GREENDALE SECONDARY SCHOOL
Preliminary Examination 2024

STUDENT NAME					
CLASS	4	TEACHING GROUP		REG. NO	

CHEMISTRY
Paper 1 Multiple Choice

6092/01
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, teaching group and register number in the spaces provided above and on the Multiple Choice Answer Sheet provided.

There are **forty** questions on this paper. Answer **all** questions. For each question there are four possible answers **A**, **B**, **C** and **D**.
Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

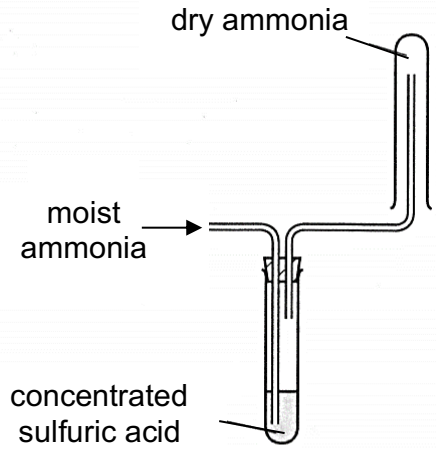
Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this booklet.
A copy of the Periodic Table is printed on page 20.
The use of an approved scientific calculator is expected, where appropriate

1 A student is provided with two drying agents: concentrated sulfuric acid and calcium oxide.

Which method should he use to collect a sample of dry ammonia?
[M_r: NH_3, 17]

A



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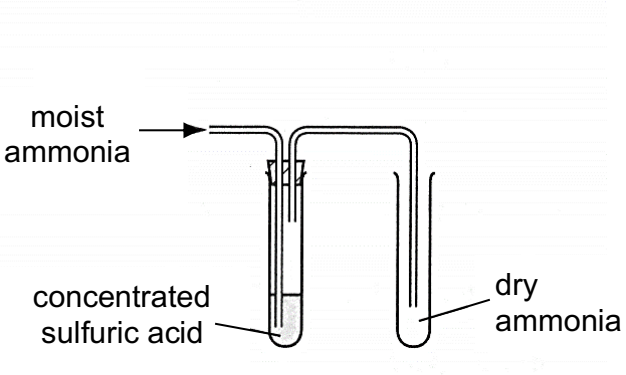

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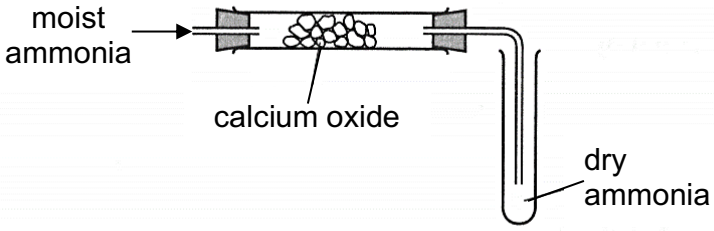

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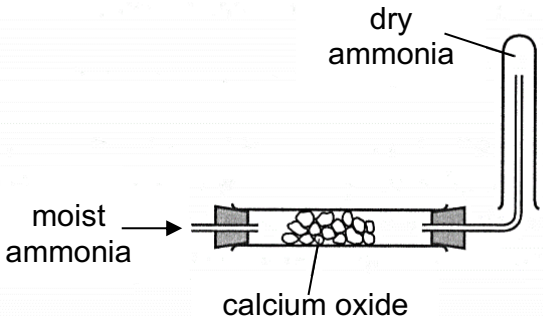
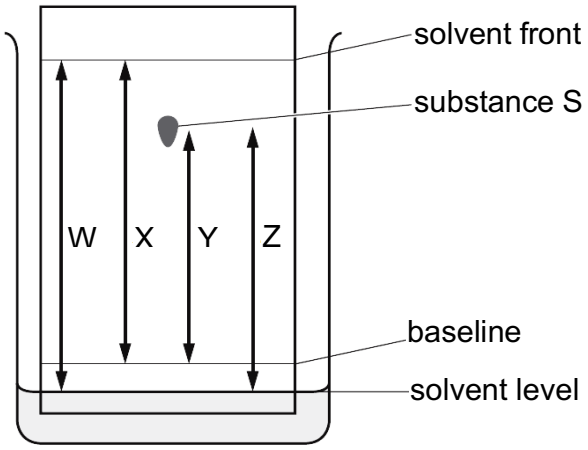


2 Which ion contains the same number of electrons as $^{56}_{26}Fe^{3+}$?

A $^{59}_{27}Co^{3+}$ **B** $^{52}_{24}Cr^{2+}$ **C** $^{56}_{25}Mn^{2+}$ **D** $^{55}_{25}Mn^{3+}$

3 The chromatogram of substance S is shown.

Some distances, W, X, Y and Z, are labelled on the diagram.

