CANBERRA SECONDARY SCHOOL

2017 Preliminary Examination 2

Secondary Four Express / Five Normal Academic

5076/01 SCIENCE ([redacted], CHEMISTRY)

26 Sept 2017
1 hour
1130 – 1230

Name: _____ ( ) **Class:** _____

READ THESE INSTRUCTIONS FIRST

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

Write your full name, class and index number in the spaces provided on the question paper and on any separate writing papers used.
Write in soft pencil.
You may use a pencil for any diagrams or graphs.
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 separate Answer Sheet (OTAS).

Read the instructions on the Answer Sheet (OTAS) very carefully.

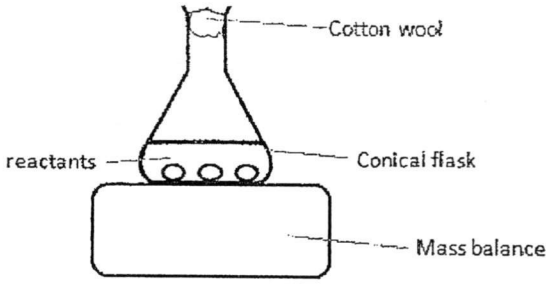
Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this booklet.
A copy of the Periodic Table is printed on page 18.

FOR MARKER'S USE		
Paper	Marks Awarded	Max Marks
1		40
Total		40

This question paper consists of 18 printed pages including the cover page.

Setter: Miss Lim HP & Agnes Lim

21 The apparatus shown can be used to measure the rate of some chemical reactions.



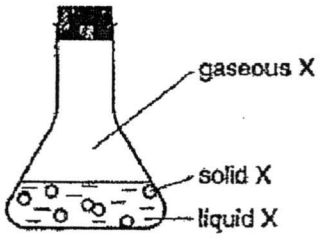
For which two reactions would this apparatus be suitable?

reaction 1	$AgNO_3(aq) + HCl(aq) \rightarrow AgCl(s) + HNO_3(aq)$
reaction 2	$2H_2O_2(aq) \rightarrow 2H_2O(l) + O_2(g)$
reaction 3	$FeO(s) + 2HCl(aq) \rightarrow FeCl_2(aq) + H_2O(l)$
reaction 4	$MgCO_3(s) + 2HCl(aq) \rightarrow MgCl_2(aq) + CO_2(g) + H_2O(l)$

A 1 and 2 B 2 and 4

C 1 and 3 D 3 and 4

22 The conical flask contains compound **X** which is present in the solid, liquid and gaseous states.



Which statement about **X** is correct?

A Particles of **X** become closer when it changes from a gas to a liquid.

B In solid **X**, the particles are close together but not orderly arranged.

C Particles of **X** lose energy when it changes from a liquid to a gas.

D In liquid **X**, the particles move independently of each other.

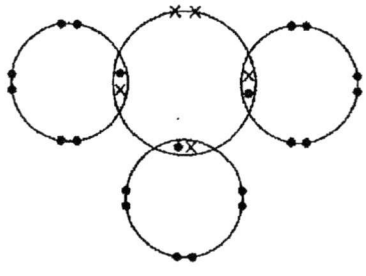
23 Chloroethane is an organic solvent used to wash off paint from clothing.
What method can be used to recover the solvent after use and how can the purity of the solvent recovered be checked?

	method to recover solvent	purity check
A	distillation	obtain a chromatogram
B	distillation	find the boiling point
C	filtration	find the boiling point
D	filtration	obtain a chromatogram

24 The nucleon number of an isotope of strontium is 90.
How many protons, neutrons and electrons are present in the ion formed by this isotope?

	protons	neutrons	electrons
A	40	50	40
B	38	52	38
C	38	52	36
D	40	50	42

25 The diagram shows how the outer shell electrons are arranged in a compound formed between two elements.



Which statements about the compound are correct?

1 It is formed between two non-metallic elements.
2 It could be ammonia, NH_3.
3 It has a low boiling point.
4 It conducts electricity when molten.

