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Class	Index Number	Name
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新加坡海星中学

MARIS STELLA HIGH SCHOOL
PRELIMINARY EXAMINATION 2
SECONDARY FOUR

CHEMISTRY
Paper 1

Additional Material.
OTAS

5073/01
31 August 2015
1 hour

READ THESE INSTRUCTIONS FIRST

Write in soft pencil
Write your name, class and index number on the Answer Sheet

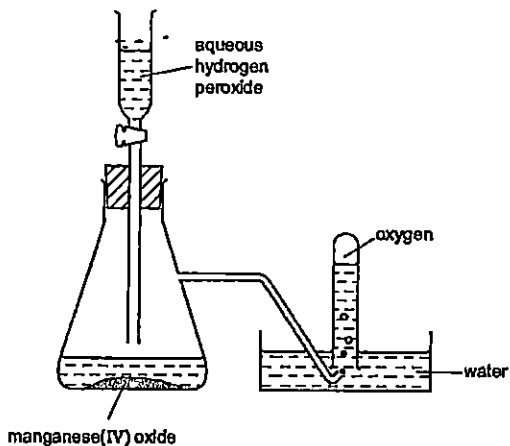
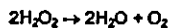
There are **forty** questions on this paper. Answer all questions. For each question there are four possible answers A, B, C and D.
Choose the one you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this question paper.
A copy of the Periodic Table is printed on page 17
The use of an approved scientific calculator is expected, where appropriate

At the end of the examination, hand in the following separately :
(1) Optical Test Answer Sheet (OTAS)
(2) Question Paper

1 Oxygen was prepared from hydrogen peroxide and collected as shown in the diagram



The first few tubes of gas were rejected because the gas was contaminated by

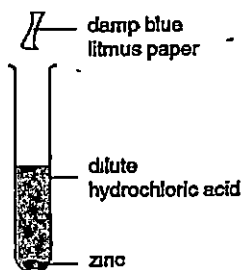
- A hydrogen
- B hydrogen peroxide.
- C nitrogen.
- D water vapour

2 Which of the following is the best method of obtaining pure water from ink?

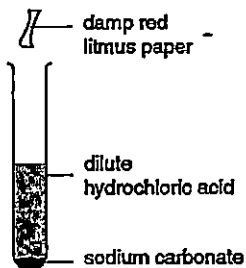
- A chromatography
- B distillation
- C filtration
- D freezing

3 The diagrams show mixtures of chemicals that react to produce gases. In which reaction will the litmus paper change colour?

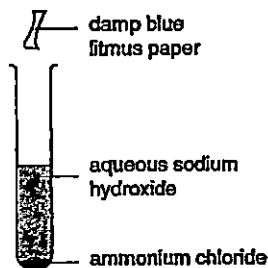
A



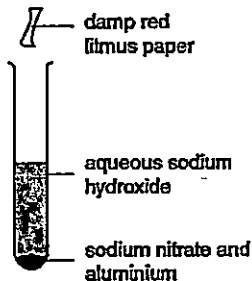
B



C



D



4 Which statement about the numbers of particles in atoms is correct?
Apart from hydrogen, most atoms contain

- A more electrons than protons.
- B more neutrons than protons.
- C more protons than electrons
- D more protons than neutrons.

10 Which of the samples below has the greatest mass?

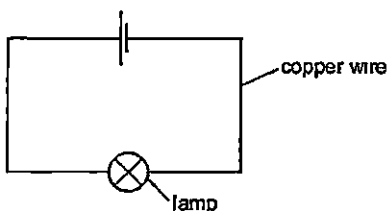
A 6.0×10^{25} molecules of hydrogen

B 5.0 mol of neon atoms

C 1.2×10^{24} atoms of silver

D 1.7×10^2 g of iron

11 An electrical circuit is set up using copper wire



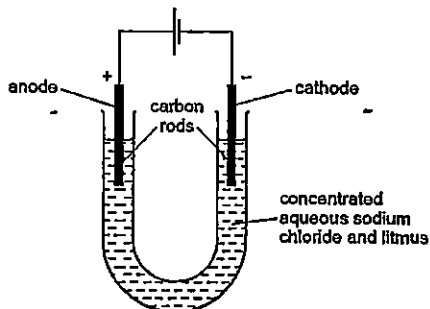
Which process takes place in the copper wire?

- A Electrons move along the wire to the negative terminal, positive ions stay in position
- B Electrons move along the wire to the positive terminal, positive ions move to the negative terminal
- C Electrons move along the wire to the positive terminal, positive ions stay in position
- D Negative ions move along the wire to the positive terminal, positive ions move to the negative terminal.

12 A substance Q conducts electricity both when solid and molten
What is Q?

- A an alloy
- B a hydrocarbon
- C a metal oxide
- D a salt

13 The diagram shows the electrolysis of concentrated aqueous sodium chloride.



What is the colour of the litmus at each electrode after five minutes?

	colour at anode	colour at cathode
A	blue	red
B	red	blue
C	red	colourless
D	colourless	blue

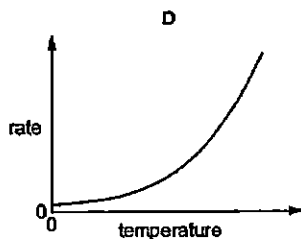
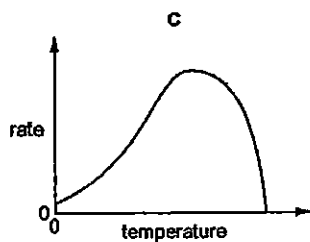
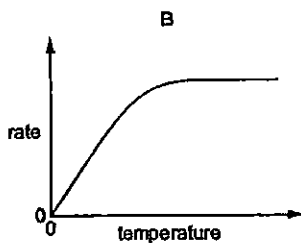
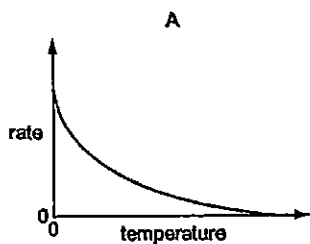
14 In which of the following reaction is sulfur dioxide acting as an oxidizing agent ?

- A $\text{SO}_2 + 2\text{H}_2\text{O} + \text{Cl}_2 \rightarrow \text{H}_2\text{SO}_4 + 2\text{HCl}$
- B $\text{SO}_2 + 2\text{NaOH} \rightarrow \text{Na}_2\text{SO}_3 + \text{H}_2\text{O}$
- C $2\text{SO}_2 + \text{O}_2 \rightarrow 2\text{SO}_3$
- D $\text{SO}_2 + 2\text{H}_2\text{S} \rightarrow 2\text{H}_2\text{O} + 3\text{S}$

15 Substance X liberates iodine from aqueous potassium iodide and decolourises acidified aqueous potassium manganate(VII).
How is the behaviour of X described?

- A as an oxidising agent only
- B as a reducing agent only
- C as an oxidising agent and a reducing agent
- D as neither an oxidising agent nor a reducing agent

- 16 Which graph shows the effect of increasing temperature on the rate of reaction of calcium carbonate with dilute hydrochloric acid?



- 17 Sulfuric acid (H_2SO_4) and nitric acid (HNO_3) are both strong acids.
Ethanoic acid (CH_3COOH) is a weak acid

20.00 cm^3 solutions of 0.10 M concentration of each of these three acids were separately titrated with a 0.10 M solution of sodium hydroxide (NaOH)
In order to react completely

- A all three acids would require the same volume of NaOH
- B CH_3COOH and HNO_3 would require the same volume of NaOH but H_2SO_4 would require more.
- C HNO_3 would require more NaOH than CH_3COOH but less than H_2SO_4 .
- D H_2SO_4 and HNO_3 would require the same volume of NaOH but CH_3COOH would require less

18 A 25 cm^3 sample of dilute sulfuric acid contains 0.025 moles of the acid. What is the concentration of hydrogen ions in the solution?

- A 2.00 mol / dm^3
- B 1.00 mol / dm^3
- C 0.50 mol / dm^3
- D 0.25 mol / dm^3

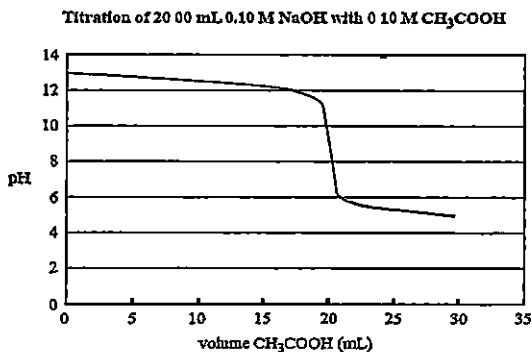
19 Titration of an acid against a base is a method often used in the preparation of salts. Which properties of the acid, the base and the salt are required if this method is to be used?

	acid	base	salt
A	insoluble	insoluble	insoluble
B	soluble	insoluble	insoluble
C	soluble	soluble	insoluble
D	soluble	soluble	soluble

20 One mole of compound X gives three moles of ions in aqueous solution. X reacts with ammonium carbonate to give an acidic gas. What is compound X?

- A calcium hydroxide
 - B ethanoic acid
 - C sodium hydroxide
 - D sulfuric acid
-

- 21 The graph below shows the change in pH of a reaction solution during a titration of 0.10 M NaOH with 0.10 M CH₃COOH



A suitable indicator for the titration and the colour change observed is

indicator	colour change observed
A methyl orange	red to yellow
B methyl orange	yellow to red
C phenolphthalein	colourless to pink
D phenolphthalein	pink to colourless

- 22 Which statement about the Periodic Table is correct?

- A The colour of the elements becomes darker down Group VII
- B The melting point of the elements increases down Group I
- C The reactivity of the elements increases down Group VII
- D The reactivity of the elements decreases down Group I

- 23 Element X is a solid at room temperature
 It needs one electron per atom to gain the electronic structure of a noble gas
 It is the least reactive element in its group
 What is the element X?

- A At B Cs C F D Li

- 24 The results of three halogen displacement experiments are shown. The table shows the results

experiment	halogen added	halide solution		
		X ⁻	Y ⁻	Z ⁻
1	X ₂	-	Y ₂ displaced	Z ₂ displaced
2	Y ₂	no reaction	-	no reaction
3	Z ₂	no reaction	Y ₂ displaced	-

What are halogens X, Y and Z?

	X	Y	Z
A	Br	Cl	I
B	Br	I	Cl
C	Cl	Br	I
D	Cl	I	Br

- 25 Rubidium is in Group I of the Periodic Table. What are properties of rubidium chloride?

	formula	approximate melting point/°C	solubility in water
A	RbCl	70	insoluble
B	RbCl	700	soluble
C	RbCl ₂	70	soluble
D	RbCl ₂	700	insoluble

26 The carbonate of metal X is a white solid. It decomposes when heated. Carbon dioxide and a yellow solid oxide are formed. What is metal X?

- A copper
- B iron
- C lead
- D sodium

27 Iron pipes corrode rapidly when exposed to sea water. Which metal, when attached to the iron, would *not* offer protection against corrosion?

