

The City School

Unified Mid-Year Examinations

2018 - 2019

Class 11



SCHOOL NAME

INDEX NUMBER

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DATE

CHEMISTRY

Paper 2 Theory

5070/22

1 hour 30 minutes

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your School name, Index number and Date in the spaces provided.

Write in dark blue or black pen.

You may use a pencil for any diagrams or graphs.

Do not use paper clips, glue or correction fluid.

Section A

Answer **all** questions in this section.

Write your answers in the spaces provided on the Question Paper.

Section B

Answer **three** questions in this section.

Write your answers in the spaces provided on the Question Paper.

Electronic calculators may be used.

You may lose marks if you do not show your working or if you do not use appropriate units.

A copy of Periodic Table is printed on page 20.

At the end of the examination, fasten all your work securely together.

The number of marks is given in brackets [] at the end of each question or part question.

Invigilated By: _____

Checked By: _____

Marks Talled By: _____

This document consists of 17 printed pages and 3 blank pages.

Section A

Answer all the questions in this section in the spaces provided.

A1 Choose from the following gases to answer the questions below.

Ammonia

Butane

Carbon dioxide

Carbon monoxide

Hydrogen

Methane

Nitrogen

Nitrogen dioxide

Oxygen

Each gas can be used once, more than once or not at all.

Which gas is:

(a) The main constituent of natural gas,

..... [1]

(b) used by plants in photosynthesis to form glucose,

..... [1]

(c) produced when aqueous sodium nitrate is warmed with aqueous sodium hydroxide and aluminium foil,

..... [1]

(d) a product of the incomplete combustion of hydrocarbon,

..... [1]

(e) produced by the Haber process,

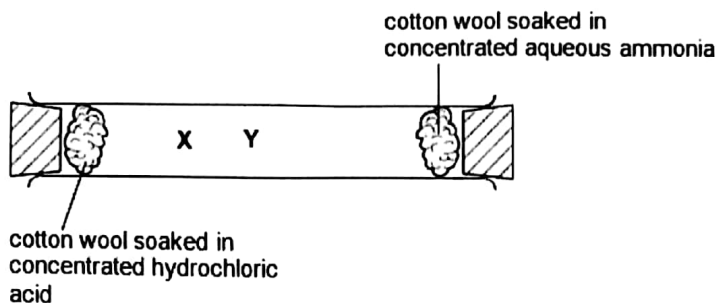
..... [1]

(f) formed at the cathode when an aqueous solution of sulfuric acid is electrolyzed?

..... [1]

[Total: 6]

A2 A student set up the apparatus shown below.



Colourless fumes of hydrogen chloride are given off by the hydrochloric acid.

Colourless fumes of ammonia are given off by the aqueous ammonia.

- (a) After a few seconds, white fumes were seen at point X in the tube. Name the compound formed at point X.

..... [1]

- (b) Use the kinetic particle theory to explain this observation.

.....

.....

..... [3]

- (c) The student repeated the experiment using a solution of methylamine, CH_3NH_2 , in place of ammonia, NH_3 .

The white fumes were seen at point Y in the tube, rather than at point X. Explain this difference.

.....

..... [2]

[Total: 6]

A3 Germanium, Ge, is an element in Group IV of the Periodic Table. Some of its chemistry resembles that of carbon.

(a) How many electrons does an atom of germanium have in its outer shell?
..... [1]

(b) Germanium forms a range of saturated compounds with hydrogen. These compounds resemble the alkanes.

(i) Predict the general molecular formula for these compounds.
..... [1]

(ii) Germanoethane, Ge_2H_6 , has a similar structure to ethane. Draw the full structural formula for germanoethane.

[1]

(iii) Hydrochloric acid reacts with magnesium germanide, Mg_2Ge , to form germanomethane, GeH_4 , and magnesium chloride.

Write an equation for this reaction.

[1]

(c) Germanium(IV) oxide, GeO_2 , is an amphoteric oxide. What do you understand by the term amphoteric?

