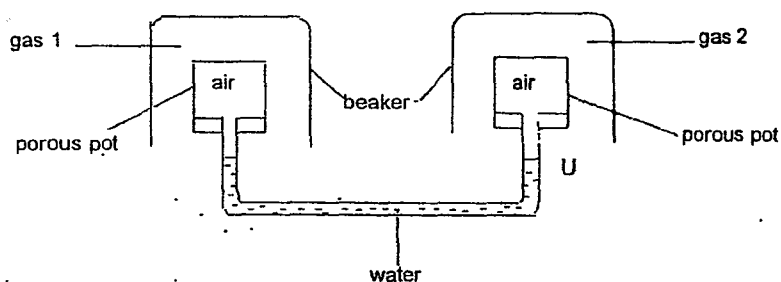


- 1 A laboratory assistant prepared 6 substances. She determined the melting and boiling points of the 6 substances and then tabulated her results as follows:

substance	melting point / °C	boiling point / °C
Jillium	50	80
Paulium	70	500
Porterium	65	67
Vickium	-15	-12
Willium	0	99

At what temperature would she have two liquids?

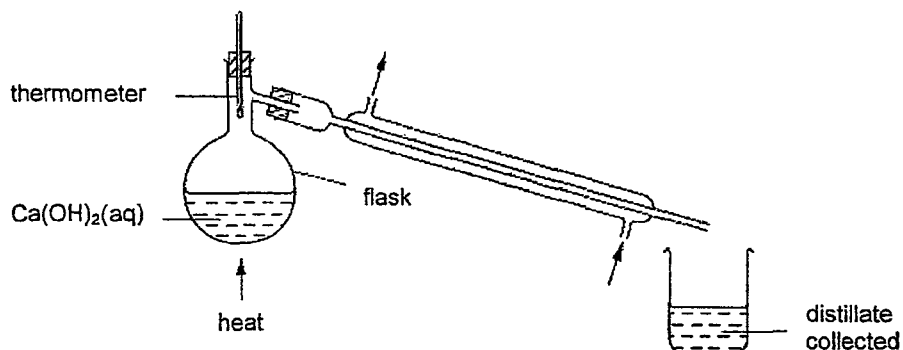
- A -20°C
 B -15°C
 C 15°C
 D 85°C
- 2 The apparatus in an experiment is set up using different gases in the two inverted beakers as shown.



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

	gas 1	gas 2
A	H ₂	CO ₂
B	CO ₂	H ₂
C	N ₂	H ₂
D	CO ₂	N ₂

- 3 The pH of some aqueous sodium hydroxide is measured. The solution is then distilled as shown.



How do the pH values of the distillate collected and of the solution left in the flask compare with the original?

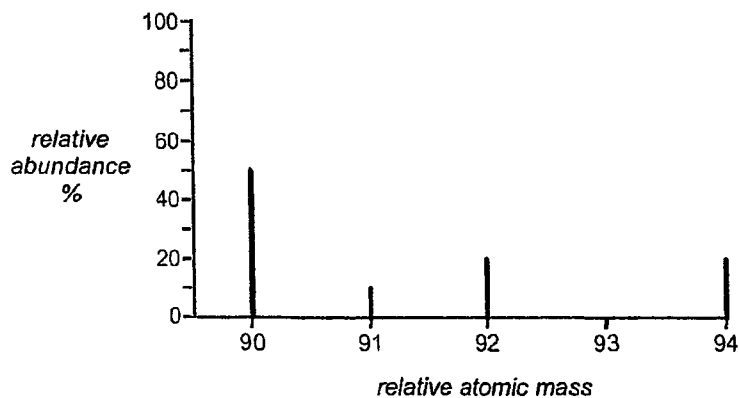
	pH of the distillate	pH of the solution left in the flask
A	higher	higher
B	higher	lower
C	lower	higher
D	lower	lower

- 4 Hexane and water are immiscible liquids.

Which method could be used to separate a mixture of hexane and water and how is the purity of separated hexane checked?

	method of separation	purity check
A	filtration	find the boiling point
B	filtration	obtain a chromatogram
C	use a separating funnel	find the boiling point
D	use a separating funnel	obtain a chromatogram

- 5 An element X consists of four isotopes. The graph shows the relative abundances of the isotopes.



What is the relative atomic mass of X?

- A 91.0
 B 91.3
 C 91.8
 D 92.0
- 6 The metals Cr, Co, Fe and Mn are all transition elements.
 Which particles have the same number of electrons?
- A Co^{2+} and Cr
 B Co^{2+} and Fe^{3+}
 C Cr and Mn^{2+}
 D Fe^{3+} and Mn^{2+}
- 7 Strontium, Sr, is a metal that forms a compound SrCl_2 .
 Sulfur, S, is a non-metal that forms a compound SCl_2 .
 Which compound is likely to have a higher melting point (m.p.) and which is more soluble in water?

	higher m.p.	more soluble in water
A	SrCl_2	SrCl_2
B	SrCl_2	SCl_2
C	SCl_2	SrCl_2
D	SCl_2	SCl_2

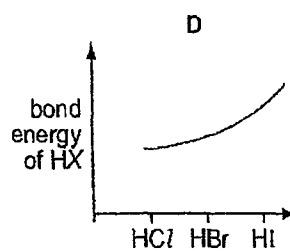
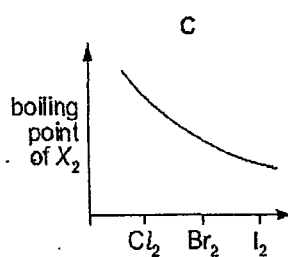
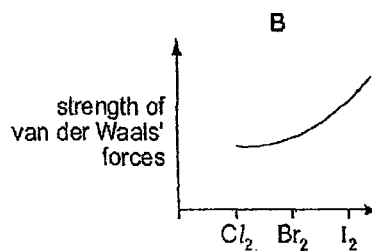
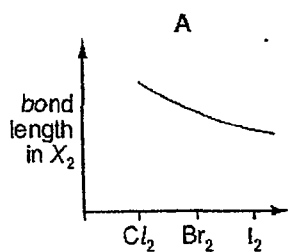
- 11 The table compares the properties of Group I elements with those of transition elements.

Which entry in the table is correct?

	Property	Group I elements	Transition elements
A	catalytic activity	low	high
B	density	high	low
C	electrical conductivity	low	low
D	melting point	high	low

- 12 Which graph correctly describes a trend found in the halogen group?

[X represents a halogen atom]



- 13 The table refers to four metals and some of their compounds.

metal	action of dilute sulfuric acid on metal	effect of hydrogen on heated metal oxide	action of metal on a solution of the sulfate of S
P	hydrogen evolved	reduced	no reaction
Q	no reaction	reduced	no reaction
R	hydrogen evolved	no reaction	S is displaced
S	hydrogen evolved	no reaction	no reaction

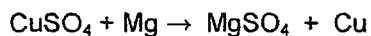
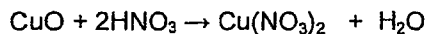
Which one of the following is the correct order of reactivity?

	most reactive	→	least reactive
A	Q	P	S R
B	S	R	P Q
C	R	S	P Q
D	R	Q	P S

- 14 In which of the following pairs is the oxidation number of chromium more than that of manganese?

A	K_2CrO_4	$KMnO_4$
B	$CrCl_3$	MnO_2
C	$Cr_2(SO_4)_3$	$MnSO_4$
D	$K_2Cr_2O_7$	MnO_4^-

- 15 Equations for reactions of copper compounds are shown.



