



ZHONGHUA SECONDARY SCHOOL
PRELIMINARY EXAMINATION 2024
SECONDARY 4 EXPRESS

Candidate's Name

Class

Register Number

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CHEMISTRY

6092 /01

Paper 1

21 August 2024
1 hour

Additional Materials: OTAS

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

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

Write your name, index number and class on the OTAS in the spaces provided.

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 OTAS.

Read the instructions on the OTAS very carefully.

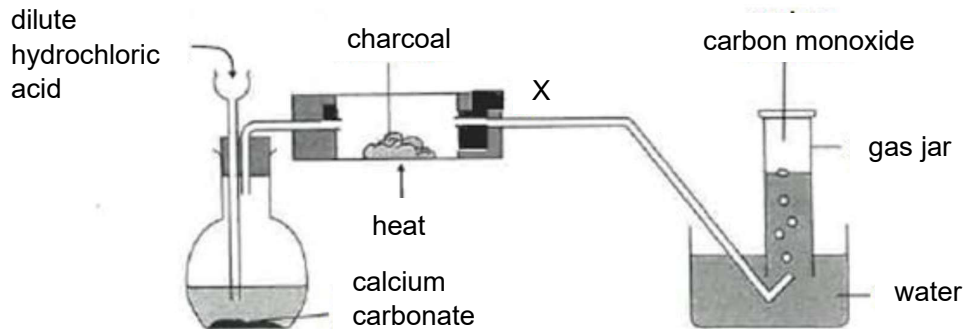
Each correct answer will score one mark. A mark will not be deducted for a wrong answer.

Any rough working should be done in this booklet.

A copy of the Periodic Table is printed on page 20.

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

- 1 The following set-up was used to obtain a sample of carbon monoxide in the laboratory. The sample of carbon monoxide collected is found to be an impure mixture of two gases.



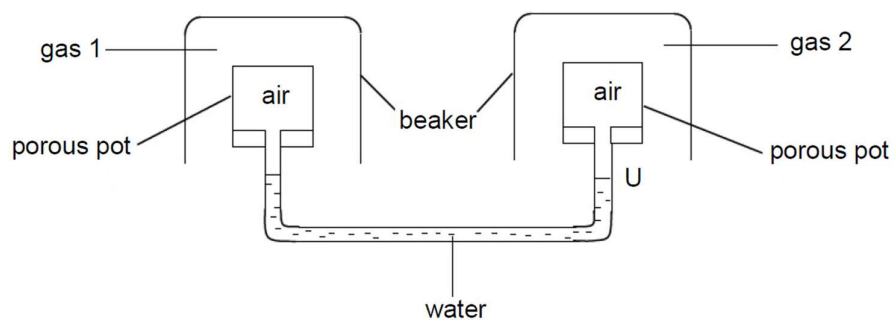
How can a pure sample of carbon monoxide be obtained?

- A bubble the stream of gas from X into a flask containing aqueous sodium hydroxide before collection
 - B bubble the stream of gas from X into a flask containing concentrated sulfuric acid before collection
 - C use concentrated sulfuric acid instead of dilute hydrochloric acid for the reaction with calcium carbonate
 - D use larger pieces of charcoal
- 2 Three separations are listed.
- 1 obtaining ethanol from a mixture of water and ethanol
 - 2 obtaining water from a mixture of oil and water
 - 3 obtaining water from calcium chloride solution

Which techniques would be involved in these separations?

	1	2	3
A	evaporation	simple distillation	simple distillation
B	fractional distillation	use of a separation funnel	evaporation
C	fractional distillation	use of a separation funnel	simple distillation
D	simple distillation	filtration	fractional distillation

- 3 The apparatus below is set up, using different gases in the two inverted beakers.