..... [1]

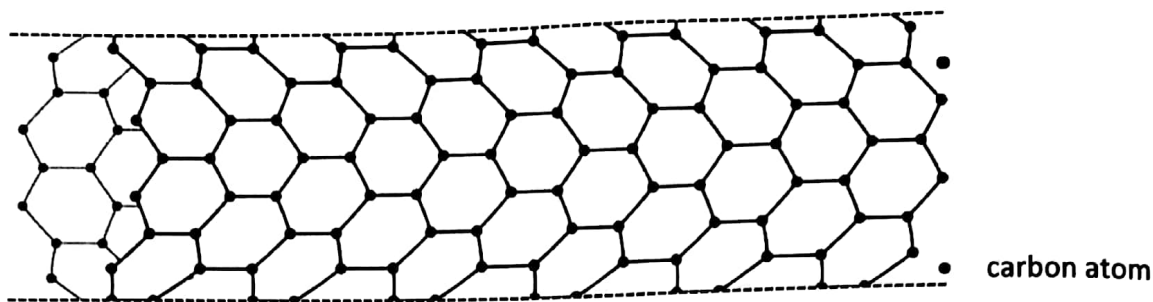
(d) An aqueous solution of germanium(II) chloride reduces iron(III) ions to iron(II) ions. Describe a test for iron(II) ions and give the result.

test

result [2]

[Total: 7]

A4 In recent years' scientists have made tube-shaped structures of carbon called nanotubes



(a) State **two** differences between the structure of a carbon nanotube and the structure of diamond.

.....
.....
.....
..... [2]

(b) Carbon nanotubes are fifty times stronger than steel.

Use ideas about structure and bonding to suggest why these nanotubes are so strong.

.....
..... [1]

(c) Carbon nanotubes are good electrical conductors.

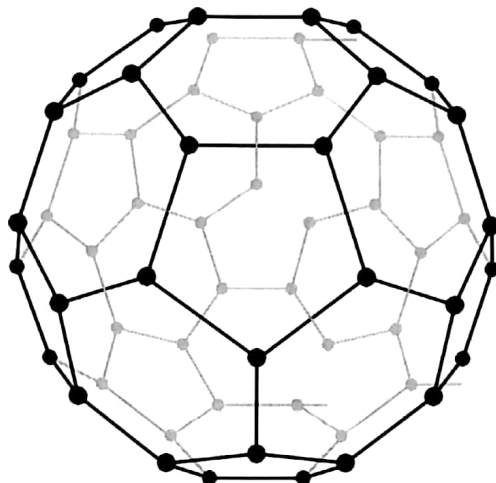
(i) State the name of another form of carbon which can conduct electricity.

..... [1]

(ii) Carbon nanotubes conduct electricity nearly as well as copper. Explain why copper is a good conductor of electricity.

..... [1]

(d) Another form of carbon in buckminsterfullerene.



• carbon atom

Argon can be trapped inside the cage-like structure of buckminsterfullerene.

(i) Explain why argon is unreactive.

..... [1]

(ii) One isotope of argon is $^{38}\text{Ar}_{18}$.

Calculate the number of neutrons in this isotope of argon.

..... [1]

(e) Recently, chemists have been trying to attach atoms of transition elements to buckminsterfullerene to make more efficient catalysts.

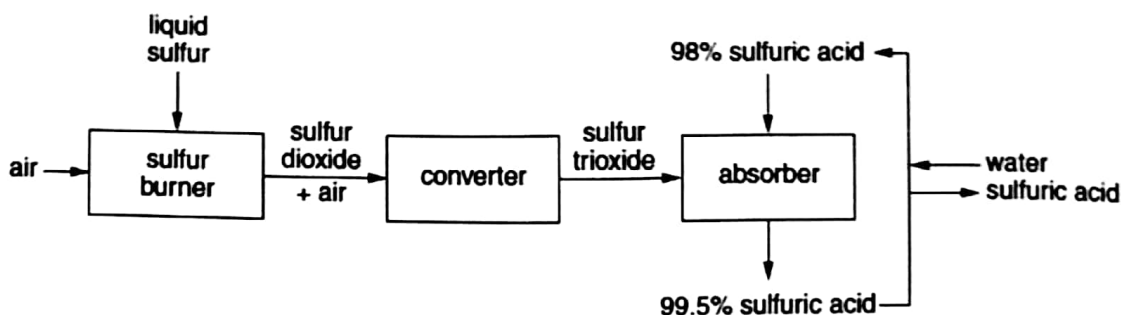
State **two** properties, other than catalysis, which distinguish transition elements from other metals.

