Candidate Name ______________________ | Class | Index Number |

ST ANDREW'S SECONDARY SCHOOL
PRELIMINARY EXAMINATION 2022
SECONDARY 4 EXPRESS

CHEMISTRY **6092/1**

PAPER 1

Tuesday **30 August 2022** **1 hour**

INSTRUCTIONS TO CANDIDATES

Do not open this question paper until you are told to do so.

READ THESE INSTRUCTIONS FIRST

Write your name, index number and class in the spaces provided on the question paper using dark blue or black pen.
Write in soft pencil your name, index number, class and NRIC on the **Answer Sheet** provided.
You must shade your NRIC correctly on the **Answer Sheet**.
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 **Answer Sheet**.

Each correct answer will score one mark.
Electronic calculators may be used.
A copy of the Periodic Table is printed on the last page.

This question paper consists of 19 printed pages.

Error Analysis

DO NOT ATTEMPT THIS PART DURING THE EXAM/TEST.

IT IS TO BE COMPLETED AFTER THE EXAM/TEST, AFTER YOU HAVE DONE CORRECTIONS FOR YOUR PAPER.

Name:_____( ) Date: _____

Exam: CT1/Mid-Year/CT2/Final/Prelim

Everyone, not just the fastest and most competent, is capable of high achievement. Care, perseverance and craftsmanship are what count.

Mistakes are not a sign of weakness. Mistakes help me learn. Consistent effort and effective strategies are the main determinant of success

A) 3 things I have learnt from this paper.

1.)_____

_____

2.)_____

_____

3.)_____

_____

B) 2 common mistakes I made in this paper.

1.)_____

_____

2.)_____

_____

C) Confession:

I could have done better if _____

_____

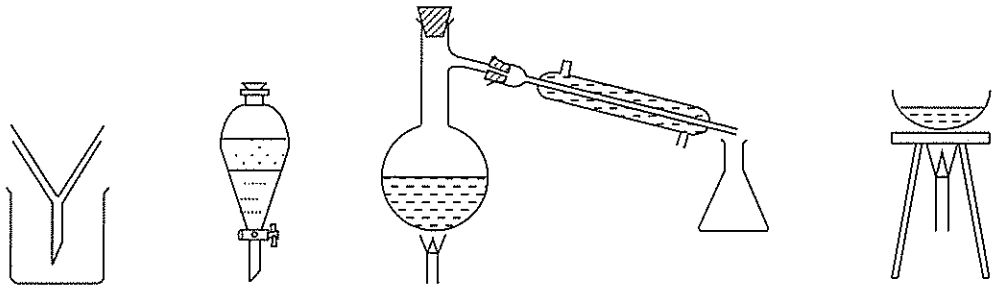
_____

Mistakes are not a sign of weakness. Mistakes help me learn. Consistent effort and effective strategies are the main determinant of success.

Everyone, not just the fastest and most competent, is capable of high achievement. Care, perseverance and craftsmanship are what count.

1 Compound **X** melts at 10 °C, boils at 150 °C and is insoluble in water.

Which apparatus can be used to obtain pure **X** from a mixture of **X** with water?



A **B** **C** **D**

2 The R_f values of some substances in ethanol are shown below.

substance	R_f value
P	0.25
Q	0.40
R	0.75

Which of the following statements is **false**?

A **P** is less soluble in ethanol than **Q** and **R**.
B The distance travelled by **R** is three times that of **P** in any solvent.
C R_f values are independent of the distance travelled by any solvent.
D The distance travelled by **P** is one-quarter the distance travelled by ethanol.

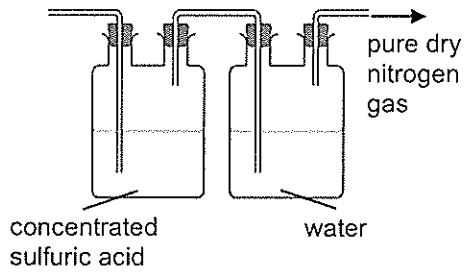
3 Which of the following instruments is the best used to measure out 25.0 cm^3 of solution quickly and accurately?

