

ANDERSON SECONDARY SCHOOL
Preliminary Examination 2023
Secondary Four Express



CANDIDATE NAME:

CLASS:

INDEX NUMBER:

CHEMISTRY

6092/01

Paper 1

22 August 2023

1 hour

0800 – 0900 h

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 index number on the Question Paper and 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 Periodic Table is printed on page 18.

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

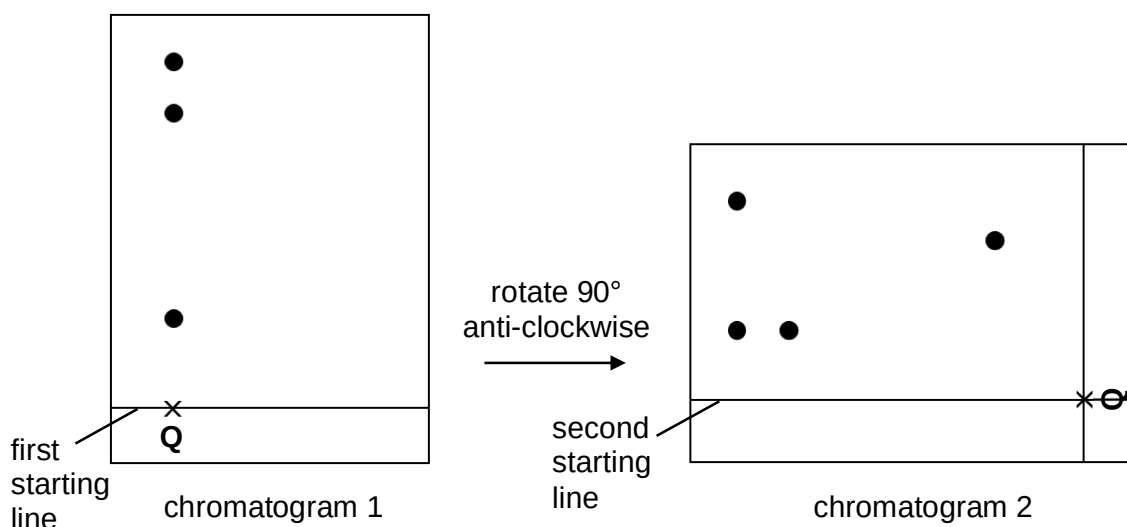
- 1 A student wants to investigate if dissolving 2.35 g of a salt in 25.0 cm³ of water is an endothermic process.

Which pieces of apparatus are required?

	electronic balance	measuring cylinder	stopwatch	thermometer
A	✓	✓	✗	✓
B	✓	✗	✗	✓
C	✗	✓	✗	✓
D	✓	✗	✓	✗

- 2 Chromatogram 1 shows the separation of coloured inks in mixture **Q**, using solvent **A**.

Chromatogram 2 shows the separation using the same piece of paper in another solvent **B** after it has been rotated 90° anti-clockwise.



How many different types of ink are present in mixture **Q**?

