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Cambridge IGCSE™

CHEMISTRY

0620/23

Paper 2 Multiple Choice (Extended)

May/June 2023

45 minutes

You must answer on the multiple choice answer sheet.

You will need: Multiple choice answer sheet
Soft clean eraser
Soft pencil (type B or HB is recommended)

INSTRUCTIONS

- 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 choice in soft pencil on the multiple choice answer sheet.
- Follow the instructions on the multiple choice answer sheet.
- Write in soft pencil.
- Write your name, centre number and candidate number on the multiple choice answer sheet in the spaces provided unless this has been done for you.
- Do **not** use correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.

INFORMATION

- The total mark for this paper is 40.
- Each correct answer will score one mark.
- Any rough working should be done on this question paper.
- The Periodic Table is printed in the question paper.

This document has **16** pages. Any blank pages are indicated.

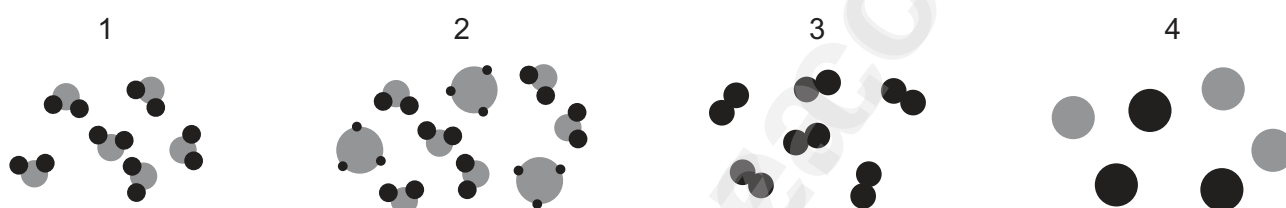
- 1 Nitrogen is heated in a balloon, which expands slightly.

Which statements about the molecules of nitrogen are correct?

- 1 They move further apart.
- 2 They move more quickly.
- 3 They remain the same distance apart.
- 4 Their speed remains unchanged.

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

- 2 The diagrams represent some elements, compounds and mixtures.



Which row describes the numbered substances?

	1	2	3	4
A	element	mixture of compounds	compound	mixture of elements
B	compound	mixture of compounds	element	mixture of elements
C	element	mixture of elements	compound	mixture of compounds
D	compound	mixture of elements	element	mixture of compounds

- 3 Two atoms, X and Y, have the same mass number but different atomic numbers.

Which statement about X and Y is correct?

- A** They have the same number of protons.
- B** They have the same number of electrons.
- C** They are in the same group of the Periodic Table.
- D** They have different numbers of neutrons.

- 4 A sample of pure iron contains three isotopes only.

percentage abundance of isotope / %	isotope
2	${}^n\text{Fe}$
6	${}^{54}\text{Fe}$
92	${}^{56}\text{Fe}$

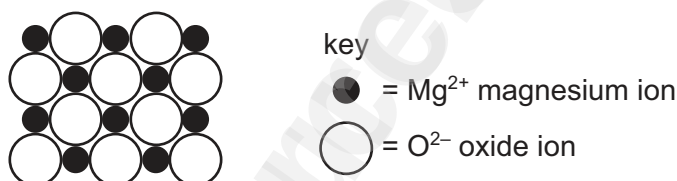
The iron in the sample has a relative atomic mass of 55.9.

What is the value of n ?

- A 53 B 55 C 57 D 58

- 5 Magnesium oxide is a white solid at room temperature and pressure.

Part of the structure of solid magnesium oxide is shown.



Three statements are listed.

- 1 Magnesium ions are smaller than oxide ions because they contain fewer electrons.
- 2 Magnesium oxide has good electrical conductivity when molten because the ions are mobile.
- 3 Magnesium oxide has a high melting point because of the strong electrostatic attraction between the ions and delocalised electrons in the giant lattice.

Which statements are correct?