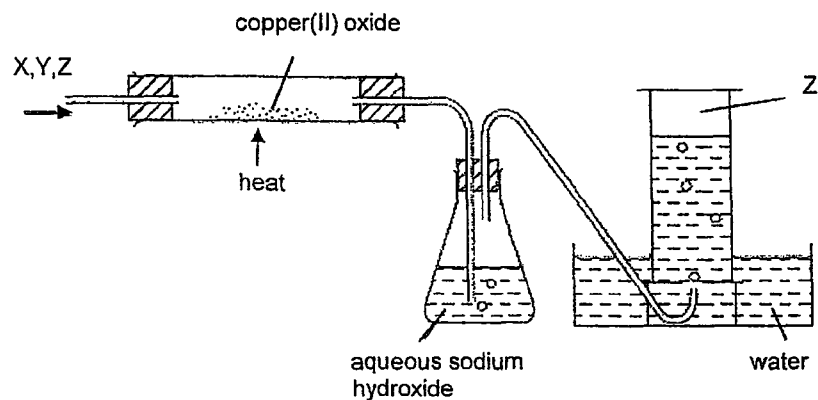
How many of these are redox reactions?

- A 1 B 2 C 3 D 4

- 16 A metal M forms a chloride which dissolves in cold water and has an oxide which dissolves in both strong acids and strong alkalis.

What is M?

- A iron
 B lead
 C sodium
 D zinc
- 17 Gas Z is to be separated from a mixture of gases X, Y and Z by the apparatus shown in the diagram.



For which mixture will this system work successfully?

	X	Y	Z
A	hydrogen	carbon dioxide	nitrogen
B	oxygen	hydrogen	carbon monoxide
C	nitrogen	oxygen	hydrogen
D	carbon dioxide	nitrogen	oxygen

- 18 The table shows four separate mixtures of a solution and a solid.
Which mixture forms a gas on warming?

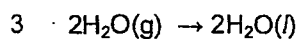
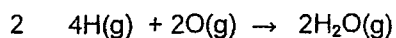
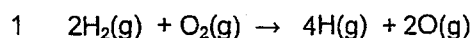
	NaOH(aq) and NH ₄ Cl(s)	NaOH(aq) and Mg(s)	H ₂ SO ₄ (aq) and NH ₄ Cl(s)	H ₂ SO ₄ (aq) and Mg(s)	
A	✓	x	✓	✓	key ✓ = gas forms x = no gas forms
B	✓	x	x	✓	
C	x	✓	✓	x	
D	x	✓	x	x	

- 19 The results of three tests on a solution of compound X are shown in the table.

test	results
aqueous sodium hydroxide added	white precipitate formed, soluble in excess
aqueous ammonia added	white precipitate formed, insoluble in excess
acidified silver nitrate added	white precipitate formed

What is compound X?

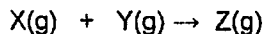
- A aluminium chloride
B aluminium iodide
C zinc chloride
D zinc iodide
- 20 The formation of liquid water from hydrogen and oxygen is thought to occur in three stages.



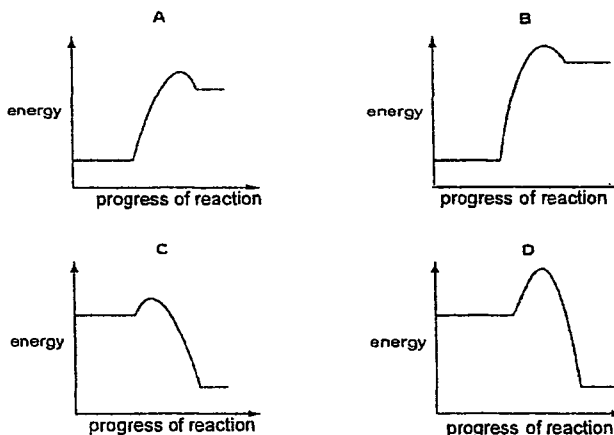
Which stage(s) would be exothermic?

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

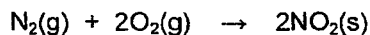
- 21 Four reactions represented by the equation are studied at the same temperature.



Which is the correct energy profile diagram for the reaction that would proceed most rapidly?



- 22 Nitrogen and oxygen react according to the equation.



The enthalpy change for the reaction is +66kJ.

If two moles of nitrogen and two moles of oxygen are used, what will be the enthalpy change?

- A +16.5 kJ
 B +33 kJ
 C +66 kJ
 D +132 kJ
- 23 In a historically famous experiment, Wohler heated 'inorganic' ammonium cyanate in the absence of air. The only product of the reaction was 'organic' urea, $CO(NH_2)_2$. No other products were formed in the reaction.

What is the formula of the cyanate ion present in ammonium cyanate?

- A CNO^-
 B CNO^{2-}
 C CO^-
 D NO^-

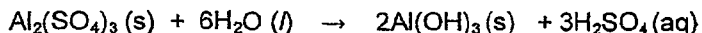
- 24 A black powder is suspected to be carbon or a mixture of carbon and copper(II) oxide.

Which of the following methods can be used to identify the black powder?

- 1 adding dilute sulfuric acid to the powder
- 2 adding sodium hydroxide to the powder
- 3 heating the powder strongly

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

- 25 Aluminium sulfate can alter the pH of the soil according to the given reaction.



A gardener adds some aluminium sulfate to the soil which has a pH of 8.5.

What is the most likely pH of this soil after the reaction occurs?

- A 1.5
 B 5.5
 C 9.5
 D 13.5

- 26 The table gives the composition of the atmosphere of four newly discovered planets.

planet	composition of atmosphere
W	argon, carbon dioxide and oxygen
X	argon, nitrogen and oxygen
Y	argon, carbon dioxide and methane
Z	methane, nitrogen and oxygen

On which planet(s) is/are the greenhouse effect likely to occur?

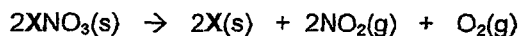
- A W only
 B W, X and Z
 C W and Y only
 D W, Y and Z

- 27 Car exhaust pipes made of iron would be expected to rust rapidly. Which of the following contribute to the rapid rusting?

- 1 Car exhausts contain acidic gases.
- 2 Car exhausts contain water vapor.
- 3 Car exhaust pipes are subjected to high temperatures.

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

- 28 Upon strong heating, a certain nitrate undergoes decomposition according to the following equation:



Complete decomposition of 3.40 g of the nitrate gives 240 cm³ of oxygen, measured at room temperature and pressure.

What is the relative atomic mass of X?

- A 54
B 99
C 108
D 197

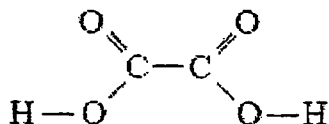
- 29 In leaded petrol, an additive is added. The additive is a compound that composed of lead, carbon and hydrogen only.

This compound contains 29.7% carbon and 6.19% hydrogen by mass.

What is the value of x in the empirical formula PbC₈H_x?

- A 5 B 6 C 16 D 20

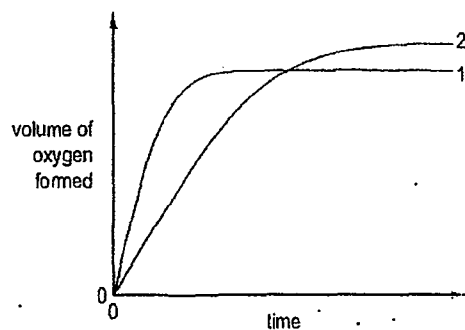
- 30 The structure of oxalic acid is shown.



A 25.0 cm³ solution of oxalic acid reacts completely with 15.0 cm³ of 2.50 mol/dm³ sodium hydroxide.

What is the concentration of the oxalic acid?

- A 0.667 mol/dm³
 B 0.750 mol/dm³
 C 1.33 mol/dm³
 D 1.50 mol/dm³
- 31 In the graph, curve 1 was obtained by observing the decomposition of 100 cm³ of 1.0 mol/dm³ hydrogen peroxide solution, catalyzed by manganese(IV) oxide.