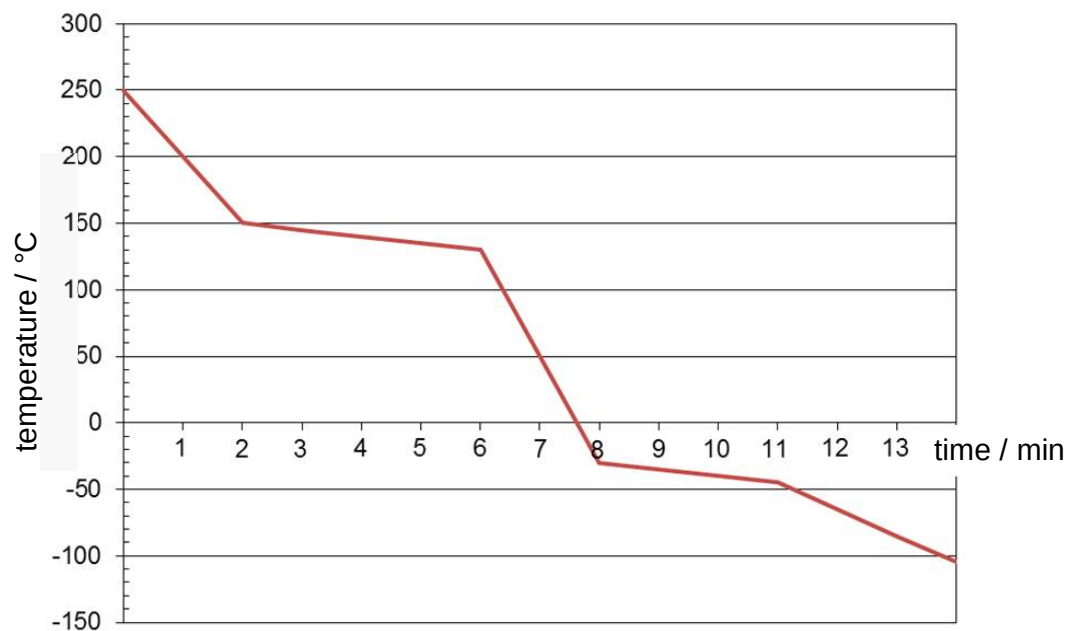
- A** 3 **B** 4 **C** 6 **D** 7

- 3 A solution contains barium ions and sodium ions and one type of anion.

What could the anion be?

- A chloride only
- B nitrate only
- C sulfate only
- D chloride or nitrate

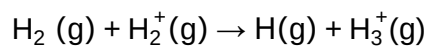
- 4 The cooling curve of an impure sample of substance Y is shown.



Which row gives possible melting and boiling points of a pure sample of Y?

	melting point / °C	boiling point / °C
A	-25	125
B	-30	150
C	-40	140
D	-55	155

- 5 A reaction in gas clouds of the Universe is as shown.



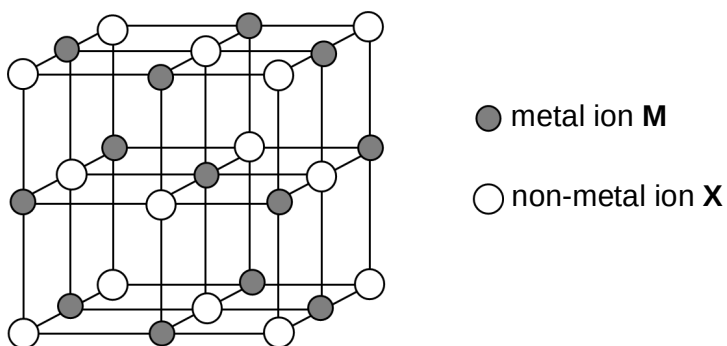
How many protons, neutrons and electrons does an H_3^+ ion contain?

	protons	neutrons	electrons
A	2	1	1
B	2	1	2
C	3	0	1
D	3	0	2

- 6 Which pair of substances conducts electricity by mobile electrons?

	substance 1	substance 2
A	aqueous potassium chloride	copper metal
B	aqueous potassium chloride	molten potassium chloride
C	graphite	copper metal
D	graphite	molten potassium chloride

- 7 The diagram shows the arrangement of ions in a compound.



What is the formula of this compound?

- A** $\text{M}_{14}\text{X}_{13}$ **B** M_2X **C** MX_6 **D** MX
- 8 Which molecule has an equal number of bonding electrons and non-bonding valence electrons?
- A** CO_2 **B** Cl_2O **C** HF **D** NH_3

- 9 Copper is a metallic element.

Which statements about copper are correct?

- 1 Copper is malleable because layers of ions are in fixed positions and cannot move.
- 2 The structure of copper consists of positive ions in a lattice.
- 3 Electrons hold copper ions together in a lattice by electrostatic attraction.

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

- 10 Sodium dichromate(VI), $\text{Na}_2\text{Cr}_2\text{O}_7$, reacts with acid and hydrogen peroxide, H_2O_2 , producing Cr^{3+} ions, water and oxygen.

What is the correctly balanced ionic equation for this reaction?

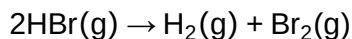
- A** $\text{Cr}_2\text{O}_7^{2-} + 2\text{H}^+ + \text{H}_2\text{O}_2 \rightarrow 2\text{Cr}^{3+} + 2\text{H}_2\text{O} + 4\text{O}_2$
B $\text{Cr}_2\text{O}_7^{2-} + 8\text{H}^+ + 3\text{H}_2\text{O}_2 \rightarrow 2\text{Cr}^{3+} + 7\text{H}_2\text{O} + 3\text{O}_2$
C $\text{Cr}_2\text{O}_7^{2-} + 8\text{H}^+ + 6\text{H}_2\text{O}_2 \rightarrow 2\text{Cr}^{3+} + 10\text{H}_2\text{O} + 6\text{O}_2$
D $\text{Cr}_2\text{O}_7^{2-} + 14\text{H}^+ + 3\text{H}_2\text{O}_2 \rightarrow 2\text{Cr}^{3+} + 7\text{H}_2\text{O} + 3\text{O}_2$

- 11 The relative molecular mass, M_r , of liquid **Z** is 60. **Z** contains 40.0% carbon, 6.7% hydrogen and 53.3% oxygen.