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

26 Two elements **P** and **Q** react together to form an ionic compound with the formula P_3Q_2
Which row describes the bonding between **P** and **Q** correct?

	electrons given away by each atom of **P**	electrons received by each atom of **Q**
A	2	3
B	3	3
C	3	1
D	3	2

27 Dilute sulfuric acid reacts with aqueous sodium hydroxide as follows.

$$H_2SO_4 + 2NaOH \rightarrow Na_2SO_4 + 2H_2O$$

A 20.0 cm^3 of dilute sulfuric acid required 25.0 cm^3 of 0.250 mol/dm^3 aqueous sodium hydroxide for complete neutralisation.

What is the concentration of the acid?

A 0.100 mol/dm^3
B 0.125 mol/dm^3
C 0.156 mol/dm^3
D 0.312 mol/dm^3

28 Both magnesium and magnesium oxide react with dilute sulfuric acid.
In what way are both reactions the same?

A a gas is set free
B water is a product
C the pH of the acid decreases
D a salt is formed

29 Which reaction is the correct way to prepare insoluble calcium sulfate?

A $Ca(NO_3)_2\ (aq) + FeSO_4\ (aq) \rightarrow CaSO_4\ (s) + Fe(NO_3)_2\ (aq)$
B $CaCO_3\ (s) + H_2SO_4\ (aq) \rightarrow CaSO_4\ (s) + CO_2\ g) + H_2O\ (l)$
C $CaO\ (s) + H_2SO_4\ (aq) \rightarrow CaSO_4\ (s) + H_2O\ (l)$
D $CaCl_2\ (aq) + PbSO_4\ (s) \rightarrow CaSO_4\ (s) + PbCl_2\ (s)$

30 When heated, solid **Z** gives off a gas. When this gas is bubbled through limewater, a white precipitate is formed.

When a salt solution prepared using solid **Z** was reacted with excess aqueous sodium hydroxide, a white precipitate was formed.

What is **Z**?

A zinc carbonate

B calcium nitrate

C lead(II) nitrate

D calcium carbonate

31 Which statement describes the changes in the elements from left to right across a period of the Periodic Table?

A The ability to conduct electricity increases.

B The number of neutrons in an atom decreases.

C The tendency to form positive ions increases.

D The number of protons in an atom increases.

32 In which reaction is the sign of energy change, ΔH, incorrect?

A	$2H_2 + O_2 \rightarrow 2H_2O$	ΔH = -ve
B	$2AgCl \rightarrow 2Ag + Cl_2$	ΔH = +ve
C	$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$	ΔH = -ve
D	$HCl + NaOH \rightarrow NaCl + H_2O$	ΔH = +ve

33 Substance **Y** produces iodine from aqueous potassium iodide and changes acidified potassium manganate(VII) from purple to colourless.

Which row is correct?

	Y	potassium iodide	acidified potassium manganate(VII)
A	is an oxidising agent only	is oxidised	is oxidised
B	is a reducing agent only	is reduced	is reduced
C	is both an oxidising agent and a reducing agent	is oxidised	is reduced
D	is both an oxidising agent and a reducing agent	is reduced	is oxidised

34 Steel is an alloy of iron containing a small percentage of carbon.
Which statements are correct?

1 Carbon disrupts the metallic structure of iron.
2 Carbon prevents the iron from rusting.
3 Increasing the percentage of carbon makes the steel softer.
4 Increasing the percentage of carbon makes the steel less malleable.

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

35 Metal **X** forms a carbonate that decomposes readily when heated while metal **Y** forms a carbonate that does not.

When iron filings are added to separate salt solutions of **X** and **Y**, **X** is displaced but **Y** is not.

Which of the following statement is true about **X** and **Y**?

A **Y** can be coated on iron to offer sacrifical protection.
B **X** is more reactive than iron.
C **X** is more reactive than **Y**.
D **X** can be coated on **Y** to offer sacrifical protection.

