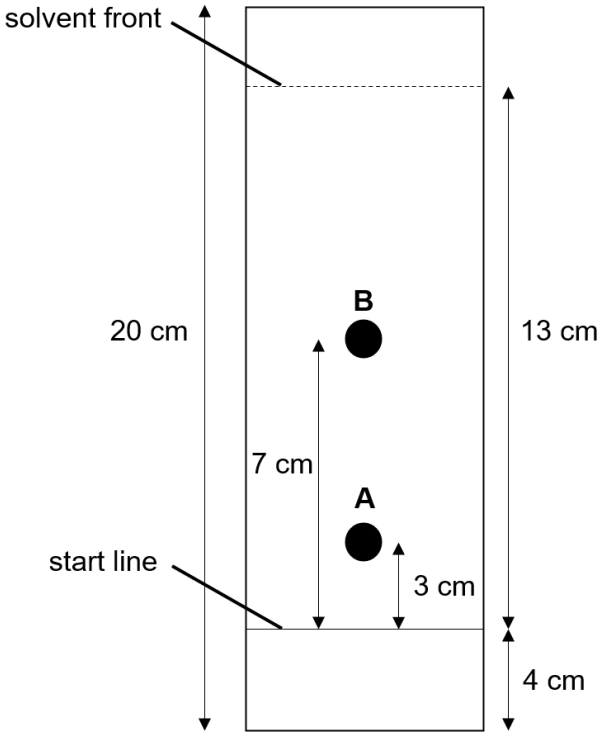
A **B** **C** **D**

5 Megan performed chromatography on some ink samples. The chromatogram below was obtained.

What could Megan have done wrong in her experiment?

A the initial spots of ink were too small
B the ink samples were insoluble in the solvent chosen
C the starting line was drawn with a pen
D the solvent level was above the starting line

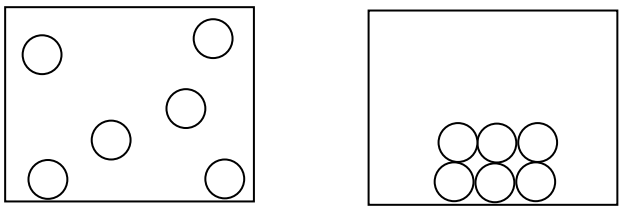
6 The diagram shows the chromatogram obtained by analysis of a single dye.



Which of the following is the correct R_f value of spot **B**?

A 0.231
B 0.350
C 0.412
D 0.538

7 The diagram below shows the spacing of the particles in a substance **Z** at two different temperatures.



at 232 ºC at 179 ºC

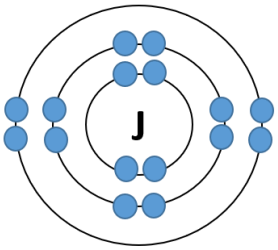
Which of the following could be substance **Z**?

	melting point/ ºC	boiling point/ ºC
A	– 21	– 9
B	160	210
C	183	253
D	194	229

8 Which option correctly describes the locations of the sub-atomic particles in an atom?

	proton	neutron	electron
A	in the nucleus	in the nucleus	orbiting the nucleus
B	in the nucleus	in the nucleus	in the nucleus
C	orbiting the nucleus	in the nucleus	orbiting the nucleus
D	orbiting the nucleus	orbiting the nucleus	in the nucleus

9 Isaac drew the electronic structure of the atom of an unknown element **J** as shown below.



Some statements made about the mistakes that Isaac made are shown below.

I the innermost shell cannot contain four electrons
II the second shell cannot contain eight electrons
III the electron pairs in the third shell should be placed at the top and bottom of the shell, instead of the left and right
IV the third shell must be fully filled with electrons

Which of the above statement(s) correctly describes the mistake(s) Isaac has made?

A **I** only
B **I** and **IV** only
C **I**, **III**, and **IV** only
D **II** and **III** only

10 Oxygen reacts with a metal **X** to form an ionic compound **X**O.

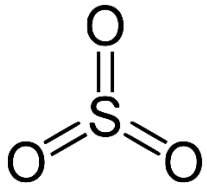
Which statement about oxygen is correct when forming this compound?

A one atom of oxygen gives away one electron to an atom of **X**
B one atom of oxygen gives away two electrons to an atom of **X**
C one atom of oxygen receives one electron from an atom of **X**
D one atom of oxygen receives two electrons from an atom of **X**

11 In which of the following sets do all the particles have the same number of electrons?

A F^-, Cl^-, Br^-
B H^+, He, N^{3-}
C K^+, Ca^{2+}, P^{3-}
D Na^+, Mg^{2+}, S^{2-}

12 The bonding of sulfur trioxide is shown below.



How many electrons are **not** involved in bonding in each oxygen atom?