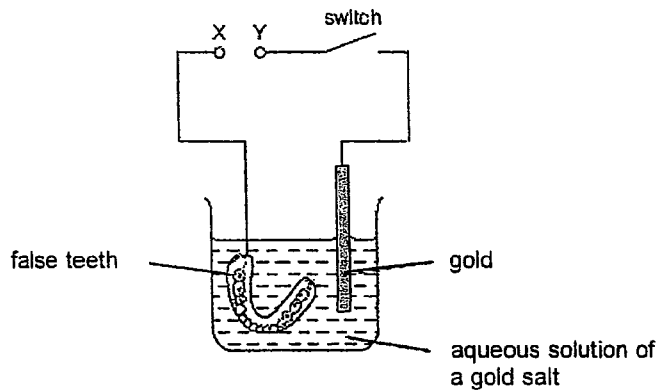


Which alteration to the original experimental conditions would produce curve 2?

- A adding some 0.1 mol/dm³ hydrogen peroxide solution
 B lowering the temperature
 C using less manganese(IV) oxide
 D using a different catalyst

- 32 Professor Chu had her false teeth electroplated with gold.

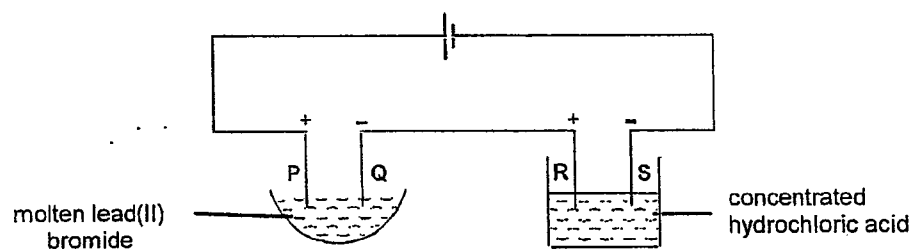
The teeth were coated with a thin layer of carbon and were then placed in the apparatus shown.



Which row is correct?

	terminal X is	the carbon powder could be
A	negative	diamond
B	negative	graphite
C	positive	diamond
D	positive	graphite

- 33 The following electrolysis circuit is set up, using inert electrodes P, Q, R and S.



At which of the electrodes is a Group VII element produced?

- A P only B P and R C Q only D Q and S

- 34 What are the usual operating conditions in the Haber Process for the manufacture of ammonia?

	pressure/ atm	temperature/ °C	catalyst
A	200	450	nickel
B	450	200	iron
C	450	200	manganese dioxide
D	200	450	iron

- 35 The following statements refer to some properties of ammonia.

- 1 ammonia is insoluble in water
- 2 ammonia is denser than air
- 3 a solution of ammonia in water has a pH of 10
- 4 ammonia has a simple molecular structure

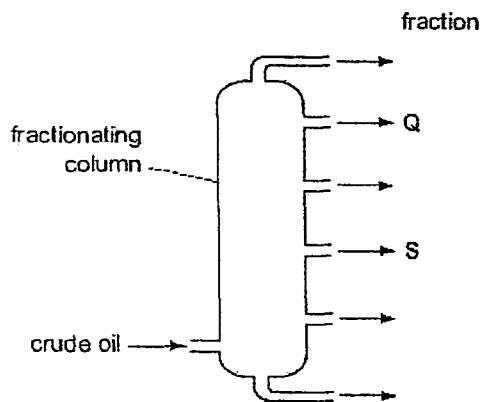
Which two statements are true about ammonia?

- A 1 and 2
 B 1 and 4
 C 2 and 3
 D 3 and 4
- 36 The table shows some suggested reactions involving ethanol.

Which suggestions about the reactants and products are correct?

reaction	reactants	products
A	ethanol and oxygen	carbon dioxide and water
B	ethene and hydrogen	ethanol and water
C	glucose and oxygen	ethanol and carbon dioxide
D	glucose and water	ethanol and oxygen

- 37 The diagram shows the fractional distillation of crude oil.



Which statements about fractions Q and S are correct?

	Q has a higher boiling point than S	Q is more viscous than S	Q burns more easily than S
A	No	No	Yes
B	Yes	No	Yes
C	Yes	Yes	No
D	No	Yes	No

- 38 Which of the following mixtures could NOT form when octane, C_8H_{18} is cracked?

- A propane + pentene
- B butane + butene
- C pentane + propene
- D butane + propene + hydrogen

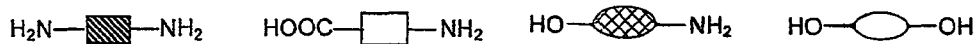
- 39 Two esters have the same molecular formula, $C_3H_6O_2$.

What are the names of these two esters?

- 1 methyl ethanoate
- 2 ethyl propanoate
- 3 ethyl methanoate
- 4 propyl methanoate

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

40 The diagram shows four monomers.



How many of these monomers would react with the molecule below to form a polymer?



- A 1 B 2 C 3 D 4

Periodic Table

The Periodic Table of the Elements

		Group																	
		I	II	III	IV	V	VI	VII	0										
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
Li Lithium	Be Beryllium	B Boron	C Carbon	N Nitrogen	O Oxygen	F Fluorine	Ne Neon	Na Sodium	Mg Magnesium	Al Aluminium	Si Silicon	P Phosphorus	S Sulphur	Cl Chlorine	Ar Argon	K Potassium	Ca Calcium	Sc Scandium	Ti Titanium
23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42
Na Sodium	Mg Magnesium	Al Aluminium	Si Silicon	P Phosphorus	S Sulphur	Cl Chlorine	Ar Argon	K Potassium	Ca Calcium	Sc Scandium	Ti Titanium	V Vanadium	Cr Chromium	Mn Manganese	Fe Iron	Ni Nickel	Cu Copper	Zn Zinc	Ga Gallium
39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58
K Potassium	Ca Calcium	Sc Scandium	Ti Titanium	V Vanadium	Cr Chromium	Mn Manganese	Fe Iron	Ni Nickel	Cu Copper	Zn Zinc	Ga Gallium	Ge Germanium	As Arsenic	Se Selenium	Br Bromine	Kr Krypton	Rb Rubidium	Sr Strontium	Y Yttrium
85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104
Rb Rubidium	Sr Strontium	Y Yttrium	Zr Zirconium	Nb Niobium	Mo Molybdenum	Tc Technetium	Ru Ruthenium	Rh Rhodium	Pd Palladium	Ag Silver	Cd Cadmium	In Indium	Sn Tin	Sb Antimony	Te Tellurium	I Iodine	Xe Xenon	Ba Barium	La Lanthanum
133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152
Cs Caesium	Ba Barium	La Lanthanum	Hf Hafnium	Ta Tantalum	W Tungsten	Re Rhenium	Os Osmium	Ir Iridium	Pt Platinum	Au Gold	Hg Mercury	Tl Thallium	Pb Lead	Bi Bismuth	Po Polonium	At Astatine	Rn Radon	Fr Francium	Ra Radium
55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74
Fr Francium	Ra Radium	Ac Actinium	La Lanthanum	Ce Cerium	Pr Praseodymium	Nd Neodymium	Pm Promethium	Sm Samarium	Eu Europium	Gd Gadolinium	Tb Terbium	Dy Dysprosium	Ho Holmium	Er Erbium	Tm Thulium	Yb Ytterbium	Lu Lutetium	Be Beryllium	B Boron
87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106
Fr Francium	Ra Radium	Ac Actinium	La Lanthanum	Ce Cerium	Pr Praseodymium	Nd Neodymium	Pm Promethium	Sm Samarium	Eu Europium	Gd Gadolinium	Tb Terbium	Dy Dysprosium	Ho Holmium	Er Erbium	Tm Thulium	Yb Ytterbium	Lu Lutetium	Be Beryllium	B Boron

†58-71 Lanthanoid series

†90-103 Actinoid series

a	X	b
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Key

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

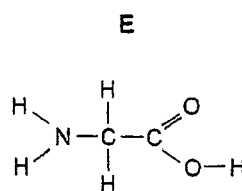
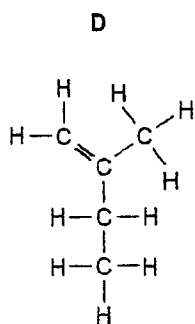
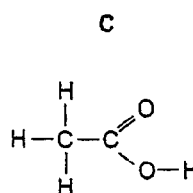
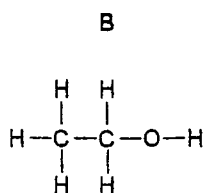
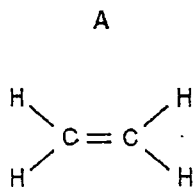
The volume of one mole of any gas is 24 dm³ at room temperature and pressure (r.t.p.).

trendyline

Section A (50 marks)

Answer all the questions in this section in the spaces provided.

