Name and Index Number: ( )	Class:

SENG KANG SECONDARY SCHOOL
PRELIMINARY EXAMINATION

CHEMISTRY 6092/01

Secondary 4 Express

30 August 2022

Paper 1 Multiple Choice

1 hour

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write your index number and name on all the work you hand in.
You may use a soft pencil for any diagrams, graphs or rough working.
Do not use staples, paper clips, highlighters, glue or correction fluid.

There are **forty** questions in 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 Multiple Choice 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 question paper.
The use of an approved scientific calculator is expected, where appropriate.

A copy of the Periodic Table is printed on page 18.

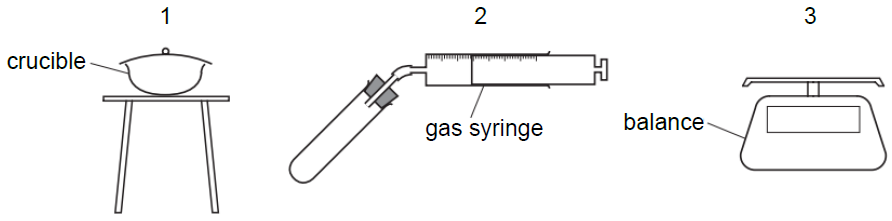
Parent's / Guardian's Signature: ……..

This document consists of **17** printed pages and **1** blank page.

Do not turn over the page until you are told to do so.

1 The formula of magnesium oxide can be investigated from heating magnesium with oxygen to form magnesium oxide.

Which apparatus are used for this investigation?



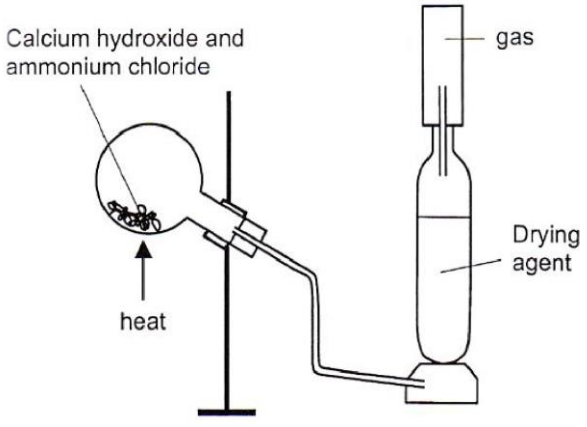
A 1 and 2 only

B 1 and 3 only

C 2 and 3 only

D 1, 2 and 3

2 A student set up the apparatus as shown.



What is the gas that will be collected from the set-up and which drying agent that should be used?

	name of gas	drying agent
A	ammonia	concentrated sulfuric acid
B	ammonia	calcium oxide
C	hydrogen chloride	calcium oxide
D	hydrogen chloride	concentrated sulfuric acid

3 Which statement about methods of purification and analysis is correct?

A A liquid that boils over a range of temperatures may still be 100% pure.

B An insoluble substance may be separated from water by crystallisation.

C Chromatography may only be used to separate coloured substances.

D Liquid air can be fractionally distilled, giving oxygen as one of the products.

4 Mary performed paper chromatography on a dye and obtained only one spot with an R_f value of 0.68.

Which statement is true about her chromatogram?

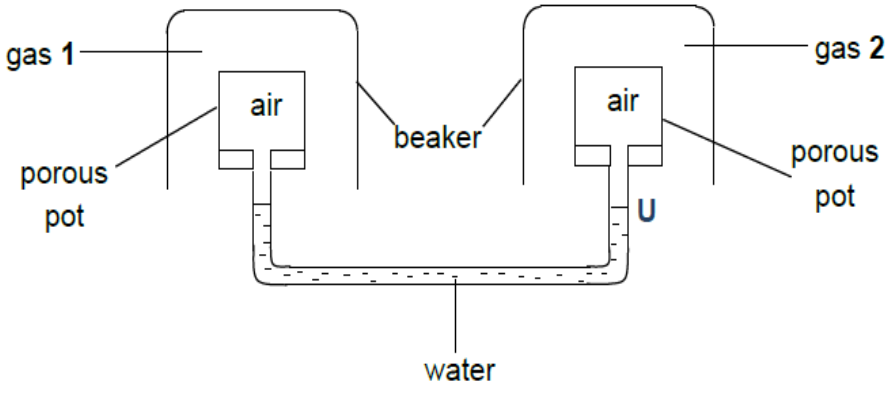
A Changing the solvent will not affect the R_f value.

