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CHEMISTRY **6092/01**

Paper 1 Multiple Choice [40 Marks]

SEMESTRAL ASSESSMENT ONE
May 2018

Additional Materials
Approved Calculator
OTAS answer sheet
Soft clean eraser
Soft pencil (type B or HB is recommended)

1 hour

INSTRUCTIONS TO CANDIDATES:

Do not start reading the questions until you are told to do so.
Write in soft pencil.

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

Write your name, class, and index number on the OTAS provided.

INFORMATION FOR CANDIDATES

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 **OTAS**.

Read the instructions on the OTAS very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.

Any rough working should be done in this booklet.

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

A copy of the Periodic Table can be found on **page 22**.

This question paper consists of **22** printed pages.

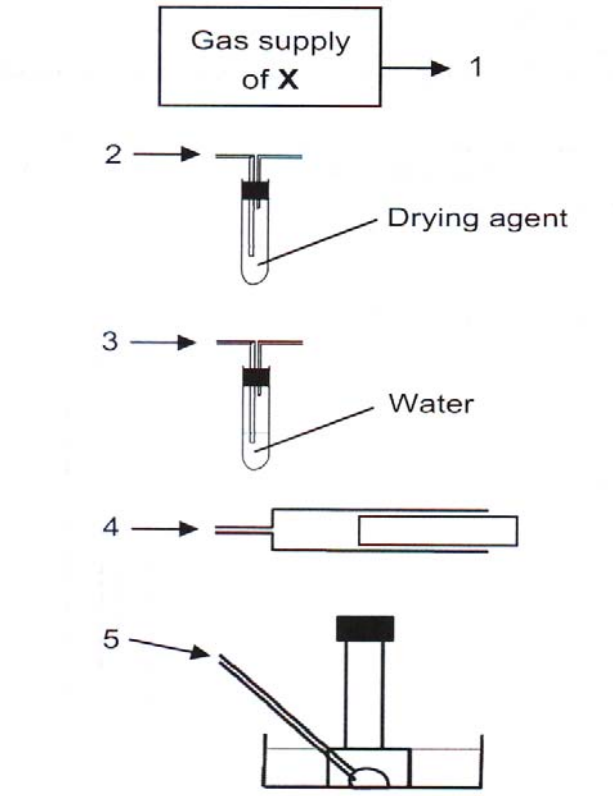
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Paper 1 (40 marks)

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 **OTAS**

1 A gas **X** is insoluble in water and less dense than air. An impure supply of **X** contains water vapour and a water-soluble impurity.



Which of the following order can be used to collect a pure dry sample of gas **X**?

A 1, 2, 3, 4
B 1, 3, 2, 4
C 1, 2, 3, 5
D 1, 3, 2, 5

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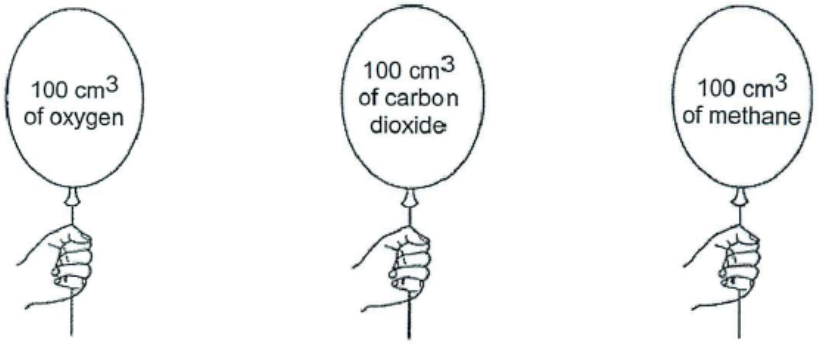
2 The reaction between aqueous iron(II) sulfate and aqueous sodium hydroxide is shown below.

$FeSO_4$ (aq) + 2NaOH (aq) $\rightarrow$ $Fe(OH)_2$ (s) + Na_2SO_4 (aq)
pale green colourless dirty green colourless

Which method could be used to separate the products?

A crystallization
B distillation
C filtration
D separatory funnel

3 The diagram shows three balloons filled with different gases held by students.



Which statements are correct?

1 The number of moles of gases in the 3 balloons is the same.
2 The number of molecules in the 3 balloons is different.
3 The mass of gases in the 3 balloons is different.

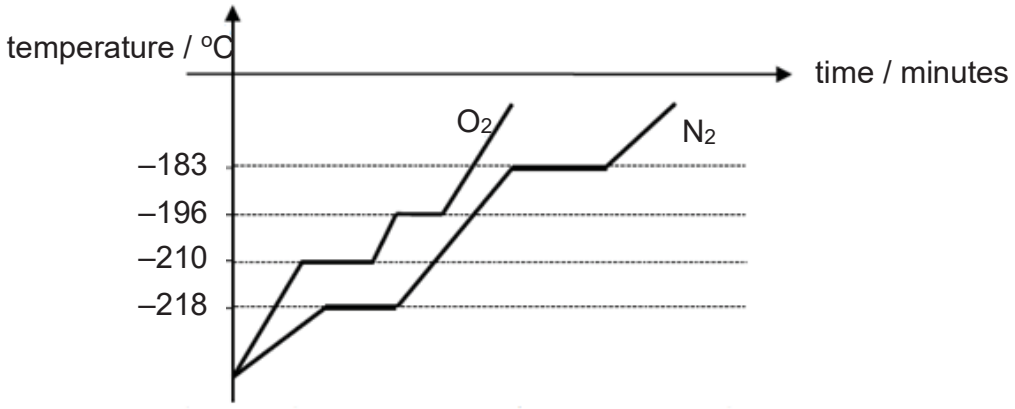
A 1 and 2 only
B 1 and 3 only
C 2 and 3 only
D 1, 2 and 3

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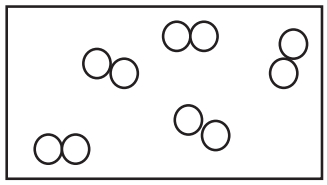
4 The graphs (not drawn to scale) show the heating curves of oxygen and nitrogen over a period of time.