- 1 The structures of some compounds found in plants are shown.



- (a) Which
- two**
- of these compounds are unsaturated hydrocarbons?

..... [1]

- (b) Write the empirical formula for compound D.

..... [1]

- (c) (i) What do you understand by the term
- isomer*
- ?

..... [1]

- (ii) Draw the full structural formula of an isomer of D.

[1]

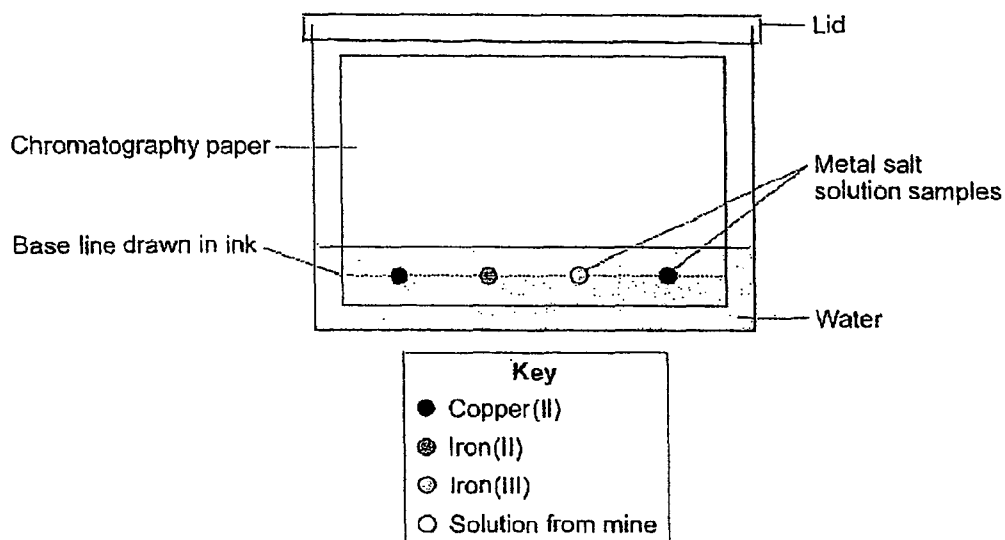
(d) Describe how B is made in industry from ethene.

.....
..... [2]

2 A student analysed a sample of water from a disused mine to find out which metal ions were in the water.

She used paper chromatography on the sample of water from the mine and of solutions containing known metal ions.

She set up the apparatus as shown.



(a) She made some errors in the set-up of this apparatus.

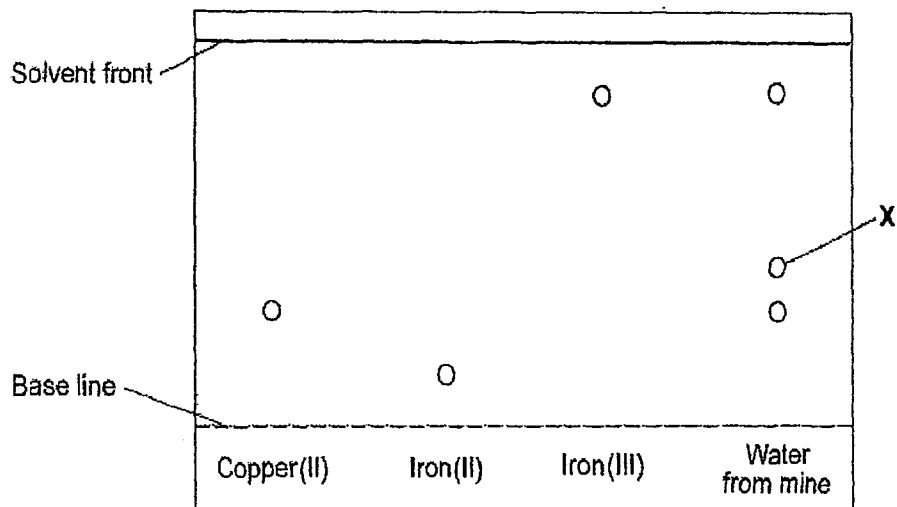
State one error she made and explain the effect of this error on the chromatogram.

.....
.....
..... [2]

- (b) Another student repeated the experiment, but without making any errors.

After the water had soaked up the chromatography paper, he sprayed it with a dilute solution of sodium hydroxide. Coloured spots appeared on the paper.

The results he obtained are shown.



- (i) Identify two of the metal ions in the sample of water from the mine.

..... [1]

- (ii) State the colour and formula of the spot formed from the iron(III) ions.

..... [2]

- (c) Calculate the R_f value of spot X.

[1]

3 Fertilizers often contain ammonium nitrate.

(a) Calculate the percentage by mass of nitrogen in ammonium nitrate.

[1]

(b) Describe a test for nitrate ions.

Test :

.....
.....
.....

Result

.....
.....

[2]

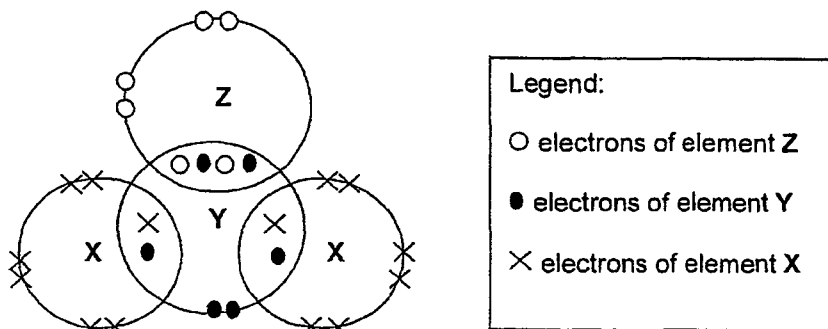
(c) Ammonium nitrate can be made by adding nitric acid to a solution of ammonia.

Write an equation, with state symbols, for the reaction.

.....

[1]

- 4 The bonding in compound, YZX_2 , formed between atoms Y, Z and X, is shown below.



- (a) State the Groups that elements X and Z belong to in the Periodic Table.

Element X:

.....

Element Z:

.....

[2]

- (b) Element Z has the smallest atomic radius in its Group in the Periodic Table.

Identify element Z.

.....

[1]

- (c) If Element Y has 16 protons, state the period that element Y is found in the Periodic Table.

.....

[1]

- (d) State the difference in electronic structure between atoms of element Y and Z.

.....

.....

[1]

5 (a) Germanium is an element in Group IV of the Periodic Table.

Germanium (Ge) has a similar structure to macromolecular diamond.

(i) Describe how a simple molecular structure differs from a macromolecular structure.

.....

 [2]

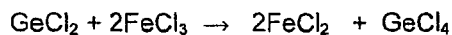
(ii) How do germanium and graphite differ in terms of electrical conductivity?

.....
 [1]

(iii) Germanium oxidizes slowly to form germanium dioxide (GeO₂) at 250°C. Draw a 'dot-and-cross' diagram of a molecule of germanium dioxide, showing only valence electrons.

[1]

(b) When aqueous solution of germanium(II) chloride and iron(III) chloride are mixed, the following reaction occurs.