B Using a more concentrated dye solution will increase the R_f value.

C The dye is likely to be a pure substance.

D The spot is closer to the starting line than it is to the solvent front.

5 The apparatus is set up, using different gases in two inverted beakers.



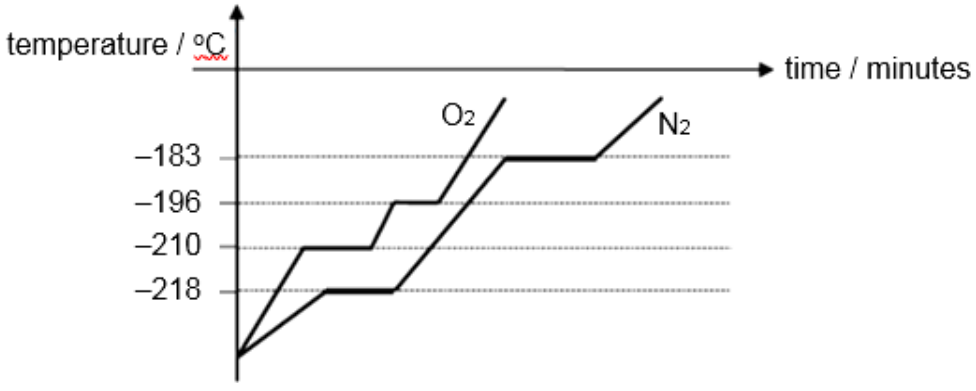
Which pair of gases would cause an upward movement of the water level at **U**?

	gas 1	gas 2
A	hydrogen	carbon dioxide
B	carbon dioxide	hydrogen
C	nitrogen	hydrogen
D	carbon dioxide	nitrogen

6 In which of the following substances are the particles closest to each other?

A dry ice
B lithium fluoride solution
C hydrogen gas
D molten aluminium

7 The graphs (not drawn to scale) show the heating curves of oxygen and nitrogen over a period of time.



Which statement about a mixture of oxygen and nitrogen is correct?

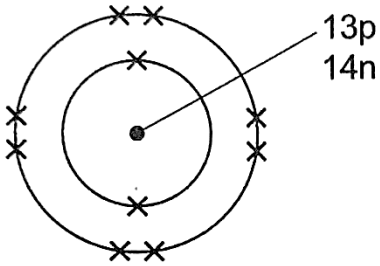
A At –185 °C, both oxygen and nitrogen molecules move rapidly in all directions.
B At –190 °C, both oxygen and nitrogen exist as a liquid.
C At –200 °C, both oxygen and nitrogen exist in the same state.
D At –215 °C, both nitrogen and oxygen molecules are vibrating about fixed positions.

8 An element with proton number 12 has a relative atomic mass of 24.4 and it is known that this element consists of two isotopes with 12 and 14 neutrons respectively.

What is the ratio of the percentage abundance of the lighter isotope to the heavier isotope?

A 1 : 2
B 1 : 4
C 2 : 1
D 4 : 1

9 The diagram shows a structure of an ion.



p = proton
n = neutron
× = electron

What is the correct position in the Periodic Table of the element from which this ion was formed?

	period	group
A	2	III
B	2	0
C	3	III
D	3	0

10 The proton numbers of elements X, Y and Z are 6, 8 and 12 respectively.

Which row shows the correct formula of the compounds formed between the elements?

	formula of compound formed		
A	Z_2Y	XY	ZX_2
B	ZY	XY_2	ZX_2
C	ZY	XY_2	Z_2X
D	Z_2Y	XY	Z_2X

11 Capsaicin, which is found in chilli and pepper, causes the spicy burning sensation in the mouth.

It has the molecular formula $C_{18}H_{27}NO_3$ and has a melting point of 65 °C.

Which of the following statements best explains why drinking water is ineffective in removing the burning sensation caused by capsaicin?

A Capsaicin has a giant molecular structure and is soluble in water.

B Capsaicin has a giant molecular structure and is not very soluble in water.

C Capsaicin has a simple molecular structure and is soluble in water.

D Capsaicin has a simple molecular structure and is not very soluble in water.