A burette
B conical flask
C measuring cylinder
D pipette

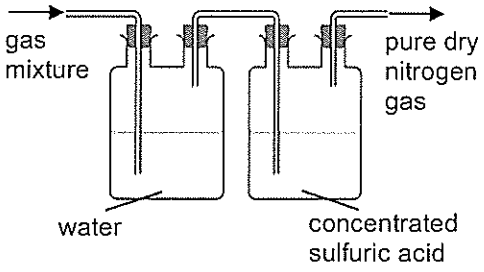
[Turn over

4 A mixture of damp nitrogen gas contains a small amount of soluble hydrogen chloride gas.

Which diagram shows the method most suitable to obtain pure dry nitrogen gas?



A



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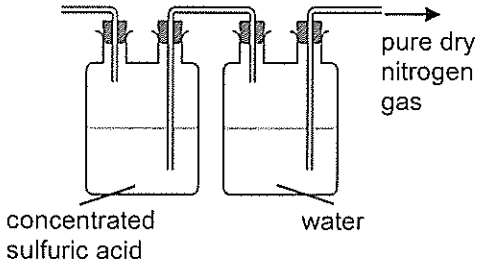
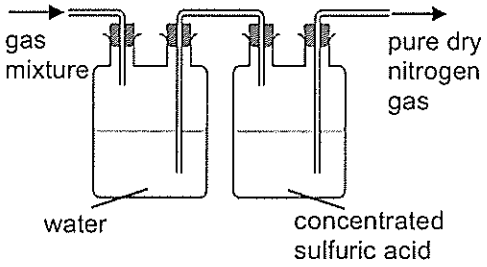


C



D

5 The relative atomic mass of naturally occurring chlorine is not a whole number.

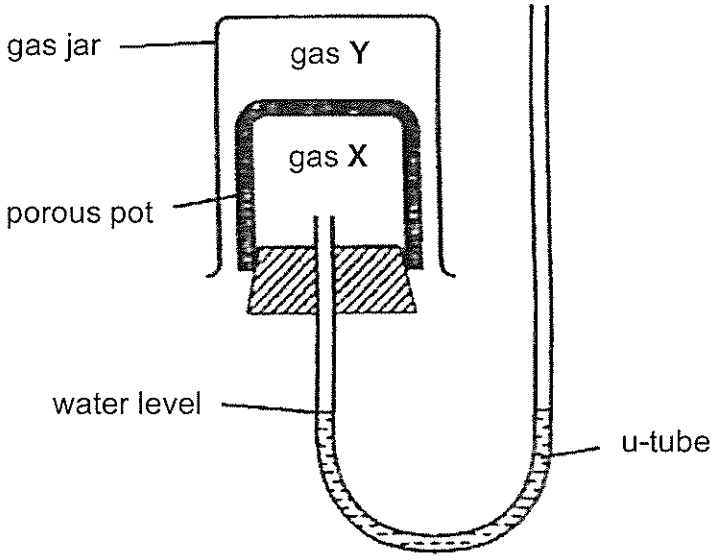
What is the reason for this?

A A chlorine atom has half a neutron in its nucleus.
B Chlorine atoms are unstable.
C Chlorine atoms have different number of neutrons.
D The mass of electrons is included.

6 Which equation describes the reaction that is most suitable for preparing lead(II) sulfate salt?

A $Pb + H_2SO_4 \longrightarrow PbSO_4 + H_2$
B $PbCO_3 + H_2SO_4 \longrightarrow PbSO_4 + CO_2 + H_2O$
C $Pb(NO_3)_2 + H_2SO_4 \longrightarrow PbSO_4 + 2HNO_3$
D $Pb(OH)_2 + H_2SO_4 \longrightarrow PbSO_4 + 2H_2O$

7 Gas **X** was placed in a porous pot and covered by a gas jar containing gas **Y**, as shown in the experimental setup below.



