PRESBYTERIAN HIGH SCHOOL

CHEMISTRY **5073/1**

Paper 1 Multiple Choice

31 August 2016 **Wednesday** **1 hour**

2016 SECONDARY FOUR EXPRESS
PRELIMINARY EXAMINATION

INSTRUCTIONS TO CANDIDATES:

DO NOT OPEN THIS QUESTION PAPER UNTIL YOU ARE TOLD TO DO SO.

Write in soft pencil.
Do not use staples, paper clips, highlighters, glue or correction fluid.
Write your name, class and register number on the Answer Sheet in the spaces provided.

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

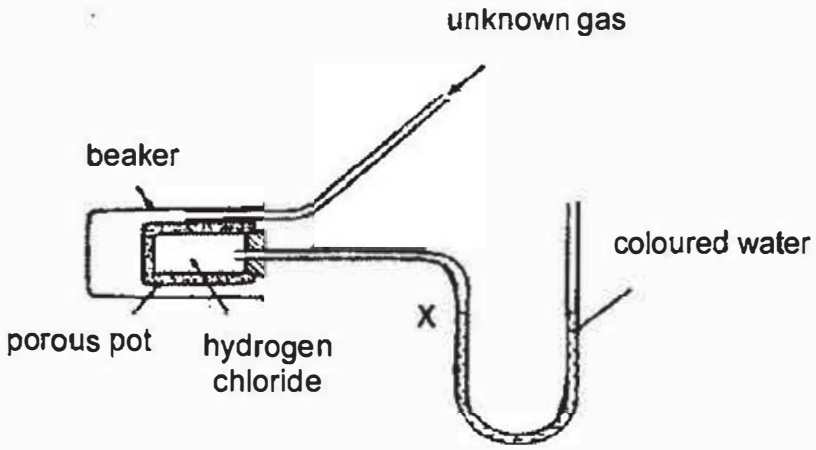
Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this booklet.

A copy of the Periodic Table is printed on page 21.

Setter: Miss Cynthia Lim

This question paper consists of 21 printed pages (including this cover page) and 1 blank page.

1 A beaker of unknown gas was placed over a porous pot containing hydrogen chloride as shown.



Over a period of time, which unknown gas would cause the water level at X to rise and then return to X?

A argon
B hydrogen
C nitrogen
D oxygen

2 Caffeine is a white solid that melts at 235 °C.

A quantity of impure caffeine is found contaminated with sugar. The solubility of caffeine and sugar in the two solvents are listed in the table.

substance	solubility in water	solubility in propanone
caffeine	moderate	high
sugar	high	nil

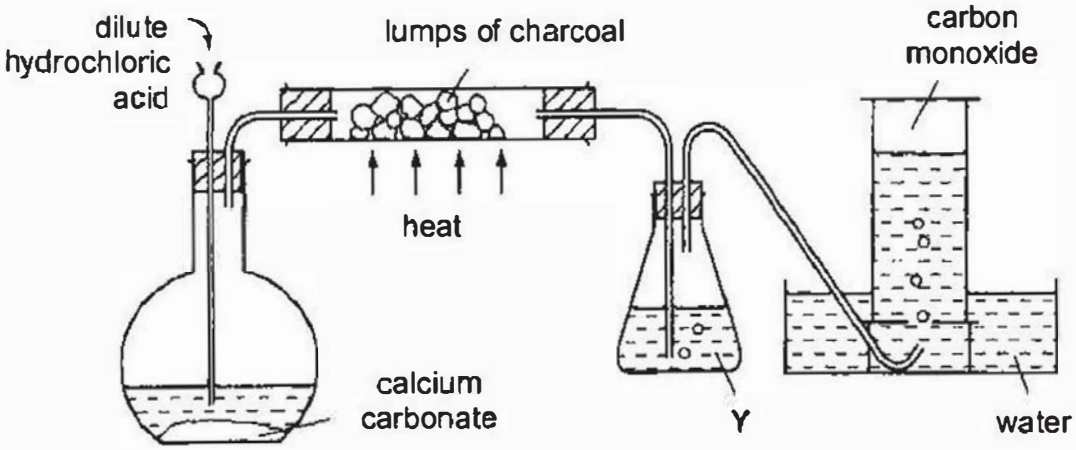
The following steps could be carried out to obtain pure caffeine from a mixture of caffeine and sugar.

I add excess water
II filter the mixture
III add excess propanone
IV cool and crystalline
V heat the filtrate

In which order should the steps be carried out?

A I, II, IV and V
B I, II, V and IV
C III, II, V and IV
D III, II, IV and V

3 The diagram shows the apparatus used to obtain carbon monoxide.



What is the main purpose of Y?

A to dry the gas
B to prevent water being sucked back on to the hot carbon
C to remove carbon dioxide from the gas
D to remove hydrogen chloride from the gas

4 An isotope of element A has 17 protons and 20 neutrons in its nucleus. Which symbol is correct for the ion of A?

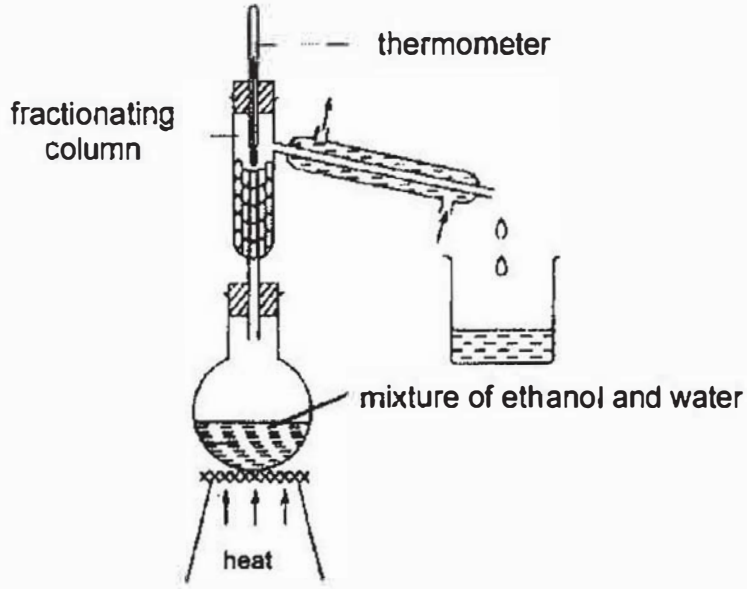
A $^{20}_{17}A^{+}$

B $^{37}_{17}A^{+}$

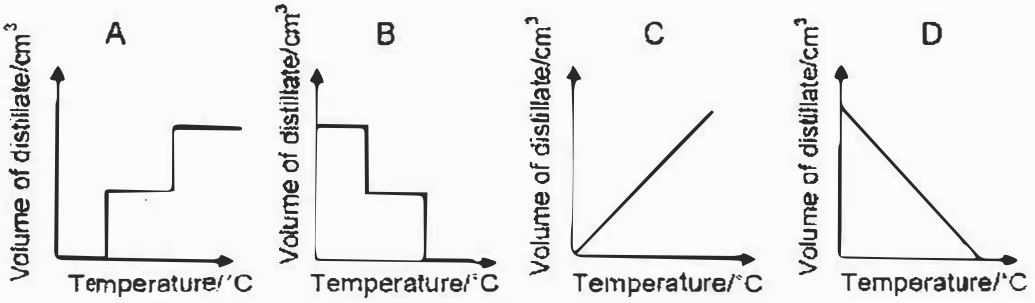
C $^{20}_{17}A^{-}$

D $^{37}_{17}A^{-}$

5 A student sets up the following apparatus to separate ethanol (boiling point 78 °C) and water (boiling point 100 °C).



Which graph correctly shows the relationship between total volume of distillate plotted against temperature?



6 The table below shows some of the physical properties of substances **P**, **Q**, **R** and **S**.

substance	melting point / °C	boiling point / °C	electrical conductivity		solubility in water
			solid state	liquid state	
P	122	550	poor	poor	insoluble
Q	690	1790	poor	good	soluble
R	1510	2489	poor	poor	insoluble
S	1453	2730	good	good	insoluble

Which of the following statements about the four substances is correct?

A Substance **P** is a simple molecular compound with weak covalent bonds.
B Substance **Q** is an ionic compound with mobile electrons in the liquid state.
C Substance **R** is a macromolecule with immobile electrons held by strong electrostatic forces.
D Substance **S** is a macromolecule with mobile electrons.

7 Element **X** has n protons and forms ions with a charge of 2-.
Element **Y** has $(n + 3)$ protons.

Which of the following correctly shows the structure and formula of a compound formed between elements **X** and **Y**?

A a covalent compound YX_2
B a covalent compound Y_2X
C an ionic compound YX_2
D an ionic compound Y_2X

8 Brass is an alloy of zinc (30%) and copper (70%). Which of the following correctly describes the atoms in a sample of **molten** brass?

	copper atoms	zinc atoms
A	close together and vibrating vigorously	close together and vibrating vigorously
B	close together and moving at random	widely spaced and moving at random
C	widely spaced and vibrating vigorously	close together and vibrating vigorously
D	widely spaced and vibrating vigorously	widely spaced and moving at random

9 When a 2.31 g sample of oxide of nitrogen was analysed, it was found to contain 0.68 g of nitrogen.

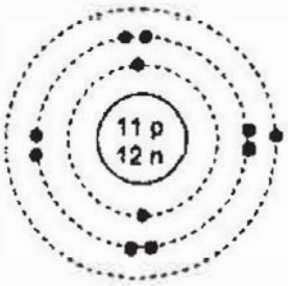
What is the empirical formula of the oxide of nitrogen?

A NO
B N_2O
C NO_2
D N_2O_4

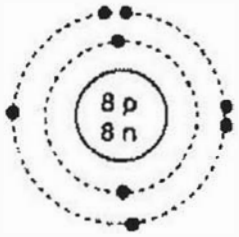
10 Which of the following will produce 1.0 mol of carbon dioxide on complete combustion?

A 0.25 mol of ethanol
B 0.5 mol of ethene
C 1.0 mol of propane
D 1.5 mol of graphite

11 The diagram below shows the atoms of two elements, **Q** and **R**.



Q



R

What is the percentage by mass of element **Q** in the compound formed between **Q** and **R**?

A 25.8%
B 41.8%
C 59.0%
D 74.2%

12 $C_2H_5OH + 2[O] \rightarrow CH_3COOH + H_2O$

The chemical equation shows the reaction of 2.30 g of ethanol mixed with an excess of aqueous potassium manganate(VII).

The reaction mixture was then warmed for one hour. The desired organic product was then collected by distillation. The yield of the product was 60.0%.

What mass of product was collected?

A 1.32 g
B 1.38 g
C 1.80 g
D 3.20 g

13 Which property generally decreases when going across a period of the Periodic Table from Group I to Group VII?

A the acidity of the oxides of the elements
B the number of electrons in the valence shell
C the reducing power of an element
D the tendency of the elements to form negative ions

14 Three experiments are carried out to determine the reactivity of three unknown halogens. The ionic equations of the three experiments are shown below.

$$Z^-(aq) + Y_2(aq) \rightarrow \text{no reaction}$$
$$X^-(aq) + Z_2(aq) \rightarrow \text{no reaction}$$
$$2Y^-(aq) + X_2(aq) \rightarrow 2X^-(aq) + Y_2(aq)$$

Predict the reactivity of the halogens in **decreasing** order.

