

聖嬰中學

HOLY INNOCENTS' HIGH SCHOOL

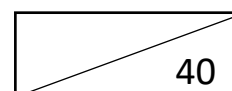


Candidate Name

Class

Index Number

PRELIMINARY EXAMINATION 2022
SECONDARY 4 EXPRESS
CHEMISTRY Paper 1



6092/01

Date: 24 Aug 2022

Duration: 1 h

Additional Materials: *NIL*

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

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

Write your name, class and index number on the Answer Sheet in the spaces provided unless this has been done for you.

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 on this question paper.

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

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

Set by: Mr Daniel Lau

Vetted by: Ms Woo Wei Shan

The Periodic Table of the Elements

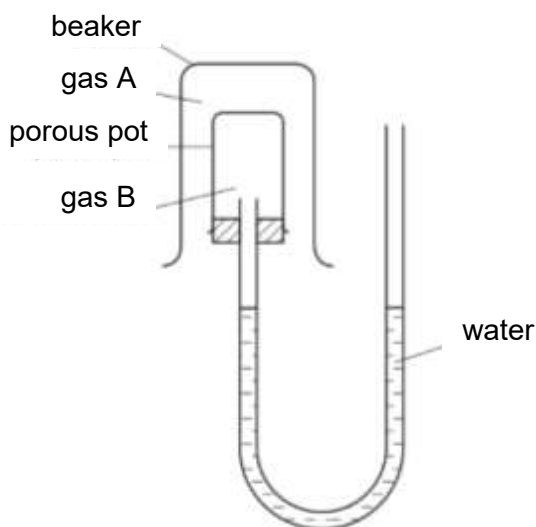
Group																		
I	II											III	IV	V	VI	VII	0	
key proton (atomic) number atomic symbol name relative atomic mass							1 H hydrogen 1											2 He helium 4
3 Li lithium 7	4 Be beryllium 9											5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20	
11 Na sodium 23	12 Mg magnesium 24											13 A/ 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 -			

lanthanoids

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

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

- 1 The diagram shows a beaker full of gas A inverted over a porous pot containing gas B.



The water level does not move. Which of the following could be gas A and gas B?

	gas A	gas B
A	carbon monoxide	neon
B	carbon dioxide	nitrogen
C	methane	ammonia
D	ethane	nitrogen monoxide

- 2 When ethanol is manufactured, ethanol can be separated from the mixture of water, sugar and yeast by fractional distillation because

- A** the boiling point of ethanol is lower than water.
- B** ethanol is a volatile liquid.
- C** ethanol does not react with water on heating.
- D** ethanol is immiscible in water.

- 3 Some brown powder is placed in a test-tube. Water is added to the test-tube and shaken. The contents are then filtered. A black solid is left on the filter paper. After evaporating the filtrate, orange crystals are left.

What does this analysis tell you about the coloured substances?

- A** The black solid is an element.
- B** The brown powder is a compound.
- C** The brown powder is a mixture.
- D** The orange crystals is a mixture.

4 Which property determines the amount of energy required to melt ice?

- A The forces of attraction between the molecules.
- B The reactivity of the molecules.
- C The shape of the molecules.
- D The strength of the covalent bonds in the molecules.

5 Tritium (symbol T) is an isotope of hydrogen.

Which formula is incorrect for a compound of tritium?

- A BaOT
- B CT₄
- C NT₃
- D T₂O

6 Compound C contains two elements, metal D and non-metal E.

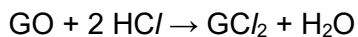
Compound C consists of a lattice of positive ions and negative ions.

Each positive ion is surrounded by eight negative ions and each negative ion is surrounded by four positive ions.

Which ions are present in, and what is the formula of, compound C?

	ions present	formula
A	D ⁺ E ²⁻	D ₂ E
B	D ²⁺ E ⁻	DE ₂
C	E ⁺ D ²⁻	E ₂ D
D	E ²⁺ D ⁻	ED ₂

7 The equation shows the reaction between oxide of an element G and dilute hydrochloric acid.



Which particles are responsible for conducting electricity in G, GO and GC_l₂?

	G	GO	GC _l ₂
A	electrons	positive & negative ions	positive & negative ions
B	electrons	positive ions	positive & negative ions
C	positive ions	electrons	electrons
D	positive & negative ions	negative ions	positive ions

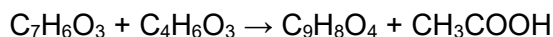
- 8 Bones contain a complex mixture of calcium salts, protein and other materials. When a bone is strongly heated in a current of air, the only residue is calcium oxide. From a sample of 100 g of bone, 42.0 g of calcium oxide were obtained.

What is the percentage by mass of calcium in the bone?

- A** 12.0 % **B** 30.0 % **C** 42.0 % **D** 71.4 %

- 9 Aspirin tablets have important medical uses such as reducing fever and relieving pain.

Aspirin, $\text{C}_9\text{H}_8\text{O}_4$, is made from salicylic acid, $\text{C}_7\text{H}_6\text{O}_3$, according to the equation

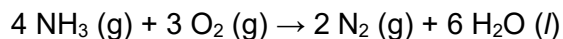


Assuming a 70% yield, what is the mass of salicylic acid required to make an aspirin tablet of 325 mg?

[Mr of $\text{C}_7\text{H}_6\text{O}_3$ = 138, Mr of $\text{C}_9\text{H}_8\text{O}_4$ = 180]

- A** 174 mg **B** 249 mg **C** 356 mg **D** 424 mg

- 10 200 cm^3 of ammonia burns in 120 cm^3 of oxygen according to the following equation:



What volume of nitrogen will be obtained?

- A** 80 cm^3 **B** 100 cm^3 **C** 240 cm^3 **D** 320 cm^3

- 11 Which method(s) is/are suitable to distinguish between 1.0 mol/dm^3 of aqueous hydrochloric acid and 1.0 mol/dm^3 of aqueous ethanoic acid?

- 1 using a pH meter
- 2 determining the volume of 1.0 mol/dm^3 of sodium hydroxide solution used to neutralise 25.0 cm^3 of the acids separately
- 3 measuring the total volume of hydrogen gas formed when excess magnesium is added to the acids separately

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

- 12 Which equation suggests that a metal oxide, JO, behaves as an amphoteric oxide?