There were no changes observed in the water levels in the U-tube.
Which of the following could be gas **X** and gas **Y**?

	gas **X**	gas **Y**
A	carbon monoxide	nitrogen
B	nitrogen dioxide	sulfur dioxide
C	nitrogen monoxide	carbon dioxide
D	sulfur dioxide	ammonia

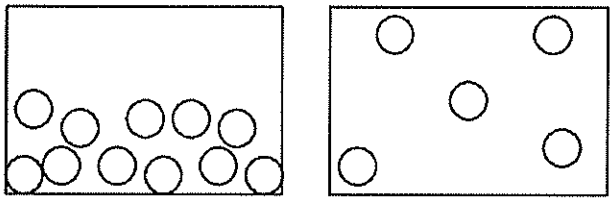
8 A 4.00 g sample of a Group II metal carbonate, MCO_3, loses 1.76 g in mass when heated strongly.

Identify metal **M**.

A barium **B** calcium

C magnesium **D** strontium

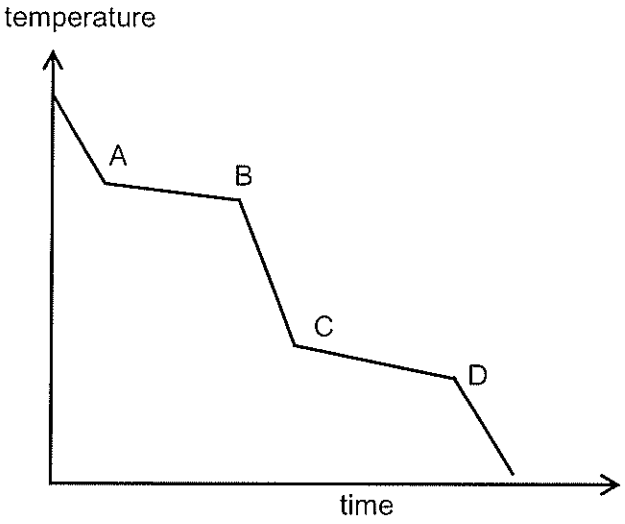
9 The diagrams show the arrangement of particles in a substance at two different temperatures.



What are the likely melting and boiling points of the substance?

	melting point / °C	boiling point / °C
A	–98	112
B	–12	35
C	19	52
D	44	280

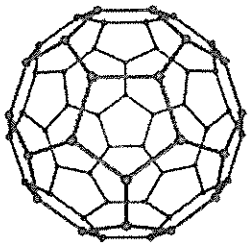
10 The graph below shows the cooling curve for an unknown sample **X**.



Which of the following statements is correct?

A From B to C, the particles are moving further apart.
B From C to D, melting is occurring.
C **X** could be air.
D **X** could be water vapour.

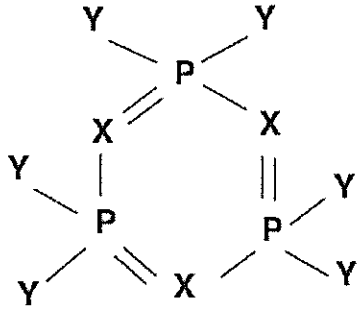
11 Buckyballs are structures of carbon used in nanotechnology. One type of buckyball has the chemical formula C_{60} and is shown in the following diagram.



Which of the following should buckyballs be classified under?

A an ionic compound
B a metallic element
C a molecule of an element
D a molecule of a compound

12 A molecule consists of three elements, **P**, **X** and **Y**.



If **P** is phosphorus, what could elements **X** and **Y** be?

	X	Y
A	iron	nitrogen
B	nitrogen	hydrogen
C	oxygen	nitrogen
D	silicon	chlorine

13 Iodine-123 is a radioactive isotope of iodine which is used in nuclear medicine imaging. Iodine-123 is produced by irradiating xenon-124 which involves radioactive decay in the process.

Which of the following statements describes the comparison between xenon-124 and iodine-123 **incorrectly**?

A Iodine-123 has 1 neutron less than xenon-124.
B Iodine-123 has 1 proton less than xenon-124.
C Iodine-123 has 1 electron less than xenon-124.
D Iodine-123 is chemically more reactive than xenon-124.

14 Concentrated aqueous sodium chloride is electrolysed using inert electrodes until no more chlorine gas is evolved.

What could be the pH of the resulting solution?

A 1 **B** 4

C 7 **D** 14

15 Iron(III) oxide, Fe_2O_3, is converted into iron(III) hydroxide, $Fe(OH)_3$ through the following reaction steps.

Step I: $Fe_2O_3 + 6HNO_3 \longrightarrow 2Fe(NO_3)_3 + 3H_2O$
Step II: $Fe(NO_3)_3 + 3NaOH \longrightarrow Fe(OH)_3 + 3NaNO_3$

Calculate the mass of iron(III) oxide required to produce 53.5 g of iron(III) hydroxide.