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

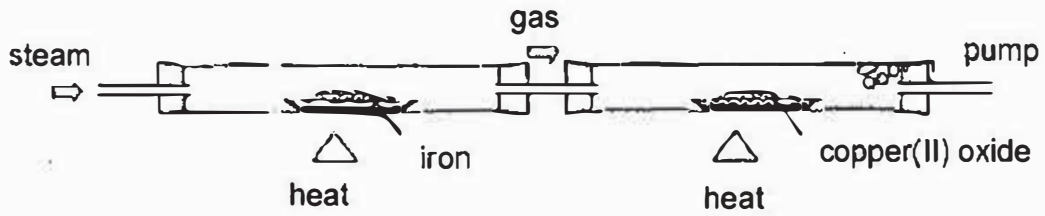
15 The properties of some elements, **W**, **X**, **Y** and **Z** in Period 3 are shown in the table below.

element	W	X	Y	Z
appearance at room temperature	grey solid	yellow solid	grey solid	yellow green gas
reaction with cold water	extremely violent reaction	no reaction	vigorous reaction	slow reaction
nature of oxide	reacts with acids	reacts with bases	reacts with both acids and bases	reacts with bases

Which of the following shows the arrangement of these elements in the Periodic Table in increasing order of group number?

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

16 Which of the following is **not** a product of the reaction sequence below?



A copper
B iron(II) oxide
C oxygen
D water vapour

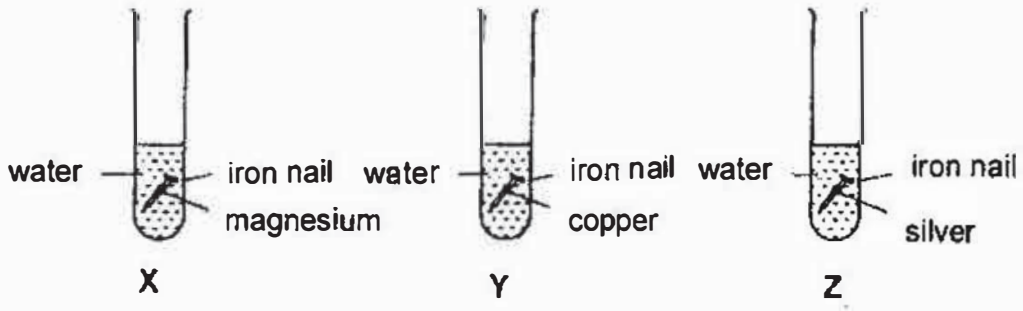
17 The table shows the results of adding weighed pieces of nickel metal in salt solutions of metals **W**, **X**, **Y** and **Z**.

salt solution of metal	initial mass of nickel / g	mass of nickel after 15 min / g
W	6.0	5.0
X	6.0	5.5
Y	6.0	4.5
Z	6.0	0.0

Which of the following statements is correct?

A Metal **W** is higher than metal **X** in the reactivity series.
B Metal **Y** can displace metal **Z** from its salt solution.
C Metal **Y** is higher than nickel in the reactivity series.
D **Z** could be nickel(II) chloride solution.

18 Three experiments are set up to investigate the sacrificial protection of iron. The iron nails are coated with some other metals as shown below.



In which test tube(s) will the iron nail rust?

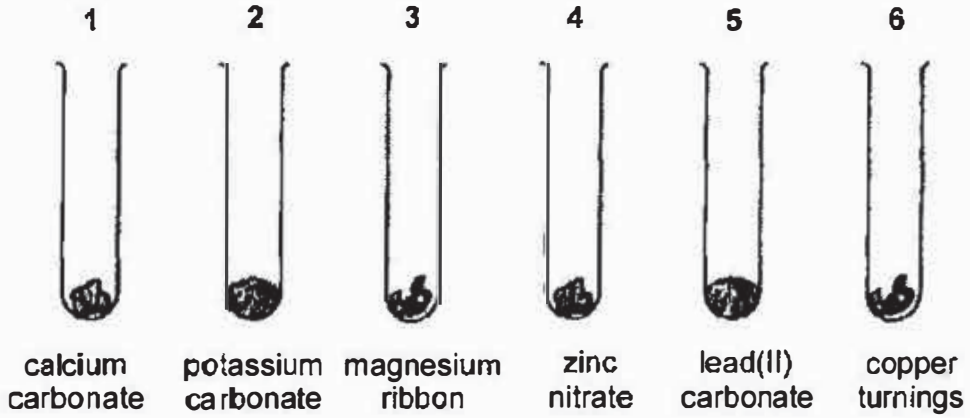
A **X** only
B **X** and **Y** only
C **X** and **Z** only
D **Y** and **Z** only

19 The water from hot springs near the Ebeko volcano in the Pacific Ocean has a very low pH.

What does the low pH indicate about the water from the hot springs?

A It has equal concentrations of H^+ and OH^- ions.
B It has equal numbers of positive and negative ions.
C It has high concentrations of H^+ ions.
D It has no detectable H^+ or OH^- ions.

20 Dilute sulfuric acid was added to the test tubes shown below. Some of them had no visible reaction while some of them reacted quickly, giving off a gas. However, some of them fizzed at first and then stopped after a short time.



In which test tubes reaction lasted for a short time only?

A test tubes **1** and **5**
B test tubes **1**, **2** and **5**
C test tubes **3** and **4**
D test tubes **2** and **6**

21 When sodium carbonate is dissolved in water, carbonic acid and sodium hydroxide are formed.

$$Na_2CO_3\,(aq) + 2H_2O\,(l) \rightarrow H_2CO_3\,(aq) + 2NaOH\,(aq)$$

Carbonic acid decomposes on standing to form CO_2 gas and H_2O.

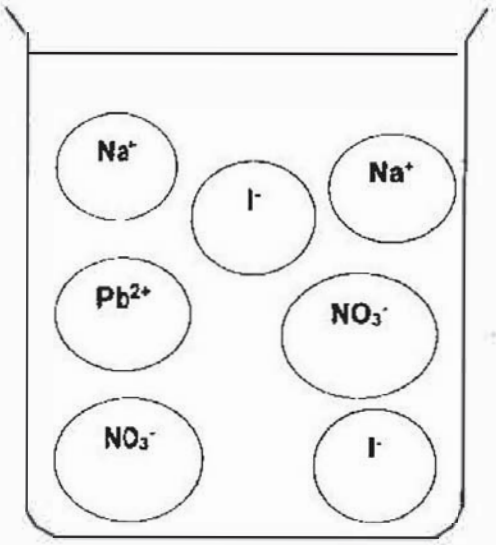
The table below shows the results of tests on the solution of sodium carbonate. Which results are correct?

	pH of solution when sodium carbonate is dissolved in water	reaction of sodium carbonate with calcium nitrate solution
A	3	white precipitate
B	3	no reaction
C	12	white precipitate
D	12	no reaction

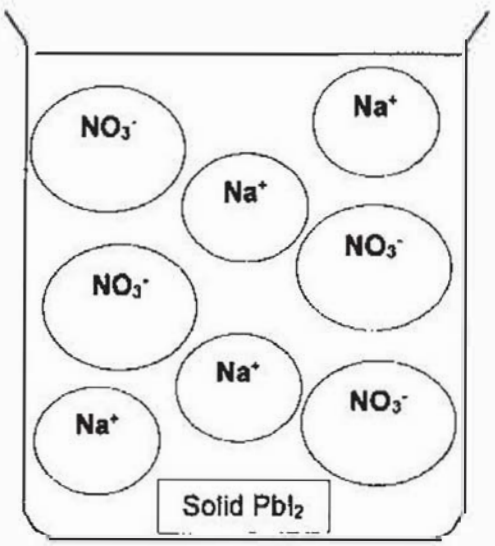
22 A 0.331 g sample of solid lead(II) nitrate is dissolved in water and then added to 125 cm^3 of 0.100 mol/dm^3 sodium iodide solution. Assume there is no change in volume of the solution, the chemical reaction takes place according to the following chemical equation.

$$Pb(NO_3)_2\ (aq) + 2NaI\ (aq) \rightarrow PbI_2\ (s) + 2NaNO_3\ (aq)$$

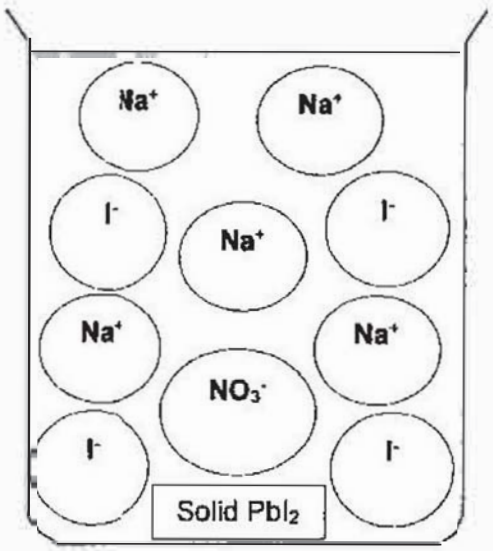
Which of the diagram below **best** represents the results after the mixture has reacted as completely as possible?



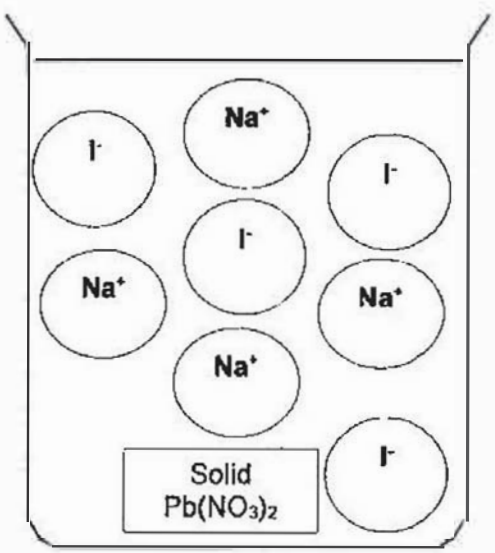
A



B



C

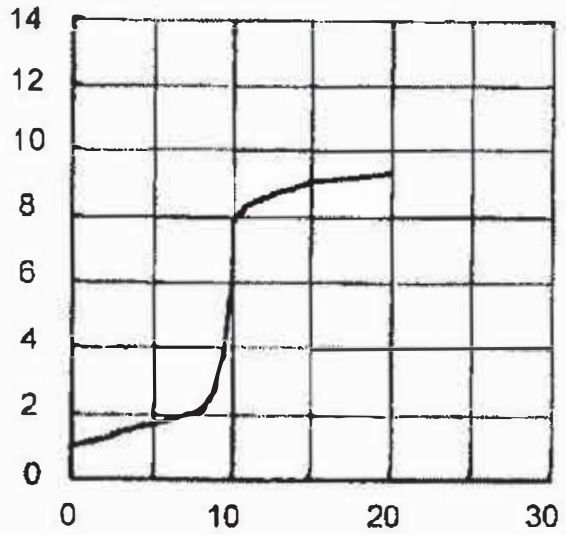


D

23 Different indicators change colour over different pH ranges and it is important to choose the correct indicator to obtain an accurate result in a titration.

indicator	pH range for the colour change	colour	
		lower pH	higher pH
indigo carmine	11.6 to 14.0	blue	yellow
methyl red	4.2 to 6.3	red	yellow
methyl violet	0.3 to 3.0	yellow	violet
phenolphthalein	8.2 to 10.0	colourless	pink

If aqueous ammonia is added to hydrochloric acid, the following graph is obtained, which shows the change of pH with the volume of aqueous ammonia added.



