

Name: _____ ()

Class: _____



CHIJ KATONG CONVENT

PRELIMINARY EXAMINATIONS 2020

Secondary Four Express

CHEMISTRY

6092/01

Duration: 1 hour

Classes: 405 and 406

Additional Material: Optical Answer Sheet.

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

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

Write your name, class and index number in the spaces provided at the top of this page and on the Optical 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 choice 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 the question booklet.

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

At the end of the examination, hand in:

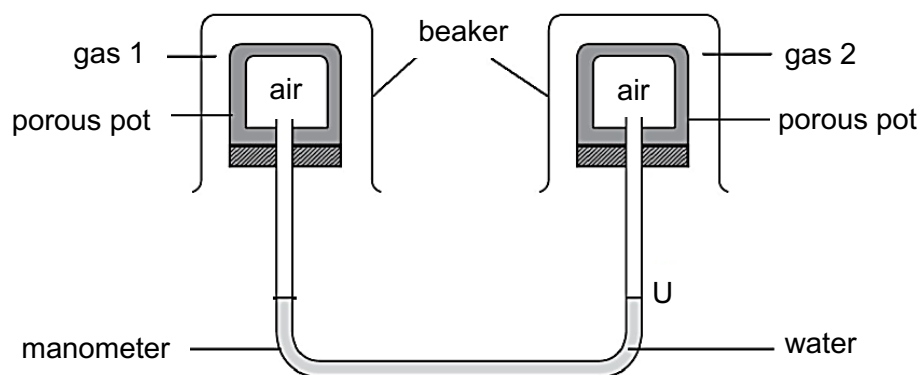
1. Optical Answer Sheet; and
2. Question booklet **separately**.

- 1 A student compares compound X in the solid, liquid and gaseous states.

Which statement about compound X is correct?

- A A molecule of gas X has a lower mass than a molecule of liquid X.
- B Energy is released when X changes from liquid to solid state.
- C Liquid X is at a lower temperature than solid X.
- D Molecules of gas X move by sliding over one another.

- 2 Two beakers, each containing a different gas, were inverted over a porous pot containing gas as shown in the set-up below.



Which pair of gases will cause the water level at U to rise?

	gas 1	gas 2
A	carbon dioxide	nitrogen
B	carbon monoxide	methane
C	methane	chlorine
D	nitrogen	carbon monoxide

- 3 A student carries out an experiment to determine the rate of reaction when 20 cm^3 of aqueous hydrogen peroxide decomposes to form oxygen gas and water.

Which set of apparatus would she need to carry out the experiment?

- A beaker, conical flask, gas syringe, measuring cylinder
- B conical flask, electronic mass balance, measuring cylinder, thermometer
- C conical flask, gas syringe, measuring cylinder, stopwatch
- D conical flask, gas syringe, stopwatch, thermometer

- 4 Which experimental procedure can be used to prepare and collect a sample of dry ammonia gas in the laboratory?

	preparation	drying	collection
A	add concentrated hydrochloric acid to manganese(IV) oxide	pass the gas through concentrated sulfuric acid	displacement of water
B	heat lead(II) nitrate	pass the gas through calcium oxide	displacement of water
C	warm a mixture of sodium hydroxide and ammonium chloride	pass the gas through concentrated sulfuric acid	downward delivery
D	warm a mixture of potassium hydroxide and ammonium chloride	pass the gas through calcium oxide	upward delivery

- 5 A liquid mixture contains methylbenzene and aqueous copper(II) sulfate. Methylbenzene is insoluble in water and it boils at 111 °C.

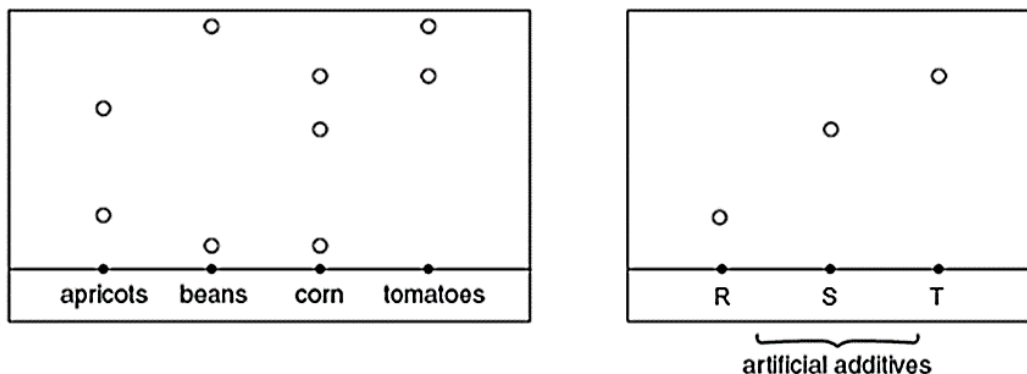
Which two steps would you use to obtain pure samples of liquid methylbenzene and copper(II) sulfate crystals from the mixture?