- A aluminium
- B copper
- C magnesium
- D zinc

28 Three types of steel have different properties:
 steel 1 easily shaped
 steel 2 brittle
 steel 3 resistant to corrosion
 What are the names of these three types of steel?

	steel 1	steel 2	steel 3
A	high carbon	mild	stainless
B	high carbon	stainless	mild
C	mild	high carbon	stainless
D	mild	stainless	high carbon

29 Which oxide is most readily reduced to the metal by heating in a stream of hydrogen?

- A calcium oxide
- B lead(II) oxide
- C sodium oxide
- D zinc oxide

30 Which method can be used to obtain ammonia from ammonium sulfate?

- A Heating it with an acid
- B Heating it with an alkali
- C Heating it with an oxidising agent
- D Heating it with a reducing agent

31 Vegetable matter is biodegradable

Which gas is released into the atmosphere when vegetable matter biodegrades?

- A carbon monoxide
- B methane
- C nitrogen dioxide
- D sulfur dioxide

32 Samples of four different substances are added to separate volumes of water

The temperature changes are measured.

For which substance does an exothermic reaction occur?

	substance added	temperature change
A	ammonium chloride	decrease
B	ethanol	none
C	ice	decrease
D	sodium	increase

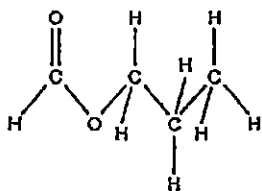
- 33 A student investigated the reaction of different vegetable oils with hydrogen. 100 cm³ of hydrogen was passed through 1 g samples of vegetable oils containing a suitable catalyst. The volume of hydrogen remaining after each reaction was recorded

vegetable oil	volume of hydrogen remaining/cm ³
P	100
Q	87
R	63
S	0

Which vegetable oils are unsaturated?

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

- 34 A compound associated with the smell or flavour of raspberries has the structure



To synthesise this compound in the laboratory you would react

- A butanol and methanoic acid.
 B methanol and butanoic acid.
 C methanol and propanoic acid.
 D propanol and methanoic acid

35 A large polyethene molecule is found to have a relative molecular mass of 4.0×10^4 .
The number of carbon atoms in this molecule would be closest to

- A 1500
- B 2900
- C 3300
- D 1.8×10^{27}

36 Methane, CH_4 , the first member of the alkane homologous series, has a boiling point of -161°C

Which molecular formula and boiling point could be correct for another alkane?

	molecular formula	boiling point/ $^\circ\text{C}$
A	C_2H_4	-88
B	C_2H_6	-185
C	C_3H_6	-69
D	C_3H_8	-42

37 A factory manufactures poly(ethene)
Which raw material will the factory need?

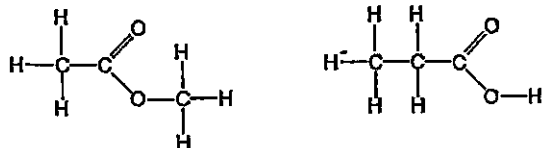
- A bitumen
- B methane
- C methanol
- D naphtha

38 Under certain conditions 1 mole of ethane reacts with 2 moles of chlorine in a substitution reaction

What is the formula of the organic product in this reaction?

- A $\text{C}_2\text{H}_5\text{Cl}$
- B $\text{C}_2\text{H}_4\text{Cl}_2$
- C $\text{C}_2\text{H}_2\text{Cl}_4$
- D CH_2Cl_2

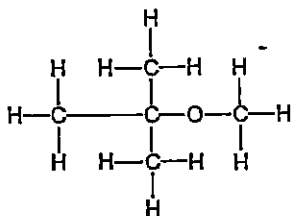
39 The displayed formulae of two compounds are shown



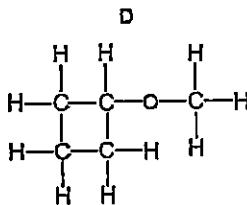
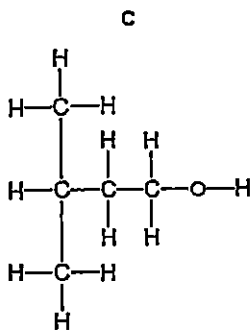
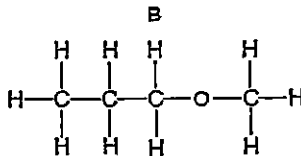
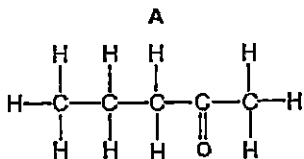
What are the similarities and differences between the two compounds?

	similarities	differences
A	molecular formulae	reactions
B	molecular formulae	relative molecular masses
C	structures	molecular formulae
D	structures	relative molecular masses

- 40 A compound known in industry as 'MTBE' is used as an additive in 'lead-free' petrol. The structural formula of MTBE is shown



Which compound is an isomer of 'MTBE'?



The Periodic Table of the Elements

		Group																										
		I	II	III	IV	V	VI	VII	0																			
1	H Hydrogen 1																											
2	He Helium 2																											
3	Li Lithium 3	9	4																									
4	Be Beryllium 4	5	5	6	7	8	9	10																				
5	B Boron 5	6	6	7	8	9	10	11	12	13	14	15	16	17	18													
6	C Carbon 6	7	7	8	9	10	11	12	13	14	15	16	17	18	19													
7	N Nitrogen 7	8	8	9	10	11	12	13	14	15	16	17	18	19	20													
8	O Oxygen 8	9	9	10	11	12	13	14	15	16	17	18	19	20	21													
9	F Fluorine 9	10	10	11	12	13	14	15	16	17	18	19	20	21	22													
10	Ne Neon 10	11	11	12	13	14	15	16	17	18	19	20	21	22	23													
11	Na Sodium 11	12	12	13	14	15	16	17	18	19	20	21	22	23	24													
12	Mg Magnesium 12	13	13	14	15	16	17	18	19	20	21	22	23	24	25													
13	Al Aluminum 13	14	14	15	16	17	18	19	20	21	22	23	24	25	26													
14	Si Silicon 14	15	15	16	17	18	19	20	21	22	23	24	25	26	27													
15	P Phosphorus 15	16	16	17	18	19	20	21	22	23	24	25	26	27	28													
16	S Sulfur 16	17	17	18	19	20	21	22	23	24	25	26	27	28	29													
17	Cl Chlorine 17	18	18	19	20	21	22	23	24	25	26	27	28	29	30													
18	Ar Argon 18	19	19	20	21	22	23	24	25	26	27	28	29	30	31													
19	K Potassium 19	20	20	21	22	23	24	25	26	27	28	29	30	31	32													
20	Ca Calcium 20	21	21	22	23	24	25	26	27	28	29	30	31	32	33													
21	Sc Scandium 21	22	22	23	24	25	26	27	28	29	30	31	32	33	34													
22	Ti Titanium 22	23	23	24	25	26	27	28	29	30	31	32	33	34	35													
23	V Vanadium 23	24	24	25	26	27	28	29	30	31	32	33	34	35	36													
24	Cr Chromium 24	25	25	26	27	28	29	30	31	32	33	34	35	36	37													
25	Mn Manganese 25	26	26	27	28	29	30	31	32	33	34	35	36	37	38													
26	Fe Iron 26	27	27	28	29	30	31	32	33	34	35	36	37	38	39													
27	Co Cobalt 27	28	28	29	30	31	32	33	34	35	36	37	38	39	40													
28	Ni Nickel 28	29	29	30	31	32	33	34	35	36	37	38	39	40	41													
29	Cu Copper 29	30	30	31	32	33	34	35	36	37	38	39	40	41	42													
30	Zn Zinc 30	31	31	32	33	34	35	36	37	38	39	40	41	42	43													
31	Ga Gallium 31	32	32	33	34	35	36	37	38	39	40	41	42	43	44													
32	Ge Germanium 32	33	33	34	35	36	37	38	39	40	41	42	43	44	45													
33	As Arsenic 33	34	34	35	36	37	38	39	40	41	42	43	44	45	46													
34	Se Selenium 34	35	35	36	37	38	39	40	41	42	43	44	45	46	47													
35	Br Bromine 35	36	36	37	38	39	40	41	42	43	44	45	46	47	48													
36	Kr Krypton 36	37	37	38	39	40	41	42	43	44	45	46	47	48	49													
37	Rb Rubidium 37	38	38	39	40	41	42	43	44	45	46	47	48	49	50													
38	Sr Strontium 38	39	39	40	41	42	43	44	45	46	47	48	49	50	51													
39	Y Yttrium 39	40	40	41	42	43	44	45	46	47	48	49	50	51	52													
40	Zr Zirconium 40	41	41	42	43	44	45	46	47	48	49	50	51	52	53													
41	Nb Niobium 41	42	42	43	44	45	46	47	48	49	50	51	52	53	54													
42	Mo Molybdenum 42	43	43	44	45	46	47	48	49	50	51	52	53	54	55													
43	Tc Technetium 43	44	44	45	46	47	48	49	50	51	52	53	54	55	56													
44	Ru Ruthenium 44	45	45	46	47	48	49	50	51	52	53	54	55	56	57													
45	Rh Rhodium 45	46	46	47	48	49	50	51	52	53	54	55	56	57	58													
46	Pd Palladium 46	47	47	48	49	50	51	52	53	54	55	56	57	58	59													
47	Ag Silver 47	48	48	49	50	51	52	53	54	55	56	57	58	59	60													
48	Cd Cadmium 48	49	49	50	51	52	53	54	55	56	57	58	59	60	61													
49	In Indium 49	50	50	51	52	53	54	55	56	57	58	59	60	61	62													
50	Sn Tin 50	51	51	52	53	54	55	56	57	58	59	60	61	62	63													
51	Sb Antimony 51	52	52	53	54	55	56	57	58	59	60	61	62	63	64													
52	Te Tellurium 52	53	53	54	55	56	57	58	59	60	61	62	63	64	65													
53	I Iodine 53	54	54	55	56	57	58	59	60	61	62	63	64	65	66													
54	Xe Xenon 54	55	55	56	57	58	59	60	61	62	63	64	65	66	67													
55	Fr Francium 55	56	56	57	58	59	60	61	62	63	64	65	66	67	68													
56	Ra Radium 56	57	57	58	59	60	61	62	63	64	65	66	67	68	69													
57	Ac Actinium 57	58	58	59	60	61	62	63	64	65	66	67	68	69	70													
58-71	Lanthanoid series										72	73	74	75	76	77	78	79	80	81	82	83	84	85	86			
72	Actinoid series										87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104

140	Ce Cerium 58	141	Pr Praseodymium 59	142	Nd Neodymium 60	143	Pm Promethium 61	144	Sm Samarium 62	145	Eu Europium 63	146	Gd Gadolinium 64	147	Tb Terbium 65	148	Dy Dysprosium 66	149	Ho Holmium 67	150	Er Erbium 68	151	Tm Thulium 69	152	Yb Ytterbium 70	153	Lu Lutetium 71						
87	Fr Francium 87	88	Ra Radium 88	89	Ac Actinium 89	90	Th Thorium 90	91	Pa Protactinium 91	92	U Uranium 92	93	Np Neptunium 93	94	Pu Plutonium 94	95	Am Americium 95	96	Cm Curium 96	97	Bk Berkelium 97	98	Cf Californium 98	99	Es Einsteinium 99	100	Fm Fermium 100	101	Md Mendelevium 101	102	No Nobelium 102	103	Lr Lawrencium 103

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

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

Class	Index Number	Name
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新加坡海星中学

MARIS STELLA HIGH SCHOOL

PRELIMINARY EXAMINATION 2

SECONDARY FOUR

CHEMISTRY
Paper 2

Additional Material: Nil

5073/02

21 August 2015
1 hour 45 minutes

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 on both sides of the paper.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.