A 40 g **B** 80 g

C 160 g **D** 320 g

16 An unknown solid **T** is strongly heated. It is observed to produce a brown gas, leaving a black solid residue.

The solid residue dissolves in dilute sulfuric acid to form a green solution but does not dissolve in aqueous sodium hydroxide.

What is solid **T**?

A aluminium carbonate
B calcium carbonate
C copper(II) nitrate
D iron(II) nitrate

17 An experiment is carried out to examine the properties of two acids, **P** and **Q**. Two identical pieces of magnesium ribbons are added into two separate tubes filled with 20 cm^3 of the acids at the same concentration.

The volume of gas collected for **P** is half that for **Q** at the end of the reactions when all the acids are reacted.

What deductions can be made from the above description?

1 **P** is a monobasic acid and **Q** is a dibasic acid.
2 **P** is a weak acid and **Q** is a strong acid.
3 **P** has a higher pH than **Q**.

A 1 and 2 only
B 1 and 3 only
C 2 and 3 only
D all of the above

18 Which option shows the optimal conditions for the manufacture of ammonia in the Haber process?

	temperature / °C	pressure / atm	ratio of N_2 : H_2
A	200	450	1:3
B	250	450	3:1
C	450	200	1:3
D	450	200	3:1

19 The half-equation written below concerns potassium dichromate (VI), $K_2Cr_2O_7$.

$$Cr_2O_7^{2-} + 14H^+ + 6e^- \longrightarrow 2Cr^{3+} + 7H_2O$$

Which of the following is correctly deduced from this half-equation?

A Chromium (III) ions are reduced.
B Dichromate (VI) ions are oxidising agents.
C Hydrogen ions are reduced.
D Water molecules are oxidised.

20 The table below shows the results of experiments that measure the volume of dilute sulfuric acid required to neutralise the mass of sodium hydroxide pellets dissolved in the volume of water given.

experiment	volume of sulfuric acid required for neutralisation / cm^3	mass of sodium hydroxide / g	volume of water / cm^3
1	20	1	20
2	40	2	40
3	40	2	20
4	**V**	1	40

From these results, what volume of sulfuric acid, **V**, is required to neutralise the sodium hydroxide in the experiment 4?

A 10 cm^3 **B** 20 cm^3

C 40 cm^3 **D** 80 cm^3

21 Steels differ in how much carbon they contain.

Which are the properties of a high carbon steel?

A soft and brittle
B soft and malleable
C strong and brittle
D strong and malleable

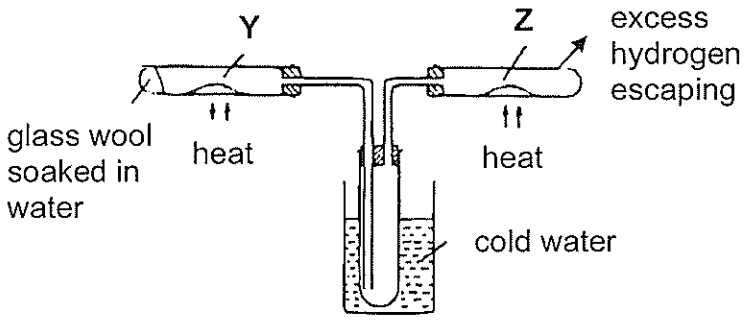
22 Zirconium, Zr, is used as a light source in some photographic flashbulbs.

When the filament inside the bulb gets hot, zirconium burns with a white light to form a mixture of zirconium(II) oxide and zirconium(IV) oxide. Zirconium does not react with water or steam.

Based on the above information, which statement shows that zirconium is a transition metal?

A Zirconium burns with a white light.
B Zirconium has the oxidation states of +2 and +4 in its oxides.
C Zirconium is unreactive to water or steam.
D Zirconium is used in flashbulbs.

23 The diagram shows a set-up used to demonstrate the reduction of a metallic oxide **Z** by hydrogen.



Which of the following could be **Y** and **Z**?

