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Preliminary Examination 2023

4E

[illegible]

6092/01

1 hour

Additional Material: Optical Mark Recognition (OMR)

Write your name, class, index number on the OMR and this question booklet.

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

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

PARENT'S SIGNATURE	FOR EXAMINER'S USE	
		40

Vetter: Miss Nur Hanis

This question paper consists of 14 printed pages including this page.

- 1 A student put exactly 25.0 cm^3 of dilute hydrochloric acid into a conical flask. He added 2.5 g of solid sodium carbonate and measured the change in temperature of the mixture.

Which apparatus does the student need?

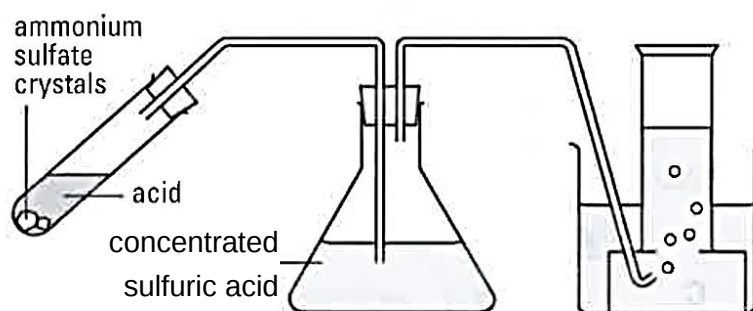
- A balance, measuring cylinder, thermometer
 B balance, pipette, stopwatch
 C balance, pipette, thermometer
 D burette, pipette, thermometer
- 2 Paper chromatography is carried out on three different mixtures of dyes, using the same solvent. Each mixture contains at least one of the dyes W, X, Y and Z.

The R_f values of the dyes in the three mixtures are shown.

dye	R_f values from mixture 1	R_f values from mixture 2	R_f values from mixture 3
W	0.14	0.14	0.14
X	0.00	0.00	0.00
Y	0.50	0.50	0.50
Z	0.82	0.82	0.00

Which conclusion is correct?

- A Dye X is the most soluble dye.
 B Dye Y is the only dye present in all three mixtures.
 C Dye W is nearest to the solvent front and present in all three mixtures.
 D Dye Z is nearest to the solvent front and is found in only two of the mixtures.
- 3 The diagram below shows a set-up to prepare a dry sample of ammonia gas.

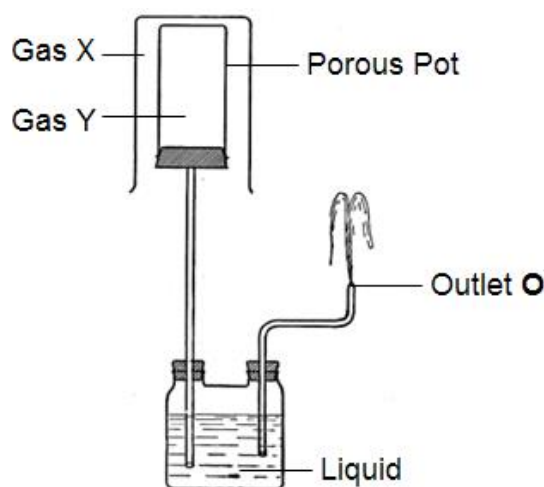


The experiment failed. What modifications should be done to correct the set-up?

- 1 An alkali should be placed in the test-tube instead of an acid.
- 2 Anhydrous calcium oxide should be used instead of concentrated sulfuric acid.
- 3 The gas should be collected in a gas syringe instead of by displacement of water.