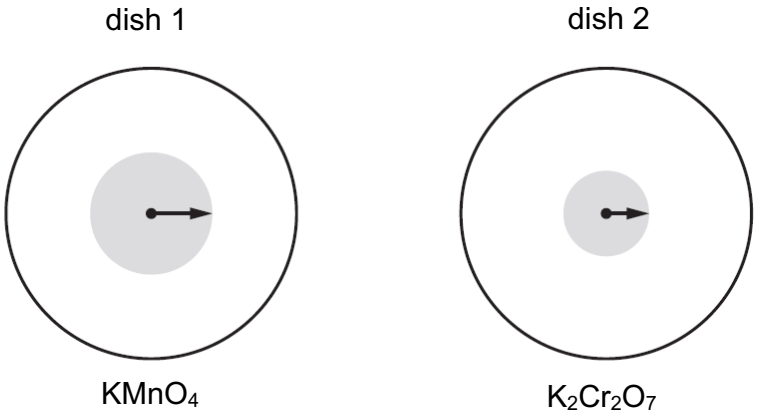


How is the R_f value of substance S calculated?

A $\frac{X}{Y}$ **B** $\frac{W}{Z}$ **C** $\frac{Y}{X}$ **D** $\frac{Y}{W}$

4 Small crystals of purple $KMnO_4$ (M_r = 158) and orange $K_2Cr_2O_7$ (M_r = 294) were placed at the centres of separate petri dishes filled with agar jelly. They were left to stand under the same physical conditions.

After some time, the colour of each substance had spread out as shown.



The lengths of the arrows indicate the relative distances travelled by particles of each substance.

Which statement is correct?

A Diffusion is faster in dish 1 because the mass of the particles is greater.

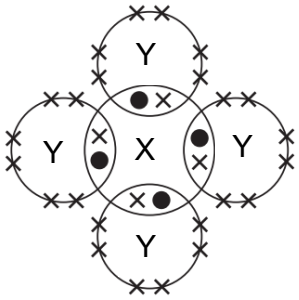
B Diffusion is faster in dish 2 because the mass of the particles is greater.

C Diffusion is slower in dish 1 because the mass of the particles is smaller.

D Diffusion is slower in dish 2 because the mass of the particles is greater.

5 A compound, XY_4, is shown below.

Both atoms of elements X and Y combine to obtain the electronic configuration of neon.



Which row shows the correct group of elements X and Y and the number of non-bonding electrons in one molecule of XY_4?

	group of X	group of Y	number of non-bonding electrons
A	14	17	24
B	14	17	34
C	17	14	24
D	17	14	34

6 How many sodium ions are there in 30 g of sodium sulfate, Na_2SO_4?

A 1.52×10^{23} **B** 2.54×10^{23}

C 1.20×10^{24} **D** 6.02×10^{24}

7 20 cm^3 of propene was reacted with 150 cm^3 of oxygen.

The equation for the reaction is shown.

$$2C_3H_6(g) + 9O_2(g) \rightarrow 6CO_2(g) + 6H_2O(l)$$

What is the **total** volume of gas, measured at room temperature and pressure, that **remained** at the end of the reaction?

A 60 cm^3 **B** 90 cm^3 **C** 120 cm^3 **D** 180 cm^3

8 Bromobutane, C_4H_9Br, can be made from butanol, C_4H_9OH, using the reaction shown.

$$C_4H_9OH + HBr \rightarrow C_4H_9Br + H_2O$$

In an experiment, 10 g of C_4H_9OH produced 12 g of C_4H_9Br.

What is the percentage yield of C_4H_9Br?

