

EXP

PUNGGOL SECONDARY SCHOOL
SECONDARY 4
EXPRESS
2024 PRELIMINARY EXAMINATION
QUESTION & ANSWER BOOKLET



NAME

CLASS

INDEX
NUMBER

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Chemistry

6092

Paper 1

27 August 2024

Additional materials: MCQ answer Sheet

1 hour

READ THESE INSTRUCTIONS FIRST

Write your class, register number and name on all the work you hand in.

Write in soft pencil.

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

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 18.

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

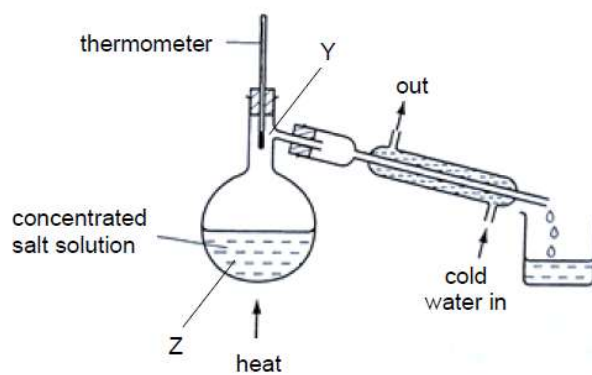
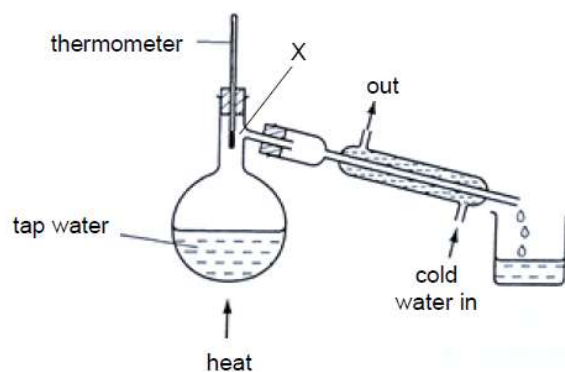
For Examiner's use	
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Total	/40

Parent's Signature

This paper consists of **18** printed pages and **0** blank page.

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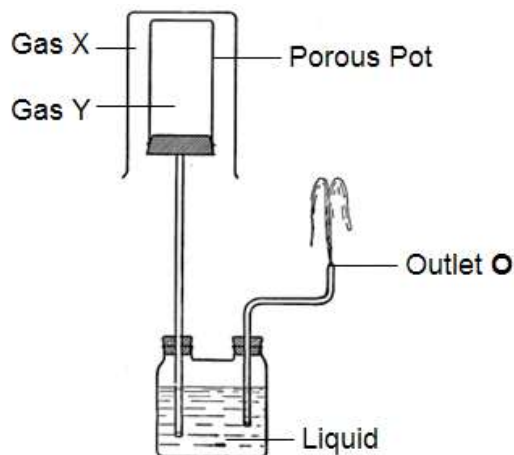
- 1 The diagram shows the apparatus used to obtain pure water from tap water and concentrated salt solution.



What are the possible temperatures indicated at **X**, **Y** and **Z**?

	X	Y	Z
A	100 °C	100 °C	100 °C
B	100 °C	100 °C	105 °C
C	95 °C	100 °C	105 °C
D	105 °C	95 °C	100 °C

- 2 The diagram shows a beaker full of gas **X** inverted over a porous pot containing gas **Y**. A known liquid is used in the container. None of the gases provided below are soluble in the liquid.



Which pair of gases will lead to the liquid spilling out at the outlet **O**?

	Gas X	Gas Y
A	chlorine	helium
B	argon	hydrogen
C	fluorine	helium
D	neon	chlorine

- 3 Products made of plastics have greatly improved our daily lives. Plastics can be made from fractions derived from crude oil.
- 1 Plastics are mixtures of substances with different boiling points.
 - 2 Crude oil is a mixture of substances with different boiling points.
 - 3 The chemical composition of the recycled plastics remains unchanged using the chemical method of recycling plastics.
 - 4 Plastics such as poly(ethene) is an example of addition polymer.

Which statements about plastics and crude oil are correct?

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

- 4 Salicylic acid is a substance used in skin ointments and a sample of it is found to contain impurities like iron and sodium iodide.