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

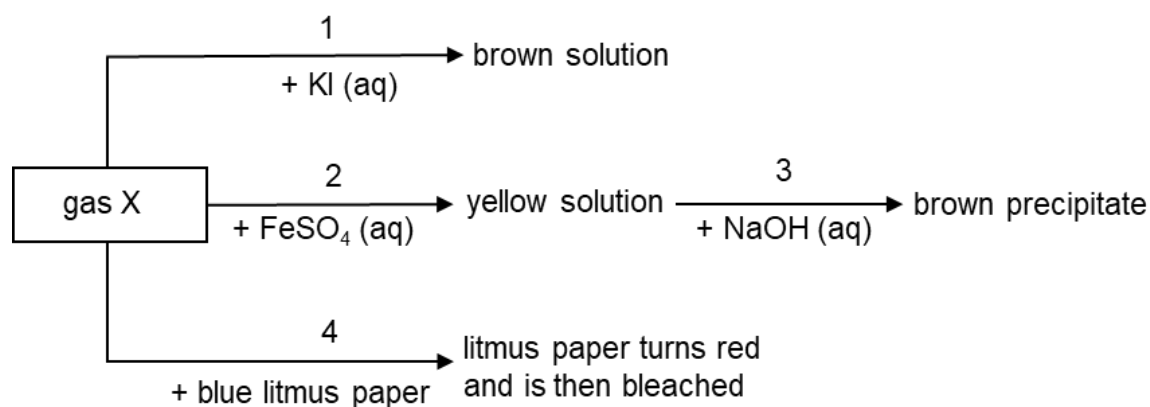
- 4 The diagram shows a beaker full of gas X inverted over a porous pot containing gas Y. None of the gases provided below is soluble in the liquid inside the container.



Which pair of gases will lead to the liquid spilling out at outlet O?

	X	Y
A	neon	nitrogen monoxide
B	fluorine	carbon monoxide
C	chlorine	hydrogen
D	propane	neon

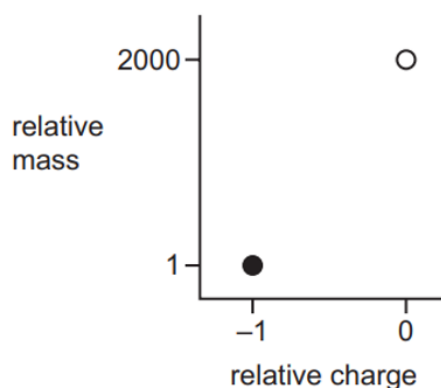
- 5 The scheme below shows reactions of a gas X.



Which statement is correct?

- A Gas X is bromine.
- B In stage 2, iron(II) sulfate acts as an oxidising agent.
- C The brown precipitate formed in stage 3 is iron(II) hydroxide.
- D In stage 1, iodide ion is oxidised as it loses electrons to form iodine.

- 6 The diagram shows the relative mass and the relative charge of two particles, ● and ○, present in atoms and ions.



Which of these particles are present in a hydrogen atom and a hydrogen ion?

	hydrogen atom, H		hydrogen ion, H ⁺	
	●	○	●	○
A	yes	yes	yes	yes
B	yes	yes	no	no
C	yes	no	yes	no
D	yes	no	no	no

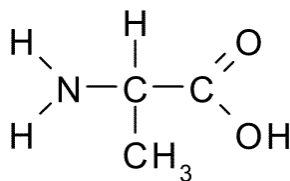
- 7 Epsom salts contain magnesium sulfate and are often used as a natural remedy for muscle aches, inflammation, and stress. A student wrote down some statements about magnesium sulfate.

- 1 It is made up of a giant lattice structure.
- 2 The ratio of positive to negative ions is 1:2.
- 3 There are both ionic and covalent bonding present.
- 4 Strong electrostatic forces of attraction exist between Mg²⁺, S²⁻ and O²⁻ ions.

Which of the above statements are correct?

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

- 8 An amino acid, alanine, has the following structure.



How many pairs of valence electrons are involved in bonding in the alanine molecule?

- A** 5 **B** 9 **C** 13 **D** 26

- 9 The formula of a nitride of element X is X_3N_2 . 23.8 g of X_3N_2 contains 4.5 g of X.

How many moles are there in 4.5 g of X?

