



Paya Lebar Methodist Girls' School (Secondary)
Preliminary Examination 2022
Secondary 4 Express

CANDIDATE NAME		CLASS		CLASS INDEX NUMBER	
CENTRE NUMBER				INDEX NUMBER	

CHEMISTRY

6092/01

Paper 1 Multiple Choice

26 August 2022

1 hour

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

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

Write your name, class and class index number on the separate 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.

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 paper.

A copy of the Periodic Table is printed on page 2.

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

The Periodic Table of Elements

Group																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	
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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 -																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																				

lanthanoids

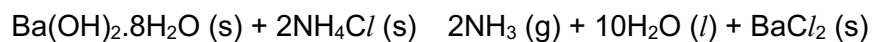
57 La lanthanum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium -	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175
89 Ac actinium -	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.).

Use the following information to answer Questions 1 and 2.

When solid hydrated barium hydroxide is added to a known quantity of solid ammonium chloride, the temperature of the mixture decreases. The chemical reaction is represented by the balanced chemical equation shown below.

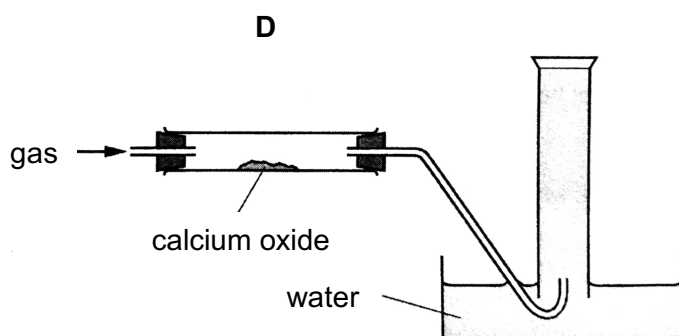
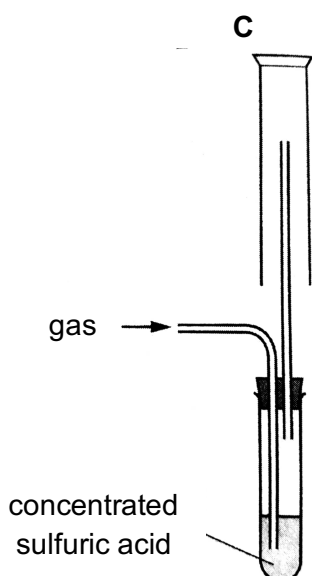
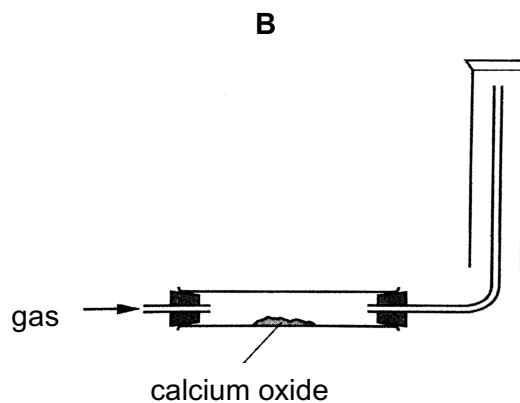
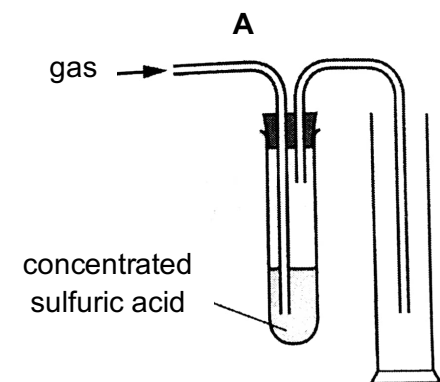


- 1 An experiment is designed to measure the temperature change when all the solid hydrated barium hydroxide reacts with the ammonium chloride. The following pieces of apparatus are available.

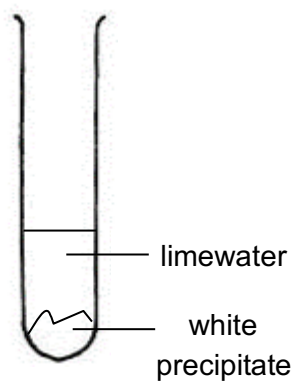
- 1 gas syringe
- 2 stopwatch
- 3 balance
- 4 Styrofoam cup

Other than a thermometer, which piece(s) of apparatus is(are) likely needed for this experiment?