- A** $\text{JO} (\text{s}) + 2 \text{H}^+ (\text{aq}) \rightarrow \text{J}^{2+} (\text{aq}) + \text{H}_2\text{O} (\text{l})$
B $\text{JO} (\text{s}) + 2 \text{OH}^- (\text{aq}) \rightarrow \text{JO}_2^{2-} (\text{aq}) + \text{H}_2\text{O} (\text{l})$
C $\text{JO} (\text{s}) + \text{H}_2\text{O} (\text{l}) \rightarrow \text{J}^{2+} (\text{aq}) + 2 \text{OH}^- (\text{aq})$
D $\text{JO} (\text{s}) + \text{NH}_4^+ (\text{aq}) \rightarrow \text{J}^{2+} (\text{aq}) + \text{H}_2\text{O} (\text{l}) + \text{NH}_3 (\text{g})$

- 13 The following scheme shows the steps to prepare pure silver chloride from silver carbonate.



Identify reagents K and L.

	reagent K	reagent L
A	aqueous sodium sulfate	barium chloride
B	aqueous sodium sulfate	dilute hydrochloric acid
C	dilute sulfuric acid	barium chloride
D	dilute sulfuric acid	dilute hydrochloric acid

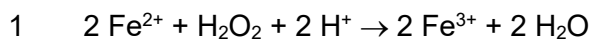
- 14 Ammonia is produced via the Haber Process. Three statements on the Haber Process are shown below.

- 1 The Haber Process is usually carried out at 450 °C and 200 atm pressure.
- 2 Unreacted nitrogen and hydrogen are recycled back to the reaction chamber.
- 3 The chemical reaction becomes irreversible when finely divided iron catalyst is used.

Which of these statements is/are correct?

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

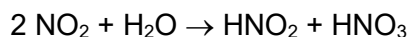
- 15 The equations below show the reactions of hydrogen peroxide.



Which row correctly describes the reactions that hydrogen peroxide undergoes?

	1	2
A	oxidation	oxidation
B	oxidation	reduction
C	reduction	oxidation
D	reduction	reduction

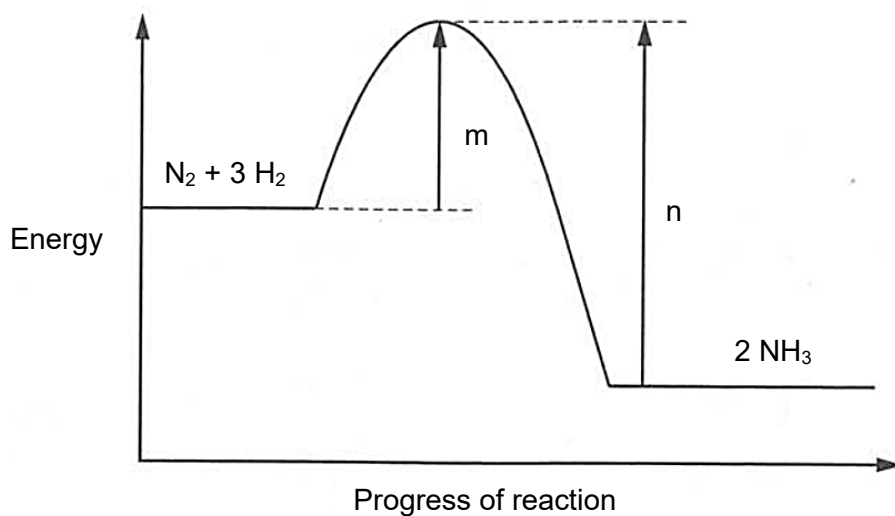
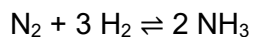
- 16 Nitrogen dioxide reacts with water according to the following equation.



Which of the following statements correctly describes this reaction?

- A NO_2 is reduced to form HNO_3 .
 - B The oxidation state of N in HNO_2 is +3.
 - C The reaction is a decomposition reaction.
 - D Water acts as a catalyst in this reaction.
- 17 Which property shows a decreasing trend for the elements listed?
- A colour intensity of F, Cl, Br
 - B density of Na, Mg, Al
 - C reactivity of F, Cl, Br
 - D reactivity of Na, K, Rb
- 18 Caesium is a Group I metal.
- Which reaction involving this element would **not** produce hydrogen?
- A adding caesium to ethanoic acid
 - B adding caesium to water
 - C electrolysis of aqueous caesium chloride
 - D electrolysis of molten caesium chloride
- 19 Which method is the **least** effective method in reducing the amount of pollutant gases that cause acid rain?
- A Burning fuel with low sulfur content.
 - B Pass waste gases through catalytic converters in motor vehicles.
 - C Reduce usage of air-conditioners.
 - D Use limestone to absorb pollutant gases from factories.

- 20 The diagram below represents the energy profile diagram for the reaction



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

	forward reaction		reverse reaction	
	enthalpy change	activation energy	enthalpy change	activation energy
A	$m - n$	m	$n - m$	n
B	$n - m$	m	$m - n$	m
C	$m - n$	n	$n - m$	n
D	$n - m$	n	$m - n$	m

- 21 Gaseous phosphorus pentachloride can be decomposed into gaseous phosphorous trichloride and chlorine by heating.



Given that the P–Cl bond energy is 330 kJ/mol and the Cl–Cl bond energy is 240 kJ/mol, what is the enthalpy change of the reaction in kJ/mol?

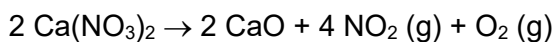
- A** - 420 **B** - 90 **C** + 90 **D** + 420

- 22 The table below shows some bond energies.