	step 1	step 2
A	crystallisation	fractional distillation
B	evaporation	use a separating funnel
C	simple distillation	evaporation
D	use a separating funnel	crystallisation

- 6 Which is the best method to obtain graphite powder from a mixture of graphite and aluminium oxide powder?

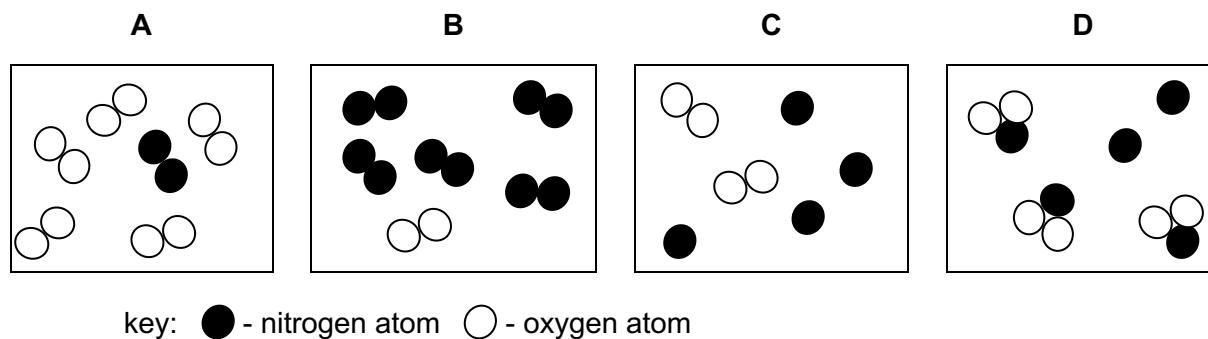
- A Dissolve the mixture in water then filter.
- B Heat the mixture so that the oxide will sublime.
- C Warm the mixture with carbon monoxide and then filter.
- D Warm the mixture with sodium hydroxide and then filter.

- 7 Samples of canned apricots, beans, corn and tomatoes were tested for additives using chromatography. The chromatograms were compared with those of three artificial additives, R, S and T. The results are shown.



Which canned food does **not** contain any of the three artificial additives?

- A apricot
 - B beans
 - C corn
 - D tomatoes
- 8 Which diagram best represents nitrogen and oxygen in a sample of air?



- 9 A sample of a white crystalline solid is heated in the absence of oxygen. It melts sharply at 120 °C but on further heating, smoky fumes and a black solid were observed.

What can be concluded about the white crystalline solid?

- A It is a compound that decomposed to form simpler substances.
- B It is a mixture known as a hydrated salt.
- C It is a pure substance that combusted to form two products only.
- D It is an element that decomposed to form simpler substances.

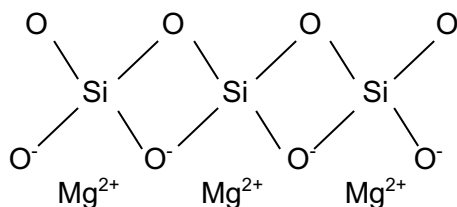
- 10 Three elements W, X and Y have consecutive, increasing proton numbers. It is known that element Y is a noble gas.

Which is the symbol for an ion of element W?

- A W^-
B W^{2-}
C W^+
D W^{2+}
- 11 Carbon has two main isotopes, ^{12}C and ^{13}C . A sample being studied is known to contain both carbon isotopes and the relative atomic mass of carbon in the molecule is 12.2.

What is the ratio of ^{12}C to ^{13}C ?

- A 1 : 4
B 3 : 1
C 3 : 4
D 4 : 1
- 12 Asbestos was commonly used in building and construction materials in the past. The diagram shows a simplified structure of asbestos.



Which is a likely property of asbestos?