- A 1, 2 and 3 only
 - B 1 and 2 only
 - C 3 and 4 only
 - D 4 only
- 2 Which diagram shows the correct way of drying and collecting the gas produced?



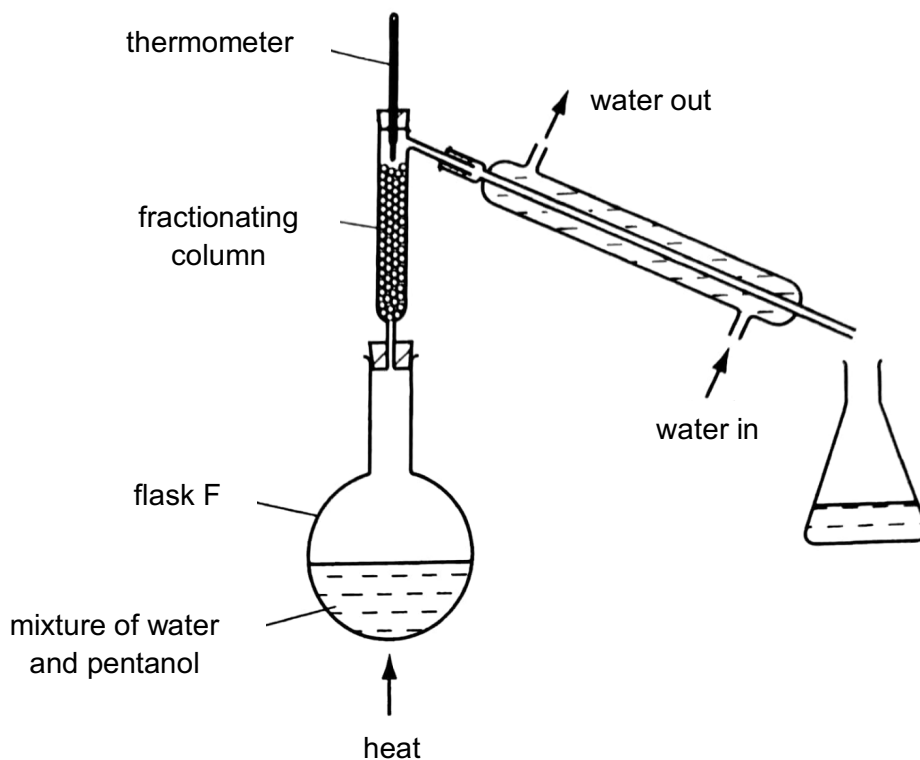
- 3 A solution of X is added to 1 cm³ of sulfuric acid. Effervescence is seen. The gas produced is bubbled into a test tube of limewater. The following observation is made.



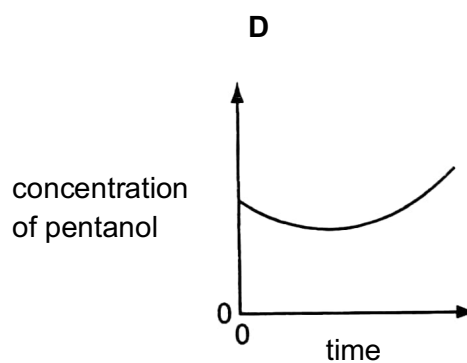
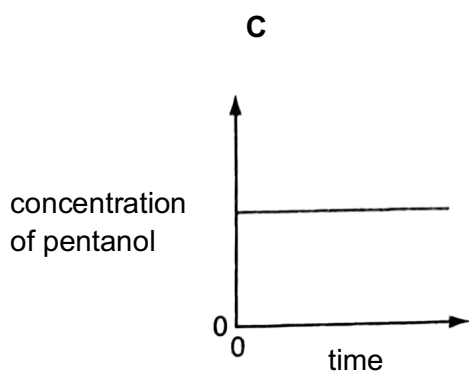
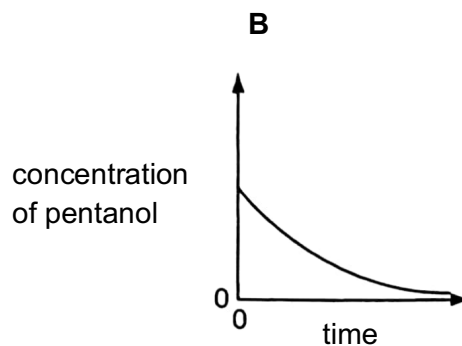
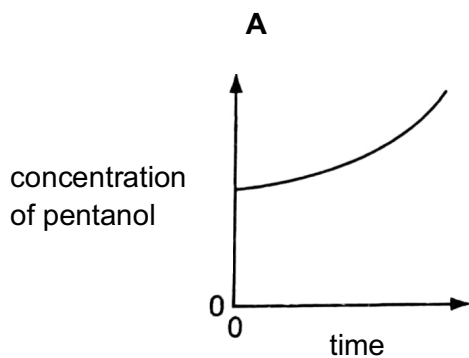
What could X be?