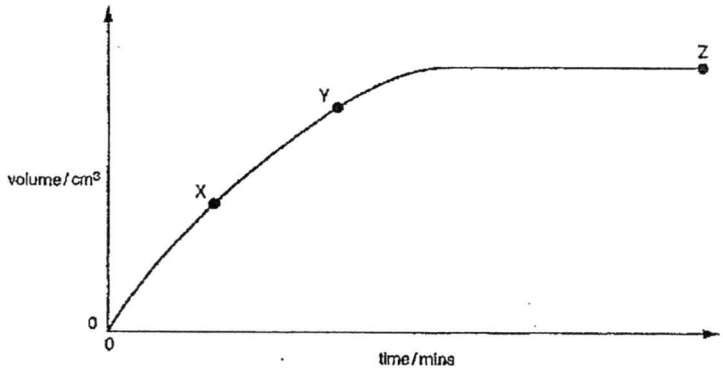
36 The table below shows information about the exhaust fume produced from car engines that run on petrol and diesel respectively.

	concentration of carbon monoxide present	concentration of nitrogen oxides present	concentration of sulfur dioxide present
petrol engine	high	low	low
diesel engine	low	high	high

Which of the following statements can be inferred using the data in the table?

A Cars running on diesel produce fumes that are less sooty.
B Burning petrol contributes more towards the formation of acid rain.
C Burning petrol generates more heat in the combustion engine.
D Cars running on diesel do not need to be fitted with catalytic converters.

37 The graph shows the total volume of carbon dioxide evolved, plotted against time, when excess calcium carbonate reacts with 20 cm^3 of hydrochloric acid containing 2 mol/dm^3.



Which statement is correct?

A The reaction is faster at point **Y** than at point **X**.

B The reaction first reaches completion at point **Z**.

C The time taken to reach completion increases if 20 cm^3 of hydrochloric acid containing 4 mol/dm^3 is used.

D The total volume of carbon dioxide produced remains the same when a greater mass of calcium carbonate is used.

38 Which statement about a homologous series is **not** correct?

A The members have similar chemical properties.

B The members have the same functional group.

C The flammability increases with increasing relative molecular mass.

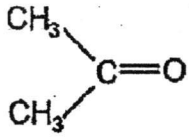
D The boiling point increases with increasing relative molecular mass.

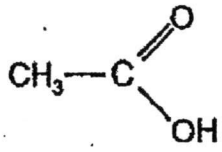
39 Which row is correct about the polymer formed using propene?

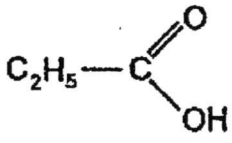
	name	formula	reaction with aqueous bromine
A	poly(propane)	$-(C_3H_6)-_n$	no visible change
B	poly(propane)	$-(C_3H_8)-_n$	turns colourless
C	poly(propene)	$-(C_3H_6)-_n$	turns colourless
D	poly(propene)	$-(C_3H_6)-_n$	no visible change

40 Wine can deteriorate after a period of time because of atmospheric oxidation. Which compound is formed by the oxidation of the alcohol in the wine?

A C_2H_5OH

B 

C 

D 

End of Paper 1

CANBERRA SECONDARY SCHOOL

2017 Preliminary Examination 2

Secondary Four Express/Five Normal Academic

SCIENCE (CHEMISTRY)
5076/03

29 Sept 2017
1 hour 15 minutes
1100h – 1215h

Name: _____ ( ) **Class:** _____

READ THESE INSTRUCTIONS FIRST

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

Write your full name, class and index number in the spaces provided on the question paper.
Write in dark blue or black pen.
You may use a pencil for any diagrams or graphs.
Do not use staples, paper clips, highlighters, glue or correction fluid.

This paper consists of **Section A** and **Section B**.
Answer **ALL** the questions in Section A and any **TWO** questions in Section B.
The number of marks is given in brackets [ ] at the end of the question or part question.

You may use a calculator for this examination.

A copy of the Periodic Table is printed on page 15.

For Marker's Use		
Section	Marks Awarded	Max Marks
A		45
B		20
Total		65

This question paper consists of 15 printed pages including the cover page.

