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GAN ENG SENG SCHOOL
Preliminary 2 Examination 2015



CANDIDATE
NAME

CLASS

INDEX
NUMBER

CHEMISTRY

Secondary 4 Express
Paper 1 Multiple Choice

5073/01
31 August 2015
1 hour

Additional Materials: OTAS

Calculators are allowed in the examination

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.

Do not use staples, paper clips, glue or correction fluid

Write your name, class and index number on the OTAS

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 separate OTAS

Read the instructions on the 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 on page 14

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

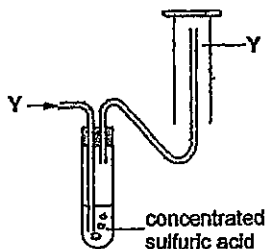
Total Marks	
40	

- 1 There are two unlabelled bottles, one of which is hydrochloric acid and the other is sulfuric acid. To distinguish the two acids, a student adds aqueous sodium hydroxide to each of the acids.

Given that the concentration of the solutions used are the same, which of the following apparatus would not be necessary in this investigation?

- A beaker
B measuring cylinder
C stop watch
D thermometer

- 2 The following diagram shows a method to collect a sample of gas Y



Which of the following information can be deduced about gas Y?

- 1 Y is alkaline.
2 Y is very soluble in water
3 Y is less dense than air

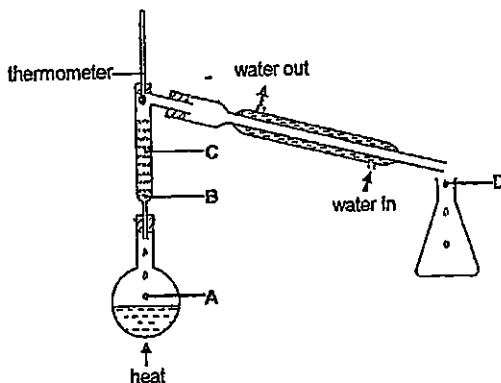
- A 1, 2 and 3
B 1 and 2
C 3 only
D None of the above

- 3 Which set of results is correct when the reagent is added to a solution containing both iron(II) sulfate and sodium nitrate?

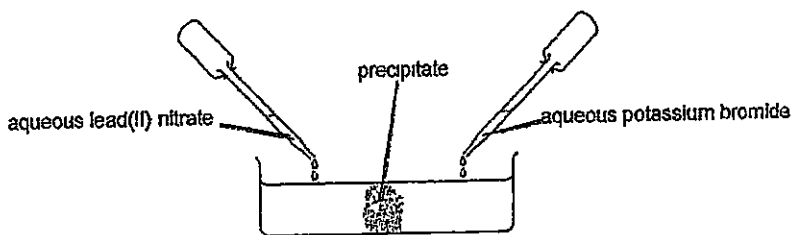
	reagent	result
A	aqueous barium chloride	green precipitate seen settled at the bottom of the test tube
B	aqueous barium chloride	white precipitate seen
C	aqueous sodium hydroxide	gas turned moist red litmus blue when warmed
D	aqueous sodium hydroxide	dark green solution seen in excess reagent

- 4 A mixture containing equal volumes of two liquids is placed in the apparatus shown and heated until the thermometer first shows a constant reading

At which position will there be the highest proportion of the liquid with the higher boiling point?



- 5 Aqueous lead(II) nitrate and aqueous potassium bromide are added to a dish containing water, as shown



A precipitate forms after a few minutes

Which of the following statements explains the phenomenon?

- A Particles collide, diffuse and then react.
- B Particles collide, react and then diffuse
- C Particles diffuse, collide and then react.
- D Particles diffuse, react and then collide.

- 6 The isotope cobalt-60 is used to destroy cancer cells in the human body.

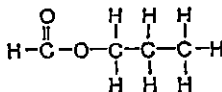
Which of the following statements about an atom of cobalt-60 are correct?

- 1 It contains 33 neutrons.
- 2 Its nucleus has 27 positive charges
- 3 It has a different number of neutrons from some atoms of cobalt.

- A 1 and 2
C 2 and 3

- B 1 and 3
D All of the above

- 7 The diagram shows the molecule propyl methanoate



What is the total number of electrons that are not involved in the bonding in the molecule?

- A 8
C 20

- B 12
D 28

- 8 Which of the following solid has both ionic and covalent bonds?

- A ammonium sulfate
B iodine
C silicon dioxide
D steel

- 9 The two statements are about chlorine. The statements may or may not be correct. They may or may not be linked

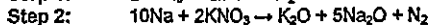
statement 1 Chlorine has weak covalent bonds in its simple molecular structure

statement 2 Chlorine is soluble in water

What is correct about these two statements?

- A Both statements are correct and statement 1 explains statement 2.
B Both statements are correct but statement 1 does not explain statement 2
C Statement 2 is correct but statement 1 is incorrect.
D Both statements are incorrect.

- 10 On collision, airbags in cars inflate rapidly due to the production of nitrogen. The nitrogen is formed in two steps as shown below



How many moles of nitrogen gas are produced from 1 mole of sodium azide, NaN_3 ?

- A 1.5 moles
B 1.6 moles
C 2.0 moles
D 4.0 moles
- 11 Dinitrogen tetraoxide, N_2O_4 , is a poisonous gas. It can be disposed of safely by reaction with sodium hydroxide



What is the minimum volume of 0.5 mol/dm^3 sodium hydroxide needed to dispose of 1.84 g of dinitrogen tetraoxide?

- A 40 cm^3
B 80 cm^3
C 12500 cm^3
D 50000 cm^3
- 12 Brine is a saturated solution of sodium chloride. In the electrolysis of brine, the products are chlorine, hydrogen and sodium hydroxide.

What is the maximum yield of each of these products when 58.5 kg of sodium chloride are electrolysed as brine?

	yield of chlorine / kg	yield of hydrogen / kg	yield of sodium hydroxide / kg
A	35.5	1	40
B	35.5	0.5	80
C	17.75	1	40
D	17.75	0.5	80

- 13 Consider the following reaction for which the heat of reaction is given



Which of the following statements about the reaction is not correct?

- A For each mole of $\text{N}_2\text{O}_5(\text{s})$ reacted, 11.5 kJ of heat is released.
B For 2 moles of $\text{N}_2(\text{g})$ produced, 11.5 kJ of heat is released.
C The energy of N_2O_5 is less than that of the products.
D The energy involved in bond forming is greater than that of bond breaking.

- 14 The two statements are about electrolysis of concentrated aqueous potassium nitrate using graphite electrodes. The statements may or may not be correct. They may or may not be linked.

statement 1 The solution around anode turned litmus red during electrolysis

statement 2 Hydroxide ions are discharged at the anode during electrolysis

Which is correct about the two statements?

