



CHEMISTRY

6092/01

Paper 1

1 hour

Question Booklet

Additional Material: OTAS

READ THESE INSTRUCTIONS FIRST

Do not open the booklet until you are told to do so.

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

Write in soft pencil.

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

You are not required to hand in this booklet at the end of the examination.

There are **forty** questions on this paper. Answer **all** questions. For each question there are four possible answers **A, B, C** and **D**.

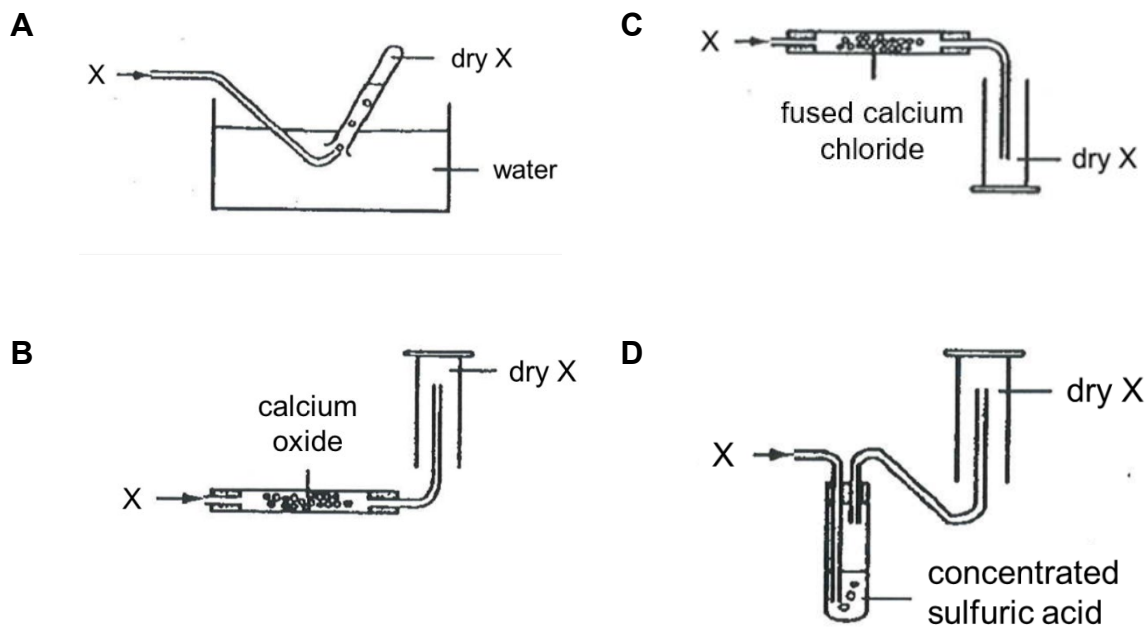
Choose the **one** you consider correct and record your choice in **soft pencil** on the separate OTAS.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer. Any rough working should be done on this booklet.

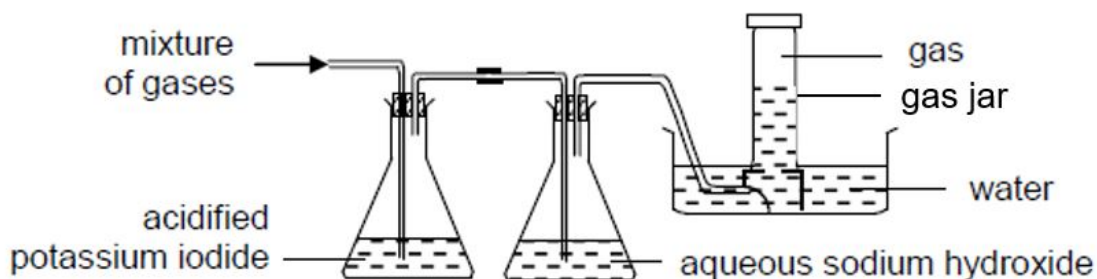
A copy of the Periodic Table is printed on page 18.

- 1 Gas X is acidic, less dense than air and very soluble in water.

Which method is used to obtain a dry sample of the gas?



- 2 A gaseous mixture of ammonia, oxygen, sulfur dioxide and chlorine was passed through the apparatus shown in the diagram below. Only one gas was collected in the gas jar.



Which of the following is a property of the gas collected in the gas jar?