This is Section A of the paper

Section A

Answer **all** questions in the spaces provided.

The number of marks is given in brackets [] at the end of question or part question.

A copy of the Periodic Table is printed on page 13 of Section B.

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

At the end of the examination, hand in the following separately :

- (1) Section A
- (2) Section B

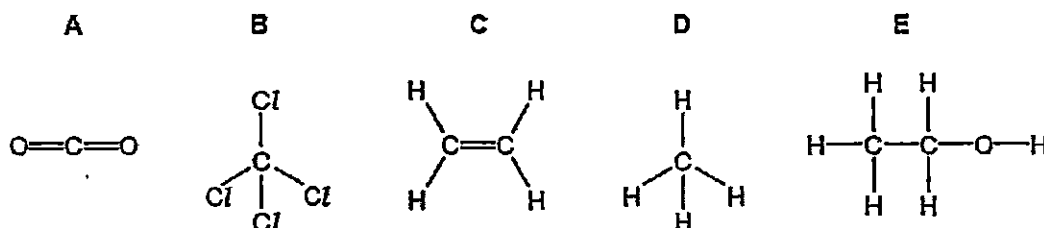
FOR EXAMINER'S USE	
Section A	/50
Section B	/30
Total	/80

Section A

Answer all the questions in this section in the spaces provided.
The total mark for this section is 50.

For
Examiner's
Use

A1 The diagram shows the structures of five compounds, A, B, C, D and E, containing carbon.



Answer these questions using the letters A, B, C, D or E.
Each compound can be used once, more than once or not at all.

Which one of these compounds

(a) can change the colour of aqueous bromine _____ [1]

(b) is a product of respiration _____ [1]

(c) is the main constituent of natural gas _____ [1]

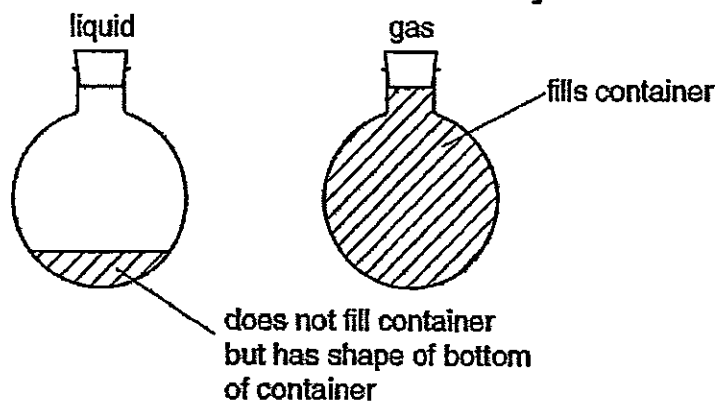
(d) is a product of substitution reaction _____ [1]

(e) is a liquid at room temperature and pressure _____ [1]

[Total : 5]

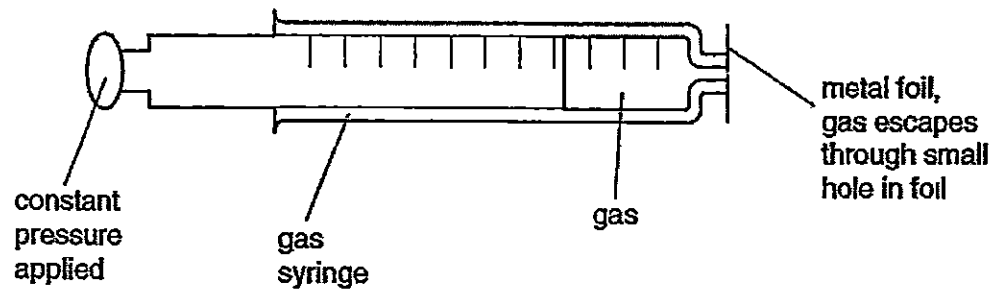
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Examiner's
Use

- A2 (a)** The Kinetic Theory explains the properties of solids, liquids and gases in terms of the movement of particles. Liquids and gases both take up the shape of the container but a gas always fills the container. Explain this, using the ideas of the Kinetic Theory.



[3]

- (b)** The following apparatus can be used to measure the rate of diffusion of a gas.



- (i)** What measurements would need to be taken to calculate the rate of diffusion of a gas?

[2]

- A2 (ii) Which gas, carbon dioxide or sulfur dioxide, would diffuse faster?
Explain your choice.

For
Examiner's
Use

[2]

- (c) A 20 cm³ sample of butyne, C₄H₆, is burnt in 150 cm³ of oxygen.



- What is the total volume of gases left at the end of the reaction? [3]

[Total : 10]

5

A3 Insoluble salts are made by precipitation.

*For
Examiner's
Use*

(a) A preparation of the insoluble salt calcium fluoride is described below.

To 15 cm^3 of aqueous calcium chloride, 30 cm^3 of aqueous sodium fluoride is added.

The concentration of both solutions is 1.00 mol/dm^3 . The mixture is filtered and the precipitate washed with distilled water. Finally, the precipitate is heated in an oven.

(i) Write the ionic equation (including state symbols) for the reaction.

_____ [2]

(ii) Why is the volume of sodium fluoride solution double that of the calcium chloride solution?

_____ [1]

(iii) Why is the precipitate washed with distilled water?

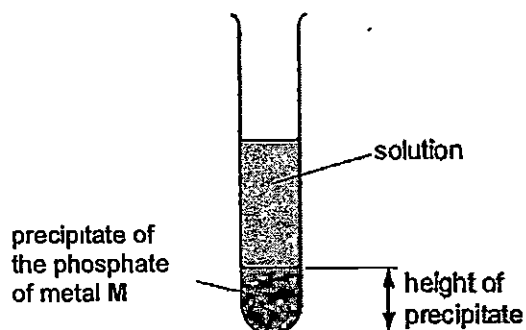
_____ [1]

(iv) Why is the solid heated?

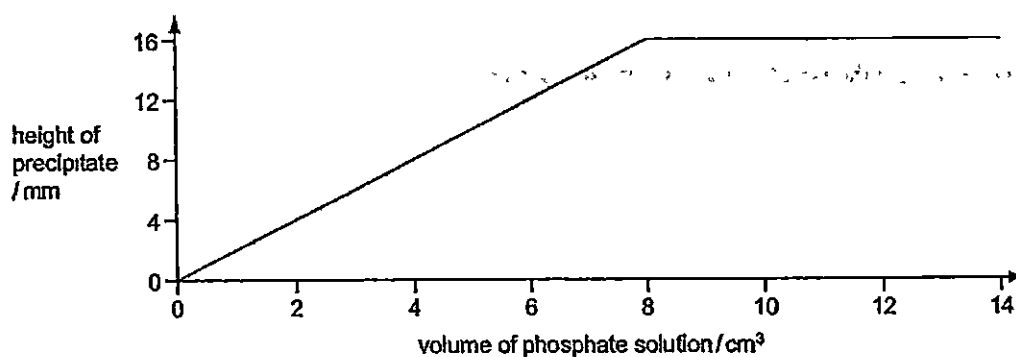
_____ [1]

- A3 (b)** The formulae of insoluble compounds can be found by precipitation reactions. 2.0 cm^3 of aqueous sodium phosphate, Na_3PO_4 was added to 12.0 cm^3 of an aqueous solution of the nitrate of metal M. The concentration of both solutions was 1.00 mol/dm^3 . When the precipitate had settled, its height was measured.

For
Examiner's
Use



The experiment was repeated using different volumes of the phosphate solution. The results are shown on the following graph.



What is the formula of the phosphate of metal M? Explain your reasoning.

[3]

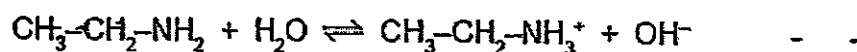
[Total : 8]

7

A4 Ethylamine, $\text{CH}_3\text{-CH}_2\text{-NH}_2$, is a base which has similar properties to ammonia.

For
Examiner's
Use

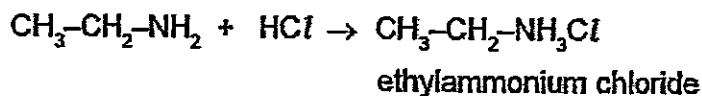
(a) In aqueous ethylamine, there is the following reaction :



Given aqueous solutions of ethylamine and sodium hydroxide, describe how you could show that ethylamine is a weak base like ammonia and not a strong base like sodium hydroxide.

[3]

(b) Ethylamine, like ammonia, reacts with acids to form salts.



Suggest how you could displace ethylamine from the salt, ethylammonium chloride.

[1]

(c) Explain the chemistry of the following reaction:

When aqueous ethylamine is added to aqueous iron(III) chloride, a red-brown precipitate is formed.

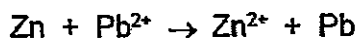
[2]

[Total : 6]

A5 The reactivity series shows the metals in order of reactivity.

(a) The reactivity series can be established using displacement reactions.

A piece of zinc is added to aqueous lead(II) nitrate. The zinc becomes coated with a black deposit of lead.



Zinc is more reactive than lead.

The reactivity series can be written as a list of ionic equations.



(i) Explain why the positive ions are likely to be oxidants (oxidising agents).

_____ [1]

(ii) Deduce which ion in the list above is the best oxidant (oxidising agent):

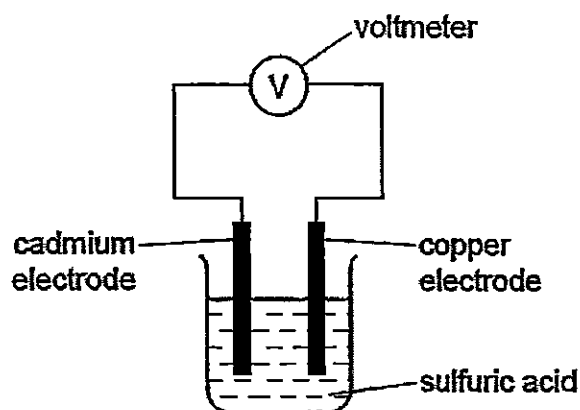
_____ [1]

(iii) Which ion(s) in the list can oxidise lead metal?

_____ [1]

- A5 (b) A reactivity series can also be established by measuring the voltage of simple cells. The diagram shows a simple cell.

