

Class/ Index Number	Centre Number/ 'O' Level Index Number	Name
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新加坡海星中学
MARIS STELLA HIGH SCHOOL
PRELIMINARY EXAMINATION
SECONDARY FOUR

CHEMISTRY

Paper 1 Multiple Choice

6092/01

01 September 2020

1 hour

Additional

Materials:

Optical Test Answer Sheet (OTAS) – 1 sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

Do not use staples, paper clips, glue or correction fluid.

Write your name, class and index number on the Answer Sheet.

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 answer in **soft pencil** on the separate 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 question paper.

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

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

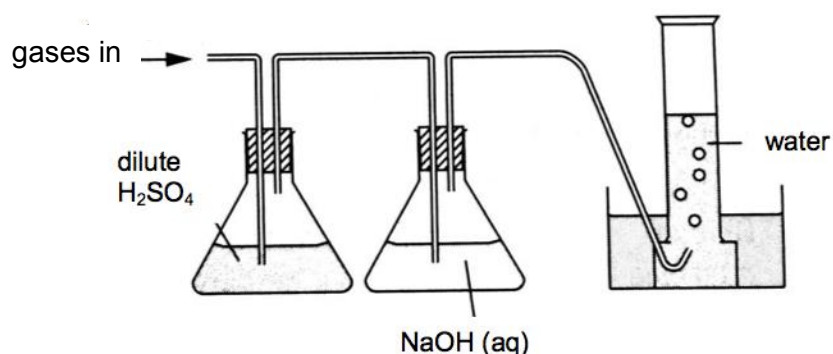
The total number of marks for this paper is 40.

At the end of the examination, hand in the following separately:

(1) Optical Test Answer Sheet (OTAS)

(2) Question Paper

- 1 A mixture of three gases was passed through the apparatus shown in the diagram. Only one gas was collected in the gas jar.



- Which of the following could be a mixture of the gases?
- A ammonia, carbon dioxide, hydrogen
 - B chlorine, ammonia, sulfur dioxide
 - C chlorine, carbon monoxide, oxygen
 - D sulfur dioxide, carbon monoxide, hydrogen
- 2 The following statements were made by four students on chromatography. Which statement is correct?
- A Locating agents are always needed to interpret a chromatogram.
 - B The substances to be separated must be soluble in water.
 - C The technique requires only a small quantity of sample for analysis.
 - D The substance with a higher R_f value is found further away from the solvent front.
- 3 What is necessary for a solid to be separated by crystallisation from its aqueous solution?
- A The solid is insoluble in both cold water and hot water.
 - B The solid is insoluble in hot water but soluble in cold water.
 - C The solid is more soluble in cold water than in hot water.
 - D The solid is more soluble in hot water than in cold water.
- 4 When testing for chloride ions using aqueous silver nitrate, the solution must be acidified with dilute nitric acid.

What is the purpose of dilute nitric acid?

- A to act as a catalyst
- B to adjust the pH such that it is suitable for the reaction to occur
- C to allow the precipitate of silver chloride to form
- D to prevent precipitation of silver carbonate

5 A gas, Q, has the following properties:

1. colourless and odourless
2. turns damp blue litmus paper red
3. does not react with acidified potassium manganate(VII)

What is Q?

- A** carbon dioxide
- B** hydrogen
- C** oxygen
- D** sulfur dioxide

6 Sulfur dioxide gas dissolves in rain to form sulfurous acid (H_2SO_3), which makes the rain acidic.

Which of the following best describes the arrangement and movement of the respective particles at room temperature?

	sulfur dioxide molecules in air	hydrogen ions and sulfite ions in acid rain	water molecules in the acid rain
A	quite closely packed, move randomly in all directions	quite closely packed, rotate and vibrate about fixed positions	quite closely packed, move randomly in all directions
B	far apart, move randomly in all directions	far apart, slide over one another	quite closely packed, slide over one another
C	quite closely packed, move randomly in all directions	far apart, move randomly in all directions	quite closely packed, slide over one another
D	far apart, move in constant random motion	quite closely packed, rotate and vibrate about fixed positions	quite closely packed, move in constant random motion

7 A sample of white crystalline solid is heated in the absence of oxygen. It melts sharply at 158°C , but on further heating, smoky fumes and a black solid are produced.

From this information, what can we conclude about the white crystalline solid?