- A It conducts electricity in the solid state.
B It has a high melting point.
C It has a low boiling point.
D It has low density.
- 13 Rubidium is in Group I of the Periodic Table.

Which row correctly shows the properties of rubidium chloride?

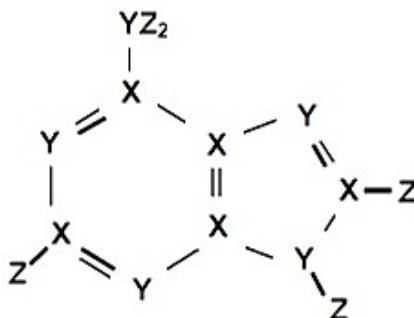
	chemical formula	melting point/ $^{\circ}\text{C}$	solubility in water
A	RbCl	69	insoluble
B	RbCl	690	soluble
C	RbCl_2	69	soluble
D	RbCl_2	690	insoluble

- 14 When heated, two moles of Z give one mole of oxygen and two moles of chlorine.

What is the molecular formula of Z?

- A ClO_2
- B Cl_2O
- C Cl_2O_2
- D Cl_4O_2

- 15 A molecule containing atoms of the elements X, Y and Z has the following structure.



Which row shows a likely combination of the elements?

	X	Y	Z
A	F	Si	P
B	P	Si	F
C	Si	P	F
D	Si	P	Na

- 16 In which substance is each carbon atom covalently bonded to only three other atoms?

- A carbon dioxide
- B diamond
- C graphite
- D methane

- 17 Which organic compound has the greatest percentage by mass of carbon?

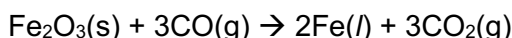
- A CH_4
- B C_2H_6
- C C_6H_6
- D $\text{C}_6\text{H}_{12}\text{O}_6$

- 18 A student carried out an experiment to determine the value of x in the formula $\text{MgSO}_4 \cdot x\text{H}_2\text{O}$. She weighed a sample of $\text{MgSO}_4 \cdot x\text{H}_2\text{O}$, heated it to drive off the water and then weighed it again. The experimental data is shown in the table.

mass of $\text{MgSO}_4 \cdot x\text{H}_2\text{O}$ / g	2.46
mass of MgSO_4 after heating/ g	1.20

What is the value of x ?

- A 2
B 4
C 5
D 7
- 19 When iron(III) oxide is reduced in a blast furnace, iron is formed. The equation for the reaction is as shown.



80 kg of iron(III) oxide was reduced and 49 kg of iron was obtained.

What is the percentage yield of iron obtained from this reaction?

- A 43.8%
B 61.3%
C 81.6%
D 87.5%
- 20 Pure gold can be extracted when dicyanoaurate ions, $\text{Au}(\text{CN})_2^-$, undergoes a reaction with zinc metal.

If 83.0 g of dicyanoaurate ions reacts completely with 10.8 g of zinc metal, what is the molar ratio of dicyanoaurate ions to zinc in this reaction?

- A 2 : 3
B 2 : 1
C 5 : 1
D 10 : 1
- 21 Powdered calcium carbonate reacts with dilute hydrochloric acid to produce calcium chloride, water and carbon dioxide.

Which is the correct ionic equation for this reaction?

- A $\text{Ca}^{2+}(\text{aq}) + \text{CO}_3^{2-}(\text{aq}) + 2\text{H}^+(\text{aq}) \rightarrow \text{Ca}^{2+}(\text{aq}) + \text{H}_2\text{O}(\text{l}) + \text{CO}_2(\text{g})$
B $\text{CaCO}_3(\text{s}) + 2\text{H}^+(\text{aq}) \rightarrow \text{Ca}^{2+}(\text{aq}) + \text{H}_2\text{O}(\text{l}) + \text{CO}_2(\text{g})$
C $\text{CaCO}_3(\text{s}) + 2\text{HCl}(\text{aq}) \rightarrow \text{CaCl}_2(\text{aq}) + \text{H}_2\text{O}(\text{l}) + \text{CO}_2(\text{g})$
D $\text{CO}_3^{2-}(\text{aq}) + 2\text{H}^+(\text{aq}) \rightarrow \text{H}_2\text{O}(\text{l}) + \text{CO}_2(\text{g})$

- 22 Zinc oxide was added separately to warm dilute solutions of an acid and an alkali.