Which row shows the correct empirical and molecular formulae of **Z**?

	empirical formula	molecular formula
A	CH_2O	CH_2O
B	CH_2O	$\text{C}_2\text{H}_4\text{O}_2$
C	$\text{C}_2\text{H}_4\text{O}_2$	$\text{C}_2\text{H}_4\text{O}_2$
D	$\text{C}_3\text{H}_8\text{O}$	$\text{C}_3\text{H}_8\text{O}$

- 12** Hydrogen bromide decomposes to form hydrogen and bromine. The equation is shown.



The bond energies are shown in the table.

bond	bond energy in kJ/mol
Br-Br	193
H-Br	366
H-H	436

What is the energy change for the reaction?

- A** +263 kJ/mol **B** +103 kJ/mol **C** -103 kJ/mol **D** -263 kJ/mol

- 13** The table gives some information about four redox reactions.

Which row gives correct information about what is oxidised and the evidence that this is oxidation?

	equation	what is oxidised	evidence for this oxidation
A	$\text{CuO(s)} + \text{C(s)} \rightarrow \text{CO(g)} + \text{Cu(s)}$	copper	copper oxide has given oxygen to carbon
B	$2\text{Na(s)} + \text{Cl}_2\text{(g)} \rightarrow 2\text{NaCl(s)}$	sodium	sodium has lost an electron
C	$\text{N}_2\text{(g)} + 3\text{H}_2 \rightleftharpoons 2\text{NH}_3\text{(g)}$	nitrogen	nitrogen has gained hydrogen
D	$\text{ZnCl}_2\text{(aq)} + \text{Mg(s)} \rightarrow \text{MgCl}_2\text{(aq)} + \text{Zn(s)}$	zinc	zinc has gained two electrons

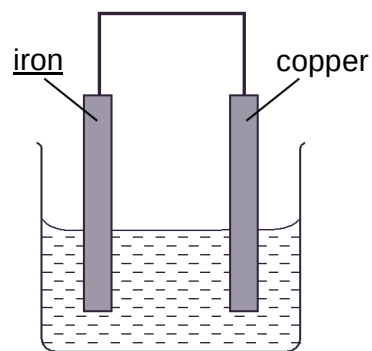
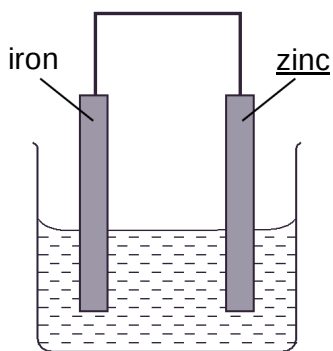
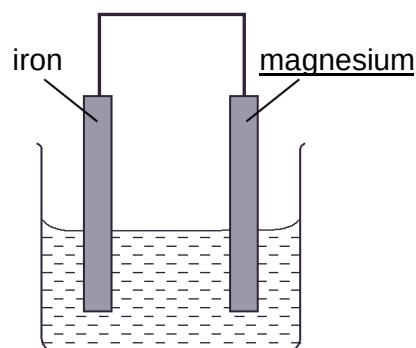
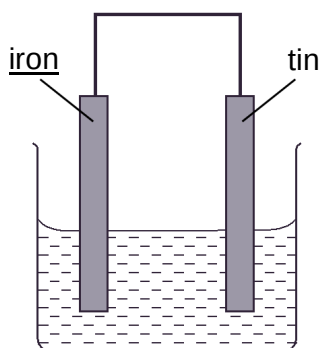
- 14** Molten sodium chloride and concentrated aqueous sodium chloride are electrolysed using platinum electrodes.

What are the products at the negative electrode in each electrolysis?

	molten sodium chloride	concentrated aqueous sodium chloride
A	hydrogen	hydrogen
B	hydrogen	sodium
C	sodium	hydrogen
D	sodium	sodium

- 15** Four cells were set up using aqueous sodium chloride as the electrolyte.