- A** It is a compound which decomposes to form simpler substances.
- B** It is a compound which undergoes combustion to form two products.
- C** It is a mixture of two pure substances.
- D** It is an element which undergoes combustion to form two products.

8 Study the following statements in a student's notebook.

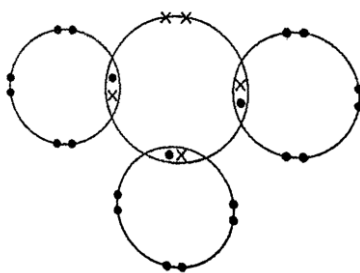
- 1 At the freezing point, the temperature of ice remains constant.
- 2 When a liquid is cooled, the particles lose energy and move slower, eventually become stationary.
- 3 When a gas is heated, the particles expand and become larger.
- 4 When the boiling point is reached, evaporation and boiling start to take place and a gas is formed.

Which of the above statement(s) is(are) true?

- A 1 only
 B 1 and 3 only
 C 1, 3 and 4 only
 D 2 and 3 only
- 9 An element X has two isotopes, ^{238}X and ^{235}X .

How does ^{238}X differ from ^{235}X ?

- A It has 3 more neutrons and 3 more electrons.
 B It has 3 more neutrons only.
 C It has 3 more protons and 3 more electrons.
 D It has 3 more protons only.
- 10 The diagram shows how the outer shell electrons are arranged in a compound.

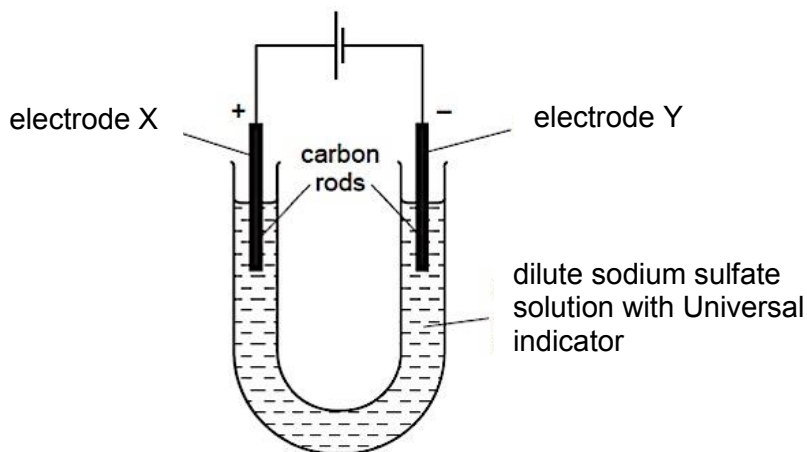


Which of the following statements about the compound is correct?

- A It could be ammonia, NH_3 .
 B It does not conduct electricity in solid state as its ions are not mobile.
 C It exist as small, discrete molecules.
 D It is a crystalline solid at room temperature.

- 11 An ion of element X has 25 electrons and a mass number of 60. What is the charge on the ion of X if the number of neutrons is 33?
- A** 2- **B** 2+ **C** 3- **D** 3+
- 12 When solid sodium hydrogen carbonate ($M_r = 84$) is heated strongly, the following reaction occurs.
- $$2 \text{NaHCO}_3(\text{s}) \rightarrow \text{Na}_2\text{CO}_3(\text{s}) + \text{H}_2\text{O}(\text{g}) + \text{CO}_2(\text{g})$$
- What is the loss in mass when 25.2 g of solid sodium hydrogen carbonate is heated?
- A** 2.7 g **B** 9.3 g **C** 15.8 g **D** 18.6 g
- 13 12.0 g of anhydrous magnesium sulfate ($M_r = 120$) combines with 12.6 g of water to form hydrated magnesium sulfate. What is the formula of the hydrated magnesium sulfate?
- A** $\text{MgSO}_4 \cdot 3\text{H}_2\text{O}$
B $\text{MgSO}_4 \cdot 5\text{H}_2\text{O}$
C $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$
D $\text{MgSO}_4 \cdot 9\text{H}_2\text{O}$
- 14 Ammonium perchlorate has a formula of NH_4ClO_4 .
- What is the formula of copper(II) perchlorate?
- A** CuClO_4 **B** Cu_2ClO_4 **C** $\text{Cu}(\text{ClO}_4)_2$ **D** $\text{Cu}_2(\text{ClO}_4)_3$
- 15 A 50 cm^3 sample of dilute sulfuric acid contains 0.075 moles of the acid. What is the concentration of hydrogen ion in the solution?
- A** 0.75 mol/dm^3
B 1.50 mol/dm^3
C 2.00 mol/dm^3
D 3.00 mol/dm^3
- 16 Fuel cells are currently being researched as a possible alternative to fossil fuels. However, there are still many disadvantages of hydrogen fuel cells.
- Which of the following is **not** one of the disadvantages?
- A** Fuel cells produce greenhouse gases in the form of carbon dioxide.
B Hydrogen is flammable and explosive if the gas leaks.
C It is expensive to produce the hydrogen fuel.
D The reactants are gases that are difficult to store and transport.