- A barium carbonate
- B sodium hydroxide
- C barium nitrate
- D sodium carbonate

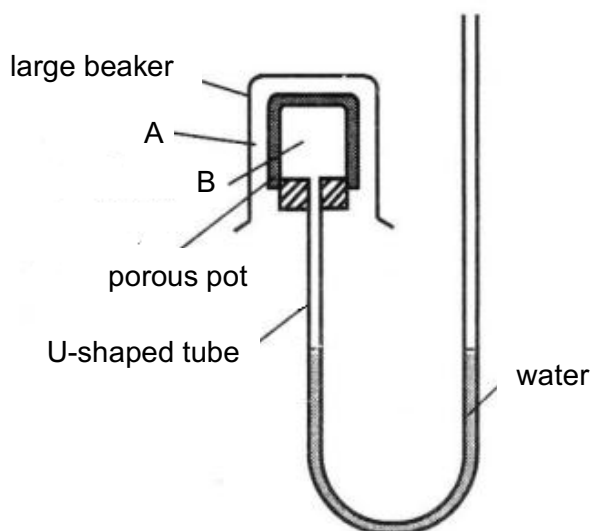
- 4 The apparatus shown is used to distil pentanol (boiling point 138°C) from a mixture of water and pentanol.



Which graph shows the change in concentration of the pentanol in flask F as the distillation proceeds?



- 5 The diagram shows the experimental set-up to investigate the movement of gases A and B. After a while, the water on the left side of the U-shaped tube moved up.



If gas A is fluorine, what could gas B be?

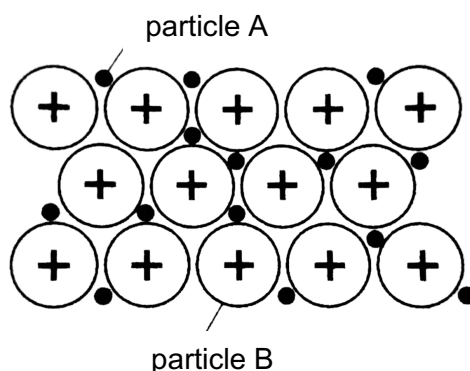
- A chlorine
 - B carbon dioxide
 - C neon-19
 - D argon-38
- 6 Four elements are shown as P, Q, R and S. The letters do not represent the chemical symbols of the elements.

An ion is formed from the atom of one of the four elements. The ratio of the number of atoms to the number of electrons gained is 1:2. The ion formed consists of 2 electron shells.

Which element is the ion formed from?

- A $^{12}_{24}\text{P}$
 - B $^{8}_{18}\text{Q}$
 - C $^{16}_{32}\text{R}$
 - D $^{4}_{10}\text{S}$
- 7 Which two substances have similar molecular structures?
- A sodium chloride and potassium chloride
 - B silicon and diamond
 - C carbon dioxide and sodium oxide
 - D diamond and methane

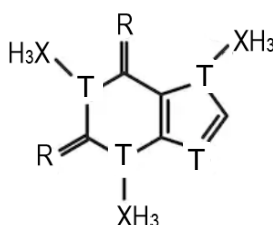
- 8 The following diagram shows the structure of substance Y.



What could substance Y and particles A and B be?

	substance Y	particle A	particle B
A	potassium chloride	anion	cation
B	graphite	electron	atom
C	potassium	electron	cation
D	copper	electron	cation

- 9 A caffeine molecule has the following structure as shown below, with three unknown elements R, T and X. H represents hydrogen atoms.



