Paya Lebar Methodist Girls' School (Secondary)
Preliminary Examination 2020
Secondary 4 Express

CANDIDATE NAME		CLASS		CLASS INDEX NUMBER	

CENTRE NUMBER					INDEX NUMBER				

CHEMISTRY 6092/01

Paper 1 Multiple Choice **25 August 2020**

Additional Materials: Multiple Choice Answer Sheet **1 hour**

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use staples, paper clips, glue or correction fluid.
Write your name and class index number on the Answer Sheet 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 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 booklet.
A copy of the Periodic Table is printed on page 2.
The use of an approved scientific calculator is expected, where appropriate.

This paper consists of 17 printed pages, including this cover page.

[Turn over

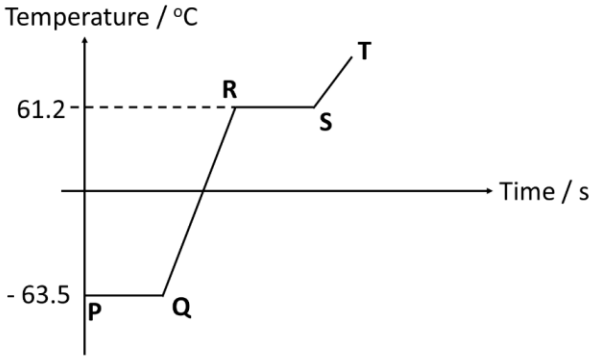
The Periodic Table of Elements

Group																	
I	II											III	IV	V	VI	VII	0
							1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9		Key proton (atomic) number atomic symbol name relative atomic mass									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
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 dm^3 at room temperature and pressure (r.t.p.).

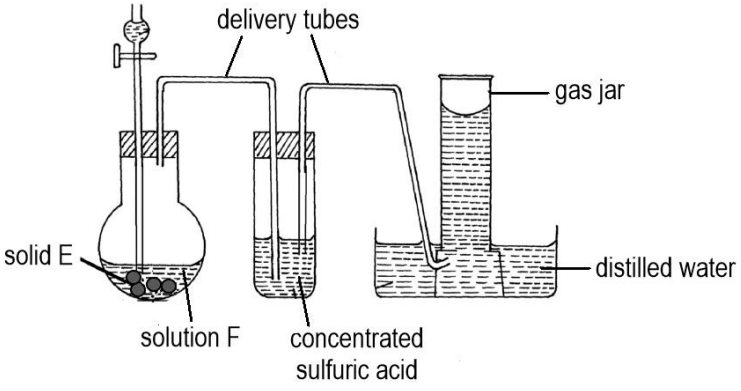
1 The graph below shows the change in temperature as a sample of chloroform is heated.



Which describes the arrangement and movement of the particles in the region **R** to **S**?

	arrangement of particles	movement of particles
A	mixture of particles closely packed in orderly and disorderly arrangement	some particles vibrate about fixed positions, some move freely around each other
B	closely packed in disorderly arrangement	particles move freely around each other
C	mixture of particles closely packed in disorderly arrangement and some far apart	closely packed particles move freely around each other, particles that are far apart move around at high speed
D	particles are far apart from each other	particles move randomly at high speed