- A Both statements are correct and statement 1 explains statement 2
- B Both statements are correct but statement 2 does not explain statement 1
- C Statement 2 is correct but statement 1 is incorrect.
- D Both statements are incorrect.

- 15 In the extraction of aluminium by electrolysis using graphite electrodes, molten aluminium oxide is dissolved in molten cryolite which is a sodium salt.

statement 1 Aluminium is deposited at the negative electrode

statement 2 Aluminium ion is less reactive than sodium ion

The statements may or may not be correct. They may or may not be linked

Which is correct about the two statements?

- A Both statements are correct and statement 1 explains statement 2.
- B Both statements are correct but statement 2 does not explain statement 1
- C Statement 1 is correct but statement 2 is incorrect.
- D Both statements are incorrect.

- 16 When a hot glass rod is placed in a gas jar of hydrogen iodide, the hydrogen iodide decomposes immediately

Which of the following statements about this reaction are correct?

- 1 Hydrogen iodide has reacted with oxygen in the air
- 2 The hot rod provides the activation energy
- 3 One of the products is a dark purple vapour.

- | | | | |
|---|---------|---|------------------|
| A | 1 and 2 | B | 1 and 3 |
| C | 2 and 3 | D | All of the above |

- 1 Burning of coke requires energy to start the reaction and hence is endothermic.
- 2 Freezing of water is endothermic as the temperature of the surroundings is cold
- 3 Reaction between sodium and water releases heat to the surroundings and hence is exothermic.

- A The amount of yeast present is unchanged in the reaction
B The presence of yeast increases the final amount of ethanol produced
C Yeast changes the energy of the reactants and products
D Yeast operates effectively at extreme low temperatures

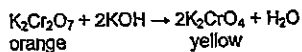
	<i>initial rate of reaction</i>	<i>total volume of hydrogen evolved</i>
A	increase	increase
B	increase	no change
C	no change	no change
D	no change	increase

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

21 Which reagent, when mixed and heated with ammonium sulfate, liberates ammonia?

- A aqueous bromine B acidified potassium manganate(VII)
C concentrated sulfuric acid D limewater

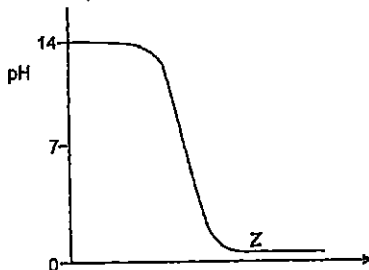
22 The equation explains the colour change that occurs when aqueous potassium hydroxide is added to aqueous potassium dichromate(VI) until no further change is seen



What happens to the oxidation state of the chromium and the pH of the reaction mixture?

	oxidation state of chromium	pH of mixture
A	decreases	decreases
B	decreases	increases
C	remains the same	decreases
D	remains the same	increases

23 The graph shows how the pH changes in a reaction between an acid and an alkali

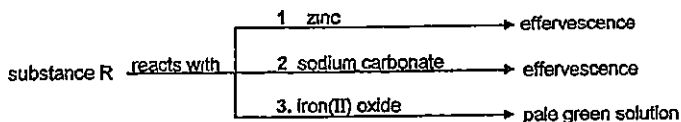


- 1 Acid is added to a fixed amount of alkali,
- 2 Only salt and water are present at Z part of the graph.
- 3 Neutralisation occurs at about pH 7

Which of the above statements could be deduced from the graph?

- A 1 and 2 B 1 and 3
C 2 and 3 D All of the above

- 24 Some reactions of a substance, R, are shown in the diagram



What is substance R?

- | | |
|--|---------------------------------------|
| <p>A aqueous ammonia</p> <p>C potassium dichromate(VI)</p> | <p>B ethanoic acid</p> <p>D steam</p> |
|--|---------------------------------------|
- 25 A mixture of the oxides of two elements of the third period is dissolved in water. The solution is approximately neutral.
- What could be the constituents of the mixture?
- A Al_2O_3 and MgO
- B CO_2 and SO_3
- C Na_2O and MgO
- D Na_2O and SO_3
- 26 Which two processes are involved in the preparation of zinc sulfate crystals from dilute sulfuric acid and zinc oxide?
- A neutralisation and filtration
- B neutralisation and oxidation
- C precipitation and filtration
- D precipitation and oxidation
- 27 Aqueous ethylamine has similar properties as aqueous ammonia. Which of the following is true about aqueous ethylamine?
- A It forms a gas with dilute sulfuric acid.
- B It forms white fumes with hydrogen chloride
- C It forms a colourless solution when added to aqueous aluminium nitrate.
- D It forms blue precipitate with aqueous copper(II) chloride when added in excess
- 28 Which information about an element can be used to predict its chemical properties?
- A colour of its compound
- B density
- C melting point
- D position in the Periodic Table

- 29 Which of the following substances would produce effervescence when added to aqueous magnesium chloride?

A copper
B iodine
C sodium
D zinc

- 30 An element M is a gray solid at room temperature and pressure. It forms an oxide of formula, MO_2 (melts at 1630°C and boils at 1800°C). It also forms a chloride of formula, MCl_4 (melts at -37°C and boils at 114°C).

These suggest that this element M is a .. 1 and its chloride is .. 2

Which words correctly fill in the blanks 1 and 2?

	1	2
A	metal	covalent
B	metal	ionic
C	non-metal	covalent
D	non-metal	ionic

- 31 Group II nitrates undergo thermal decomposition according to the following equation.



Which Group II nitrate requires the highest temperature to bring about its thermal decomposition?

A barium nitrate
B calcium nitrate
C magnesium nitrate
D strontium nitrate

- 32 Dilute sulfuric acid is added to a mixture of excess copper, magnesium and lead in a beaker. The beaker is left for about 10 minutes and its contents are then filtered.

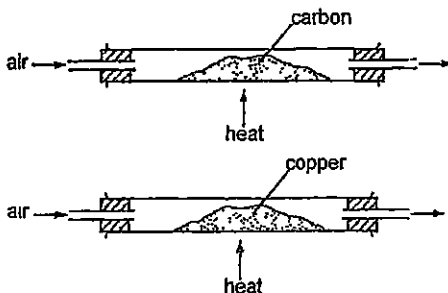
What does the filtrate contain?