What could element R, S and X be?

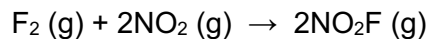
	R	T	X
A	sulfur	carbon	silicon
B	oxygen	carbon	chlorine
C	chlorine	boron	carbon
D	oxygen	nitrogen	carbon

- 10 20 cm³ of dilute phosphoric acid, H₃PO₄, contains 0.04 mol of the acid. Assuming that phosphoric acid ionises completely in a reaction with sodium hydroxide, what is the concentration of the hydrogen ions in the solution?

A 0.67 mol/dm³

- B** 2.00 mol/dm³
C 4.00 mol/dm³
D 6.00 mol/dm³

- 11** Fluorine reacts with nitrogen dioxide according to the equation below.

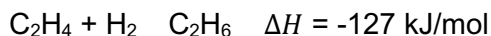


If 90 cm³ of gaseous fluorine is mixed with 110 cm³ of gaseous nitrogen dioxide, what is the total volume of the resultant mixture at room temperature and pressure?

- A** 55 cm³
B 110 cm³
C 145 cm³
D 165 cm³
- 12** Anhydrous washing soda, Na₂CO₃, is a component of many dry soap powders. The remaining mass of the anhydrous sample after a hydrated sample, Na₂CO₃.10H₂O, is heated to dryness is 15.3 g.
 What is the mass of oxygen found in the hydrated sample, Na₂CO₃.10H₂O?
 [Mr of anhydrous Na₂CO₃ is 106; Mr of H₂O is 18]
- A** 9.24 g **B** 23.1 g **C** 30.0 g **D** 81.0 g
- 13** In an electrolysis of an aqueous solution, what effect could increasing its concentration have?
- A** The product at the cathode may change.
B The product at the anode may change.
C Products at both electrodes may change.
D There is no effect on the products formed.
- 14** Which of the following correctly describes the electrolysis of molten zinc chloride?

	product formed at the negative electrode	product formed at the positive electrode	terminal of the dry cell that electrons flow out of
A	zinc	chlorine	negative
B	chlorine	zinc	negative
C	zinc	chlorine	positive
D	chlorine	zinc	positive

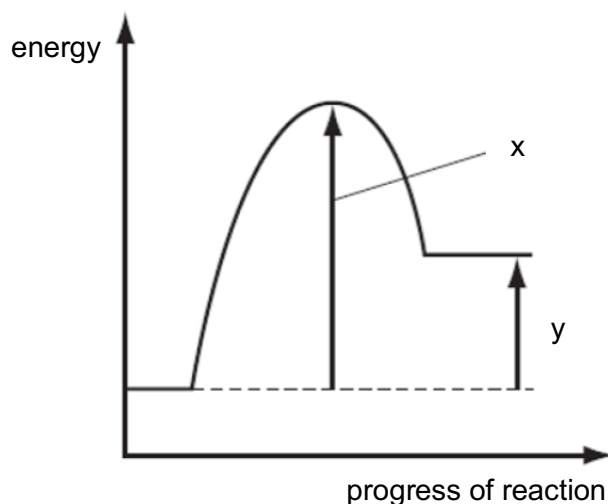
- 15 The equation for the addition reaction of ethene is shown.



	C–H	H–H	C–C
bond energy in kJ/mol	413	432	347

What is the energy of the C=C bond found in ethene?

- A** 307 kJ/mol **B** 582 kJ/mol **C** 614 kJ/mol **D** 768 kJ/mol
- 16 The energy profile diagram for the forward reaction in a reversible reaction is shown.



Which statement about the energy profile diagram is correct?

- A** The enthalpy change is the difference between x and y.
B The value of y is unaffected by the addition of a catalyst.
C The value of x remains the same when a catalyst is added.
D The activation energy of the backward reaction is y – x.
- 17 Which pair of substances, when mixed together, will produce the lowest initial rate of reaction?

	volume of nitric acid / cm ³	concentration of nitric acid / cm ³	size of zinc
A	30	0.1	powder
B	30	0.2	granules
C	120	0.2	powder

D	120	0.1	granules
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Use the following information to answer Questions **18** and **19**.