Salicylic acid sublimes at 76 °C and is soluble in water.

What is the **best** method to obtain pure salicylic acid from the sample?

- A Add water, filter and evaporate
 - B Add water, filter and sublime
 - C Use magnets, add water and filter
 - D Add water, filter, crystallise and sublime
- 5 An ion R^{2-} contains 45 neutrons and 36 electrons. Which of the following shows the proton number and nucleon number of an atom of **R**?

	proton number	nucleon number
A	34	79
B	36	81
C	34	81
D	38	83

- 6 The element thallium, Tl, has only two isotopes with mass numbers 203 and 205. The relative abundance of Tl -203 is 30%.

Which of the following is the relative atomic mass of thallium?

- A 203.8
 - B 204.0
 - C 204.4
 - D 204.8
- 7 The boiling points of aluminium chloride and carbon tetrachloride are shown below.

	boiling point / °C
aluminium chloride	180
carbon tetrachloride	76

Aluminium chloride does not conduct electricity in both solid and molten states.

Which of the following best explain the difference in boiling points between the two compounds?

- A Electrostatic forces of attraction between the oppositely charged ions in aluminium chloride are stronger.
- B Metallic bonds in aluminium chloride are stronger.
- C Covalent bonds in aluminium chloride are stronger.
- D Intermolecular forces of attraction in aluminium chloride are stronger.

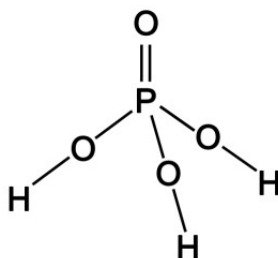
- 8 Ionic bonding results when electrons are transferred from one atom to another.

How many electrons are transferred from/to each of the atoms of elements magnesium, zinc, nitrogen, and fluorine when they form ionic compounds?

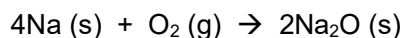
	magnesium	zinc	nitrogen	fluorine
A	2	2	3	1
B	2	1	3	7
C	2	2	5	1
D	1	1	5	7

- 9 The structure of phosphoric acid is shown below.

What is the total number of shared electrons in one molecule of phosphoric acid?



- A** 7 **B** 8 **C** 14 **D** 16
- 10 Patients with iron deficiency are prescribed with iron tablets. When the iron in these tablets reacts with oxygen, it forms iron(II) oxide.
- A sample of 100 g of iron tablets yields 36 g of iron(II) oxide.
- What is the percentage by mass of iron in the tablet?
- A** 14% **B** 28% **C** 42% **D** 56%
- 11 A sample of sodium was heated in excess oxygen according to the equation shown below.



The percentage purity of the sodium sample was 80%.

What would be the maximum mass of sodium oxide obtained when 2.56 g of the impure sodium was used?

- A** 0.96 g **B** 1.38 g **C** 2.76 g **D** 3.45 g

- 12** 15.7 g of a metal chloride, XCl_4 , was heated with zinc. 7.17 g of metal **X** was obtained.



What could be the identity of **X**?

- A** $^{59}_{27}\text{Co}$
 - B** $^{91}_{40}\text{Zr}$
 - C** $^{115}_{49}\text{In}$
 - D** $^{119}_{50}\text{Sn}$
- 13** A solution of a strong acid, HX , contains molecules of water and the ions H^+ and X^- .

Which statement is correct?

- A** The pH value of the acid solution is above 7.
 - B** The acid solution contains OH^- ions.
 - C** The acid solution contains more H^+ ions than X^- ions.
 - D** The acid solution contains higher concentration of HX molecules than H^+ ions.
- 14** What is the substance that farmers add to reduce acidity in soils?
- A** calcium hydroxide
 - B** magnesium oxide
 - C** sodium hydroxide
 - D** aqueous ammonia

- 15** 10.00 cm³ solutions of 0.10 mol/ dm³ concentration of sulfuric acid, hydrochloric acid and ethanoic acid were separately titrated with a 0.10 mol/ dm³ solution of sodium hydroxide until neutralisation is complete.

- 1 Ethanoic acid and hydrochloric acid would require the same volume of sodium hydroxide solution.
- 2 Hydrochloric acid would require more sodium hydroxide solution than ethanoic acid.
- 3 Hydrochloric acid would require more sodium hydroxide than sulfuric acid.
- 4 Hydrochloric acid would require lesser sodium hydroxide than sulfuric acid.