Setter: **Mr Jason Tan**

Section A: [45 marks]

Answer **all** the questions. Write your answers in the spaces provided.

1 The term species is sometimes used to refer to neutral atoms and to positive and negative ions. The table shows the numbers of subatomic particles in eight different species.

species	number of protons	number of neutrons	number of electrons
E	4	5	2
F	4	3	2
G	6	7	6
H	6	7	7
I	7	7	7
J	7	7	10
K	8	8	10
L	8	10	10

(a) Which letter or letters from **E**, **F**, **G**, **H**, **I**, **J**, **K** and **L** represent

(i) the atom with the largest mass number? [1]

.....

(ii) two different isotopes of the same element? [1]

.....

(iii) two negative ions formed from the same element? [1]

.....

(iv) two positive ions that form an ionic compound with a formula of the type YZ_2? [1]

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(b) Use your knowledge of electronic structures to explain why when moving across the Periodic Table from lithium to fluorine, the character of these elements changes from being metallic to non-metallic. [1]

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2 Complete the following table by stating if the substance is an element, compound or mixture, and giving one use for each substance. [3]

The first line, for hydrogen, has been completed for you.

substance	type of substance	use
hydrogen	*element*	*making of margarine*
brass		
ethanol		
bitumen		

3 A salt solution is prepared by dissolving excess iron(II) oxide in dilute sulfuric acid.

(a) Complete the table to give information about sulfuric acid. [3]

formula	approximate pH	symbol of ion that gives the acid its acidity

(b) Describe a chemical test and state the result that is used to show that the salt solution contains iron(II) ions. [2]

test .....

.....

result .....

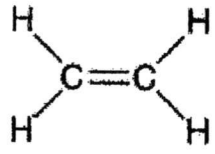
.....

(c) Give the ionic equation, with state symbols, for the test in **(b)**. [2]

.....

4 The table below shows information about some organic compounds.

(a) Complete the table by filling in the missing **names**, **formulae** and by completing the description of the **processes**. [3]

name of compound	structural formula	process used to manufacture the compound
		..... of long chain alkanes
poly(ethene)		..... of ethene
ethanoic acid		..... of ethanol

(b) Ethanol is a member of the alcohol homologous series. [2]

Describe a chemical test to distinguish between ethanol and ethanoic acid and the result you would expect.

method .....

result for ethanol .....

result for ethanoic acid .....

5 The list below shows how long ago some metals were discovered.

calcium	206 years ago
copper	7000 years ago
iron	3000 years ago
lead	7000 years ago
magnesium	259 years ago
sodium	207 years ago
zinc	2000 years ago

(a) With reference to their reactivity, explain why metals such as copper and lead were discovered much earlier than others. [1]

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.....

(b) Recycling metals helps to conserve metal ores which are non-renewable. However in some countries, metals are not recycled. [2]

Suggest two reasons why metals are **not** recycled.

reason 1 .....

.....

reason 2 .....

.....

(c) When iron is extracted from its ore in the blast furnace, molten slag is also produced.

(i) Describe how slag is formed. Include a suitable chemical equation in your answer. [2]

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(ii) Explain why sodium cannot be extracted in the same way as iron in the blast furnace. [1]

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(d) Metals can form either *basic oxides* or *amphoteric oxides* when they react with oxygen.

(i) Explain what is meant by a *basic oxide*. [1]

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.....

(ii) Describe a chemical test that can be used to determine if a metal oxide is basic or amphoteric in nature. [2]

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(iii) Unlike metals, non-metals form oxides with relatively low boiling points. Explain why. [2]