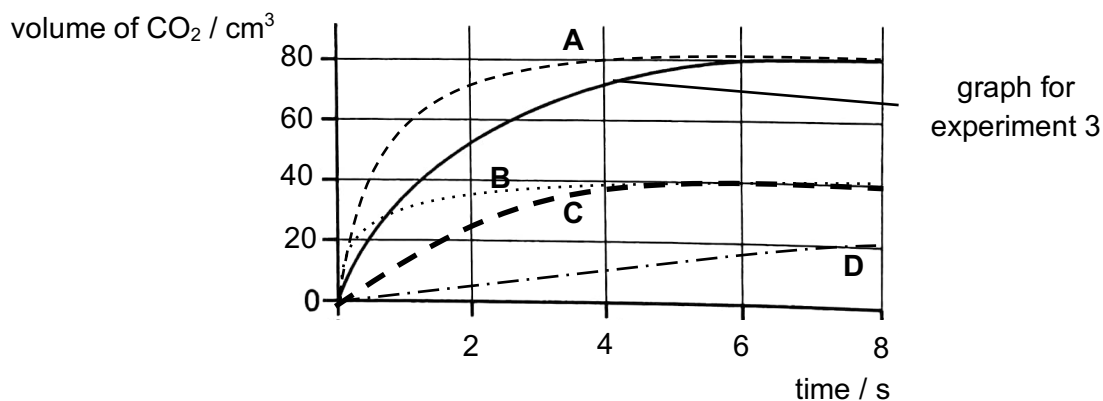
A student investigated the rate of reaction when acid reacted with excess powdered copper(II) carbonate. He used the same volume of monobasic acid each time. The table below showed the results he obtained.

experiment	type of acid	concentration / mol/dm ³	time taken to collect 10 cm ³ of gas / s	total volume of gas / cm ³
1	X	0.5	15	40
2	X	0.5	7	40
3	X	1.0	8	80
4	Y	0.5	15	40

- 18** Three experiments were carried out at room temperature and one experiment was carried out at 60 °C.
Which experiment was carried out at 60 °C?

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

- 19** The student conducted a fifth experiment using half the volume of 1.0 mol/dm³ of acid X.
Assuming all other variables were kept constant, which graph would the fifth experiment produce, compared to the graph for experiment 3?



- 20** Peroxodisulfuric acid, H₂S₂O₈, reacts with potassium iodide, KI, according to the equation:



Two statements were made about the above reaction.

Statement I: Peroxodisulfuric acid is an oxidising agent.

Statement II: Brown solution turns colourless due to the change in oxidation state of iodine.

What best describes the two statements?

- A** Both statements are incorrect.
- B** Both statements are correct and statement II explains statement I.
- C** Both statements are correct but statement II does not explain statement I.
- D** Statement I is correct, but statement II is incorrect.

21 Ethene undergo several reactions.

Which of the following is(are) formed from a non-redox reaction of ethene?

- A** $\text{C}_2\text{H}_5\text{OH}$
- B** C_2H_6
- C** C_6H_6
- D** CO_2 and H_2O

22 Ammonia is produced industrially by the Haber process. Which of the following statements is **not** true about the Haber process?

- A** Unreacted nitrogen is fed back to the reactor to reduce waste.
- B** The product can decompose to form simpler molecules.
- C** A catalyst is added to increase the yield of ammonia.
- D** High temperature is applied to overcome the activation energy.

23 A student found a bottle of limewater contaminated with calcium carbonate. What particles cannot be found in the bottle?

- A** carbonate ions only
- B** calcium ions and carbonate ions
- C** water molecules and hydroxide ions
- D** calcium ions and hydroxide ions

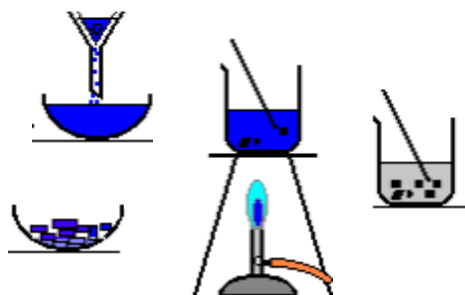
24 The formulae of some oxides are shown below.



Which of the following gives the correct number of each type of oxides?