- A It bleaches moist red litmus paper.
- B It relights a glowing splint.
- C It turns acidified potassium manganate(VII) solution from purple to colourless.
- D It turns moist red litmus blue.

- 3** A student carried out an experiment to confirm the identity of a solid E by determining its melting point. It was found to be 80 °C, the same as that of naphthalene. The experiment was repeated, this time using one part of solid E and two parts of pure naphthalene. The sample started to melt at 70 °C.

What can be concluded from this observation?

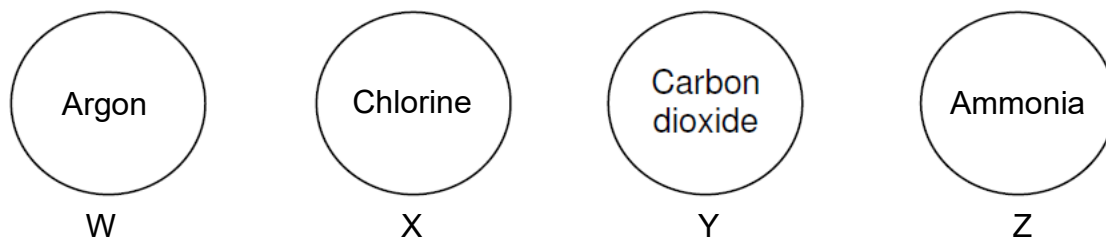
- A** E is a mixture.
B E is naphthalene.
C E is not naphthalene.
D E is impure naphthalene.
- 4** A student is analysing a mixture of two soluble compounds. He carries out some tests and the results are shown in the table below:

test	results
addition of aqueous sodium hydroxide	White precipitate formed which is soluble in excess sodium hydroxide to form a colourless solution.
addition of aqueous ammonia	White precipitate formed which is soluble in excess aqueous ammonia to form a colourless solution.
addition of aqueous barium nitrate, followed by nitric acid	White precipitate formed which is soluble in dilute nitric acid to form colourless solution.
addition of aqueous silver nitrate, followed by nitric acid	Yellow precipitate formed which is insoluble in dilute nitric acid.

From the results, which of the following mixtures might be present?

- A** sodium carbonate and zinc iodide
B aluminium carbonate and zinc chloride
C lead(II) sulfate and potassium iodide
D zinc sulfate and potassium chloride

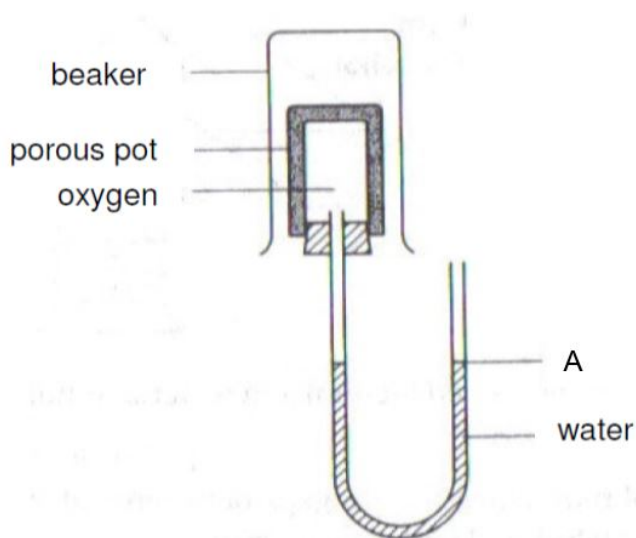
- 5 The following diagram shows four balloons W, X, Y and Z, which were inflated to the same size with four different gases: argon, chlorine, carbon dioxide and ammonia.



After several hours, all four balloons became smaller.

Which of the following shows the correct decreasing order of balloon size?

- A** Y, W, X, Z
B X, Y, W, Z
C W, Z, Y, X
D Z, W, Y, X
- 6 The apparatus shown is set up, using different gases in the beaker.



Which gas, when present in the beaker, causes the water level at A to fall?