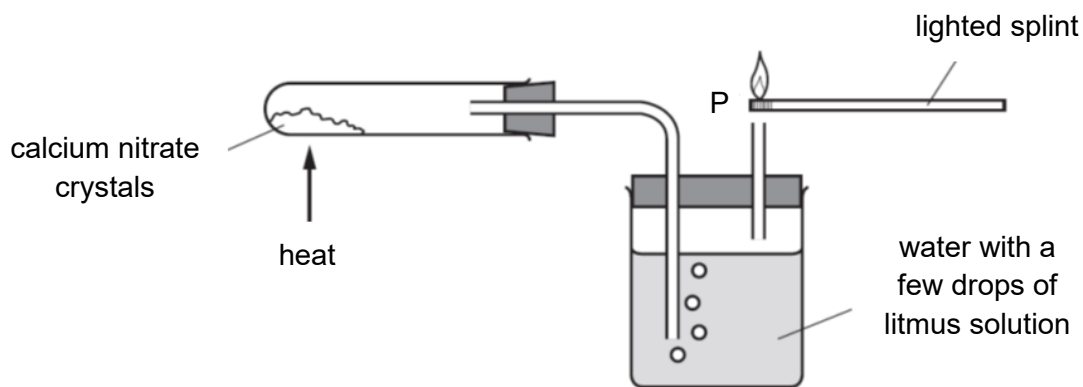
bond	kJ/mol
C - C	346
C - H	413
Si - Si	176
Si - H	318

Which of the following statements could be considered to be consistent with these values?

- A** 346 kJ is the energy evolved when 1 mole of graphite sublimes.
B Si – Si bonds are the least readily broken of those listed.
C Si – Si chains are more stable than C – C chains.
D Methane, CH₄, is chemically more stable than silane, SiH₄.
- 23 A student investigates calcium nitrate crystals by heating them in the apparatus shown.



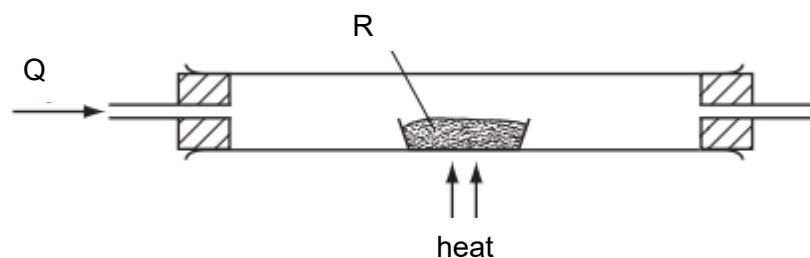
A colourless gas leaves the apparatus at P. A flame is held to this gas.



What observations would the student make?

	litmus solution	formula
A	changes to blue	flame burns more brightly
B	changes to blue	flame goes out
C	changes to red	flame burns more brightly
D	changes to red	flame goes out

- 24 In the apparatus shown, gas Q is passed over solid R.



No reaction occurs if Q and R are

	Q	R
A	hydrogen	calcium oxide
B	hydrogen	copper(II) oxide
C	oxygen	carbon
D	oxygen	copper

- 25 The following equation and statements describe three metals, X, Y and Z.

- 1 $Y + 2 XNO_3 \rightarrow Y(NO_3)_2 + 2 X$
- 2 ZNO_3 decomposes readily at room temperature to form Z.
- 3 XNO_3 and $Y(NO_3)_2$ decompose only at temperatures above $250^\circ C$.

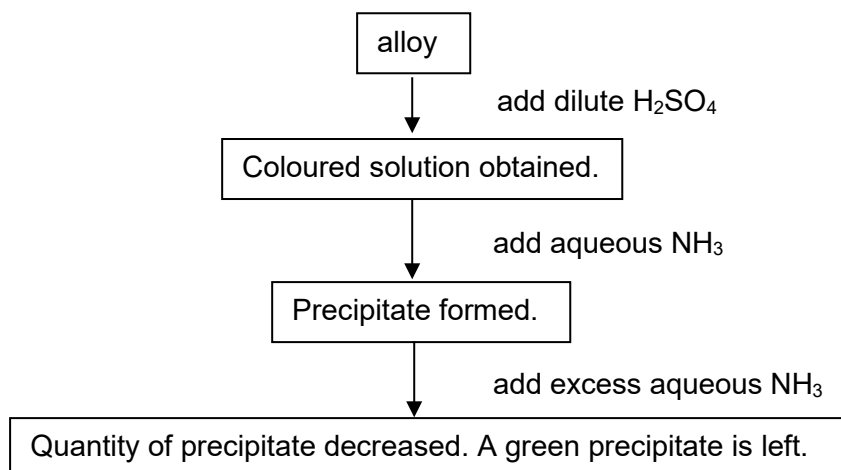
What is the reactivity of the three metals, starting from the most reactive?

- A X, Y, Z
- B Y, X, Z
- C Z, X, Y
- D Z, Y, X
- 26 Ships made from steel often have pieces of magnesium attached to them to protect the steel from corrosion.

Which equation shows a reaction that occurs when magnesium is used to protect steel from corrosion?

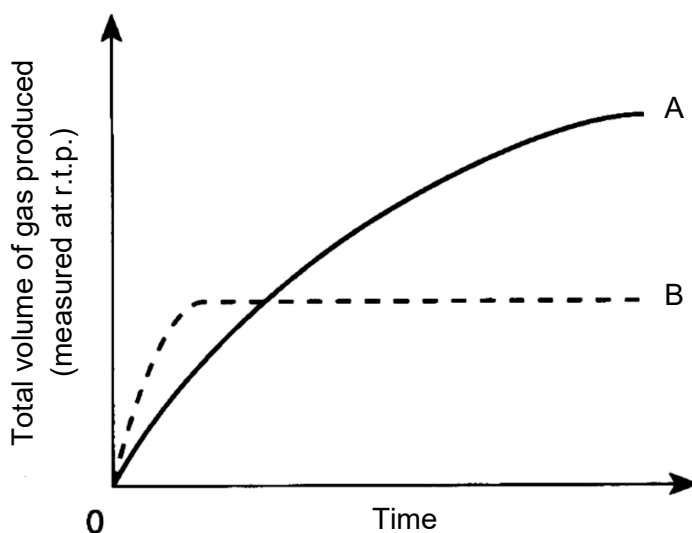
- A $Fe(s) \rightarrow Fe^{2+}(aq) + 2e$
- B $Fe(s) \rightarrow Fe^{3+}(aq) + 3e$
- C $Mg(s) \rightarrow Mg^{2+}(aq) + 2e$
- D $Mg^{2+}(aq) + 2e \rightarrow Mg(s)$

- 27 A sample of an alloy containing two metals was subjected to the following tests.



What are the two metals present in the alloy?

- A copper and lead
 B copper and zinc
 C iron and lead
 D iron and zinc
- 28 In the graph shown below, curve A represents the results of the reaction between 2 g of zinc granules and an excess acid at 25 °C. Which of the following changes will produce curve B?