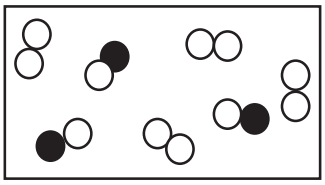
At what temperature will there be two different phases (states) of matter co-existing at the same time, in a mixture of oxygen and nitrogen under room conditions?

A -180 °C
B -195 °C
C -200 °C
D -210 °C

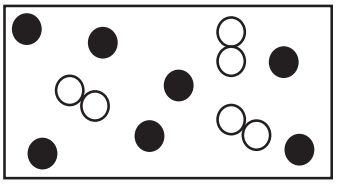
5 Which of the following diagrams shows a pure hydrogen gas?



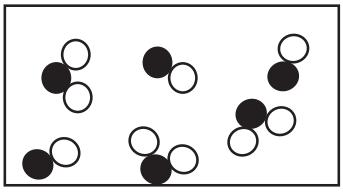
A



B



C



D

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6 An element **X** has two isotopes of 16 and 18. Its relative atomic mass is 16.4. Which statement correctly states the proportion of isotope-16 in the sample?

A 20 %
B 40 %
C 60 %
D 80 %

7 Elements **X**, **Y** and **Z** have consecutive, increasing proton numbers.

If element **X** is a noble gas, what is the symbol for the ion of element **Z** in its compounds?

A Z^{+}
B Z^{2+}
C Z^{2-}
D Z^{3+}

8 Which molecule has the largest number of electrons involved in covalent bonds?

A C_2H_4
B CO_2
C CH_3OH
D N_2

9 Substance **X** has the following properties:

- melting point above 500°C
- insoluble in water
- conducts electricity only when molten.

What would substance **X** be?

A aluminium oxide
B copper
C graphite
D sodium chloride

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10 1.97 g of an unknown metal carbonate, **M**CO_3, reacts completely with 50.0 cm^3 of 0.400 mol/dm^3 hydrochloric acid.

What is the relative atomic mass of **M**?

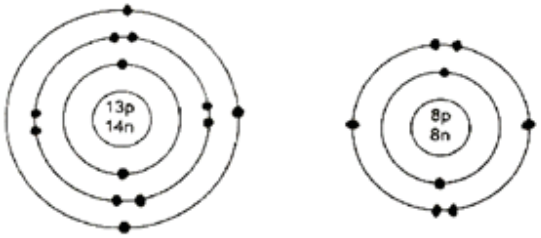
A 35.0
B 94.5
C 137
D 150

11 A metal **Y** forms a sulfate salt with the formula, **Y**SO_4 while a non-metal **Z** forms an ammonium salt with the formula, $(NH_4)_3$**Z**.

What is the formula of the substance formed between **Y** and **Z**?

A **YZ**
B $\mathbf{Y_3Z}$
C $\mathbf{YZ_3}$
D $\mathbf{Y_3Z_2}$

12 The electronic structure of two atoms P and Q are shown.



atom P atom Q

What is the type of chemical bonding and the mass of one mole of compound formed between these two elements?

	type of bonding	mass of one mole of compound / g
A	covalent bonding	70
B	covalent bonding	113
C	ionic bonding	43
D	ionic bonding	102

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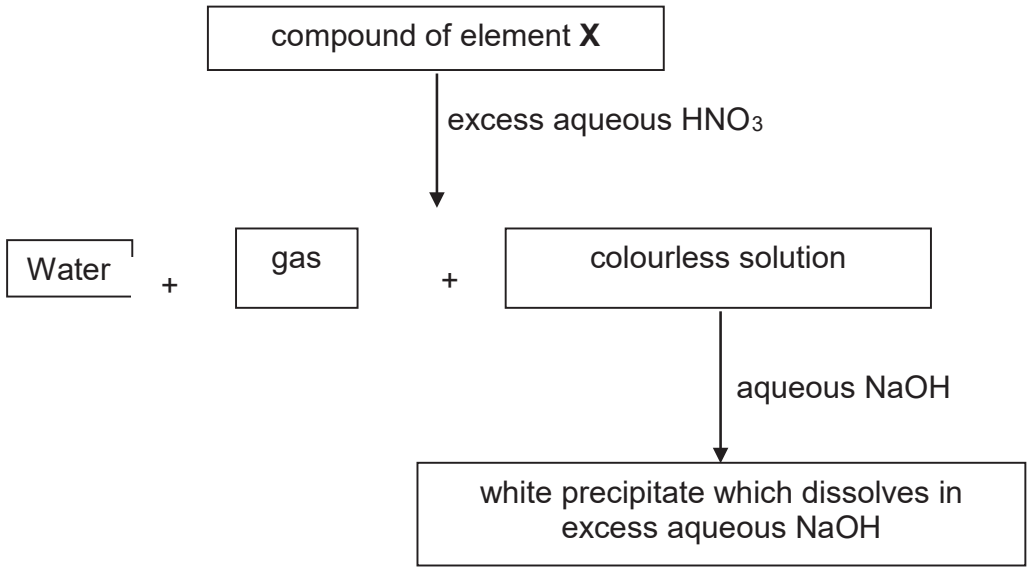
13 Ozone, a gas found in stratosphere, helps to filter the harmful ultraviolet rays from the sun. CFCs from aerosol sprays can cause the ozone layer to decompose as follows:

$$2O_3\ (g) \rightarrow 3O_2\ (g)$$

Which one of the following statements is correct at room temperature and pressure?

A 2 mol of ozone produce 9 x10^{23} oxygen molecules.
B 24 dm^3 of ozone produce 24 dm^3 of oxygen.
C 48 dm^3 of ozone produces 32 g of oxygen.
D 48 g of ozone produce 48 g of oxygen.

14 The scheme below shows some reactions of a compound of element **X**.



What could the compound of element ***X*** have been?