	Y	Z
A	copper	iron(II) oxide
B	magnesium	zinc oxide
C	lead	magnesium oxide
D	zinc	lead(II) oxide

24 Aqueous iron(II) sulfate is completely reacted with acidified potassium manganate (VII).

Which of the following correctly describes the colours of aqueous iron(II) sulfate and the colour of the resultant solution?

	colour of iron(II) sulfate	colour of resultant solution
A	green	colourless
B	green	yellow
C	yellow	green
D	yellow	purple

25 The table gives information of four different metals and some of their compounds.

metal	reaction with dilute hydrochloric acid	effect of heating the metal oxide with carbon	action of metal on a solution of **Z** chloride
W	effervescence observed	oxide is reduced	no observable change
X	no observable change	oxide is reduced	no observable change
Y	effervescence observed	not reduced	metal **Z** formed
Z	effervescence observed	not reduced	no observable change

Which of the following shows the metals in decreasing reactivity?

A **W, X, Y, Z**
B **X, W, Z, Y**
C **Y, Z, W, X**
D **Z, Y, W, X**

26 Which statement about the production of iron from iron oxide in a blast furnace is correct?

A Iron is extracted using carbon monoxide as an oxidising agent.
B Iron oxide is reduced by carbon dioxide.
C Limestone reacts with slag to remove the impurities.
D Molten iron has a higher density than slag.

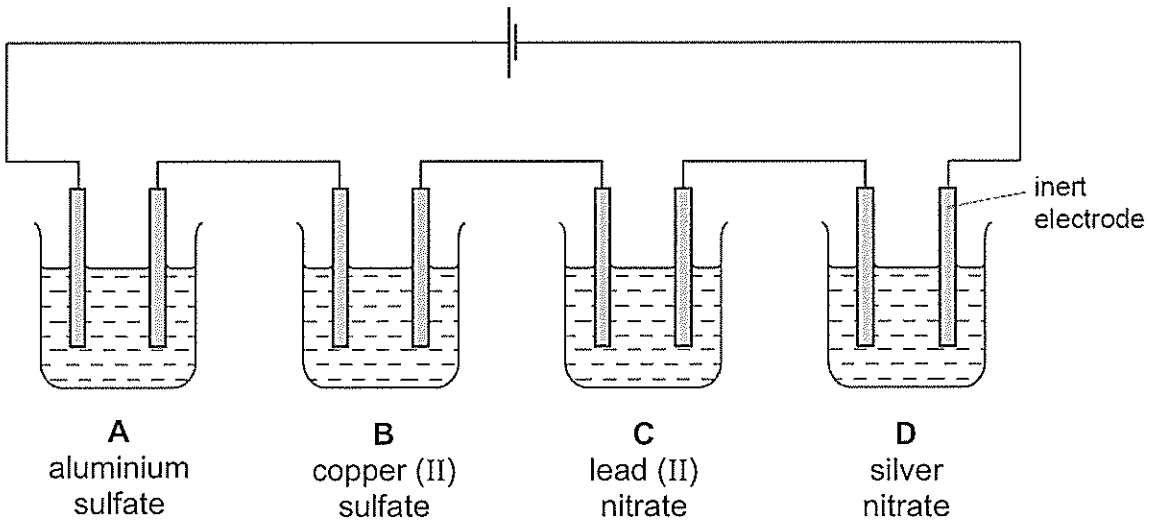
27 The alkali metals will change in its reactivity down the group because

A its atomic radius increases.
B its ionization energy increases.
C its proton number increases.
D its valency increases.