Which row gives the correct observations?

	acid	alkali
A	no reaction	no reaction
B	no reaction	salt formed
C	salt formed	no reaction
D	salt formed	salt formed

- 23 Different volumes of aqueous potassium hydroxide and sulfuric acid of equal concentration are mixed in a styrofoam cup.

Which combination of volumes of each solution would give the greatest temperature rise?

	volume of potassium hydroxide/ cm ³	volume of sulfuric acid/ cm ³
A	20.0	40.0
B	30.0	30.0
C	40.0	20.0
D	45.0	15.0

- 24 Substance Q is an aqueous solution containing three different ions.

Some tests are carried out on Q, and the observations made are shown in the table.

test	observation
To 2 cm ³ of Q, add aqueous ammonia dropwise until it is in excess	A mixture of blue precipitate and white precipitate forms. Both precipitates dissolve in excess aqueous ammonia to give a dark blue solution.
To 1 cm ³ of Q, add an equal volume of dilute nitric acid, and then a few drops of aqueous silver nitrate	A yellow precipitate forms.

What are the ions present in Q?

- A Al^{3+} , Cu^{2+} , Cl^-
 B Cu^{2+} , Zn^{2+} , I^-
 C Fe^{2+} , Zn^{2+} , I^-
 D Cu^{2+} , Pb^{2+} , I^-

- 25 Excess dilute sulfuric acid is added to separate solutions of barium hydroxide and barium chloride.

Which statement is correct about **both** reactions?

- A A gas is evolved.
 B A precipitate is formed.
 C The pH of the resulting solution is 7.
 D Water is formed.

26 Which is **not** a redox reaction?

- A $\text{Al}_2\text{O}_3(\text{s}) + 3\text{H}_2\text{SO}_4(\text{aq}) \rightarrow \text{Al}_2(\text{SO}_4)_3(\text{aq}) + 3\text{H}_2\text{O}(\text{l})$
- B $\text{CH}_4(\text{g}) + 2\text{O}_2(\text{g}) \rightarrow \text{CO}_2(\text{g}) + 2\text{H}_2\text{O}(\text{g})$
- C $\text{Fe}^{2+}(\text{aq}) + \text{Zn}(\text{s}) \rightarrow \text{Fe}(\text{s}) + \text{Zn}^{2+}(\text{aq})$
- D $\text{Zn}(\text{s}) + \text{H}_2\text{SO}_4(\text{aq}) \rightarrow \text{ZnSO}_4(\text{aq}) + \text{H}_2(\text{g})$

27 Which compound contains hydrogen with oxidation state -1 ?

- A H_2O
- B H_2O_2
- C NaH
- D NaOH

28 A large volume of copper(II) sulfate solution is left in an iron container overnight.

Which statement describes the observation after one day?

- A Atmospheric oxygen reacts with the copper(II) sulfate to give black copper(II) oxide.
- B Some fine iron particles are formed in the solution.
- C The part of the container in contact with the solution is coated with copper.
- D The solution evaporates completely and some copper(II) sulfate crystals are left behind.

29 Magnalium is an alloy of aluminium (85%) and magnesium (15%). Some properties of magnalium are listed below.

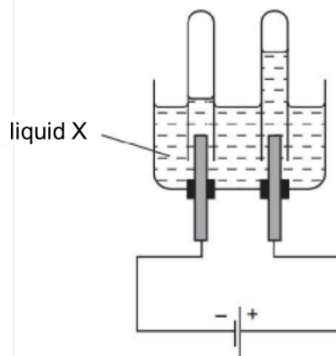
Which property of magnalium is **not** a reason for its use in the construction of aircraft?

- A It conducts heat and electricity.
- B It is less dense than aluminium.
- C It is stronger than aluminium or magnesium.
- D It is covered by a layer of aluminium oxide.

30 Which row is correct for a simple cell and an electrolytic cell?

	simple cell	electrolytic cell
A	Anode is the positive electrode.	Anode is the negative electrode.
B	Reduction occurs at the cathode.	Reduction occurs at the cathode.
C	Cathode is the negative electrode.	Anode is the positive electrode.
D	Oxidation occurs at the anode.	Reduction occurs at the anode.

- 31 The diagram shows the electrolysis of liquid X using inert electrodes.