In each cell, only the underlined electrode dissolved. To establish the order of reactivity of the metals, it is necessary to set up two or more cells.

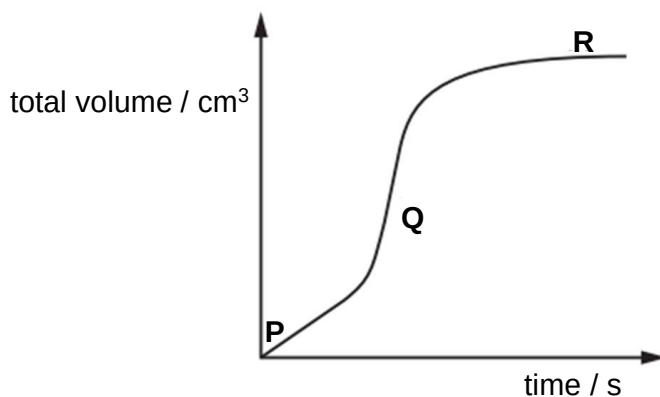


Which pairs of cells are needed in addition to the four cells above?

	first cell electrodes	second cell electrodes
A	copper / tin	magnesium / zinc
B	iron / iron	iron / zinc
C	magnesium / tin	copper / zinc
D	tin / zinc	magnesium / copper

- 16** A large excess of magnesium ribbon is added to dilute hydrochloric acid and the volume of hydrogen gas produced is measured as the reaction proceeds. The reaction is exothermic.

The results are shown.



Which row explains the changes in the rate of reaction between points **P** and **Q** and between points **Q** and **R**?

	between points P and Q	between points Q and R
A	the reaction temperature is increasing	the acid concentration is falling
B	the reaction temperature is increasing	the magnesium has been used up
C	surface area of magnesium is decreasing	the acid concentration is falling
D	surface area of magnesium is decreasing	the magnesium has been used up

- 17** The oxides of three elements, **T**, **U** and **V**, are added to water.

	oxide of T	oxide of U	oxide of V
water added	dissolved to form a solution of pH 10	insoluble	dissolved to form a solution of pH 2

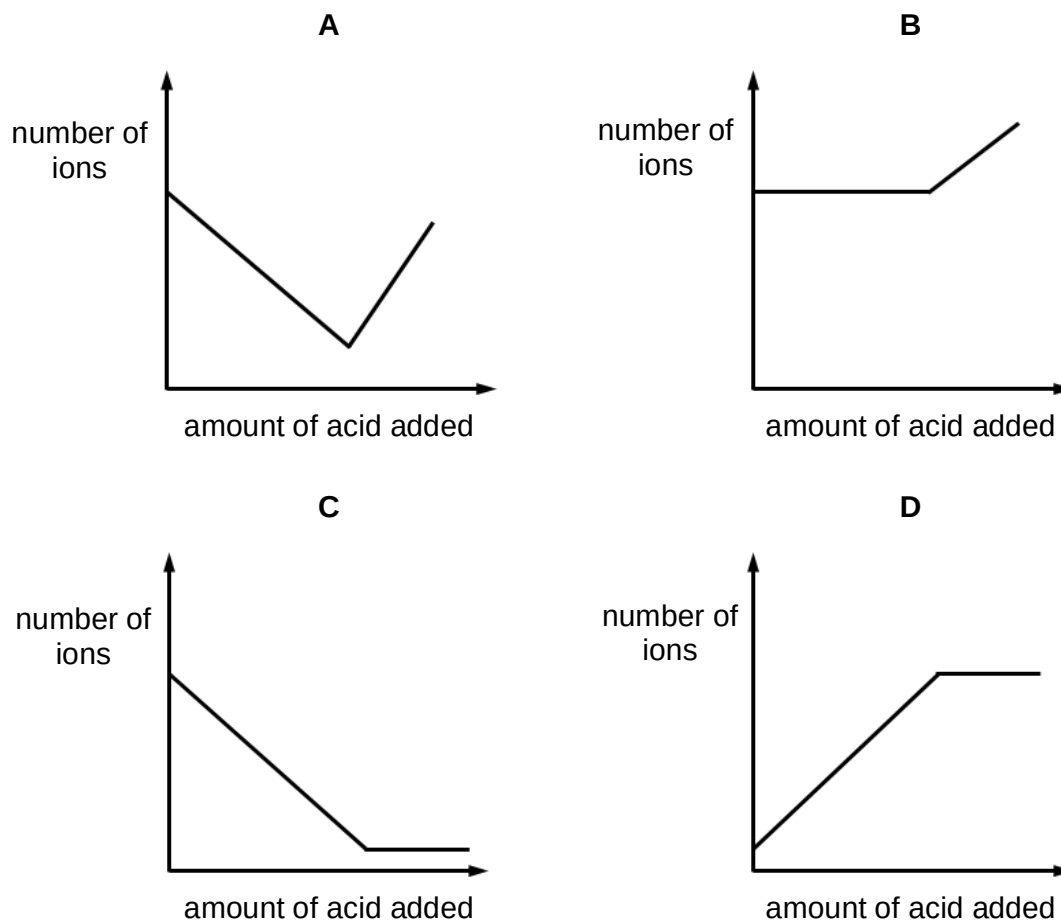
The oxide of **U** is white in colour.