[M_r: C_4H_9OH, 74; C_4H_9Br, 137]

A 45% **B** 54% **C** 65% **D** 83%

9 Calcium carbonate reacts with dilute hydrochloric acid according to the equation shown.

$$CaCO_3 + 2HCl \rightarrow CaCl_2 + CO_2 + H_2O$$

10 g of calcium carbonate is reacted with 100 cm^3 of 1.0 mol / dm^3 hydrochloric acid.

The following statements are made.

1 1.20 dm^3 of carbon dioxide is formed.
2 5.55 g of calcium chloride is formed.
3 4.80 g of carbon dioxide is formed.
4 No calcium carbonate is left when the reaction is completed.

Which statements about the reaction are correct?

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

10 The following statements describe acids, alkalis and water.

1 Hydrochloric acid is acidic because it contains H^+ ions and no OH^- ions.
2 Nitric acid is acidic because it contains more H^+ ions than OH^- ions.
3 Sodium hydroxide is alkaline because it contains OH^- ions and no H^+ ions.
4 Water is neutral because the concentration of H^+ ions is equal to the concentration of OH^- ions.

Which statements are correct?

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

11 Beryllium hydroxide is an amphoteric white solid.

Which reagent can be used to distinguish beryllium hydroxide from solid calcium hydroxide?

1 HC*l*(aq)
2 HNO_3(aq)
3 KOH(aq)
4 NaOH(aq)

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

12 Which method should be used to make a pure sample of potassium chloride?

A adding AgC*l*(s) to KNO_3(aq)
B adding excess K_2CO_3(s) to HC*l*(aq)
C mixing KNO_3(aq) with NaC*l*(aq)
D titrating KOH(aq) with HC*l*(aq)

13 50.0 cm^3 of hydrochloric acid has a pH of 1.0.

This acid requires 25.0 cm^3 of aqueous sodium hydroxide to be neutralised.

A second 50.0 cm^3 solution contains the weak acid, ethanoic acid.

The hydrochloric acid and ethanoic acid have the same concentration.

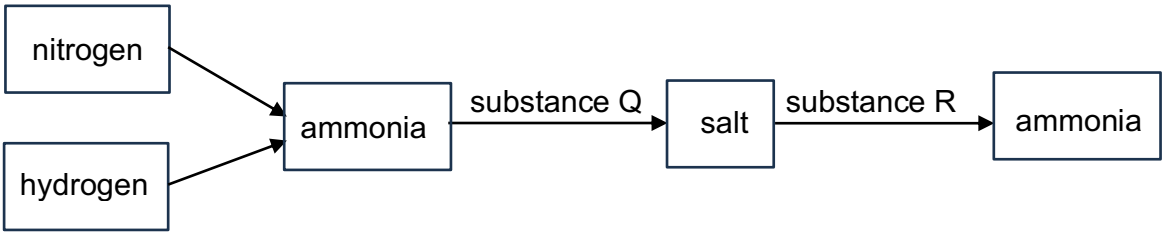
How will the pH of ethanoic acid and the volume of NaOH needed for neutralisation differ, if at all, from the hydrochloric acid?

	pH	volume of NaOH needed for neutralisation
A	higher than HC*l*	lower than for HC*l*
B	higher than HC*l*	equal to HC*l*
C	lower than HC*l*	lower than for HC*l*
D	lower than HC*l*	equal to HC*l*

14 Ammonia is produced by the reaction of the elements hydrogen and nitrogen in the Haber process.

One of these elements is obtained from crude oil.

The ammonia formed can be reacted with substance Q to form a salt.
Ammonia can be displaced from this salt by reacting with substance R.



Which row correctly shows the element obtained from crude oil and the types of substances corresponding to Q and R?

	element obtained from crude oil	substance Q	substance R
A	hydrogen	acid	base
B	hydrogen	base	acid
C	nitrogen	acid	base
D	nitrogen	base	acid

15 A mixture W, containing two compounds, is tested with different reagents.

The results are shown.

reagent	observation
excess aqueous ammonia followed by filtration	green precipitate and colourless solution
dilute nitric acid and aqueous silver nitrate	no visible reaction
dilute nitric acid and aqueous barium nitrate	white precipitate
warm with aqueous sodium hydroxide and aluminium foil	moist red litmus paper remains red

What are the two salts in solution W?