- A 1 and 2 B 1 and 3 C 2 and 3 D 2 only
- 6 In which molecule are all the outer-shell electrons involved in covalent bonding?
- A Cl_2 B CH_4 C HCl D NH_3

7 Which row describes the properties of silicon(IV) oxide?

	giant covalent structure	melting point
A	no	high
B	no	low
C	yes	high
D	yes	low

8 Which row describes the structure of a solid metal and explains the property?

	structure of solid metal	property of solid metal
A	lattice of negative ions in a sea of electrons	conducts electricity because the electrons are free to move
B	lattice of negative ions in a sea of electrons	is malleable because the layers of ions can slide over each other
C	lattice of positive ions in a sea of electrons	conducts electricity because the ions are free to move
D	lattice of positive ions in a sea of electrons	is malleable because the layers of ions can slide over each other

9 What is the formula of potassium oxide?

A P_2O

B PO_2

C KO

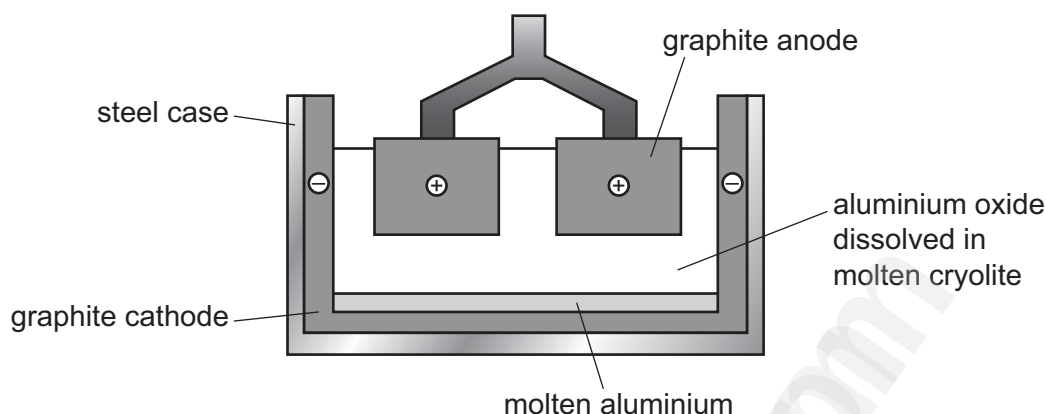
D K_2O

10 A dilute aqueous solution of sodium bromide is electrolysed using inert electrodes.

Which row identifies the product at the cathode and at the anode?

	cathode	anode
A	bromine	hydrogen
B	hydrogen	bromine
C	hydrogen	oxygen
D	oxygen	hydrogen

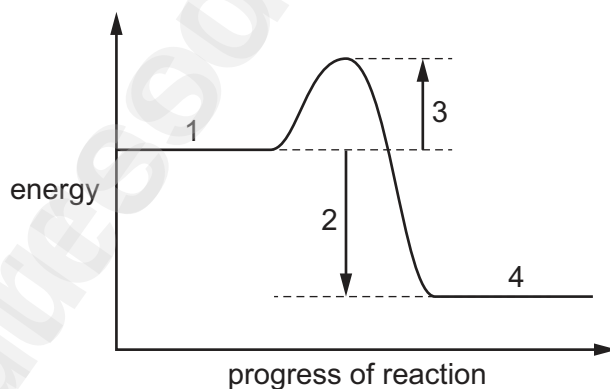
11 Aluminium is extracted by electrolysis, as shown.



Which row shows the ionic half-equations at the cathode and the anode?

	cathode	anode
A	$Al^{3+} \rightarrow Al + 3e^{-}$	$2O^{2-} \rightarrow O_2 + 4e^{-}$
B	$Al^{3+} \rightarrow Al + 3e^{-}$	$2O^{2-} + 4e^{-} \rightarrow O_2$
C	$Al^{3+} + 3e^{-} \rightarrow Al$	$2O^{2-} \rightarrow O_2 + 4e^{-}$
D	$Al^{3+} + 3e^{-} \rightarrow Al$	$2O^{2-} + 4e^{-} \rightarrow O_2$

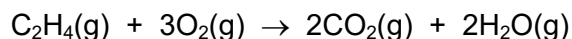
12 The reaction pathway diagram for an exothermic reaction is shown.



Which row identifies labels 1, 2, 3 and 4?

	1	2	3	4
A	reactants	ΔH	E_a	products
B	products	ΔH	E_a	reactants
C	reactants	E_a	ΔH	products
D	products	E_a	ΔH	reactants

- 13 The equation for the complete combustion of ethene is shown.



Some bond energies are listed.

bond	bond energy in kJ/mol
C–H	412
C–C	348
C=C	612
C–O	360
C=O	743
O–O	146
O=O	496
O–H	463

What is the overall energy change when one mole of ethene is completely burned?