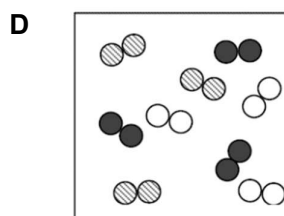
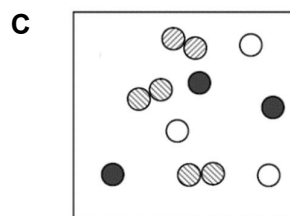
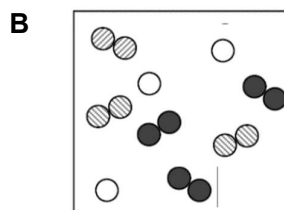
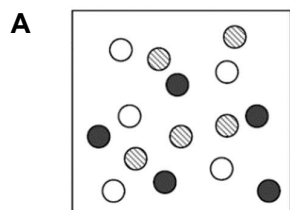


Which pair of gases would cause an upward movement of the water level at U?

	gas 1	gas 2
A	helium	carbon dioxide
B	nitrogen	carbon monoxide
C	nitrogen	hydrogen
D	oxygen	hydrogen

- 4 A gaseous mixture is made up of argon, chlorine and nitrogen.

Which diagram shows a pure sample of this mixture?



- 5 The formulae of four covalent molecules are shown.

- 1 $\text{CH}_3\text{CH}_2\text{OH}$
- 2 CH_3COOH
- 3 H_2O
- 4 O_2

In which pair of molecules does oxygen form at least one double bond in both molecules?

- A 1 and 2
 - B 2 and 3
 - C 2 and 4
 - D 3 and 4
- 6 Formation of metallic oxides requires electrons to be transferred from metal atoms to oxygen atoms.
- In the formation of one mole of metallic oxide, which oxide does not involve the metal atoms transferring exactly two moles of electrons?
- A aluminium oxide
 - B calcium oxide
 - C copper(II) oxide
 - D potassium oxide
- 7 In an experiment, aqueous barium nitrate, molten calcium chloride, solid graphite and solid iron metal are found to be able to conduct electricity.
- Which pair of substances conduct electricity utilising mobile electrons?
- A aqueous barium nitrate and molten calcium chloride
 - B molten calcium chloride and solid graphite
 - C molten calcium chloride and solid iron metal
 - D solid graphite and solid iron metal

8 In which molecule are all the valence electrons in the atoms involved in bonding?

- A ammonia
- B butene
- C carbon dioxide
- D nitrogen

9 The table shows four elements P, Q, R and S with their atomic numbers.

element	P	Q	R	S
atomic number	6	12	13	8

What are the likely formulae of a ionic compound and a covalent compound formed from P, Q, R and S?

	formula of ionic compound	formula of covalent compound
A	QS ₂	Q ₂ P
B	Q ₃ R ₂	R ₂ S ₃
C	R ₂ S ₃	PS ₂
D	S ₂	Q ₂ P

10 An element X has two isotopes, which can be represented as ²³⁹X and ²⁴³X.

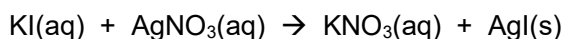
How does ²⁴³X differ from ²³⁹X?

- A It has 4 more electrons and has a higher melting point.
- B It has 4 more neutrons and has a higher density.
- C It has 4 more neutrons and is more reactive.
- D It has 4 more protons and is more reactive.

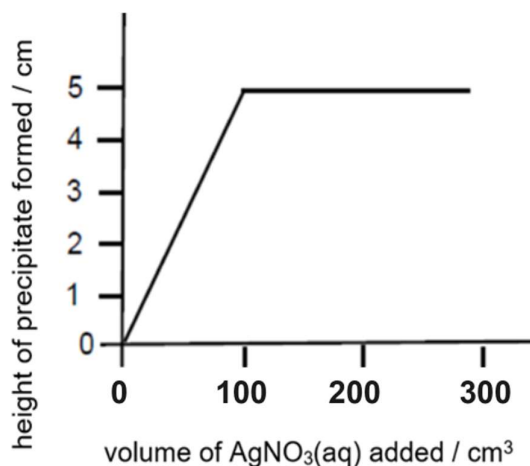
- 11 Graphite can be used as a dry lubricant, with the advantage of not leaving sticky residues. Powdered graphite can be used in a lock to allow the key to turn more easily.

Which statement best describes the structure of graphite that allows it to be used as a lubricant?

- A** Each carbon atom has four bonds and can form an unreactive film over which the metal can slide.
- B** The bonds between the carbon atoms are weak and the carbon atoms can easily slide over one another.
- C** The carbon atoms are bonded with weak intermolecular forces of attraction between layers, which can slide freely over one another.
- D** The tetrahedral arrangement of bonds around each carbon atom causes the neighboring atom to slide past one another easily.
- 12 When potassium iodide is added to silver nitrate, a yellow precipitate is formed. The chemical reaction is represented in the chemical equation below.