2 A set up below is used to prepare and collect a dry gas.

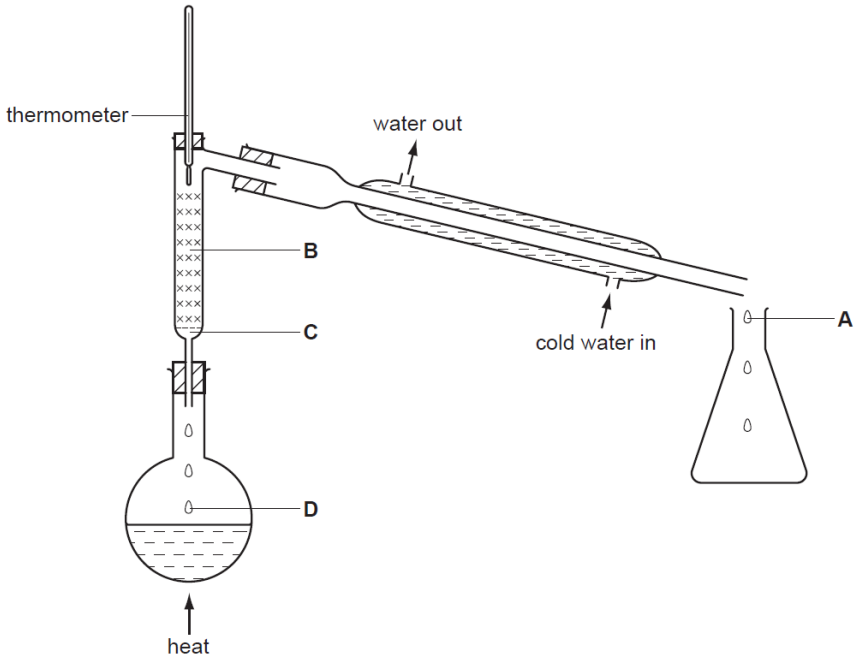


Which pair of reactants would be most suitable to prepare the gas produced using this set up?

	solid E	**solution F**
A	calcium carbonate	dilute hydrochloric acid
B	ammonium sulfate	sodium hydroxide solution
C	zinc granules	dilute nitric acid
D	iodine crystals	sodium chloride solution

[Turn over

3 A mixture containing equal volumes of two liquids that mix completely but do not react together is placed in the apparatus shown and heated until the thermometer first shows a steady reading.
At which position will there be the highest proportion of the liquid with the higher boiling point?



4 Caesium fluoride has a melting point of 682 °C and boiling point of 1251 °C.

Which of the following gives the correct boiling point of water when some caesium fluoride is added to it, and the correct method to obtain the dissolved caesium fluoride?

	boiling point of water with caesium fluoride / °C	method to obtain dissolved caesium fluoride
A	105	crystallisation
B	92	fractional distillation
C	698	filtration
D	1265	crystallisation

5 What can be deduced about two gases that have the same relative molecular mass?

A They have the same number of atoms in one molecule.

B They have equal solubility in water at room temperature.

C They occupy the same volume at room temperature and pressure.

D They diffuse at the same rate at room temperature and pressure.

6 **X** is a white powder. The following tests are done on **X**.

- No precipitate is seen when a few drops of aqueous sodium hydroxide are added to a solution of **X**.
- No gas is formed when **X** is heated with aqueous sodium hydroxide.
- When acidified aqueous silver nitrate is added to a solution of **X** a yellow precipitate is seen.

What is **X**?

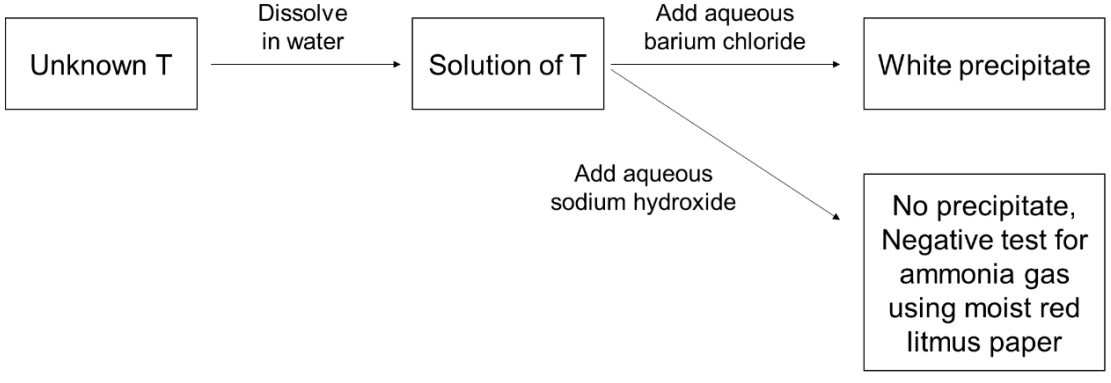
A ammonium bromide

B ammonium iodide

C potassium bromide

D potassium iodide

7 A student analysed a solid sample of unknown T and recorded the following observations.



The student concluded that unknown T is sodium sulfate or potassium sulfate, but the teacher said it was the wrong conclusion.

What could have caused the student to make a wrong conclusion?

A She should use barium nitrate instead of barium chloride.

B She did not add excess hydrochloric acid to the solution of T.

C She should have used moist blue litmus paper to test for ammonia gas.