A ammonium chloride and calcium sulfate

B calcium nitrate and iron(II) chloride

C iron(II) sulfate and zinc nitrate

D iron(II) sulfate and zinc sulfate

16 The following substances are used in the laboratory to test for various gases.

acidified potassium manganate(VII)	aqueous sodium hydroxide	blue litmus paper
limewater	red litmus paper	wooden splint

When testing for ammonia, chlorine, hydrogen and oxygen, what is the **minimum** number of items from the table above needed to identify these four gases?

A 2 **B** 3 **C** 4 **D** 5

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

	conduction during electrolysis	conduction by metals
1	The current is due to the movement of both positive and negative ions.	The current is due to the movement of electrons.
2	Charged particles move towards both electrodes.	Charged particles move in one direction only.
3	It results in a chemical change.	It does not result in a chemical change.

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

18 Chemical Z is a powerful oxidising agent.

Which statement about Z is correct?

A Z reacts with aqueous potassium iodide producing a brown solution and gains electrons in the process.

B Z reacts with aqueous potassium iodide producing a brown solution and loses electrons in the process.

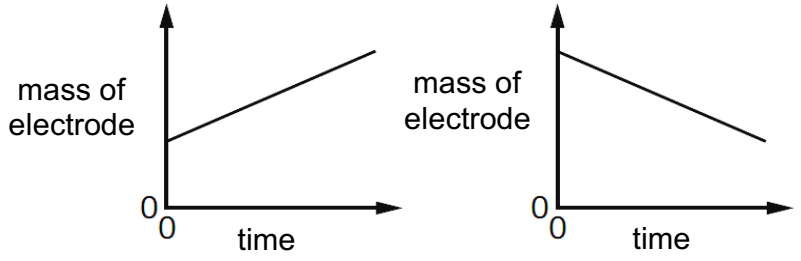
C Z decolourises acidified potassium manganate(VII) and gains electrons in the process.

D Z decolourises acidified potassium manganate(VII) and loses electrons in the process.

19 Impure copper can be purified via electrolysis, using copper electrodes and dilute aqueous copper(II) sulfate as the electrolyte.

The current is constant and the positive and negative electrodes are weighed at regular time intervals.

The following graphs were obtained when the mass of the positive and negative electrodes are plotted against time.



1 2

Which row correctly describes the electrolytic cell and the respective graphs obtained?

	negative electrode	positive electrode	graph for negative electrode	graph for positive electrode
A	impure copper	pure copper	1	2
B	impure copper	pure copper	2	1
C	pure copper	impure copper	1	2
D	pure copper	impure copper	2	1

20 Three statements about fuel cells are given.

1 A hydrogen-oxygen fuel cell requires a continuous input of fuel and oxygen.

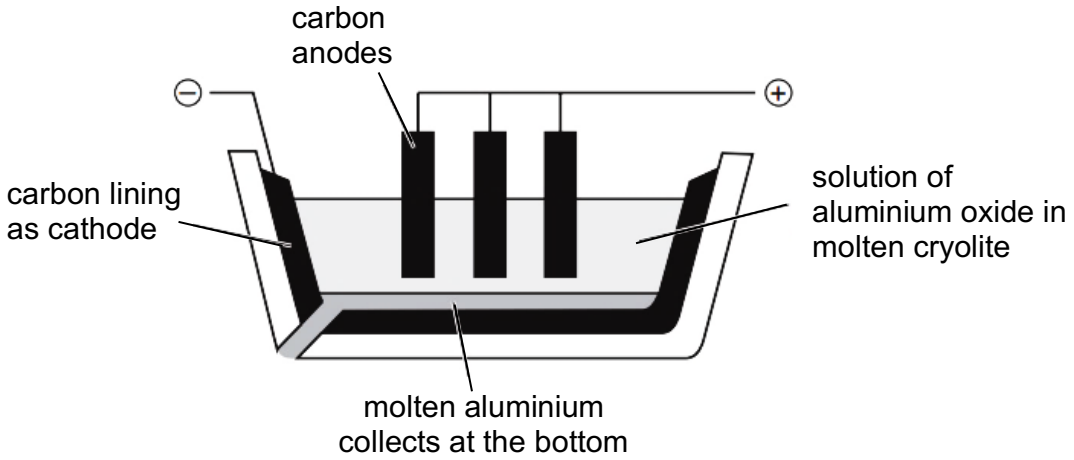
2 In a hydrogen-oxygen fuel cell, hydrogen is burned in oxygen to produce electricity.