50.0 cm³ of potassium iodide solution was added to 0.600 mol/dm³ silver nitrate solution. The height of the precipitate formed was plotted to give the graph shown below.



What is the concentration of the potassium iodide solution?

- A** 0.6 mol/dm³
- B** 1.2 mol/dm³
- C** 60 mol/dm³
- D** 100 mol/dm³

- 13** 2.50 g of an impure sample of a metal carbonate, MCO_3 , was heated strongly in a crucible until its mass remains constant. At the end of the experiment, 0.48 dm^3 of carbon dioxide was produced and 1.12 g of pure oxide remained in the crucible. The decomposition of the metal carbonate is shown by the equation below:



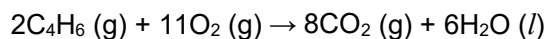
What is the relative atomic mass of M?

- A** $1.12 \div \frac{0.48}{24}$
- B** $1.12 \div \frac{0.48}{24} - 16$
- C** $2.50 \div \frac{0.48}{24}$
- D** $2.50 \div \frac{0.48}{24} - 60$
- 14** Which fuel produces 144 dm^3 of carbon dioxide upon complete combustion?
- A** 0.5 mol of C_6H_{12}
- B** 1.5 mol of C_4H_8
- C** 3.0 mol of $\text{C}_3\text{H}_7\text{OH}$
- D** 6.0 mol of C_2H_6
- 15** Bromine can be extracted from a solution of calcium bromide.

What is the mass of bromine that can be extracted from 100 g of a calcium bromide solution that is 36% by mass?

- A** 28.8 g
- B** 36.0 g
- C** 57.6 g
- D** 72.0 g

- 16 Butyne, C_4H_6 , reacts with oxygen as shown in the equation below.



In an experiment, 100 cm^3 of butyne, reacts with 660 cm^3 of oxygen at r.t.p.

What is the total volume of gas remaining at the end of the reaction?

- A 110 cm^3
- B 400 cm^3
- C 510 cm^3
- D 810 cm^3
- 17 Which two reactants will react to give products that contains two salts?
- A aqueous potassium hydroxide and aqueous ammonium nitrate
- B aqueous sodium chloride and aqueous silver nitrate
- C dilute hydrochloric acid and iron
- D dilute nitric acid and solid calcium carbonate
- 18 Nitrogen is needed for production of amino acids in plants and thus nitrogenous fertilisers such as ammonium nitrate is used to increase crop yield by increasing nitrogen content in the soil.
- In a region suffering from acid rain, which substance can be added to control the pH of the soil in a farm using ammonium nitrate as fertiliser without causing a loss of nitrogen?
- A calcium carbonate
- B calcium hydroxide
- C magnesium hydroxide
- D sodium hydroxide

- 19 A few drops of Universal Indicator are added to solutions X and Y and the results are shown below.

solution	Universal Indicator
X	red
Y	yellow

Which conclusion is correct about solution X and Y?

- A Solution X is acidic while solution Y is alkaline.
- B Solution X is more alkaline than solution Y.
- C Solution X reacts with zinc to give hydrogen gas while solution Y does not react with zinc.
- D The concentration of hydrogen ions in X is higher than the concentration of hydrogen ions in solution Y.
- 20 The following tests are performed to determine the identity of an unknown salt P.

step	test	observations
1	Dissolve 5 g of P in 10 ml of water.	Green solution formed.
	Add 2 cm ³ of the solution into two test tubes.	
2	To the first test tube, add aqueous ammonia dropwise.	Green precipitate formed in green solution.
	Allow the mixture to stand for 5 minutes.	Green precipitate turns into reddish-brown precipitate.
3	To the second test tube, add an equal volume of nitric acid and followed by aqueous barium nitrate.	White precipitate formed in the green solution.

What is the chemical formula of salt P?