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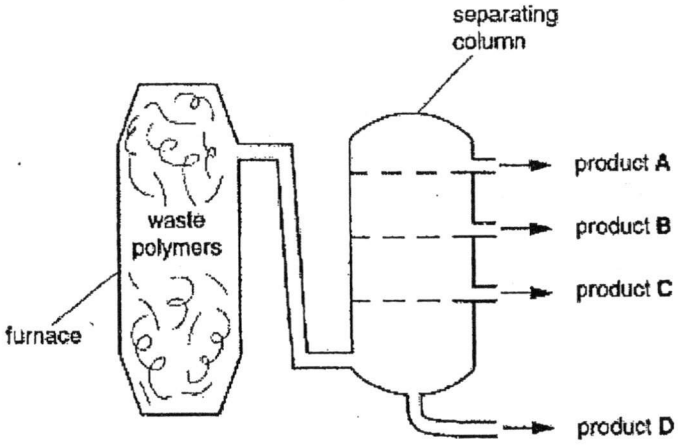
6 Some plastic waste can be recycled. One way of recycling plastic waste is by heating it in a furnace. The waste decomposes into a mixture of hydrocarbons which can be separated in a separating column.



(a) Name the type of separation process that happens in the separating column. [1]

.....

(b) Which of the products, **A**, **B**, **C** or **D**, has the lowest boiling point? ..... [1]

(c) It was found that the boiling point of the products increases as the number of carbon atoms in the molecules present increases. [2]

Suggest a reason for this.

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(d) The disposal of both plastics and iron or steel can cause pollution problems. An article made from plastics is likely to cause pollution for a longer period of time than a similar article made from iron or steel. [2]

Explain why.

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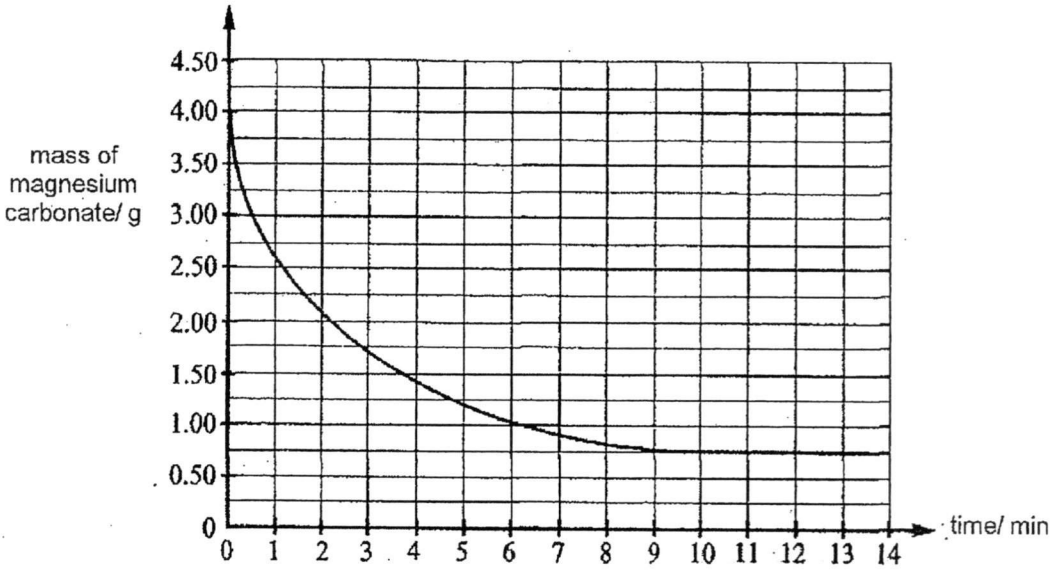
7 Dilute hydrochloric acid is added to magnesium carbonate in a conical flask.

The chemical equation for the reaction is given.

$$2HCl\ (aq) + MgCO_3\ (s) \rightarrow MgCl_2\ (aq) + CO_2\ (g) + H_2O\ (l)$$

The graph below shows how the mass of magnesium carbonate in the flask changes with time.



(a) Using the graph, identify the limiting reagent in the reaction. [1]

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(b) What can you tell from the graph about the speed of the reaction during its first 14 minutes? [1]

.....

.....