- A using 2 g of zinc powder at 15 °C
 B using 2 g of zinc granules at 30 °C
 C using 1 g of zinc granules at 15 °C
 D using 1 g of zinc granules at 30 °C

- 29 A student wishes to investigate the effect of acid concentration on the speed of the reaction between a given mass of calcium carbonate and an excess of hydrochloric acid.

Which measurement would **not** allow him to achieve the aim of his investigation?

- A change in the mass of the reaction mixture with time
- B final temperature of the reaction mixture
- C time taken for a given volume of gas to be collected
- D volume of gas produced in a given time

- 30 Methane reacts very slowly with air at room temperature. But if a transition metal C is added to the methane-air mixture, the methane ignites quickly.

The addition of C:

- 1 causes the activation energy to be lower.
- 2 increases the ΔH .
- 3 increases the rate of reaction.
- 4 reduces the energy of the reactants.

Which of the following statements are true when C is added to methane-air mixture?

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

- 31 In an experiment, 2 moles of aluminium ions, Al^{3+} , were discharged in the electrolysis of molten aluminium oxide.

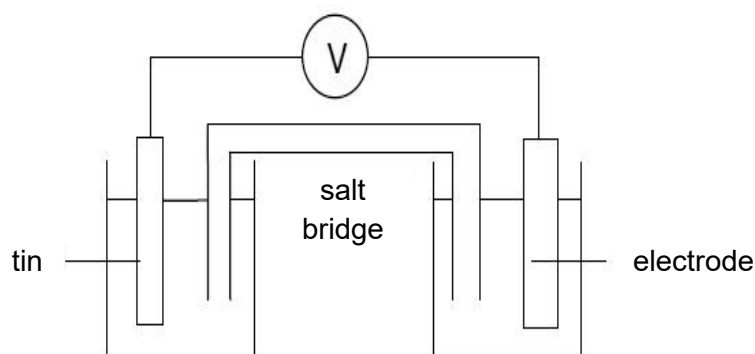
How much metal ions would be discharged by an equal amount of electricity in the following experiments?

- A 2 mol of Cu^{2+} , in the electrolysis of aqueous copper(II) nitrate
- B 3 mol of Ag^+ , in the electrolysis of aqueous silver nitrate
- C 3 mol of Pb^{2+} , in the electrolysis of molten lead(II) bromide
- D 6 mol of Zn^{2+} , in the electrolysis of aqueous zinc sulfate

- 32 In which electrolysis experiment would there be **no** change in pH of the solution when inert electrodes are used?

- A aqueous copper (II) nitrate
- B aqueous silver sulfate
- C concentrated copper (II) chloride solution
- D concentrated potassium bromide solution

- 33 Four metals, D, E, G and tin were connected in pairs and the voltages were recorded.



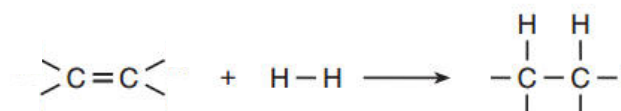
electrode	voltage (V)
E	- 1.10
D	+ 0.90
G	+ 2.50

Which option correctly describes the reactivity of the metal from the most reactive to the least reactive?

- A** D, tin, E, G
B G, D, tin, E
C G, E, tin, D
D G, E, D, tin
- 34 Recent medical studies have suggested that oils made up of polyunsaturated fatty acids are healthier than those with monosaturated ones.

In the analysis of oleic acid (relative molecular mass, $M_r = 280$), it is found that 56.0 g of the acid requires 0.8 g of hydrogen gas for complete hydrogenation.

Given that one mole of C=C group reacts with one mole of hydrogen gas as shown in the general equation below:



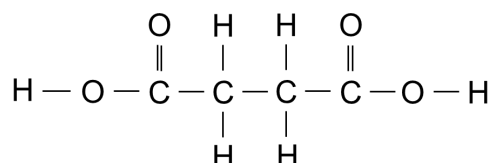
What is the number of C=C bonds in a molecule of oleic acid?

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

- 35 Which property shows an increase in the alkane series as the number of carbon atoms decreases from butane to methane?

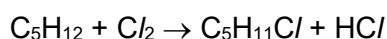
A boiling point
 B melting point
 C viscosity
 D flammability

- 36 The diagram below shows an organic molecule, J.



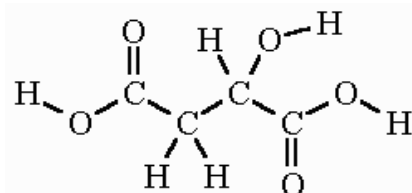
Which statement is **not** true about molecule J?

- A It can be used as one of monomers to make a polyester.
 B It has a higher boiling point than methanoic acid.
 C Upon combustion, 1 mole of J produces 4 moles of carbon dioxide gas.
 D 2 moles of J produces 1 mole of H_2 gas when reacted with excess iron.
- 37 When a straight-chained pentane is reacted with chlorine gas in the presence of UV light, a substitution reaction occurs according to the following equation:



How many different isomers of $\text{C}_5\text{H}_{11}\text{Cl}$ can be formed from the substitution reaction?

- A 3 B 5 C 7 D 12
- 38 Apples contain malic acid. The diagram below shows the structural formula of malic acid.

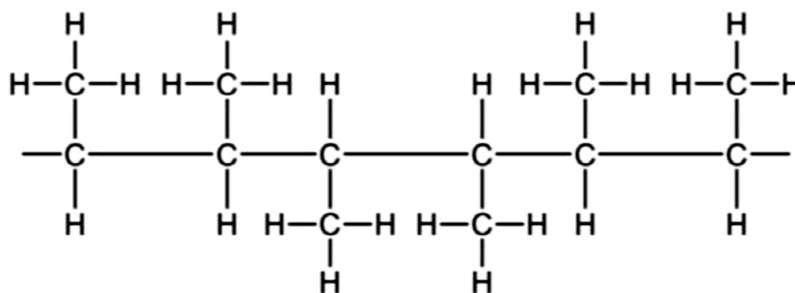


Which of the following salt(s) could be formed upon reacting malic acid with sodium hydroxide?