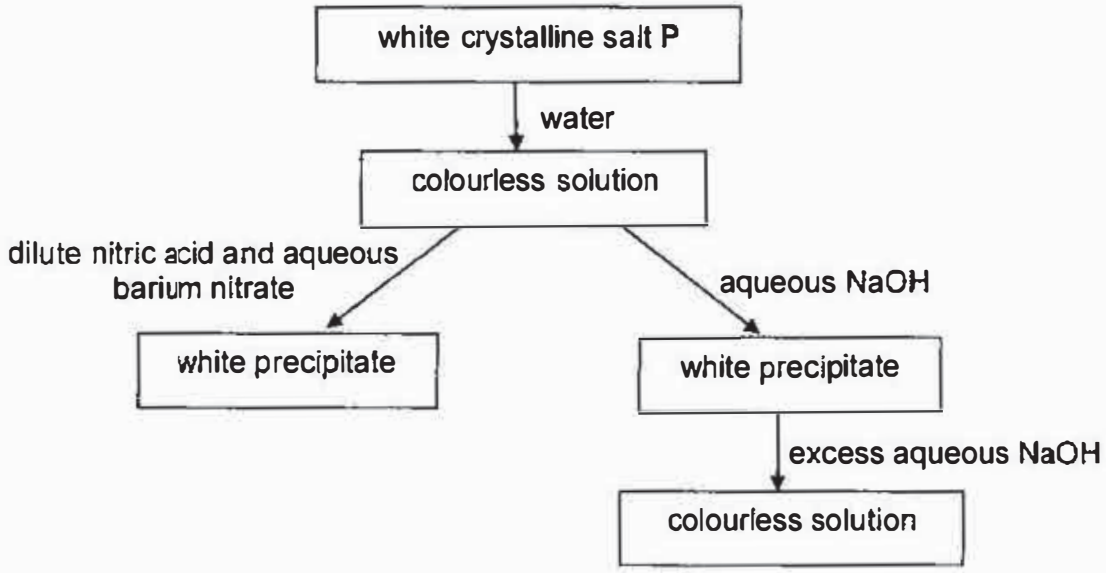
Which of the indicators below would be the best choice to use in the titration?

A indigo carmine
B methyl red
C methyl violet
D phenolphthalein

24 Which statement is true about the Haber Process?

A Increasing the pressure to be above 200 atm will speed up the reaction but cause yield to be low.
B Increasing the temperature to above 450 °C will speed up the reaction but cause the yield to be low
C Nitrogen is obtained from the cracking of petroleum.
D Unreacted gases produced are released into the atmosphere.

25 The diagram shows a reaction scheme.



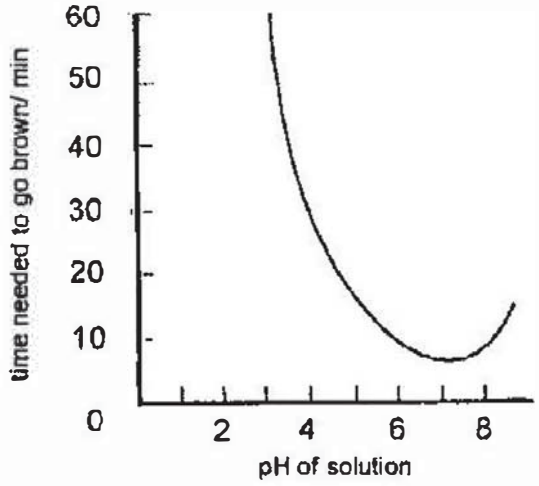
What is the identity of salt P?

A aluminium chloride
B lead(II) sulfate
C zinc chloride
D zinc sulfate

26 Separate samples of hydrogen peroxide are added to aqueous potassium iodide and to acidified potassium manganate(VII). The iodide ions are oxidised and the manganate(VII) ions are reduced. What colour changes are seen?

	potassium iodide	acidified potassium manganate(VII)
A	brown to colourless	colourless to purple
B	brown to colourless	purple to colourless
C	colourless to brown	colourless to purple
D	colourless to brown	purple to colourless

27 Pieces of apples usually go brown when they are left in air for a few minutes. In food processing factories, it is important to stop this browning. The graph shows how browning is controlled by the pH of a solution.



In a laboratory experiment, cut apples are contained in special solutions to stop browning. Which one of these solutions is the best solution to prevent browning of the apples?

A aqueous ammonia
B ethanol
C nitric acid
D propanoic acid

28 The heat-reflecting shields of some space rockets are gold-plated using electrolysis.

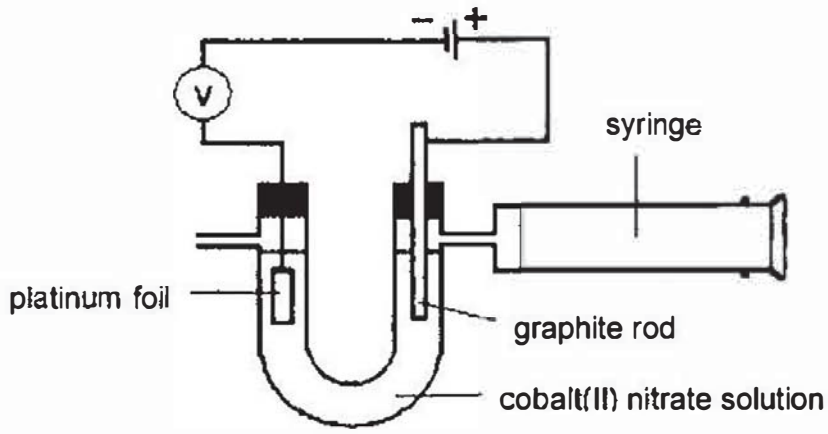
Which electrodes and electrolyte would be used to gold-plate the heat shield?

	negative electrode	positive electrode	electrolyte
A	carbon	heat shield	gold compound
B	gold	heat shield	copper compound
C	heat shield	carbon	copper compound
D	heat shield	gold	gold compound

29 In two separate electrolysis experiments, the same quantity of electricity deposited 16 g of copper from copper(II) nitrate solution and 6 g of titanium. What was the charge on titanium ion?

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

30 A dilute solution of cobalt(II) nitrate was electrolysed in the apparatus shown.



During electrolysis, a grey solid formed on the platinum foil and bubbles of gas appeared around the graphite rod. The gas was collected in the syringe. The gas collected was able to relight a glowing wooden splint.

Which of the following statements are correct?

I Cobalt(II) ions are higher in the electrochemical series than hydrogen ions and are thus preferentially discharged to form grey cobalt metal.

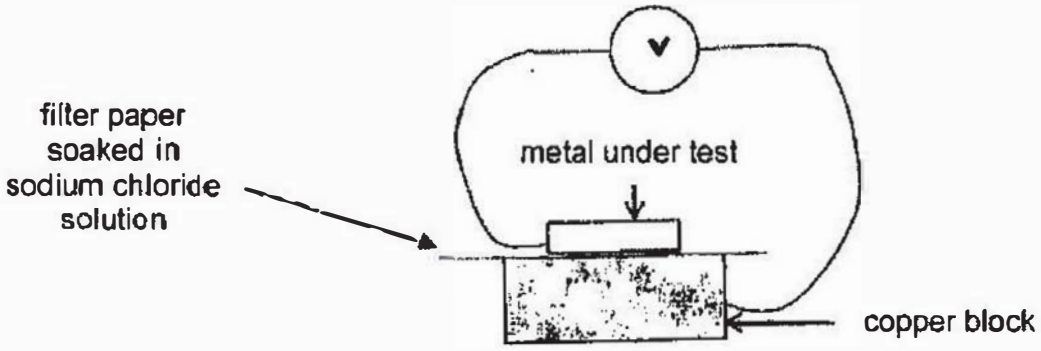
II Hydroxide ions are discharged to form oxygen gas which then reacts with graphite to form carbon dioxide.

III The solution left behind is nitric acid.

IV After a period of time, hydrogen ions are found at higher concentrations and are thus discharged to form hydrogen gas at the graphite rod.

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

31 The apparatus shown below was used to compare the reactivity of metals **P**, **Q**, **R** and **S**.



In each test, the voltmeter reading was recorded in the table shown below.

metal under test	direction of electron flow in external circuit	voltage recorded / V
P	**P** to Cu	+0.87
Q	Cu to **Q**	-1.20
R	**R** to Cu	+1.58
S	**S** to Cu	+0.36

What is the correct order of the metals in **decreasing** reactivity (most reactive to least reactive)?

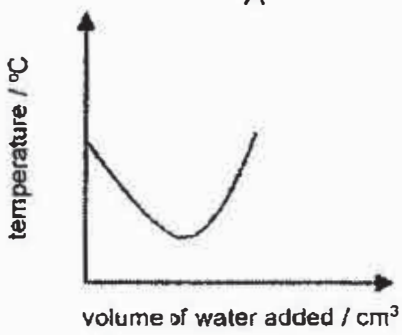
A **P**, **Q**, **R**, **S**
B **Q**, **S**, **P**, **R**
C **R**, **P**, **S**, **Q**
D **R**, **S**, **Q**, **P**

32 Which statement is true about the hydrogen-oxygen fuel cell?

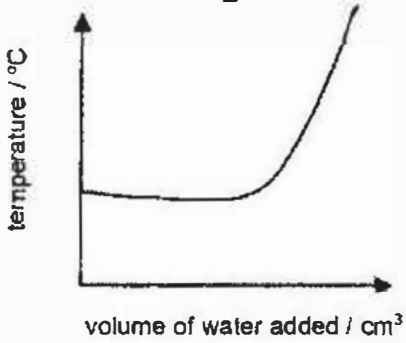
A Hydrogen gas is oxidised at the negative electrode to form water.
B Hydrogen gas is reduced at the negative electrode to form water.
C Oxygen gas is oxidised at the negative electrode to form hydroxide ions.
D Oxygen gas is reduced at negative electrode to form hydroxide ions.

33 When ammonium chloride is dissolved in water, weak forces of attractions are formed between the ions and water molecules. Which graph best represents the observed temperature change?