Which does **not** show the products formed at the electrodes and in the electrolyte?

	gas produced at		electrolyte
	cathode	anode	
A	hydrogen	chlorine	concentrated sodium chloride
B	hydrogen	chlorine	concentrated hydrochloric acid
C	hydrogen	oxygen	dilute copper(II) chloride
D	hydrogen	oxygen	dilute sulfuric acid

- 32 The table gives the atomic radii of some Group I elements (P, Q, R and S).

element	atomic radius/ pm (1 pm = 10^{-12} m)
P	231
Q	152
R	248
S	186

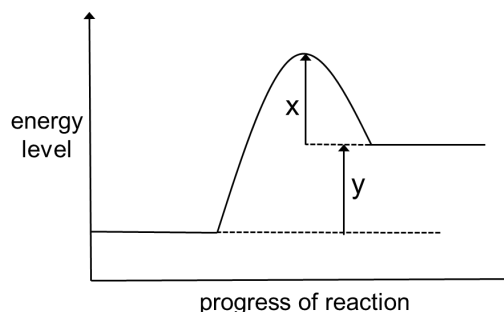
Which row correctly arranges the elements in increasing order of melting points?

	lowest			highest
A	P	Q	R	S
B	Q	S	P	R
C	R	P	S	Q
D	S	R	Q	P

- 33 Which equation represents a halogen displacement reaction?

- A** $\text{Br} + \text{NaI} \rightarrow \text{NaBr} + \text{I}$
B $\text{Cl}_2 + 2\text{NaBr} \rightarrow 2\text{NaCl} + \text{Br}_2$
C $\text{F} + \text{NaCl} \rightarrow \text{NaF} + \text{Cl}$
D $\text{I}_2 + 2\text{NaF} \rightarrow 2\text{NaI} + \text{F}_2$

34 The energy profile diagram of a reaction is shown.



Which statement is correct?

- A The value of x is the activation energy for the reverse reaction.
- B The value of y would decrease in the presence of a catalyst.
- C This reaction could be between sodium hydroxide and nitric acid.
- D More energy was released in bond formation than energy absorbed in bond breaking.

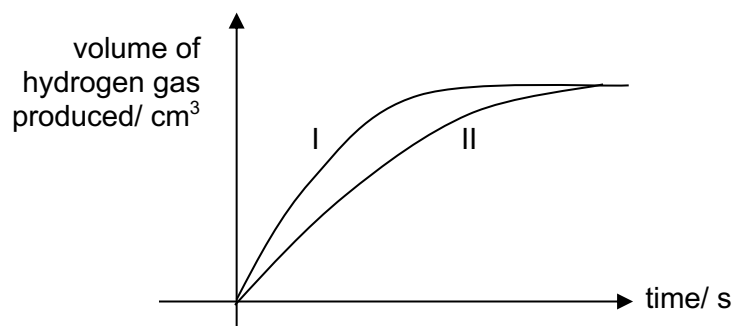
35 The energy required to break the following bonds are as shown in the table.

bond	energy required to break bond/ kJ / mol
F – F	158
H – H	436
H – F	556

Which can be deduced from the information provided above?

- A Hydrogen fluoride molecules are the least stable compared to hydrogen and fluorine molecules.
- B Hydrogen gas is more reactive than fluorine gas.
- C The bond in the fluorine molecule is the strongest compared to hydrogen and hydrogen fluoride molecules.
- D The energy produced when forming 1 mole of hydrogen fluoride from its elements is 259 kJ.

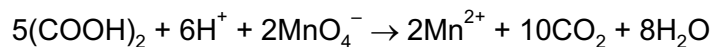
36 In the graph, curve I was obtained when 1 g of granulated zinc was reacted with an excess of 1 mol/dm^3 hydrochloric acid at 50°C .



Which change would produce curve II?