12 In the lattice structure of ionic compounds, the coordination number of each ion is the number of neighbouring ions of opposite charge.

The table shows the ions present and the coordination number of the ions in some ionic compounds. Taking sodium chloride for instance, each sodium ion is surrounded by 6 chloride ions, while each chloride ion is surrounded by 6 sodium ions. Hence, the coordination number for both the sodium ions and chloride ions is 6.

ionic compound	ion present		coordination number of		formula
	cation	anion	cation	anion	
sodium chloride	Na^+	Cl^-	6	6	NaCl
titanium (IV) oxide	Ti^{4+}	O^{2-}	6	3	TiO_2
unknown compound	Q	R	4	8	?

What is the formula of the unknown compound?

A QR_2

B Q_2R

C QR_4

D Q_4R

13 A sample of a white crystalline substance is heated in the absence of oxygen. It melts sharply at 120 ^oC. On further heating, it gives off smoky fumes and a black solid remains.

What can we conclude about the white crystalline substance?

A an element which decomposed to simpler substance.

B a mixture of substances which combined chemically.

C a compound which decomposed to form simpler substance.

D a compound which combusted to form two products.

14 Nitrogen monoxide gas from motor vehicle exhausts can be removed by injecting a stream of ammonia gas into the exhaust vapour. The reaction is shown below.

$$6NO(g) + 4NH_3(g) \rightarrow 5N_2(g) + 6H_2O\ (g)$$

What volume of ammonia gas is needed to completely react with 3600 cm^3 of nitrogen monoxide?

A 600 cm^3

B 1200 cm^3

C 2400 cm^3

D 5400 cm^3

15 In an experiment, 10 cm^3 of a gaseous hydrocarbon, **X**, required 75 cm^3 of oxygen for complete combustion to give 60 cm^3 of carbon dioxide. All gas volumes were measured at room temperature and pressure.

What is the formula of **X**?

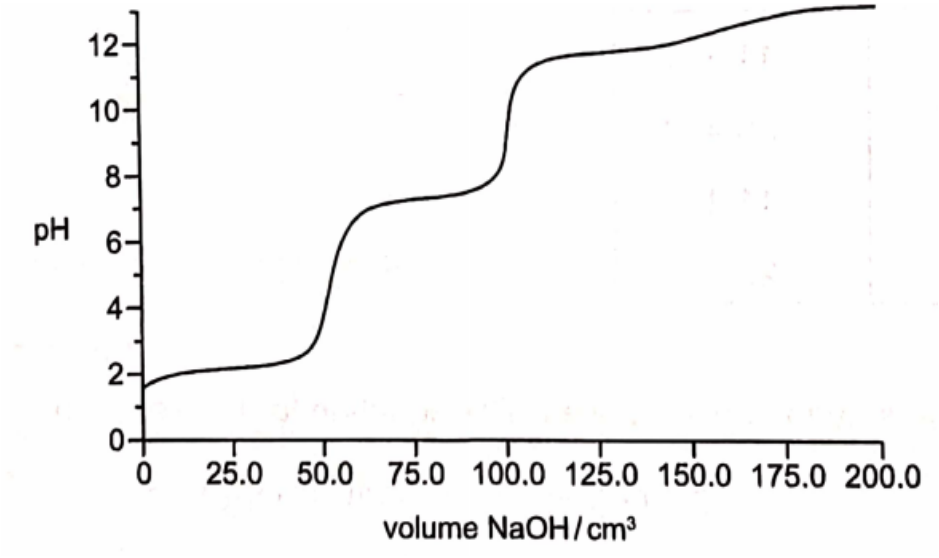
A C_6H_6
B C_6H_8
C C_6H_{10}
D $C_{12}H_{15}$

16 Which of the following contains 1 mole of ions when in aqueous state?

A 0.25 mol of Na_3PO_4
B 0.50 mol of CO
C 0.50 mol Cs_2O
D 1.00 mol CaO

17 When an acid is titrated with a strong base, an equivalence point is reached when the amount of base added is equal to the amount of H^+ dissociated.

The curve for the titration of 50.0 cm^3 of 0.10 mol/dm^3 phosphoric acid, H_3PO_4, against 0.10 mol/dm^3 NaOH is shown.



The table shows the pH range of colour changes of some acid-base indicators.

indicator	pH of colour changes
thymol blue	1.2 - 2.8 and 8.0-9.6
naphthyl red	3.7-5.0
neutral red	6.8-8.0

Which indicators should be used to show the first and second equivalence points?