- A CuSO_4
- B FeCl_3
- C FeSO_4
- D $\text{Fe}_2(\text{SO}_4)_3$

21 Which oxidation state of the underlined element is correct?

	substance	oxidation state
A	H <u>N</u> O ₃	+3
B	Ca <u>S</u> O ₄	+6
C	Fe <u>O</u>	-3
D	NaH <u>C</u> O ₃	+3

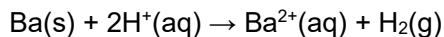
22 2 cm³ of acidified aqueous potassium manganate(VII), and potassium iodide are added to four unknown solutions Q, R, S and T. The observations are shown below.

solution	acidified aqueous potassium manganate(VII)	potassium iodide
Q	purple to colourless	colourless to brown
R	no change	colourless to brown
S	purple to colourless	no change
T	no change	no change

Which solution(s) contained reducing agents?

- A** Q and R only
- B** Q and S only
- C** S and T only
- D** T only

- 23** Barium reacts with hydrochloric acid to produce a salt and hydrogen gas. The ionic equation for this reaction is shown below.



Which statement about this reaction is true?

- A** Barium is acting as an oxidising agent.
- B** Barium is acting as a reducing agent.
- C** Barium is oxidised because it gained electrons.
- D** Barium is oxidised because it gained oxygen.

- 24** Element X forms an ion X^{2-} which has an electronic configuration of 2.8.

- 1 A X atom loses 2 electrons to form X^{2-} ion.
- 2 X burns with hydrogen to form a neutral oxide.
- 3 X is a strong oxidising agent.
- 4 X is found in Group 2 of the Periodic Table.

Which statements above are true about element X?

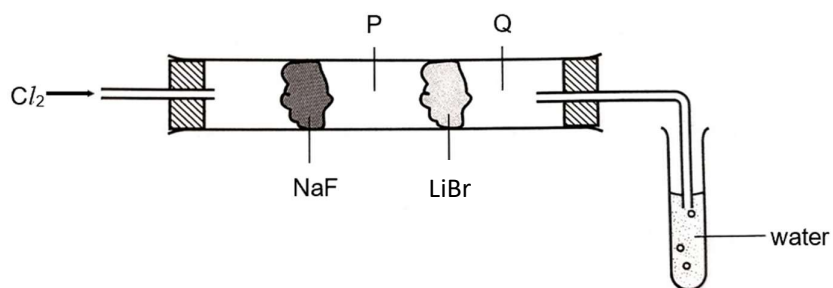
- A** 1 and 3 only
- B** 1 and 4 only
- C** 2 and 3 only
- D** 2 and 4 only

- 25** Brass is an alloy manufactured by adding zinc to copper. Brass is harder than pure copper and the higher the percentage of zinc the brass alloy contains, the harder it will be.

Which statement best explains why brass is harder than pure copper?

- A** The copper atoms are bonded strongly to the valence electrons of zinc atoms.
- B** The copper atoms form strong metallic bonds with zinc atoms in brass.
- C** The zinc atoms are bonded strongly to the 'sea of electrons' and prevent the electrons from moving freely in the lattice.
- D** The zinc atoms disrupt the orderly arrangement of copper atoms and prevent the layers of copper atoms from sliding over one another easily.

- 26 Chlorine is passed through the setup as shown below.



What colours are observed at P, Q and water during the experiment?

	P	Q	water
A	black	red-brown	reddish-brown
B	red-brown	yellow-green	black
C	yellow-green	red-brown	reddish-brown
D	yellow-green	yellow-green	violet

- 27 An iron container is filled with copper(II) sulfate solution.

Which observation can be seen after 24 hours?

- A** A layer of reddish-brown solid forms on the surface of container in contact with copper(II) sulfate solution.
- B** Bubbles of pungent gas are produced.
- C** Small pieces of silver solids are observed at the bottom of the container.
- D** The blue solution turns dark blue.

28 The following are information on four metals, Q, R, S and T.

- The metals form cations Q^{2+} , R^{2+} , S^+ and T^{2+} .
- When a piece of solid Q is placed in a solution of T^{2+} ions, a layer of solid T is formed on the piece of solid Q.
- No reaction when a piece of solid Q is placed in a solution containing R^{2+} ions.
- Only the carbonate of S does not undergo thermal decomposition.
- T reacts with hydrochloric acid to produce hydrogen gas.

What is the order of decreasing reactivity of the metals?