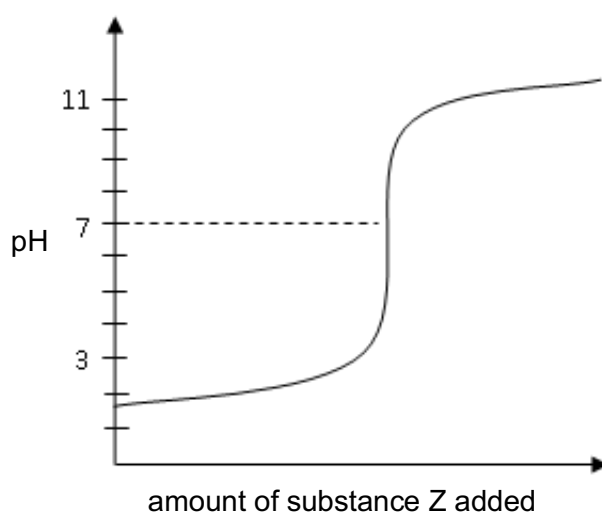
	number of each type of oxide		
	acidic	amphoteric	basic
A	1	1	2
B	1	1	1
C	2	0	3
D	2	1	2

- 25 These were diagrams drawn by a student to illustrate the steps of a salt preparation method. However, they are not in order of sequence.



Which reagents can be used to prepare a large quantity of salt that would involve the above steps?

- A potassium oxide and hydrochloric acid
 - B lead(II) carbonate and nitric acid
 - C calcium nitrate and sulfuric acid
 - D calcium oxide and sulfuric acid
- 26 An aqueous solution of Z was added a little at a time, with stirring to substance Y. The changes in pH of the mixture are shown in the graph below.



What could Y and Z be?

	Y	Z
A	barium oxide	sulfuric acid
B	zinc oxide	sulfuric acid
C	calcium oxide	ethanoic acid
D	hydrochloric acid	calcium oxide

- 27** The diagram shows part of the Periodic Table.

A simplified periodic table with 18 columns and 4 rows. The first two columns are highlighted in light blue. The 13th column is highlighted in light green. The 18th column is highlighted in light orange. Element 'W' is in the 10th column, 4th row. Element 'X' is in the 16th column, 3rd row. Element 'Y' is in the 1st column, 2nd row. Element 'Z' is in the 18th column, 2nd row.

Which row is correct?

	valency of 1	smallest atom
A	Y	Z
B	W, Y	W
C	X	Y
D	Y, Z	X

- 28** A student carried out several tests and made the following observations of two unknown ionic chlorides of P and Q.

test	observation	
	chloride P	chloride of Q
(a) Add half a spatula of P and Q to each of two test tubes containing 2 cm ³ distilled water.	P dissolved to give a colourless solution.	Q dissolved to give a coloured solution.
(b) Add 2 cm ³ aqueous silver nitrate to each salt solution from (a).	A white precipitate is formed.	A white precipitate is formed.

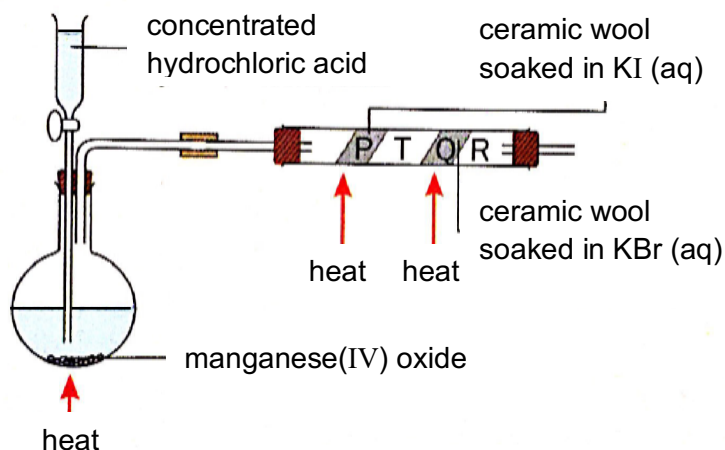
She then made the following deductions about the groups P and Q could be found in.

- I: P could be a group I metal.
II: P could be a group II metal.
III: Q could be a group III metal.
IV: Q could be a transition metal.

Which deductions are correct?

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

- 29** Chlorine gas can be made by reacting concentrated hydrochloric acid with manganese (IV) oxide (MnO_2) using the apparatus below.