A thymol blue for both
B thymol blue and then neutral red
C naphthyl red and then thymol blue
D naphthyl red and then neutral red

18 Sulfuric acid and nitric acid are both strong acids.

Ethanoic acid is a weak acid.

20.00 cm^3 solutions of 0.10 mol/dm^3 concentration of each of these three acids were separately titrated with a 0.10 mol/dm^3 solution of sodium hydroxide.

Which statement will correctly describe the condition for a complete reaction?

A all three acids would require the same volume of sodium hydroxide solution

B ethanoic acid and nitric acid would require the same volume of sodium hydroxide solution but sulfuric acid would require more

C nitric acid would require more sodium hydroxide solution than ethanoic acid but less than sulfuric acid

D sulfuric acid and nitric acid would require the same volume of sodium hydroxide solution but ethanoic acid would require less

19 The following table gives some information about four solutions P, Q, R and S. All the solutions have the same concentration.

solution	effect of adding zinc	electrical conductivity	effect of warming with ammonium chloride
P	no effervescence	low	ammonia gas evolved
Q	effervescence	high	no visible change
R	no effervescence	high	ammonia gas evolved
S	effervescence	low	no visible change

What is the order of the solutions in increasing pH?

	lowest pH → highest pH			
A	P	R	S	Q
B	Q	S	P	R
C	R	P	S	Q
D	S	Q	P	R

20 A student mixed two aqueous solutions of ionic compounds at a time and made the observations.

solution 1	solution 2	observations
$MgCrO_4$	$Ca(ClO_3)_2$	no precipitate observed.
$MgCrO_4$	$Pb(ClO_3)_2$	a yellow precipitate observed
$Mg(IO_3)_2$	$Ni(ClO_3)_2$	a brown precipitate observed
$Mg(IO_3)_2$	$Sr(ClO_3)_2$	a yellow precipitate observed

Which statement can be concluded based on these observations?

A $CaCrO_4$, $Ni(IO_3)_2$, $PbCrO_4$ and $Sr(IO_3)_2$ are insoluble.

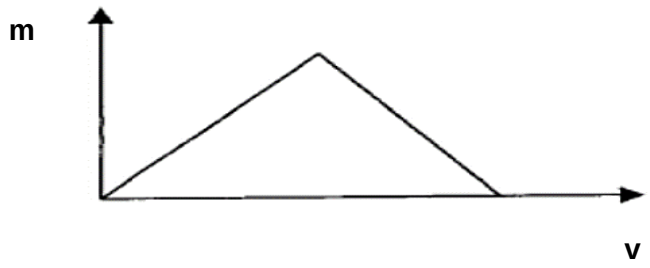
B $Ni(IO_3)_2$, $PbCrO_4$ and $Sr(IO_3)_2$ are insoluble.

C Only $Mg(ClO_3)_2$ and $Ni(IO_3)_2$ are insoluble.

D Only $Ni(IO_3)_2$ and $PbCrO_4$ are insoluble

21 In a test for the presence of a cation in an aqueous salt solution, aqueous sodium hydroxide is added slowly until in excess.

The diagram shows how the mass (m) of the precipitate varies with the volume (v) of sodium hydroxide added.



Which compound **cannot** be the aqueous salt solution?

A aluminium nitrate

B lead(II) nitrate

C zinc nitrate

D sodium nitrate

22 The following scheme shows the steps to prepare lead(II) chloride from lead(II) carbonate.

lead(II) carbonate $\xrightarrow{\text{reagent X}}$ lead(II) nitrate $\xrightarrow{\text{reagent Y}}$ lead(II) chloride

What are reagents X and Y?

	X	Y
A	aqueous sodium nitrate	dilute hydrochloric acid
B	aqueous sodium nitrate	sodium chloride
C	dilute nitric acid	dilute hydrochloric acid
D	dilute nitric acid	sodium chloride

23 One way of recovering tin from old printed circuit boards is to dissolve it in a mixture of concentrated hydrochloric acid and concentrated nitric acid.

The tin dissolves because it reacts with the mixture of these concentrated acids.

$$Sn + 4HCl + 2HNO_3 \rightarrow SnCl_4 + NO_2 + NO + 3H_2O$$

Which statement about this reaction is/are correct?