D Barium chloride is a test for nitrate, so the unknown T should be sodium nitrate or potassium nitrate.

[Turn over

8 A metal M was analysed and found to contain only two isotopes M-58 and M-60. Given that the relative atomic mass is 58.6, determine the ratio of the relative abundance of M-58 and M-60 respectively.

A 3:7

B 7:3

C 65:35

D 35:65

9 The mass number of three elements are given.

Element	Mass Number
P	27
Q	32
R	19

The elements can react with each other to form compounds.

Which of the following statements is true?

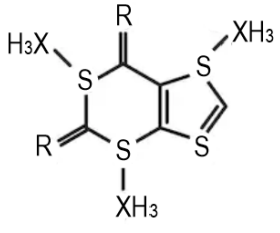
A **P** and **Q** form a compound with the formula $\mathbf{PQ_2}$.

B **P** forms an ion that has a smaller radius than the original atom, while **Q** forms an ion that has a larger radius than the original atom.

C **Q** and **R** form a compound with the formula **QR**.

D When **P** and **R** form a compound, **P** is reduced and **R** is oxidised.

10 A caffeine molecule has the following structure as shown below, with three unknown elements **R**, **S** and **X**. H represents hydrogen atoms.



What could element **R**, **S** and **X** be?

	R	S	X
A	sulfur	carbon	silicon
B	oxygen	carbon	chlorine
C	oxygen	nitrogen	carbon
D	chlorine	boron	germanium

11 Substances are able to conduct electricity due to free-moving charged particles.

Which of the following is able to conduct electricity due to the correct particles identified?

	Substance	Particles
A	brass	copper and zinc atoms
B	graphite	all electrons
C	sodium chloride crystals	Na^+ ions, Cl^- ions
D	aqueous ammonia	NH_4^+ ions, OH^- ions

12 What is the number of ions in 319.5 g of aluminium nitrate, $Al(NO_3)_3$?
[Relative formula mass of $Al(NO_3)_3$ is 213.]

A 6.0×10^{23} **B** 9.0×10^{23} **C** 1.8×10^{24} **D** 3.6×10^{24}

13 Harmful gases are converted to less harmful ones in the catalytic converter as shown.

$$2CO + 2NO \rightarrow 2CO_2 + N_2$$

If 30 cm^3 of carbon monoxide and 20 cm^3 of nitrogen monoxide passes through the catalytic converter, what is the total volume of gases that will be released at the end?

A 10 cm^3 **B** 30 cm^3 **C** 40 cm^3 **D** 50 cm^3

14 What is the minimum concentration needed for 1500 cm^3 of dilute hydrochloric acid to react with exactly 100 g of calcium carbonate?

A 0.100 mol/dm^3 **B** 1.33 mol/dm^3

C 1.20 mol/dm^3 **D** 1.50 mol/dm^3

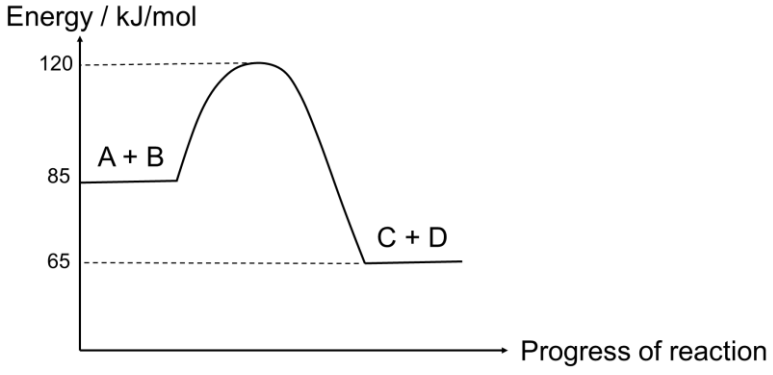
15 Epsom salt, $MgSO_4.7H_2O$, is commonly used to treat body aches. A sample of the hydrated salt is found to contain 25.0 g of oxygen by mass. What is the remaining mass of the anhydrous sample after it was heated to dryness?

A 17.0 g **B** 17.9 g **C** 23.0 g **D** 34.9 g

[Turn over

16 The energy profile diagram of a reversible reaction is shown below.

$$A + B \rightleftharpoons C + D$$



Which of the following statements is correct about the reversible reaction?