A R, Q, T, S

B S, R, Q, T

C S, T, Q, R

D T, Q, R, S

29 Which process has a positive enthalpy change?

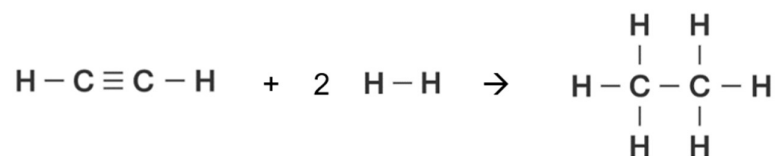
A combustion of fuels

B melting

C reaction of acid with metals

D reaction of alkali metals with water

- 30 Ethyne (C_2H_2) reacts with hydrogen to form ethane (C_2H_6) as shown in the equation below.



The average energies of the bonds in the substances involved are shown in the table below.

bond	bond energy (kJ/mol)
$\text{C}-\text{H}$	413
$\text{C}-\text{C}$	347
$\text{C}\equiv\text{C}$	839
$\text{H}-\text{H}$	432

What is the enthalpy change for this reaction?

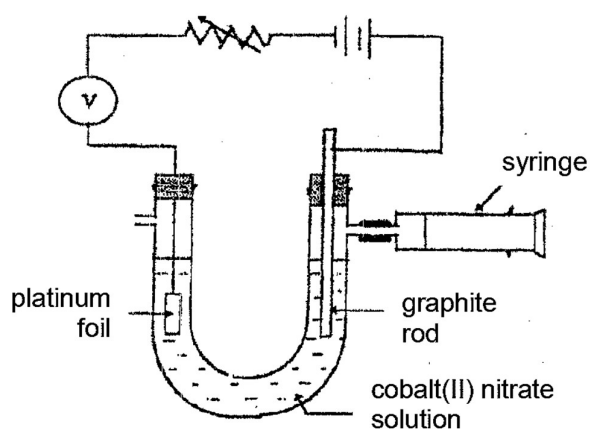
- A** +51 kJ/mol
B -176 kJ/mol
C -296 kJ/mol
D -726 kJ/mol
- 31 All ammonium salts on heating with sodium hydroxide produce ammonia gas.
- From which ammonium salt can the greatest mass of ammonia be obtained?
- A** 1.0 mol $(\text{NH}_4)_3\text{PO}_4$
B 1.0 mol $(\text{NH}_4)_2\text{SO}_4$
C 2.0 mol NH_4Cl
D 2.0 mol NH_4NO_3

32 Ammonia is produced by the Haber process.

Which statement about the process is not correct?

- A Each nitrogen molecule reacts with three hydrogen molecules to form two molecules of ammonia.
- B Hydrogen used in the process can be obtained by the cracking of hydrocarbons.
- C Powdered iron is used to lower the activation energy of the reaction.
- D The process involved a non-reversible reaction.

33 In an electrolysis experiment, dilute aqueous cobalt(II) nitrate was electrolysed in the apparatus shown below.



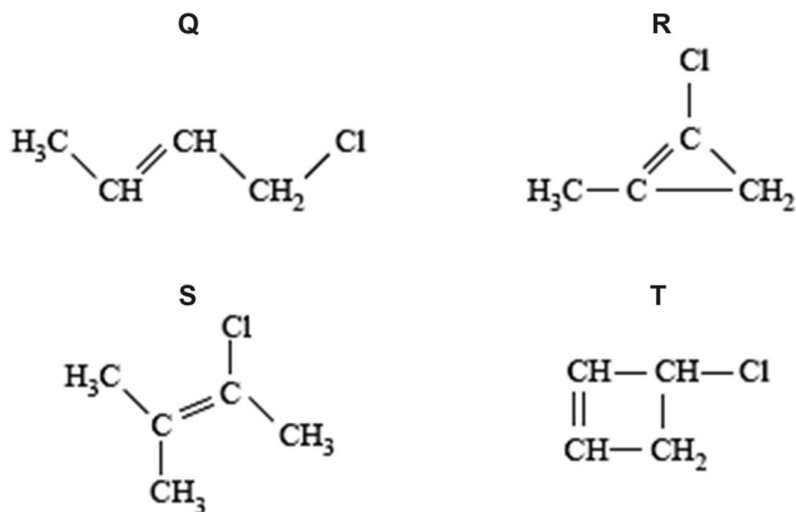
The following observations were made.