(c) (i) Calculate the number of moles of magnesium carbonate used in the reaction. [2]

moles of magnesium carbonate = ...mol

(ii) Calculate the volume of carbon dioxide produced. [2]

volume of carbon dioxide = ...dm^3

(d) Sketch on the given graph the curve you would expect if the reaction was repeated with all the conditions kept the same except that **larger pieces** of magnesium carbonate were used. [2]

Section B: [20 marks]

Answer any **two** questions. Write your answers in the space provided.

8 Use the Periodic Table provided to answer the following question.

(a) Explain, using sodium as an example, what you understand by the terms 'group' and 'period'. [2]

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(b) Lithium, sodium and potassium are elements found in Group I of the Period Table. [5]

Describe how water can be used to show a trend in the reactivity of these elements. Write a balanced chemical equation, with state symbols, for one of the reactions.

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(c) When sodium burns in chlorine, sodium chloride is formed. [3]

Use the ideas of electron sharing and electron transfer to explain why sodium chloride exists as the ions Na^+Cl^- rather than the covalent molecule Na-Cl.

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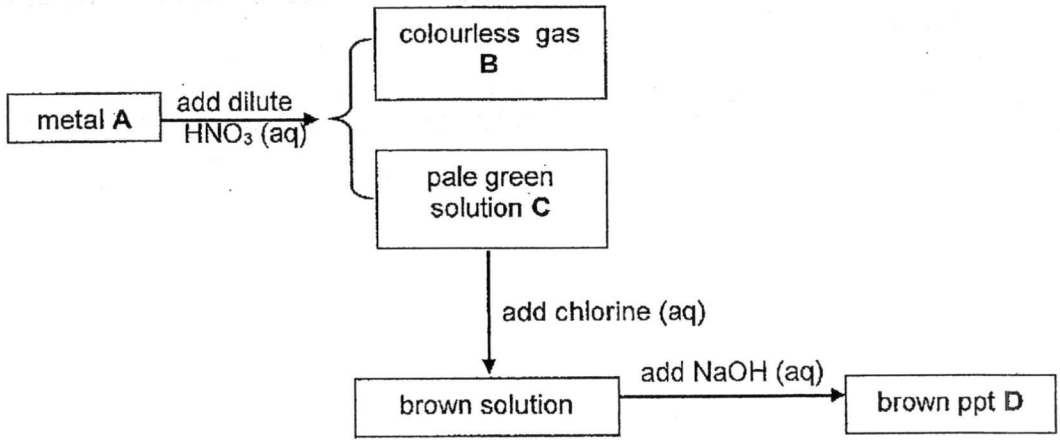
9 Study the reaction scheme given in the figure below.



(a) Identify the four substances. [4]

A, ...

B, ...

C, ...

D. .....

(b) Describe a chemical test to show the presence of nitrate ions in the brown solution. [2]

test .....

.....

result .....

.....

(c) Explain, in term of electron transfer, why chlorine is said to act as an oxidising agent in one of the reactions. Include a suitable ionic equation in your answer. [2]

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(d) When pieces of magnesium were added to solution **C**, the solution turned colourless and a grey deposit was formed. [2]

Explain why these changes have occurred.

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10 In some countries, ethanol is used as a fuel instead of petrol. Glucose obtained from plants such as sugar cane can be converts into ethanol by fermentation.

(a) Describe, with the aid of an equation, how ethanol is manufactured by fermentation. [5]

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(b) An environmentalist claims that ethanol as a fuel is 'carbon neutral' because using it does not add to the amount of carbon dioxide in the atmosphere. [1]

Explain why this is true.

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(c) Besides fermentation, ethanol can be formed by the addition reaction of ethene with a gaseous compound.