A 2
B 4
C 6
D 8

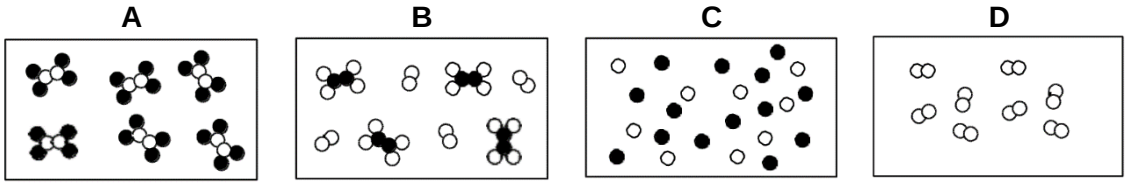
13 Which of the following pairs of elements forms covalent bonds?

A bromine and calcium
B phosphorus and oxygen
C strontium and sulfur
D zinc and chlorine

14 Which of the following correctly describes metallic bonding?

A electrostatic forces of attraction between positive metal ions surrounded by a 'sea of delocalised electrons'
B electrostatic forces of attraction between negative metal ions surrounded by a 'sea of delocalised electrons'
C intermolecular forces of attraction between positive metal ions surrounded by a 'sea of delocalised electrons'
D intermolecular forces of attraction between negative metal ions surrounded by a 'sea of delocalised electrons'

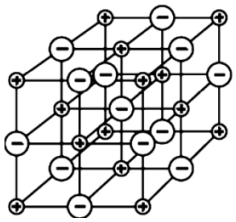
15 Which diagram shows a mixture of an element and a compound?



16 Which physical properties below are true of potassium oxide?

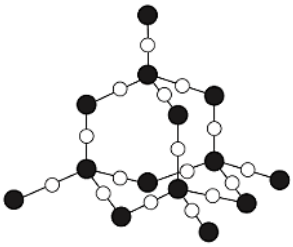
A hard and brittle
B hard and malleable
C soft and brittle
D soft and malleable

17 Which of the following structures represents lithium bromide?

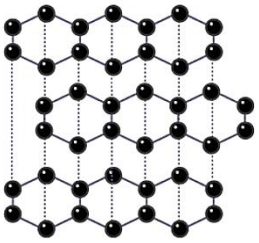


A

B

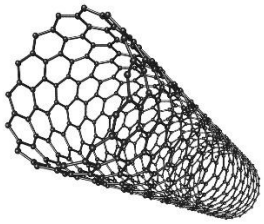


C



D

18 The diagram below shows a carbon nanotube. Carbon nanotubes are made by isolating a single carbon layer from graphite.



How are carbon nanotubes able to conduct electricity?

A Each carbon atom forms three bonds and carbon ions formed are mobile.
B One unbonded electron in each carbon atom is delocalised and mobile.
C Strong covalent bonds between the carbon atoms allow electrons to easily flow through.
D Weak intermolecular forces of attraction exist between carbon atoms and electrons can overcome these forces of attraction easily.

19 Dimethylglyoxime has the chemical formula $(CH_3CNOH)_2$. How many atoms does one molecule of dimethylglyoxime contain?

A 5
B 8
C 10
D 16

20 The formula of iridium sulfate is $Ir_2(SO_4)_3$ and that of zinc hypochlorite is $Zn(ClO)_2$.

What is the formula of iridium hypochlorite?

A $Ir_2(ClO)_2$
B $Ir_2(ClO)_3$
C $IrClO$
D $Ir(ClO)_3$

21 Ammonia can be displaced from its salts.

Which equation is correct?

A $Mg(OH)_2\ (s) + (NH_4)_2SO_4\ (aq) \rightarrow MgSO_4\ (aq) + 2NH_3\ (g) + 2H_2O\ (g)$
B $Mg(OH)_2\ (s) + NH_4Cl\ (aq) \rightarrow MgCl\ (aq) + NH_3\ (g) + H_2O\ (g)$
C $KOH\ (aq) + 2NH_4NO_3\ (s) \rightarrow KNO_3\ (aq) + 2NH_3\ (g) + H_2O\ (g)$
D $KOH\ (aq) + (NH_4)_2SO_4\ (s) \rightarrow KSO_4\ (aq) + 2NH_3\ (g) + H_2O\ (g)$

22 Element E has an electronic structure 2.5.
Element G has an electronic structure 2.8.2.

What would be the chemical formula of the compound formed between E and G?