- A $\frac{19.3}{14} \times \frac{2}{3}$ B $\frac{19.3}{14} \times \frac{3}{2}$ C $\frac{9.65}{14} \times \frac{2}{3}$ D $\frac{9.65}{14} \times \frac{3}{2}$

- 10 50 cm³ of ethane is burnt completely in 200 cm³ of oxygen at 200°C.
What is the total volume of the gases, measured at room temperature and pressure, at the end of the reaction?

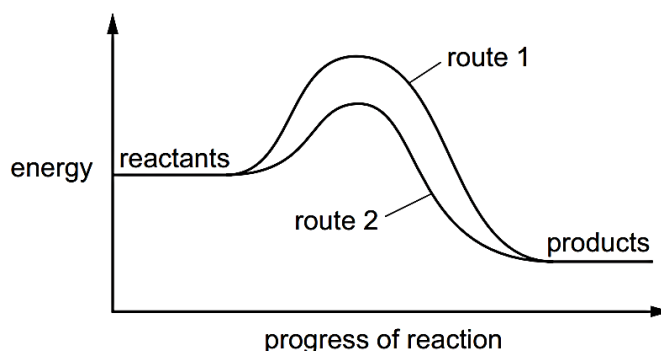
- A 100 cm³ B 125 cm³ C 250 cm³ D 275 cm³

- 11 Citric acid, the predominant acid in lemon juice, is a tribasic acid. A student titrated 25.0 cm³ samples of lemon juice with 0.55 mol/dm³ NaOH. The average titration volume was 29.50 cm³. The molar mass of citric acid is 192 g/mol.

What was the concentration of citric acid in the lemon juice?

- A 0.216 g/dm³ B 41.5 g/dm³ C 125 g/dm³ D 374 g/dm³

- 12 The diagram below shows the energy profile for a reaction.



Which statements about this reaction are correct?

- 1 Route 1 uses a catalyst.
- 2 The reaction is exothermic.
- 3 Route 1 and route 2 give the same overall equation for the reaction.
- 4 More energy is taken in to break the bonds than released when the bonds are formed.

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

16 Which method produces the highest yield of calcium sulfate from calcium carbonate?

- A** addition of dilute sulfuric acid
- B** addition of aqueous ammonium sulfate
- C** addition of dilute hydrochloric acid, followed by barium sulfate
- D** addition of dilute hydrochloric acid, followed by aqueous ammonium sulfate

17 The nitrogen cycle is a biochemical cycle that occurs naturally. It involves the conversion of nitrogen-containing substances that takes place through biological and physical processes.

Which of the following conversion of nitrogen-containing substances shows the greatest increase in oxidation number?

- A** NH_4^+ to NO_3^-
- B** N_2 to NO_3^-
- C** NO_2^- to N_2O
- D** N_2O to NO_3^-

18 The formulae of some oxides are shown below.



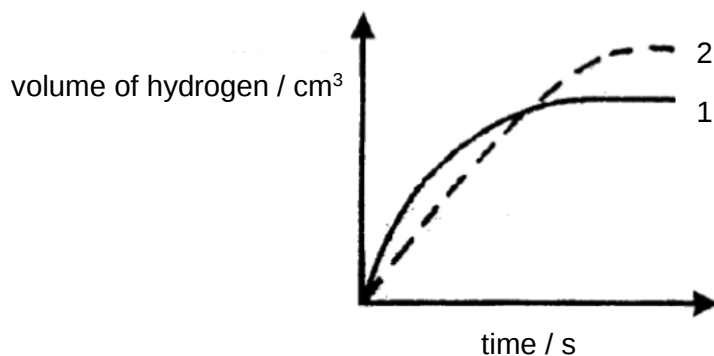
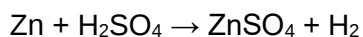
Which of the following gives the correct number for each type of oxides?