- 1 $\text{C}_4\text{H}_5\text{O}_5\text{Na}$
 2 $\text{C}_4\text{H}_4\text{O}_5\text{Na}_2$
 3 $\text{C}_4\text{H}_3\text{O}_5\text{Na}_3$

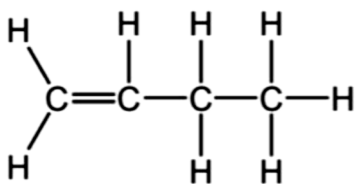
- A 2 only B 3 only C 1 and 2 D 1, 2 and 3

- 39 The diagram below shows the structure of a polymer.

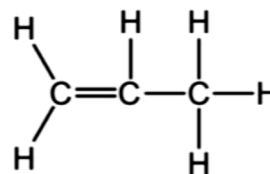


Which of the following monomer was used to form the polymer?

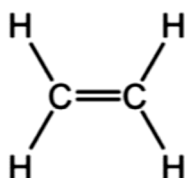
A



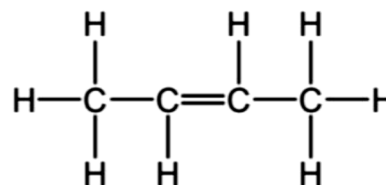
B



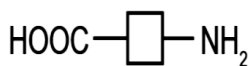
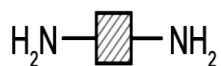
C



D



- 40 The diagrams show four monomers.



How many of these monomers would react with the molecule below to form a polymer?



A 1

B 2

C 3

D 4

- End of Paper -



General Certificate of Education Ordinary Level
JUYING SECONDARY SCHOOL, SINGAPORE
Secondary Four Express
Preliminary Examination

CANDIDATE
NAME

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CENTRE
NUMBER

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INDEX
NUMBER

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CHEMISTRY

6092/01

Paper 1 Multiple Choice

30 August 2022

1 hour

Additional Materials: Multiple Choice Answer Sheet

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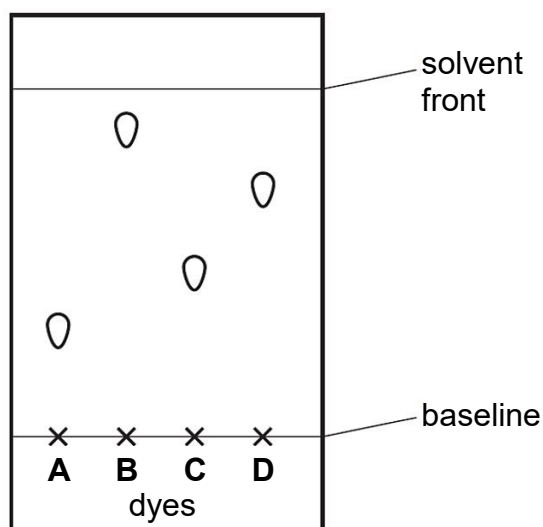
- 1 A student performed an experiment on enthalpy change.

The student put exactly 25.0 cm^3 of dilute hydrochloric acid into a conical flask, and added 2.5 g of solid sodium carbonate.

Which set of apparatus does the student need to use?

- A electronic balance, measuring cylinder, thermometer
 - B electronic balance, pipette, stopwatch
 - C electronic balance, pipette, thermometer
 - D burette, pipette, thermometer
- 2 Chromatography is a technique used to separate coloured dyes.

Which dye has an R_f value of 0.7?



- 3 Four gas jars each contain one of the gases ammonia, chlorine, hydrogen chloride and oxygen. A strip of damp blue litmus paper and a strip of damp red litmus paper are placed in each jar.

Which gas will change the colour of both strips of litmus paper?

- A ammonia
- B chlorine
- C hydrogen chloride
- D oxygen

- 4 An aqueous solution of zinc nitrate is tested by adding reagents.

Which observation is correct?

	reagent added	observations
A	acidified aqueous barium nitrate	forms a white precipitate
B	aqueous ammonia	forms a white precipitate, soluble in excess of the reagent
C	aqueous sodium hydroxide	forms a white precipitate, insoluble in excess of the reagent
D	powdered copper	forms a grey precipitate

- 5 Which statement is **not** correct?

- A** Energy is released when a liquid changes into a solid.
- B** Particles move faster in the gaseous state than in the liquid state.
- C** The carbon atoms in gaseous methane are further apart than those in solid diamond.
- D** There is a large decrease in the volume of a solid metal when pressure is applied to it.

- 6 A particle contains 34 protons, 45 neutrons and 36 electrons.

Which symbol is correct for this particle?

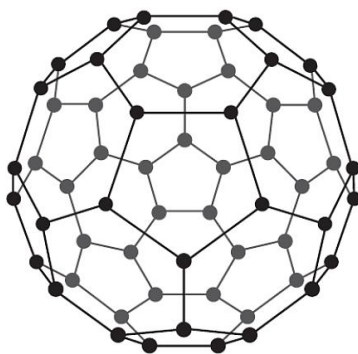
- A** ${}^{45}_{21}\text{Sc}$ **B** ${}^{45}_{21}\text{Sc}^{2-}$ **C** ${}^{79}_{34}\text{Se}^{2-}$ **D** ${}^{79}_{34}\text{Se}^{2+}$

- 7 Two naturally occurring isotopes of oxygen are ${}^{16}\text{O}$ and ${}^{17}\text{O}$.

Which statement is correct?

- A** Both isotopes react with iron to form rust.
- B** Neither isotope reacts with iron to form rust.
- C** Only ${}^{16}\text{O}$ reacts with iron to form rust.
- D** Only ${}^{17}\text{O}$ reacts with iron to form rust.

- 8 Buckminsterfullerene has the chemical formula C_{60} .



How is the structure of buckminsterfullerene best described?

- A a covalent compound
 - B an ionic compound
 - C a polymer
 - D a molecule
- 9 Which statement describes the structure of an ionic compound?
- A It is a giant lattice of oppositely charged ions.
 - B It is a giant lattice of positive ions in a 'sea' of electrons.
 - C It is a giant molecule of oppositely charged ions.
 - D It is a simple molecule of oppositely charged ions.
- 10 A compound P is the only substance formed when two volumes of ammonia gas react with one volume of carbon dioxide gas at room temperature and pressure.
- What is the formula of compound P?
- A $NH_2CO_2NH_4$ B $(NH_2)_2CO$ C $NH_4CO_2NH_4$ D $(NH_4)_2CO_3$
- 11 A compound contains 70% by mass of iron and 30% by mass of oxygen.