- A** nitrogen **B** hydrogen
C methane **D** nitrogen dioxide

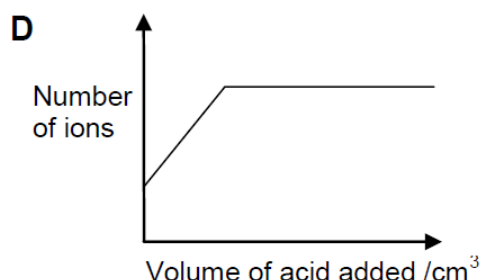
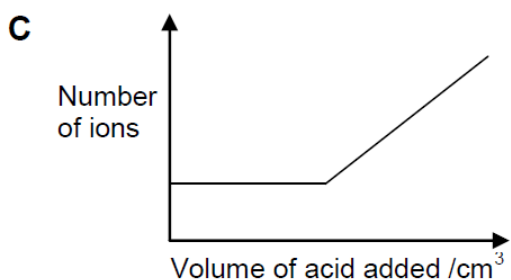
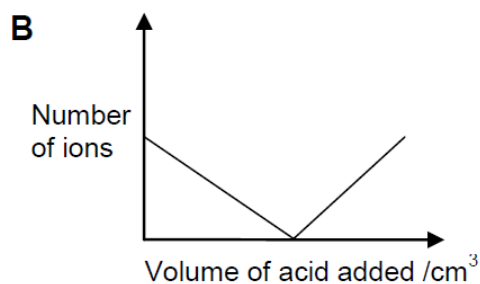
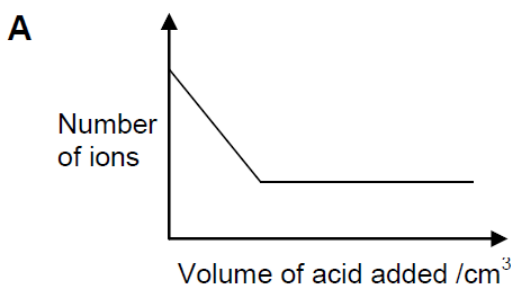
- 7 The solubility of three solids in two solvents is given in the table below.

solid	solubility in water	solubility in methylbenzene
sand	nil	nil
sodium chloride	good	nil
sulfur	nil	good

Which method would be suitable for obtaining pure sand from a mixture of sand, sodium chloride and sulfur?

- A** Add water and stir; then filter; then evaporate the filtrate to dryness.
- B** Add methylbenzene and stir; then filter.
- C** Add water and stir; then filter; then add methylbenzene to the filtrate and stir; then evaporate the solvent.
- D** Add methylbenzene and stir; then filter; then add the residue to water the stir; and then filter this mixture.
- 8 Which observation suggests that solid X is **not** an element?
- A** X forms oxides with two different chemical formulae when heated in air.
- B** X dissolves in water to form a pale blue solution.
- C** X melts at $-1\text{ }^{\circ}\text{C}$ and boils at $102\text{ }^{\circ}\text{C}$.
- D** X gives out a colourless gas and leave behind a black residue when heated.
- 9 Dilute sulfuric acid was added to aqueous barium hydroxide until the acid was in excess.

Which graph shows the variation in the total number of ions in the solution?



- 10** In the presence of an electric field, some particles are deflected to the negative plate of the electric field while other particles are deflected to the positive plate of the electric field.

If a scientist fires a stream of electrons and protons towards the electric field, where will the electrons and the protons be deflected (if any)?

	protons deflected towards	electrons deflected towards
A	negative plate	positive plate
B	no deflection	no deflection
C	no deflection	positive plate
D	positive plate	negative plate

- 11** Element Y exists as 3 stable isotopes and has a relative atomic mass of 65.0.

Which of the following compositions of isotopes is correct?

	^{64}Y	^{66}Y	^{67}Y
A	32.1%	56.4%	11.5%
B	54.6%	6.6%	38.8%
C	56.3%	31.1%	12.6%
D	53.3%	25.5%	21.2%

- 12** Element P has proton number n . It is virtually unreactive under most conditions. Another element Q has proton number $(n+2)$.

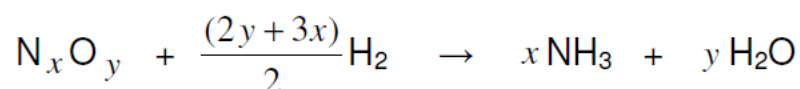
What is the formula of the oxide of Q?

- A** QO
- B** QO₂
- C** Q₂O₃
- D** QO₃

- 13** Boron nitride is a man-made substance and exists in different crystalline forms. One form is known as c-BN. It is used as an abrasive for cutting and grinding purposes, and also as parts of high temperature equipment.

Which of the following most likely explains these properties of c-BN?