A copper(II) sulfate, lead(II) sulfate, magnesium sulfate,
B copper(II) sulfate, magnesium sulfate
C lead(II) sulfate, magnesium sulfate
D magnesium sulfate

33 In which industrial process is the presence of water not essential?

- A electrolytic purification of copper
- B manufacture of ethanol from ethene
- C manufacture of ethanol by fermentation
- D manufacture of iron in the Blast Furnace

34 Powdered carbon and powdered copper are separately heated as shown.



What observations would be seen when each of the substances is heated over a period of time?

	carbon	copper
A	less black solid formed	more black solid formed
B	more black solid formed	more reddish-brown solid formed
C	less black solid remained	more black solid formed
D	more black solid remained	more reddish-brown solid formed

35 Which gas is present in the exhaust fumes of a car engine in a much greater amount than any other gas?

- A carbon dioxide
- B carbon monoxide
- C nitrogen
- D water vapour

36 The hydrocarbon $C_{17}H_{36}$ can be cracked. Which compound is the least likely to be produced in this reaction?

- A C_3H_8
- B C_4H_{10}
- C $C_{10}H_{20}$
- D $C_{16}H_{34}$

—

-

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-

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-

-

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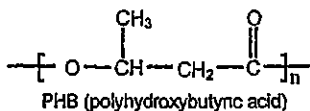


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-

-

- 40 PHB (polyhydroxybutyric acid) is a natural polymer produced by a range of micro-organisms. The structure of this polymer is as shown below.



Which of the following statements are true about PHB?

- | | |
|---|--|
| 1 | PHB is a condensation polymer |
| 2 | PHB molecule contains many ester groups |
| 3 | PHB is made from two different types of unsaturated monomers |
-
- | | | | |
|---|---------|---|------------------|
| A | 1 and 2 | B | 1 and 3 |
| C | 2 and 3 | D | All of the above |

- END OF PAPER -

The Periodic Table of the Elements

Group																	
I	II	III										IV	V	VI	VII	0	
7 Li Lithium 3	9 Be Beryllium 4	1 H Hydrogen 1															2 He Helium
23 Na Sodium 11	24 Mg Magnesium 12																20 Ne Neon 10
39 K Potassium 19	40 Ca Calcium 20	48 Ti Titanium 22	50 V Vanadium 23	51 Cr Chromium 24	52 Mn Manganese 25	55 Fe Iron 26	56 Co Cobalt 27	59 Ni Nickel 28	60 Cu Copper 29	65 Zn Zinc 30	70 Ga Gallium 31	72 Ge Germanium 32	73 As Arsenic 33	75 Se Selenium 34	78 Br Bromine 35	80 Kr Krypton 36	84 Rb Rubidium 37
85 Rb Rubidium 37	86 Sr Strontium 38	91 Y Yttrium 40	92 Zr Zirconium 40	93 Nb Niobium 41	96 Mo Molybdenum 42	101 Ru Ruthenium 44	102 Rh Rhodium 45	106 Pd Palladium 46	108 Ag Silver 47	112 Cd Cadmium 48	115 In Indium 49	118 Sn Tin 50	119 Sb Antimony 51	122 Te Tellurium 52	127 I Iodine 53	131 Xe Xenon 54	137 Cs Cesium 55
133 Fr Francium 87	137 Ba Barium 56	173 La Lanthanum 57	174 Ce Cerium 58	175 Pr Praseodymium 59	176 Nd Neodymium 60	180 Sm Samarium 62	181 Eu Europium 63	182 Gd Gadolinium 64	183 Tb Terbium 65	188 Dy Dysprosium 66	192 Ho Holmium 67	194 Er Erbium 68	197 Tm Thulium 69	201 Yb Ytterbium 70	209 Lu Lutetium 71	210 Hf Hafnium 72	227 Ac Actinium 89
Fr Francium 87	Ra Radium 88											Po Polonium 84	At Astatine 85	Rn Radon 86			

140 Ce Cerium 58	141 Pr Praseodymium 59	144 Nd Neodymium 60	145 Pm Promethium 61	150 Sm Samarium 62	152 Eu Europium 63	157 Gd Gadolinium 64	159 Tb Terbium 65	162 Dy Dysprosium 66	163 Ho Holmium 67	167 Er Erbium 68	169 Tm Thulium 69	173 Yb Ytterbium 70	176 Lu Lutetium 71
232 Th Thorium 90	238 Pa Protactinium 91	238 U Uranium 92	238 Np Neptunium 93	241 Pu Plutonium 94	244 Am Americium 95	247 Cm Curium 96	251 Bk Berkelium 97	254 Cf Californium 98	257 Es Einsteinium 99	261 Fm Fermium 100	265 Md Mendelevium 101	269 No Nobelium 102	271 Lr Lawrencium 103

X

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

Key

58-71 Lanthanoid series
104-103 Actinoid series

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

Key

a	relative atomic mass
X	atomic symbol
b	proton (atomic) number

103-118 Lanthanoid series
109-110 Actinoid series

15

Answers

1	C	6	D	11	B	16	C	21	D	26	A	31	A	36	D
2	C	7	C	12	A	17	B	22	C	27	B	32	D	37	C
3	B	8	A	13	C	18	A	23	B	28	D	33	D	38	D
4	A	9	C	14	B	19	C	24	B	29	C	34	C	39	C
5	C	10	B	15	C	20	C	25	D	30	A	35	C	40	A



GAN ENG SENG SCHOOL
Preliminary 2 Examination 2015



CANDIDATE
NAME

CLASS

 -

INDEX
NUMBER

CHEMISTRY

Paper 2

Secondary 4 Express

5073/02

28 August 2015
1 hour 45 minutes

Candidates answer on the Question Paper.
Calculators are allowed in the examination

READ THESE INSTRUCTIONS FIRST

Write your class, index number and name on all the work you hand in.
Write in dark blue or black pen.
You may use a soft pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid / tape.

Section A

Answer all questions in the spaces provided.

Section B

Answer all three questions, the last question is in the form either/or.
Answer all questions in the spaces provided.

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 on page 17.

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

	For Examiner's Use
Section A	
Section B	
B9	
B10	
B11 *Either / OR	
*Circle where appropriate	
Total	80

This paper consists of 17 printed pages including the cover page.

Section A (50 marks)

Answer all the questions in the spaces provided.

A1 The diagram shows part of the Periodic Table.

				He
C	N	O	F	Ne
		S	Cl	Ar
			Br	Kr

Answer the following questions using **only** the elements shown in the diagram.
Each element may be used once, more than once or not at all.