A G_2E_3
B G_2E_5
C G_3E_2
D G_5E_2

23 Mercury hydroxide reacts with phosphoric acid in the reaction below.

$$\boldsymbol{w}\ Hg(OH)_2 + \boldsymbol{x}\ H_3PO_4 \rightarrow \boldsymbol{y}\ Hg_3(PO_4)_2 + \boldsymbol{z}\ H_2O$$

Which values of ***w***, ***x***, ***y***, and ***z*** will correctly balance the above equation?

	w	***x***	***y***	***z***
A	2	3	1	4
B	3	3	2	7
C	3	2	1	6
D	6	4	2	11

24 Which compound contains the highest percentage of nitrogen by mass?

A $Al(NO_3)_3$
B Mg_3N_2
C NO
D NO_2

25 The forward reaction for the Haber process is given below.

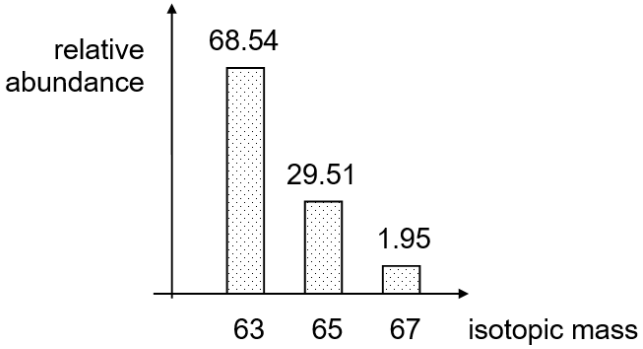
$$N_2\,(g) + 3H_2\,(g) \rightarrow 2NH_3\,(g)$$

15 cm^3 of nitrogen was added to 60 cm^3 of hydrogen in a container.

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

A 30 cm^3
B 40 cm^3
C 45 cm^3
D 105 cm^3

26 A new element was discovered. The relative abundance of its isotopes is shown below.



What is its relative atomic mass?

A 33.33
B 63.67
C 63.71
D 65.00

27 What is the empirical formula for a compound consisting of 4.8 g of carbon and 0.8 g of hydrogen?

A CH
B CH_2
C C_2H_3
D C_4H_8

28 On adding 53 g of impure sodium carbonate, Na_2CO_3 (M_r = 106), to excess hydrochloric acid, 3.0 dm^3 of CO_2 was evolved at room temperature and pressure.

What is the percentage purity of sodium carbonate?

A 25%
B 50%
C 75%
D 100%

29 Which row correctly classifies the nature of these oxides?

	aluminium oxide	nitrogen dioxide	sodium oxide
A	amphoteric	basic	acidic
B	basic	acidic	amphoteric
C	amphoteric	acidic	basic
D	acidic	amphoteric	basic

30 A farmer wishes to grow some ceanothus flowers. The pH of his soil is 5.1. Ceanothus flowers are known to grow best at around pH 7.2.

Which substance should he add to his soil for the ceanothus to grow well?

A calcium hydroxide
B citric acid
C sodium hydroxide
D water

31 Which particle is found in a solution of oxalic acid, $C_2H_2O_4$?

A OH^-
B H_2^+
C H
D H^+

32 Which of the following pairs of reagents should be mixed to prepare a sample of lead(II) sulfate salt?

A lead metal and sulfuric acid
B lead(II) carbonate and sulfuric acid
C lead(II) chloride and barium sulfate
D lead(II) nitrate and sodium sulfate

33 When preparing a salt via titration, the experiment is usually repeated without the addition of an indicator after the volume required for neutralisation has been obtained.

Why is the indicator removed when preparing the salt crystals?

A The indicator acts as a drying agent and removes moisture from the crystals.
B The indicator is an impurity and will lead to impure crystals formed.
C The indicator slows down the process of crystal formation during crystallisation.
D The indicator will dye and change the original colour of the crystals.