What is its empirical formula?

- A FeO B Fe_2O_3 C Fe_3O_2 D Fe_3O_4

12 Aluminium is produced by the electrolysis of molten aluminium oxide.

What is the correct equation for the reaction at the positive electrode?

- A** $Al \rightarrow Al^{3+} + 3e^{-}$
B $Al^{3+} + 3e^{-} \rightarrow Al$
C $O_2 + 4e^{-} \rightarrow 2O^{2-}$
D $2O^{2-} \rightarrow O_2 + 4e^{-}$

13 Iron can be electroplated with silver to make its appearance attractive.

Which row about electroplating iron with silver is correct?

	anode	cathode	electrolyte
A	iron	silver	iron nitrate
B	iron	silver	silver nitrate
C	silver	iron	iron nitrate
D	silver	iron	silver nitrate

14 The formation of liquid water from hydrogen and oxygen may occur in three stages.

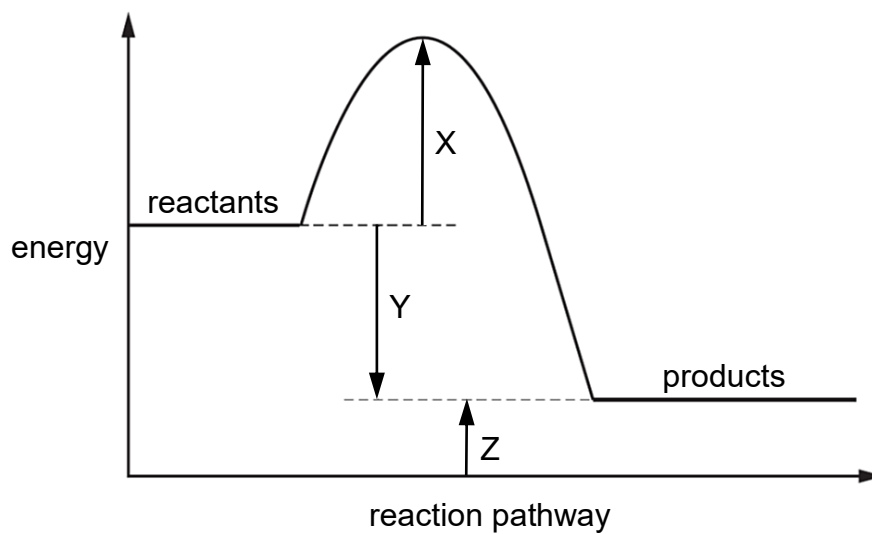
- 1 $2H_2(g) + O_2(g) \rightarrow 4H(g) + 2O(g)$
 2 $4H(g) + 2O(g) \rightarrow 2H_2O(g)$
 3 $2H_2O(g) \rightarrow 2H_2O(l)$

Which stages are exothermic?

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

15 The diagram shows the energy profile of a chemical reaction.

Two energy changes are labelled X and Y.



Which statement about the reaction is correct?

- A The activation energy of the reaction is $X + Y + Z$.
- B The activation energy of the reaction is Z .
- C The enthalpy change of the reaction is $X + Z - Y$.
- D The enthalpy change of the reaction is Y .

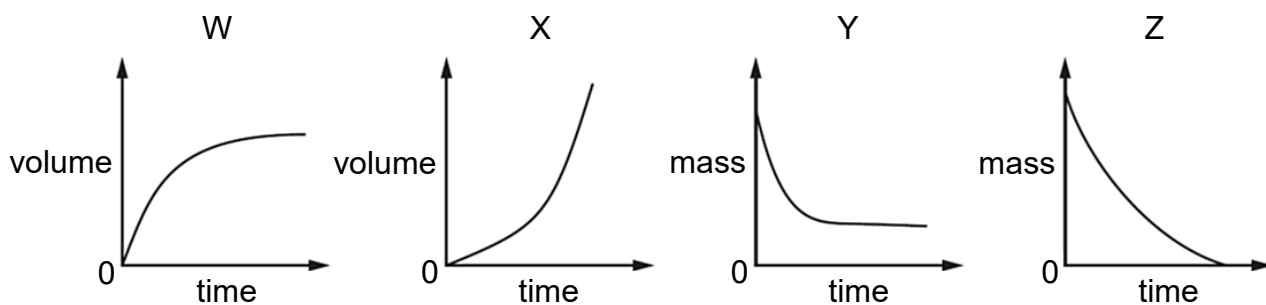
16 In two experiments, 1 and 2, an excess of powdered calcium carbonate was reacted in a flask with dilute hydrochloric acid.

In experiment 1, the carbon dioxide evolved was collected in a gas syringe over time.

In experiment 2, the mass of the flask and its contents was measured over time.

The results of both experiments were plotted on graphs.

Which graphs correctly show the results of these two experiments?

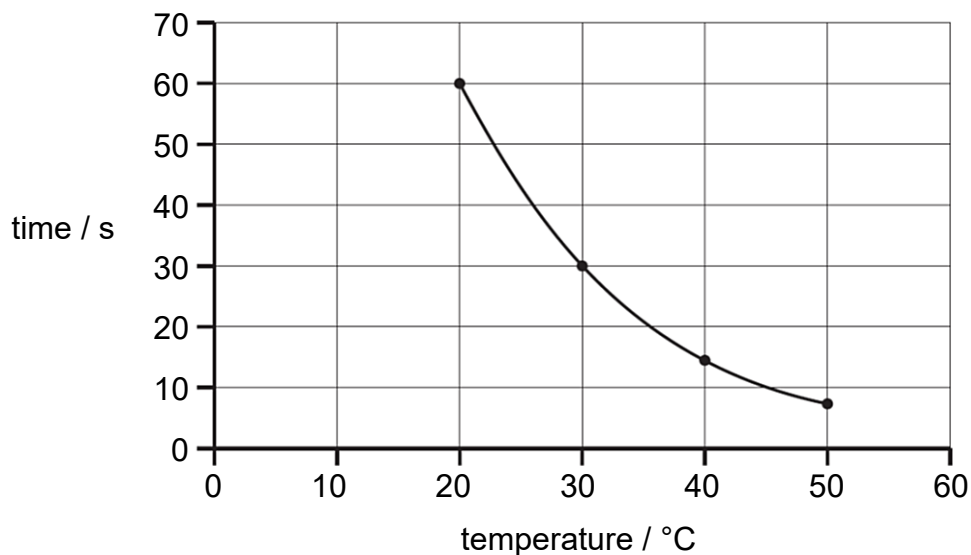


	experiment 1	experiment 2
A	W	Y
B	W	Z
C	X	Y
D	Y	W

17 A reaction is carried out at four different temperatures.

The time taken for the reaction to complete at each temperature is measured.