A aluminium sulfate
B calcium sulfate
C copper(II) carbonate
D lead(II) carbonate

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15 Chlorine gas is a severe irritant to the eyes and respiratory system. The maximum safe toleration level of chlorine gas is 0.005 mg/dm^3.

How many molecules of chlorine gas are present in 1 dm^3 of air at this toleration level?

A $\frac{0.005}{6\times10^{23}}\times71$

B $\frac{0.005}{1000}\times\frac{1}{71}\times6\times10^{23}$

C $\frac{0.005}{71}\times6\times10^{23}$

D $\frac{0.005}{1000}\times71\times6\times10^{23}$

16 The equation for the reduction of iron ore in the blast furnace is shown below.

Fe_2O_3 (s) + 3CO (g) → 2Fe (*l*) + $3CO_2$ (g)

When 20 tonnes of the iron ore were reduced, 7 tonnes of molten iron were produced.

What is the percentage yield of this reduction?

A 17.5 %
B 54 %
C 50 %
D 70 %

17 Which of the following reactions is **NOT** a redox reaction?

A KI + Br_2 → KBr + I_2

B CuO + H_2SO_4 → $CuSO_4$ + H_2O

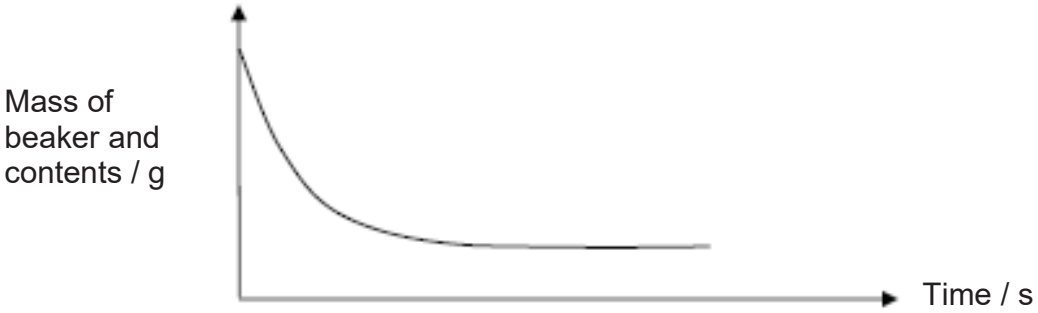
C Mg + 2HC*l* → Mg$C*l*_2$ + H_2

D N_2 + $3H_2$ → $2NH_3$

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18 Two solutions were mixed in a beaker and the mass of the beaker and contents was then recorded at various times. The graph shows the results.



What could the two solutions be?

A aqueous ammonia and aqueous iron(II) nitrate
B dilute hydrochloric acid and aqueous potassium hydroxide
C dilute nitric acid and solid copper(II) carbonate
D dilute sulfuric acid and aqueous barium nitrate

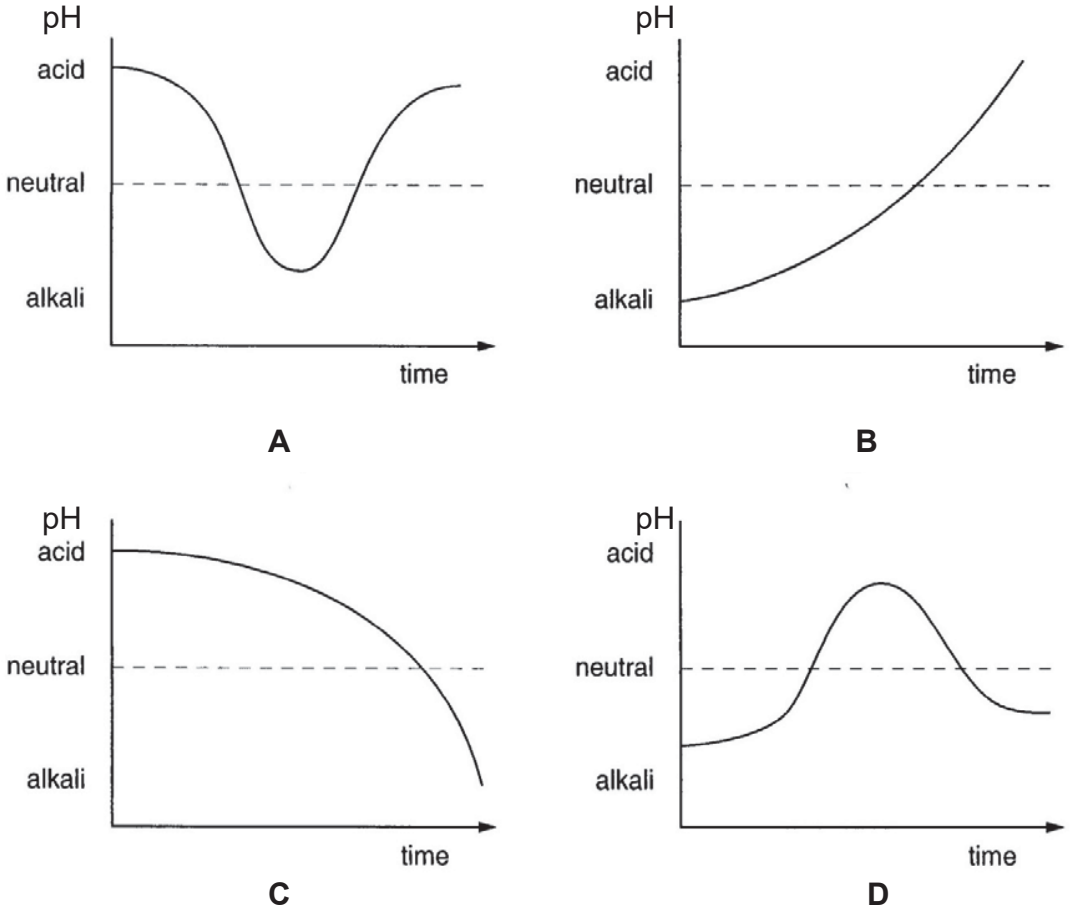
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19 The mouth contains saliva which is a weak alkali. When sweets containing sugar are eaten, bacteria in the mouth change the sugar into acids.