- (a) Which element has 2 electrons only? _____ [1]
- (b) Which element has a giant covalent structure? _____ [1]
- (c) Which element(s) form(s) oxides that often result in acid rain? _____ [1]
- (d) Which element has diatomic molecules? _____ [1]
- (e) Which element gains electrons most readily? _____ [1]
- (f) Which element has one oxidation number only? _____ [1]
- (g) Which element can form a compound of formula MgX ? _____ [1]

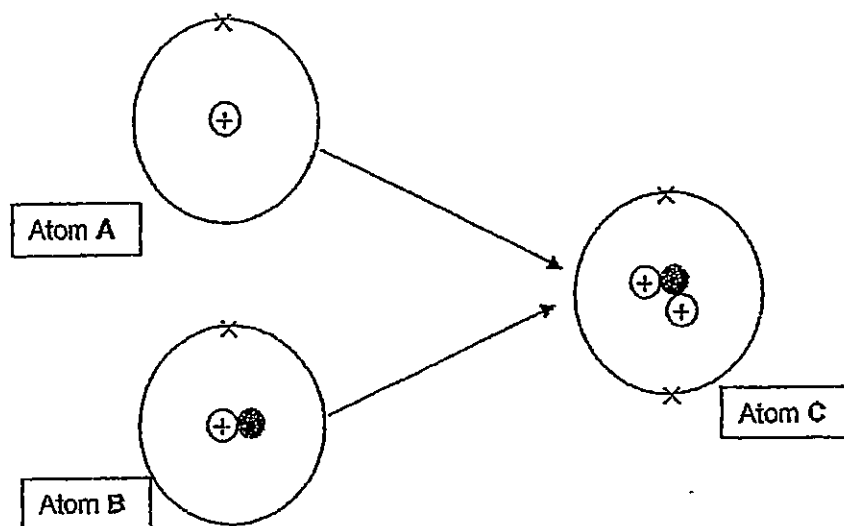
[Total: 7]

- A2 Nuclear fusion involves two atoms joining to make a heavier atom which releases a lot of energy in the process.

The Sun and other stars use nuclear fusion to release energy. The elements that make up the Sun and the stars are mainly:

- those that undergo nuclear fusion and
- those that are made from nuclear fusion

The sequence of nuclear fusion reactions in a star is complex. Below is one nuclear fusion reaction that could take place in the Sun and the stars.



- (a) From the above diagram, what are the two elements mainly present in the Sun and the stars? Explain your answer.

.....

.....

.....

..... [3]

- (b) What is the name given for atoms A and B?

..... [1]

- (c) Explain why atom C is heavier than atom A.

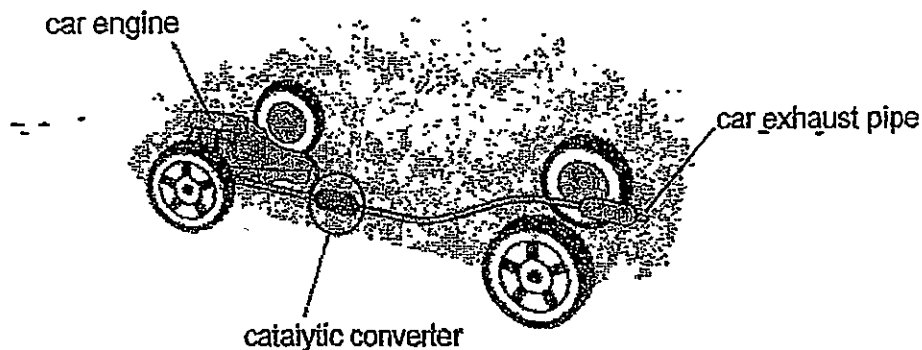
.....

.....

..... [2]

[Total: 6]

- A3 Since 1975, the cars have been installed with catalytic converters to convert harmful pollutants into less harmful emissions before leaving the car exhaust pipe. Most of the cars are powered by burning petrol which is a mixture of hydrocarbons in the car engine. As a result, the pollutants are mainly carbon monoxide, oxides of nitrogen and unburnt hydrocarbons.



- (a) Which pollutant is least likely to be produced when the petrol is just ignited in a *cold* car engine? Explain your answer.

[2]

- (b) Recent innovation in the automobile industry includes the use of gold to *improve the efficiency* of oxidation process in catalytic converters.

- (i) Why does the use of gold improve the efficiency of the catalytic converter?

[1]

- (ii) The catalytic converter contains a very small amount of gold.
Do you expect the amount of gold to change after the catalytic converter is used for a few years?
Explain your answer.

[1]

[Total: 4]

- A4 John Newlands was one of the first chemists who attempted to classify elements in a systematic way based on atomic weight. In 1866 he suggested that there was a repeating pattern of elements with similar properties every eighth element. Part of Newlands' Periodic Table using his symbols is shown below.

H	F	Cl	Co/Ni
Li	Na	K	Cu
Gl	Mg	Ca	Zn
Bo	Al	Cr	Y
C	Si	Ti	In
N	P	Mn	As
O	S	Fe	Se

- (a) Describe a trend that is observed in both Newlands's Periodic Table and the Modern Periodic Table that we use today.

.....
 [1]

- (b) The symbols Gl and Bo have been changed in the Modern Periodic Table. State the current symbols used for Gl and Bo.

Gl
 Bo [2]

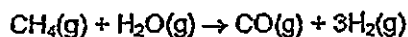
- (c) Describe one similarity and two differences between the Newland's Periodic Table and the Modern Periodic Table.

.....

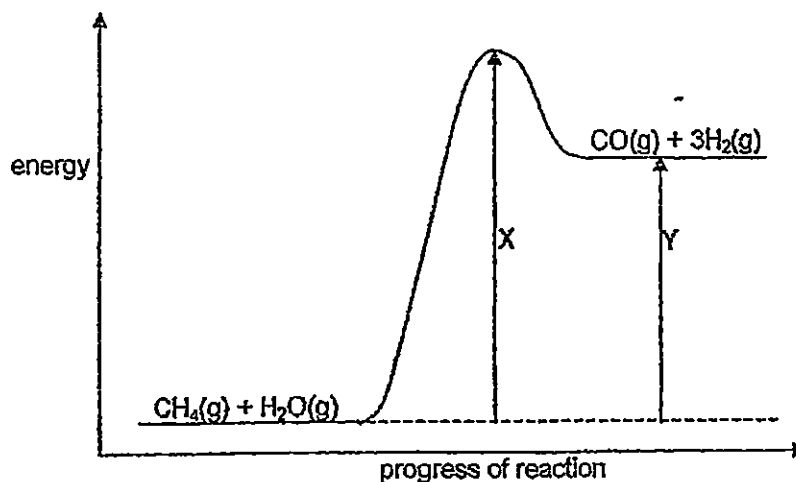
 [3]

[Total: 6]

- A5** Hydrogen has many industrial uses. One possible way to manufacture hydrogen involves the reaction between methane and steam.