For
Examiner's
Use



Results from cells using the metals tin, cadmium, zinc and copper are given in the table below.

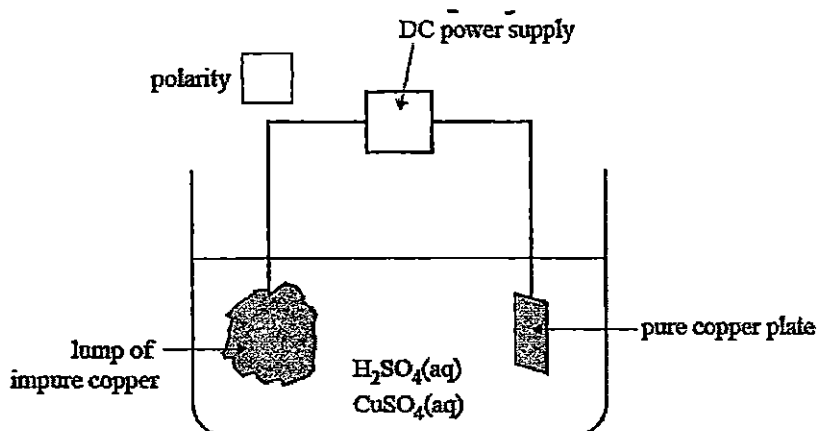
cell	electrode 1 positive electrode	electrode 2 negative electrode	voltage / volts
1	copper	cadmium	0.74
2	copper	tin	0.48
3	copper	zinc	1.10

Write the four metals in order of increasing reactivity and explain how you used the data in the table to determine this order.

[3]

[Total : 6]

- A6** An electrolytic process known as electro-refining is the final stage in producing highly purified copper. In a small-scale trial, a lump of impure copper is used as one electrode and a small plate of pure copper is used as the other electrode. The electrolyte is a mixture of aqueous sulfuric acid and copper(II) sulfate.



- (a) Indicate in the box labelled 'polarity' on the diagram above, the polarity of the impure copper electrode by putting either + or -. [1]

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

The results are provided in the following table.

	Mass of lump of impure copper	Mass of pure copper
Before electrolysis	10.30 kg	1.55 kg
After electrolysis	0.855 kg	9.80 kg

- (b) On the basis of these results

- (i) calculate the percentage purity of the lump of impure copper;

[3]

A6 (ii) state one factor that may affect the accuracy of these results.

For
Examiner's
Use

_____ [1]

(c) Lumps of impure copper typically contain impurities such as silver, gold, cobalt, nickel and zinc. Cobalt, nickel and zinc are oxidised from the copper lump and exist as ions in the electrolyte. Silver and gold are not oxidised and form part of an insoluble sludge at the base of the cell.
Why is it important that silver and gold are not present as cations in the electrolyte?

_____ [1]

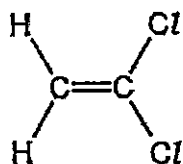
[Total : 6]

A7 There are two types of polymerisation - addition and condensation.

(a) Describe the difference between them.

[2]

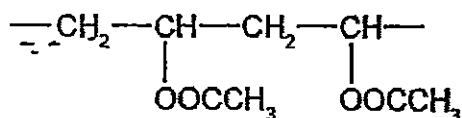
(b) Poly(dichloroethene) is used to package food.
The structural formula of dichloroethene is shown below.



Draw the structure of poly(dichloroethene) showing two repeat units. [2]

13

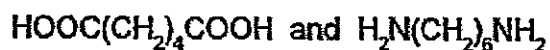
- A7 (c) The polymer known as PVA is used in paints and adhesives. Its structure is shown below.



Deduce the structural formula of its monomer.

[1]

- (d) A condensation polymer can be made from the following monomers.



- (i) Draw the structure of this polymer showing two repeat units.

[2]

- (ii) Describe the pollution problems caused by non-biodegradable polymers.

[2]

[Total : 9]

For
Examiner's
Use

Class	Index Number	Name
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新加坡海星中学

MARIS STELLA HIGH SCHOOL

PRELIMINARY EXAMINATION 2

SECONDARY FOUR

CHEMISTRY
Paper 2

Additional Material: Nil

5073/02

21 August 2015
1 hour 45 minutes

INSTRUCTIONS TO CANDIDATES

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

This is Section B of the paper

Section B

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

The number of marks is given in brackets [] at the end of question or part question.
A copy of the Periodic Table is printed on page 13.
The use of an approved scientific calculator is expected, where appropriate.

FOR EXAMINER'S USE	
B8	/10
B9	/10
B10	/10
Total	/30

This document consists of 12 printed pages and 1 blank page.

REPRODUCTION OF ANY PART OF THIS QUESTION PAPER WITHOUT PERMISSION IS STRICTLY PROHIBITED.

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3

Section B

Answer the questions in this section in the spaces provided.

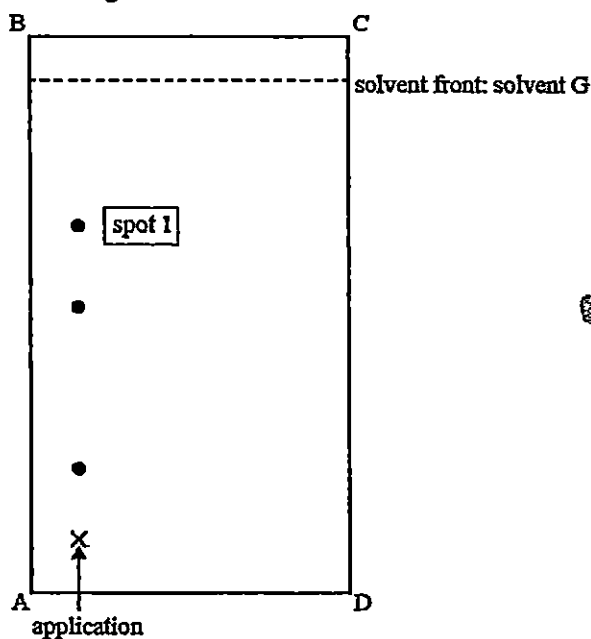
Answer three questions from this section.

For
Examiner's
Use

The last question is in the form of either/or and only one of the alternatives should be attempted.

The total mark for this section is 30.

- B8 (a)** Enzymes are biological catalysts. They are used both in research laboratories and in industry. Enzymes called proteases can hydrolyse proteins to amino acids. The amino acids can be separated and identified by chromatography. A drop that contains a mixture of four amino acids was applied to a thin layer chromatography plate. The plate was placed in solvent G and the following chromatogram was obtained.



The R_f values for each of the amino acids in solvent G are provided in table below.

amino acid	R_f (solvent G)
alanine	0.51
arginine	0.16
threonine	0.51
tyrosine	0.68

4

B8 (i) Name the amino acid that corresponds to spot 1.

_____ [1]

For
Examiner's
Use

(ii) What factor determines the different R_f values of the different amino acids?

_____ [1]

(iii) Explain why the chromatogram must be exposed to a locating agent before R_f values can be measured.

_____ [1]

(iv) Measuring R_f values on a chromatogram is one way of identifying amino acids. Suggest another.

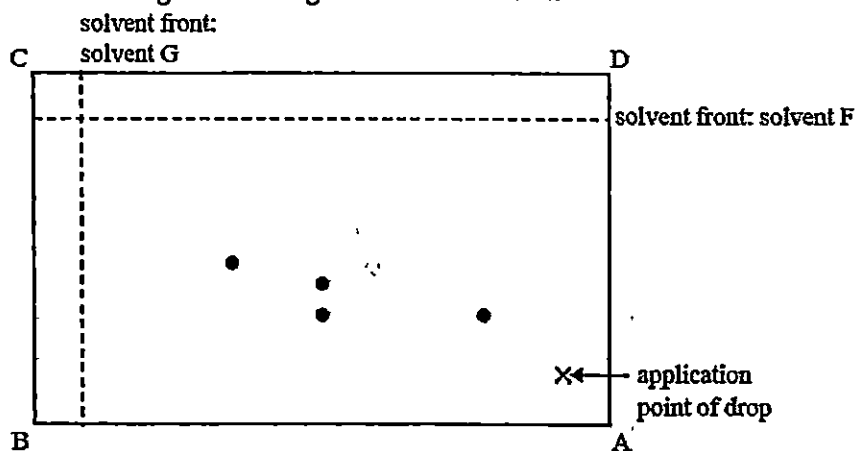
_____ [1]

(v) The plate was dried, rotated through 90° in an anticlockwise direction and then placed in solvent F.

The R_f values for each of the amino acids in solvent F are provided in table below.

amino acid	R_f (solvent F)
alanine	0.21
arginine	0.21
threonine	0.34
tyrosine	0.43

The following chromatogram was obtained.



chromatogram II

5

B8 Circle the spot on chromatogram II that represents alanine. [1]

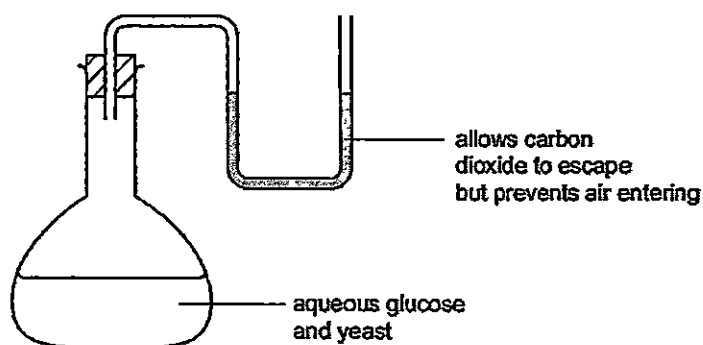
[1]

For
Examiner's
Use

Explain, in terms of the data provided, why only three spots are present in chromatogram I while four spots are present in chromatogram II.

_____ [2]

- (b) The enzyme called zymase catalyses the anaerobic respiration of glucose during fermentation which can be carried out in the apparatus drawn below. After a few days the reaction stops. It has produced a 12% aqueous solution of ethanol.



- (i) Complete the equation.



- (ii) Suggest a reason why the reaction stops after a few days.

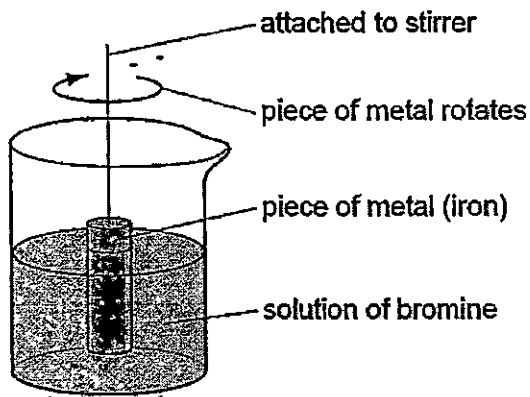
_____ [1]

- (iii) Why is it essential that there is no oxygen in the flask?