- A** It has a giant metallic structure with metallic bonding.
 - B** It has a giant ionic structure with ionic bonding between atoms.
 - C** It has a giant molecular structure with covalent bonds between atoms.
 - D** It has a giant molecular structure with layers of atoms and intermolecular forces of attraction between the different layers.
- 14** Which property is common to both diamond and graphite?
- A** Each atom in the structure forms four covalent bonds.
 - B** They act as lubricant when finely divided.
 - C** They are electrical insulators.
 - D** They react with oxygen to produce carbon dioxide.
- 15** To identify an oxide of nitrogen, 0.100 mol of the oxide is mixed with an excess of hydrogen and passed over a catalyst at a suitable temperature.



The water produced weighs 7.20 g. The ammonia produced is neutralised by 200 cm³ of 1.0 mol /dm³ HCl.

What is the formula of the oxide of nitrogen?

- | | |
|---------------------------|--|
| A N ₂ O | B NO |
| C NO ₂ | D N ₂ O ₄ |

- 16** The following results were obtained from an experiment involving the reduction of an oxide of lead to lead metal.

Mass of test tube	21.28 g
Mass of test tube + lead oxide	29.84 g
Mass of test tube + lead	29.04 g

What is the empirical formula of this oxide of lead?

- A** PbO **B** PbO₂
- C** Pb₂O₃ **D** Pb₃O₄

- 17** The foul smell that skunks spray is due to a number of thiols, one of which is methanethiol, CH_3SH , which burns as follows.



A sample of 20 cm³ of methanethiol was exploded with 30 cm³ of oxygen.

What would be the final volume of the resultant mixture of gases when cooled to room temperature and pressure?

- A** 20 cm³
- B** 30 cm³
- C** 40 cm³
- D** 50 cm³

- 18** Bones contain a complex of mixture of calcium salts, proteins and other materials. When a bone is strongly heated in air, the only residue is calcium oxide. 14.0 g of calcium oxide was obtained when a sample of 50.0 g of bone was heated.

What is the percentage by mass of calcium in the bone?

- | | | | |
|----------|--------|----------|--------|
| A | 10.0 % | B | 14.0 % |
| C | 20.0 % | D | 23.3 % |

- 19** An element Y reacts violently with water to form a hydroxide YOH, which is soluble in water.

Which of the following could be true of Y?

I	Y is a metal.
II	Y forms a covalent chloride.
III	Y forms a gaseous oxide.
IV	Y forms white compounds.

- A** IV only
- B** I and IV only
- C** I, III and IV only
- D** I, II and IV only

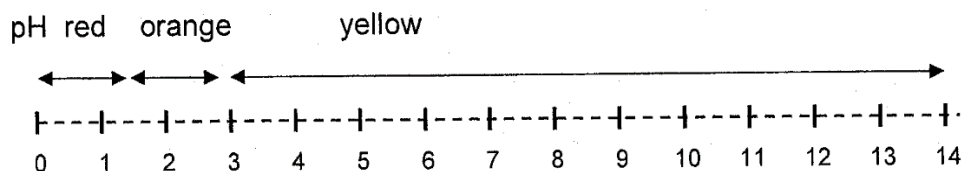
- 20** A student mixed aqueous solutions of A and B and made the observations listed in the table.

solution A	solution B	observation
MgCrO ₄	Ca(C/O ₃) ₂	no observable reaction
Mg(IO ₃) ₂	Pb(C/O ₃) ₂	white precipitate formed
MgCrO ₄	Pb(C/O ₃) ₂	white precipitate formed
Ba(C/O ₃) ₂	Mg(IO ₃) ₂	yellow precipitate formed

What can the student conclude most accurately from these observations?

- A** Only $\text{Ba}(\text{IO}_3)_2$ and PbCrO_4 are insoluble in water.
- B** Both $\text{Ba}(\text{IO}_3)_2$ and $\text{Mg}(\text{ClO}_3)_2$ are soluble in water.
- C** Both PbCrO_4 and $\text{Mg}(\text{ClO}_3)_2$ are insoluble in water.
- D** $\text{Ba}(\text{IO}_3)_2$, $\text{Pb}(\text{IO}_3)_2$, and PbCrO_4 are insoluble in water.

- 21 The colours of an indicator X in solutions of different pH are shown below.