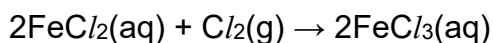
The results are shown.



Which statement about the reaction is correct?

- A** The time taken increases as the temperature increases.
- B** The time taken decreases by 10 s for every 10 °C rise in temperature.
- C** The rate is inversely proportional to the temperature.
- D** The rate is inversely proportional to the time taken.

18 Iron(II) chloride solution reacts with chlorine gas.



Which statements about this reaction are correct?

- 1 Fe^{2+} ions are reduced to Fe^{3+} ions.
- 2 Chlorine acts as a reducing agent.
- 3 Fe^{2+} ions each lose an electron.
- 4 Cl_2 molecules are reduced to Cl^- ions.

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

19 Which statement about oxides is correct?

- A** A solution of magnesium oxide has a pH less than 7.
- B** A solution of sulfur dioxide has a pH greater than 7.
- C** Magnesium oxide reacts with nitric acid to make a salt.
- D** Sulfur dioxide reacts with hydrochloric acid to make a salt.

20 In which reaction are two of the products salts?

- A** aqueous lead(II) nitrate and aqueous copper(II) sulfate
- B** aqueous sodium hydroxide and solid ammonium sulfate
- C** dilute hydrochloric acid and aqueous sodium carbonate
- D** dilute hydrochloric acid and magnesium

21 Which methods are suitable for preparing both zinc sulfate and copper(II) sulfate?

- 1 reacting the metal oxide with warm dilute sulfuric acid
- 2 reacting the metal with dilute sulfuric acid
- 3 reacting the metal carbonate with dilute sulfuric acid

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

22 Ammonia is manufactured by reacting hydrogen with nitrogen in the Haber process.

Which row correctly describes the Haber process?

	source of hydrogen	source of nitrogen	temperature of reaction / °C	pressure of reaction / atm
A	air	natural gas	450	2
B	air	natural gas	250	200
C	natural gas	air	250	2
D	natural gas	air	450	200

23 P and Q are two elements from the same period in the Periodic Table.

The table gives some properties of P and Q.

property	P	Q
appearance	shiny grey	dull yellow
electrical conductivity when solid	good	poor
malleability	malleable	brittle

Which statement about P and Q is correct?

- A** P forms an acidic oxide.
- B** P is found to the left of Q in the Periodic Table.
- C** Q forms positive ions when it reacts with another element.
- D** Q is more metallic than P.

24 Tennessine, Ts, is a newly discovered element.

The atomic number of tennessine is 117 and it is placed directly below astatine in the Periodic Table.

Which statement about the properties of tennessine is likely to be correct?

- A** Tennessine has a higher reactivity than astatine.
- B** Tennessine has a lower boiling point than astatine.
- C** Tennessine has a lighter colour than astatine.
- D** Tennessine has a higher density than astatine.

25 In the chemical formulae of some ionic compounds, the metal is represented by M.

Which pair of compounds shows that the metal is a transition element?

- A** M_2O_3 and $M_2(SO_4)_3$
- B** M_2O and MCO_3
- C** MS and MSO_4
- D** MO and $M(NO_3)_2$

26 Which statement about the uses of metals is **not** correct?

- A Copper is used for making brass.
- B Iron is used for making steel.
- C Aluminum is used as a catalyst in the cracking of hydrocarbons.
- D Nickel is used as a catalyst in the hydrogenation of alkenes.

27 Three metals, X, Y and Z, were reacted with water.

The oxides of the same three metals were also heated strongly with carbon.

The results are shown.

metal	reaction of the metal with water	reaction of the metal oxide with carbon
X	vigorous reaction with cold water	no reaction
Y	no reaction	metal and carbon dioxide produced
Z	very slow reaction with cold water but violent reaction with steam	no reaction

What is a correct conclusion about X, Y and Z?

- A X is sodium and Y is magnesium.
- B X is the least reactive and Y is the most reactive.
- C Z is less reactive than Y.
- D Z is magnesium and Y is copper.

28 Aqueous copper(II) sulfate solution is placed in an iron container and left to stand for several days.

Which statement describes what happens?

- A Copper(II) sulfate reacts with atmospheric oxygen to form black copper(II) oxide.
- B Some fine iron particles are formed in the solution.
- C The part of the container in contact with the solution is coated with copper.
- D The solution turns from green to blue.

29 Iron is extracted from its ore in a blast furnace.

Haematite, coke, limestone and hot air are added to the furnace.

Which explanation is **not** correct?

- A** Coke burns and produces a high temperature.
- B** Haematite is the ore containing the iron as iron(III) oxide.
- C** Hot air provides the oxygen for the burning.
- D** Limestone reduces the iron(III) oxide to iron.

30 Which metal is attached to underground pipes made of iron, to provide sacrificial protection from corrosion?

- A** Ag **B** Cu **C** Mg **D** Pb

31 The table shows the composition of exhaust gases from the internal combustion engine of a petrol vehicle.

gas	percentage of the gas in the exhaust fumes / %
gas X	71
carbon dioxide	14
water vapour	13
gas Y	1
hydrocarbons	0.3
nitrogen oxides	0.2
sulfur dioxide	< 0.003

What are gases X and Y most likely to be?

	X	Y
A	argon	oxygen
B	carbon monoxide	methane
C	oxygen	argon
D	nitrogen	carbon monoxide

32 Four sources of air pollution are listed.

- 1 burning fossil fuels containing sulfur
- 2 nitrogen reacting with oxygen in car engines
- 3 incomplete combustion of carbon fuels
- 4 adding lead compounds to petrol

Which sources produce acid rain?

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

33 Which statements about the carbon cycle are correct?

- 1 Carbon dioxide is added to the atmosphere by respiration.
- 2 Carbon dioxide is added to the atmosphere by combustion of coal.
- 3 Carbon dioxide is removed from the atmosphere by photosynthesis.