Which graph best shows how the acidity in the mouth changes during and after the eating of sweets?



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20 Solid **Z** was dissolved in dilute sulfuric acid to give a colourless solution and a gas that combusts with a blue flame. When aqueous ammonia solution was added to the colourless solution, a white precipitate was obtained, which dissolved in excess aqueous ammonia. The same colourless solution gave a white precipitate with barium nitrate solution.

What is the identity of solid **Z**?

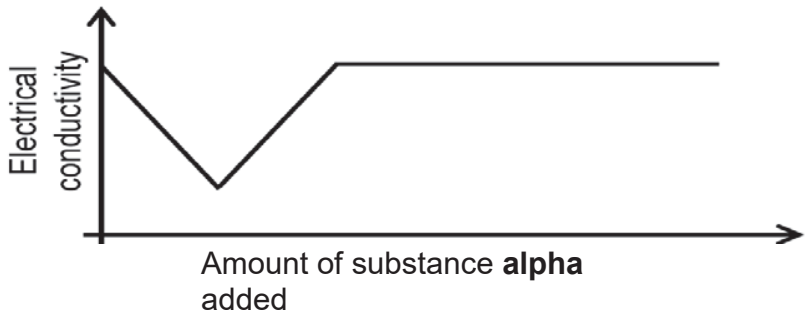
A calcium metal
B zinc metal
C calcium chloride
D zinc sulfate

21 The presence of ethanol vapour in the breath of a person who has very recently consumed alcohol can be detected using a filter paper moistened with acidified potassium dichromate(VI).

If ethanol vapour is present, orange potassium dichromate(VI) spot will turn green. What does this suggest about the property of ethanol?

A Ethanol acts as an indicator.
B Ethanol acts as a drying agent.
C Ethanol is a reducing agent.
D Ethanol is an oxidising agent.

22 A substance alpha is added to lead(II) nitrate solution. The change of conductivity is plotted as shown below.



What could substance alpha be?

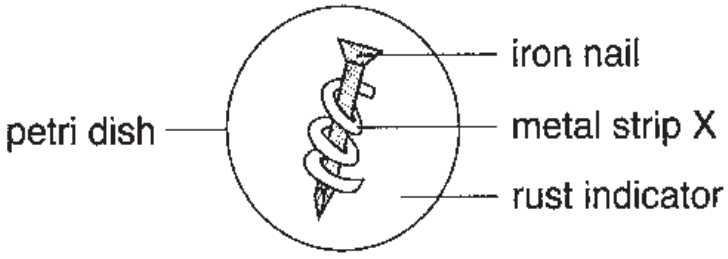
A potassium
B potassium iodide solution
C potassium manganate(VII) solution
D potassium nitrate solution

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23 Consider the following set-up.



The rust indicator will turn blue in the presence of rust.

Some statements concerning the experiment are given below.

(I) If **X** is copper, the iron nail will not corrode readily.
(II) If **X** is iron, the iron nail will not corrode readily.
(III) If **X** is silver, a blue colour is observed around the iron nail.

Which of the following statements is/are correct?

A (I) only
B (III) only
C (I) and (II) only
D (II) and (III) only

24 During the electrolysis of an aqueous solution of a *cerium* salt, 70 g of *cerium* (Ar = 140) is deposited at the cathode by 1 mole of electron.

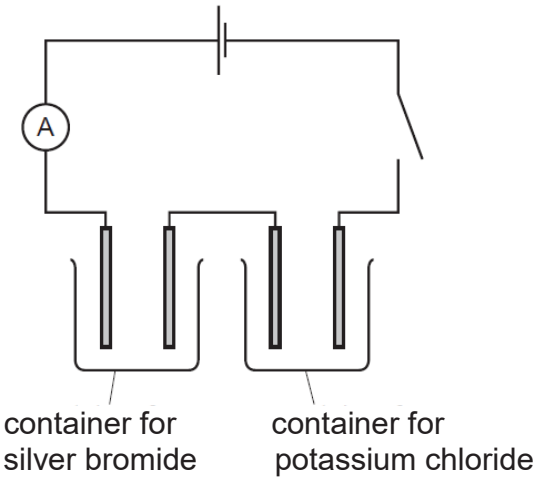
What is the formula of the cerium ion?

A Ce^{+}
B Ce^{2+}
C Ce^{3+}
D Ce^{4+}

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25 The diagram shows the circuit for electrolysing silver bromide and potassium chloride to produce the metal.



To produce a metal, what form must these salts be?

	silver bromide	potassium chloride
A	concentrated solution	molten
B	dilute solution	concentrated solution
C	molten	molten
D	molten	molten

26 Many properties of an element and its compounds can be predicted from the position of the element in the Periodic Table.

What property could **not** be predicted in this way?

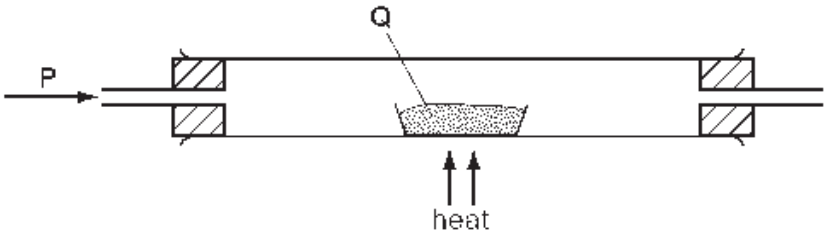
A the formula of its oxide
B the nature of its oxide
C the number of isotopes it has
D the number of electron shells of its atom

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27 In the apparatus shown, gas **P** is passed over solid **Q**.



Which of the following identities of **P** and **Q** would **not** result in a reaction?