A Activation energy of the forward reaction is – 35 kJ/mol.

B Enthalpy change of the forward reaction is – 55 kJ/mol.

C Activation energy of the backward reaction is + 55 kJ/mol.

D Enthalpy change of the backward reaction is – 20 kJ/mol.

17 Calcium chloride salt is prepared from calcium carbonate in the following stages:

$$\underset{}{CaCO_3\,(s)} \xrightarrow{\textbf{I}} \underset{}{CaO\,(s)} \xrightarrow{\textbf{II}} \underset{}{CaCl_2\,(aq) + H_2O\,(l)} \xrightarrow{\textbf{III}} \underset{}{CaCl_2\,(aq) + H_2O\,(g)}$$

Which stage/s is/are endothermic?

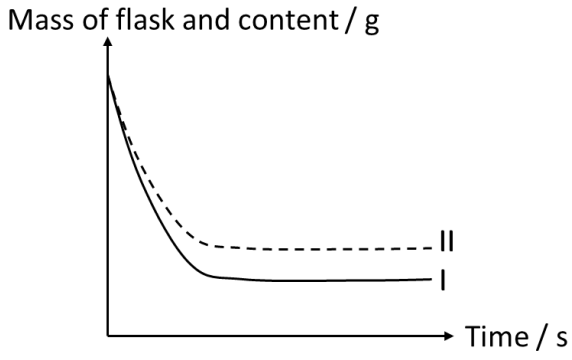
A **I** only **B** **II** only **C** **I** and **III** **D** **II** and **III**

18 Two experiments were carried out in which magnesium carbonate was added to excess dilute sulfuric acid. A graph of mass loss against time is plotted for both experiments.

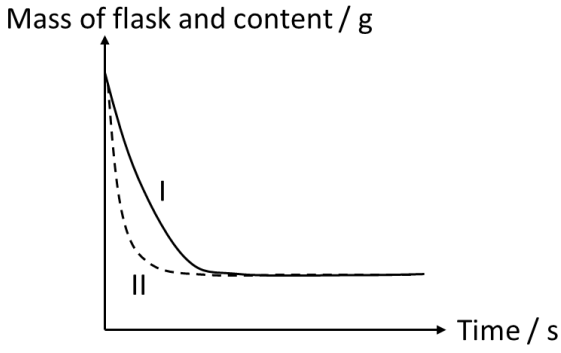
Experiment I	25 cm^3 of 0.1 mol/dm^3 sulfuric acid + 2.0 g of magnesium carbonate in lumps
Experiment II	25 cm^3 of 0.1 mol/dm^3 sulfuric acid + 2.0 g of magnesium carbonate in powder

Which graph best shows the results for these experiments?

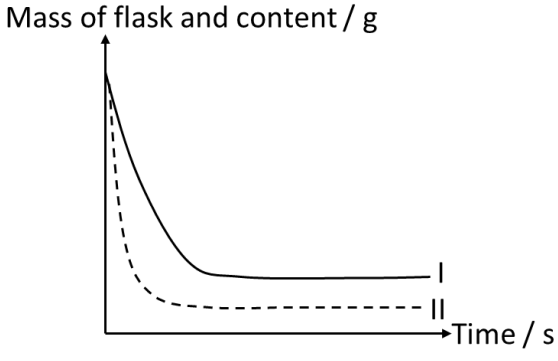
A



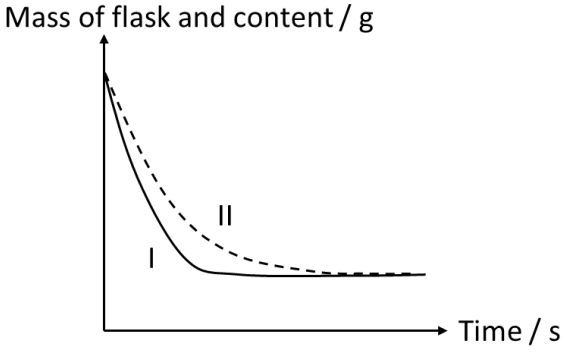
B



C



D



19 In which reaction is the pressure least likely to affect the rate of reaction?

A $2H_2O_2$ (l) → $2H_2O$ (l) + O_2 (g)

B HCl (l) + NH_3 (g) → NH_4Cl (s)