What are elements, **T**, **U** and **V**?

	T	U	V
A	calcium	aluminium	sulfur
B	calcium	copper	sulfur
C	sulfur	aluminium	calcium
D	sulfur	copper	calcium

- 18** Dilute sulfuric acid was added to aqueous barium hydroxide until the acid was present in excess.

How will the total number of ions present in the reacting mixture vary?



- 19** A mixture contains copper(II) carbonate and iron(II) carbonate. A sample of the mixture is dissolved in nitric acid to produce a solution.

How could this solution be processed into a copper(II) compound and a separate iron(II) compound?

- A** Add excess $\text{NH}_3(\text{aq})$, filter off the solid copper(II) hydroxide.
- B** Add excess $\text{NH}_3(\text{aq})$, filter off the solid iron(II) hydroxide.
- C** Add excess $\text{NaOH}(\text{aq})$, filter off the solid copper(II) hydroxide.
- D** Add excess $\text{NaOH}(\text{aq})$, filter off the solid iron(II) hydroxide.

- 20 In the Haber process, a high yield of ammonia is favoured by high pressure and low temperature. In practice, a high temperature is used.

Which statement best explains the discrepancy in the preferred temperature?

- A At low temperature, ammonia decomposes back to its original reactants.
- B At low temperature, the activation energy is too low.
- C At low temperature, the catalyst is inactive.
- D At low temperature, the reaction is too slow.

- 21 Elements in Group IV of the Periodic Table are shown.

carbon
silicon
germanium
tin
lead

Which does **not** occur in Group IV as it is descended?

- A The proton number of the elements increases.
- B The elements become more metallic.
- C The elements have more electrons in their outer shell.
- D The elements have more electrons shells.

- 22 Rubidium has the atomic number 37.

Rubidium reacts with water to form gas **P** and solution **Q**. When solution **Q** reacts with dilute sulfuric acid, salt **R** is formed.

What are the formulae of **P**, **Q** and **R**?

	P	Q	R
A	H ₂	RbOH	Rb ₂ SO ₄
B	H ₂	Rb(OH) ₂	RbSO ₄
C	O ₂	RbOH	RbSO ₄
D	O ₂	Rb(OH) ₂	Rb ₂ SO ₄

- 23** The table gives some information on elements **X**, **Y** and **Z**.

element	X	Y	Z
melting point / °C	−7	63	−189
boiling point / °C	58	766	−186
colour	red-brown	silvery	colourless
density / g cm ^{−3}	3.1	0.86	0.0017

To which group do **X**, **Y** and **Z** belong?

	X	Y	Z
A	I	0	VII
B	VII	I	0
C	VII	0	I
D	0	I	VII

- 24** Which statement describes a transition element?

- A** It can act as a catalyst and some of its compounds can also act as catalysts.
- B** It forms white compounds with sulfur, oxygen, chlorine, and bromine.
- C** It has a low density and a piece of it will float on water.
- D** It is a very poor conductor of electricity.

- 25** Steels differ in how much carbon they contain.

Which are the properties of a high carbon steel?

- A** soft and brittle
- B** soft and easily shaped
- C** strong and brittle
- D** strong and easily shaped

- 26** Reactions of three metals and their oxides are shown.

metal	add dilute hydrochloric acid to metal	heat metal oxide with carbon
1	✓	✓
2	✓	✗
3	✗	✓

key
 ✓ = reacts
 ✗ = does not react

What is the order of reactivity of these metals, from most reactive to least reactive?