	acidic	amphoteric	basic
A	1	1	2
B	1	2	1
C	2	0	3
D	2	1	2

19 A liquid can react separately with sodium carbonate, potassium hydroxide and propanol. What is the liquid?

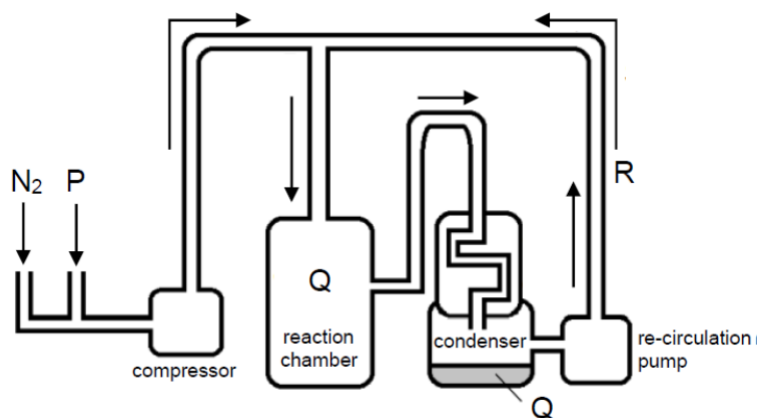
- A** aqueous ammonia
- B** dilute hydrochloric acid
- C** ethanoic acid
- D** ethyl ethanoate

- 20 In the graph below, curve 1 was obtained by the reaction between 50.0 cm³ of 1.00 mol/dm³ sulfuric acid and 6.5 g of zinc granules as shown in the equation.



Which change would produce curve 2?

- A increase the temperature by 10°C
 - B use 100.0 cm³ of 0.75 mol/dm³ sulfuric acid
 - C use 100.0 cm³ of 1.00 mol/dm³ sulfuric acid
 - D add the same mass of zinc powder instead of zinc granules
- 21 The diagram below shows a simplified diagram of the Haber Process. P, Q and R refer to the different substances present in different parts of the Haber Process.



Which of the following statements are true?

- 1 P is obtained from the fractional distillation of liquid air.
- 2 Q is formed under reaction conditions of 450°C and 250 atm.
- 3 Q is an essential element used to make fertilisers.
- 4 R is a mixture of two compounds.

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

22 Which of the following reactions produce hydrogen gas?

- 1 potassium with water
- 2 zinc with steam
- 3 copper with dilute hydrochloric acid.

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

23 Four different metals, zinc, silver, magnesium and iron were added separately, in excess, to different beakers of blue copper(II) sulfate solution.

How many beakers of solution will be colourless after a week?

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

24 Which statement about the blast furnace is correct?

- A** Haematite is the ore which contains iron(II) oxide.
B Most carbon monoxide is formed from the combustion of quicklime.
C Nitrogen is released as a waste gas.
D The decomposition of limestone forms a product to remove sulfur dioxide.

25 Which statements are reasons for recycling of metals?

- 1 More energy is required to mine and extract a metal than to recycle it.
- 2 The recycling of metals involves transport, separation and reprocessing.
- 3 Some metals are present in Earth's crust in very small quantities.
- 4 People in the future will need metals.

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

26 Which one of the following sets of information is correct?

	type of steel	additive	property	use
A	high carbon steel	carbon	strong and malleable	machinery
B	low carbon steel	chromium	brittle	drill bits
C	mild steel	carbon	softer and easily shaped	car bodies
D	stainless steel	platinum	corrosion-resistant	cutlery

27 An element R reacts in the following ways.

- 1 $2R(s) + O_2(g) \rightarrow 2RO(s)$
- 2 $R(s) + 2HCl(aq) \rightarrow RCl_2(aq) + H_2(g)$
- 3 $R(s) + H_2O(l) \rightarrow \text{no reaction}$
- 4 $RO(s) + H_2(g) \rightarrow \text{no reaction}$

Which statement can be deduced about element R?