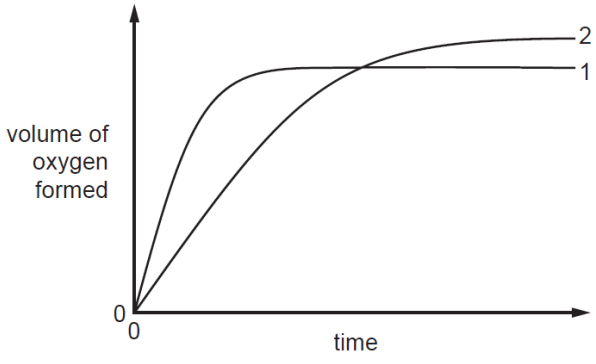
C C_2H_5OH (l) + $3O_2$ (g) → $2CO_2$ (g) + $3H_2O$ (g)

D 2CO (g) + 2NO (g) → $2CO_2$ (g) + N_2 (g)

[Turn over

20 In the graph, curve 1 was obtained by observing the decomposition of 100 cm^3 of 1.0 mol/dm^3 hydrogen peroxide solution, catalysed by manganese(IV) oxide.

$$2H_2O_2 \rightarrow 2H_2O + O_2$$



Which alteration to the original experimental conditions would produce curve 2?

A Adding some 0.2 mol/dm^3 hydrogen peroxide.

B Lowering the temperature.

C Using less manganese (IV) oxide.

D Using a different catalyst.

21 Which reaction does not involve oxidation or reduction?

A $Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$

B $2Al + 6HCl \rightarrow 2AlCl_3 + 3H_2$

C $ZnCO_3 + H_2SO_4 \rightarrow ZnSO_4 + CO_2 + H_2O$

D $2Na_2S_2O_3 + I_2 \rightarrow Na_2S_4O_6 + 2NaI$

22 When potassium manganate(VII) is added slowly to a sample of iron(II) sulfate solution, it turns from purple to colourless. The iron(II) sulfate solution turns from green to light brown.

Which of the following can be concluded from the observation?

	Role of potassium manganate(VII)	Reaction that iron(II) sulfate has undergone
A	oxidising agent	oxidation
B	oxidising agent	reduction
C	reducing agent	oxidation
D	reducing agent	reduction

23 Phosphine has the formula PH_3. It has similar properties to ammonia.

Which property does **not** represent phosphine?

A It undergoes partial ionisation in water to give hydroxide ions.

B It is a simple molecule with low melting and boiling points.

C It conducts electricity in the gaseous state.

D It reacts with hydrogen chloride to form a compound with the formula PH_4Cl.

24 Which method(s) is/are suitable to distinguish between aqueous ammonia and sodium hydroxide solution of the same concentration?

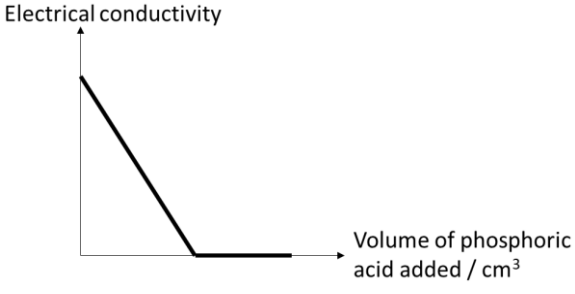
1. titration
2. measuring their electrical conductivity
3. measuring temperature change when dilute hydrochloric acid is added
4. using the Universal Indicator

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

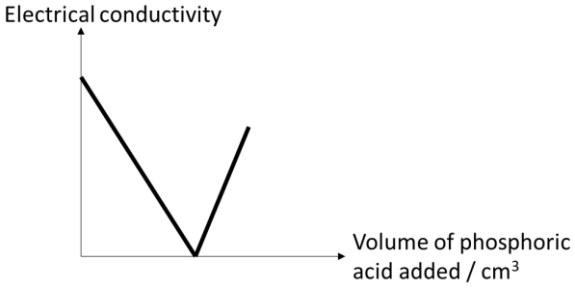
25 Phosphoric acid is added slowly to calcium hydroxide solution, forming insoluble calcium phosphate. The electrical conductivity of the mixture is measured as reaction proceeds.

Which graph below shows the change in electrical conductivity against volume of phosphoric acid added?