- A** 1 → 2 → 3 **B** 1 → 3 → 2 **C** 2 → 1 → 3 **D** 2 → 3 → 1

- 27** Equal masses of calcium carbonate and copper(II) carbonate are heated at the same temperature.

Which carbonate decomposes faster, and which one produces a greater volume of carbon dioxide gas?

	faster rate of decomposition	greater volume of carbon dioxide
A	calcium carbonate	calcium carbonate
B	calcium carbonate	copper(II) carbonate
C	copper(II) carbonate	calcium carbonate
D	copper(II) carbonate	copper(II) carbonate

- 28** Some types of chemical reaction are listed.

- 1 neutralisation
- 2 combustion
- 3 redox

Which types of reaction occur in a blast furnace during the extraction of iron?

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

- 29** Scrap iron is often recycled.

Which reason for recycling is **not** correct?

- A** It conserves finite metal resources.
- B** It reduces the amount of pollution at the site of the ore extraction.
- C** It reduces the amount of waste taken to landfill sites.
- D** It reduces the need to collect the scrap iron.

- 30** Mild steel is galvanised to prevent corrosion of the iron.

Which statements about galvanising are correct?

- 1 Galvanising prevents corrosion because zinc forms an alloy.
- 2 If the coating is damaged, water and oxygen do not corrode the iron.
- 3 Zinc is a sacrificial metal and corrodes in preference to iron.

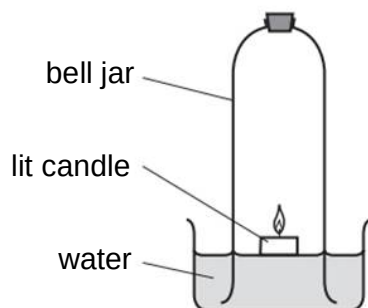
- A** 1 and 2 **B** 1 and 3 **C** 2 and 3 **D** 3 only

- 31** To reduce atmospheric pollution, the waste gases from a coal-burning power station are passed through powdered calcium carbonate.

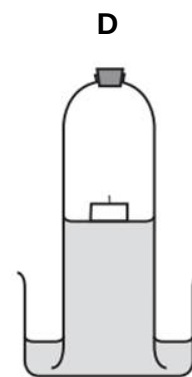
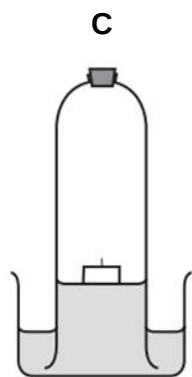
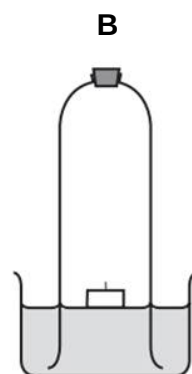
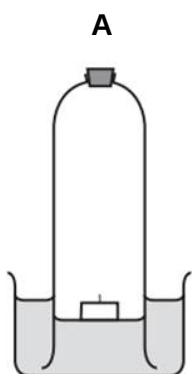
Which waste gas will **not** be removed by the powdered calcium carbonate?

- A** carbon monoxide
- B** nitrogen dioxide
- C** phosphorus(V) oxide
- D** sulfur dioxide

- 32 The diagram shows an experiment to determine the percentage of oxygen in air.



Which diagram shows the correct level of water after the candle stops burning?



- 33** Two statements about the fractional distillation of crude oil are given.

statement 1 Fractional distillation is used to separate crude oil into useful fractions.

statement 2 The fractions with lower boiling points are found at the top of the fractionating column.

Which of the following is true?

- A** Both statements are correct and statement 2 explains statement 1.
- B** Both statements are correct but statement 2 does not explain statement 1.
- C** Statement 1 is correct but statement 2 is incorrect.
- D** Statement 1 is incorrect but statement 2 is correct.

- 34** Petroleum is separated to produce useful fractions.

Which row matches the fraction to its use?

	fraction	use
A	bitumen	fuel in cars
B	lubricating oils	for maxing waxes and polishes
C	paraffin	provide feedstock for petrochemical industry
D	petrol	aircraft fuel

- 35** In which lists are the compounds in the same homologous series?

