



**ST. JOSEPH'S INSTITUTION
PRELIMINARY EXAMINATION 2024
(YEAR 4)**

CANDIDATE NAME

--

CLASS

--	--	--	--	--

INDEX
NUMBER

--	--

CHEMISTRY

6092/01

Paper 1

26 August 2024

Additional Materials:
Multiple Choice Answer Sheet

**1 hour
(08:05 – 09:05)**

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

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

Write your name, index number and class 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 Question paper.

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

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

The Periodic Table of Elements

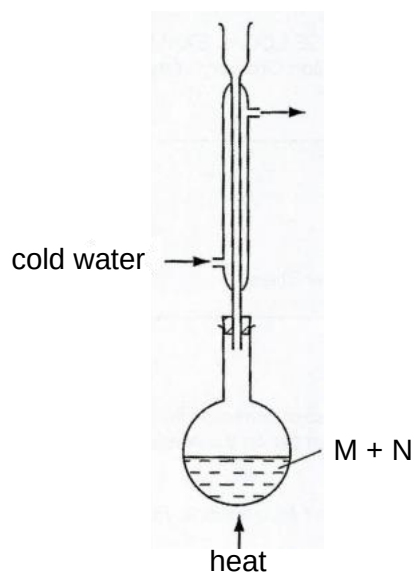
Group																			
1	2	1 H hydrogen 1										13	14	15	16	17	18		
3 Li lithium 7		Key																2 He helium 4	
4 Be beryllium 9		proton (atomic) number atomic symbol relative atomic mass																10 Ne neon 20	
11 Na sodium 23	12 Mg magnesium 24																	17 Cl chlorine 35.5	18 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 —	113 Nh nihonium —	114 Fl flerovium —	115 Mc moscovium —	116 Lv livermorium —	117 Ts tennessine —	118 Og oganesson —	

lanthanoids	57 La lanthanum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium —	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175
actinoids	89 Ac actinium —	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	93 Np neptunium —	94 Pu plutonium —	95 Am americium —	96 Cm curium —	97 Bk berkelium —	98 Cf californium —	99 Es einsteinium —	100 Fm fermium —	101 Md mendelevium —	102 No nobelium —	103 Lr lawrencium —

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

The Avogadro constant, $L = 6.02 \times 10^{23} \text{ mol}^{-1}$

- 1 The diagram shows the apparatus used to prepare a liquid compound L.



Compound L (boiling point 57 °C) is made by heating together two liquids, M (boiling point 78 °C) and N (boiling point 95 °C). The reaction is slow.

What is the purpose of the condenser?

- A to allow liquid L to escape as fast as it is formed
- B to enable M and N to mix more efficiently
- C to keep air away from the reacting liquids
- D to prevent M and N from escaping before the reaction is complete

2 A student plans two experiments.

In experiment 1, he wants to determine the concentration of an aqueous solution of sodium hydroxide by reacting it with dilute hydrochloric acid.

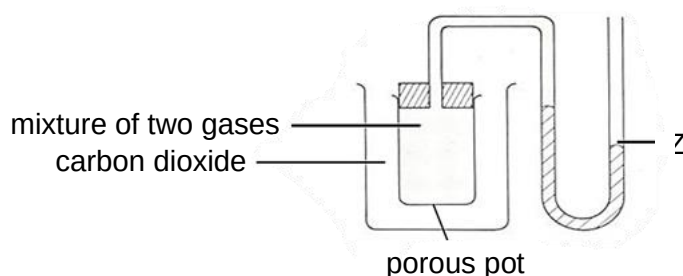
In experiment 2, he wants to investigate the rate of the reaction between calcium carbonate and dilute nitric acid by measuring the volume of gas produced at regular intervals.

The student is provided with conical flasks for the experiments.