	P	Q
A	carbon monoxide	copper (II) oxide
B	carbon monoxide	lead (II) oxide
C	hydrogen	iron (III) oxide
D	hydrogen	zinc oxide

28 Three elements **X**, **Y** and **Z** belong to the same period in the Periodic Table. The properties of their oxides are given below.

oxide of **X:**	soluble in both nitric acid and aqueous sodium hydroxide
oxide of **Y:**	insoluble in water and aqueous sodium hydroxide but dissolves readily in nitric acid
oxide of **Z:**	changes acidified potassium manganate(VII) from purple to colourless

Based on the statements above, arrange **X**, **Y** and **Z** in order of decreasing atomic number in the Periodic Table.

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

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29 A hand warmer bag purchased by skiers consists of powdered iron, water, salt and sawdust. When the bag is shaken, it becomes hot because the following reaction occurs.

$$4Fe\,(s) + 3O_2\,(g) \rightarrow 2Fe_2O_3\,(s) \qquad \Delta H = -823\ kJ/mol$$

Which statement is **not** true about the reaction above?

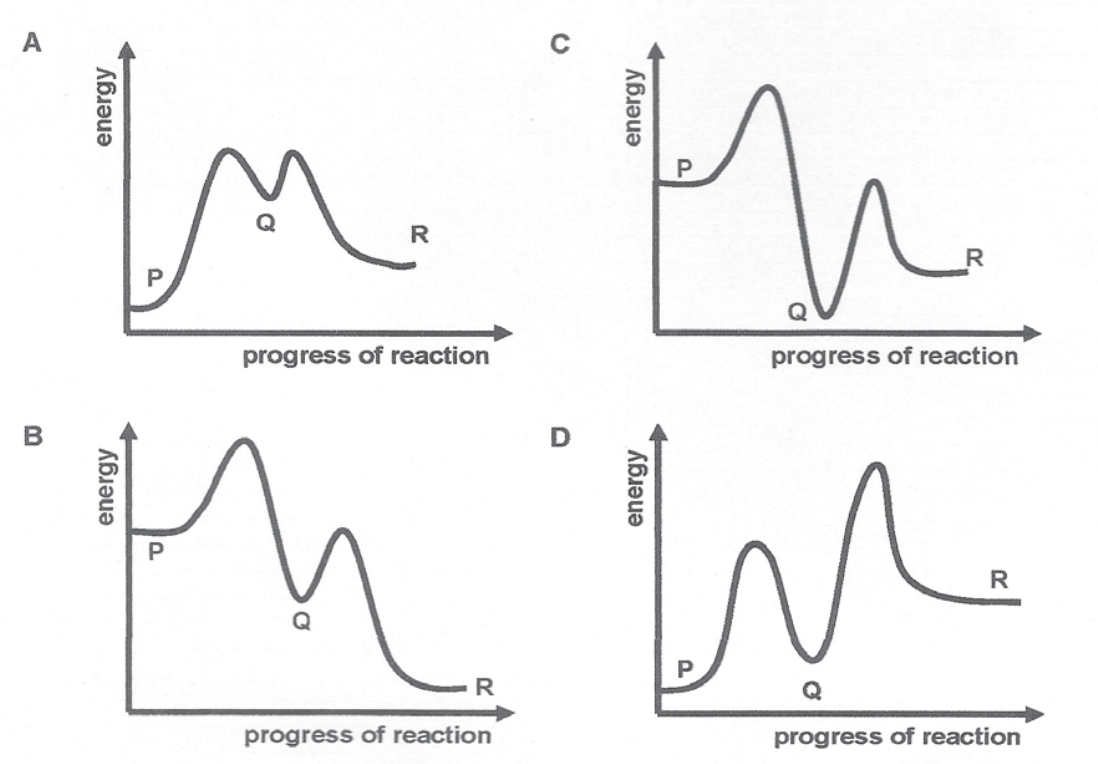
A The energy change involved in bond-forming is more than that in bond-breaking.
B The energy level of products is lower than that of the reactants.
C The energy level of reactants is lower than that of the products.
D The temperature of the reaction mixture increases.

30 In the conversion of compound P into compound R, it was found that the reaction proceeded by way of compound Q, which could be isolated.

The steps involve were:

P → Q ΔH = negative
Q → R ΔH = positive

Which one of the following reaction profiles agrees with this data?

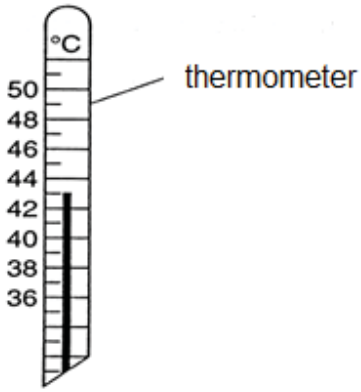


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31 A thermometer is placed in water and the temperature measured is shown.



An endothermic change takes place as a solid is dissolved in the water. The temperature change is 4.5 °C.

What would be the temperature reading immediately after the reaction?

A 38.0 °C
B 38.5 °C
C 47.0 °C
D 47.5 °C

32 A sample of hydrogen peroxide is decomposed by a metal oxide catalyst.

$2H_2O_2$ (aq) → O_2(g) + $2H_2O$(*l*)

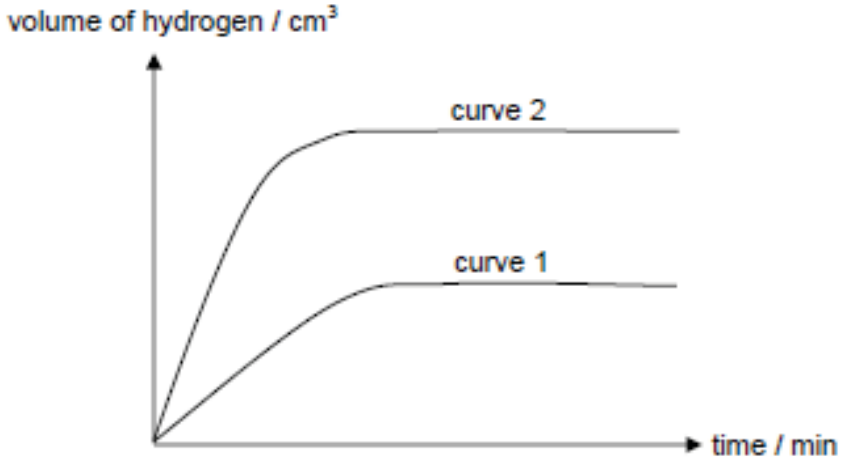
What will become larger if the experiment is repeated using a better catalyst?