Is germanium(II) chloride acting as an oxidising agent or a reducing agent?

Explain your answer using the idea of electron transfer.

.....

 [2]

6 Acid rain is caused by emission of sulfur dioxide and nitrogen dioxide from factories and vehicles. These gases react with moisture and atmospheric oxygen to form acids.

(a) State the chemical equations for the formation of sulfuric acid and nitric acid in acid rain.

Sulfuric acid:

.....

Nitric acid:

[2]

.....

(b) Aluminium hydroxide is commonly found in soil clay.

When acid rain seeps into the soil, it reacts with the aluminium hydroxide in the soil. The aluminium is said to be 'mobilised' and is toxic to plants. The 'mobilised' aluminium affects root growth and absorption of nutrients in the soil.

(i) Write an ionic equation for the reaction between acid rain and aluminium hydroxide.

[1]

.....

(ii) Explain why aluminium hydroxide in the soil is **not** toxic to the plants but the 'mobilised aluminium' is a toxin to plants.

.....

.....

.....

.....

[1]

.....

- 7 Metals are extracted from their oxides by reduction.

The table shows the minimum temperature that is needed for the reduction of some metal oxides by reaction with carbon.

Formulae of metal oxide	minimum temperature needed for reduction / °C
MO	2100
NO	400
XO	900
YO	100
ZO	1600

- (a) (i) Arrange the five metals in ascending order of reactivity.

..... [1]

- (ii) Using the data in the table, explain your answer in (a)(i) in terms of bonding.

.....

 [3]

- (b) Metal oxides also react with some metals.

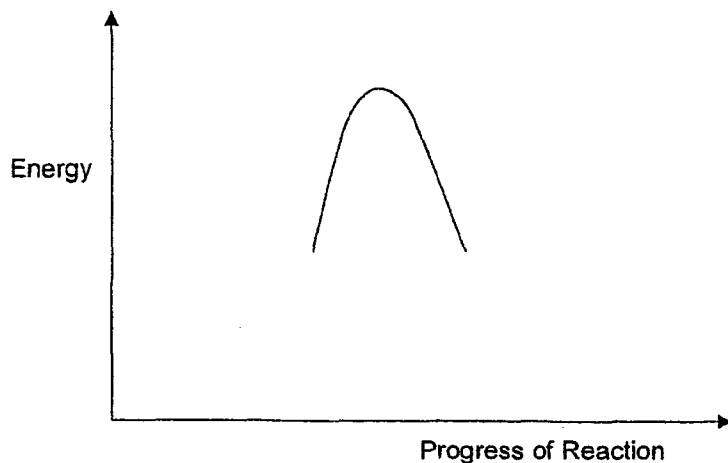
In the Thermit reaction, aluminium reacts vigorously with iron(III) oxide to release a lot of heat.

- (i) Write an equation for this Thermit reaction.

..... [1]

- (ii) Complete the following energy profile diagram for the reaction between aluminium and iron(III) oxide. [2]

Label the activation energy and enthalpy change in the diagram.



- (iii) Suggest another metal that can react even more vigorously with iron(III) oxide.

..... [1]

- (iv) In the Thermit reaction, the mixture of aluminium and iron(III) oxide is initially heated with a small flame.

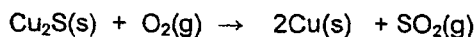
Explain why the mixture needs to be heated only initially.

..... [2]

- 8 This question is about copper.

Copper can be extracted by smelting copper-rich ores in a furnace.

The equation for one of the reactions in the smelting process is:

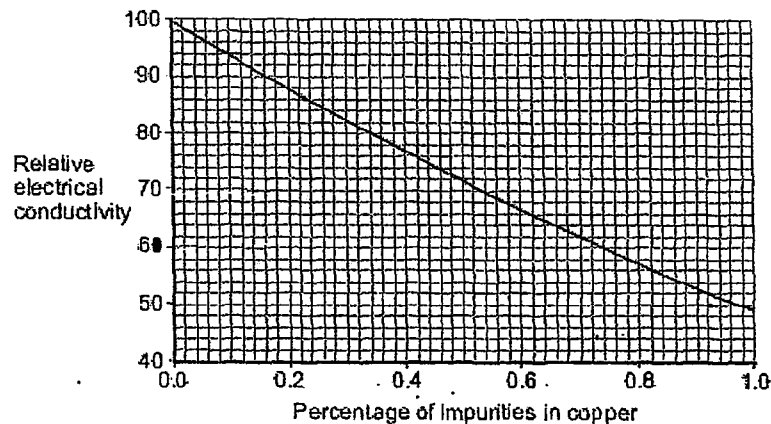


- (a) If sulfur dioxide is allowed to escape causes serious environmental problem.
Suggest how sulfur dioxide can be removed.

.....

 [2]

- (b) Most of the copper extracted is used in electric circuits.
Copper extracted by smelting is about 99% pure. The 99% pure copper produced by smelting is purified to 99.9999% pure copper by electrolysis.
The graph shows how impurities change the electrical conductivity of copper.

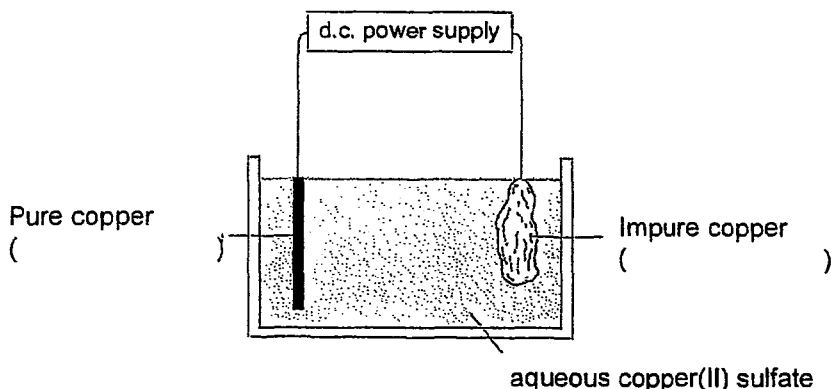


Use information from the graph to explain why copper is purified to 99.9999%.

.....

 [2]

- (c) The diagram shows the set-up on how impure copper produced by smelting is purified by electrolysis.



- (i) Indicate on the diagram, the cathode and anode in the brackets. [1]

- (ii) Write an ionic equation for the reaction at the anode.

[1]

In a trial experiment, the electrodes are weighed before and after electrolysis.

The results are given in the table.

	mass of impure copper/ kg	mass of pure copper/ kg
before electrolysis	10.30	1.55
after electrolysis	0.855	9.80

- (iii) Using the information given above to calculate the percentage purity of the of impure copper.

[2]

- (iv) State one factor that may affect the accuracy of these results.

[1]

Class Index Number

Name : _____

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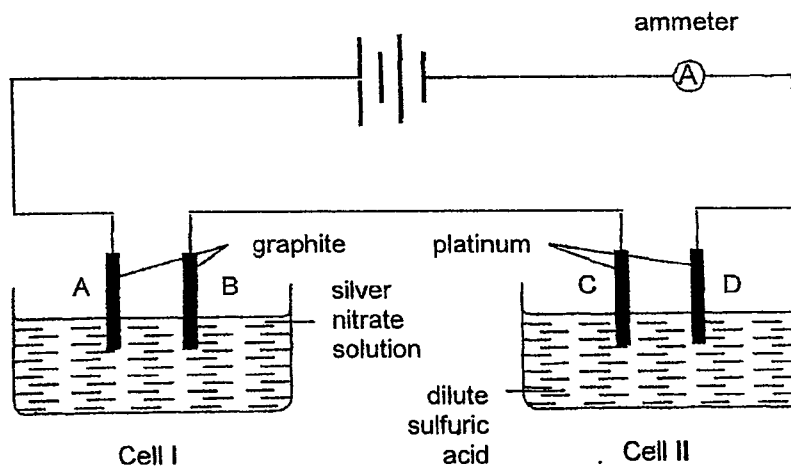
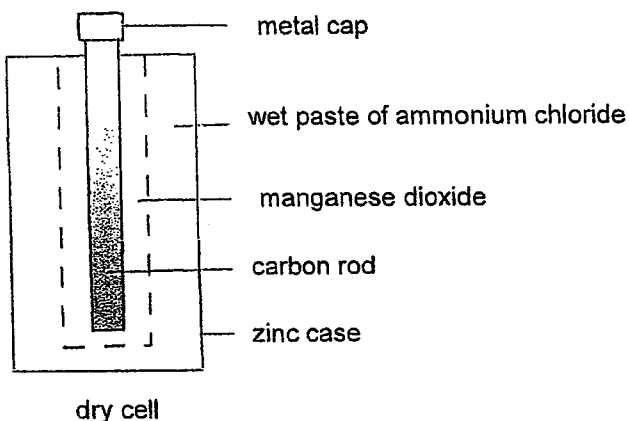
Section B (30 marks)

Answer all three questions in this section. The last question is in the form of an either/or and only one of the alternatives should be answered.