_____ [1]

[Total : 10]

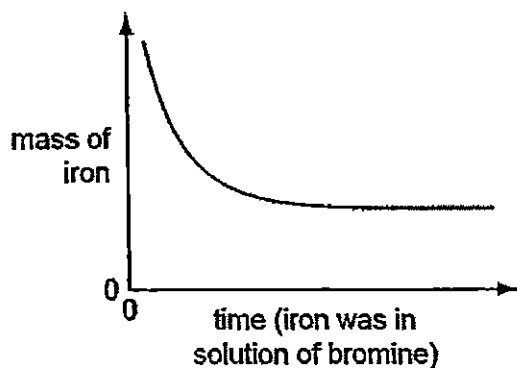
- B9 (a) The rate of the reaction between iron and aqueous bromine can be investigated using the apparatus shown below.



A piece of iron was weighed and placed in the apparatus. It was removed at regular intervals and the clock was paused. The piece of iron was washed, dried, weighed and replaced. The clock was restarted.

This was continued until the solution was colourless.

The mass of iron was plotted against time. The graph shows the results obtained.



- (i) Suggest an explanation for the shape of the graph.

[2]

7

- B9 (ii)** Predict the shape of the graph if a similar piece of iron (same mass) with a much rougher surface had been used. Explain your answer.

For
Examiner's
Use

[2]

- (iii)** Describe how you could find out if the rate of this reaction depended on the speed of stirring.

[3]

- (b)** Iron is extracted from its ore (haematite) in a blast furnace. Using chemical equations, describe the essential reactions taking place in the blast furnace which results in the production of iron.

[3]

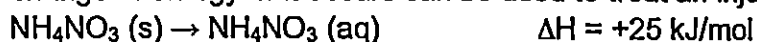
[Total : 10]

EITHER

For
Examiner's
Use

- B10 (a)** A 'QwikCure' pack, used to treat sporting injuries, contains a bag of water inside a larger bag of finely powdered ammonium nitrate, NH_4NO_3 . Squeezing the pack causes the bag of water to break and the NH_4NO_3 to dissolve.

The change of energy that occurs can be used to treat an injury.



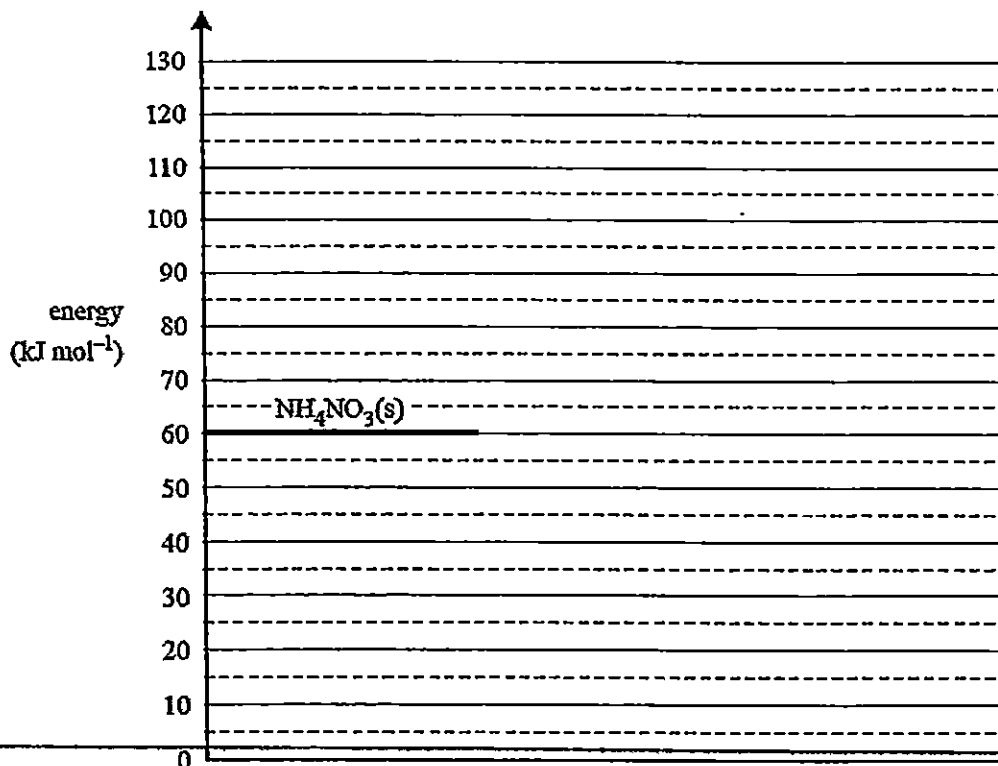
- (i) State and explain if the dissolving process is exothermic or endothermic.

[2]

- (ii) Suppose the activation energy of the reverse change is 35 kJ/mol. Explain the meaning of the term 'activation energy'.

[1]

- (iii) On the graph below, sketch an energy profile diagram showing the changes that occur in chemical energy as the NH_4NO_3 powder dissolves. [3]



EITHER

*For
Examiner's
Use*

B10 (b) Sodium reacts with nitrogen to form a compound called sodium nitride.

The chemical formula of sodium nitride is Na_xN .

A sample of sodium in a porcelain boat was heated in a combustion tube while nitrogen gas was passed over it.

The following masses were recorded.

Mass of porcelain boat when empty = 14.84 g

Mass of porcelain boat + sodium = 15.13 g

Mass of porcelain boat + sodium nitride = 15.19 g

(i) Determine the empirical formula of sodium nitride.

[3]

(ii) Write an equation for the formation of sodium nitride.

_____ [1]

[Total : 10]

OR

For
Examiner's
Use

- B10 (a)** In 1894, the scientist W. Ramsay, carried out the following experiments starting with 100 cm^3 of air.

The 100 cm^3 of air were passed through solution X to remove traces of acidic gases. Then the air was bubbled through concentrated sulfuric acid to remove water vapour. The remaining gases were treated with excess of hot copper and the volume decreased from almost 100 cm^3 to 80 cm^3 . The gases that did not react with hot copper were heated with magnesium. 1 cm^3 of gas Y remained and a white solid Z was formed. Solid Z reacted with water to form only magnesium hydroxide and ammonia.

- (i) Name the ion, in solution X, which reacts with the acidic gases.

_____ [1]

- (ii) Give the formula of solid Z.

_____ [1]

- (iii) Gas Y has a density of 1.66 g/dm^3 at r.t.p.
Calculate the mass of 1 mole of gas Y and hence identify the gas.

[1]

- (iv) Most gases are identified by a chemical test.
Why must gas Y be identified using a physical property?

_____ [1]

OR

For
Examiner's
Use

B10 (b) The table shows some properties of gases in dry air.

Gas in dry air	Density in kg/m^3	Melting point in $^{\circ}\text{C}$	Boiling point in $^{\circ}\text{C}$	Percentage (%) in air
Nitrogen	1.2506	-210	-196	78.08
Oxygen	1.4290	-219	-183	20.95
Carbon dioxide	1.977	-57	-57	0.033
Helium	0.1785	-272	-269	0.00052
Neon	0.8999	-249	-246	0.0019
Argon	1.7837	-189	-186	0.934
Krypton	3.74	-157	-153	0.00011
Xenon	5.86	-112	-108	0.0000087

In 1895, Lord Rayleigh isolated nitrogen from dry air by removing the other known gases, oxygen and carbon dioxide. He then discovered that nitrogen from dry air had a different density to pure nitrogen produced from chemical reactions. He concluded that nitrogen extracted from dry air was mixed with another gas. The density of nitrogen extracted from dry air was higher than the density of pure nitrogen.

Use the information above to explain why.

[2]

OR

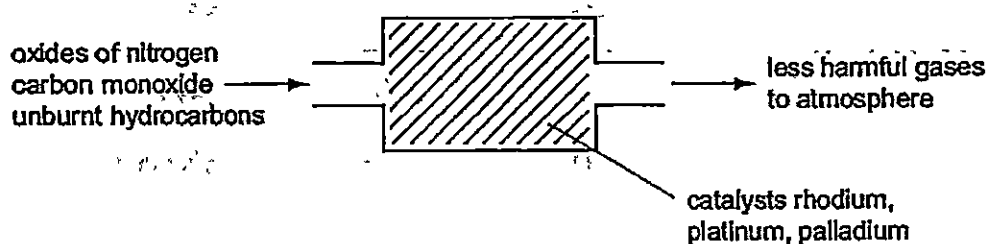
For
Examiner's
Use

B10 (c) Minimising air pollution is essential for health and for the environment.

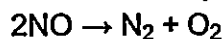
- (i) Low sulfur fuels are being introduced. Ordinary diesel contains 500 ppm of sulfur but low sulfur diesel contains less than 50 ppm.
Why is this an advantage to the environment?

[2]

- (ii) Catalytic converters reduce pollution from motor vehicles, as shown in the following diagram.



Rhodium catalyses the decomposition of the oxides of nitrogen.



Two other pollutants are carbon monoxide and unburnt hydrocarbons.

How are they converted into less harmful substances?

[2]

[Total : 10]

The Periodic Table of the Elements

Group																		
I	II											III	IV	V	VI	VII	0	
							1 H Hydrogen 1											4 He Helium 2
7 Li Lithium 3	9 Be Beryllium 4											11 B Boron 5	12 C Carbon 6	14 N Nitrogen 7	16 O Oxygen 8	19 F Fluorine 9	20 Ne Neon 10	
23 Na Sodium 11	24 Mg Magnesium 12											27 Al Aluminium 13	28 Si Silicon 14	31 P Phosphorus 15	32 S Sulphur 16	35.5 Cl Chlorine 17	40 Ar Argon 18	
39 K Potassium 19	40 Ca Calcium 20	45 Sc Scandium 21	48 Ti Titanium 22	51 V Vanadium 23	52 Cr Chromium 24	55 Mn Manganese 25	56 Fe Iron 26	59 Co Cobalt 27	59 Ni Nickel 28	64 Cu Copper 29	65 Zn Zinc 30	70 Ga Gallium 31	73 Ge Germanium 32	75 As Arsenic 33	79 Se Selenium 34	80 Br Bromine 35	84 Kr Krypton 36	
85 Rb Rubidium 37	88 Sr Strontium 38	89 Y Yttrium 39	91 Zr Zirconium 40	93 Nb Niobium 41	96 Mo Molybdenum 42	Tc Technetium 43	101 Ru Ruthenium 44	103 Rh Rhodium 45	106 Pd Palladium 46	108 Ag Silver 47	112 Cd Cadmium 48	115 In Indium 49	119 Sn Tin 50	122 Sb Antimony 51	128 Te Tellurium 52	127 I Iodine 53	131 Xe Xenon 54	
133 Cs Caesium 55	137 Ba Barium 56	139 La Lanthanum 57	178 Hf Hafnium 72	181 Ta Tantalum 73	184 W Tungsten 74	186 Re Rhenium 75	190 Os Osmium 76	192 Ir Iridium 77	195 Pt Platinum 78	197 Au Gold 79	201 Hg Mercury 80	204 Tl Thallium 81	207 Pb Lead 82	209 Bi Bismuth 83	Po Polonium 84	At Astatine 85	86 Rn Radon 86	
Fr Francium 87	226 Ra Radium 88	227 Ac actinium 89 †																