28 Which of the following pairs of substances are used to remove sulfur dioxide from flue gases?

A $CaCO_3$ and CaO
B $CaCO_3$ and $CaSO_3$
C $CaSO_3$ and CaO
D $CaSO_3$ and $CaSO_4$

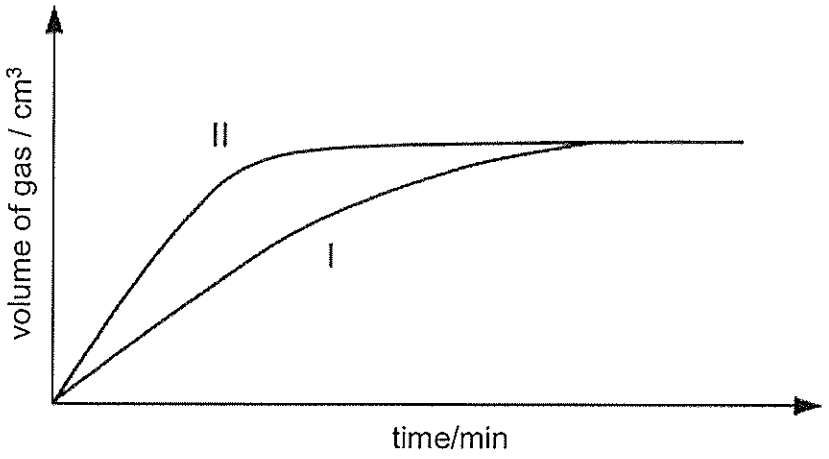
29 When electrolysed using inert electrodes as shown below, which dilute solution, **A**, **B**, **C** or **D**, would produce the greatest increase in mass of its cathode?



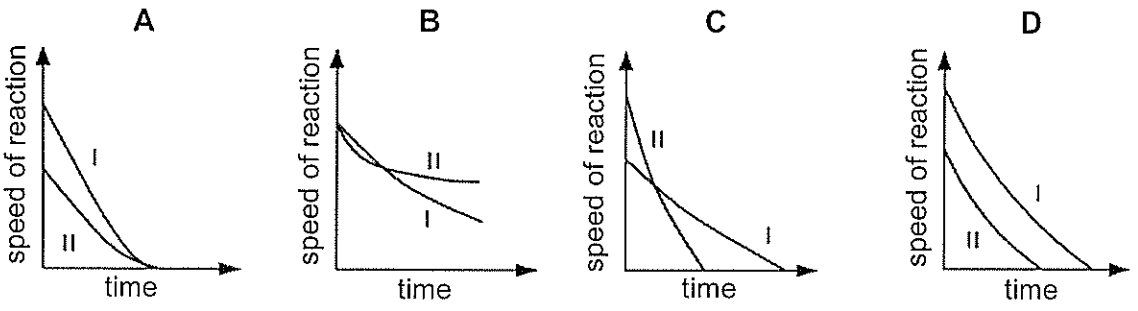
30 Which of the following is an accurate comparison of the positive electrodes in a simple electric cell and the positive electrodes in an electrolysis set-up?

	positive electrode in the electric cell	positive electrode in the electrolysis
A	anode	anode
B	anode	cathode
C	cathode	anode
D	cathode	cathode

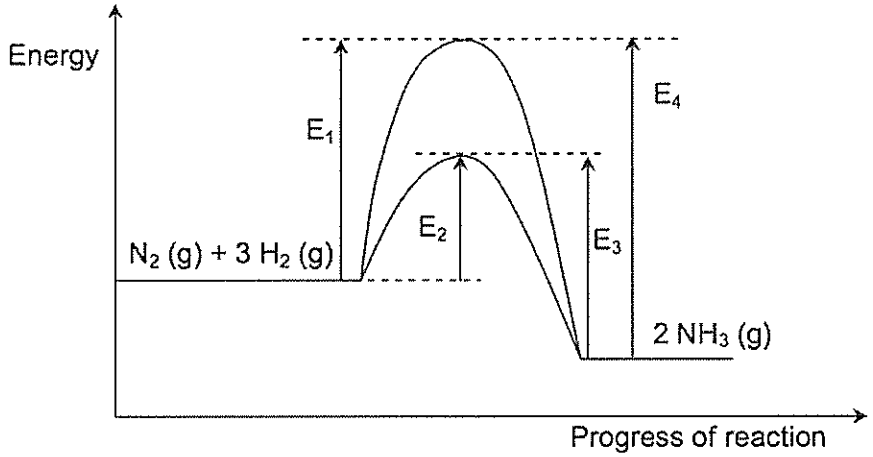
31 In two separate experiments, equal masses of a substance are decomposed. The gas evolved is collected. The graph shows the total volume of gas collected against time for each experiment.



Which graph best shows how the speed of reaction varies with time in each experiment?