- Which two solutions would indicator X be suitable to identify?
- A** water and aqueous solution of sodium hydroxide
B aqueous solution of sodium hydroxide and ammonia
C aqueous solution of hydrogen chloride and carbon dioxide
D aqueous solution of sodium hydroxide and sodium chloride
- 22 Many agricultural fertilizers are made from ammonia. Ammonium compounds supply plants with nitrogen for protein synthesis. An example of such a fertilizer is ammonium nitrate that can be produced using the following reaction scheme:



What are the reactants that can be used to carry out steps 1 & 2?

	step 1	step 2
A	sodium hydroxide	nitric acid
B	water	sodium nitrate
C	water	nitric acid
D	sodium hydroxide	sodium nitrate

- 23 Which statement is true with regard to the Haber process?
- A** A high pressure will increase the yield of ammonia.
B A nickel catalyst is added to the process.
C Equal proportions of nitrogen and hydrogen are reacted in the process.
D Nitrogen is the raw material obtained from the cracking of air.

- 24 The table shows information about some fuels.

fuel	formula	enthalpy of combustion in kJ/mol
hydrogen	H ₂	-286
methane	CH ₄	-889
octane	C ₈ H ₁₈	-5330

Which statement(s) is/are correct?

1	Octane produces more heat than hydrogen or methane for each gram of fuel burned.
2	On complete combustion, 1 g of hydrogen produces 286 kJ of energy.
3	When methane is completely combusted, the energy required for bond breaking is less than the energy released in bond forming.

- A** 2 only
B 3 only
C 2 and 3
D 1 and 3
- 25 Methane reacts very slowly with air at room temperature. But if a transition metal T is added to the methane-air mixture, the methane ignites quickly.

1	The addition of T causes the activation energy to be lower.
2	The addition of T increases the ΔH .
3	The addition of T increases the rate of reaction.
4	The addition of T reduces the energy of the reactants.

Which of the above statements about the addition of T are correct?

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

- 26** In an experiment, 50 cm³ of 1.0 mol/dm³ hydrochloric acid is added to 30 cm³ of 1.0 mol/dm³ sodium thiosulfate according to the equation as shown:



What causes the reaction to stop?

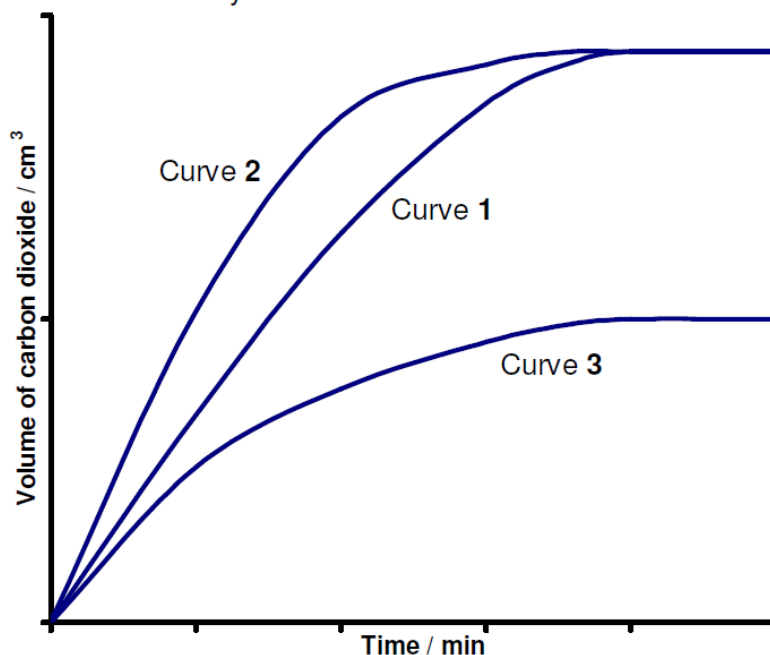
- A** Hydrochloric acid is completely used up.
 - B** Sodium thiosulfate is completely used up.
 - C** Sulfur dioxide gas escapes into the air.
 - D** Sulfur deposits form a coating around sodium thiosulfate.
- 27** In which of the following will there be no change in the rate of reaction when there is a reduction of pressure?
- A** Passing of steam over iron
 - B** Burning of carbon monoxide
 - C** Reacting sodium with chlorine
 - D** Addition of calcium hydroxide to dilute nitric acid
- 28** Potassium chlorate solution can be decomposed according to the equation:



What would be the effect on the initial rate of reaction and the final volume of oxygen produced, if an equal volume of water was added to the potassium chlorate solution before the reaction began?

	initial rate	final volume of oxygen
A	decreased	unchanged
B	unchanged	unchanged
C	decreased	decreased
D	increased	decreased

- 29 In the graph below, Curve 1 was obtained when 20 g of magnesium carbonate reacted with an excess of hydrochloric acid at 30 °C.