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

34 Petroleum is separated into fractions by fractional distillation.

Separation occurs in a fractionating column.

Some properties of three of these fractions are shown.

fraction	boiling point range / °C	number of carbon atoms in the molecules
1		5 – 10
2	320 – 350	16 – 24
3	120 – 210	

Which statement is correct?

- A** Fraction 1 has a higher boiling point range than fraction 2.
- B** Fraction 2 is removed from a position that is higher up the fractionating column than fraction 1.
- C** Molecules in fraction 3 have shorter chains than those in fraction 2.
- D** None of the fractions are liquid at room temperature.

35 Bromine reacts with methane.

Which statements are correct?

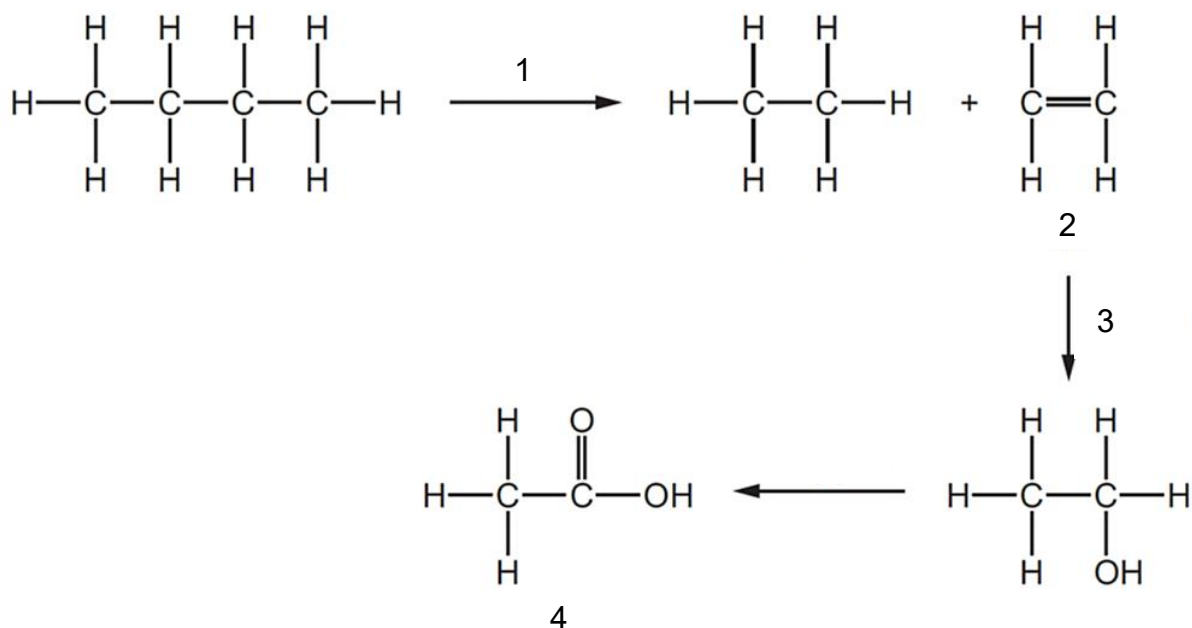
- 1 The reaction takes place in the dark.
- 2 The reaction of bromine with methane forms bromomethane.
- 3 Bromomethane reacts with bromine to produce dibromomethane.
- 4 The reaction of bromine with methane is an addition reaction.

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

36 Which compound is **not** produced by an addition reaction of ethene?

A CH_3CH_3 **B** $\text{CH}_2\text{BrCH}_2\text{Br}$ **C** $\text{CH}_3\text{CH}_2\text{OH}$ **D** $\text{CH}_3\text{CO}_2\text{H}$

37 What are the names of the reactions and compounds labelled in the reaction scheme?



	1	2	3	4
A	cracking	ethane	steam	methanoic acid
B	cracking	ethene	steam	ethanoic acid
C	substitution	ethane	oxygen	methanoic acid
D	substitution	ethene	oxygen	ethanoic acid

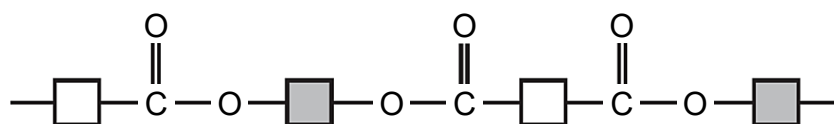
38 Which statement about carboxylic acids is correct?

- A** Ethanoic acid can be made by the fermentation of glucose.
- B** Propanoic acid can react with ethanoic acid to form an ester.
- C** Solutions of 1.0 mol/dm^3 ethanoic acid and 1.0 mol/dm^3 hydrochloric acid will react with magnesium at equal rates.
- D** The formula of butanoic acid is $\text{CH}_3\text{CH}_2\text{CH}_2\text{CO}_2\text{H}$.

39 In the addition polymer poly(propene), what is the simplest ratio of carbon atoms to hydrogen atoms?

	carbon atoms	hydrogen atoms
A	1	2
B	2	1
C	2	4
D	3	6

40 The diagram shows the partial structure of a polymer.



From which pair of compounds is it made?

- A** $\text{HO}-\text{C}(=\text{O})-\text{[white square]}-\text{C}(=\text{O})-\text{OH}$ + $\text{HO}-\text{[grey square]}-\text{OH}$
- B** $\text{HO}-\text{[white square]}-\text{C}(=\text{O})-\text{OH}$ + $\text{HO}-\text{[grey square]}-\text{C}(=\text{O})-\text{OH}$
- C** $\text{HO}-\text{[white square]}-\text{OH}$ + $\text{HO}-\text{C}(=\text{O})-\text{[grey square]}-\text{C}(=\text{O})-\text{OH}$
- D** $\text{HO}-\text{C}(=\text{O})-\text{[white square]}-\text{C}(=\text{O})-\text{OH}$ + $\text{HO}-\text{C}(=\text{O})-\text{[grey square]}-\text{C}(=\text{O})-\text{OH}$

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The Periodic Table of Elements

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																
11 Na sodium 23	12 Mg magnesium 24																
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 F/ flerovium -		116 Lv livermorium -		
lanthanoids																	
actinoids																	