- A** R can be obtained from its oxide by reduction with carbon.
- B** R reacts more vigorously with hydrochloric acid than calcium with hydrochloric acid.
- C** R can displace magnesium from a solution of magnesium nitrate.
- D** R forms a metal carbonate that will not decompose under strong heating.

28 Which statements are true about all noble gases?

- 1 The number of protons in their atoms equals the number of neutrons.
- 2 They have eight electrons in their outer shell.
- 3 They do not react to form ionic compounds.

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

29 The following waste gases from a coal burning power station are passed through wet powdered calcium carbonate to reduce gaseous pollutants from escaping into the atmosphere.

sulfur dioxide	carbon monoxide	sulfur trioxide
nitrogen monoxide	nitrogen dioxide	

How many waste gases will be removed by the wet powdered calcium carbonate?

- A** 2 **B** 3 **C** 4 **D** 5

30 The exhaust gas of a car fitted with a catalytic converter contains oxides of nitrogen. Which of the following modifications should be made to lower the concentration of oxides of nitrogen present in the exhaust gas?

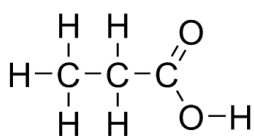
- 1 decrease the particle size of the catalyst in the converter
- 2 increase the temperature of combustion in the engine
- 3 decrease the rate of exhaust gas flowing through the converter

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

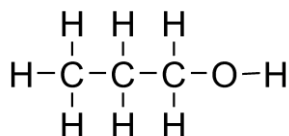
- 31** Petroleum can be separated into fractions using fractional distillation. Which statements is correct?

- A** Alkanes used in polishes and waxes have a lower boiling point than those used as diesel fuel.
- B** Any of the fractions could be used as fuels because their enthalpy changes of combustion are negative.
- C** The fraction containing paraffin (kerosene) is extracted from higher up the fractionating column than the fraction containing petrol (gasoline).
- D** The fractions obtained at different points in the fractionating column always contain unsaturated hydrocarbons in a different ratio.

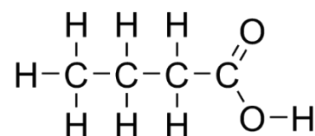
- 32** The structures of six organic molecules are shown.



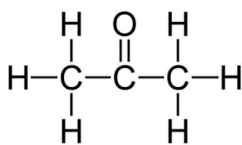
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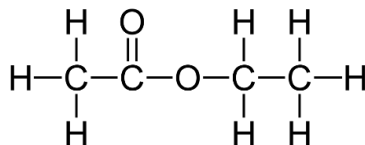
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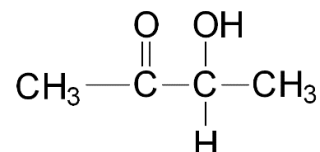
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4



5



6

Which structures are isomers?

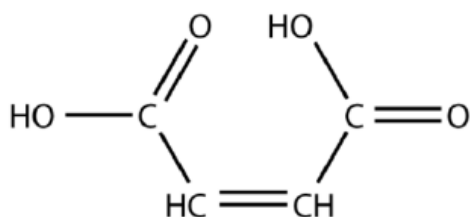
- A** 1 and 3
 - B** 2 and 4
 - C** 3 and 5
 - D** 3, 5 and 6
- 33** When the alcohol $\text{C}_3\text{H}_7\text{OH}$ reacts with the carboxylic acid $\text{C}_3\text{H}_7\text{COOH}$, an ester is formed. What is the name and structural formula of this ester?

	name	structural formula
A	propyl propanoate	$\text{CH}_3\text{CH}_2\text{COOCH}_2\text{CH}_2\text{CH}_2\text{CH}_3$
B	propyl propanoate	$\text{CH}_3\text{CH}_2\text{CH}_2\text{COOCH}_2\text{CH}_2\text{CH}_3$
C	propyl butanoate	$\text{CH}_3\text{CH}_2\text{COOCH}_2\text{CH}_2\text{CH}_2\text{CH}_3$
D	propyl butanoate	$\text{CH}_3\text{CH}_2\text{CH}_2\text{COOCH}_2\text{CH}_2\text{CH}_3$

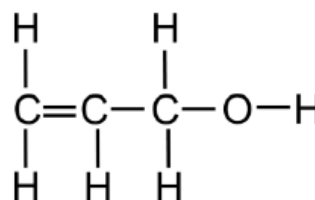
34 In which reaction is water produced?