3 When a hydrogen-oxygen fuel cell is operating, water is the only chemical product.

Which statements are correct?

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

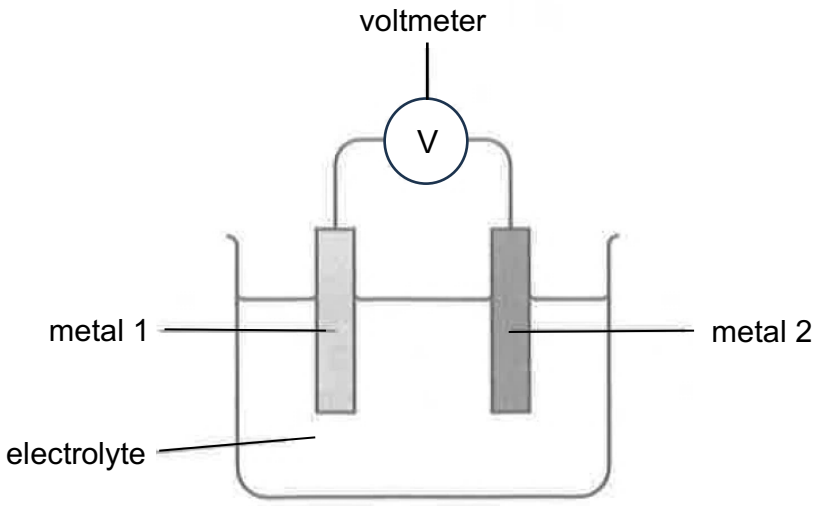
21 The apparatus used for the extraction of aluminium by electrolysis of molten aluminium oxide is shown.



Which row correctly describes the electrolysis of molten aluminium oxide?

	negative electrode	positive electrode
A	aluminium ions oxidised to aluminium	oxide ions reduced to oxygen
B	aluminium ions reduced to aluminium	oxide ions oxidised to oxygen
C	oxide ions oxidised to oxygen	aluminium ions reduced to aluminium
D	oxide ions reduced to oxygen	aluminium ions oxidised to aluminium

22 Two metal electrodes and an electrolyte can be used to produce electrical energy.



The table shows the voltage produced by some cells when different metals are used.

metal 1	metal 2	voltage / V
silver	zinc	1.56
silver	nickel	1.06
silver	iron	1.25
silver	magnesium	K
copper	iron	L

Which row best describes the voltage values K and L, and the relative reactivity of nickel?

	voltage K	voltage L	relative reactivity of nickel
A	greater than 1.56 V	greater than 1.25 V	more reactive than iron but less reactive than zinc
B	less than 1.56 V	less than 1.25 V	more reactive than both iron and zinc
C	greater than 1.56 V	less than 1.25 V	less reactive than both iron and zinc
D	less than 1.56 V	greater than 1.25 V	less reactive than both iron and zinc

23 X is a Group 1 metal, more reactive than sodium.

Y and Z are Group 17 elements.

When X reacts with Y, a salt is formed. A solution of this salt reacts with Z to form a different salt.

What are X, Y and Z?

	X	Y	Z
A	K	Cl_2	I_2
B	Li	Cl_2	Br_2
C	Li	Br_2	Cl_2
D	K	I_2	Cl_2

24 Some properties of metals are listed.

1 forms chloride of formula X*Cl* only, where X is the metal
2 forms coloured compounds
3 high density
4 its presence can lower the activation energy of a reaction
5 low melting point

Which row shows the properties of group 1 metals and transition metals?

	properties of group 1 metals	properties of transition metals
A	1 and 5	2, 3 and 4
B	1, 4 and 5	2 only
C	2, 3 and 4	1 and 5
D	2 and 3	1 and 4 only

25 An equal number of moles of metal carbonates XCO_3 and ZCO_3 are heated strongly.

They both decompose and release a gas.

The time taken for the compound to decompose completely is measured.

metal carbonate	time taken to decompose / s
XCO_3	92
ZCO_3	266

Which row describes the reactivity of the metals and the suggested method of extraction of each metal from its compound?

	reactivity of metals X and Z	method of extraction of X	method of extraction of Z
A	X is more reactive than Z	electrolysis	reduction with carbon
B	X is more reactive than Z	reduction with carbon	electrolysis
C	Z is more reactive than X	electrolysis	reduction with carbon
D	Z is more reactive than X	reduction with carbon	electrolysis

26 Two large pieces of iron are placed in water.

In experiment 1, a small piece of copper is attached to the iron.