Which statements are correct?

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

- 16** A student wants to prepare calcium sulfate which is an insoluble salt.

Which pair of reagents are the most suitable for making calcium sulfate?

- A** calcium and sulfuric acid
- B** calcium carbonate and sulfuric acid
- C** calcium nitrate and sulfuric acid
- D** calcium oxide and sulfuric acid

- 17** A salt, **T**, on warming with excess aqueous sodium hydroxide, produced a gas that turned damp red litmus paper blue. No further gas was produced when a piece of aluminium foil was added and warmed.

A white precipitate was produced when barium nitrate solution was added to solution **T**.

What could be **T**?

- A** ammonium nitrate
- B** ammonium sulfate
- C** aluminium nitrate
- D** aluminium sulfate

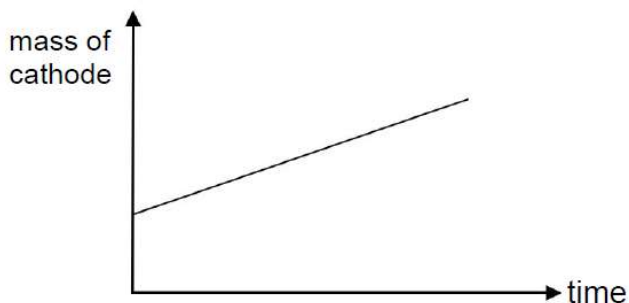
18 In which of the following reactions is the underlined substance acting as the reducing agent?

- A $\text{Br}_2 + 2\text{I}^- \rightarrow \text{I}_2 + 2\text{Br}^-$
 B $3\text{CuO} + 2\underline{\text{NH}_3} \rightarrow \text{N}_2 + 3\text{H}_2\text{O} + 3\text{Cu}$
 C $\text{CaCO}_3 + 2\underline{\text{H}^+} \rightarrow \text{Ca}^{2+} + \text{CO}_2 + \text{H}_2\text{O}$
 D $\text{Mg} + \underline{\text{Pb}^{2+}} \rightarrow \text{Mg}^{2+} + \text{Pb}$

19 Which statement about the electrolysis of molten potassium chloride is correct?

- A A gas that bleaches damp litmus paper is produced at the anode.
 B No gas is produced at the anode.
 C Potassium metal is deposited at the anode.
 D A gas that extinguishes a lighted splint is produced at the cathode.

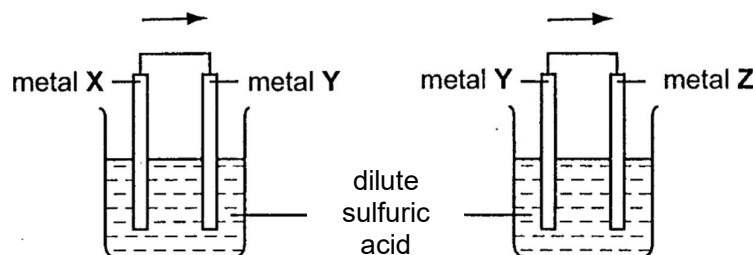
20 An aqueous solution **R** is electrolysed. The current is constant and the cathode is weighed at regular intervals. The graph shown is obtained when the mass of cathode is plotted against time.



Which combination of anode, cathode and solution **R** will **not** produce the graph shown?

	cathode	anode	solution R
A	copper	copper	copper(II) nitrate solution
B	graphite	graphite	copper(II) nitrate solution
C	graphite	graphite	dilute sulfuric acid
D	graphite	silver	silver nitrate solution

- 21 Two cells were set up as shown in the diagram. The arrows show the direction of electron flow in the external circuits.



Which set of metals would give the electron flow in the directions shown?

	metal X	metal Y	metal Z
A	iron	magnesium	copper
B	copper	iron	magnesium
C	magnesium	iron	copper
D	magnesium	copper	iron

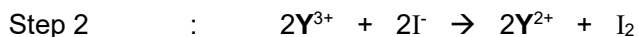
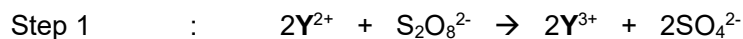
- 22 Elements **S** and **T** are in Group 17 of the Periodic Table.

S is a gas at room temperature and **T** is a liquid at room temperature.