The diagram shows the energy profile diagram for this reaction.



- (a) What is one industrial use of hydrogen?

_____ [1]

- (b) What do the arrows, X and Y, represent in the diagram?

_____ [2]

- (c) A student wrote the following statement:

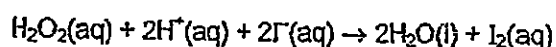
In the reaction between methane and steam, the energy for bond forming is smaller than the energy for bond breaking.

Do you agree with the student? Explain your answer.

_____ [3]

[Total: 6]

- A6 Hydrogen peroxide is a colourless liquid. An aqueous solution of hydrogen peroxide reacts with the iodide ions in acidified potassium iodide to form water and iodine.



- (a) (i) Which substance is the reducing agent in this reaction? Explain your answer.

[2]

- (ii) Describe the observation when this reaction is complete.

[1]

- (b) . An investigation on the effect of concentration of potassium iodide and dilute sulfuric acid on the speed of reaction occurring between hydrogen peroxide and acidified potassium iodide is carried out.
The table shows how the speed of this reaction changes when different concentrations of same volume of potassium iodide and dilute sulfuric acid are used.

experiment	concentration of potassium iodide in mol/dm ³	concentration of dilute sulfuric acid in mol/dm ³	speed of reaction in mol/dm ³ /s
1	0.1	0.1	0.00017
2	0.2	0.1	0.00034
3	0.1	0.2	0.00017
4	0.3	0.1	0.00051
5	0.1	0.3	0.00017

- (i) Describe the measurement that has to be taken during the investigation in order to calculate the speed of reaction.

[1]

- (ii) State **two** key conditions, other than no catalyst is used, that have to be held constant during the investigation.

[2]

- (iii) Using the information in the table, describe how concentration of the following reagents affects the speed of reaction.

potassium iodide

[1]

sulfuric acid

[1]

[Total: 8]

- A7** Both strontium and sulfur form chlorides of the formula XCl_2 . The table below compares some of their properties.

	strontium chloride	sulfur dichloride
appearance	white crystals	red liquid
melting point / °C	874	-120
boiling point / °C	1250	59
conductivity of liquid	good	poor
solubility in water	dissolves to form a neutral solution	reacts with water and form the following: - two different sulfur-containing substances - one acidic compound that ionises in water according to the following equation: $\text{HA(aq)} \rightarrow \text{H}^+(\text{aq}) + \text{A}^-(\text{aq})$

- (a) Explain why sulfur dichloride is likely to be a liquid at room temperature.

[1]

- (b) Strontium is a metal and sulfur is a non-metal. Explain why both form chlorides of the formula XCl_2 .

[2]

- (c) Deduce the name of the acidic solution formed when sulfur dichloride reacts with water.

[1]

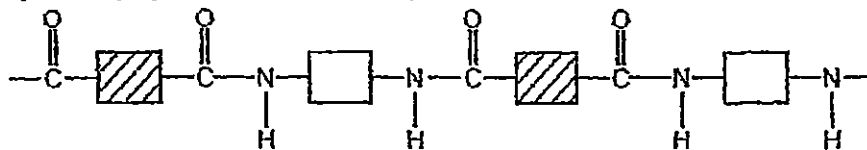
- (d) Explain the difference in electrical conductivity of liquid strontium chloride and liquid sulfur dichloride in terms of bonding and structure.

[4]

[Total: 8]

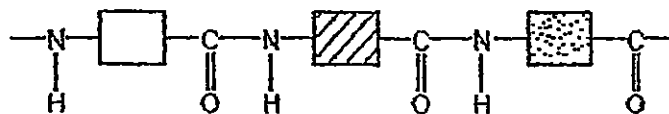
A8 Nylon and protein are macromolecules with amide linkages.

Nylon, a synthetic polymer, has the following structure.



Nylon

Protein, a natural macromolecule, has the following structure



Protein

(a) Describe two differences between nylon and protein.

[2]

(b) (i) Draw one repeating unit of nylon.

Repeating unit of nylon

[1]

(ii) Draw two monomers of protein.

Monomers of protein

[2]

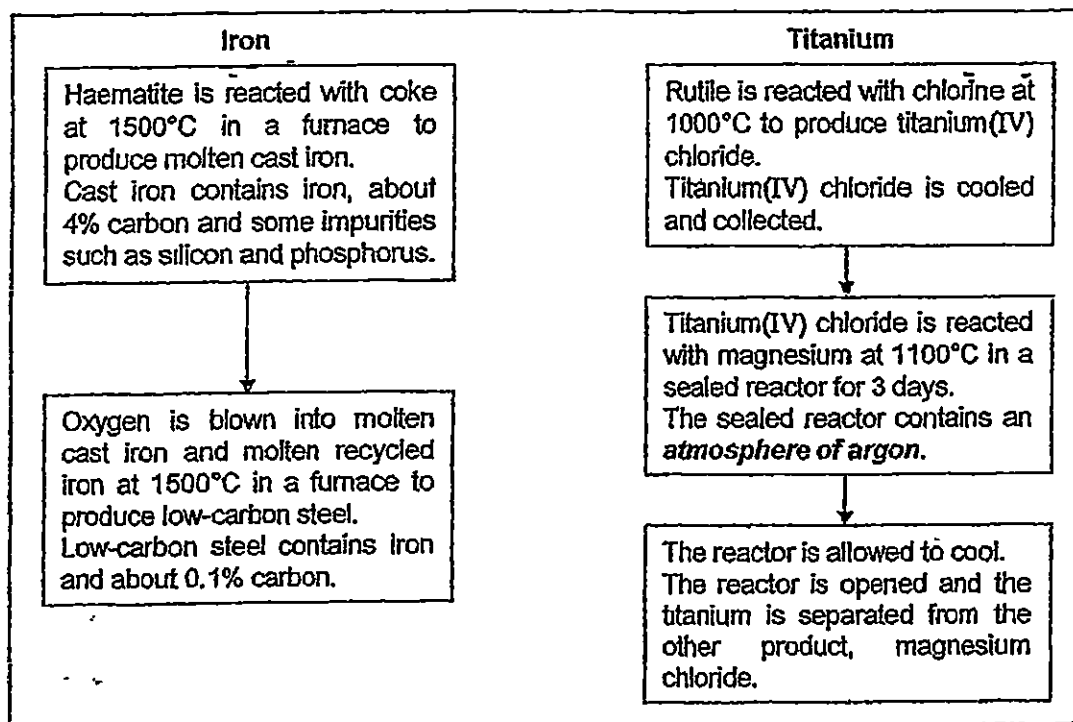
[Total: 5]

Section B (30 marks)

Answer all three questions. The last question is in the form either/or.