In experiment 2, a small piece of magnesium is attached to the iron.

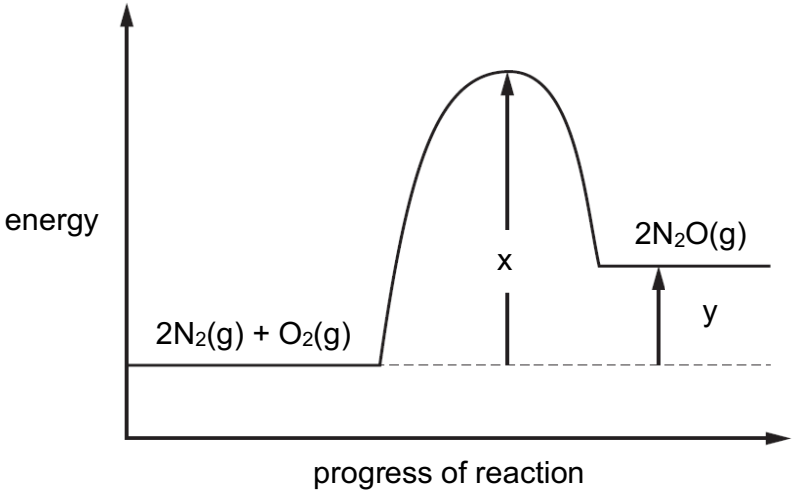
Which are the equations for reactions that would take place in experiment 1 and experiment 2?

	experiment 1	experiment 2
A	$Cu(s) \rightarrow Cu^{2+}(aq) + 2e^-$	$Fe(s) \rightarrow Fe^{2+}(aq) + 2e^-$
B	$Cu(s) \rightarrow Cu^{2+}(aq) + 2e^-$	$Mg(s) \rightarrow Mg^{2+}(aq) + 2e^-$
C	$Fe(s) \rightarrow Fe^{2+}(aq) + 2e^-$	$Fe(s) \rightarrow Fe^{2+}(aq) + 2e^-$
D	$Fe(s) \rightarrow Fe^{2+}(aq) + 2e^-$	$Mg(s) \rightarrow Mg^{2+}(aq) + 2e^-$

27 Under certain conditions, nitrogen reacts with oxygen to form N_2O.

$$2N_2(g) + O_2(g) \rightleftharpoons 2N_2O(g)$$

The reaction pathway diagram is shown.



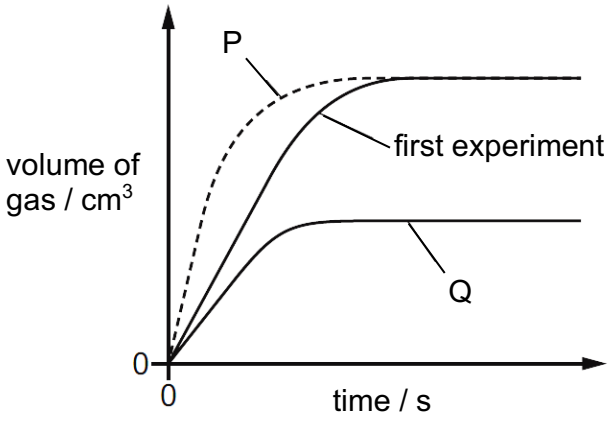
Which of the following correctly represents the enthalpy change and activation energy for the forward and backward reactions?

	forward reaction		backward reaction	
	enthalpy change	activation energy	enthalpy change	activation energy
A	x – y	x	y – x	y
B	y	x	–y	x – y
C	x – y	y	y – x	y
D	y	x – y	–y	x – y

28 25 cm^3 of 1.0 mol / dm^3 hydrochloric acid reacts with 10 g of a solid to produce a gas.

The solid is in excess. The graph labelled first experiment shows the volume of gas produced over time.

Graphs P and Q show the volume of gas produced under different conditions.



Which changes in conditions produce graphs P and Q, if all other conditions are kept the same?

A P uses 25 cm^3 of more concentrated of acid and Q has a lower temperature.