- A** –456 **B** –1076 **C** –1340 **D** –2126

- 14 Magnesium reacts with hydrochloric acid to form magnesium chloride and hydrogen.

Why does magnesium powder react faster than magnesium ribbon?

- A** The magnesium atoms in the powder have a lower activation energy.
B The powder has a smaller surface area.
C The magnesium atoms in the powder have more frequent collisions with acid particles.
D The magnesium atoms in the powder have greater kinetic energy.

- 15 Which row shows the conditions used in the Contact process?

	catalyst	pressure / atm	temperature / °C
A	iron	2	100
B	iron	200	450
C	vanadium(V) oxide	2	450
D	vanadium(V) oxide	200	100

- 16 A student heats hydrated copper(II) sulfate. The blue crystals change to a white powder.

How can the student reverse this reaction?

- A Add anhydrous copper(II) sulfate to the white powder.
- B Add water to the white powder.
- C Cool the white powder.
- D Reheat the white powder.

- 17 Which reaction of hydrochloric acid is a redox reaction?

- A $\text{MgCO}_3 + 2\text{HCl} \rightarrow \text{MgCl}_2 + \text{H}_2\text{O} + \text{CO}_2$
- B $\text{Mg}(\text{OH})_2 + 2\text{HCl} \rightarrow \text{MgCl}_2 + 2\text{H}_2\text{O}$
- C $\text{MgO} + 2\text{HCl} \rightarrow \text{MgCl}_2 + \text{H}_2\text{O}$
- D $\text{Mg} + 2\text{HCl} \rightarrow \text{MgCl}_2 + \text{H}_2$

- 18 Which oxide is amphoteric?

- A Al_2O_3
- B CaO
- C Na_2O
- D SO_2

- 19 Four statements about strong acids are listed.

- 1 They react with carbonates to form carbon dioxide.
- 2 They completely dissociate in aqueous solution.
- 3 They react with ammonium salts to form ammonia.
- 4 They are proton acceptors.

Which statements are correct?

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

- 20 Which reaction mixture will produce a precipitate?

- A aqueous Na_2CO_3 and aqueous CuSO_4
- B dilute H_2SO_4 and aqueous NaOH
- C dilute HNO_3 and solid MgO
- D solid CuO and dilute H_2SO_4

21 Which set of elements shows the change from metallic to non-metallic character across a period of the Periodic Table?

- A** beryllium → magnesium → calcium
- B** fluorine → bromine → iodine
- C** oxygen → boron → lithium
- D** sodium → silicon → chlorine

22 A sample of ethanoic acid and a sample of hydrochloric acid have the same concentration.

How do the hydrogen ion concentration and pH of ethanoic acid compare to those of hydrochloric acid?

	ethanoic acid compared to hydrochloric acid	
	hydrogen ion concentration	pH
A	higher	higher
B	higher	lower
C	lower	higher
D	lower	lower

23 What is a typical property of transition elements?

- A** can act as catalysts
- B** poor electrical conductivity
- C** low melting point
- D** low density

24 Which statement about copper or aluminium is correct?

- A** Aluminium is more dense than copper.
- B** Aluminium is less reactive than copper.
- C** Copper has high ductility.
- D** Copper has poor electrical conductivity.

- 25** Water from a reservoir flows to the water works where purification process 1 takes place followed by process 2.

What are processes 1 and 2?

	process 1	process 2
A	chlorination	filtration
B	filtration	chlorination
C	fractional distillation	filtration
D	filtration	fractional distillation

- 26** Calcium reacts with cold water to produce hydrogen.

Lead reacts slowly when heated in air to form an oxide but has almost no reaction with steam.

Silver does not react with either air or water.

Zinc reacts when heated with steam to produce hydrogen.

What is the order of reactivity starting with the least reactive?

	least reactive $\longrightarrow$ most reactive			
A	calcium	lead	zinc	silver
B	calcium	zinc	lead	silver
C	silver	lead	zinc	calcium
D	silver	zinc	lead	calcium

- 27** Blocks of magnesium are attached to the bottom of a steel boat to prevent rusting.

Which equation describes a change that prevents the steel from rusting?