.....

..... [2]

[Total: 9]

A5 A flow diagram for the manufacture of sulfuric acid is shown below.



(a) In the sulphur burner, a spray of molten sulfur is burned in a furnace. Construct an equation for this reaction Include state symbols.

..... [1]

(b) In the converter, the following reaction occurs:



The yield of SO_3 is 95% at 450°C and atmospheric pressure.

(i) Name the catalyst used in this reaction.

..... [1]

(ii) Explain why increasing the pressure shifts the position of equilibrium further to the right.

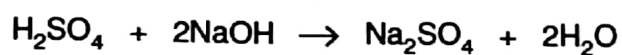
..... [1]

(iii) Explain why the reaction is carried out at 450°C and not at a higher or lower temperature.

.....

 [2]

(c) Aqueous sulfuric acid is titrated with aqueous sodium hydroxide.

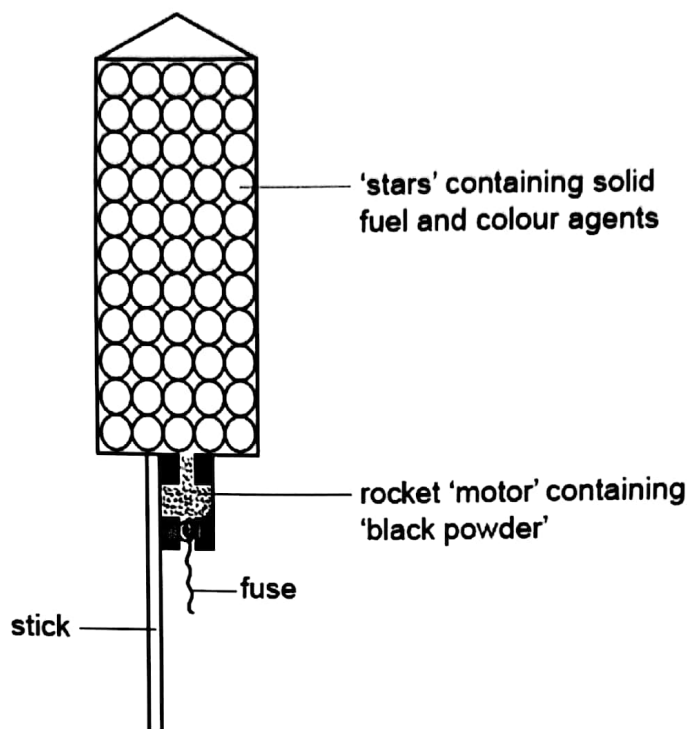


It requires 28.0 cm³ of 0.0100 mol/dm³ aqueous sodium hydroxide to neutralize 9.50 cm³ of sulfuric acid. Calculate the concentration, in mol/dm³, of the aqueous sulfuric acid. Give your answer to 3 significant figures.

Concentration of the aqueous sulfuric acid mol/dm³ [3]

[Total: 8]

A6 The diagram shows the inside of a fireworks rocket.



(a) Black powder is a mixture of charcoal, potassium nitrate and sulfur.

When black powder is ignited, the potassium nitrate decomposes to form potassium nitrite, KNO_2 , and oxygen.

Write the equation for the decomposition of potassium nitrate.

..... [1]

(b) The oxygen liberated by the potassium nitrate oxidises the sulfur to sulfur dioxide. State one harmful effect of sulfur dioxide on the environment.