What are the observations at T and R?

	observation at T	observation at R
A	no vapour	no vapour
B	brown vapour	no vapour
C	violet vapour	no vapour
D	violet vapour	reddish brown vapour

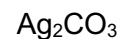
- 30** Which of the following does **not** correctly show why lithium and sodium are in the same Group?

	evidence	lithium	sodium
I	density	low	low
II	reaction with copper(II) nitrate	Copper is displaced.	Copper is displaced.
III	pH of the solution formed from its reaction with water	12	13
IV	formula of its sulfate salt	Li_2SO_4	Na_2SO_4

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

- 31** The formulae of some metal carbonates are shown below.

[Turn over



How many thermally stable carbonates are there?

A 1

B 2

C 3

D 4

- 32 Which pairs of statements correctly describe the differences between the conduction of electricity by metals and during electrolysis?

	conduction by metals	conduction in the electrolytes during electrolysis
I	charged particles move in one direction only	charged particles move towards both electrodes
II	it does not result in a chemical change	it results in a chemical change
III	current is due to the movement of electrons	current is due to movement of oppositely charged ions

A I only

B I and II only

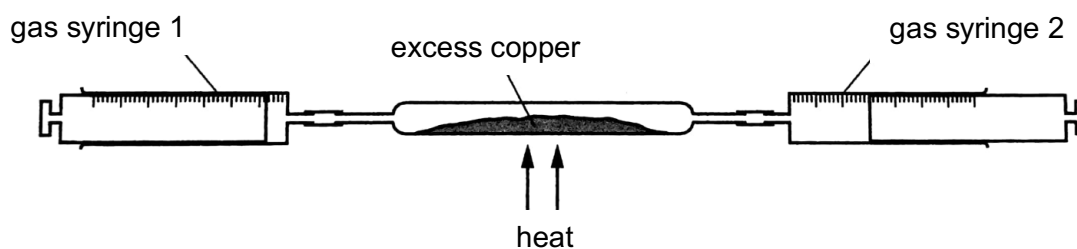
C II and III only

D all correct

- 33 Iron is extracted from iron ore in a blast furnace in several chemical reactions, some of which are redox reactions. Which of the following shows an **incorrect** chemical reaction involved in the extraction of iron from the iron ore?

	chemical reaction	Is it a redox reaction?
A	$\text{CaCO}_3 + \text{SiO}_2 \rightarrow \text{CaSiO}_3 + \text{CO}_2$	✓
B	$\text{C} + \text{O}_2 \rightarrow \text{CO}_2$	✓
C	$\text{Fe}_2\text{O}_3 + 3\text{CO} \rightarrow 2\text{Fe} + 3\text{CO}_2$	✓
D	$\text{CaCO}_3 \rightarrow \text{CaO} + \text{CO}_2$	✗

- 34 The oxygen in air can be removed by passing air over heated copper using the apparatus in the diagram.



80 cm³ of air is collected in gas syringe 1. Each syringe, 1 and 2, is pushed alternatively so that the air passes repeatedly over the heated copper.

When the volume of gas no longer changes, and the gas has cooled to room temperature, what volume of air will remain?

- A 20 cm³ B 40 cm³ C 64 cm³ D 80 cm³

- 35 Biodiesel, made by vegetable oil, can be used as a fuel for cars. Even though carbon dioxide is released when biodiesel is combusted, some scientists still claimed that biodiesel is a carbon neutral fuel.
What is the basis for this argument?

- A Biodiesel is not a carbon compound.
B Plants release carbon dioxide in respiration.
C Biodiesel produces less carbon dioxide when burnt.
D Plants take up carbon dioxide as they photosynthesize.

- 36 Crude oil is separated into different fractions by fractional distillation. Fraction X is obtained from near the top of the fractionating column. Fraction Y is obtained from near the bottom of the fractionating column. Which row of the table shows the ease of ignition and viscosity of fraction X compared with fraction Y?

	ease of ignition	viscosity
A	easier than Y	higher than Y
B	easier than Y	lower than Y
C	more difficult than Y	higher than Y
D	more difficult than Y	lower than Y

- 37 How many **other** isomers does butan-1-ol have?