- 17 The diagram shows the electrolysis of dilute sodium sulfate solution.



Which of the following changes would occur when a current is passed through the solution for some time?

- A a brown coloured gas is produced at electrode X
 - B electrode X dissolves and become smaller
 - C the aqueous sodium sulfate becomes diluted
 - D the indicator around electrode Y turns blue
- 18 Carbon electrodes are used in the electrolysis of a dilute solution containing both copper(II) chloride and potassium nitrate.

What will be produced at the positive electrode?

- A copper
 - B chlorine
 - C hydrogen
 - D oxygen
- 19 Which of the following is an endothermic process?
- A addition of water to ammonium nitrate
 - B combustion of ethanol in air
 - C oxidation of iron to hydrated iron(III) oxide
 - D reaction of glucose and oxygen

- 20** The enthalpy of vaporization, (ΔH_{vap}) is the amount of energy absorbed to convert one mole of a liquid substance into a gas. The ΔH_{vap} for water is +40.7 kJ/ mol at 100°C and 1 atm.

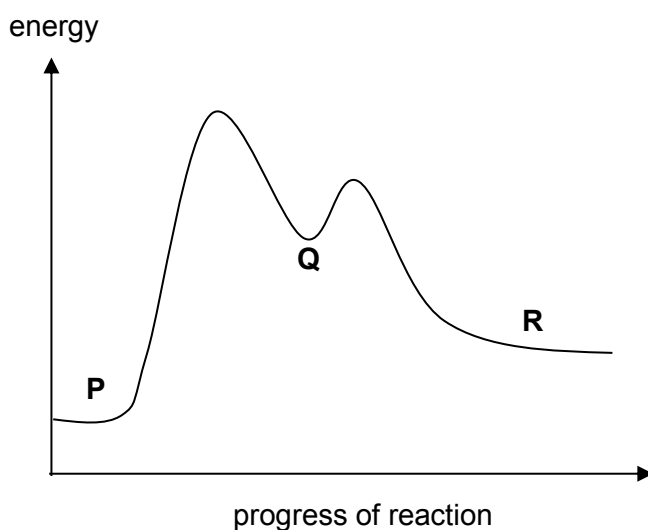
Which of the following statements is true?

- A** 226 kJ of heat is absorbed to convert 100g of water into steam at 100°C and 1 atm.
 - B** Energy is absorbed to transform water molecules vibrating in fixed positions into molecules moving randomly at high speeds.
 - C** The ΔH_{vap} for water is positive as energy is absorbed to break O-H bonds.
 - D** The ΔH_{vap} for water shows that vaporisation is an exothermic process.
- 21** In the conversion of compound P into compound R, it was found that the reaction proceeded in 2 steps as shown below.

Step 1: $\text{P} \rightarrow \text{Q}$

Step 2: $\text{Q} \rightarrow \text{R}$

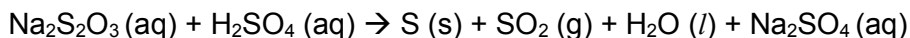
The following graph shows the energy profile diagram for the reactions.



What can be deduced from the diagram?

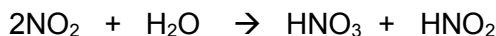
- A** Both steps are endothermic.
- B** The energy absorbed for bond breaking in step 1 is higher than that in step 2.
- C** The energy released for bond forming in step 2 is lower than that in step 1.
- D** The overall reaction to convert P to R is exothermic.

- 22** The equation for the reaction between sodium thiosulfate, $\text{Na}_2\text{S}_2\text{O}_3$ and dilute sulfuric acid is shown below.



Which of the following will **not** affect the rate of reaction?