What additional apparatus is needed?

	experiment 1	experiment 2
A	burette, pipette	balance, gas syringe
B	burette, pipette	gas syringe, stopwatch
C	gas syringe, stopwatch	burette, pipette
D	measuring cylinder, thermometer	gas syringe, stopwatch

3 The apparatus below can be used to show the diffusion of gases.



Which pair of gases in the porous pot will cause the water level at Z to rise after some time?

- A** chlorine and krypton
- B** ethene and methane
- C** helium and nitrogen
- D** hydrogen and propene

- 4 What is the number of electrons and neutrons in a hydroxide ion?

	electrons	neutrons
A	9	8
B	9	9
C	10	8
D	10	9

- 5 Calcium and iodine react together to form a compound.

Which statement describes this reaction?

- A** Each calcium atom gains one electron and each iodine atom gains one electron.
- B** Each calcium atom loses one electron and each iodine atom loses one electron.
- C** Each calcium atom loses two electrons and each iodine atom gains one electron.
- D** Each calcium atom loses two electrons and each iodine atom gains two electrons.

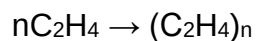
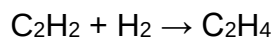
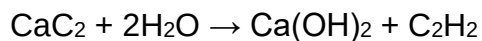
- 6 Which statements about calcium chloride and potassium chloride are correct?

- 1 Calcium chloride has a higher melting point than potassium chloride as the calcium atom has a greater charge than the potassium atom.
- 2 In the calcium chloride lattice, the ratio of calcium ions to chloride ions is half that of the ratio of potassium ions to chloride ions in the potassium chloride lattice.
- 3 Molten calcium chloride has a greater electrical conductivity than molten potassium chloride as calcium contributes more electrons to the delocalised 'sea of electrons' than does potassium.

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

- 7 Which molecule has the largest number of electrons involved in bonding?
- A C_2H_4
 - B CO_2
 - C CH_3OH
 - D N_2
- 8 Which statement about metals is correct?
- A A giant metallic lattice consists of metal atoms in a 'sea of electrons'.
 - B All metals have high melting points.
 - C Electrons in a metal move randomly through the giant metallic lattice.
 - D Metals are malleable as the atoms in a metal are mobile.
- 9 At room temperature and pressure, carbon dioxide is a gas while silicon dioxide is a solid.
- Which statement explains this?
- A Attractive forces between carbon dioxide molecules are weaker than the attractive forces between ions in silicon dioxide.
 - B Both substances have different covalent structures.
 - C The covalent bonds in carbon dioxide are weaker than those in silicon dioxide.
 - D There are less covalent bonds in carbon dioxide than in silicon dioxide.

- 10** The equations show the reactions involved in the formation of poly(ethene) from calcium carbide, CaC_2 .



In the first reaction, 64 kg of calcium carbide is reacted with 54 kg of water.

What is the maximum mass of poly(ethene) obtained?

- A** 14 kg
 - B** 28 kg
 - C** 42 kg
 - D** 84 kg
- 11** 6.0 cm^3 of a 0.5 mol/dm^3 solution of acid X exactly neutralises 22.50 cm^3 of 0.4 mol/dm^3 aqueous potassium hydroxide.

What is the formula of acid X?

- A** $\text{C}_2\text{H}_5\text{COOH}$
 - B** HNO_3
 - C** H_2SO_4
 - D** H_3PO_4
- 12** In an experiment, 41.4 g of potassium carbonate reacted with excess dilute hydrochloric acid to form 20.5 g of potassium chloride.

What is the percentage yield of potassium chloride?

- A** 45.9 %
- B** 49.5 %
- C** 65.9 %
- D** 91.7 %

- 13** A pure fat has a relative molecular mass of 300.

150 g of the fat reacts with 240 g of bromine.

What volume of hydrogen, measured at room temperature and pressure, is needed to fully convert 75 g of the fat into margarine?