- A manufacture of ethane from ethene
- B manufacture of ethanol from glucose
- C manufacture of poly(ethene) from ethene
- D manufacture of Terylene

35 The structures of butenedioic acid and propenol are shown.



butenedioic acid



propenol

How many of the following substances can be used to distinguish between the two compounds?

- limewater
- aqueous bromine
- copper(II) carbonate
- copper metal

- A 1 B 2 C 3 D 4

36 In how many of the reactions does the relative molecular mass of the carbon-containing compound decrease?

- 1 combustion of ethanol
- 2 fermentation of glucose
- 3 reaction between steam and ethene
- 4 reaction between ethanoic acid and ethanol

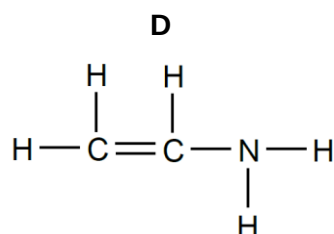
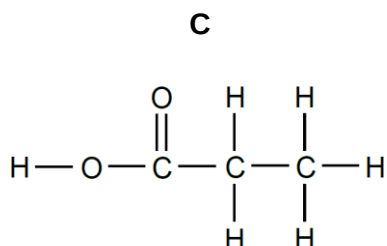
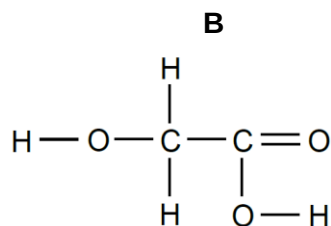
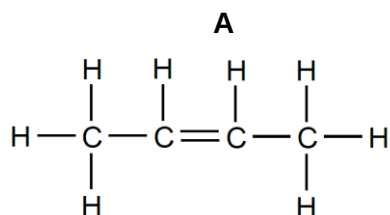
- A 1 B 2 C 3 D 4

37 An oil molecule has a relative molecular mass of 300.
150 g of the oil reacts with 240 g aqueous bromine.

How many moles of hydrogen is needed to turn 75 g of oil completely into margarine?

- A 0.50 B 0.75 C 1.5 D 3

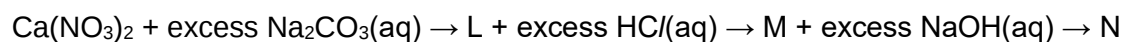
38 Which of the molecules shown **cannot** be polymerised?



39 Iron can be electroplated with copper to make it resistant to corrosion. Which row about electroplating iron with copper is correct?

	positive electrode	negative electrode	electrolyte
A	iron	copper	iron(II) nitrate
B	iron	copper	copper(II) nitrate
C	copper	iron	iron(II) nitrate
D	copper	iron	copper(II) nitrate

40 Solutions of $\text{Ca}(\text{NO}_3)_2$ and $\text{Zn}(\text{NO}_3)_2$ undergo a series of reactions using pure reagents. Side products are omitted from both sequences.



L, M and N are calcium compounds.

X, Y and Z are zinc compounds.

How many of the following compounds, L, M, N, X, Y and Z, are white precipitate?

- A** 2 **B** 3 **C** 4 **D** 5

The Periodic Table of Elements

Group																		
I	II	1 H hydrogen 1										III	IV	V	VI	VII	0	
		Key																
		proton (atomic) number atomic symbol name relative atomic mass																
3 Li lithium 7	4 Be beryllium 9																	
11 Na sodium 23	12 Mg magnesium 24																	
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	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 dm³ at room temperature and pressure (r.t.p.).