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

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

Key

a	X
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)

MSHS 2015 Chemistry Prelim II Answer Key

Paper 1

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

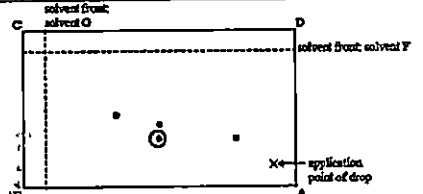
Paper 2 Section A

Q no	Answer
1	(a) C (b) A (c) D (d) B (e) E
2(a)	In liquid, the particles are <u>close together</u> ; the <u>strong forces of attraction between the particles do not allow them to move apart</u> . They can move in the volume of the liquid to take up the shape of the container. In gas, the forces are <u>much weaker and the particles can move in all directions / freely to fill the container</u>
(b)(i)	Measure the <u>volume of gas left</u> in the gas syringe (or volume of gas that escapes) at <u>regular intervals of time</u>
(ii)	Carbon dioxide, It has <u>lower relative molecular mass / molar mass / mass</u>
(c)	From the equation, 2 moles of C ₄ H ₆ react with 11 moles of O ₂ Since both are gases at rtp, applying Avogadro's Law, 2 volumes of C ₄ H ₆ react with 11 volumes of O ₂ to form 8 volumes of CO ₂ Thus 20 cm ³ of C ₄ H ₆ react with 110 cm ³ of O ₂ to form 80 cm ³ of CO ₂ Volume of gases left = 40 cm ³ of excess O ₂ + 80 cm ³ of carbon dioxide = 120 cm ³
3(a)(i)	Ca ²⁺ (aq) + 2F ⁻ (aq) → CaF ₂ (s)
(ii)	Mole ratio of F ⁻ (or NaF) : Ca ²⁺ (or CaCl ₂) is 2 : 1 Or 2 moles of NaF react with 1 mole of CaCl ₂
(iii)	To remove sodium chloride or sodium fluoride or calcium chloride solution
(iv)	To dry (precipitate) or to remove water or to evaporate water
(b)	M ₃ (PO ₄) ₂ : From the graph, <u>8 cm³ of sodium phosphate</u> totally react with <u>12 cm³ of nitrate of M</u> Since both solutions have same concentration, <u>2 moles of sodium phosphate react totally with 3 moles of nitrate of M</u>
4(a)	Using equal volume and concentration of both solutions, add a few drops of Universal indicator / pH sensor / pH meter; Indicator in ethylamine shows blue/indigo while that in sodium hydroxide shows violet / ethylamine has a lower pH or Using equal volume and concentration of both solutions,

	measure electrical conductivity using circuit with battery and bulb/ammeter; bulb is less bright/ammeter shows lower reading for ethylamine
(b)	Add aqueous sodium/potassium/calcium hydroxide, warm
(c)	Aqueous ethylamine has hydroxide ions which react with aqueous iron(III) ions to form insoluble iron(III) hydroxide
-	-
5(a)(i)	They can accept or gain electrons (from another substance) to form atoms
(ii)	silver ion (Ag^+)
(iii)	silver ion and copper(II) ion (Ag^+ and Cu^{2+})
(b)	copper, tin, cadmium, zinc, copper is the least reactive metal as it is always the positive electrode, zinc is the most reactive since the voltage is the highest, followed by cadmium, then tin or the bigger the difference in reactivity between the metals, the bigger the voltage
6(a)	+
(b)(i)	Decrease in mass of impure electrode = $10.30 \text{ kg} - 0.855 \text{ kg} = 9.445 \text{ kg}$ Increase in mass of pure electrode = mass of pure copper = $9.80 \text{ kg} - 1.55 \text{ kg} = 8.25 \text{ kg}$ % purity = $(8.25/9.445) \times 100 = 87.3$ (to 3 sig fig)
(ii)	electrodes not properly dried before weighing / not all the copper produced at the pure copper plate sticks to the copper plate
(c)	Silver and gold ions (when present in higher concentration than copper(II) ions) could be selectively charged to form silver and gold which is deposited at the pure copper plate
7(a)	Any TWO Addition polymerisation produces only one product, the polymer, but condensation polymerisation produces the polymer and a by-product such as water The total mass of the monomers is the same as that of the addition polymer while the total mass of the monomers is greater than that of the condensation polymer as the process eliminates a simple molecule such as water. In addition polymerisation, each monomer has a carbon-carbon double bond while in condensation polymerisation, each monomer has a functional group at each end.
(b)	$ \begin{array}{cccc} \text{H} & \text{Cl} & \text{H} & \text{Cl} \\ & & & \\ -\text{C} & -\text{C} & -\text{C} & -\text{C}- \\ & & & \\ \text{H} & \text{Cl} & \text{H} & \text{Cl} \end{array} $
(c)	$ \begin{array}{ccc} & \text{H} & \\ & & \\ \text{H} & \text{C} = \text{C} & \text{H} \\ & & \\ \text{H} & & \text{OOCCH}_3 \end{array} $

(d)(i)	$\begin{array}{cccccccc} \text{O} & - & - & - & \text{O} & \text{H} & - & - & - & \text{H} & \text{O} & - & - & \text{O} & \text{H} & - & \text{H} \\ & & & & & & & & & & & & & & & & & \\ -\text{C} & - & (\text{CH}_2)_4 & - & \text{C} & - & \text{N} & - & (\text{CH}_2)_6 & - & \text{N} & - & \text{C} & - & (\text{CH}_2)_4 & - & \text{C} & - & \text{N} & - & (\text{CH}_2)_6 & - & \text{N} & - \end{array}$
(ii)	Any TWO from. -causes litter / land pollution if not properly disposed -incomplete combustion produces poisonous carbon monoxide -complete combustion produces carbon dioxide a greenhouse gas -combustion produces other named poisonous gas

Paper 2 Section B

Q no	Answer
8(a)(i)	tyrosine
(ii)	Difference in solubility of the amino acids in the solvent used
(iii)	The spots are colourless, locating agent reacts with the spots to form coloured substances
(iv)	Determine the melting point and/or boiling point
(v)	 <p>In chromatogram I, which used solvent G, alanine and threonine appeared at the same spot/were not separated since both had the same R_f value (0.51) which means they have the same solubility in solvent G</p> <p>In chromatogram II, which used solvent F, alanine and threonine had different R_f values and were thus separated.</p>
(b)(i)	$\text{C}_6\text{H}_{12}\text{O}_6 \rightarrow 2\text{C}_2\text{H}_5\text{OH} + 2\text{CO}_2$
(ii)	yeast is 'killed'/poisoned / enzyme is denatured by ethanol
(iii)	Oxygen will oxidise ethanol to ethanoic acid or oxygen is absent to ensure anaerobic respiration of glucose occurs so as to form ethanol
9(a)(i)	Rate at which mass of iron decreases becomes lower / gradient decreases because concentration of aqueous bromine decreases; Mass of iron stops decreasing / gradient becomes zero because all the aqueous bromine is used up
(ii)	The initial rate / gradient is greater because of bigger surface area / more iron particles exposed; final mass of iron is the same because the same mass of iron is reacted with aqueous bromine
(iii)	Repeat the experiment using same mass of iron and same volume and concentration of aqueous bromine but by increasing/decreasing the speed of stirring/not stirring the iron piece; measure the mass of iron piece at regular time intervals; calculate the rate of reaction / gradient and compare
(b)	Coke is heated in air to form carbon dioxide; $\text{C} + \text{O}_2 \rightarrow \text{CO}_2$

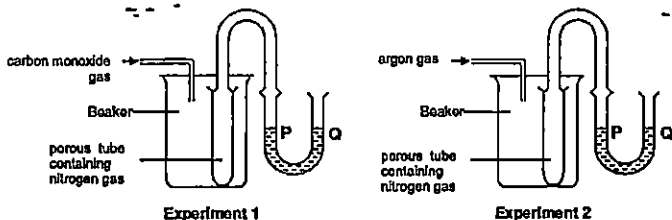
	Carbon dioxide reacts with more coke to form carbon monoxide; $\text{CO}_2 + \text{C} \rightarrow 2\text{CO}$ Carbon monoxide reduces [iron(III) oxide in] haematite to iron; $\text{Fe}_2\text{O}_3 + 3\text{CO} \rightarrow 2\text{Fe} + 3\text{CO}_2$															
10	Endothermic,															
(a)(i)	The enthalpy change is positive which means heat is absorbed from the surrounding during the process															
(ii)	The minimum energy that particles must possess in order to collide effectively leading to a reaction															
(iii)																
(b)(i)	<table border="1"> <thead> <tr> <th></th> <th>Sodium (Na)</th> <th>Nitrogen (N)</th> </tr> </thead> <tbody> <tr> <td>Mass (g)</td> <td>15 13-14 84 = 0.29</td> <td>15 19-15 13 = 0.06</td> </tr> <tr> <td>Molar mass (g)</td> <td>23</td> <td>14</td> </tr> <tr> <td>No of mole</td> <td>0.29/23 = 0.0126</td> <td>0.06/14 = 0.00429</td> </tr> <tr> <td>Mole ratio</td> <td>3</td> <td>1</td> </tr> </tbody> </table> <p>The empirical formula is Na_3N</p>		Sodium (Na)	Nitrogen (N)	Mass (g)	15 13-14 84 = 0.29	15 19-15 13 = 0.06	Molar mass (g)	23	14	No of mole	0.29/23 = 0.0126	0.06/14 = 0.00429	Mole ratio	3	1
	Sodium (Na)	Nitrogen (N)														
Mass (g)	15 13-14 84 = 0.29	15 19-15 13 = 0.06														
Molar mass (g)	23	14														
No of mole	0.29/23 = 0.0126	0.06/14 = 0.00429														
Mole ratio	3	1														
(ii)	$6\text{Na} + \text{N}_2 \rightarrow 2\text{Na}_3\text{N}$															
10 OR	Hydroxide (ion)															
(a)(i)																
(ii)	Mg_3N_2															
(iii)	Molar mass = $1.66\text{g} \times 24 = 39.84\text{g}$ or 39.8g (to 3 sig fig) Gas Y is argon/ Ar															
(iv)	Argon is a noble gas/has completely filled valence shells and is chemically unreactive or inert															
(b)	Nitrogen from dry air contained argon/krypton/xenon; argon/krypton/xenon have density higher than that of nitrogen															
(c)(i)	Combustion of low sulfur diesel would release less sulfur dioxide into the atmosphere, less acid rain would be formed which means less corrosion to limestone buildings and/or metal structures															
(ii)	Carbon monoxide would be converted into carbon dioxide; unburnt hydrocarbons (reacted with oxygen) are converted to carbon dioxide and water (vapour)															

MGS - P1

Page 2 of 19

- 1 Two experimental set-ups used to demonstrate diffusion of gases are shown in the diagram below. The gas in each porous tube is nitrogen (M_r is 28).