A



B



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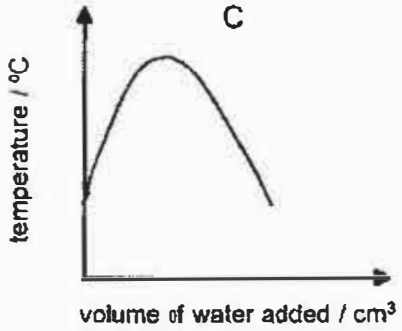

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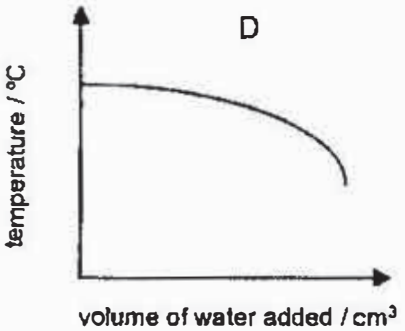

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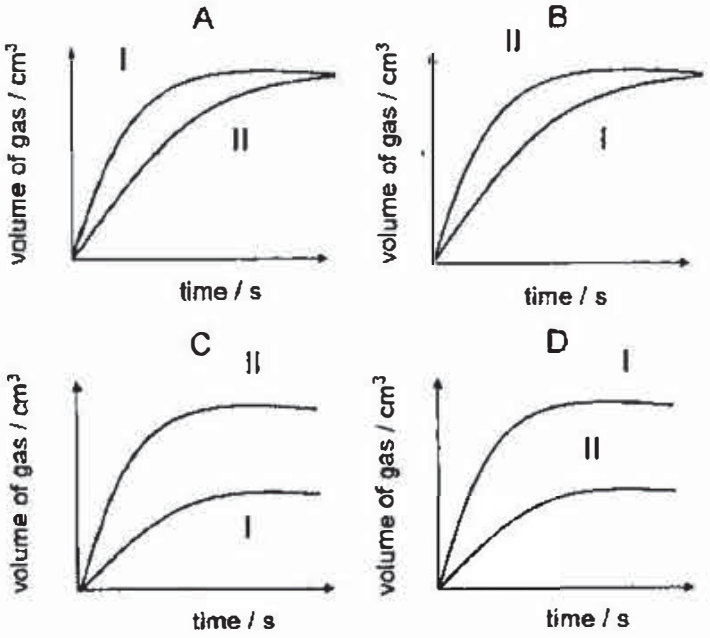
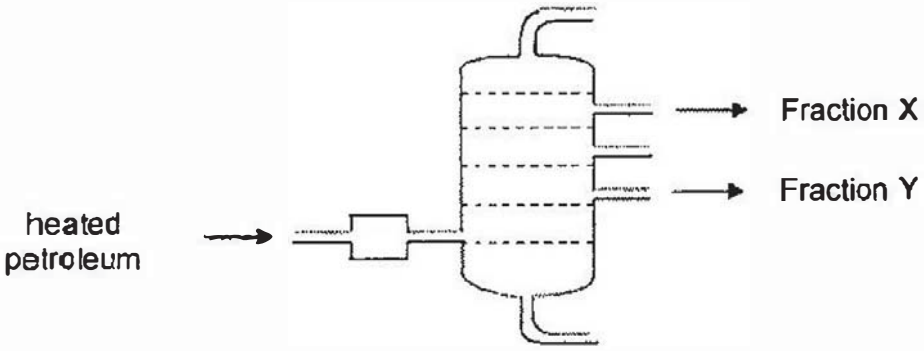
34 In two separate experiments, magnesium carbonate was reacted with an excess of dilute acid. The following shows the different conditions used in each experiment, with all other conditions being identical in both experiments.

Experiment I: 0.05 dm^3 of 1.0 mol/dm^3 of hydrochloric acid
Experiment II: 0.05 dm^3 of 1.0 mol/dm^3 of sulfuric acid

Which graph correctly represents the results of the two experiments?



35 The diagram shows the fractional distillation of petroleum.

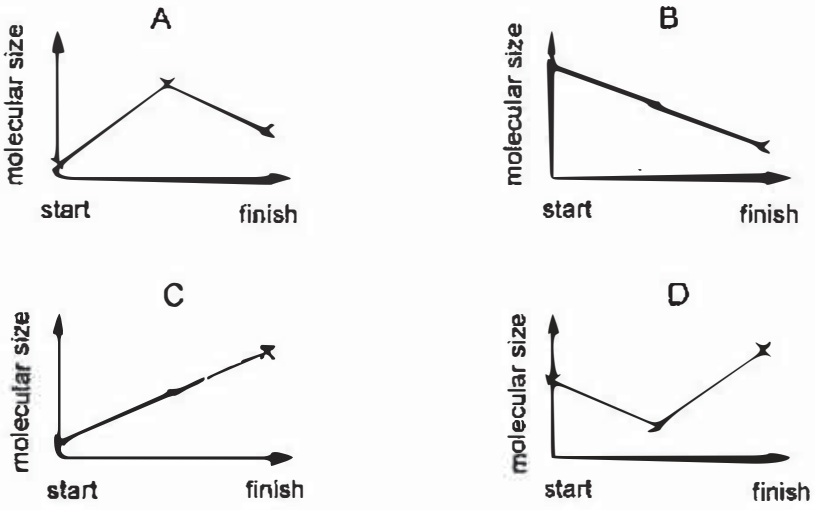


Which of the following comparisons are correct about fractions X and Y?

	X burns more easily than Y	X has a lower boiling point than Y
A	yes	no
B	yes	yes
C	no	no
D	no	yes

36 Poly(ethene) can be manufactured by the process below.

Which graph shows the change in molecular size during this process?



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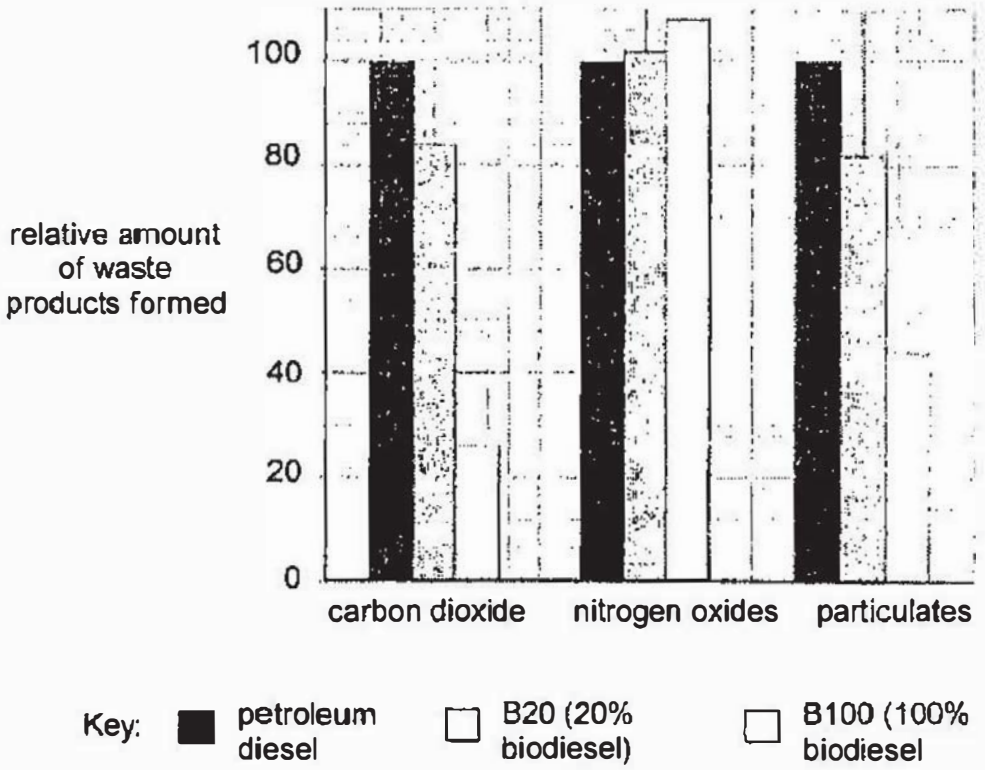
For Questions 37 and 38, refer to the information below.

Biodiesel can be mixed with petroleum diesel to make a fuel for cars.

The bar chart compares the relative amounts of waste products made when three different types of diesel fuel burn in a car engine.



37 From the graph, it can be seen that biodiesel releases carbon dioxide but some scientists claim that biodisel is a carbon neutral fuel.

What is the basis for this argument?

A Biodiesel is not a carbon compound.
B Biodiesel produces less carbon dioxide when it burns.
C Plants release carbon dioxide in respiration.
D Plants take up carbon dioxide as they photosynthesise.

38 Which of the following is one disadvantage of using fuel with a high percentage of biodiesel?

A It could increase global warming.
B It could increase the amount of acid rain.
C It is non-biodegradable.
D It is non-renewable.

39 The reaction between a carboxylic acid, $C_xH_yCO_2H$, and an alcohol, $C_nH_{2n+1}OH$, produces an ester.

How many hydrogen atoms does one molecule of the ester contain?

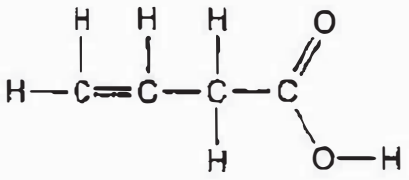
A $y + 2n$
B $y + 2n + 1$
C $y + 2n + 2$
D $y + 2n + 3$

40 The table shows the results of tests carried out on compound **X**.

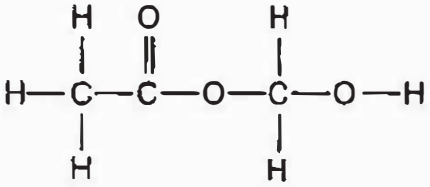
test	result
aqueous bromine added	decolourised
sodium carbonate added	colourless gas evolved

Which formula represents compound **X**?