1 Nitrogen is present in three different oxidation states in the reactants and products.
2 The oxidation state of tin increases from 0 to +4.
3 The oxidation state of chlorine remains the same.

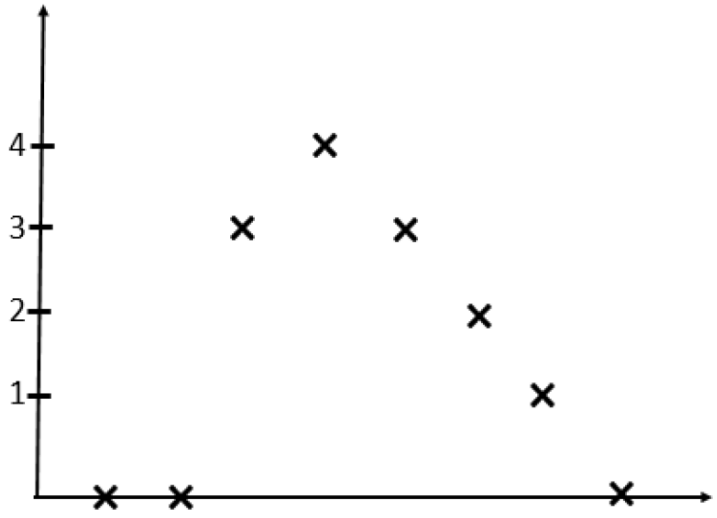
A 1 only
B 2 and 3
C 1 and 2
D 1, 2 and 3

24 Which of the properties listed will a typical group I element have?

1 A low density
2 A high melting point
3 Variable oxidation states
4 Form colourless compounds

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

25 The graph below shows the trend of some elements.



Which labels could the axes be?

	x-axis	y-axis
A	melting point	elements across the period
B	reactivity	elements down the group
C	number of valence electrons shared during bonding	elements across the period
D	number of valence electrons transferred during bonding	elements down the group

26 Gallium is in Group III of the Periodic Table. It has a proton number of 31.

Selenium is in Group VI of the Periodic Table. It has a proton number of 34.

Which prediction is **incorrect**, based on the positions of gallium and selenium in the Periodic Table?

A A gallium atom has three valence electrons while a selenium atom has six.

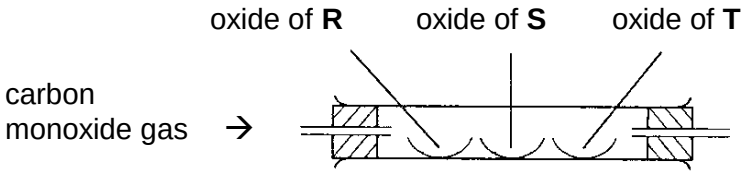
B Gallium forms Ga^{3+} ion and selenium forms Se^{2-} ion.

C Gallium has less metallic character than selenium.

D Gallium has similar properties to aluminium and selenium has similar properties to sulfur.

27 Three metallic oxide powders containing metals **R**, **S** and **T** are heated strongly in a hard glass tube as shown.

At the same time carbon monoxide gas is directed through the tube.



Oxide of **R** reacts slowly, oxide of **T** glows strongly while oxide of **S** does not undergo any changes.

Based on these observations, what is the order of reactivity of **R**, **S**, **T** and carbon?

	most reactive → least reactive			
A	**R**	**S**	**T**	carbon
B	**T**	**R**	carbon	**S**
C	**S**	carbon	**R**	**T**
D	**T**	carbon	**R**	**S**

28 A metal block left in the open for a few months was observed to have corroded. The rough coating on the surface of the metal block was scraped off and analysed.

The coating dissolved completely in dilute hydrochloric acid producing an orange solution.

What is the metal block made of, and what is the identity of the rough coating?

	metal block	rough coating
A	Fe	$Fe(OH)_3$
B	Zn	$ZnCO_3$
C	Cu	$CuCO_3$
D	A*l*	Al_2O_3

29 Which property best describes a metal which is found at the top of the reactivity series?

A readily loses electron

B burns to form an acidic oxide

C always forms an unstable compound

D forms an oxide which is easy to reduce with carbon

30 During electrolysis, 0.015 moles of chromium is deposited on the cathode when 0.090 moles of electrons is passed through molten electrolyte containing chromium.

Which substance could be the electrolyte?