- A** 12 dm³
- B** 18 dm³
- C** 36 dm³
- D** 72 dm³

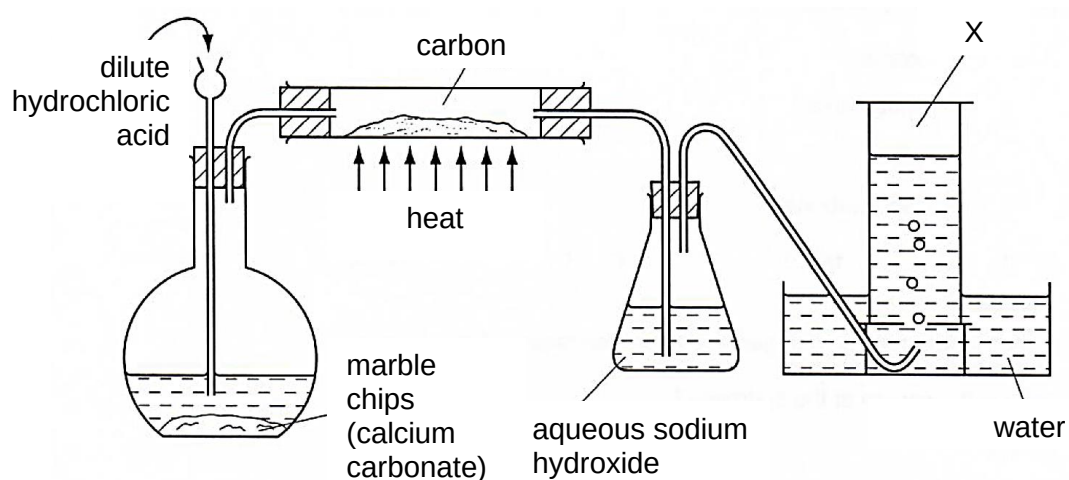
- 14** The table gives some statements about acids and bases and explanations for these statements.

One of the substances below, hydrazine, has similar properties to ammonia, and the formula H₂NNH₂.

Which row shows both a correct statement and a correct explanation for the statement?

	statement	explanation
A	ammonia can be made by heating ammonium carbonate with calcium hydroxide	the hydroxide ion gives H ⁺ to the ammonium ion
B	hydrazine reacts with hydrogen chloride to form a compound with formula C/H ₃ NNH ₃ Cl	hydrazine molecules remove H ⁺ ions from hydrogen chloride
C	the pH of a weak acid is always higher than the pH of a strong acid	pH shows the strength of acid – the stronger the acid, the lower the pH
D	when copper is added to dilute hydrochloric acid, copper is oxidised	oxidation is loss of electrons

- 15 The diagram shows an experiment for the formation of gas X.



What is gas X?

- A carbon dioxide
 - B carbon monoxide
 - C chlorine
 - D hydrogen
- 16 Copper(II) nitrate is made by reacting an excess of a powdered solid with an aqueous solution.

The mixture is filtered and the filtrate crystallised.

Which row identifies a solid and an aqueous solution that can be used to make a pure sample of copper(II) nitrate?

	solid in excess	aqueous solution
A	copper	zinc nitrate
B	copper	silver nitrate
C	copper(II) hydroxide	sodium nitrate
D	copper(II) sulfate	dilute nitric acid

17 Which statement about the Haber process is correct?

- A** Both gaseous reactants are obtained from fractional distillation of liquid air.
- B** Finely-divided iron is used to increase the rate and yield of the reaction.
- C** High pressure is used to increase the rate and yield of the reaction.
- D** High temperature is used to increase the rate and yield of the reaction.

18 Aqueous ammonium sulfate is warmed with an excess of aqueous sodium hydroxide. The resulting mixture is neutralised with dilute nitric acid.

The mixture is then mixed with aqueous barium nitrate.

The precipitate is filtered off and the filtrate is evaporated to leave a white solid.

What could the white solid be?