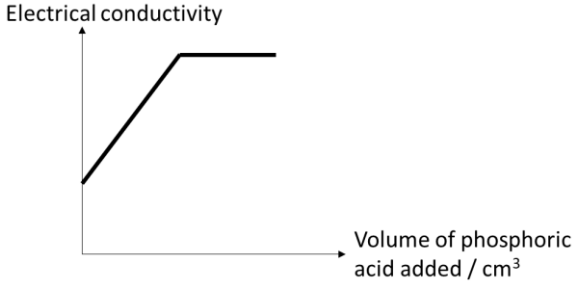
A



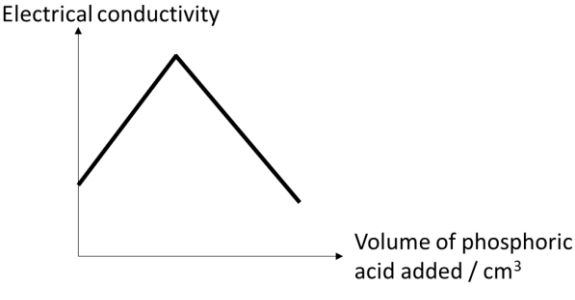
B



C



D



[Turn over

26 Which of the following reactants and preparation method should be used to prepare lead(II) sulfate?

	Reactants	Preparation method
A	lead(II) chloride and sodium sulfate	precipitation
B	lead(II) nitrate and magnesium sulfate	precipitation
C	lead(II) carbonate and sulfuric acid	adding excess insoluble solid to acid
D	lead(II) hydroxide and sulfuric acid	titration

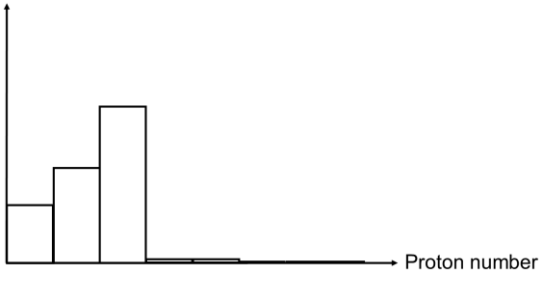
27 Which of the following statements is/are true for the manufacture of ammonia in the Haber process?

I. Hydrogen may be obtained from the fractional distillation of air.
II. High pressure increases only the speed, but not the yield of the reaction.
III. Unreacted hydrogen and nitrogen are pumped back into the system in order to increase the yield.
IV. Ammonia gas is collected in the liquid state.

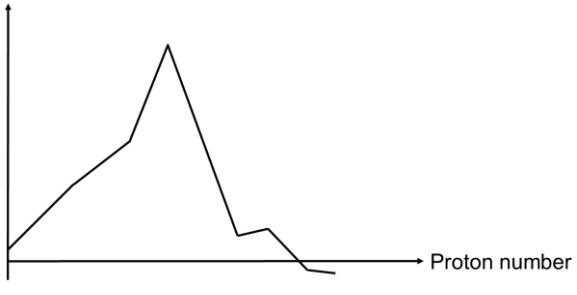
A I and III **B** II and IV **C** III and IV **D** I, III and IV

28 The graphs below show the trend in two different physical properties of the elements across Period 3.

Graph 1



Graph 2



Which physical properties are represented by the graphs?

	Graph 1	Graph 2
A	number of valence electrons	melting point
B	metallic properties	charge of ions
C	electrical conductivity	melting point
D	electrical conductivity	atomic radius

29 Elements **X** and **Y** are found in the same period in the Periodic Table. The properties of their oxides are given below.

Oxide of **X**:	A solid that dissolves in sodium hydroxide solution to form a green solution.
Oxide of **Y**:	A gas that changes acidified potassium dichromate(VI) from orange to green.

Which of the following statement/s about the elements and their oxides is/are true?

I. Element **X** is a transition metal.
II. Oxide of **X** is an acidic oxide.
III. Oxide of **Y** is a reducing agent.

A I only **B** II and III **C** I and III **D** All of the above

30 An unknown metal is concluded to be a Group I metal because it has low melting point, is soft and floats on water. Further tests conclude that it is found between potassium and rubidium in the Group.

Which of the following best describes the unknown metal?