34 When sulfur is burned, sulfur dioxide is produced.

How can the identity of sulfur dioxide be confirmed?

	test	observation
A	insert a glowing splint into the gas	the glowing splint rekindles
B	use a piece of damp blue litmus paper	blue litmus paper turns red and is then bleached
C	use a piece of damp red litmus paper	red litmus paper turns blue and is then bleached
D	use a piece of filter paper soaked with acidified potassium manganate(VII)	purple potassium manganate(VII) turns colourless

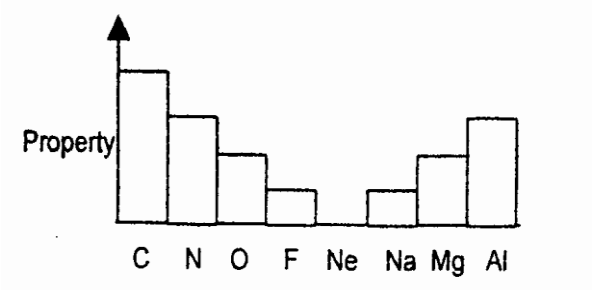
35 Separate tests were performed on an unknown solution. The results are shown in the table below.

test	observation
add aqueous sodium hydroxide	green precipitate forms and is insoluble in excess sodium hydroxide
add nitric acid	no observable change
add aqueous sodium hydroxide, aluminium foil and warm	pungent gas evolved which turned moist red litmus paper blue

What is the unknown solution?

A ammonium nitrate
B iron(II) carbonate
C iron(II) nitrate
D iron(III) sulfate

36 A property of the elements from carbon to aluminium is shown on the chart.



What are the elements arranged according to?

A group number
B number of electron shells
C number of protons
D valency

37 Which statement is true for all noble gases?

A They are coloured elements.
B They are stable and inert.
C They have high densities.
D They have the octet configuration.

38 Halogens can take part in displacement reactions.

$$\mathbf{X}_2 + 2NaBr \rightarrow 2Na\mathbf{X} + Br_2$$

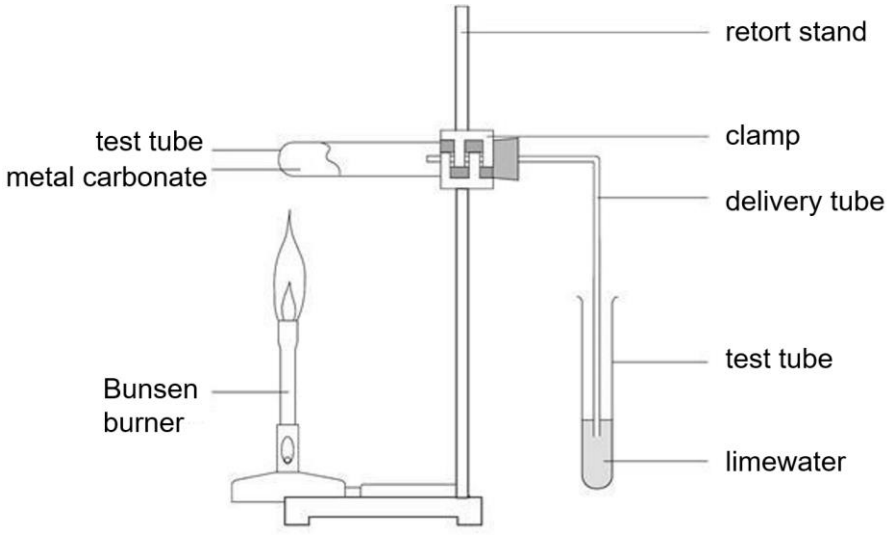
Some halogens are listed below.

I fluorine
II chlorine
III iodine
IV astatine

Which halogens could **X** be?

A **I** and **II**
B **I** and **IV**
C **II** and **III**
D **III** and **IV**

39 A metal carbonate was heated as shown in the diagram below.



The metal carbonate was heated strongly for an hour, but the limewater showed no observable change.

Which of the following could the metal carbonate most likely be?

A calcium carbonate
B magnesium carbonate
C sodium carbonate
D zinc carbonate

40 The table below shows some information on four metals and their compounds.

Metal	adding hydrochloric acid	heating with hydrogen	adding the metal to a solution of the sulfate of **J**
G	hydrogen evolved	steam produced	no visible change
H	no visible change	steam produced	no visible change
I	hydrogen evolved	no visible change	J formed
J	hydrogen evolved	no visible change	no visible change

What is the order of reactivity of these metals?

	least reactive		→	most reactive
A	H	I	G	J
B	I	G	J	H
C	H	G	J	I
D	J	G	H	I

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											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 –

Key

proton (atomic) number
atomic symbol
name
relative atomic mass

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, $L = 6.02 \times 10^{23}\ mol^{-1}$