- A** ammonium nitrate
- B** barium hydroxide
- C** barium sulfate
- D** sodium nitrate

19 A white solid reacted with dilute hydrochloric acid to form a colourless solution and a gas.

The following tests were performed on the colourless solution and the gas.

Test 1: Upon adding aqueous silver nitrate to the colourless solution, a white precipitate was formed.

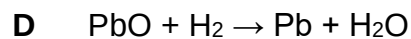
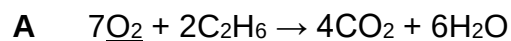
Test 2: Upon adding aqueous ammonia in excess to the colourless solution, a colourless solution was formed.

Test 3: The gas formed a white precipitate when bubbled into aqueous calcium hydroxide.

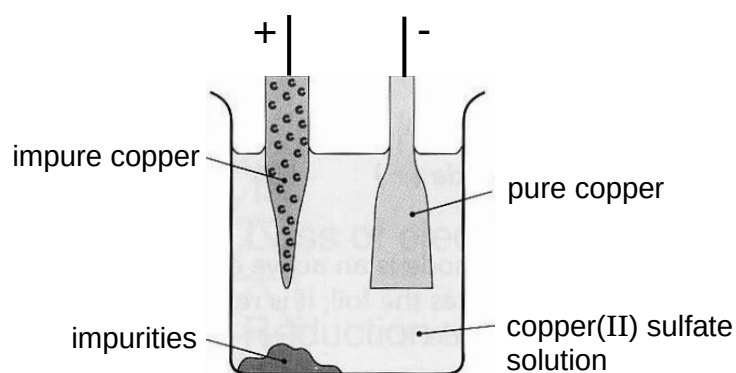
What is the white solid?

- A** aluminium carbonate
- B** aluminium chloride
- C** zinc carbonate
- D** zinc chloride

20 In which reaction does the underlined substance act as a reducing agent?



21 A block of impure copper was purified using the apparatus shown below.



The mass of the impure copper block decreased from 15.8 g to 3.2 g, while the mass of the pure copper strip increased from 1.2 g to 9.7 g.

How many statements about the purification process are correct?

- A red-brown solid is deposited on the cathode.
- The blue colour of the electrolyte fades over time.
- The equation for the reaction at the cathode is $\text{Cu} \rightarrow \text{Cu}^{2+} + 2\text{e}^-$.
- The impurities collected below the block of impure copper consist of unreactive metals.
- The percentage purity of the block of impure copper is 67.5 %.

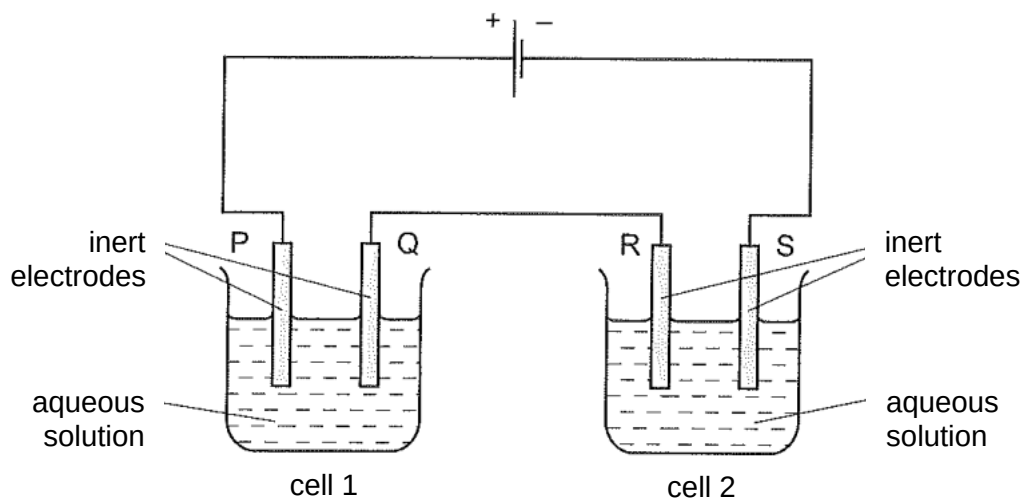
A 2

B 3

C 4

D 5

- 22** In the diagram, each cell contains an aqueous solution of a single salt. All four electrodes are platinum.