..... [1]

(c) The gases produced by the burning charcoal and sulfur cause the rocket to move upwards.

Explain why the charcoal and sulfur in the rocket 'motor' are present as small grains rather than as large lumps.

.....

..... [2]

(d) Sodium sulfate is often used in fireworks to give yellow sparks. Describe a test for sulfate ions and give the result.

test

result [2]

(e) Potassium chlorate(V), $KClO_3$, is often used in fireworks to produce flash and noise effects.

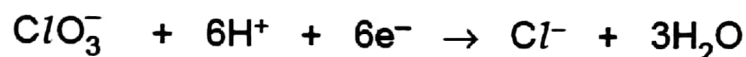
(i) An aqueous solution of potassium chlorate(V) is a good oxidising agent.

Describe a chemical test for an oxidising agent and state the result.

test

result [2]

(ii) When potassium chlorate(V) reacts as an oxidising agent, the chlorate(V) ions are reduced to chloride ions.



How does this equation show that the chlorate(V) ion gets reduced?

.....

..... [1]

[Total: 9]

Section B

Answer **three** questions from this section.

B7 Petroleum is separated into fractions by fractional distillation.

(a) Explain how fractional distillation separates petroleum into different fractions.

.....
.....
.....
.....
..... [3]

(b) The refinery gas fraction contains the first four members of the alkane homologous series.

(i) Explain the difference between saturated and unsaturated hydrocarbons.

.....
..... [2]

(ii) Draw the structure, showing all atoms and bonds of the two isomers of fourth member of alkanes.

[2]

(c) Construct an equation for the reaction between methanol and ethanoic acid.

..... [1]

(d) When long chained alkanes are cracked in an oil refinery, shorter chained-alkanes and alkenes are formed.

(i) Explain why the process of cracking needs to be carried out.

.....
..... [1]

(ii) Describe a chemical test that can help to distinguish between an alkane and alkene.

.....
..... [1]

[Total: 10]

B8 Propanoic acid, $C_2H_5CO_2H$, is a weak acid.

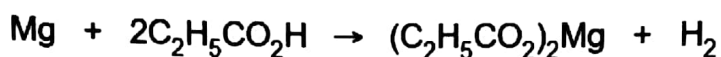
(a) Explain what is meant by the term *weak acid*.

.....
..... [1]

(b) Propanoic acid reacts with sodium carbonate. Write the equation for this reaction.

..... [1]

(c) Magnesium reacts with propanoic acid to form magnesium propanoate and hydrogen.



A student added 4.80 g of magnesium to 30.0 g of propanoic acid.

(i) Which one of these reactants, magnesium or propanoic acid, is in excess?

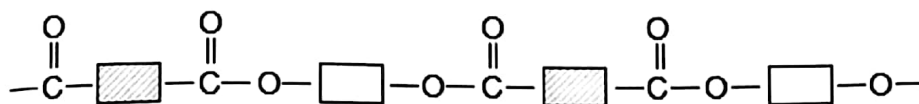
Explain your answer.

.....
.....
..... [2]

(ii) Calculate both the number of moles of hydrogen and the volume of hydrogen formed at r.t.p.

[2]

(d) *Terylene* has the simplified structure shown.



(i) State the functional groups on the monomers used to make *Terylene*.

.....
..... [1]

(ii) State the type of polymerisation that occurs when *Terylene* is made.

..... [1]

(iii) State one large scale use of *Terylene*.

.....
..... [1]

(e) Many problems are caused by the disposal of plastics.

Describe one method of disposal of a plastic and a problem caused by this method.

.....
.....
.....
..... [1]

[Total: 10]

B9 Copper pyrites is an ore containing compounds of copper. One of the compounds in the ore is CuFeS_2 .

(a) Calculate the mass of copper in 20.0 tonnes of CuFeS_2 .

mass of copper tonnes [2]

(b) CuFeS_2 is heated in air. Copper(II) oxide, iron(III) oxide and sulfur dioxide are formed.

Construct the equation for this reaction.