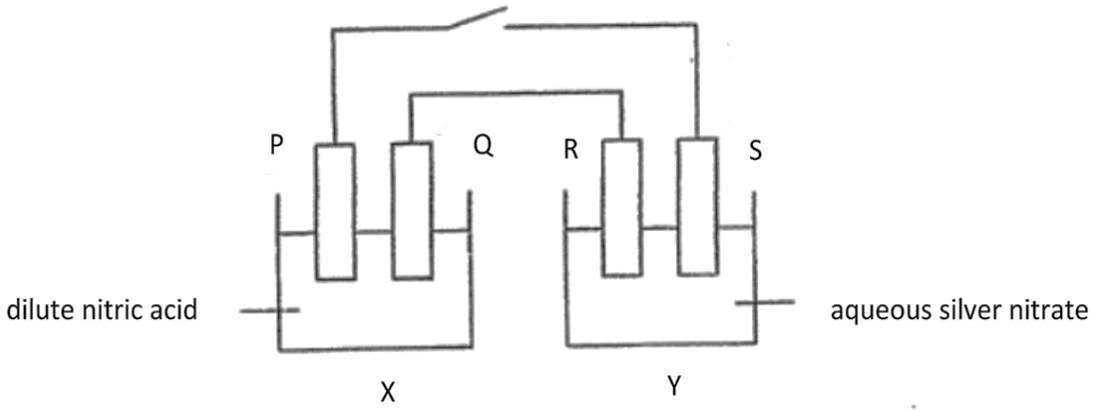
A $CrCl_4$

B $CrBr_2$

C $Cr_2(SO_4)_3$

D $Cr(NO_3)_6$

31 In the set-up X, P and Q are two different metals. In the set-up Y, R and S are carbon electrodes. When the circuit is closed, electric current flows. After some time, silver is formed on the carbon electrode S.



Which statement(s) concerning the set-up is/are correct?

1. In set-up Y, pH of the electrolyte decreases after some time.
2. Electrons flow in a clockwise direction in the circuit.
3. Metal Q is more reactive than metal P.
4. Effervescence is observed at Q.

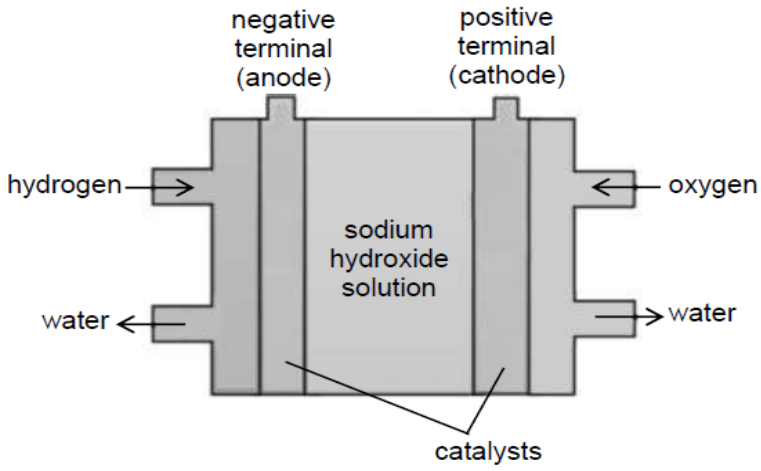
A 1 only

B 1 and 2 only

C 2 and 3 only

D 1, 2 and 4 only

32 Some cars use hydrogen-oxygen fuel cells to generate electricity as shown in the diagram.



Which half-equation represents the reaction that takes place at the positive terminal of the fuel cell?

A $H_2(g) + 2OH^-(aq) \rightarrow 2H_2O(l) + 2e$

B $O_2(g) + 2H_2O(l) + 4e \rightarrow 4OH^-(aq)$

C $2H_2O(l) + 2e \rightarrow H_2(g) + 2OH^-(aq)$

D $4OH^-(aq) \rightarrow O_2(g) + 2H_2O(l) + 4e$

33 Ammonia is manufactured by the Haber Process. The equation for the Haber process is given below.

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g) \qquad \Delta H = -92kJ/mol$$

Which statement about the Haber Process is true?

A Hydrogen used is obtained from the hydrogenation of alkenes.

B Nitrogen used is obtained from the fractional distillation of crude oil.