Write your answers in the spaces provided.

- B9 Iron is produced in the blast furnace using the ore haematite, iron(III) oxide (melting point 1566°C), as one of the raw materials.
Titanium is produced from the ore rutile, titanium dioxide (melting point 1843°C), which cannot be reduced by coke and hence requires a different method of extraction.



Titanium reactors produce about 1 tonne of the metal per day.

Iron blast furnaces produce about 20 000 tonnes of the metal per hour.

- (a) Explain why the production of low-carbon steel uses oxygen but the production of titanium requires '*an atmosphere of argon*'.

[3]

- (b) The melting point of iron(III) oxide is higher than the temperature in the blast furnace. Explain why iron(III) oxide could remain in molten state in the blast furnace.

[1]

- (c) Other than blowing oxygen into molten cast iron, lime (calcium oxide) is also added in the same furnace during the production of low-carbon steel.

Explain the purpose of the addition of lime in the furnace.

..... [1]

- (d) There is less titanium than iron in the Earth's crust.
Other than titanium's scarcity, explain why titanium costs much more than iron.

..... [3]

- (e) Explain why water is used to wash titanium at the last stage.

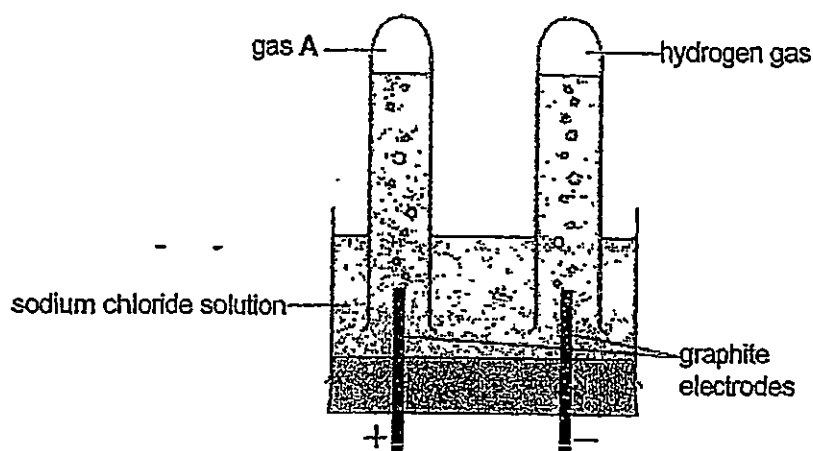
..... [1]

- (f) Suggest the position of titanium in the Reactivity Series of Metals.
Explain your answer.

..... [3]

[Total: 12]

- B10** A student investigated the electrolysis of sodium chloride solution. The diagram below shows the results of the electrolysis.



- (a) Explain why hydrogen gas is produced at the negative electrode.

_____ [2]

- (b) Explain why gas A cannot be oxygen. Support your answer with relevant equations.

_____ [4]

- (c) Describe a test to verify the identity of gas A.

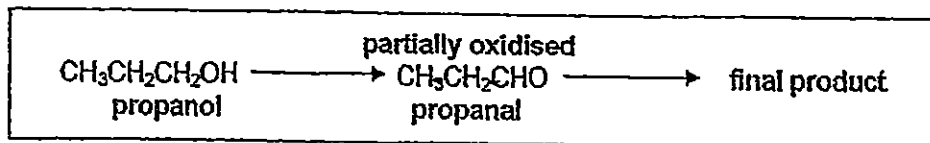
_____ [2]

[Total: 8]

EITHER

- B11 Alcohols are a homologous series of organic compounds.
This homologous series of compounds typically undergoes oxidation.

Using propanol as an example, the reaction scheme of oxidation of alcohol is shown in the box below.



The propanol is first partially oxidised to an intermediate, propanal, which is then quickly oxidised to the final product.

- (a) Such oxidation of alcohol can be achieved by reacting the alcohol using one chemical in the laboratory.

- (i) Name the chemical that can be used to oxidise propanol as shown in the above reaction scheme.

..... [1]

- (ii) Describe how the chemical in (a)(i) would be used to indicate whether the reaction is complete.

.....

 [3]

- (b) Name the final product in the above reaction scheme.

..... [1]

- (c) Butanol undergoes similar oxidation process as propanol.

Name and draw the full structural formula of the *intermediate* formed when butanol is *partially oxidised*.

[2]

(d) The table shows the formulae and names of two compounds.

Compound	Formula	Name
1	$\text{CH}_3\text{CH}_2\text{CHO}$	propanal
2	CH_3COCH_3	propanone

A student said:

"I think compound 1 and 2 are from the same homologous series because their relative molecular mass is the same."

Comment on the student's statement.

[3]

[Total: 10]

OR

B11 Cooking oils contain polyunsaturated fats, which are healthier than polysaturated fats.

A scientist wanted to find the amount of polyunsaturated fats in cooking oils.

The scientist tested four cooking oils, V, W, X, Y and Z. The volume of oil and the concentration of bromine water used are the same for each test.

The results are shown below.

Cooking oil	Number of drops of bromine water reacted		
	Test 1	Test 2	Test 3
V	12	13	15
W	28	18	29
X	18	19	18
Y	4	5	3
Z	15	14	16

(a) What is meant by the term '*polyunsaturated*'?

..... [1]

(b) What type of reaction has occurred between polyunsaturated fats and bromine water?

..... [1]

(c) Describe how bromine water is used to obtain the results in the table.

.....

 [3]

(d) Which one of the results in the table should be tested again? Explain your answer.

.....

 [2]

- (e) The cooking oil V is claimed to have more polyunsaturated fats than other cooking oils.

Do you agree with the claim? Explain your answer.