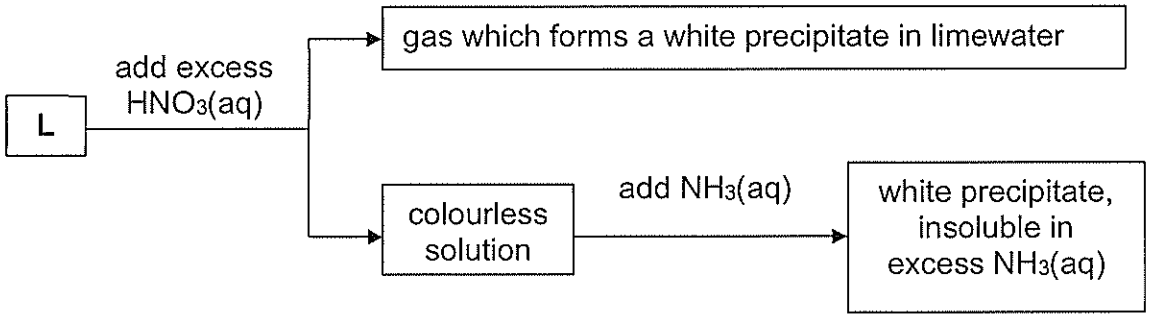
32 In the Haber Process, the synthesis of ammonia from nitrogen and hydrogen is a reversible reaction. The energy profile diagram of the reaction with and without a catalyst is shown below.



Which of the following statements is correct?

A E_1 is the activation energy of the catalyzed forward reaction.
B E_3 is the activation energy of the uncatalyzed backward reaction.
C ($E_3 - E_2$) is the enthalpy change of the forward reaction.
D ($E_4 - E_1$) is the enthalpy change of the backward reaction.

33 The flow chart shows the reaction of compound **L**.



Which substance could compound **L** be?

A aluminium carbonate
B calcium carbonate
C lead (II) sulfate
D zinc carbonate

34 Both magnesium and magnesium oxide can react with dilute nitric acid.

Which statement is **false**?

A A gas is liberated in both reactions.
B Only two products are obtained in each reaction.
C The salt obtained in both reactions is magnesium nitrate.
D Both magnesium and magnesium oxide dissolve in both reactions.

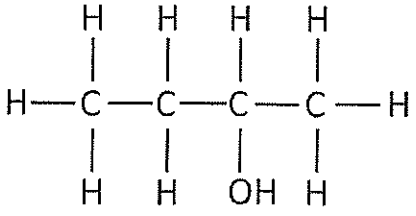
35 Which of the following statements describing fossil fuels are true?

I All fossil fuels contain carbon in its structure.
II All fossil fuels are renewable sources of energy.
III All fossil fuels are liquids at room temperature and pressure.
IV All fossil fuels are formed from the ancient remains of living things.

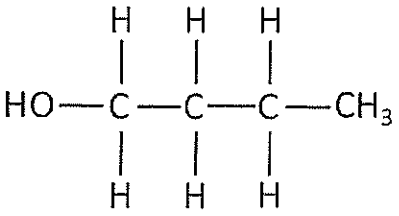
A I and II only
B I and IV only
C II and III only
D III and IV only

36 Four molecular structures are shown below.

Which one below is **not** an isomer of the others?