- a grey solid was formed on the platinum foil
- effervescence appeared around the graphite rod
- the gas collected in the gas syringe was bubbled through limewater and a white precipitate was formed.

What were the substances formed at the platinum foil, graphite rod, and gas syringe?

	platinum foil	graphite rod	gas syringe
A	cobalt	nitrogen dioxide	carbon dioxide
B	cobalt	oxygen	carbon dioxide
C	copper	oxygen	oxygen
D	oxygen	hydrogen	carbon dioxide

- 34 The structural formula of four organic molecules Q, R, S, and T are shown below.



Which statement is incorrect?

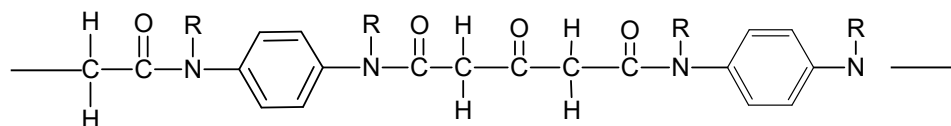
- A** Hydrogenation of Q, R, S and T results in increased melting and boiling point.
- B** Q, R, S and T are unsaturated organic molecules.
- C** R and T are isomers of each other.
- D** S has the lowest melting and boiling point.
- 35 X is a compound containing 5 carbon atoms. The results of some tests with X are shown below.

test	results
aqueous bromine	negative
acidified potassium manganate(VII) solution	negative
sodium carbonate solution	negative

What could the formula of X be?

- A** $\text{CH}_3\text{CH}_2\text{CH}_2\text{CO}_2\text{CH}_3$
- B** $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}=\text{CH}_2$
- C** $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CO}_2\text{H}$
- D** $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$

- 36 A section of a polymer is shown below.



Which monomer is involved in the formation of the above polymer?

- A**
-
- B**
-
- C**
-
- D**
-

- 37 1 mol of propane reacts with 2 mol of chlorine gas in a reaction.

What is the type of reaction and the formula of the organic product in this reaction?

	type of reaction	formula of organic product
A	addition	$C_3H_4Cl_4$
B	addition	$C_3H_6Cl_2$
C	substitution	$C_3H_2Cl_6$
D	substitution	$C_3H_6Cl_2$

38 Which statement is true about nylon and terylene?

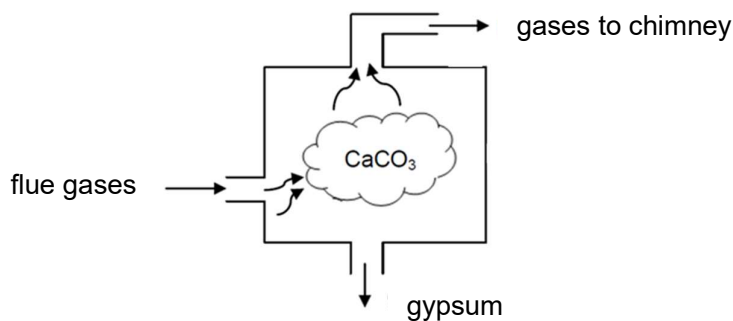
- A Both nylon and terylene have a dicarboxylic acid as one of their monomers.
- B Hydrogen is formed during their manufacturing processes.
- C Nylon has ester linkages while terylene has amide linkages
- D They are both made from addition polymerisation reactions.

39 Atmospheric pollutants from vehicles can be removed via redox reactions in catalytic converters.

Which row shows the pollutants that are oxidised and reduced in the catalytic converter?

	oxidised	reduced
A	carbon monoxide	unburnt hydrocarbon
B	nitrogen monoxide	unburnt hydrocarbon
C	unburnt hydrocarbon	carbon monoxide
D	unburnt hydrocarbon	nitrogen monoxide

40 The diagram below shows how flue gas is treated in a power plant burning fossil fuels.



Which statement best describe the properties of the gases to the chimney?

- A The gases decolourise acidified aqueous potassium manganate(VII).
- B The gases produce a white precipitate when bubbled through limewater.
- C The gases reignite a glowing splint.
- D The gases turn moist red litmus paper blue.

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The Periodic Table of Elements

Group																			
1	2	1 H hydrogen 1												13	14	15	16	17	18
		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
	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 -