Which one of the following changes to this reaction would result in Curve 2 and Curve 3?

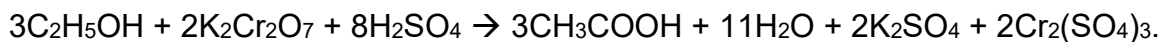
	curve 2	curve 3
A	using powdered magnesium carbonate	using acid at 20 °C
B	using powdered magnesium carbonate	diluting the acid with water
C	using twice as much magnesium carbonate	using half as much magnesium carbonate
D	warming the acid to 40 °C	using half as much magnesium carbonate

- 30** Chlorine is bubbled into aqueous iron(II) chloride. Subsequently, aqueous sodium hydroxide is added to the resultant solution.

Which statement best explains why a reddish brown precipitate is formed?

- A** Chlorine causes iron(II) chloride to undergo reduction.
- B** Chlorine has precipitated out.
- C** Iron(III) hydroxide is formed.
- D** The oxidation state of chlorine has decreased from 0 to -1.

- 31** Ethanol is oxidized to ethanoic acid by acidified potassium dichromate(VI).



What is the final oxidation state of chromium?

- A** -2
- B** +2
- C** -3
- D** +3

- 32** Vanadium has various oxidation states and forms coloured compounds.

The aqueous VO^{2+} ion is blue while the aqueous VO_2^+ ion is yellow. The aqueous V^{3+} ion is blue-green and the aqueous V^{2+} ion is violet.

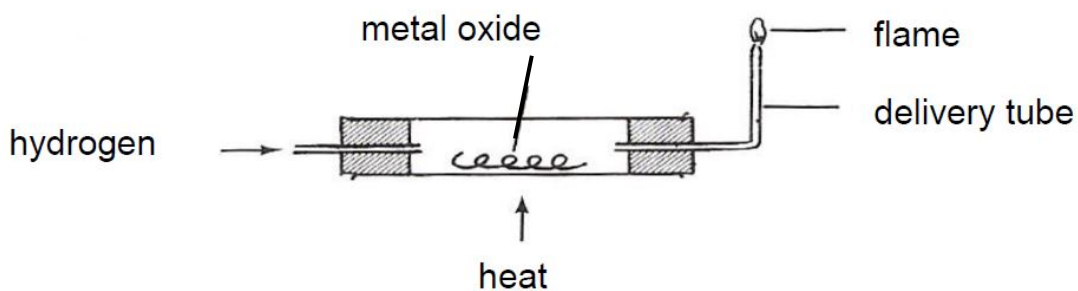
Which statement about Vanadium is correct?

- A** It has a low melting point.
- B** It has a high density.
- C** Vanadium compounds are unlikely to be catalysts.
- D** If a vanadium compound in solution changes colour from violet to blue-green, reduction has taken place.

- 33** A catalytic converter in a car exhaust system changes pollutants into less harmful products.

Which change does not occur in a catalytic converter?

- A** Unburned hydrocarbons $\rightarrow$ carbon dioxide and water
B Carbon monoxide $\rightarrow$ carbon dioxide
C Nitrogen oxides $\rightarrow$ nitrogen
D Carbon dioxide $\rightarrow$ carbon
- 34** Which pollutant(s) can be removed from the flue gas of factories and power stations by treatment with calcium carbonate?
- A** nitrogen dioxide only
B sulfur dioxide only
C nitrogen dioxide and sulfur dioxide
D carbon monoxide and sulfur dioxide
- 35** The reaction of a metal oxide with hydrogen is shown below.



Which of the following is correct?

	metal oxide	mass of metal oxide after heating
A	zinc oxide	decreases
B	lead(II) oxide	decreases
C	copper(II) oxide	increases
D	iron(II) oxide	increases

- 36** Iron is manufactured in the blast furnace.

Which statement about iron and its manufacture is not true?