- A** decrease the temperature of the reaction
 - B** decrease the concentration of dilute sulfuric acid
 - C** increase the concentration of sodium thiosulfate
 - D** increase the pressure of the reaction
- 23** Which equation does **not** represent a redox reaction?
- A** $\text{Ba}^{2+}(\text{aq}) + \text{SO}_4^{2-}(\text{aq}) \rightarrow \text{BaSO}_4(\text{s})$
 - B** $\text{Br}_2(\text{aq}) + 2\text{I}^-(\text{aq}) \rightarrow 2\text{Br}^-(\text{aq}) + \text{I}_2(\text{aq})$
 - C** $\text{Cu}^{2+}(\text{aq}) + \text{Zn}(\text{s}) \rightarrow \text{Zn}^{2+}(\text{aq}) + \text{Cu}(\text{s})$
 - D** $2\text{Fe}^{2+}(\text{aq}) + \text{Cl}_2(\text{g}) \rightarrow 2\text{Fe}^{3+}(\text{aq}) + 2\text{Cl}^-(\text{aq})$
- 24** Nitrogen dioxide reacts with water in a redox reaction as shown in the equation below.



Which statement about this reaction is **not** correct?

- A** Hydrogen does not change its oxidation state.
 - B** Nitrogen changes its oxidation state from +4 to +5.
 - C** Nitrogen changes its oxidation state from +4 to +3
 - D** Oxygen changes its oxidation state from -2 to -1.
- 25** The following statements about dilute sulfuric acid are all correct.
- 1 A white precipitate is formed when aqueous lead(II) nitrate is added.
 - 2 The solution turns anhydrous copper(II) sulfate from white to blue.
 - 3 Addition of Universal Indicator shows that the solution has a pH value of less than 7.0.
 - 4 The solution reacts with copper(II) oxide, forming a blue solution.

Which two statements confirm the acidic nature of the solution?

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

26 Which of the following substances is able to react with both limewater and vinegar?

- A** aluminium oxide
- B** carbon monoxide
- C** iron(III) oxide
- D** nitrogen dioxide

27 Which pair of reactants is best used to prepare the corresponding salt?

	reactant 1	reactant 2	salt
A	ammonium sulfate	nitric acid	ammonium nitrate
B	copper	sulfuric acid	copper(II) sulfate
C	lead(II) carbonate	hydrochloric acid	lead(II) chloride
D	lithium hydroxide	nitric acid	lithium nitrate

28 Zinc is added slowly to a beaker containing hydrochloric acid until the zinc is added in excess.

Which of the following statements about this reaction is true?

- 1 the temperature of the mixture increases
- 2 the pH of the mixture increases until pH 7
- 3 effervescence is seen
- 4 a precipitate is formed

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

29 Element X has the following properties.

- density is 19.3 g/cm^3
- forms oxides XO_2 , XO_3 and X_2O_3
- has the ability to conduct electricity in solid state

What is the possible identity of element X?

- A** calcium
- B** phosphorus
- C** tungsten
- D** zinc

- 30** The atomic radius of some Group I elements of the Periodic Table is given in the table.

element	atomic radius/ pm (1 pm = 10^{-12} m)
G	186
H	231
I	248
J	152

What are the possible melting points of the four elements G, H, I and J?

	melting points / °C			
	G	H	I	J
A	64	98	180	39
B	98	64	180	39
C	64	98	39	180
D	98	64	39	180

- 31** Excess chlorine gas is bubbled into a mixture of potassium bromide and potassium fluoride solution. What would remain in the final solution?

- A** bromine, chlorine, potassium chloride, potassium fluoride
B bromine, potassium chloride, potassium fluoride
C chlorine, fluorine, potassium chloride, potassium bromide
D fluorine, potassium chloride, potassium bromide

- 32** The table shows the properties of some elements, Q, R, S and T in period 3.

	Q	R	S	T
appearance at room temperature	silvery grey solid	yellow solid	silvery grey solid	yellow green gas
reaction with cold water	extremely violent reaction	no reaction	no reaction	slow reaction
nature of oxide	reacts with acid	reacts with bases	reacts with acids and bases	reacts with bases

Which of the following shows the arrangement of these elements in the Periodic Table in increasing order of group number?