C The reaction is exothermic as energy is absorbed to break the strong N≡N bonds.

D The yield of the reaction is always lower than 100% as the reaction is reversible.

34 Nitrogen in fertilisers are often found in the form of nitrates. The presence of certain bacteria in the soil converts nitrates into ammonium ions which can be retained in the soil better. However, in less ideal conditions, nitrogen is lost as ammonia gas.

What conditions in the soil would improve the production and retention of ammonium ions?

A oxidising and acidic

B oxidising and alkaline

C reducing and acidic

D reducing and alkaline

35 Which of the following statements about atmospheric pollutants is true?

A Carbon monoxide is oxidised by oxygen and dissolves in rainwater to form acid rain.

B Hydrocarbons react with fluorine to produce a gas that depletes the ozone layer.

C Ozone at low altitudes in the atmosphere helps to block off ultra-violet rays

D Sulfur dioxide can be removed from flue gases by passing over calcium carbonate

36 Diesel and petrol are used commonly as fuels for cars. The combustion of these fuels produces air pollutants.

The table shows the mass of air pollutants found in exhaust fumes when 1 kg of each fuel is combusted under identical conditions.

air pollutant produced	mass of air pollutant after diesel is combusted / g	mass of air pollutant after petrol is combusted / g
carbon monoxide	15	300
unburnt hydrocarbons	20	25
oxides of nitrogen	95	40

Which of the following can be inferred from the information in the table?

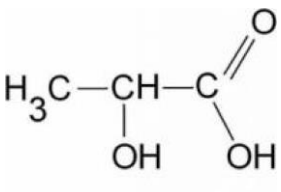
A A diesel engine has a higher temperature than a petrol engine.

B Burning of petrol contributes more towards acid rain.

C Combustion of petrol is more exothermic than that of diesel.

D Petrol requires less oxygen for complete combustion.

37 A molecule of 2-hydroxyl propanoic acid is shown.



Which of the following reactions can occur with this acid?

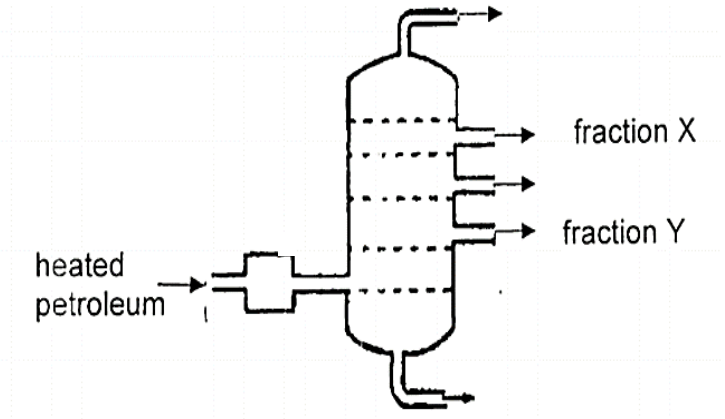
A It produces ammonia gas with ammonium nitrate.

B It decolourises aqueous bromine.

C It is insoluble in water.

D It undergoes condensation polymerisation.

38 The diagram shows the fractional distillation of petroleum.



Which statements about fractions **X** and **Y** are correct?

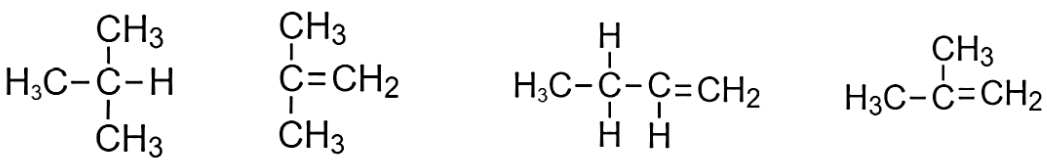
	X is more flammable than Y	X burns with a less sooty flame than Y	X is more viscous than Y
A	yes	no	no
B	yes	yes	no
C	no	yes	yes
D	no	no	yes

39 5 g of vegetable oil (M_r = 800) reacted completely with 900 cm^3 of hydrogen gas (measured at room temperature and pressure) to form margarine which is a saturated fat.

How many C=C bonds are there in one molecule of the oil?

A 3 **B** 4 **C** 5 **D** 6

40 The structures of four hydrocarbons are shown.



How many isomers of butene are there?

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

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 –

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