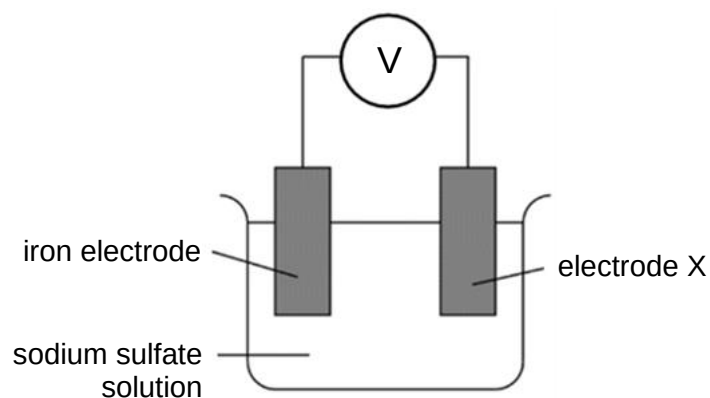


Electrodes Q and S increase in mass during the electrolysis but no gas is given off at Q or S. The increase in mass of Q is greater than the increase in mass of S.

Which statement must be correct?

- A** The cation in cell 1 is the same as in cell 2 but the solution in cell 1 is more concentrated than in cell 2.
- B** The cation of the solution in cell 1 is different from the cation of the solution in cell 2.
- C** The current flowing in cell 1 is greater than the current flowing in cell 2.
- D** The loss of mass of electrode P is less than the loss of mass of electrode R.

- 23** A series of experiments was conducted to compare the reactivities of three metals, A, B and copper, which were connected as electrode X in the setup below.



The results are shown in the table below.

electrode X	voltage / V
A	-2.75
B	0.00
copper	+2.10

Which row gives the identity of metal B, and arranges the three metals in decreasing order of reactivity?

	identity of metal B	decreasing order of reactivity
A	iron	A, B, copper
B	zinc	A, B, copper
C	iron	copper, B, A
D	zinc	copper, B, A

- 24** The electronic configurations of three ions are shown below.

ion	electronic configuration
X ⁺	2.8
Y ⁺	2.8.8
Z ⁻	2.8.8

Which statement is correct?

- A** Element X exists as a gas at room temperature.
 - B** Element Y has a smaller atomic number than element Z.
 - C** Element Y is more reactive than element X.
 - D** Elements Y and Z are in the same period of the Periodic Table.
- 25** Elements W, X, Y and Z are all in period 3 of the Periodic Table.

Some of their properties are shown below.

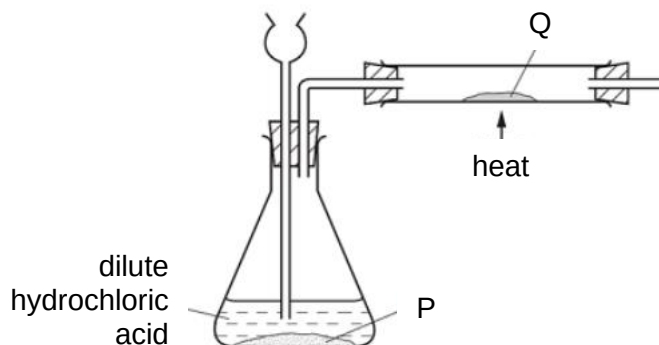
element	W	X	Y	Z
appearance at room temperature	silvery-grey solid	yellow solid	silvery-grey solid	yellowish-green gas
reaction with cold water	violent reaction	no reaction	no reaction	slow reaction
nature of oxide	reacts with acids	reacts with bases	reacts with acids and bases	reacts with bases

What is the sequence of these elements in increasing Group number?