- 9 The diagrams show two types of cells – an electrolytic cell and a dry cell. Electrolysis occurs in both cells and the electrolyte must be an ionic compound.

Electrolytic cells are often used in the decomposition of chemical compounds. An external source provides the electrical energy required for the chemical changes to take place.

Dry cells are electricity-producing chemical cells. A dry cell uses a paste electrolyte, with only enough moisture to allow current to flow.

**Diagram 1 Electrolytic Cell****Diagram 2 Dry Cell**

- (a) Identify the cathode and anode in Cell I.

..... [1]

- (b) Describe the changes you would expect to see in Cell I.

..... [2]

- (c) Write the half equations for the reactions that take place at electrodes C and D of Cell II.

..... [2]

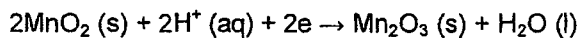
- (d) Explain what happens to the electrolyte of Cell II.

..... [2]

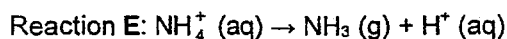
- (e) 10.8 g of silver was deposited in Cell I. Calculate the total volume of gas that would be produced in Cell II at room temperature and pressure.

[2]

- (f) The reaction at the carbon electrode of the dry cell is:



The H^+ ions for the reaction at the carbon electrode are provided by ammonium ions in ammonium chloride, as shown by Reaction E.



- (i) Identify the cathode and the anode for the dry cell.

..... [1]

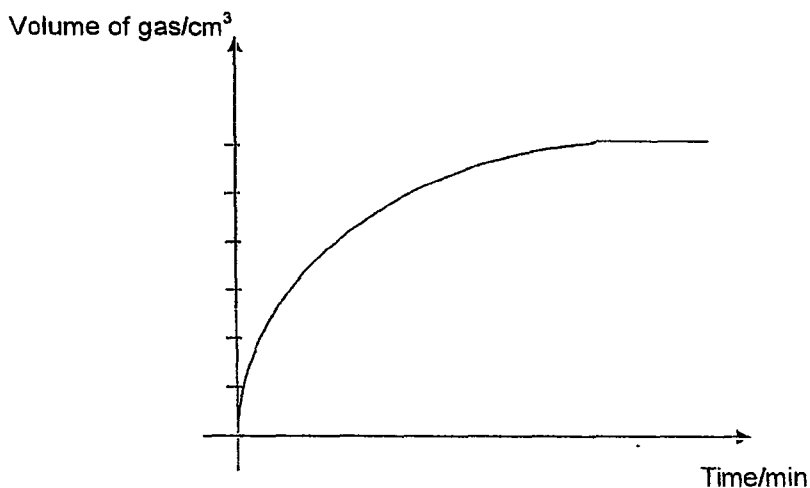
(ii) Write the ionic equation for the reaction at the zinc electrode.

..... [1]

(iii) Is Reaction E a redox reaction? Explain your answer in terms of oxidation state.

..... [2]

10 In an experiment, 20 cm³ of 1.0 mol/dm³ sulfuric acid was reacted with excess magnesium carbonate powder. A graph of volume of gas produced against time is shown.



(a) Write the chemical equation for the reaction between sulfuric acid and magnesium carbonate.

..... [1]

(b) Explain in terms of Collision Theory how the speed of reaction is affected when the reaction mixture is placed in an ice bath.

..... [2]

(c) Sketch on the same axes the following graphs.

(i) When 20 cm^3 of 1.0 mol/dm^3 hydrochloric acid is reacted with excess magnesium carbonate powder instead of sulfuric acid.

Label this graph as **A**. [1]

(ii) When granules of magnesium carbonate are used instead of powdered magnesium carbonate.

Label this graph as **B**. [1]

(d) Explain the graph you sketched for (c)(i).

.....
.....
..... [2]

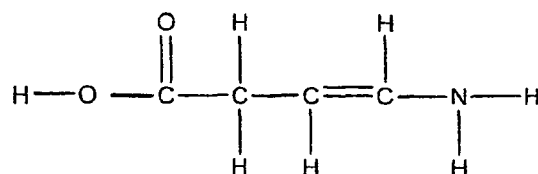
(ii) Name the compound in (d)(i).

..... [1]

(iii) Write a chemical equation for the reaction formed in (d)(i).

..... [1]

(e) The following molecule can also undergo condensation polymerisation.

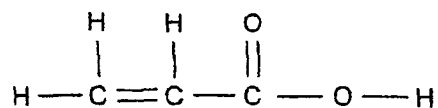


Draw the full structural formula of the resulting polymer, showing two repeat units.

[2]

Or

- 11 A molecule of an organic compound is shown below. The compound exists as a liquid at room temperature and pressure.



- (a) There are two functional groups present in the molecule.
- (i) Circle and label the functional groups on the diagram above. [2]
- (ii) Describe the test for the presence of the functional groups stated in (a)(i).

.....

.....

.....

.....

.....

.....

[2]

- (b) (i) Draw the full structural formula of the product when this molecule is reacted with chlorine gas.

[1]

- (ii) Name the product formed in (b)(i).

[1]

(c) The molecule is a monomer which can undergo addition polymerisation.

(i) Explain what is meant by the term addition polymerisation.

.....
.....
..... [2]

(ii) Draw the full structural formula of the polymer formed when this molecule undergoes addition polymerisation, showing three repeat units.

[2]

End of Paper

2016 Prelim Paper 1 Answers

Question	1	2	3	4	5	6	7	8	9	10
Answers	D	A	C	C	B	D	A	B	C	B

Question	11	12	13	14	15	16	17	18	19	20
Answers	A	B	C	C	B	D	A	B	A	C

Question	21	22	23	24	25	26	27	28	29	30
Answers	C	C	A	C	B	D	D	C	D	B

Question	31	32	33	34	35	36	37	38	39	40
Answers	A	B	B	D	D	A	A	D	B	C

SECONDARY FOUR PRELIMINARY EXAMINATION (2016)

Answer Scheme

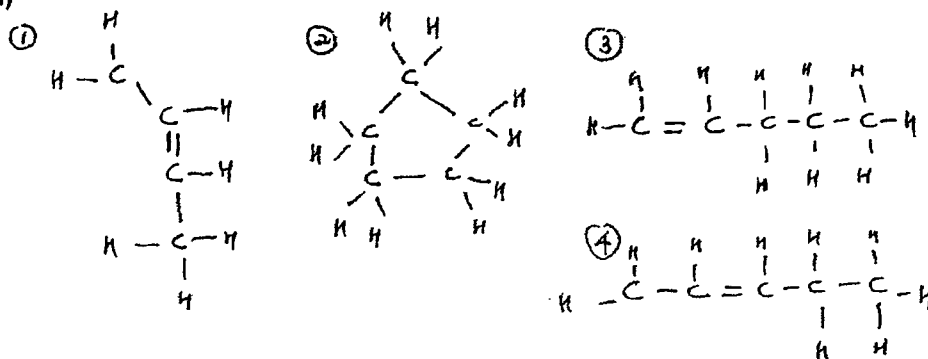
Section A

1 (a) A & D 1

(b) CH₂ 1

(c)(i) Organic compounds with the same molecular formula but different arrangement of the atoms in their molecules 1

(c)(ii) 1



(Any 1)

(d) Addition of steam to ethene 1

at a temperature of 300°C, 65 atmospheres, phosphoric acid as catalyst 1

2 (a) Error: Base line is drawn in ink. 1

Explanation: Ink is a mixture of dyes which will separate out into its components hence interfering with the experiment/ dissolve in water and travel up the paper with the metal ions 1

Or

Error: Spots of sample solutions is below the base line

Explanation: spots of sample solution will dissolve in the water and not separate out.