[3]

[Total: 10]

END OF PAPER

The Periodic Table of the Elements

Group																		
I	II											III	IV	V	VI	VII	0	
																		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	98 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 Cesium 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	188 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	209 Po Polonium 84	At Astatine 85	Rn Radon 86	
Fr Francium 87	226 Ra Radium 88	227 Ac actinium 89																

[†]58-71 Lanthanoid series

[†]90-103 Actinoid series

Key	a X b	a = relative atomic mass X = atomic symbol b = proton (atomic) number
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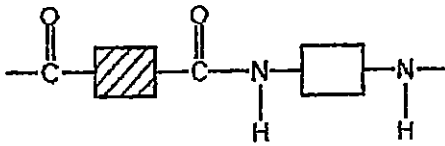
140 Ce Cerium 58	141 Pr Praseodymium 59	144 Nd Neodymium 60	150 Pm Promethium 61	152 Sm Samarium 62	152 Eu Europium 63	157 Gd Gadolinium 64	159 Tb Terbium 65	162 Dy Dysprosium 66	165 Ho Holmium 67	167 Er Erbium 68	169 Tm Thulium 69	173 Yb Ytterbium 70	175 Lu Lutetium 71
232 Th Thorium 90	238 Pa Protactinium 91	238 U Uranium 92	238 Np Neptunium 93	244 Pu Plutonium 94	244 Am Americium 95	244 Cm Curium 96	247 Bk Berkelium 97	251 Cf Californium 98	252 Es Einsteinium 99	254 Fm Fermium 100	258 Md Mendelevium 101	259 No Nobelium 102	261 Lr Lawrencium 103

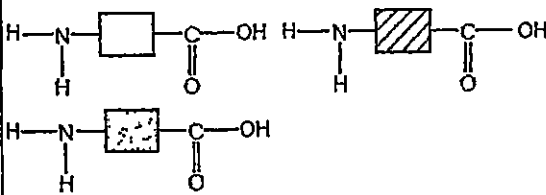
The volume of one mole of any gas is 24 dm³ at room temperature and pressure (r.t.p.)

Paper 2

Qn	Answer	Marks	Remarks -
A1a	He [Accept name of the element]	1	
b	C [Accept name of the element]	1	
c	S and N [Accept name of the element]	1	Ignore O / oxygen
d	F / Cl / Br / O / N - - [Accept name of the element, molecular formula]	1	
e	F [Accept name of the element, molecular formula]	1	Reject spelling error
f	Any one of the noble gases e.g. Ne [Accept name of the element]	1	Many students do not understand the meaning of 'element has only one oxidation state'
g	O / S [Accept name of the element]	1	
A2a	Hydrogen and Helium [1 mark each] Atoms A AND B have 1 proton while atom C has 2 protons.	2 1	Some students have difficulty understanding the context and apply their atomic structure knowledge to it.
b	Isotopes	1	Students thought it's to name the element rather than referring to the particles which are atoms.
c	Atom C has 2 protons and 1 neutron while atom A has only 1 proton The mass of electrons is negligible / electrons are too light to contribute significantly to the mass of an atom	1 1	Many students did not think of negligible mass of electrons which shows they could not interpret the context given.
A3a	Oxides of nitrogen The temperature is low and hence nitrogen and oxygen in the air are less likely/unlikely to combine/react and form oxides of nitrogen	1 1	Many thought CO and unburnt hydrocarbons which are not accepted because these would more likely to be produced rather less.
bi	Gold is a better catalyst than other metals in speeding up the reaction/oxidation in the catalytic converter	1	Students need to understand the meaning of improve efficiency of oxidation which implies that there are catalysts in the catalytic converter already but are more efficient with gold
bi i	No, catalyst / gold remains chemically unchanged / is not used up at the end of the reaction.	1	
A4a	• Elements are arranged in order of increasing atomic / proton number	1	

b	GI – Be Bo – B	1 1	
c	Similarity - Some elements such as F and Cl with the same number of valence/outer electrons are grouped together [Accept: a correct link between any two named elements and same group/column] Differences: - Metals and non-metals are in the same period / row in Newland's Periodic Table but metals are placed in separate groups such as Transition Metals from non-metals in the Modern Periodic Table - Elements with the same number of valence electrons such as F and Cl are arranged in horizontal rows in Newland's Periodic Table instead of vertical columns in the Modern Periodic Table - No noble gases / only group I to VII elements and transition metals	1 2	
A5a	To manufacture ammonia [Accept: use in Haber Process] Accept: conversion of vegetable oils to margarine	1	Industrial is defined as large scale as well as common in daily life. Hence fuel cell is not accepted
b	X. activation energy / <u>minimum</u> energy to start the reaction Y. enthalpy change / energy change	1 1	
c	[No marks for response to agree / partially agree / partially disagree / disagree with the statement] From the diagram, <u>energy of the reactants are lower than energy of the products / energy of products are higher than energy of the reactants / energy change is positive</u> Therefore <u>reaction is endothermic.</u> <u>Less energy given out for bond forming than energy taken in for bond breaking / More energy taken in for bond breaking than energy given out for bond forming</u>	1 1 1	Some students still confuse with direction of energy change for bond breaking and bond forming
A6a	I⁻ / iodide ion / acidified potassium iodide / acidified KI <u>H₂O₂ is reduced as the oxidation number of O in H₂O₂ decreases from -1 in H₂O₂ to -2 in H₂O</u> OR <u>H₂O₂ is reduced as it loses oxygen and form H₂O</u>	1 1	Many tend to explain a reducing agent as one that oxidises itself rather than one that reduces others
all	<u>Solution turned</u> (from colourless to) <u>brown</u>	1	
bi	Record the <u>time taken</u> at the instant when the <u>solution just turned brown</u> / <u>for a cross to be obscured</u>	1	Many simply described time taken for complete reaction without describing how one could see reaction is really complete

bii	• same <u>temperature</u> • <u>aqueous hydrogen peroxide</u> / H_2O_2 has to be <u>in excess</u> / <u>same number of moles</u>	1 1	
biii	From <u>experiment 1, 2 and 4</u>, as the <u>concentration of potassium iodide increases</u>, the <u>speed of reaction increases</u> From <u>experiment 1, 3 and 5</u>, as the <u>concentration of sulfuric acid increases</u>, the <u>speed of reaction remains constant</u> / <u>the speed of reaction is not affected by (concentration of) sulfuric acid</u>	1 1	Many did not use the information by citing the experiments that enable them to make the conclusion for the impact of each solution
A7a	The <u>melting point</u> of sulfur chloride is <u>below / lower than room temperature</u> AND <u>boiling point</u> is <u>above / higher than room temperature</u> .	1	
b	Strontium <u>has 2 valence electrons</u> and hence <u>loses two valence electrons</u> to chlorine. Sulfur <u>has 6 valence electrons</u> and hence <u>shares two valence electrons</u> with chlorine [1] mark awarded if students only mention strontium loses 2 electrons and sulfur shares/gains 2 electrons	1 1	
c	Hydrochloric acid	1	
d	Liquid/molten <u>strontium chloride</u> is an ionic compound which has a giant <u>ionic crystal lattice</u> that has been <u>broken down / electrostatic attraction is overcome</u> and hence there are [1] into <u>mobile ions</u> [1]. Liquid sulfur chloride has a <u>simple molecular structure</u> [1] consists of <u>only molecules</u> [1]	4	
A8a	1. <u>Nylon</u> has only <u>two monomers</u> but <u>protein</u> has <u>3 monomers</u> / <u>at least 3 monomers</u> / <u>many monomers</u> 2. In <u>nylon</u>, one <u>monomer</u> has <u>two COOH</u> and the <u>other monomer</u> has <u>two NH₂</u> but in <u>protein</u>, each <u>monomer</u> has <u>one COOH</u> and <u>one NH₂</u> OR In <u>nylon</u>, one <u>monomer</u> is a <u>dicarboxylic acid</u> and the <u>other</u> is a <u>diamine</u> but in <u>protein</u>, all <u>monomers</u> are <u>amino acids</u>	1 1	
bi	Nylon repeating unit 	1	