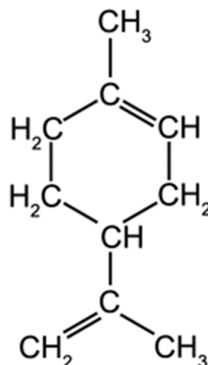
1 CH_4 , C_2H_4 , C_3H_8

2 CH_3OH , $\text{C}_2\text{H}_5\text{OH}$, $\text{C}_3\text{H}_7\text{OH}$

3 $\text{CH}_3\text{CO}_2\text{H}$, $\text{CH}_3\text{CH}_2\text{OH}$, $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$

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

- 36** The citrus flavour of lemon is due to the compound limonene, present in both the peel and the juice.



Which statement correctly describes limonene?

- A** Limonene burns in excess oxygen to form carbon dioxide and water only.
 - B** Limonene can decolourise aqueous bromine only in the presence of sunlight.
 - C** Limonene cannot undergo addition polymerisation.
 - D** The empirical formula of limonene is CH_2 .
- 37** A vegetable oil is polyunsaturated.

Which statement about this vegetable oil is correct?

- A** It has double bonds between carbon and hydrogen atoms.
 - B** It reacts with hydrogen to form a solid compound.
 - C** It reacts with steam to form margarine.
 - D** It turns aqueous bromine from colourless to brown.
- 38** When ethanol is left standing in the air for some time, it become acidic.

Which equation represents this change?

- A** $\text{CH}_3\text{CH}_2\text{OH} + \text{CO} \rightarrow \text{CH}_3\text{CH}_2\text{CO}_2\text{H}$
- B** $\text{CH}_3\text{CH}_2\text{OH} + \text{O}_2 \rightarrow \text{CH}_3\text{CO}_2\text{H} + \text{H}_2\text{O}$
- C** $\text{CH}_3\text{CH}_2\text{OH} + 3\text{O}_2 \rightarrow 2\text{CO}_2 + 3\text{H}_2\text{O}$
- D** $2\text{CH}_3\text{CH}_2\text{OH} + \text{O}_2 \rightarrow 2\text{CH}_3\text{CO}_2\text{H} + \text{H}_2$

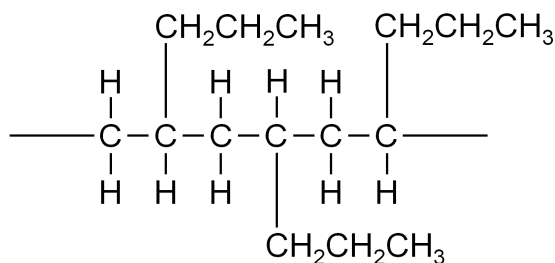
- 39** Ethanol can be manufactured from ethene or from glucose. The table gives statements about the processes involved.

In which row are both statements **incorrect**?

	process using ethene	process using glucose
A	conversion to ethanol needs temperature greater than 100 °C	conversion to ethanol also produces carbon dioxide
B	conversion to ethanol uses yeast as catalysts	conversion to ethanol is carried out at 100 °C
C	ethene is obtained from cracking	glucose is obtained from plants
D	conversion reaction is carried out with reagents as gases	conversion reaction is carried out in aqueous solution

- 40** Engine oil is used to lubricate the car engine. Certain polymers are added to engine oil to improve its viscosity.

A part of the chain of one such polymer is shown.



A molecule of this polymer contains 16 000 carbon atoms.

How many monomer molecules are required to form one molecule of this polymer?

- A** 1600 **B** 2667 **C** 3200 **D** 4000

Group																	
I	II	1 H hydrogen 1					III				IV	V	VI	VII	0		
		Key proton (atomic) number atomic symbol name relative atomic mass															
3 Li lithium 7	4 Be beryllium 9											5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24											13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium -	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57 – 71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium -	85 At astatine -	86 Rn radon -
87 Fr francium -	88 Ra radium -	89 – 103 actinoids	104 Rf Rutherfordium -	105 Db dubnium -	106 Sg seaborgium -	107 Bh bohrium -	108 Hs hassium -	109 Mt meitnerium -	110 Ds darmstadtium -	111 Rg roentgenium -	112 Cn copernicium -	114 Fl flerovium -	116 Lv livermorium -	117 Ts tennessine -	118 Og oganesson -	119 Uue unbinilium -	120 Uuh ununilium -
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.).