In experiment 1, the gas introduced into the beaker is carbon monoxide (M_r is 28) while in experiment 2, the gas is argon (A_r is 40).



What changes, if any, to the water levels at P and Q would you expect to see in both experiments?

	Experiment 1	Experiment 2
A	P and Q remain at the same level	P is at a higher level than Q
B	P and Q remain at the same level	Q is at a higher level than P
C	P is at a higher level than Q	P is at a higher level than Q
D	P is at a higher level than Q	Q is at a higher level than P

- 2 Three separations are listed below

- Obtaining ethanol from alcoholic drink.
- Obtaining ammonium chloride from a mixture of ammonium chloride and sodium chloride.
- Obtaining solid copper(II) sulfate from aqueous copper(II) sulfate.

Which techniques would be involved in separation 1, 2 and 3 respectively?

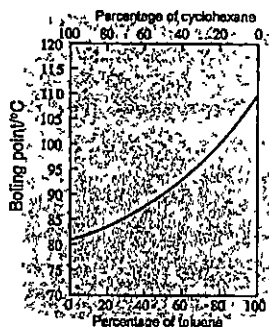
	1	2	3
A	fractional distillation	sublimation	crystallisation
B	fractional distillation	sublimation	filtration
C	distillation	crystallisation	evaporation
D	distillation	crystallisation	filtration

3 Which quantity is the same for 1 mole of ethane and 1 mole of ethene?

- A mass
- B number of molecules
- C number of atoms
- D number of ions

4 Toluene and cyclohexane are two common organic solvents and they form a homogenous mixture when mixed together

The following graph shows the boiling points of mixtures containing different percentages of toluene and cyclohexane

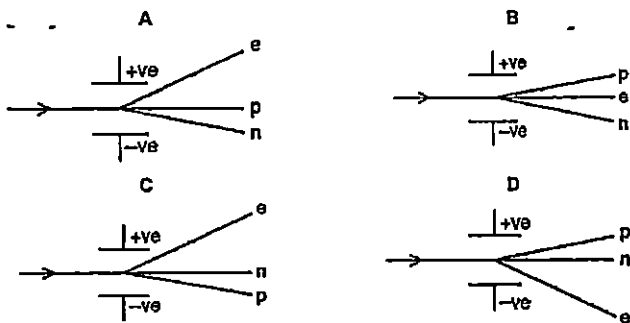


Which of the following best describes the boiling point of any mixture of toluene and cyclohexane as shown by the graph?

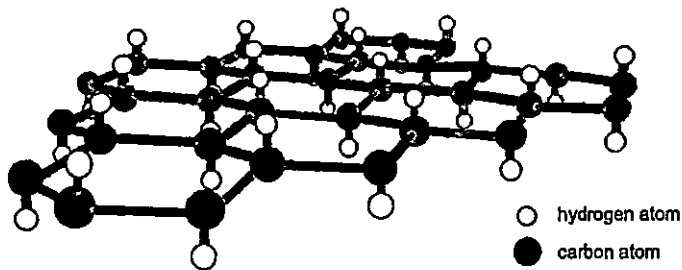
- A The boiling point is below that of toluene.
- B The boiling point is higher than that of cyclohexane
- C The boiling point is below that of both toluene and cyclohexane.
- D The boiling point is between that of toluene and cyclohexane.

- 5 A beam of particles contains neutrons, n , protons, p , and electrons, e . The beam is passed between charged plates.

Which diagram shows how the particles are affected by the plates?



- 6 Graphane, an allotrope of carbon has a similar structure to graphite, except that, it has one hydrogen atom attached to each carbon as shown in the diagram.



Which set of properties will graphane have?

- 1 It is hard.
- 2 It has a giant molecular structure.
- 3 It conducts electricity in the solid state.

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

- 7 The formulae of the ions of some elements are shown below



Which of the following statements about these ions is correct?

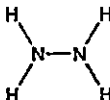
- A All have full outer shell
 B All have the same number of electron shells
 C All have the same number of neutrons in their nuclei
 D All have more electrons than protons
- 8 Four substances have the following electrical properties

Substance	Property
W	Does not conduct under any conditions
X	Conducts only in aqueous solution
Y	Conducts in both the molten and solid states
Z	Conducts in both molten and aqueous states

What are these four substances?

	W	X	Y	Z
A	HCl	S	KCl	Zn
B	Zn	HCl	KCl	S
C	S	HCl	Zn	KCl
D	S	KCl	HCl	Zn

- 9 The diagram shows the structural formula of the covalent molecule hydrazine,
- N_2H_4



Consider all the electrons in a molecule of hydrazine

Which statement is true of the number of electrons in the molecule?

	Total number of electrons involved in bonding	Total number of electrons not involved in bonding
A	5	4
B	5	8
C	10	4
D	10	8

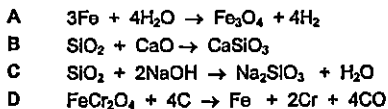
- 10 Compound X consists of a lattice of positive ions of metal Y and negative ions of non-metal Z.

Each positive ion is surrounded by eight negative ions and each negative ion is surrounded by four positive ions

Which of the following shows the formulae of the ions present and compound X?

	Ions present	Formula
A	Y^+, Z^{2-}	Y_2Z
B	Y^{2+}, Z	YZ_2
C	Z^+, Y^{2-}	Z_2Y
D	Z^{2+}, Y^-	ZY_2

- 11 Which reaction takes place in the blast furnace?



- 12 Dinitrogen tetroxide, N_2O_4 is a poisonous gas. It can be disposed of safely by reaction with sodium hydroxide. In the experiment, the concentration of aqueous sodium hydroxide used is 1.5 mol/dm^3 .



Which of the following is the least volume of aqueous sodium hydroxide required to dispose of 300 cm^3 of N_2O_4 at room temperature and pressure?

- A 10 cm^3
 B 20 cm^3
 C 120 cm^3
 D 240 cm^3

- 13 The dissociation constant for an acid indicates the extent to which it dissociates into ions. The higher the dissociation constant, the stronger the acid.

The dissociation constant for some acids are given below along with two possibly correct statements.

Acid	Dissociation Constant
Methanoic acid, HCO_2H	1.80×10^{-4}
Ethanoic acid, $\text{CH}_3\text{CO}_2\text{H}$	1.75×10^{-5}
Propanoic acid, $\text{CH}_3\text{CH}_2\text{CO}_2\text{H}$	1.34×10^{-6}
Chloroethanoic acid, $\text{ClCH}_2\text{CO}_2\text{H}$	1.40×10^{-3}

Statement 1	Increasing the length of the carbon chain makes the acid stronger.
Statement 2	Replacing a hydrogen by a chlorine in ethanoic acid makes the acid stronger.

Based on the data above, which of the above two statements are correct?

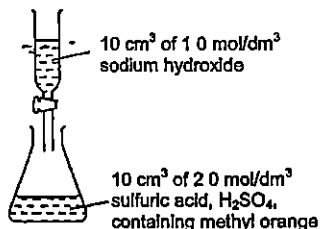
- A Statement 1 and 2
 B Statement 1 only
 C Statement 2 only
 D Neither statement
- 14 Which pair of reagents is most suitable in preparing the following salts?

	Salt	Reagents
A	magnesium sulfate	magnesium nitrate + sodium sulfate
B	ammonium nitrate	aqueous ammonia + nitric acid
C	lead (II) chloride	lead (II) oxide + hydrochloric acid
D	sodium chloride	sodium + hydrochloric acid

- 15 A student performed a number of tests on an aqueous solution of lead(II) nitrate. Which test must be repeated because the student's observation was incorrect?

	Test	Observation
A	Add aqueous zinc sulfate	A white precipitate was formed.
B	Add aqueous barium chloride	No precipitate was formed.
C	Add aqueous sodium hydroxide	A white precipitate was formed.
D	Add aqueous sodium hydroxide and aluminium foil, then heat	A gas was evolved that turned moist red litmus paper blue.

- 16 During an experiment, 10 cm^3 of 1.0 mol/dm^3 sodium hydroxide, NaOH, is gradually added to 10 cm^3 of 2.0 mol/dm^3 sulfuric acid, H_2SO_4 , containing methyl orange indicator

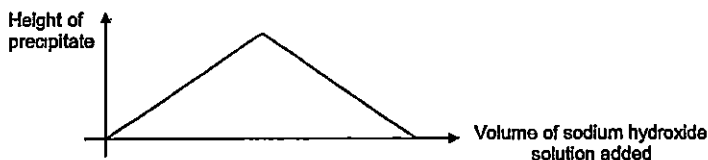


Which change occurs in the mixture?

- A The concentration of the OH^- ions increases
 B The methyl orange changes colour
 C A precipitate is formed
 D More water molecules are formed
- 17 To reduce atmospheric pollution, the waste gases from a coal-burning power station are passed through a wet suspension of powdered calcium carbonate

Which waste gas will **NOT** be removed by powdered calcium carbonate?

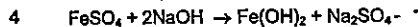
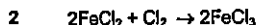
- A carbon monoxide, CO
 B nitrogen dioxide, NO_2
 C sulfur dioxide, SO_2
 D phosphorus(V) oxide, P_2O_5
- 18 An aqueous solution of a salt, X, is placed in a test-tube and sodium hydroxide solution is gradually added. The height of the precipitate in the test-tube is plotted against the volume of sodium hydroxide added.



Which cation is found in X?

- A aluminium ion
 B ammonium ion
 C copper(II) ion
 D iron(II) ion

19 Equations for reactions of iron and iron compounds are shown

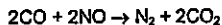


How many of these are redox reactions?

- A 1
B 2
C 3
D 4

20 Waste gases from a car engine are passed through a catalytic converter to remove the pollutant gases

One of pollutant gases is nitrogen monoxide. The equation below shows how it is removed



Which statement about the reaction is incorrect?

- A The oxidation state of carbon changes from +2 to +4
B The oxidation state of nitrogen changes from +2 to 0
C The oxidation state of oxygen is unchanged
D The oxidation state of oxygen changes from -2 to -4
- 21 The table shows the reactions of each of the metals A, B, C and D with separate solutions containing ions of the other metals

Which metal forms an oxide that is most easily reduced by heating with carbon?

Metal	Solution of			
	A nitrate	B nitrate	C nitrate	D nitrate
A	reaction	reaction	no reaction	no reaction
B	no reaction	reaction	no reaction	no reaction
C	reaction	reaction	no reaction	reaction
D	reaction	reaction	no reaction	reaction

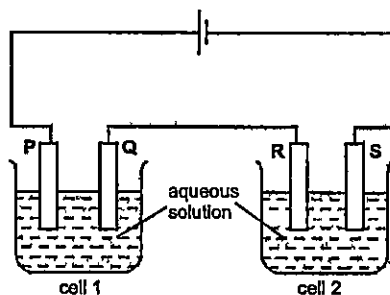
- 25 Metal M forms a chloride MCl_2 . M is between copper and silver in the reactivity series.

If a concentrated aqueous solution of MCl_2 is electrolysed, which reactions will occur at the cathode and the anode?