Which statement is **not** correct?

- A **T** has darker colour than **S**.
- B There is a colour change when aqueous **T** is added to ethene.
- C **S** displaces **T** from an aqueous solution of T^- ions.
- D **T** produces hydrogen gas when added to water.

- 23 The following reactions take place in the presence of an ion of the element **Y**.



Which statement is correct?

- A 238 g of $\text{Na}_2\text{S}_2\text{O}_8$ produces 254 g of I_2 .
- B Compounds of **Y** are colourless.
- C Oxide of **Y** reacts with alkalis to form salt and water.
- D Element **Y** can be zinc.

24 **R**, **S** and **T** are three elements in period 3 of the Periodic Table.

The following are the properties of the elements or the compounds of the elements **R**, **S** and **T**.

- When oxide of **R** dissolves in water, the resultant solution reacts with potassium carbonate that liberates a gas to form white precipitate with limewater.
- **S** reacts vigorously with cold water to produce a gas that extinguishes a lighted splint.
- Oxide of **T** reacts with both hydrochloric acid and aqueous sodium hydroxide.

Which statement is correct?

- A** **S** has more protons than **R**.
- B** The element below **S** in the same group reacts more violently with water.
- C** **T** has more valence electrons than **R**.
- D** Oxide of **R** causes acid rain which corrodes buildings.

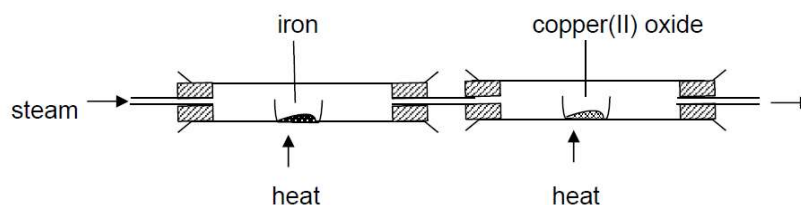
25 Some of the reactions of cadmium are shown below.

reaction with	observations
cold water	Slow streams of bubbles were observed
dilute hydrochloric acid	Bubbles of gas that extinguished a lighted splint

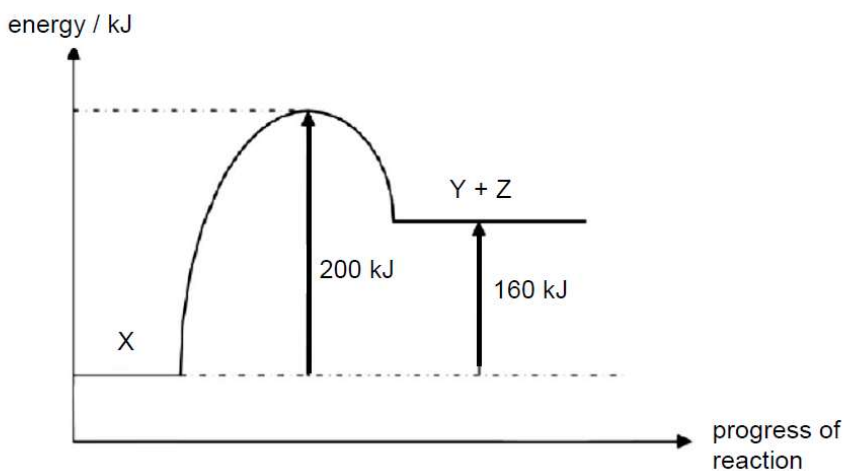
What is the correct order of decreasing reactivity of the metals?

- A** calcium, copper, cadmium
- B** cadmium, copper, calcium
- C** copper, cadmium, calcium
- D** calcium, cadmium, copper

26 Which of the following is **not** a product of the reaction sequence below?



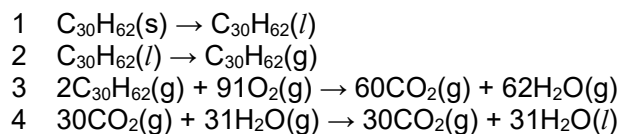
- A water vapour
 B copper
 C hydrogen
 D oxygen
- 27 Which of the following methods will **not** slow down the rusting of an iron nail?
- A Coating the nail with a layer of oil.
 B Attaching a copper wire to the iron nail.
 C Electroplating the nail with a layer of chromium metal.
 D Submerging the nail in boiled water.
- 28 The diagram shows the energy profile diagram of the thermal decomposition of compound **X** to form two products, **Y** and **Z**.