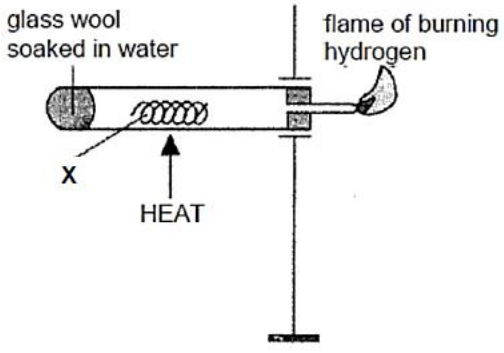
A It has a lower melting point than rubidium.

B It forms covalent bonds with halogens.

C It forms a basic oxide on reacting with water.

D It reacts with water more violently than potassium.

31 The set up below shows the reaction of substance **X**. A white solid is formed.



Which conclusion about **X** is true?

A **X** is a metal below hydrogen in the reactivity series.

B **X** is a metal that can be extracted from its ore by reaction with carbon.

C **X** is an oxide of a metal that is above hydrogen in the reactivity series.

D When **X** is added to a solution of calcium nitrate, grey deposits will be seen.

[Turn over

32 The following observations were made when chromium and cobalt are added to three different solutions.

	magnesium chloride solution	**copper(II) sulfate solution**	**iron(II) nitrate solution**
chromium	no deposit formed	reddish brown deposit formed	grey deposit formed
cobalt	no deposit formed	reddish brown deposit formed	no deposit formed

What is the correct order in decreasing reactivity of the five metals?

A Cu > Cr > Fe > Co > Mg

B Cu > Co > Fe > Cr > Mg

C Mg > Co > Fe > Cr > Cu

D Mg > Cr > Fe > Co > Cu

33 Which of the following about the production of iron in the blast furnace is **not** true?

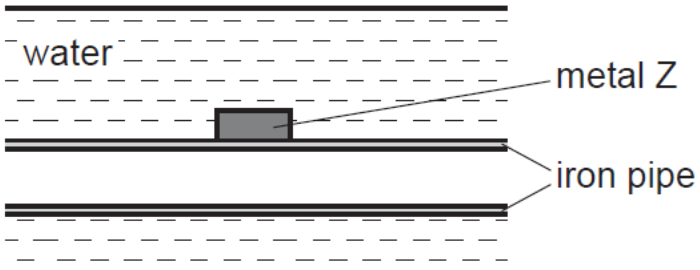
A Limestone is added to remove acidic impurities.

B Haematite is reduced by carbon monoxide to form iron.

C The main gases that escape from the top of the furnace are oxygen, carbon dioxide and carbon monoxide.

D Slag is formed due to a reaction between an acidic oxide and a basic oxide.

34 The diagram shows how an underwater iron pipe can be protected from rusting.



Metal Z can be …..1….. because it is …..2….. reactive than iron.

Which words correctly complete the gaps 1 and 2?

	1	2
A	copper	less
B	copper	more
C	magnesium	less
D	magnesium	more

35 A sample of air is obtained near some factories in the outskirt of a city, and another from a busy road in the city.
The table shows the mass of pollutants per 1 dm^3 of air in the samples.

Pollutant produced	Mass of pollutants in air from outskirt of the city / g	Mass of pollutants in air from busy road in city / g
carbon monoxide	170	80
oxides of nitrogen	25	60
unburnt hydrocarbon	40	5
sulfur dioxide	25	30

Which of the following statements explains the data in the table?

A More incomplete combustion occurs in the factories.

B There is higher chance for the formation of acid rain in the outskirt than in the city.

C The consumption rate of fuel is higher in the city than in the outskirt.

D The factories are operating at a lower temperature than the internal combustion engine of vehicles.

[Turn over

36 Which of the following about atmospheric pollutant is **not** true?

A Methane is a greenhouse gas that leads to global warming.