A The total volume of gas produced at the end of the reaction.
B The amount of hydrogen peroxide left over at the end of the reaction.
C The initial gradient of a graph of total volume of gas produced against time.
D The time needed to produce a particular volume of gas.

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33 In the graph below, curve 1 was obtained when 25.0 cm^3 of 1.0 mol/dm^3 of dilute hydrochloric acid is reacted with an excess of magnesium ribbons at 30 °C.



Which of the following changes would result in curve 2?

A adding a catalyst to the reaction
B heating the acid to a higher temperature
C using 25.0 cm^3 of 2.0 mol/dm^3 of dilute hydrochloric acid
D using finely powdered magnesium metal of the same mass

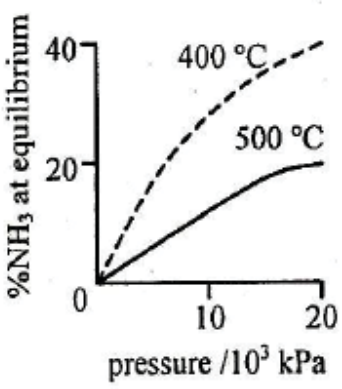
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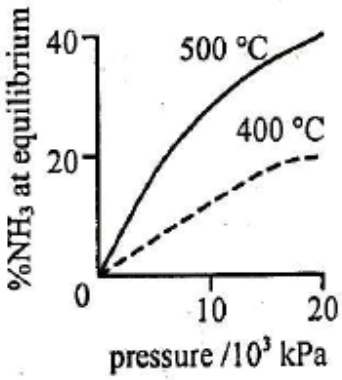
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34 The percentage of ammonia obtained at equilibrium in the Haber Process is plotted against pressure for two temperatures, 400 °C and 500 °C.

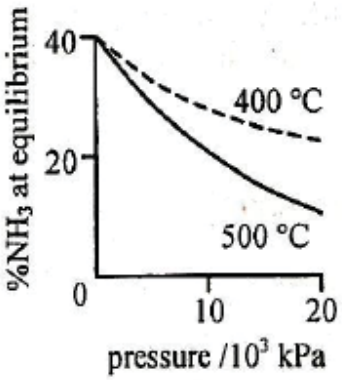
Which of the following correctly represents the two graphs obtained?



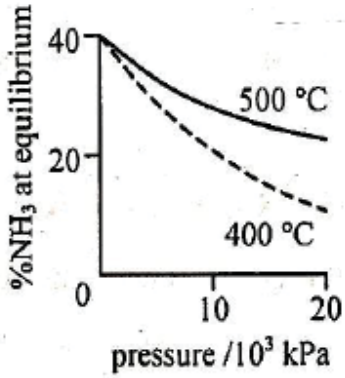
A



B



C



D

35 Which statement about the properties of ammonia is correct?

A It decomposes on heating at high temperature to form nitrogen gas and hydrogen gas.
B It dissolves in water to form an acidic solution.
C It is formed by heating ammonium salts with sulfuric acid.
D It reacts with alkalis to form salts.

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36 The table shows the boiling points of four fractions when crude oil is distilled.

fraction	W	X	Y	Z
boiling point /°C	35 – 75	80 – 145	150 – 250	greater than 250

Which statement regarding the fractions is true ?

A Fraction W is more flammable than fraction Y.
B Fraction W is more viscous than fraction Z
C The density of fraction X is greater than that of fraction Z.
D The molecules in X have a longer chain length than those in fraction Z.

37 Which of the following statements about air are true?

I Clean air has a lower density than carbon dioxide.
II Clean air has a constant composition of oxygen and water vapour.
III Clean air contains mainly argon.
IV Clean air is a mixture of elements and compounds.

A **I** and **III** only
B **I, II** and **III** only
C **I**, **III** and **IV** only
D all of the above

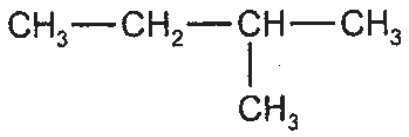
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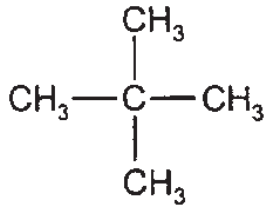
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38 Which structure is not an isomer of the structure shown?

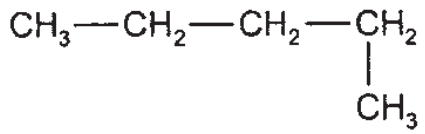
A



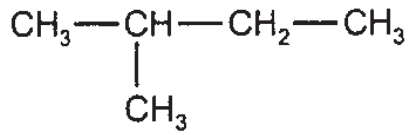
B



C



D



39 Some unsaturated compounds contain more than one carbon-carbon double bond. An example is the compound with the formula $C_{21}H_{26}$.

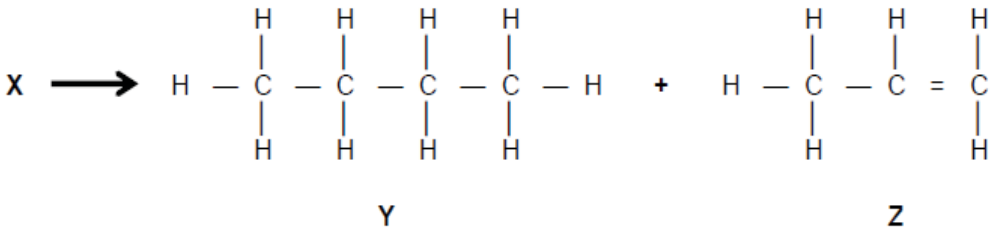
How many carbon-carbon double bonds are present in one molecule of this compound?