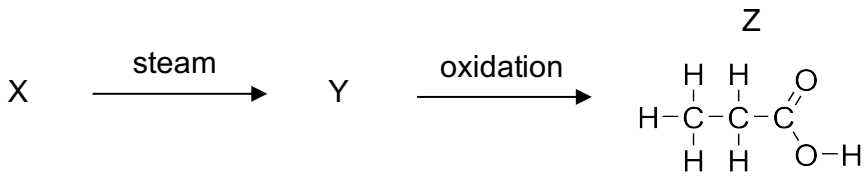
B P uses higher temperature and Q uses 25 cm^3 of more dilute acid.

C P uses higher temperature and Q uses smaller pieces of solid.

D P uses smaller pieces of solid and Q uses larger pieces of solid.

29 X reacts with steam to form Y.

Y is oxidised to form Z.

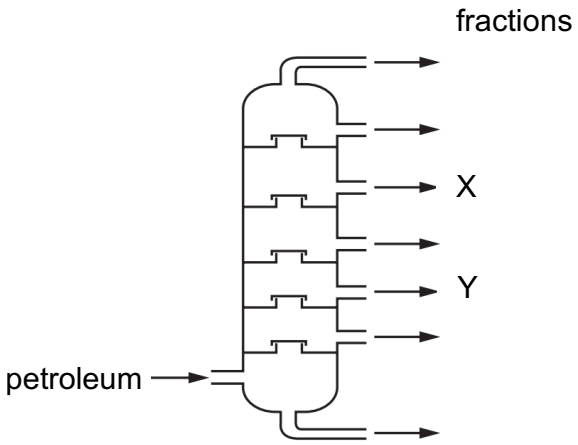


What are the formulae of X and Y?

	formula of X	formula of Y
A	C_3H_6	C_3H_7O
B	C_3H_6	C_3H_8O
C	C_3H_8	C_3H_7O
D	C_3H_8	C_3H_8O

30 Petroleum (crude oil) is separated into useful fractions by fractional distillation.

The positions at which fractions X and Y are collected from the fractionating column are shown.



Which statements are **not** correct?

1 The temperature increases up the column.

2 X condenses at a lower temperature than Y.

3 X has longer chain molecules than Y.

4 X is more flammable than Y.

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

31 The reactants and products of two reactions are shown.

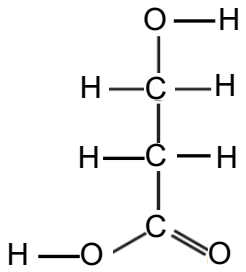
reaction 1 $C_2H_6 + Cl_2 \rightarrow X + HCl$

reaction 2 $C_{17}H_{36} \rightarrow 2C_2H_4 + C_3H_6 + 2Y + H_2$

Which row correctly describes these two reactions?

	formula of X	conditions for reaction 1	reaction 2	Y
A	C_2H_5Cl	in the dark	cracking	saturated
B	$C_2H_4Cl_2$	in the dark	substitution	unsaturated
C	$C_2H_4Cl_2$	in ultraviolet light	cracking	saturated
D	C_2H_5Cl	in ultraviolet light	cracking	unsaturated

32 The structure of hydracrylic acid is shown.



A student added the following reagents to hydracrylic acid.

1 acidified potassium manganate(VII)

2 aqueous sodium carbonate

3 Universal Indicator

Which row correctly identifies the results obtained that correspond to the experiments?

	acidified potassium manganate(VII)	aqueous sodium carbonate	Universal Indicator
A	colourless to purple	effervescence occurred	green to yellow
B	purple to colourless	effervescence occurred	green to orange
C	purple to colourless	effervescence occurred	green to blue
D	purple to colourless	no effervescence	green remains

33 A vegetable oil is polyunsaturated.

Which statement about this vegetable oil is **not** correct?

A It has many carbon – carbon double bonds.

B It reacts with hydrogen to form a solid compound.

C It will turn colourless aqueous bromine brown.

D Nickel catalyst is added when forming margarine from vegetable oil.

34 There are two isomers of butene, C_4H_8. Their structures are given below.

$CH_2=CHC_2H_5$ $CH_3CH=CHCH_3$

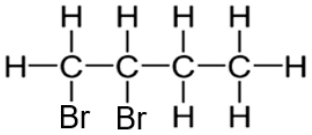
The following statements are made about the isomers.