A



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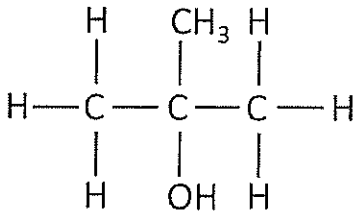
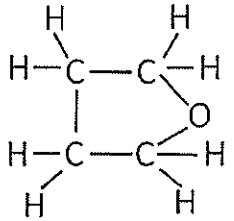
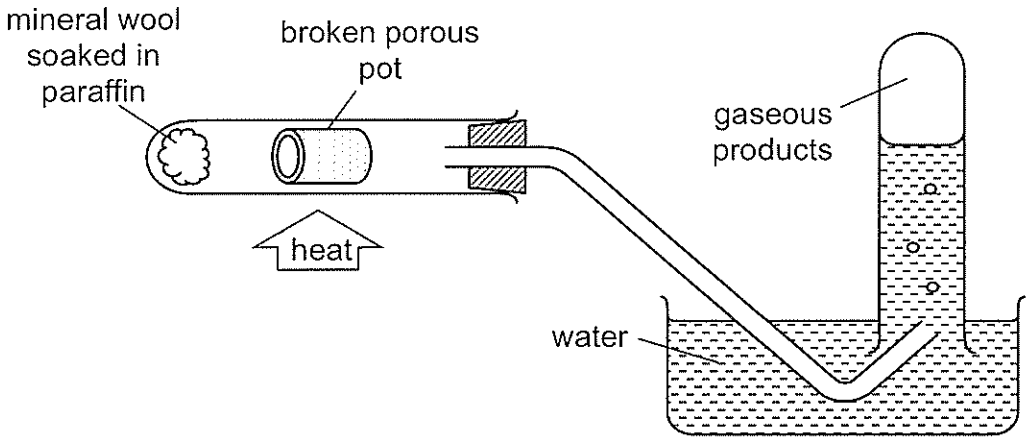


C



D

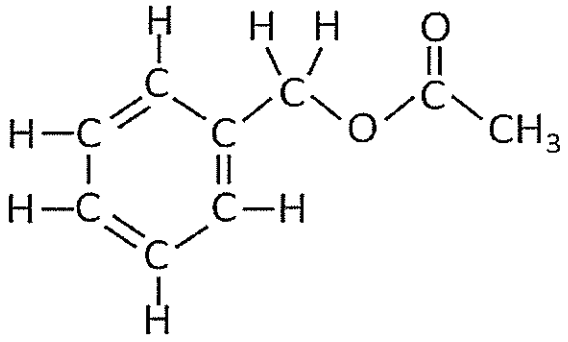
37 An experiment is set up as shown below.



Which of the following **incorrectly** describes the products formed?

A A mixture of alkanes and hydrogen could be formed.
B A mixture of alkenes and hydrogen could be formed.
C A mixture of only hydrocarbons could be formed.
D The products are all flammable.

38 An ester, benzyl acetate, is found in natural sources such as jasmine flowers. Its full structural formula is shown below.



Which pair of reactants could react to form benzyl acetate?

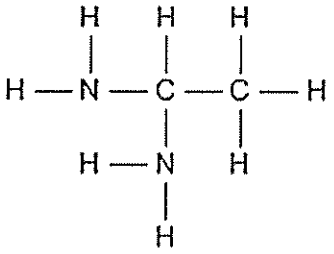
A $C_6H_5CH_3$ and CH_3COOH
B $C_6H_5CH_2OH$ and CH_3COOH
C C_6H_5COOH and C_2H_5COOH
D $C_6H_5CH_2COOH$ and C_2H_5OH

39 0.01 mol of a polyunsaturated hydrocarbon is found to react with 720 cm^3 of hydrogen gas measured at room temperature and pressure. The product formed has ten carbon atoms in its molecule.

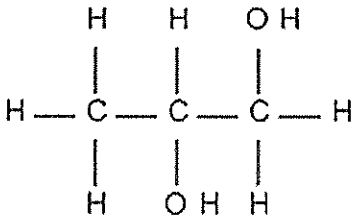
What is the molecular formula of the polyunsaturated hydrocarbon?

A $C_{10}H_{14}$
B $C_{10}H_{16}$
C $C_{10}H_{18}$
D $C_{10}H_{20}$

40 Which of the following molecules is **not** able to undergo condensation polymerisation?



A



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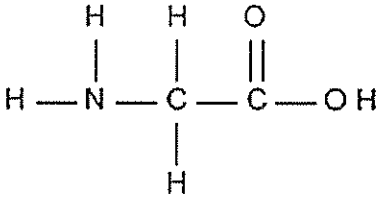
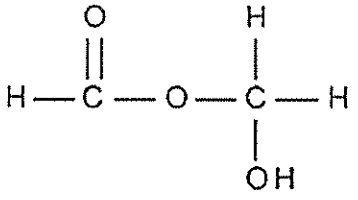


C



D

END OF PAPER

The Periodic Table of Elements

Group																	
I	II											III	IV	V	VI	VII	0
							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											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 –		

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.).