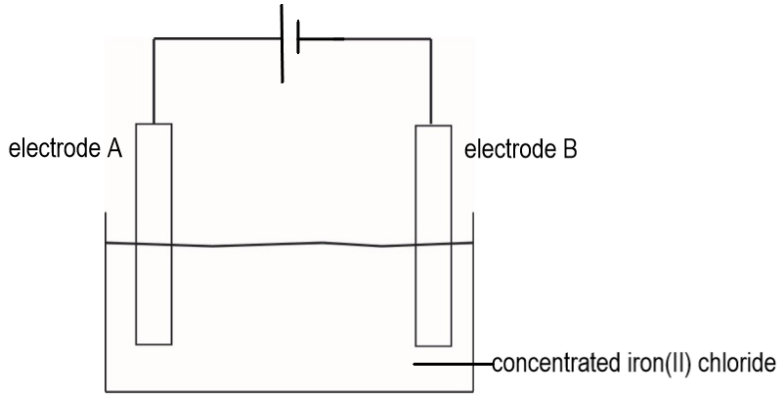
B Carbon monoxide and nitrogen dioxide react together in the catalytic converter to form less harmful products.

C Sulfur dioxide is removed from flue gases by reaction with calcium carbonate.

D Unburnt hydrocarbons are oxidised to form oxygen gas in the catalytic converter.

Use the information and diagram below to answer Questions **37** and **38**.

A sample of concentrated iron(II) chloride solution is electrolysed using iron electrodes.



37 Which of the following gives the correct reaction at electrode A?

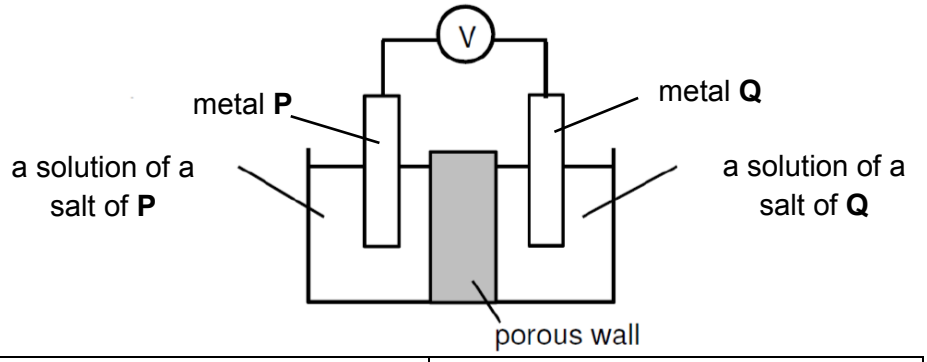
	Reaction	Is this an oxidation/reduction reaction?
A	$2Cl^-$ (aq) → Cl_2 (aq) + 2e	oxidation
B	Fe (s) → Fe^{2+} (aq) + 2e	oxidation
C	$4OH^-$ (aq) → $2H_2O$ (l) + O_2 (g) + 2e	reduction
D	$2H^+$ (aq) + 2e → H_2 (g)	reduction

38 What would happen as the reaction proceeds?

I. Electrode A would decrease in size.
II. Electrode B would increase in size.
III. Effervescence is seen at electrode B.
IV. The electrolyte will turn from green to colourless.

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

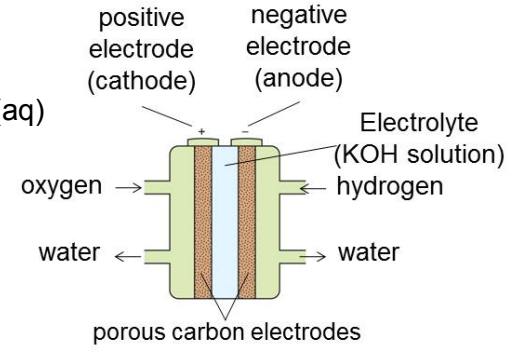
39 Which pair of metals will make metal **Q** the cathode and produce the highest voltage when used as electrodes in a simple cell as shown in the diagram below?



	metal **P**	metal **Q**
A	zinc	iron
B	magnesium	silver
C	copper	magnesium
D	copper	iron

40 A hydrogen fuel cell can be used to provide electrical power to vehicles.

$O_2(g) + 2H_2O(l) + 4e^- \rightarrow 4OH^-(aq)$



$2H_2(g) + 4OH^-(aq) \rightarrow 4H_2O(l) + 4e^-$

Which of the following is not true about the hydrogen fuel cell?

A The reactants must be continuously supplied to the fuel cell.

B Hydrogen needed can be obtained from the electrolysis of water or from cracking of large hydrocarbons.

C Every 1 dm^3 of hydrogen requires 0.5 dm^3 of oxygen for complete reaction.

D Hydrogen is a completely non-polluting fuel.

End of paper