(b)(i) Iron(III) ions and copper(II) ions 1

(b)(ii) Reddish brown, Fe(OH)₃ 2

(c) Rf value = distance travelled by X ÷ distance travelled by solvent 1

3 (a) % by mass of nitrogen = $\frac{14 \times 2}{(2 \times 14 + 4 + 16 \times 3)} \times 100\%$ 1
= $\frac{28}{80} \times 100\%$
= 35.0%

(b) Test : Add aqueous NaOH and Devarda's Alloy/
aluminium/zinc to ammonium nitrate and warm. Test the gas
evolved using moist red litmus paper. 2

Result: Red litmus paper turned blue. Ammonia gas was
given off.

(c) $\text{NH}_3(\text{aq}) + \text{HNO}_3(\text{aq}) \rightarrow \text{NH}_4\text{NO}_3(\text{aq})$ 1

4 (a) Element X : Group VII 1
Element Z : Group VI 1

(b) Oxygen 1

(c) Period 3 1

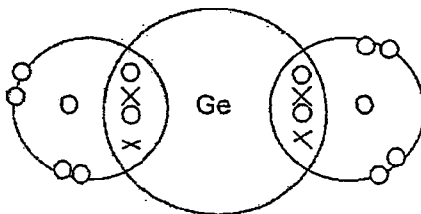
(d) Atoms of element Y has 1 more electron shell than those of element Z 1

5 (a)(i) A few atoms covalently bonded/many atoms covalently
bonded which extend throughout the entire structure/ strong
covalent bonds within the molecule but weak intermolecular
forces/strong covalent bonds throughout the entire giant
structure. 1
1

(a)(ii) Germanium does not conduct electricity. 1
Graphite conducts electricity.

(a)(iii)

1



(b) Reducing agent :

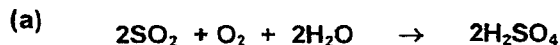
1

Each iron(III) ions gain 1 electron from germanium to form iron(II) ions.

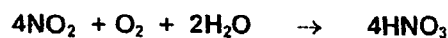
Hence, iron(III) ions is reduced/ Germanium ions lose 1 electron to iron(II) ions to form iron(II) ions

1

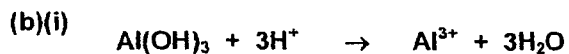
6



1



1



1

(b)(ii) Aluminium hydroxide is insoluble but 'mobilised aluminium' is aluminium that has dissolves in the soil water to form mobile aluminium ion that can be absorbed by the root.

1

7

(a)(i) Metals Y, N, X, Z, M

1

(a)(ii) The more reactive the metal, the stronger the ionic bond in the metal oxide.

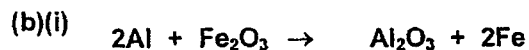
1

Hence the higher the minimum temperature needed to break the ionic bond.

1

Since MO needed the highest minimum temperature to reduce it, metal M is the most reactive metal.

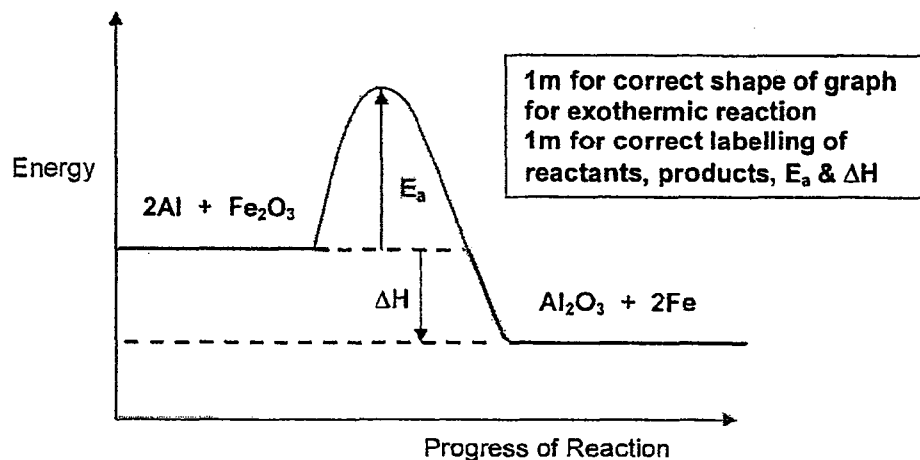
1



1

(b)(ii)

2



(b)(iii) Any metal above Al in the reactivity series

1

(b)(iv) The small flame is needed to provide activation energy to break existing bonds for the reaction to start.

1

Since the reaction is exothermic, the heat released will sustain the reaction.

1

8 (a) Pass the gas through wet CaO/CaCO₃.

1

CaSO₃ formed will be further oxidised to CaSO₄ and then removed.

1

(b) When 1% of impurities is present in copper, the relative electrical conductivity is about 50.

1

When copper is almost 100% pure, the relative electrical conductivity increases to about 100 which means that pure copper is twice as good a conductor as 99% pure copper.

1

(c)(i) Pure copper : cathode

1

Impure cathode : anode

(c)(ii) Cu → Cu²⁺ + 2e

1

(c)(iii) % purity = $\frac{9.80 - 1.55}{10.30 - 0.855} \times 100\%$

1

$$= \frac{8.25}{9.445} \times 100\%$$

$$= 87.3 \%$$

1

(c)(iv) The electrodes are not fully dried before weighing.

1

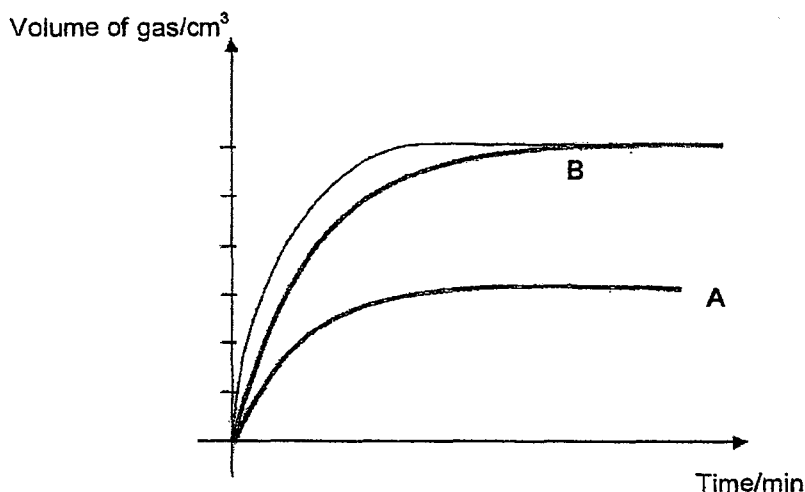
SECONDARY FOUR CHEMISTRY PRELIMINARY EXAMINATION (2016)