- A** W, X, Y, Z
 - B** W, Y, X, Z
 - C** Y, W, X, Z
 - D** Z, X, Y, W
- 26** Which statement about Group 17 elements is correct?
- A** Solid astatine is light brown.
 - B** The elements are good oxidising agents.
 - C** The melting point of the elements decreases down Group 17.
 - D** The reactivity of the elements increases down Group 17.

27 Substance P reacts with dilute hydrochloric acid to produce a gas.

This gas reduces substance Q.

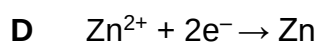
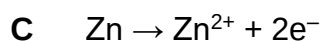
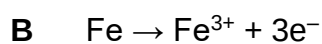
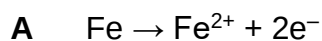


What are substances P and Q?

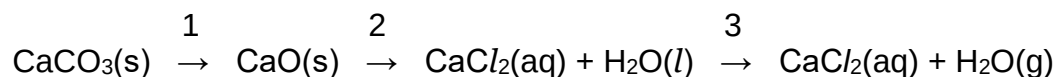
	P	Q
A	copper	copper(II) oxide
B	lead	silver oxide
C	magnesium	zinc oxide
D	zinc	copper(II) oxide

28 Ships made from steel often have pieces of zinc attached to them to protect the steel from corrosion.

Which equation shows a reaction that occurs?

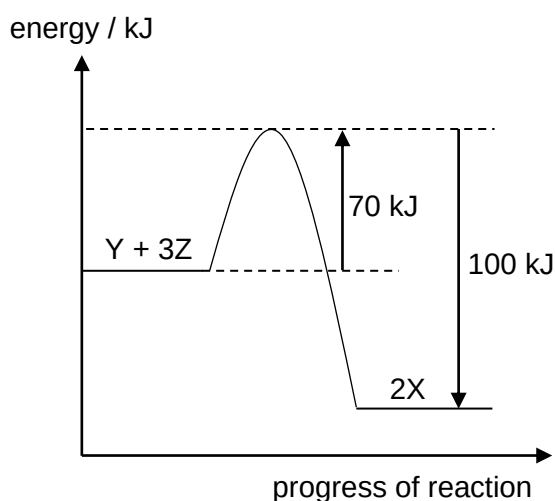
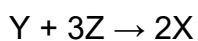


- 29 Concentrated aqueous calcium chloride salt is prepared from calcium carbonate via stages 1, 2 and 3.



Which stages are exothermic?

- A 1 only
 - B 2 only
 - C 1 and 3 only
 - D 2 and 3 only
- 30 The diagram below shows the energy profile diagram for the following reaction:



What is the enthalpy change for the decomposition of six moles of X into Y and Z?

- A +30 kJ
- B -30 kJ
- C +90 kJ
- D -90 kJ

- 31** Potassium chlorate, KClO_3 , decomposes when heated.



Two experiments are conducted using potassium chlorate and a catalyst, manganese(IV) oxide.

In experiment 1, powdered manganese(IV) oxide is heated with 0.1 g of powdered potassium chlorate.

In experiment 2, lumps of manganese(IV) oxide are heated with 0.2 g of powdered potassium chlorate.

What is the initial rate of reaction and the final volume of oxygen gas formed in experiment 2, compared to experiment 1?

	initial rate of reaction	final volume of oxygen formed
A	faster than experiment 1	larger than experiment 1
B	faster than experiment 1	same as experiment 1
C	slower than experiment 1	larger than experiment 1
D	slower than experiment 1	same as experiment 1

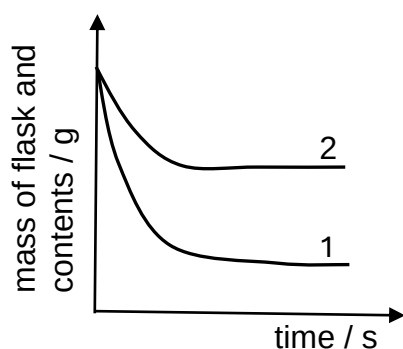
- 32** In two separate conical flasks, excess powdered zinc carbonate is added to dilute sulfuric acid (Experiment 1) and to dilute nitric acid (Experiment 2).