A 3
B 5
C 8
D 9

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40 A chemist carried out a cracking reaction on a hydrocarbon, **X** and obtained two products, **Y** and **Z**.



The chemist then wrote the following statements in his notebook.

(1) A molecule of **X** has 7 carbon atoms.
(2) **Y** is unsaturated.
(3) **Z** will decolourise bromine water.

Which statement(s) is/are correct?

A (3) only
B (1) and (2)
C (1) and (3)
D (1), (2) and (3)

- - - End of Paper 1 - - -

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The Periodic Table of Elements

Group																	
I	II											III	IV	V	VI	VII	0
							1 H hydrogen 1										2 He helium 4
3 Li lithium 7	4 Be beryllium 9		Key proton (atomic) number atomic symbol name relative atomic mass									5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20
11 Na sodium 23	12 Mg magnesium 24											13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40
19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium -	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131
55 Cs caesium 133	56 Ba barium 137	57 – 71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium –	85 At astatine –	86 Rn radon –
87 Fr francium –	88 Ra radium –	89 – 103 actinoids	104 Rf Rutherfordium –	105 Db dubnium –	106 Sg seaborgium –	107 Bh bohrium –	108 Hs hassium –	109 Mt meitnerium –	110 Ds darmstadtium –	111 Rg roentgenium –	112 Cn copernicium –		114 Fl flerovium –		116 Lv livermorium –		

lanthanoids	57 La lanthanum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium –	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175
actinoids	89 Ac actinium –	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	93 Np neptunium –	94 Pu plutonium –	95 Am americium –	96 Cm curium –	97 Bk berkelium –	98 Cf californium –	99 Es einsteinium –	100 Fm fermium –	101 Md mendelevium –	102 No nobelium –	103 Lr lawrencium –

The volume of one mole of any gas is 24 dm^3 at room temperature and pressure (r.t.p.).

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4EX

CHEMISTRY **6092/02**

Paper 2 [80 Marks]

SEMESTRAL ASSESSMENT ONE
May 2018

Additional Materials
Approved Calculator

1 hr 45 mins

INSTRUCTIONS TO CANDIDATES:

Do not open this booklet until you are told to do so.
Write your name, index number and class in the spaces at the top of this page and on any separate answer paper used.
Write in dark blue or black pen on both sides of the paper.
You may use a soft pencil for any diagrams, graphs, tables or rough working.
Do not use staples, paper clips, highlighters, glue or correction fluid.

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

Section B
Answer **all** three questions, the last question is in the form of either/or.
Write your answers in the spaces provided.

FOR EXAMINER'S USE		
Section		**Marks**
MCQ (P1)		**/ 40**
A		**/ 50**
B	**Q 7**	**/ 10**
	Q 8	**/ 10**
	Q 9	**/ 10**
Total		**/ 120**

INFORMATION FOR CANDIDATES

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

A copy of the Periodic Table can be found on **page 23.**
At the end of the examination, fasten all your work securely together.

Candidates are advised to show all their working in a clear and orderly manner, as more marks are awarded for sound use of chemistry than for correct answers.

This question paper consists of **23** printed pages.

Setter: Mr Mohamad Gaddafi Annuar | Vetter: Mdm Jarina

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Section A [50 Marks]
Answer ALL questions in the spaces provided.

A1 Name the following chemical processes.

	reaction	name of process
(i)	$SiO_2 + 2NaOH \rightarrow Na_2SiO_3 + H_2O$	
(ii)	$H_2SO_4 + CaCl_2 \rightarrow 2HCl + CaSO_4$	
(iii)	$Fe^{2+} \rightarrow Fe^{3+} + e^-$	
(iv)	$MgBr_2 + F_2 \rightarrow MgF_2 + Br_2$	
(v)	$CuCO_3 \rightarrow CuO + CO_2$	

[5]

[Total: 5 marks]

A2 This question concerns the chemistry of carbon and silicon, elements from Group IV of the Periodic Table.
Table 2.1 provides some information on two different forms of carbon (allotropes) and silicon:

Table 2.1

Substance	Melting point / °C	Electrical conductivity	Uses
Carbon allotrope **A**	Above 3000	Poor	Cutting tools, drill bits
Carbon allotrope **B**	Above 3000	Good	Lubricant
Silicon	1414	Good	Semiconductors in electronics

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(a) Carbon tends to form covalent compounds.

By drawing the dot-and-cross diagram of a carbon compound of your choice, describe how a covalent bond is formed. You only need to show valence electrons.

……...

……...

……...

……..[3]

(b) Explain, in terms of structure and bonding, why carbon allotrope **A** can be used as a drill bit while carbon allotrope **B** can be used as a lubricant.

……...

……...

……...

……..[2]

(c) Carbon is commonly used as a reducing agent. For example, it can reduce zinc oxide to form zinc.

Explain, using oxidation states, how carbon is acting as a reducing agent in the reduction of zinc oxide.

……...

……...

……..[1]

[Total: 6 marks]

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A3 Table 3.1 shows the results of some of the chemical reactions of **four** unknown metals.

Table 3.1

Metals	Thermal decomposition of metal carbonates	Reaction of metal with cold water
A	Greenish-blue solid turns black. White precipitate formed when gas produced is being passed through limewater	No reaction
B	White solid remains. No gas was produced.	Very vigorous reaction
C	White solid turns yellow, turns back to white after when cooled. White precipitate formed when gas produced is being passed through limewater	No reaction
D	White solid remains white. White precipitate formed when gas produced is being passed through limewater	Little bubbles formed on the surface of the metal.

(a) Arrange the metals in ascending order of their chemical reactivity.

…….[1]

(b) Metal **A** and **D** are placed into two separate beakers of iron(III) sulfate solution. Describe the observations you will see in each beaker.

……...

……...

……..[3]

(c) Pure iron can be extracted using the Blast furnace in the presence of carbon monoxide.