A



B



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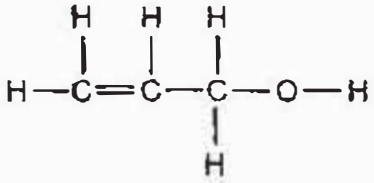

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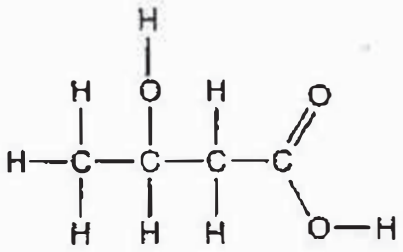

END OF PAPER

The Periodic Table of the Elements

Group I	Group II											Group III	Group IV	Group V	Group VI	Group VII	Group 0
							1 H hydrogen 1										4 He helium 2
7 Li lithium 3	9 Be beryllium 4											11 B boron 5	12 C carbon 6	14 N nitrogen 7	16 O oxygen 8	19 F fluorine 9	20 Ne neon 10
23 Na sodium 11	24 Mg magnesium 12											27 Al aluminium 13	28 Si silicon 14	31 P phosphorus 15	32 S sulfur 16	35.5 Cl chlorine 17	40 Ar argon 18
39 K potassium 19	40 Ca calcium 20	45 Sc scandium 21	48 Ti titanium 22	51 V vanadium 23	52 Cr chromium 24	55 Mn manganese 25	56 Fe iron 26	59 Co cobalt 27	59 Ni nickel 28	64 Cu copper 29	65 Zn zinc 30	70 Ga gallium 31	73 Ge germanium 32	75 As arsenic 33	79 Se selenium 34	80 Br bromine 35	84 Kr krypton 36
85 Rb rubidium 37	88 Sr strontium 38	89 Y yttrium 39	91 Zr zirconium 40	93 Nb niobium 41	96 Mo molybdenum 42	– Tc technetium 43	101 Ru ruthenium 44	103 Rh rhodium 45	106 Pd palladium 46	108 Ag silver 47	112 Cd cadmium 48	115 In indium 49	119 Sn tin 50	122 Sb antimony 51	128 Te tellurium 52	127 I iodine 53	131 Xe xenon 54
133 Cs caesium 55	137 Ba barium 56	139 La lanthanum 57 *	178 Hf hafnium 72	181 Ta tantalum 73	184 W tungsten 74	186 Re rhenium 75	190 Os osmium 76	192 Ir iridium 77	195 Pt platinum 78	197 Au gold 79	201 Hg mercury 80	204 Tl thallium 81	207 Pb lead 82	209 Bi bismuth 83	– Po polonium 84	– At astatine 85	– Rn radon 86
– Fr francium 87	– Ra radium 88	– Ac actinium 89 †															

*58-71 Lanthanoid series
†90-103 Actinoid series

140 Ce cerium 58	141 Pr praseodymium 59	144 Nd neodymium 60	– Pm promethium 61	150 Sm samarium 62	152 Eu europium 63	157 Gd gadolinium 64	159 Tb terbium 65	162 Dy dysprosium 66	165 Ho holmium 67	167 Er erbium 68	169 Tm thulium 69	173 Yb ytterbium 70	175 Lu lutetium 71
232 Th thorium 90	– Pa protactinium 91	238 U uranium 92	– Np neptunium 93	– Pu plutonium 94	– Am americium 95	– Cm curium 96	– Bk berkelium 97	– Cf californium 98	– Es einsteinium 99	– Fm fermium 100	– Md mendelevium 101	– No nobelium 102	– Lr lawrencium 103

Key: a = relative atomic mass; X = atomic symbol; b = proton (atomic) number

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PRESBYTERIAN HIGH SCHOOL

SCIENCE DEPARTMENT

Subject: Chemistry **Exam: Prelim**
Level: 4 Express **Year: 2016**
Setter: Miss Cynthia Lim

MARKING SCHEME

Paper 1 (40 marks)

Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
A	C	C	D	A	D	D	B	C	B
Q11	**Q12**	**Q13**	**Q14**	**Q15**	**Q16**	**Q17**	**Q18**	**Q19**	**Q20**
D	C	C	B	B	C	B	D	C	A
Q21	**Q22**	**Q23**	**Q24**	**Q25**	**Q26**	**Q27**	**Q28**	**Q29**	**Q30**
A	C	B	B	D	D	D	D	D	B
Q31	**Q32**	**Q33**	**Q34**	**Q35**	**Q36**	**Q37**	**Q38**	**Q39**	**Q40**
C	A	A	B	B	D	D	B	B	A

Name:..... Register/Index Number: ..... Class: .....

PRESBYTERIAN HIGH SCHOOL

CHEMISTRY **5073/2**

Paper 2

29 August 2016 **Monday** **1 hour 45 minutes**

2016 SECONDARY FOUR EXPRESS PRELIMINARY EXAMINATION

INSTRUCTIONS TO CANDIDATES

Write your class, register number and name on all the work you hand in.
Write in dark blue or black pen.
Do not use correction fluid.

Section A
Answer **all** questions.
Write your answers in the spaces provided on the question paper.

Section B
Answer **all** questions.
Write your answers in the spaces provided on the question paper.

You are advised to spend no longer than one hour on Section A and no longer than 45 minutes on Section B.
At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

A copy of the Periodic Table is printed on page 22.

Setter: Miss Cynthia Lim

For Examiner's Use	
Section A	
Section B	
Total	

This question paper consists of **22** printed pages (including this cover page) and **0** blank page.

Section A (50 marks)
Answer **all** questions.
Write your answers in the spaces provided.

1 Carbon-14 is an isotope of carbon used to determine the age of organic materials through a process called carbon dating.

(a) How does a carbon-14 atom differ from a carbon-12 atom?

.....

..... [1]

(b) After undergoing radioactive decay, a sample of carbon contained 80% of carbon-12 and 20% of carbon-14. Calculate the relative atomic mass of carbon in this sample.

[2]

[Total: 3]

2 Fig. 2 shows the variation in the melting point of the elements in Period 3.

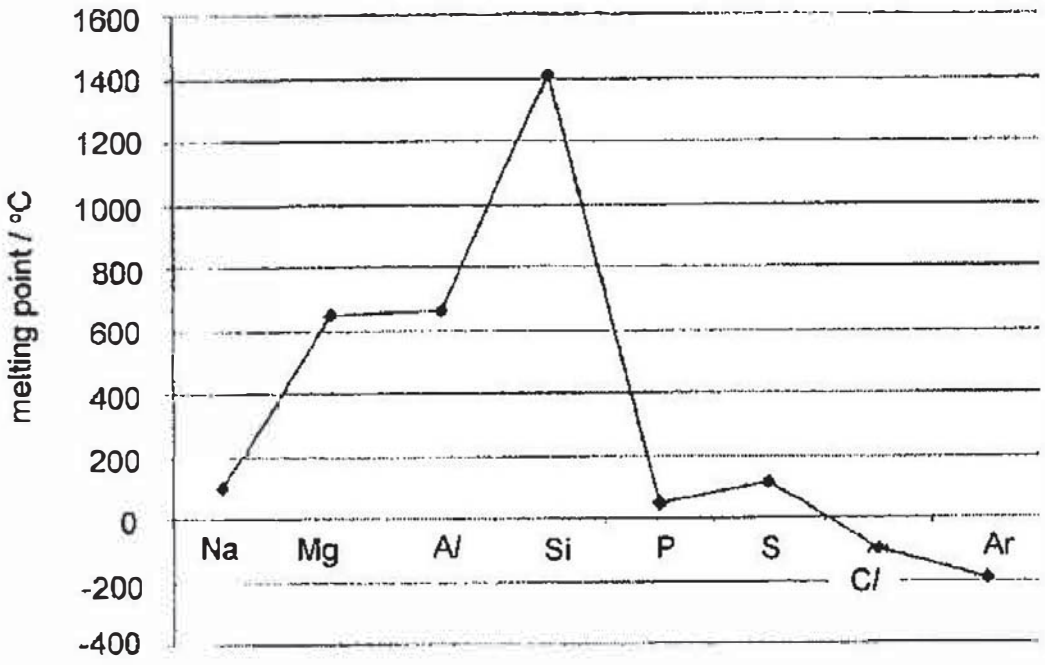


Fig. 2

(a) Which element in Period 3 has the lowest melting point? Explain, in terms of structure and bonding, why this element has a low melting point.

.....

.....

.....

..... [2]

(b) Which element in Period 3 has the highest melting point? Explain, in terms of structure and bonding, why this element has a high melting point.

.....

.....

.....

..... [2]

(c) (i) Draw a 'dot and cross' diagram for the compound formed between sodium and sulfur. Show only the valence electrons.

[2]

(ii) Explain why, the compound formed between sodium and sulfur, cannot conduct electricity in the solid state, but able to when it is in molten or aqueous state.

.....

.....

..... [2]

[Total: 8]

3 Sodium hypochlorite solution, NaC*l*O, commonly known as bleach, is frequently used as a disinfectant. When heated, sodium hypochlorite decomposes to form sodium chlorate(V), NaC*l*O$_3$ and sodium chloride.

(a) Construct a balanced chemical equation when sodium hypochlorite is heated.

..... [1]

(b) Explain, in terms of oxidation states, why the above reaction is a redox reaction.

.....

.....

..... [2]

(c) When sodium hypochlorite dissolves in water, oxygen gas and chlorine gas are produced.

Explain why oxygen gas is detected first.

.....

.....

..... [2]

[Total: 5]

PLEASE TURN OVER TO THE NEXT PAGE

4 (a) Alkenes can be hydrogenated, under appropriate conditions, to form alkanes.

The energy profile for the hydrogenation of ethene at room temperature and pressure with substance **X** is shown in Fig. 4.1.

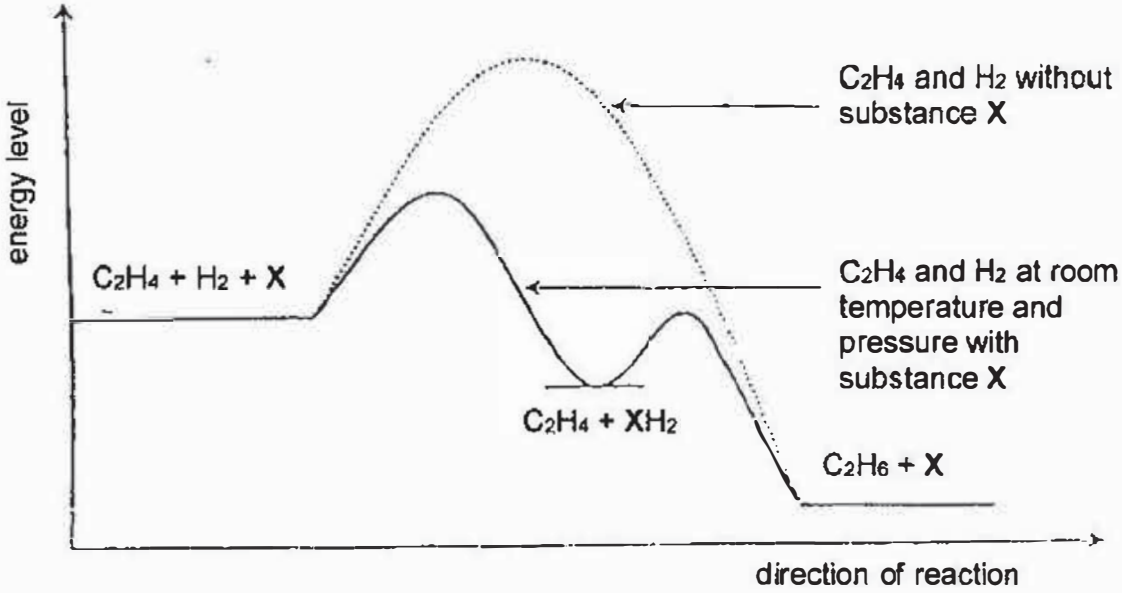


Fig. 4.1

On the same axes, the energy profile for the hydrogenation of ethene under the same conditions but without substance **X** is also shown.

(i) State the role of substance **X** and explain how it affects the rate of reaction.