- A** $\text{Fe} \rightarrow \text{Fe}^{3+} + 3\text{e}^{-}$
- B** $\text{Fe}_2\text{O}_3 + 3\text{Mg} \rightarrow 2\text{Fe} + 3\text{MgO}$
- C** $3\text{Mg}^{2+} + 2\text{Fe} \rightarrow 2\text{Fe}^{3+} + 3\text{Mg}$
- D** $\text{Mg} \rightarrow \text{Mg}^{2+} + 2\text{e}^{-}$

28 Which statements about the extraction of iron in a blast furnace are correct?

- 1 The temperature inside the blast furnace is increased by burning carbon.
- 2 Iron(III) oxide is reduced to iron by carbon monoxide.
- 3 The thermal decomposition of calcium carbonate forms slag.
- 4 Slag reacts with acidic impurities.

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

29 Which statements about water are correct?

- 1 Tap water has fewer impurities than distilled water.
- 2 Tap water will turn anhydrous cobalt(II) chloride pink.
- 3 The domestic water supply is treated with carbon to kill microbes.
- 4 Phosphates from fertilisers can cause deoxygenation of water.

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

30 Oxides of nitrogen form in car engines and are removed by catalytic converters.

Which equation represents a reaction that occurs in a catalytic converter?

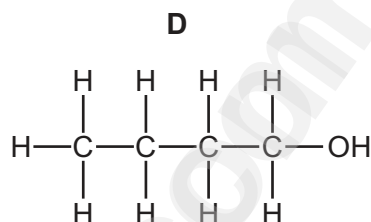
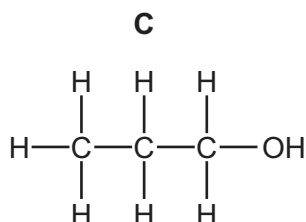
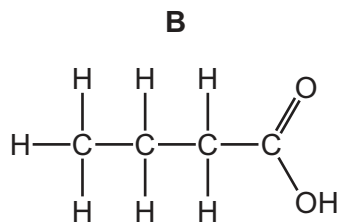
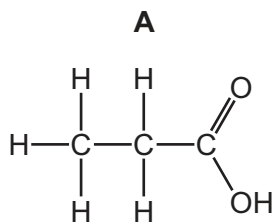
- A $\text{CO} + \text{NO}_2 \rightarrow \text{NO} + \text{CO}_2$
- B $2\text{CO} + 2\text{NO} \rightarrow \text{N}_2 + 2\text{CO}_2$
- C $\text{CO}_2 + \text{NO} \rightarrow \text{NO}_2 + \text{CO}$
- D $\text{CO}_2 + 2\text{NO}_2 \rightarrow \text{N}_2 + 3\text{O}_2 + \text{C}$

31 An alkene is represented by the formula $\text{CH}_3\text{CH}=\text{CH}_2$.

Which name is given to this type of formula?

- A displayed
- B empirical
- C general
- D structural

32 What is the structure of propanoic acid?



33 Butane reacts with chlorine in the presence of ultraviolet radiation.

What is the equation for this reaction?

- A** $\text{C}_4\text{H}_{10} + \text{Cl}_2 \rightarrow \text{C}_4\text{H}_8\text{Cl}_2 + \text{H}_2$
- B** $\text{C}_4\text{H}_{10} + \text{Cl}_2 \rightarrow \text{C}_4\text{H}_9\text{Cl} + \text{HCl}$
- C** $\text{C}_4\text{H}_{10} + \text{Cl}_2 \rightarrow 2\text{C}_2\text{H}_5\text{Cl} + \text{H}_2$
- D** $\text{C}_4\text{H}_{10} + \text{Cl}_2 \rightarrow \text{C}_2\text{H}_4 + \text{C}_2\text{H}_5\text{Cl} + \text{HCl}$

34 A hydrocarbon P is cracked to make compound Q and hydrogen.

Compound R is formed by the addition polymerisation of compound Q.

To which homologous series do P, Q and R belong?

	alkene	alkane
A	P only	Q and R
B	Q only	P and R
C	P and Q	R only
D	P and R	Q only

35 Which substances are structural isomers?

- A** but-2-ene and propene
- B** ethyl ethanoate and butanoic acid
- C** methyl methanoate and ethanol
- D** propan-1-ol and butan-1-ol

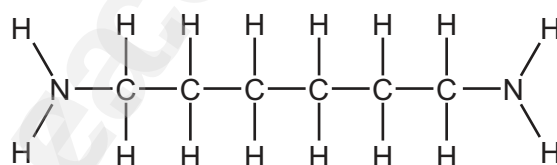
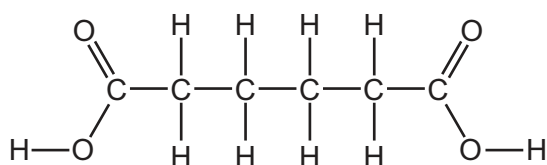
36 Ethanol is produced by:

- 1 the catalytic addition of steam to ethene
- 2 fermentation.