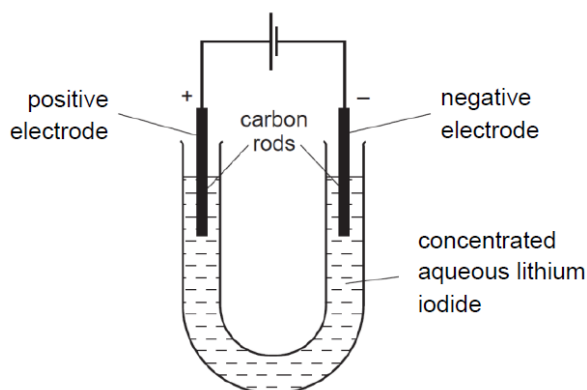
- A** Coke is the reducing agent.
- B** Iron ore is a finite resource.
- C** Pure iron is produced.
- D** Molten slag formed floats on the molten iron.

- 37** The thermal stability of metal nitrates is related to the position of the metal in the reactivity series in the same way as carbonates.

Which metal nitrate, on heating, will least likely decompose to form the metal oxide?

- A** calcium nitrate
- B** potassium nitrate
- C** silver nitrate
- D** zinc nitrate

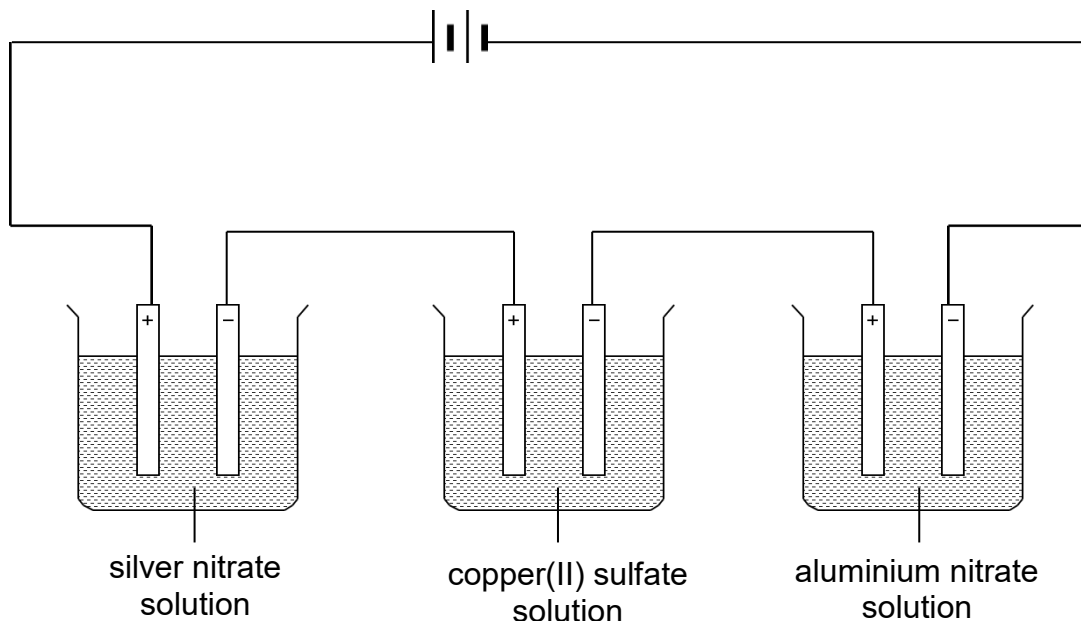
- 38** The diagram shows the electrolysis of concentrated aqueous lithium iodide.



What is produced at each of the electrodes?

	product at cathode	product at anode
A	hydrogen	oxygen
B	hydrogen	iodine
C	lithium	iodine
D	lithium	oxygen

- 39** Three electrolytic cells are set up as shown in the diagram. In all the cells, only carbon electrodes are used and the electrolytes are different aqueous salt solutions.



Which of the following correctly gives the masses of metals deposited at the cathode of each cell if 0.5 mole of electrons flows through the circuit?

	mass of silver / g	mass of copper / g	mass of aluminium / g
A	54.0	32.0	0.0
B	54.0	16.0	0.0
C	108.0	64.0	27.0
D	54.0	16.0	4.5

- 40** A metal fork is to be electroplated with nickel.

Which of the following shows the correct setup for this process?

	anode	cathode	electrolyte
A	nickel	metal fork	nickel (II) nitrate
B	nickel	metal fork	sulfuric acid
C	metal fork	nickel	sulfuric acid
D	metal fork	nickel	nickel (II) nitrate

The Periodic Table of Elements

Group																			
I	II											III	IV	V	VI	VII	0		
Key proton (atomic) number atomic symbol name relative atomic mass								1 H hydrogen 1											2 He helium 4
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 -		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 -

actinoids

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