.....

..... [2]

(ii) On Fig. 4.1, draw arrows to represent the enthalpy change, ΔH, as well the activation energy, E_a, for the reaction with substance **X**. [1]

PLEASE TURN OVER TO THE NEXT PAGE

(iii) Table 4 gives the bond energies of some bonds.

bond	bond energy / $kJmol^{-1}$
C-C	350
C=C	600
C-H	410
H-H	440

Table 4

Calculate the enthalpy change, ΔH, for the hydrogenation of ethene.

$$C_2H_4 + H_2 \rightarrow C_2H_6$$

[2]

(iv) Based on your answer in **a (iii)**, explain in terms of bond breaking and bond forming whether the hydrogenation of ethene is an exothermic or endothermic reaction.

.....

.....

.....

..... [2]

(b) Hydrogenation of alkenes is used to make margarine. Fig. 4.2 shows how margarine is produced by saturating vegetable oils which are high in polyunsaturates.

$$n(C_2H_2) + n(H_2)\,(g) \rightarrow n(C_2H_4)$$

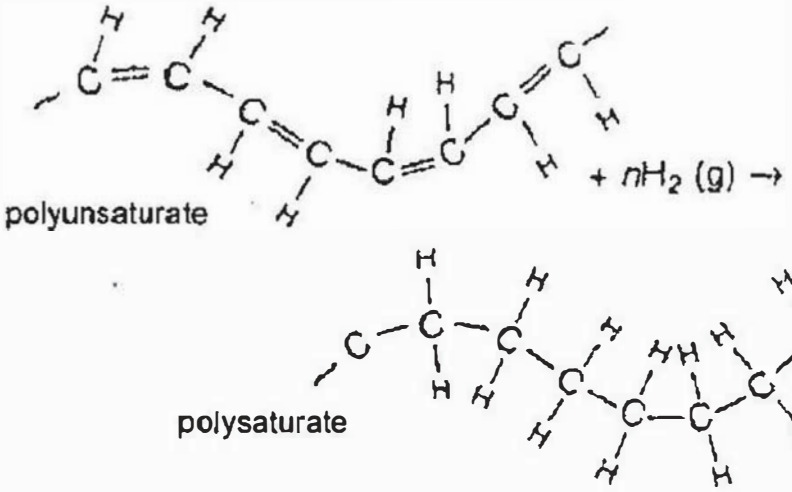


Fig. 4.2

(i) If a polyunsaturated is shaken with aqueous bromine, what would you expect to observe and explain why.

.....

..... [2]

(ii) Are saturated vegetable oils more or less dense than unsaturated ones? Explain your answer.

.....

..... [1]

(iii) Explain whether it is advisable to completely saturate the vegetable oils.

.....

..... [1]

[Total:11]

5 Duralumin is an alloy of aluminium. It is made from a mixture of aluminium and copper and was first used as rigid airship frames.

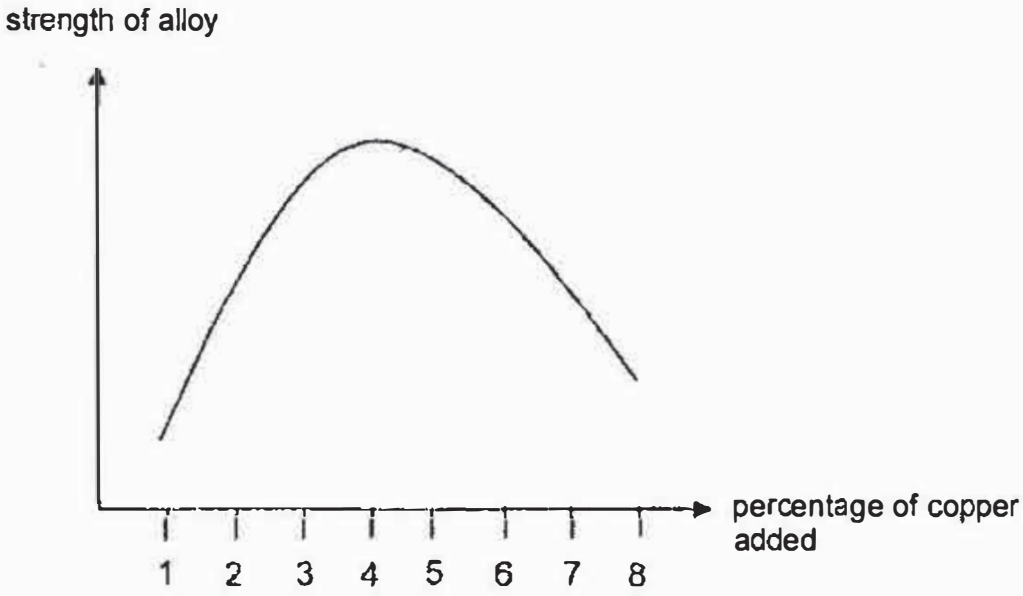


Fig. 5.1

(a) With reference to Fig. 5.1, state the optimum percentage of copper that should be added to produce the strongest alloy.

..... [1]

(b) (i) Explain why duralumin is strong enough to be used as airship frames.

.....

.....

.....

.....

..... [3]

(ii) Suggest why this alloy of aluminium, containing copper, is more prone to corrosion.

.....

..... [1]

(iii) Explain how the addition of a high-purity aluminium surface layer to the sheets of duralumin helps to overcome the corrosion issue.

.....

.....

..... [2]

(c) Why is it more costly to extract aluminium from its oxide as compared to copper of the same mass?

.....

.....

..... [2]

[Total: 9]

6 (a) Strontium metal can be obtained by the electrolysis of molten strontium bromide, using the apparatus shown in Fig. 6.1.

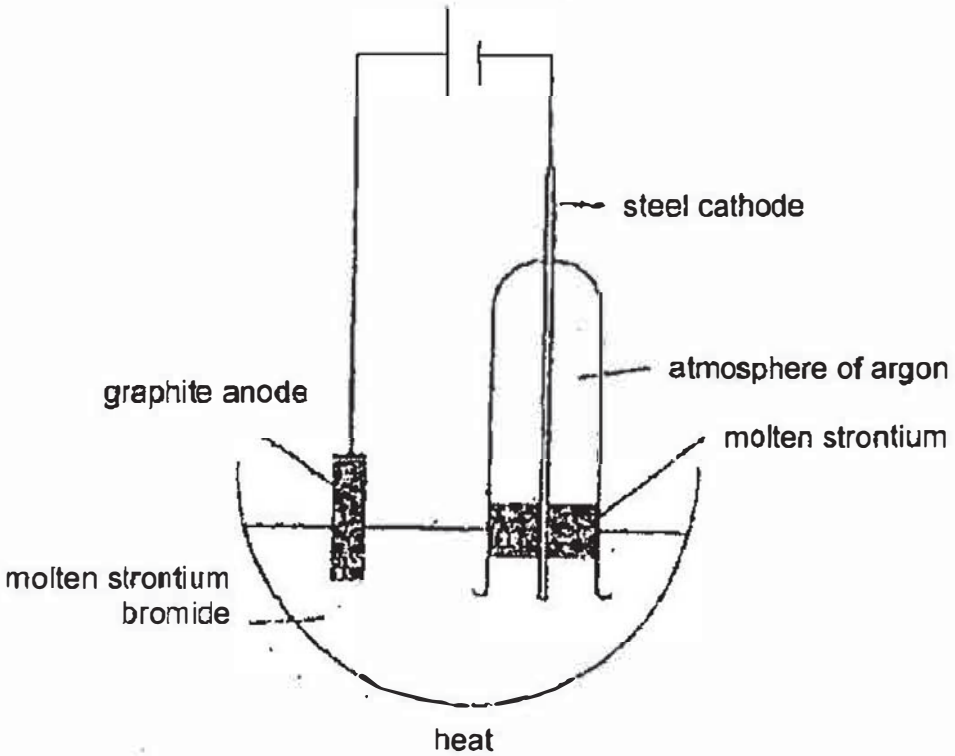


Fig. 6.1

(i) Write the half equations for the electrode reactions at the anode and cathode.

.....

..... [2]

(ii) Explain why strontium is unable to be extracted from the electrolysis of aqueous strontium bromide.

.....

..... [1]

(b) An electrolysis experiment is carried out as shown in Fig. 6.2.
P and Q are copper electrodes while R and S are silver electrodes.

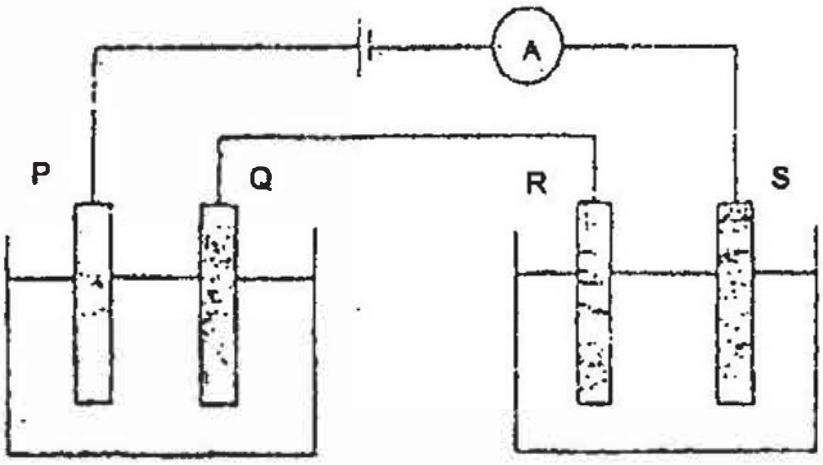


Fig. 6.2

(i) At which electrode would the mass increase faster? Explain your answer.

.....

.....

.....

..... [2]

(ii) P and Q are then replaced with platinum electrodes and gas bubbles are observed. Explain why this gas does not appear when P and Q are copper electrodes.

.....

.....

.....

..... [2]

[Total: 7]

7 The fractional distillation of crude oil yields many fractions. One of the fractions is paraffin. Butane is an example of an organic molecule found in this fraction. Butane can undergo cracking to produce hydrogen and a useful small alkene.

(a) Draw a branched-chain isomer of butane.

[1]

(b) Construct an equation for the above cracking process.

..... [1]

(c) The Gulf of Mexico oil-spill disaster released large volumes of crude oil into the sea. Biosurfactants were used to reduce the massive oil-spill pollution. The use of industrial chemicals to treat hydrocarbon-polluted site can lead to further contamination due to by-products formed. Biosurfactants can be conveniently produced from yeast and bacteria.

State two advantages of using biosurfactants as compared to industrial chemicals.

.....

..... [2]

[Total: 4]

8 Plumbers sometimes use acids to remove the surface layer of rust from sinks.

A plumber uses dilute hydrochloric acid and dilute sulfuric acid of the same concentration to remove two samples of rust of equal mass.

(a) State and explain which acid would give the plumber a faster rate of removal of the rust.

.....

.....

..... [2]

(b) The plumber tried using ethanoic acid of the same concentration to remove another sample of rust. However, the results were not as effective. Explain the results obtained.