Experiment 1	25 cm ³ of 0.1 mol/dm ³ sulfuric acid + 2.0 g of powdered zinc carbonate
Experiment 2	25 cm ³ of 0.1 mol/dm ³ nitric acid + 2.0 g of powdered zinc carbonate

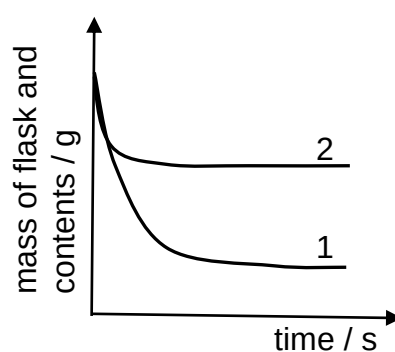
The masses of the conical flasks and their contents are measured at regular time intervals.

Which option best shows the graphs for both experiments?

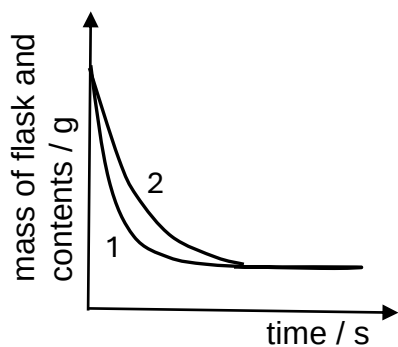
A



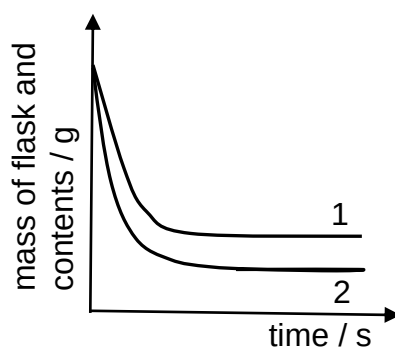
B



C



D



33 Petroleum can be separated into fractions using fractional distillation.

Which statements are correct?

- 1 Any of the fractions could be used as fuels because their enthalpy changes of combustion are negative.
- 2 The fraction obtained at a particular point in the fractionating column always contains the same compounds in the same ratio.
- 3 The fraction obtained at the top of the fractionating column is the most viscous.
- 4 The relative molecular masses of the compounds obtained near the bottom of the fractionating column are higher than those of the compounds obtained near the top of the column.

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

34 Upon cracking, a hydrocarbon X produced two moles of ethene, two moles of butene and one mole of butane as the only products.

Which statement about hydrocarbon X is correct?

- A** It can undergo a chemical reaction with steam.
B It can undergo a substitution reaction with chlorine to form only one compound.
C It contains more than one carbon-carbon double bond.
D It is a saturated compound.

- 35** Ethanol can be made from ethene or from glucose. Burning ethanol made from glucose can cause less harm to the environment than burning ethanol made from ethene.

The table gives statements about the two processes used to make ethanol.

In which row are both statements correct?

	process using ethene	process using glucose
A	ethene is obtained by cracking	carbon dioxide is also produced in the reaction
B	the reaction is carried out with the reagents as gases	the reaction mixture is an aqueous solution
C	uses an acid catalyst	the rate of the reaction is fast
D	uses temperatures around 300 °C	uses temperatures around 100 °C

- 36** The structural formulae of two isomers of butene, C₄H₈, are shown.



How many statements about these two isomers are correct?