(i) Use your knowledge of addition reaction to name this gaseous compound and write a balanced chemical equation for the reaction. [2]

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(ii) Use your knowledge of collisions between reacting particles to explain how and why the rate of the reaction between these two substances changes with decreasing pressure. [2]

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2017 Sec 4E5N Science Chemistry Prelim 2

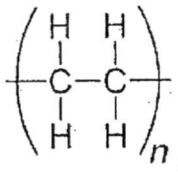
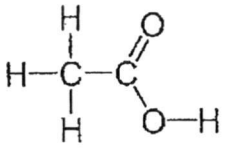
Suggested Answer Scheme

Paper 1

21	22	23	24	25	26	27	28	29	30
B	A	B	C	B	A	C	D	A	D
31	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**
D	D	C	B	A	A	D	C	D	C

Paper 3 Section A

1	(a)i	I	[1]
	(a)ii	E and F or K and L	[1]
	(a)iii	K, L	[1]
	(a)vi	E and F	[1]
	(b)	Moving across the Periodic Table, the elements have increasing number of valence electrons. Hence they need to gain rather than lose electrons to achieve a stable electronic configuration.	[1]
2		brass / mixture / make coins, medals, musical instruments ethanol / compound / as a fuel, make alcoholic drinks, as a solvent for paint and drugs bitumen / mixture / repair road surface 1 mark for 2 correct entries; no 1/2 mark Accept any other possible answer for uses	[3]
3	(a)	H_2SO_4 // 1 or 2 // H^+	[3]
	(b)	Test: add aqueous sodium hydroxide/ aqueous ammonia to the solution. Result: green precipitate formed (insoluble in excess)	[2]
	(c)	Fe^{2+} (aq) + $2OH^-$ (aq) –> $Fe(OH)_2$ (s) 1 mark for all correct formulae 1 mark for all correct balancing and state symbols; award only when all formulae are correct.	[2]

4	(a)	Ethene; cracking  ; addition polymerisation  ; oxidation 1 mark for 2 correct entries; no 1/2 mark	[3]
	(b)	Method: Add magnesium strip to both organic compounds. result for ethanol: no visible change / result for ethanoic acid: effervescence observed/ hydrogen produced OR Method: Add calcium carbonate to both organic compounds. result for ethanol: no visible change result for ethanoic acid: effervescence observed/ carbon dioxide produced [1m] for correct method [1m] for correct result for both ethanol and ethanoic acid. Accept other possible chemical tests such as use of oxidising agents; Reject test using pH Indicator	[2]
5	(a)	These metals are unreactive and relatively stable. Hence they can be discovered in their natural form easily.	[1]
	(b)	It is expensive to collect/gather scrap metals for recycling. Recycling metals can lead to air/ water pollution due to the toxic waste generated. Recycling metals require more energy than the extraction of metals from their ores. Accept other possible answers.	[2]

	(c)(i)	Slag is formed when acidic impurities such as silicon dioxide present in iron ore react with calcium oxide formed from the thermal decomposition of limestone. $CaO + SiO_2 \rightarrow CaSiO_3$ [1m] for full description. [1m] for equation.	[2]
	(c)(ii)	Sodium is a highly reactive metal. It forms compounds that are highly stable and cannot be reduced by reaction with carbon/carbon monoxide.	[1]
	(d)(i)	A metal oxide that reacts with acids to form salt and water.	[1]
	(d)(ii)	Add the metal oxide into a beaker of aqueous sodium hydroxide. If is it amphoteric, it will dissolve to form a salt. If is it basic, there will be no visible change. [1m] for correct test. [1m] for stating both results.	[2]
	(d)(iii)	Oxides formed by non-metals are covalent. [1m] The weak intermolecular forces present can be overcome easily with a small amount of energy. [1m]	[2]
6	(a)	Fractional distillation	[1]
	(b)	A	[1]
	(c)	As the molecules get bigger/heavier, the intermolecular forces present become stronger. The boiling point hence increases as more energy will be needed to overcome the forces.	[2]
	(d)	Plastics are non-biodegradable and hence will not decompose easily/naturally when disposed. Iron or steel however will rust/corrode away when exposed to air and water.	[2]