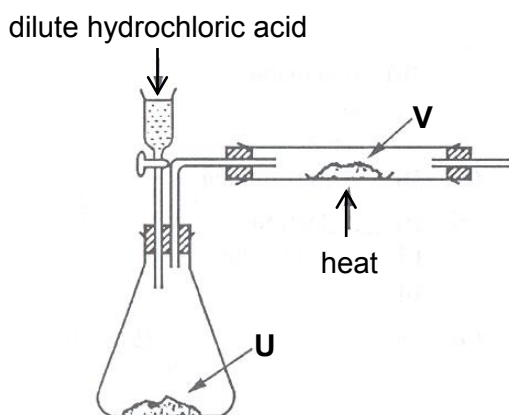
- A** Q, R, S, T
B Q, S, R, T
C S, Q, R, T
D T, R, S, Q

- 33 W, X, Y and Z are metals. When various mixtures of one of the metals is heated with a metal oxide, the following results were obtained.

- (i) oxide of Z + W $\rightarrow$ oxide of W + Z
- (ii) oxide of X + W $\rightarrow$ no reaction
- (iii) oxide of Z + Y $\rightarrow$ oxide of Y + Z
- (iv) oxide of W + Y $\rightarrow$ no reaction

Which of the following arrangements shows the metals W, X, Y and Z in order of **increasing** reactivity?

- A Z W X Y
 - B Y X W Z
 - C W X Y Z
 - D Z Y W X
- 34 The diagram shows the apparatus used in an experiment to reduce substance V with the gas produced by the reaction between dilute hydrochloric acid and substance U.



Which of the following pairs could be U and V?

	U	V
A	copper	zinc oxide
B	zinc	lead(II) oxide
C	copper	lead(II) oxide
D	lead	zinc oxide

35 The following gases can be found in the blast furnace that is used to extract iron.

- 1 Carbon monoxide
- 2 Carbon dioxide
- 3 Nitrogen

Which of the above gases can be both a reactant and a waste gas?

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

36 Which of the following best describes the properties of the three types of steel?

	high carbon steel	low carbon steel	stainless steel
A	corrosion resistant	soft and easily shaped	strong and brittle
B	corrosion resistant	strong and brittle	soft and easily shaped
C	soft and easily shaped	strong and brittle	corrosion resistant
D	strong and brittle	soft and easily shaped	corrosion resistant

37 Scrap iron is often recycled. Which reason for recycling is **incorrect**?

- A** It reduces the amount of pollution at the site of ore extraction.
- B** It reduces the amount of waste taken to the landfill sites.
- C** It reduces the need to collect the scrap iron.
- D** It reduces the reliance on natural resources.

38 The reaction in the Haber process is represented as



Which of the following statements about the Haber process is **incorrect**?

- A** 92 kJ of energy is released when 2 moles of ammonia are formed.
- B** Iron catalyst does not affect the enthalpy change.
- C** The process is carried out at a high temperature of 450 °C.
- D** When 2 moles of nitrogen and 6 moles of hydrogen are used, 4 moles of ammonia are collected.

- 39** Petrol and diesel are two common fuels used by cars and buses respectively. The combustion of these fuels produces air pollutants.

The following table shows the mass of pollutants found in the exhaust fumes when 1 kg of each fuel is burnt.

pollutant	mass of pollutant / g (by burning petrol)	mass of pollutant / g (by burning diesel)
carbon monoxide	14	10
oxides of nitrogen	30	60
sulfur dioxide	1	4
unburnt hydrocarbons	15	20

Which of the following statements can be inferred using the data in the table?

- A** Diesel contributes less to global warming.
B Petrol contributes more towards the formation of acid rain.
C The temperature in petrol engine is lower than that in diesel engine.
D Unburnt hydrocarbons are produced by complete combustion of the fuels.
- 40** In which parts of a motor car do these reactions take place?

	$2\text{CO} + 2\text{NO} \rightarrow 2\text{CO}_2 + \text{N}_2$	$\text{N}_2 + \text{O}_2 \rightarrow 2\text{NO}$
A	engine	engine
B	engine	exhaust
C	exhaust	engine
D	exhaust	exhaust

The Periodic Table of Elements

Group																																																																																							
I	II	Key															0																																																																						
		1 H hydrogen 1																																																																																					
		proton (atomic) number atomic symbol name relative atomic mass																																																																																					
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	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 Lv livermorium -	116 Lv livermorium -	117 Ts tennessine -	118 Og oganeson -

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
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 -

actinoids

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