bii	Protein monomers – <u>Any two of the following</u> 	2	Many drew the monomers with eliminated atoms
B9a	<u>Oxygen is needed to react with / oxidised carbon to reduce carbon</u> content and produce low-carbon steel. (To produce titanium), <u>argon</u> is used to create an <u>unreactive / inert</u> atmosphere as any <u>oxygen would react with / air would oxidise magnesium / titanium</u>.	1 1 1	Students need to be taught how to read in between the lines of the question. In this case, there are 3 questions explain why use O ₂ in low C steel, explain why use argon in Ti, explain why cannot use O ₂ in Ti
b	The presence of <u>impurities such as silicon dioxide / sand</u> <u>lower the melting point of iron(III) oxide</u> and hence iron(III) oxide could melt at lower temperatures Accept: Impurities such as silicon and phosphorus OR The <u>energy released from the combustion of carbon/coke</u> results in <u>more heat / higher temperature in the blast furnace</u> for the iron(III) oxide to melt.	1	Many did not refer to the context and cite the impurities.
c	To <u>react with acidic impurities such as silicon dioxide</u> and remove them as molten slag	1	Many did not describe acidic which has to be emphasized as CaO can only remove such impurities and not any other types
d	There are <u>more stages to manufacture</u> titanium less efficient / more energy are needed In <u>one day, blast furnace</u> could produce (24 x 20000 =) <u>480000 tonnes of metal</u> while the <u>reactors</u> could only produce <u>1 tonne of metal</u> and hence the <u>rate of production is slower</u>. [student must extract the data on the quantities of metal produced to support the production rate is slower] Blast furnace <u>uses coke/carbon</u> which is <u>abundant and cheaper than magnesium / Magnesium</u> used in reactor is <u>more expensive than coke/carbon</u> because it is extracted by <u>electrolysis</u>	1 1 1	Students must pick out the relevant data that best support why Ti is more expensive
e	To <u>remove soluble magnesium chloride</u> from titanium	1	
f	<u>Titanium is below magnesium AND above zinc</u> in the reactivity series	1	Many students cannot see why Ti must be above Zn and not just Fe
	Magnesium could <u>displace titanium from titanium(IV)</u>		Fe

	<u>chloride</u> and hence magnesium is more reactive than titanium <u>Titanium dioxide cannot be reduced by coke</u> but iron(III) oxide can be reduced by coke. Therefore, titanium is more reactive as it forms more stable compound than iron.	1 1	
B10	<u>Both hydrogen ions / H^+ AND sodium ions / Na^+ in sodium chloride solution are attracted / migrate to the negative electrode / are in the solution.</u> <u>Hydrogen ions / H^+ are more preferentially discharged / reduced</u> than sodium ions / Na^+ and hence hydrogen gas is produced at the negative electrode.	1 1	
b	At anode / positive electrode $2Cl^-(aq) \rightarrow Cl_2(g) + 2e^-$ The <u>volume gas A is the same as the volume of hydrogen</u> The <u>concentration of chloride ions / Cl^- is higher than hydroxide ions / OH^-</u>. Therefore <u>chloride ions / Cl^- are discharged / oxidised</u> instead of hydroxide ions / OH^- <u>at the anode</u>	1 1 1 1	This question cannot be just merely proving why the gas is not oxygen because based on the context given, one can infer the identity of the gas instead of just proving it is not
c	Gas A would <u>turn moist blue litmus red and then bleach it / bleach moist red litmus paper</u> And hence it is <u>chlorine</u>.	1 1	Reject the whole answer if the test and observation are wrong as this would contradict with the identity of the gas
Either B11a)	<u>Acidified aqueous potassium dichromate(VI) / potassium manganate(VII)</u>	1	
all	<u>Add acidified aqueous potassium dichromate(VI) / potassium manganate(VII) dropwise / drop by drop to propanol.</u> If <u>potassium dichromate(VI) turn from orange to green / potassium manganate(VII) turn from purple to colourless</u> with every drop, <u>reaction is not complete.</u> If <u>potassium dichromate(VI) remains orange / potassium manganate(VII) remains purple / not decolourised, reaction is complete.</u>	1 1 1	This question is meant to test student's procedural knowledge rather than content knowledge. Many students explained instead of describing the steps taken to obtain results which show lack of understanding in question stem
b	propanoic acid	1	
c	Butanal $ \begin{array}{ccccccc} & H & H & H & & O & \\ & & & & & & \\ H & -C & -C & -C & -C & & \\ & & & & & H & \\ & H & H & H & & & \end{array} $	1 1	

d	Compound 1 and 2 are <u>isomers</u> They have the <u>same molecular formula / same type and number of each atom</u> and hence relative molecular mass is the same. However, their <u>functional groups are not the same</u> and hence they do <u>not</u> come <u>from the same homologous series</u>	1 1 1	
OR B11a	A polymer / macromolecule with <u>many C=C / carbon-carbon double (covalent) bonds</u>	1	
b	Addition Reject: Addition <u>polymerisation</u>	1	
c	<u>Add bromine (water) dropwise / drop by drop to the fats</u> <u>Count the number of drops</u> <u>Until bromine (water) remain reddish brown</u>	1 1 1	
d	<u>Test 2 for oil W</u> both need to be correct [Allow Ws, 18] <u>Result is not consistent with test 1 and 3 / is anomalous</u> [Reject: does not fit pattern/trend]	1 1	Reject answer that says W only as it implies all three tests of W have to be tested again instead of one test
e	No [No marks] The <u>greater the number of drops of bromine (water) used, the more polyunsaturated / unsaturated fats</u> in the cooking oil. <u>W and X have more polyunsaturated / unsaturated fats than V</u> [Accept: W has the most unsaturated fats] [Ignore Z has more unsaturated fats] <u>V has much more polyunsaturated / unsaturated fats than Y only</u>	1 1 1	Many students simply concluded V does not have more polyunsaturated fats than other cooking oils which is rejected as it implies that V has less polyunsaturated fats than Y