7	(a)	Hydrochloric Acid	[1]
	(b)	The speed is fast at first then it slow down and stop at the 10th minute.	[1]
	(c)(i)	Mass of magnesium carbonate used = 4 - 0.75 = 3.25g [1m] Mole of magnesium carbonate used = 3.25/ 84 = 0.0387 mol [1m]	[2]
	(c)(ii)	Mole of carbon dioxide produced = 0.0387 mol [1m] Volume of carbon dioxide produced = 0.0387 x 24 = 0.929 dm^3 [1m]	
	(d)	Less steep [1m] end off at 0.75 g after 10 minutes [1m]	[2]
8	(a)	Elements can be arranged in Groups based on their number of valence electrons. They can also be arranged in periods based on their number of electrons shells. Sodium is in Group I since it has only 1 valence electron and is in Period 3 as it has 3 electron shells. [1m for explaining 'group' and 'period'] [1m for using sodium as example]	[2]
	(b)	Place a small piece of each element separately into a trough of water. Lithium will float on the water surface and melt away. Sodium will darts on the water surface and catches fire. Potassium will darts more rapidly on the water surface, catches fire and explodes. The reactions of three elements in water show that lithium is the least reactive while potassium is the most reactive among the three. elements $2Li\ (s) + 2H_2O\ (l) \rightarrow 2LiOH\ (aq) + H_2\ (g)$ $2Na\ (s) + 2H_2O\ (l) \rightarrow 2NaOH\ (aq) + H_2\ (g)$ $2K\ (s) + 2H_2O\ (l) \rightarrow 2KOH\ (aq) + H_2\ (g)$ [2m for describing reactions of all 3 metals in water correctly; 1m for describing reaction of at least 1 metal in water correctly] [1m for stating reactivity trend] [2m for correct equation; 1m for all correct formulae + 1m for correct balancing & ss (award only when all formulae are correct)]	[5]

	(c)	Sodium has the electronic configuration 2.8.1. Chlorine has the electronic configuration 2.8.7. When sodium chloride is formed, each sodium atom transfers 1 electron to a chlorine atom. This result in the formation of Na^+ and Cl^- ions which have stable electronic configurations. Sharing of electrons between a sodium atom and chlorine atom will not enable the atoms to achieve a stable electronic configuration. Hence sodium chloride does not exist as a covalent molecule. [1m for stating e.c. of Na and Cl] [1m for explaining how Na+ and Cl- are formed] [1m for explaining why NaCl is not covalent]	[3]

9	(a)	A: Iron B: hydrogen C: iron(II) nitrate D: iron(III) hydroxide	[4]
	(b)	Test: Add aluminium foil and aqueous sodium hydroxide to the brown solution and warm. [1m] Result: Ammonia gas which turns damp red litmus paper blue will be produced. [1m] ; Allow 'ammonia gas will be produced'	[2]
	(c)	Chlorine causes iron(II) ions to lose an electron each to become iron(III) ions. [1m]/ Chlorine gains electrons $Fe^{2+} \rightarrow Fe^{3+} + e$ [1m] $2Cl^- \rightarrow Cl_2 + 2e$ $2Fe^{2+} + Cl_2 \rightarrow 2Fe^{3+} + 2Cl^-$	[2]
	(d)	Magnesium is more reactive than iron. [1m] It displaces iron from the solution as the grey deposit and form a colourless solution of magnesium nitrate. [1m]	[2]

10	(a)	Yeast is added to glucose solution and kept at 37 °C in the absence of air. During the process ethanol and carbon dioxide is formed. Ethanol is extracted from the mixture by filtration followed by fractional distillation of the filtrate. $C_6H_{12}O_6 \rightarrow 2C_2H_5OH + 2CO_2$ [1m for each description above] [2m for correct equation; 1m for all correct formulae + 1m for correct balancing (award only when all formulae are correct)]	[5]
	(b)	Carbon dioxide produced from the burning of ethanol is used/removed by the plants during photosynthesis.	[1]
	(c)(i)	Steam [1m] $C_2H_4 + H_2O \rightarrow C_2H_5OH$ [1m]	[2]
	(c)(ii)	As pressure decreases, the rate of reaction also decreases. [1m] This is because at lower pressure, the reacting gaseous particles are further apart. This reduces the frequency of successful collision between the reacting gaseous particles to form the product. [1m]	[2]