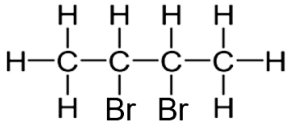
1 Combustion of 1 mole of each produces equal numbers of moles of both carbon dioxide and water.

2 Both produce the same molecule when reacted with hydrogen.

3 When polymerised, the same polymer is produced.

4 The following are the possible products from the reaction between bromine and each isomer.

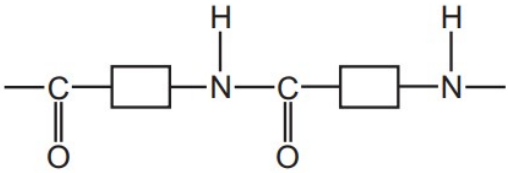




Which statements are correct?

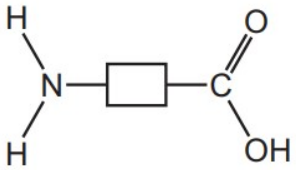
A 1, 2 and 4 **B** 1 and 2 only **C** 2 and 3 only **D** 2, 3 and 4

35 The partial structure of a polyamide is shown.



Which monomers would produce this polymer?

1



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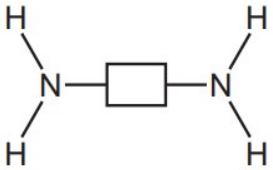

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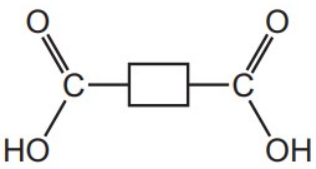


A 1 only **B** 1 and 2 **C** 1 and 3 **D** 2 and 3

36 A pure fat has a molecular mass of 400.

100 g of the fat reacts with 127 g of iodine, I_2.

How many moles of carbon – carbon double bonds are there in each molecule of the fat?

A 1 mol **B** 1.5 mol **C** 2 mol **D** 4 mol

37 Carbon dioxide and methane are both greenhouse gases.

Which activity produces both of these gases?

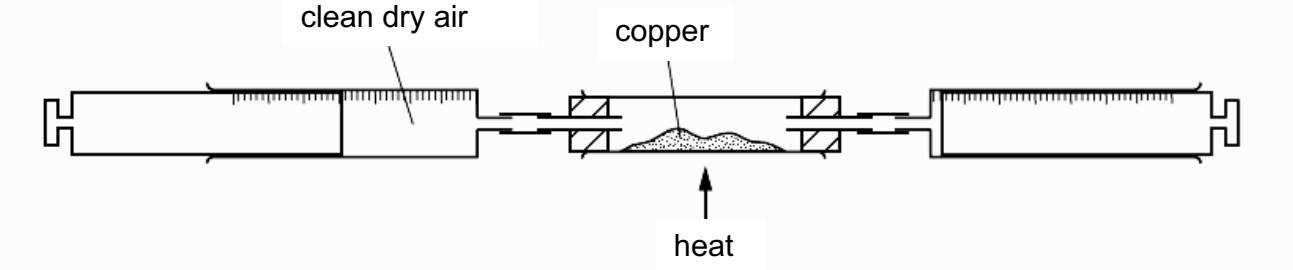
A farming animals

B cracking alkanes

C the thermal decomposition of calcium carbonate

D using petrol-powered cars

38 A sample of clean, dry air is passed repeatedly over hot copper until all the oxygen reacts with the copper as shown.



The volume of air decreases by 25 cm^3.

What is the starting volume of the sample of air?

A 50 cm^3 **B** 75 cm^3 **C** 100 cm^3 **D** 120 cm^3

39 Which gas will react with ozone in the upper atmosphere of the Earth?

A CF_2Cl_2 **B** CH_4 **C** CO_2 **D** CF_4

40 The carbon cycle includes the processes combustion, photosynthesis and respiration.

Which row shows how each process changes the amount of carbon dioxide in the atmosphere?

	combustion	photosynthesis	respiration
A	decreases	decreases	increases
B	decreases	increases	decreases
C	increases	decreases	increases
D	increases	increases	decreases

END OF PAPER

The Periodic Table of Elements

Group 1	2											13	14	15	16	17	18
							1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9		**Key** proton (atomic) number atomic symbol name relative atomic mass									5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24	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 –	103 Lr lawrencium –

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).

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