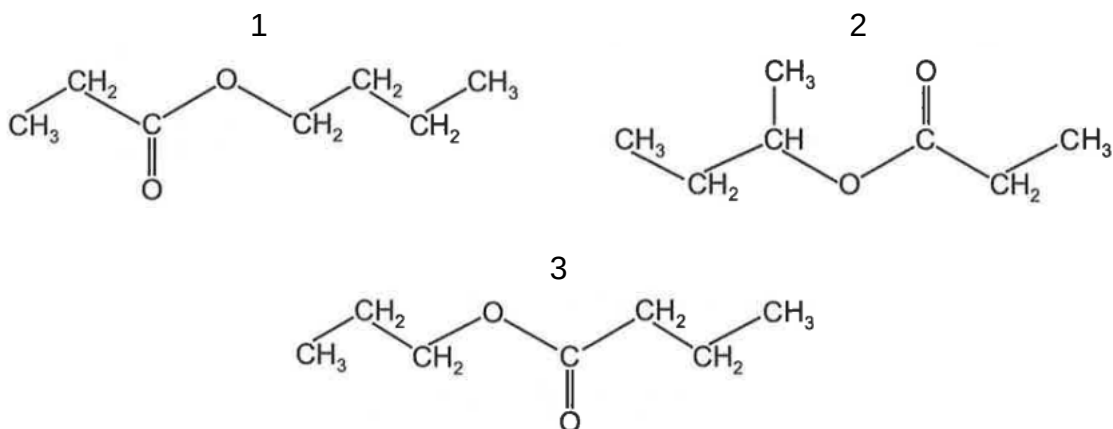
- Besides these two isomers, there is only one other isomer of butene.
- Both produce the same molecule when reacted with chlorine.
- Both produce the same molecule when reacted with hydrogen.
- When polymerised, the same polymer is produced.
- When polymerised, the polymer has the empirical formula C₄H₈.

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

- 37** Butene, $\text{CH}_2\text{CHC}_2\text{H}_5$, is reacted with steam in a catalysed reaction to form compound P.

Compound P reacts with propanoic acid to form ester Q.

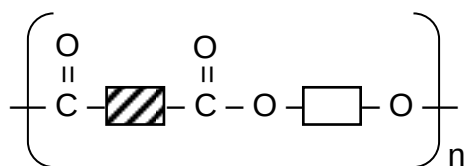
What could be the structure of ester Q?



- A** 1 only
- B** 3 only
- C** 1 and 2 only
- D** 2 and 3 only
- 38** In which of the processes listed below is water involved either as a reactant or a product?
- 1 fermentation of glucose
 - 2 manufacture of poly(ethene) from ethene
 - 3 manufacture of *Terylene*
 - 4 oxidation of ethanol to ethanoic acid
- A** 2 and 4 only
- B** 3 and 4 only
- C** 1, 2 and 3 only
- D** 1, 3 and 4 only

- 39** One method of recycling polymers is the melting of poly(ethene) waste into pellets.

Another method, hydrolysis, can be used on polymer X, which has the structure shown below.



where 'n' is the number of repeating units in the polymer.

Which statement about these methods is correct?

- A** Both methods of recycling polymers form new chemical products.
- B** If hydrocarbon chain  has $M_r = 14$ and hydrocarbon chain  has $M_r = 28$, each repeat unit of X contains three carbon atoms.
- C** In the hydrolysis of polymer X, the mole ratio of X to water is 1 : 2n.
- D** In the hydrolysis of polymer X, the products formed are mainly used as fuels.
- 40** Which row correctly shows the harmful effect of each air pollutant?

	carbon monoxide	chlorofluorocarbons	oxides of nitrogen
A	global warming	depletes ozone layer	acid rain
B	global warming	eye cataracts	respiratory problems
C	respiratory problems	depletes ozone layer	acid rain
D	respiratory problems	eye cataracts	respiratory problems

END OF PAPER