Which statement best describes the energy profile diagram?

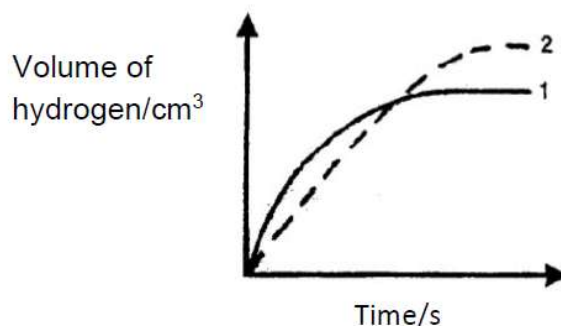
- A The enthalpy change for the reverse reaction is -200 kJ.
 B The enthalpy change for the forward reaction is $+40$ kJ.
 C The activation energy for the reverse reaction is 40 kJ.
 D The activation energy for the forward reaction is 160 kJ.

- 29** There are four stages, 1 to 4, in the conversion of solid candlewax, $C_{30}H_{62}$, into carbon dioxide and water.



Which stage(s) is/are exothermic?

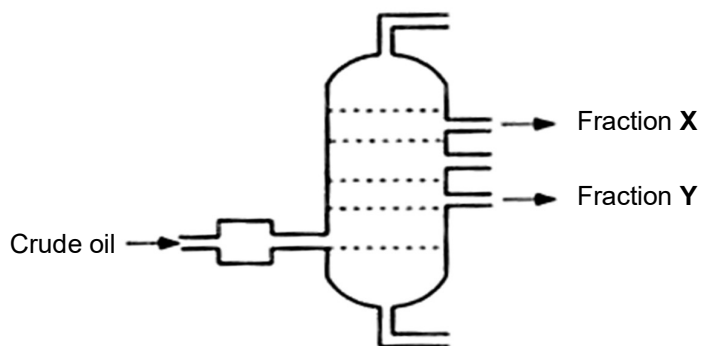
- A** 1 and 2 only
B 3 and 4 only
C 3 only
D 1, 3 and 4 only
- 30** In the graph below, curve **1** was obtained by the reaction between 50.0 cm^3 of 1.00 mol/dm^3 nitric acid and excess zinc granules.



Which change would produce curve **2**?

- A** increase the temperature
B add the same mass of zinc powder instead of zinc granules
C use 100.0 cm^3 of 1.00 mol/dm^3 nitric acid instead of 50.0 cm^3 of 1.00 mol/dm^3 nitric acid
D use 100.0 cm^3 of 0.75 mol/dm^3 nitric acid instead of 50.0 cm^3 of 1.00 mol/dm^3 nitric acid

- 31** The diagram below represents the process of fractional distillation of crude oil.

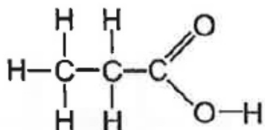


Which of the following statements about fractions **X** and **Y** is correct?

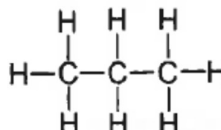
- A** **X** is less viscous than **Y**.
 - B** **X** has a higher boiling point than **Y**.
 - C** **X** is likely to be a solid.
 - D** **X** has more carbon atoms than **Y**.
- 32** Compound **T** produces a gas which forms white precipitate with limewater when sodium carbonate is added.

What could be compound **T**?

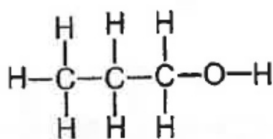
A



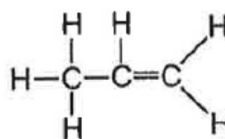
B



C



D



- 33 The full structural formulae of three organic molecules are shown below.

molecule 1	molecule 2	molecule 3
<pre> H O H H — C — C — C — H H H H </pre>	<pre> H H H H — C — C — O — C — H H H H </pre>	<pre> H H O H — C — C — C \ H H O — H </pre>

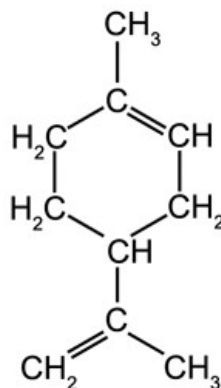
Which statement is correct?