.....

..... [1]

[Total: 3]

PLEASE TURN OVER TO THE NEXT PAGE

Section B (30 marks)
Answer **three** questions.
Question **11** is in the form of an **Either/Or** question.
Only **one** part should be answered.

9 The element platinum is an expensive metallic element with proton number 78 and electronic configuration of 2.8.18.32.17.1.

Platinum melts at 17770 °C and is three times the density of iron. It is very corrosion resistant as it does not react with air or water and is not affected by common acids even at high temperature.

Platinum can form several compounds. One of which is platinum(II) chloride, a brown crystalline solid which is insoluble in water. Another compound is platinum(IV) chloride, a brown-red powder which dissolves in water to give a red solution.

The main uses of platinum are summarised in Fig. 9.1.

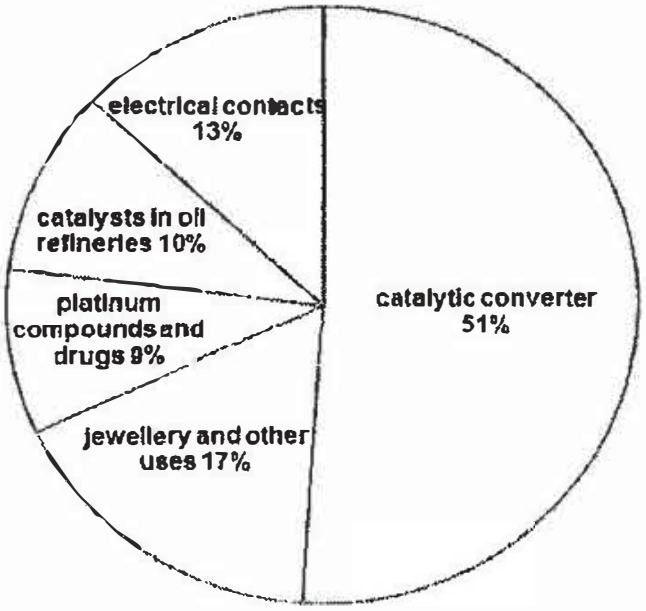


Fig. 9.1

Source: JGR Briggs Chemistry Insights

Platinum, palladium and rhodium are metals found to exhibit outstanding catalytic properties which have led to their use in catalytic converters installed in motor vehicles.

Table 9 below illustrates the relative abundance and the annual production of these three metals.

metal	relative abundance in earth crust / parts per million	annual production / tonne
platinum	0.0063	24
palladium	0.0037	30
rhodium	0.0007	3

Table 9

Source 1: Wikipedia – Abundance of elements in Earth's crust
Source 2: http://www.stillwaterpalladium.com/historyoverview.html

(a) What percentage of platinum is used as catalysts? [1]

(b) What change would you expect in the pie chart if a cheap substitute were found to replace platinum in car exhausts? Give a reason to your answer. [1]

(c) State one property of platinum, other than electrical conductivity, that explains its use in electrical contacts. [1]

(d) Platinum belongs to the transition metals section in the Periodic Table. State two properties from the above account which show why platinum should be placed in this section of the Periodic Table. [2]

(e) Some chemists place platinum in one of the main groups (Group I, II etc). Which group do you think platinum should be placed in? Explain your answer. [2]

(f) (i) Platinum(IV) chloride decomposes upon heating to produce a choking gas which bleaches blue litmus paper and another product.

Write a chemical equation for this decomposition. [1]

(ii) Deduce, with reasoning, the position of platinum in the reactivity series. [2]

(g) Using the information from Table 9, which of the three metals are the highest and lowest in demand to be used as auto catalyst? Explain your answers. [2]

[Total: 12]

10 The table below shows a study of a precipitation reaction between dilute sulfuric acid and aqueous barium hydroxide.

The reaction tubes contained different volumes of barium hydroxide and dilute sulfuric acid as stated in Table 10. To each tube, two drops of methyl orange indicator were added. Precipitation occurred in all the reaction tubes and after 20 minutes, the height of the precipitate in each tube was measured and recorded.

reaction tube	1	2	3	4	5	6
volume of 0.500 mol/dm^3 barium hydroxide /cm^3	5.0	5.0	5.0	5.0	5.0	5.0
volume of 1.00 mol/dm^3 sulfuric acid /cm^3	1.0	1.5	2.0	2.5	3.0	3.5
Height of precipitate /cm	2.5	3.0	3.5	4.0	4.0	

Table 10

(a) Construct an ionic equation for the precipitation reaction. [1]

(b) State the observations made in reaction tube 1. [1]

(c) (i) Predict the height of the precipitate in reaction tube 6. [1]

(ii) Explain your answer to c (i). [1]

(d) The electrical conductivity of each reaction tube was measured. Sketch a graph of electrical conductivity (y-axis) against the reaction tube number (x-axis) for the experiment. [1]

(e) A student tried to prepare two salts, barium sulfate and sodium nitrate, using the method described in the paragraph below.

Aqueous barium nitrate was mixed with aqueous sodium sulfate and the precipitate of barium sulfate was obtained through filtration. The residue was dried in an oven.

The filtrate was heated until the solution was saturated. Crystals of sodium nitrate were formed when the saturated solution was cooled.

(i) State one omission in the preparation of barium sulfate. [1]

(ii) Explain why the student could not obtain pure crystals of sodium nitrate using the method described above. [1]

(iii) Name a suitable method to prepare pure crystals of sodium nitrate. [1]

[Total: 8]

11 **EITHER**

Methyl cyanopropenoate is an active ingredient in superglue. Superglue is a very strong adhesive used to fasten materials like wood together. The structure is shown in Fig. 11.1.

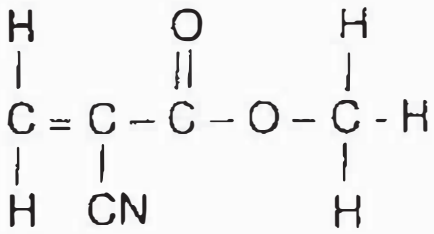


Fig. 11.1

Superglue polymerises when exposed to moisture in air. This causes the glue to set.

(a) State two functional groups of super glue. [1]

(b) Suggest the type of polymerisation that superglue undergoes. [1]

(c) Draw the repeating unit of the polymer formed. [1]

(d) (i) Methyl cyanopropenoate can be made from an acid and an alcohol. Draw the structural formulae of both molecules. [2]

(ii) The alcohol named in d(i) and an acid chloride can also be used to synthesise methyl cyanopropenoate. A by-product of hydrogen chloride gas is produced in this reaction.

Draw the structure of the acid chloride. [1]

(e) Kevlar is another polymer that is used for making bulletproof vests, army helmets and 'puncture-proof' tyres. Kevlar is also used in the protective clothing worn by firefighters.

Kevlar is made by condensation polymerisation from two different monomers shown in Fig. 11.2. It forms linkages similar to nylon.

Fig. 11.2

(i) Define condensation polymerisation. [2]

(ii) Draw the structural formula of the repeat unit of Kevlar. [2]

[Total: 10]

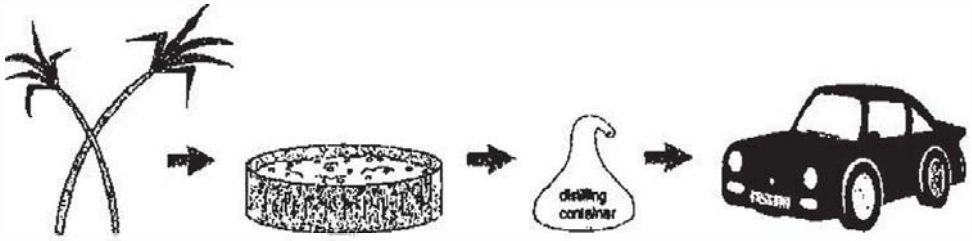
11 **OR**

Read the following article and answer the questions.

Production of ethanol fuel

In Brazil, the ethanol is produced from sugar cane. The sugar cane grows quickly and so can be replaced quickly. The sugar is extracted as a juice by crushing the sugar cane with rollers. The fibrous part of the cane is dried and used as a fuel to provide heat for the fractional distillation stage.

After filtering, the juice is allowed to ferment to make a dilute solution of ethanol. This is then distilled to obtain the alcohol which is used as the fuel. Nowadays, about 90% of all new cars solid in Brazil use ethanol as a fuel.



sugar cane | sugar is fermented | fermented mixture is fractionally distilled to give pure ethanol | ethanol used a fuel

(a) Describe how fermentation is carried out in the laboratory. [2]

(b) Explain why the fermentation reaction only takes place within a narrow temperature range. [1]

(c) Brazil has very little crude oil but has plenty of land suitable for growing sugar cane. Give two advantages of using ethanol as a fuel for cars in Brazil. [2]

(d) In order to get more land, some of the Amazon jungle must be cut down. Suggest two problems this will cause. [2]

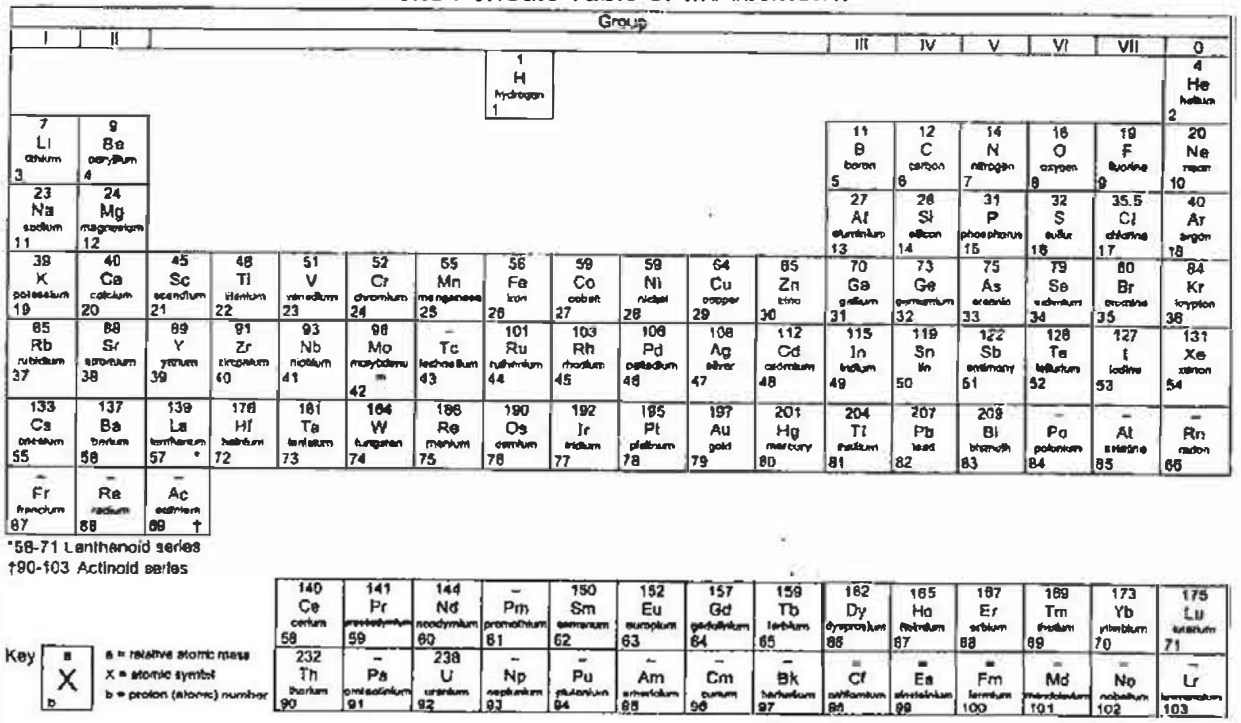
(e) Ethanol produced by this process becomes sour when exposed to air for a few days. Briefly explain how the ethanol solution becomes sour. [2]