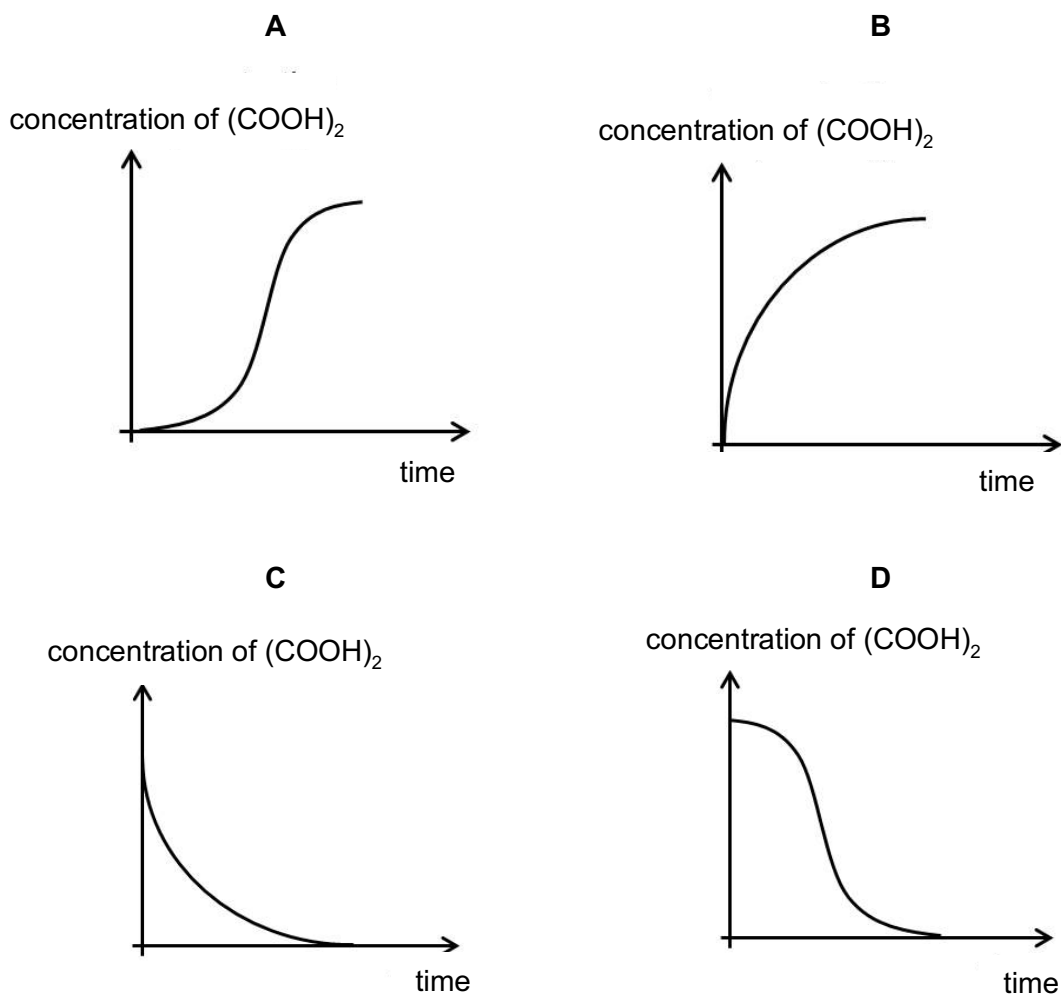
- A lower the concentration of hydrochloric acid to 0.5 mol/dm^3
- B increase the temperature
- C reduce the pressure of the reacting mixture
- D use 1 g of zinc powder

- 37 In autocatalysis, a chemical reaction is catalysed by one of its products. An example is the reaction between oxalic acid, $(\text{COOH})_2$, and acidified potassium manganate(VII).



The reaction is very slow at room temperature, but it is catalysed by Mn^{2+} ions that are produced during the reaction.

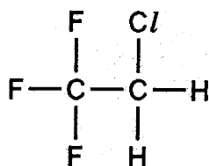
Which graph correctly shows the changes in concentration of $(\text{COOH})_2$ as the reaction proceeds?



- 38 Which method would **not** produce ammonia?

- A heating ammonium chloride with calcium hydroxide
- B heating ammonium sulfate with hydrochloric acid
- C heating ammonium sulfate with sodium hydroxide
- D heating concentrated aqueous ammonia

- 39 In the past, chlorofluorocarbons (CFCs) were used as aerosol propellants. The structure of one CFC is shown.



Which element in this compound can cause a depletion of ozone?

- A carbon
 - B chlorine
 - C fluorine
 - D hydrogen
- 40 A catalytic converter in a car exhaust system converts pollutants into less harmful products.

Which conversion occurs in a catalytic converter?

- A carbon dioxide $\rightarrow$ carbon monoxide
- B nitrogen $\rightarrow$ nitrogen oxides
- C sulfur dioxide $\rightarrow$ calcium sulfite
- D unburnt hydrocarbons $\rightarrow$ carbon dioxide + water

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.).