- A** Molecule 3 has the smallest relative molecular mass of the three molecules.
B Molecule 1 and molecule 2 belong to the same homologous series.
C Molecule 1 and molecule 2 are isomers of each other.
D All three molecules have the same empirical formula.
- 34 Compound **X** was heated with acidified potassium manganate(VII) to form compound **Y**. Compound **Y** reacts with calcium carbonate to give a salt of formula $(C_3H_7COO)_2Ca$.

What could be compound **X**?

- A** ethanol
B butanol
C butene
D propanoic acid
- 35 Which of these equations represents a substitution reaction?
- A** $C_2H_6 + Cl_2 \rightarrow C_2H_5Cl + HCl$
B $C_3H_6 + Br_2 \rightarrow C_3H_6Br_2$
C $n C_2H_4 \rightarrow (-CH_2-CH_2-)_n$
D $C_3H_6 + H_2O \rightarrow C_3H_7OH$

- 36** Limonene is the major component of citrus fruit peels. The structure of limonene is shown below.



One mole of limonene is completely burned in excess oxygen to produce carbon dioxide.

One mole of limonene is also reacted with excess liquid bromine.

What is the number of moles of carbon dioxide formed and liquid bromine reacted for the two reactions?

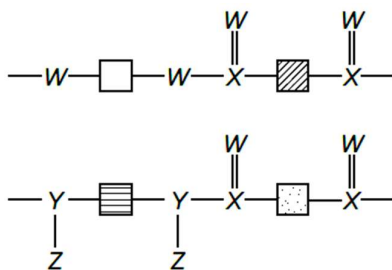
	number of moles of carbon dioxide produced	Number of moles of liquid bromine reacted
A	8	2
B	10	1
C	10	2
D	9	1

- 37** The cracking of one mole of **Y**, a large alkane, produces three moles of ethane, three moles of propene and two moles of propane.

How many carbon atoms does one molecule of **Y** contain?

- A** 3 **B** 8 **C** 16 **D** 21

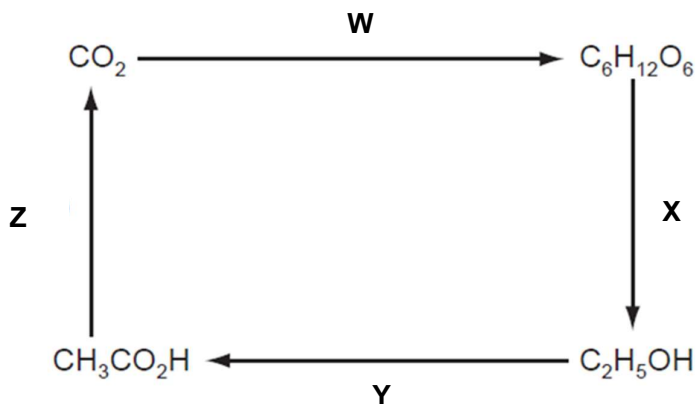
- 38 The diagrams show the partial structures of two different polymers.



Which chemical symbols should replace **W**, **X**, **Y** and **Z**?

	W	X	Y	Z
A	C	N	H	O
B	N	H	O	C
C	O	C	H	N
D	O	C	N	H

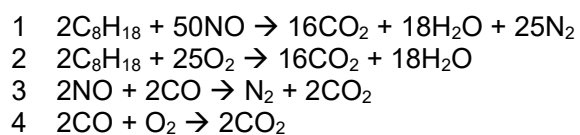
- 39 The diagram shows the steps by which carbon dioxide can be converted into organic products and finally returned to the atmosphere.



Which row correctly identifies processes **W**, **X**, **Y** and **Z**?

	W	X	Y	Z
A	ocean uptake	fermentation	oxidation	combustion
B	photosynthesis	fermentation	oxidation	combustion
C	photosynthesis	reduction	oxidation	oxidation
D	ocean uptake	reduction	combustion	combustion

- 40** A catalytic converter is used in cars to remove the harmful pollutants from the exhaust of cars.



Which of the above reactions are catalysed by the catalytic converter?

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

End of paper

The Periodic Table of Elements

The Periodic Table of Elements																	
Group												13	14	15	16	17	18
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	3	4	5	6	7	8	9	10	11	12	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 –	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 –

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

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