Which statement is correct?

- A Both processes use similar amounts of energy.
- B Both processes use a catalyst.
- C Process 1 uses a temperature of 25–35 °C.
- D Process 2 uses a pressure of 60 atm.

37 The two monomers shown can be used to form a condensation polymer.



Which small molecule is released during this reaction?

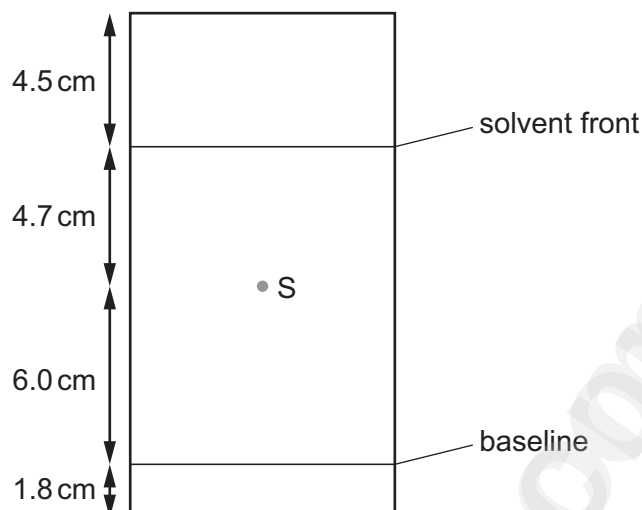
- A H_2O
- B NH_3
- C CO_2
- D CONH_2

38 Dilute hydrochloric acid is titrated into a conical flask containing sodium hydroxide solution and a few drops of methyl orange indicator.

Which piece of apparatus is used to add the hydrochloric acid?

- A beaker
- B burette
- C measuring cylinder
- D pipette

- 39 The chromatogram obtained from a chromatography experiment on substance S is shown.



What is the R_f value of S?

- A** 0.39 **B** 0.46 **C** 0.56 **D** 0.62
- 40 Element X burns in air to form an acidic gas that decolourises potassium manganate(VII).

What is X?

- A** carbon
B nitrogen
C magnesium
D sulfur

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11Na sodium 23	12Mg magnesium 24	13Al aluminium 27	14Si silicon 28	15P phosphorus 31	16S sulfur 32	17Cl chlorine 35.5	18Ar argon 40	19K potassium 39	20Ca calcium 40	21Sc scandium 45	22Ti titanium 48	23V vanadium 51	24Cr chromium 52	25Mn manganese 55	26Fe iron 56	27Co cobalt 59	28Ni nickel 59	29Cu copper 64	30Zn zinc 65	31Ga gallium 70	32Ge germanium 73	33As arsenic 75	34Se selenium 79	35Br bromine 80	36Kr krypton 84																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	
37Rb rubidium 85	38Sr strontium 88	39Y yttrium 89	40Zr zirconium 91	41Nb niobium 93	42Mo molybdenum 96	43Tc technetium —	44Ru ruthenium 101	45Rh rhodium 103	46Pd palladium 106	47Ag silver 108	48Cd cadmium 112	49In indium 115	50Sn tin 119	51Sb antimony 122	52Te tellurium 128	53I iodine 127	54Xe xenon 131	55Cs caesium 133	56Ba barium 137	lanthanoids	72Hf hafnium 178	73Ta tantalum 181	74W tungsten 184	75Re rhenium 186	76Os osmium 190	77Ir iridium 192	78Pt platinum 195	79Au gold 197	80Hg mercury 201	81Tl thallium 204	82Pb lead 207	83Bi bismuth 209	84Po polonium —	85At astatine —	86Rn radon —																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
87Fr francium —	88Ra radium —	actinoids	104Rf rutherfordium —	105Db dubnium —	106Sg seaborgium —	107Bh bohrium —	108Hs hassium —	109Mt meitnerium —	110Ds darmstadtium —	111Rg roentgenium —	112Cn copernicium —	113Nh nihonium —	114Fl flerovium —	115Mc moscovium —	116Lv livermorium —	117Ts tennessine —	118Og oganeson —	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).