.....
..... [2]

(c) Copper(II) oxide can be reduced by heating with carbon to form copper.

Construct the equation for this reaction.

..... [1]

(d) Copper made by this reduction is impure.

Impure copper can be purified using electrolysis.

(i) Name the electrolyte used.

..... [1]

(ii) What are the electrodes made from?

positive electrode (anode)

negative electrode (cathode) [2]

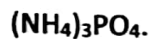
(iii) Write the equations for the reactions at both electrodes.

positive electrode (anode)

negative electrode (cathode) [2]

[Total: 10]

B10 Concentrated aqueous ammonia is used to make fertilisers such as ammonium phosphate,



(a) Calculate the percentage by mass of nitrogen in ammonium phosphate.

..... % by mass [2]

(b) Explain why farmers spread nitrogen-containing fertilisers on their fields.

..... [1]

(c) Describe a test for ammonia.

test

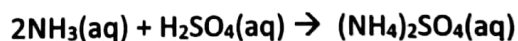
result [2]

(d) Explain why adding calcium hydroxide to the soil at the same time as ammonium phosphate results in loss of nitrogen from the soil.

.....

..... [2]

(e) Aqueous ammonia reacts with dilute sulfuric acid.



A student titrates 20.0 cm³ of aqueous ammonia with 0.150 mol / dm³ sulfuric acid. 10.5 cm³ of sulfuric acid is required to neutralise the aqueous ammonia.

Calculate the concentration, in mol / dm³, of the aqueous ammonia.

concentration of aqueous ammonia = mol / dm³ [3]

[Total: 10]