	Cathode(negative electrode)	Anode(positive electrode)
A	$M^{2+} + 2e^- \rightarrow M$	$2Cl^- \rightarrow Cl_2 + 2e^-$
B	$M^{2+} + 2e^- \rightarrow M$	$4OH^- \rightarrow 2H_2O + O_2 + 4e^-$
C	$2H^+ + 2e^- \rightarrow H_2$	$2Cl^- \rightarrow Cl_2 + 2e^-$
D	$2H^+ + 2e^- \rightarrow H_2$	$4OH^- \rightarrow 2H_2O + O_2 + 4e^-$

- 26 In the diagram, each cell contains an aqueous solution of a single salt and all four electrodes are platinum.

Electrodes Q and S increase in mass during the electrolysis but no gas is given off at Q or S.



If the increase in mass of Q is greater than the increase in mass of S in the same duration of time, which statement must be true?

- A The loss of mass of electrode P is less than the loss of mass of electrode R.
 B The current passing through cell 1 is greater than the current passing through cell 2.
 C The cation of the solution in cell 1 is different from the cation of the solution in cell 2.
 D The cation in cell 1 is the same as in cell 2 but the solution in cell 1 is more concentrated than in cell 2.

- 27 Gaseous phosphorus pentachloride, PCl_5 , can be decomposed into gaseous phosphorus trichloride and chlorine by heating

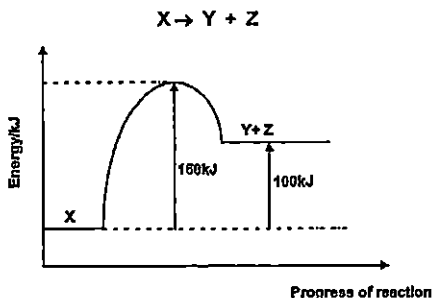


The table below gives the bond energies

Bond	Bond energy (kJ/mol)
P-Cl (in both chlorides)	330
Cl-Cl	240

What is the enthalpy change of the decomposition of phosphorus pentachloride?

- A +90 kJ
 B -90 kJ
 C +420 kJ
 D -420 kJ
- 28 The diagram shows the energy profile for the decomposition of X to form products, Y and Z.

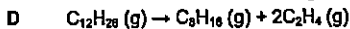


Which statement is correct?

- A The overall enthalpy change is +60kJ
 B The reaction is exothermic
 C The value of 160kJ would decrease in the presence of a catalyst.
 D The value of 100kJ would decrease in the presence of a catalyst.
- 29 Cracking of hydrocarbons is done to obtain smaller molecules

Which of the following cracking reactions carried out at the same temperature and pressure will produce the largest volumes of products from one mole of hydrocarbon?

- A $\text{C}_8\text{H}_{14}(\text{g}) \rightarrow 3\text{C}_2\text{H}_4(\text{g}) + \text{H}_2(\text{g})$
 B $\text{C}_8\text{H}_{18}(\text{g}) \rightarrow 2\text{C}_3\text{H}_6(\text{g}) + \text{C}_2\text{H}_2(\text{g})$
 C $\text{C}_{10}\text{H}_{22}(\text{g}) \rightarrow \text{C}_8\text{H}_{18}(\text{g}) + \text{C}_2\text{H}_4(\text{g})$



- 30 In each of three experiments, a halogen was added to separate solutions containing ions of one of the other two halogens. The table shows the results.

Experiment	Halogen added	Solution of halide		
		U	V	W
1	U ₂	No reaction	No reaction	Reaction occurs
2	V ₂	Reaction occurs	No reaction	Reaction occurs
3	W ₂	No reaction	No reaction	No reaction

What were the halogens U, V and W?

	U	V	W
A	Br ₂	Cl ₂	I ₂
B	Br ₂	I ₂	Cl ₂
C	Cl ₂	Br ₂	I ₂
D	Cl ₂	I ₂	Br ₂

- 31 Petrol and diesel are two common fuels used by cars and buses respectively. The combustion of these fuels produces air pollutants.

The following table shows the mass of pollutants found in the exhaust fume when 1 kg of each fuel is burnt.

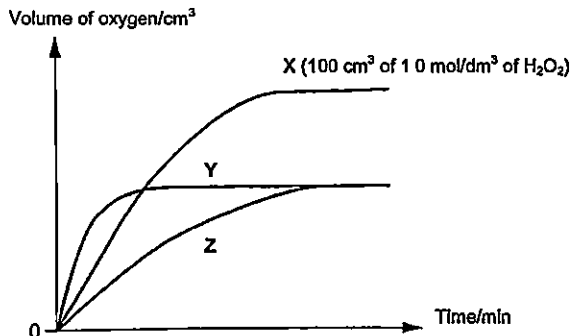
Pollutant	Petrol/g	Diesel/g
carbon monoxide	14	10
oxides of nitrogen	30	60
sulfur dioxide	1	4
unburnt hydrocarbons	15	20

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

- A Petrol contributes more towards the formation of acid rain
- B The temperature in petrol engine is lower than that in diesel engine
- C All the pollutants listed in the table can be removed by installing a catalytic converter
- D Unburnt hydrocarbons are produced by complete combustion of the fuels

- 32 The volume of oxygen produced as hydrogen peroxide decomposes was measured over time

In the first experiment, 100 cm^3 of 1.0 mol/dm^3 of hydrogen peroxide was used. A graph, labelled X, was obtained, as shown in the diagram below.



The experiment was repeated twice with changes in the conditions and graphs Y and Z were obtained.

Which of the following set of changes could possibly produce the results illustrated by graphs Y and Z?

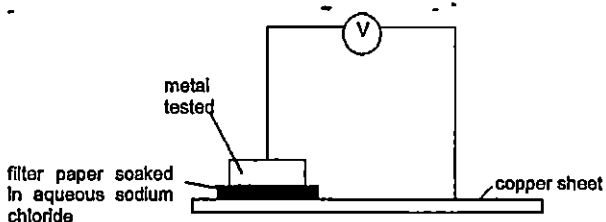
	Graph Y	Graph Z
A	50 cm^3 of 1.5 mol/dm^3 of H_2O_2	150 cm^3 of 0.5 mol/dm^3 of H_2O_2
B	100 cm^3 of 1.5 mol/dm^3 of H_2O_2	50 cm^3 of 0.5 mol/dm^3 of H_2O_2
C	50 cm^3 of 2.0 mol/dm^3 of H_2O_2	100 cm^3 of 0.1 mol/dm^3 of H_2O_2
D	100 cm^3 of 2.0 mol/dm^3 of H_2O_2	50 cm^3 of 0.5 mol/dm^3 of H_2O_2

- 33 Which change would increase the speed of the reaction between 1 mol of two gases?

- A A decrease in surface area of the catalyst
- B A decrease in temperature
- C A decrease in the volume of the reaction flask
- D A decrease in the pressure of the gases

- 34 The reactivity of Group II metals follows a similar trend to that of Group I metals

Four Group II metals, P, Q, R and S were tested in an electric cell as shown in the diagram below



The voltage produced is recorded and shown in the following table

Metal	Voltage/V
P	0.2
Q	0.8
R	0.6
S	0.4

The four metals tested were magnesium, calcium, strontium and barium

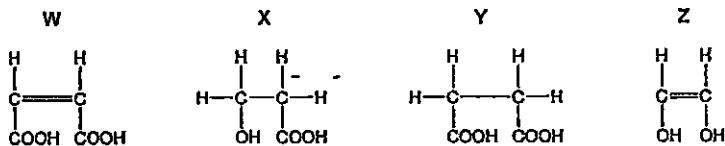
What is a possible identity of metal R?

- A magnesium
 B calcium
 C strontium
 D barium
- 35 Which statements are true about alkenes?

- 1 Their general formula is C_nH_{2n}
- 2 They are saturated
- 3 They react with halogens

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

36 What are the reactions of compounds W, X, Y and Z?



	decolourises aqueous bromine	has a pH of less than 7	condensation polymerisation
A	X and Y	W and Y	W, X, Y and Z
B	X and Y	W and Y	X, Y and Z
C	W and Z	W, X and Y	X, Y and Z
D	W and Z	W, X and Y	W, X, Y and Z

37 Engine oil is used to lubricate the car engine. Certain polymers are added to engine oil to improve its viscosity.

A portion of the chain of one such polymer is shown below

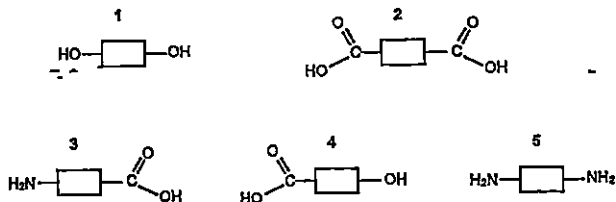


A molecule of this polymer contains 40 carbon atoms.

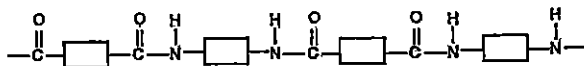
How many molecules of monomer are required to form one molecule of this polymer?

- A 4
 B 5
 C 8
 D 10

- 38 The structures of five monomers are shown below



Which pair of monomers will form a polyamide with the following structure?



- A 1 and 2
 B 2 and 3
 C 2 and 5
 D 4 and 5
- 39 The table shows the composition of four different brands of crude oil namely Arabian Heavy, Arabian Light, Iranian Heavy and North Sea

When each brand of crude oil undergoes fractional distillation, the percentage of each fraction collected is listed in the table below

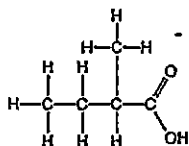
Crude oil / Fraction	Arabian Heavy / %	Arabian Light / %	Iranian Heavy / %	North Sea / %
petrol	18	21	21	23
kerosene	11.5	13	13	15
diesel	18	20	20	24
naphtha	52.5	46	46	38

Which type of crude oil is best for the use in motor vehicle industry?

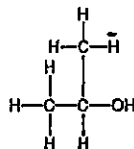
- A Arabian Heavy
 B Arabian Light
 C Iranian Heavy
 D North Sea

40 Esters are formed when an alcohol reacts with a carboxylic acid

Which ester would be formed using the carboxylic acid and alcohol shown?

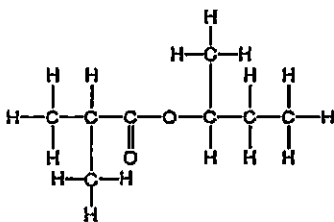


carboxylic acid

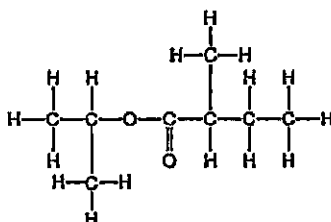


alcohol

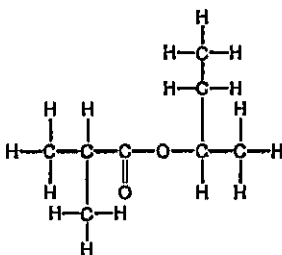
A



B



C



D