Answer Scheme

Paper 2 Section B

- 9 (a) Cathode is electrode B. Anode is electrode A. 1
- (b) Silver solid coats electrode B. 1
- Colourless bubbles seen at electrode A. 1
- (c) C: $4\text{OH}^- (\text{aq}) \rightarrow 2\text{H}_2\text{O} (\text{l}) + \text{O}_2 (\text{g}) + 4\text{e}$ 1
- D: $2\text{H}^+ (\text{aq}) + 2\text{e} \rightarrow \text{H}_2 (\text{g})$ 1
- (d) Electrolyte in Cell II becomes more concentrated. 1
- As water is being decomposed into hydrogen gas and oxygen gas. 1
- (e) Number of moles of Ag = $\frac{10.8}{108} = 0.1 \text{ mol}$
- $\text{Ag}^+ (\text{aq}) + \text{e} \rightarrow \text{Ag} (\text{s})$
- Therefore number of moles of electrons = 0.1 mol 1
- From the half equations in (c), this means that $\frac{0.1}{4} = 0.025 \text{ mol}$ of oxygen
and $\frac{0.1}{2} = 0.05 \text{ mol}$ of hydrogen are produced.
- Therefore, total volume of gas produced in Cell II = $0.075 \times 24 = 1.8 \text{ dm}^3$ 1
- (f)(i) Cathode – carbon electrode 1
Anode – zinc electrode
- (f)(ii) $\text{Zn} (\text{s}) \rightarrow \text{Zn}^{2+} (\text{aq}) + 2\text{e}$ 1
- (f)(iii) Reaction E is not a redox reaction 1
As the oxidation state of nitrogen is -3 1
in both the ammonium ion and ammonia gas.
- 10 (a) $\text{MgCO}_3 + \text{H}_2\text{SO}_4 \rightarrow \text{MgSO}_4 + \text{H}_2\text{O} + \text{CO}_2$ 1
- (b) Speed of reaction decreases
- As the decrease in temperature results in the particles having lower energy
and thus less energy for the reaction to start/ insufficient energy to
overcome activation energy 1
- Leading to lower frequency of effective collisions and thus a lower speed of
reaction. 1

10 (c)



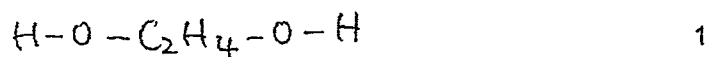
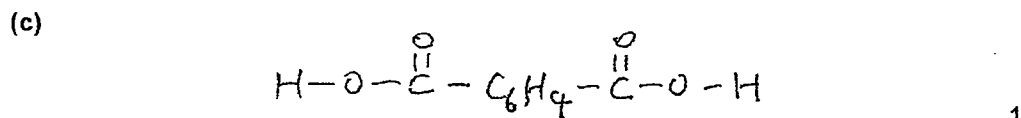
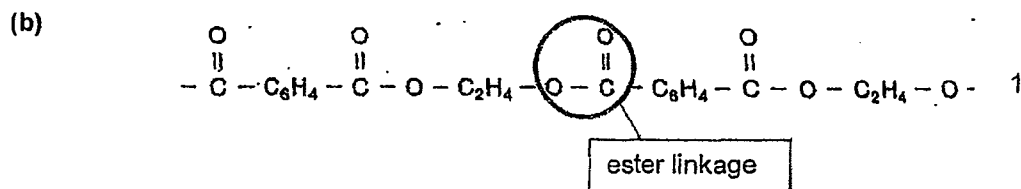
(d) The graph is less steep as the concentration of hydrogen ions is halved/the concentration is lower. 1

The volume of gas produced is halved because hydrochloric acid is monobasic/has a basicity of one but sulfuric acid is dibasic/has a basicity of two/ mole ratio of acid to volume of hydrogen produced is 2:1 instead of 1:1. 1

Either

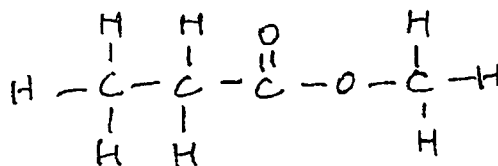
11 (a) Condensation polymerisation is the process where small molecules (monomers) react to form a single large molecule 1

losing small molecules such as water in the process. 1



Can also accept $\text{HOOC}-\text{C}_6\text{H}_4-\text{COOH}$ and $\text{HO}-\text{C}_2\text{H}_4-\text{OH}$

(d)(i)



1

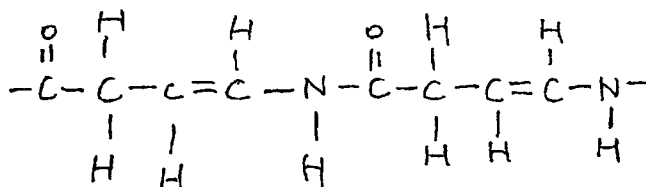
(d)(ii) Name: methyl propanoate

1

(d)(iii) $\text{C}_2\text{H}_5\text{CO}_2\text{H} + \text{CH}_3\text{OH} \rightleftharpoons \text{C}_2\text{H}_5\text{CO}_2\text{CH}_3 + \text{H}_2\text{O}$

1

(e)

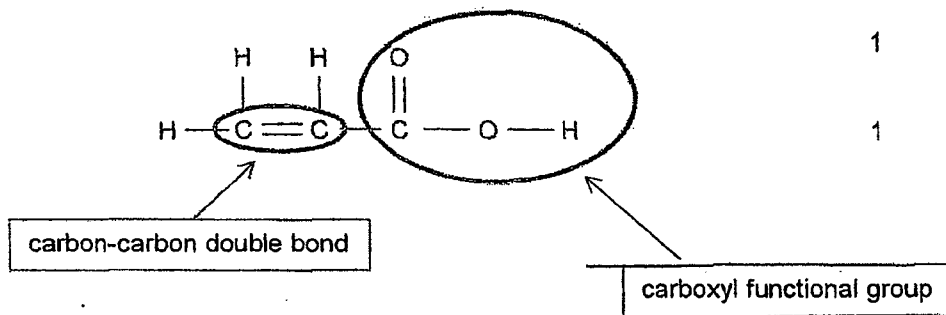


2

Minus marks for any mistake made.

Or

11 (a)(i)



1

1

(a)(ii) Test the presence of $\text{C}=\text{C}$ by mixing liquid with aqueous bromine/bromine solution. If reddish-brown bromine solution quickly decolourises/turns colourless, $\text{C}=\text{C}$ is present.

1

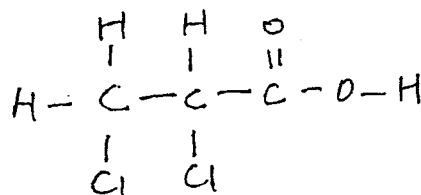
Test for presence of carboxyl group by mixing the liquid with water before testing using Universal Indicator/blue litmus paper. If carboxyl group is present, Universal Indicator will change from green to orange/blue litmus paper will turn red.

1

{no marks if adding of water is not mentioned}

(b)(i)

1



(b)(ii) Name: dichloropropanoic acid

1

(correct name should be 2,3-dichloropropanoic acid but at their level we can accept dichloropropanoic acid)

(c)(i) Addition polymerisation is the process where small alkene molecules (monomers) react to form a large molecule

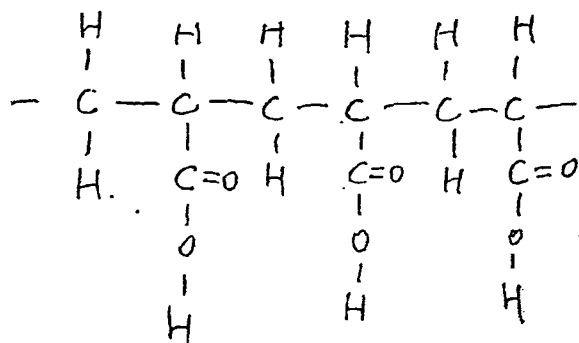
1

with the polymer being the only product/without any loss of atoms/materials/molecules.

1

(c)(ii)

2



[1] for straight chain.

Minus marks for any mistake made.