- A 1 B 2 C 3 D 4

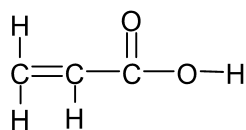
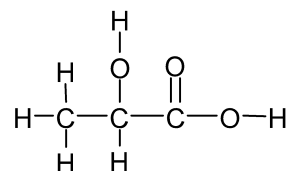
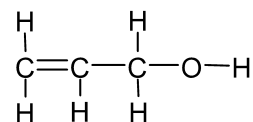
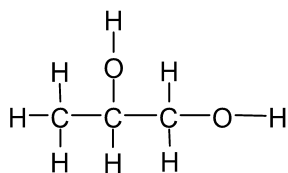
- 38 An organic compound S has the following reactions:

- oxidised by potassium manganate(VII)
- decolourises aqueous bromine at room temperature

Which of the following structures represents S?

A

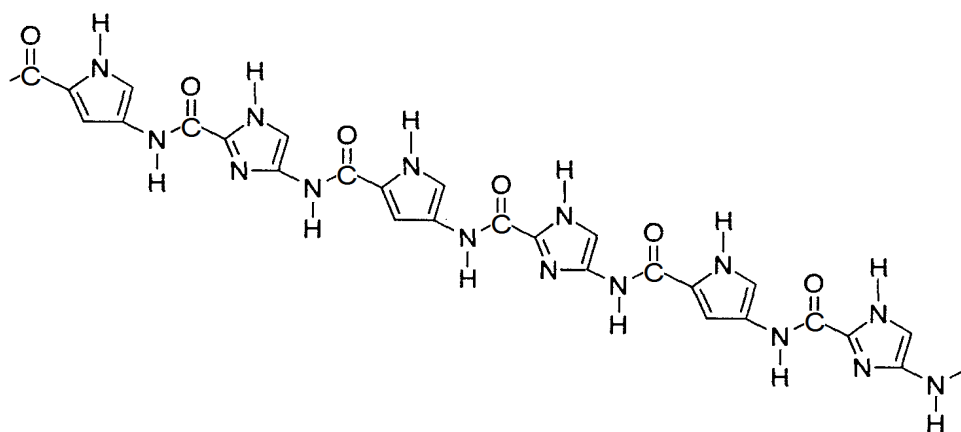
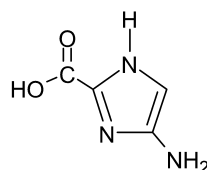
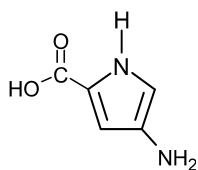
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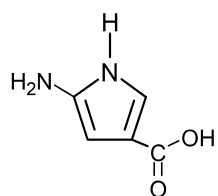
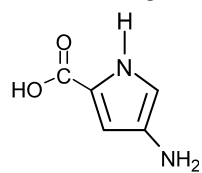
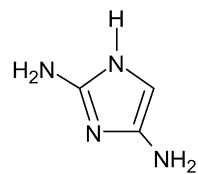
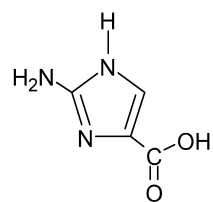
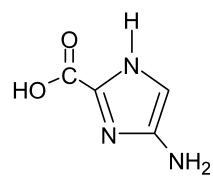
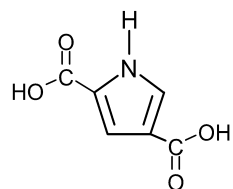
**C****D**

- 39** A food chemist wants to create the odour of pineapples using the organic compound $\text{CH}_3\text{COOCH}_2\text{CH}_2\text{CH}_2\text{CH}_3$. Which of the following pairs of reactants would react to form this compound and what is the name of the compound formed?

	reactant 1	reactant 2	name of compound
A	$\text{CH}_3\text{CH}_2\text{OH}$	$\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$	ethyl butanoate
B	$\text{CH}_3\text{CH}_2\text{OH}$	$\text{CH}_3\text{CH}_2\text{CH}_2\text{COOH}$	ethyl butanoate
C	CH_3COOH	$\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$	butyl ethanoate
D	$\text{CH}_3\text{CH}_2\text{CH}_2\text{COOH}$	CH_3COOH	butyl ethanoate

- 40** The structure below shows part of a polymer. Which one of the following options show the correct monomers?

**A**

B**C****D****End of paper**