(f) Name another method used to produce ethanol on a large scale. [1]

[Total: 10]

END OF PAPER

The Periodic Table of the Elements



Group	I	II											III	IV	V	VI	VII	0
												1 H hydrogen 1						4 He helium 2
	7 Li lithium 3	9 Be beryllium 4											11 B boron 5	12 C carbon 6	14 N nitrogen 7	16 O oxygen 8	19 F fluorine 9	20 Ne neon 10
	23 Na sodium 11	24 Mg magnesium 12											27 Al aluminium 13	28 Si silicon 14	31 P phosphorus 15	32 S sulfur 16	35.5 Cl chlorine 17	40 Ar argon 18
	39 K potassium 19	40 Ca calcium 20	45 Sc scandium 21	48 Ti titanium 22	51 V vanadium 23	52 Cr chromium 24	55 Mn manganese 25	56 Fe iron 26	59 Co cobalt 27	59 Ni nickel 28	64 Cu copper 29	65 Zn zinc 30	70 Ga gallium 31	73 Ge germanium 32	75 As arsenic 33	79 Se selenium 34	80 Br bromine 35	84 Kr krypton 36
	85 Rb rubidium 37	88 Sr strontium 38	89 Y yttrium 39	91 Zr zirconium 40	93 Nb niobium 41	96 Mo molybdenum 42	– Tc technetium 43	101 Ru ruthenium 44	103 Rh rhodium 45	106 Pd palladium 46	108 Ag silver 47	112 Cd cadmium 48	115 In indium 49	119 Sn tin 50	122 Sb antimony 51	128 Te tellurium 52	127 I iodine 53	131 Xe xenon 54
	133 Cs caesium 55	137 Ba barium 56	139 La lanthanum 57 *	178 Hf hafnium 72	181 Ta tantalum 73	184 W tungsten 74	186 Re rhenium 75	190 Os osmium 76	192 Ir iridium 77	195 Pt platinum 78	197 Au gold 79	201 Hg mercury 80	204 Tl thallium 81	207 Pb lead 82	209 Bi bismuth 83	– Po polonium 84	– At astatine 85	– Rn radon 86
	– Fr francium 87	– Ra radium 88	– Ac actinium 89 †															

*58-71 Lanthanoid series
†90-103 Actinoid series

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	232 Th thorium 90	– Pa protactinium 91	238 U uranium 92	– Np neptunium 93	– Pu plutonium 94	– Am americium 95	– Cm curium 96	– Bk berkelium 97	– Cf californium 98	– Es einsteinium 99	– Fm fermium 100	– Md mendelevium 101	– No nobelium 102	– Lr lawrencium 103

Key: a = relative atomic mass; X = atomic symbol; b = proton (atomic) number

PRESBYTERIAN HIGH SCHOOL

SCIENCE DEPARTMENT

Subject: Chemistry **Exam: Prelim**
Level: 4 Express **Year: 2016**
Setter: Miss Cynthia Lim

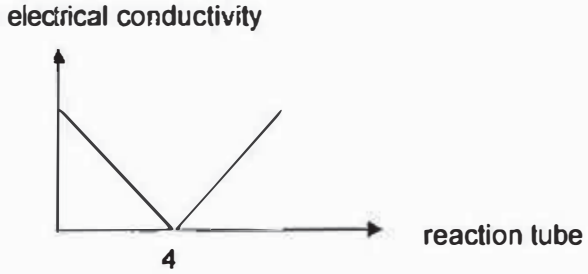
MARKING SCHEME

Section A (50 marks)

Qn	Scoring Points	Sub-total	Total
1a	Carbon-14 atom has 2 more neutrons than carbon12 atom	1	
b	80/100 x 12 + 20/100 x 14	1	
	= 12.4	1	3
2a	Argon;	1	
	Small amount of energy is required to overcome the weak (Van der Waals) forces holding the discrete atoms together	1	
	Accept: monatomic atom		8
b	silicon;	1	
	large amount of energy is required to overcome the strong and numerous covalent bonds between atoms in a giant covalent structure	1	
c(i)	correct number of electrons;	1	
	correct charges	1	
(ii)	in solid state, ions are held in fixed positions, thus not mobile;	1	
	in molten or aqueous state, the ions are mobile to act as electrical carriers	1	
3a	$3NaClO \rightarrow NaClO_3 + NaCl$	1	
b	NaClO is reduced as oxidation state of Cl decreases from +1 in NaClO to -1 in NaCl;	1	
	NaClO is oxidised as oxidation state of Cl increases from +1 in NaClO to +5 in $NaClO_3$	1	5
c	Oxygen gas has a smaller molecular mass (M_r = 32) than chlorine gas (M_r = 71);	1	
	thus diffuses faster OR	1	
	chlorine gas is very soluble in water;		
	oxygen gas is less soluble in water		
4a(i)	Catalyst;	1	
	Provides an alternative pathway of lower activation energy	1	
(ii)	Enthalpy change: single arrow pointing from energy level of reactants down to energy level of products		11
	Activation energy: singe arrow pointing from energy level of reactants up to peak of curve	1	

(iii)	Energy absorbed in bond breaking = + (600 + 4 x 410 + 440) = + 2680 kJ Energy released in bond forming = - (350 + 6 x 410) = - 2810 kJ 1 mark awarded for energy absorbed and energy released Enthalpy change = +2680 + (-2810) = -130 kJ ecf for working	1 1	
(iv)	exothermic; more energy released in forming C-C and C-H bonds in ethane; than energy absorbed in breaking C=C and C-H bonds in ethene and H-H bonds in H_2 ecf	1 1	
b(i)	reddish brown aqueous bromine decolourises / turns colourless rapidly; contains carbon-carbon double bonds (C=C)	1 1	
(ii)	more dense, saturated vegetable oils have more hydrogen atoms, thus having a larger molecular mass	1	
(iii)	not advisable, margarine will be too hard	1	
5a	4%	1	
b(i)	Contains atoms of different sizes / copper atoms are of different size; Disrupt orderly layered arrangement of aluminium atoms; Layers of aluminium atoms unable to slide over one another when a force is applied	1 1 1	9
(ii)	Aluminium is more reactive than copper, thus corrode in place of copper	1	
(iii)	Aluminium coated with a layer of non-porous aluminium oxide; Prevents aluminium to come in contact with oxygen from air	1 1	
c	Electrolysis is used to extract aluminium from its molten compound, more expensive as used a lot of electricity; Copper extracted using reduction of its oxide with carbon, carbon is cheaper	1 1	
6a(i)	Cathode: Sr^{2+} (l) + 2e- → Sr (l) Anode: $2Br^-$ (l) → Br_2 (g) + 2e-	1 1	
(ii)	Strontium is too reactive to be discharged at the cathode, instead H^+ ions are selectively discharged to form hydrogen gas	1	7
b(i)	S; Silver is deposited since 1 mol of silver is 108 g	1 1	

(ii)	Copper anode dissolves to form Cu^{2+} ions; Oxygen gas is produced at platinum electrode since Pt is inert	1 1	
7a	Correct structure	1	
b	$C_4H_{10} \rightarrow 2C_2H_4 + H_2$ OR $C_4H_{10} \rightarrow C_4H_6 + H_2$	1	4
c	Biodegradable; renewable	1 1	
8a	Sulfuric acid; Dibasic acid as it dissociates to form 2 mol of H^+ per acid molecule as compared to HCl that dissociates to form 1 mol of H^+ per acid molecule	1 1	3
b	Ethanoic acid is a weak acid that partially dissociates / ionizes to produce fewer H^+ ions	1	
	Section B (30 marks)		
9a	51 + 10 = 61%	1	
b	Percentage of platinum used as catalytic converter will decrease; Using platinum will incur high cost as platinum is an expensive metal	1	
c	High melting point; corrosion resistant	1	
d	Forms coloured compounds; High melting point; variable oxidation states (any 2)	2	12
e	Group I; Has one valence electron / has one outer shell electron (refer to electronic configuration)	1 1	
f(i)	$PtCl_4 \rightarrow PtCl_2 + Cl_2$ OR $PtCl_4 \rightarrow Pt + 2Cl_2$	1	
(ii)	Below copper; Does not react with acids just like copper; Reject: low in reactivity series; does not react with air or water and is not affected by common acids even at high temperature	1 1	
g	Highest in demand: palladium; Highest amount produced though not highest amount left in earth crust; Lowest in demand: rhodium; Lowest amount in earth crust thus lowest amount produced	1 1	
10a	$Ba^{2+}(aq) + SO_4^{2-}(aq) \rightarrow BaSO_4(s)$	1	
b	Tube 1: Yellow [alkaline – excess $Ba(OH)_2$]	1	
c(i)	4.0 cm	1	8

(ii)	The height of precipitate has become constant after reaction tube 4. This shows that reaction is complete/<u>all the hydroxide ions</u> are used up/ <u>barium hydroxide is the limiting reagent</u>	1	
d		1	
e(i)	Rinse residue with distilled water	1	
(ii)	After filtration, besides aqueous sodium nitrate, the filtrate may contain <u>unreacted aqueous barium nitrate and aqueous sodium sulfate.</u> Hence, the crystal formed may not be pure sodium nitrate.	1	
(iii)	titration	1	
11	**EITHER**		
a	Alkene and ester	1	
b	Addition polymerisation	1	
c	correct repeating unit	1	10
d(i)	1 mark each for one correct structure	2	
(ii)	Correct structure of acid chloride	1	
e(i)	Process by which many monomer molecules join together to form a macromolecule; with elimination of small molecules like water	1 1	
(ii)	Shows amide linkage; Overall correct structure showing continual chain	1 1	
	OR		
a	yeast is added to sugar/glucose solution; in the absence of oxygen and at 37°C	1 1	
b	enzyme produced by yeast will be denatured under too high temperature or the yeast is sensitive to temperature changes.	1	10
c	Ethanol is a cleaner fuel as compared to petrol when burnt; Ethanol is a renewable resource	1 1	
d	Global warming; Extinction of animals	1 1	

e	ethanol is oxidized by oxygen in the air in the presence of bacteria; to become ethanoic acid which is sour.	1 1	
f	addition of steam to ethene / hydration of ethene	1	