The Periodic Table of Elements

Group																																																																																																																																																																																																							
I	II	III										IV	V	VI	VII	VIII																																																																																																																																																																																							
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 —	113 Nh nihonium —	114 Fl flerovium —	115 Lv livermorium —	116 Ts tennessine —	117 Og oganesson —	118 Uue unbinilium —	119 Uuh ununilium —	120 Uuq ununquadium —	121 Uuq ununquadium —	122 Uub ununbium —	123 Uut ununtrium —	124 Uuq ununquadium —	125 Uur ununpentium —	126 Uus ununseptium —	127 Uuo ununoctium —	128 Uuq ununquadium —	129 Uuq ununquadium —	130 Uuq ununquadium —	131 Uuq ununquadium —	132 Uuq ununquadium —	133 Uuq ununquadium —	134 Uuq ununquadium —	135 Uuq ununquadium —	136 Uuq ununquadium —	137 Uuq ununquadium —	138 Uuq ununquadium —	139 Uuq ununquadium —	140 Uuq ununquadium —	141 Uuq ununquadium —	142 Uuq ununquadium —	143 Uuq ununquadium —	144 Uuq ununquadium —	145 Uuq ununquadium —	146 Uuq ununquadium —	147 Uuq ununquadium —	148 Uuq ununquadium —	149 Uuq ununquadium —	150 Uuq ununquadium —	151 Uuq ununquadium —	152 Uuq ununquadium —	153 Uuq ununquadium —	154 Uuq ununquadium —	155 Uuq ununquadium —	156 Uuq ununquadium —	157 Uuq ununquadium —	158 Uuq ununquadium —	159 Uuq ununquadium —	160 Uuq ununquadium —	161 Uuq ununquadium —	162 Uuq ununquadium —	163 Uuq ununquadium —	164 Uuq ununquadium —	165 Uuq ununquadium —	166 Uuq ununquadium —	167 Uuq ununquadium —	168 Uuq ununquadium —	169 Uuq ununquadium —	170 Uuq ununquadium —	171 Uuq ununquadium —	172 Uuq ununquadium —	173 Uuq ununquadium —	174 Uuq ununquadium —	175 Uuq ununquadium —	176 Uuq ununquadium —	177 Uuq ununquadium —	178 Uuq ununquadium —	179 Uuq ununquadium —	180 Uuq ununquadium —	181 Uuq ununquadium —	182 Uuq ununquadium —	183 Uuq ununquadium —	184 Uuq ununquadium —	185 Uuq ununquadium —	186 Uuq ununquadium —	187 Uuq ununquadium —	188 Uuq ununquadium —	189 Uuq ununquadium —	190 Uuq ununquadium —	191 Uuq ununquadium —	192 Uuq ununquadium —	193 Uuq ununquadium —	194 Uuq ununquadium —	195 Uuq ununquadium —	196 Uuq ununquadium —	197 Uuq ununquadium —	198 Uuq ununquadium —	199 Uuq ununquadium —	200 Uuq ununquadium —	201 Uuq ununquadium —	202 Uuq ununquadium —	203 Uuq ununquadium —	204 Uuq ununquadium —	205 Uuq ununquadium —	206 Uuq ununquadium —	207 Uuq ununquadium —	208 Uuq ununquadium —	209 Uuq ununquadium —	210 Uuq ununquadium —	211 Uuq ununquadium —	212 Uuq ununquadium —	213 Uuq ununquadium —	214 Uuq ununquadium —	215 Uuq ununquadium —	216 Uuq ununquadium —	217 Uuq ununquadium —	218 Uuq ununquadium —	219 Uuq ununquadium —	220 Uuq ununquadium —	221 Uuq ununquadium —	222 Uuq ununquadium —	223 Uuq ununquadium —	224 Uuq ununquadium —	225 Uuq ununquadium —	226 Uuq ununquadium —	227 Uuq ununquadium —	228 Uuq ununquadium —	229 Uuq ununquadium —	230 Uuq ununquadium —	231 Uuq ununquadium —	232 Uuq ununquadium —	233 Uuq ununquadium —	234 Uuq ununquadium —	235 Uuq ununquadium —	236 Uuq ununquadium —	237 Uuq ununquadium —	238 Uuq ununquadium —	239 Uuq ununquadium —	240 Uuq ununquadium —	241 Uuq ununquadium —	242 Uuq ununquadium —	243 Uuq ununquadium —	244 Uuq ununquadium —	245 Uuq ununquadium —	246 Uuq ununquadium —	247 Uuq ununquadium —	248 Uuq ununquadium —	249 Uuq ununquadium —	250 Uuq ununquadium —	251 Uuq ununquadium —	252 Uuq ununquadium —	253 Uuq ununquadium —	254 Uuq ununquadium —	255 Uuq ununquadium —	256 Uuq ununquadium —	257 Uuq ununquadium —	258 Uuq ununquadium —	259 Uuq ununquadium —	260 Uuq ununquadium —	261 Uuq ununquadium —	262 Uuq ununquadium —	263 Uuq ununquadium —	264 Uuq ununquadium —	265 Uuq ununquadium —	266 Uuq ununquadium —	267 Uuq ununquadium —	268 Uuq ununquadium —	269 Uuq ununquadium —	270 Uuq ununquadium —	271 Uuq ununquadium —	272 Uuq ununquadium —	273 Uuq ununquadium —	274 Uuq ununquadium —	275 Uuq ununquadium —	276 Uuq ununquadium —	277 Uuq ununquadium —	278 Uuq ununquadium —	279 Uuq ununquadium —	280 Uuq ununquadium —	281 Uuq ununquadium —	282 Uuq ununquadium —	283 Uuq ununquadium —	284 Uuq ununquadium —	285 Uuq ununquadium —	286 Uuq ununquadium —	287 Uuq ununquadium —	288 Uuq ununquadium —	289 Uuq ununquadium —	290 Uuq ununquadium —	291 Uuq ununquadium —	292 Uuq ununquadium —	293 Uuq ununquadium —	294 Uuq ununquadium —	295 Uuq ununquadium —	296 Uuq ununquadium —	297 Uuq ununquadium —	298 Uuq ununquadium —	299 Uuq ununquadium —	300 Uuq ununquadium —

Key

atomic number

atomic symbol

name

relative atomic mass

1
H
hydrogen
1

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
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 —

lanthanoids

actinoids

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