(i) Write a balanced equation for the reaction mentioned above.

……..[1]

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(ii) State and explain if the reaction written in **(ci)** is a redox reaction.

……...

……..[1]

(d) Iron oxidises to form iron(III) oxide, which is a reddish-brown deposit commonly known as rust.

Using your knowledge of the reactivity series of metals, describe and explain how rusting of iron can be prevented.

…….....

…….....

……..[2]

[Total: 8 marks]

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A4 A student carried out a series of experiments to determine the rate of reaction between excess zinc and dilute hydrochloric acid (HC*l*) by measuring the volume of gas produced per unit time.

In Experiment **1** (conducted at 25 °C), he used 5 g of zinc granules and 30 cm^3 of 0.5 mol/dm^3 dilute hydrochloric acid.

The experiments were repeated two more times, with different variables.

Experiment **2**: 5 g of zinc powder and 30 cm^3 of 0.5 mol/dm^3 of HC*l*, 25 °C
Experiment **3**: 5 g of zinc granules and **y** cm^3 of **z** mol/dm^3 of HC*l*, 25 °C

Fig 4.1 shows the volume of gas produced over time.

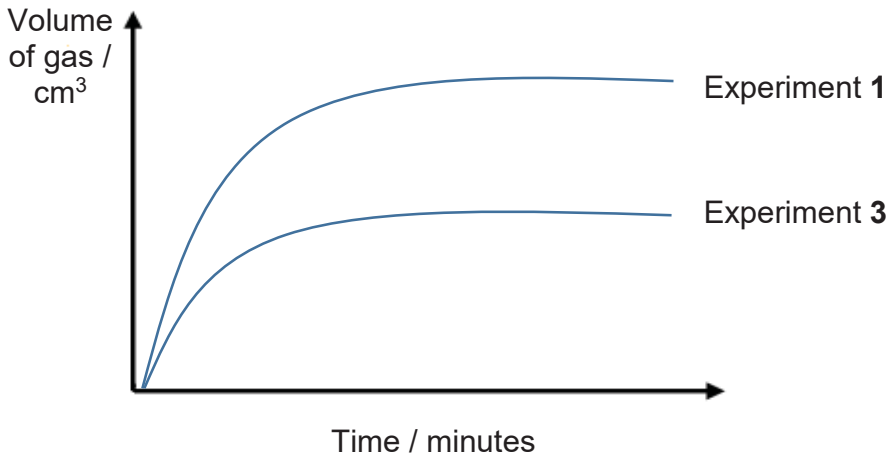
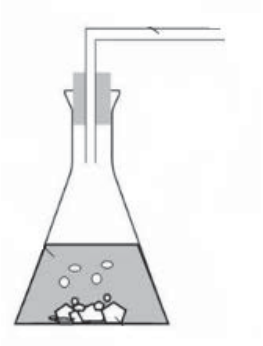


Fig 4.1

(a) Complete the diagram below with the appropriate apparatus used in the experiment.



[1]

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(b) Write a balanced equation for the reaction between zinc and dilute hydrochloric acid.

……..[1]

(c) On **Fig 4.1** sketch and label the graph for Experiment **2**.

[1]

(d) Taking reference from the Fig 4.1, suggest appropriate values for **y** and **z** for Experiment 3.

y = …… cm^3

z = ……... mol/dm^3

[2]

(e) The student repeated the experiment at 50 ^oC. Explain in terms of energy and particle collisions how an increase in temperature increases the rate of a reaction.

……...

……...

……...

……...

……..[3]

[Total: 8 marks]

A5 The table shows some information about a homologous series of organic compounds called ketones.

name	number of carbon atoms	formula
propanone	3	CH_3COCH_3
butanone	4	$C_2H_5COCH_3$
pentanone	5	$C_3H_7COCH_3$

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(a) Deduce the name and formula of the ketone that contains 6 carbon atoms.

name ……

formula ……

[2]

(b) From **(a)**, deduce the general formula for ketones.

……..[1]

(c) The oxygen atom in a ketone forms a double bond with a carbon atom.

Draw the full structural formula of butanone.

[1]

(d) Separate samples of propanone and propene were placed in separate test tubes and each shaken with bromine water.

Predict what will be seen in each test tube after shaken with bromine water.

……...

……...

……..[2]

[Total: 6 marks]

A6 Ozone is considered a pollutant at ground level but is important in the stratosphere.

(a) Explain why the ozone layer is important to us.

……..[1]

(b) Explain why ozone is considered as a pollutant at ground level.

……...

……..[1]

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(c) Ozone is destroyed when chlorine atoms from CFCs attack the ozone molecules.

$$2Cl + O_3 \rightarrow Cl_2O + O_2$$

Explain, in terms of oxidation states which element is oxidised.

……...

……...

……..[2]

(d) Nitrogen dioxide can also contribute to the depletion of the ozone layer and must be removed.

(i) Besides breathing issues, describe **one** other harmful effect of nitrogen dioxide.

……...

……..[1]

(ii) Write an equation to show how nitrogen dioxide can be removed in the catalytic converter.

……..[1]

[Total: 6 marks]

A7 Table 7.1 shows the enthalpy of combustion of three fuels.

fuel	enthalpy change of combustion (kJ/mol)
ethanol	- 1370
hydrogen	- 256
octane	- 5510

combustion of ethanol: $C_2H_5OH + 3O_2 \rightarrow 2CO_2 + 3H_2O$

(a) Use ideas about breaking and forming bonds to explain why the enthalpy change for combustion of ethanol is negative.

……...

……..[2]

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(b) Octane also undergoes combustion to produce carbon dioxide. The equation for the combustion of octane is given below.

$$2C_8H_{18} + 25O_2 \rightarrow 16CO_2 + 18H_2O$$

Calculate the volume of carbon dioxide that will be produced when ethanol undergoes combustion to produce 100 kJ of energy.

[2]

(c) Explain why the combustion of hydrogen is considered a 'cleaner' alternative as compared to octane and ethanol.

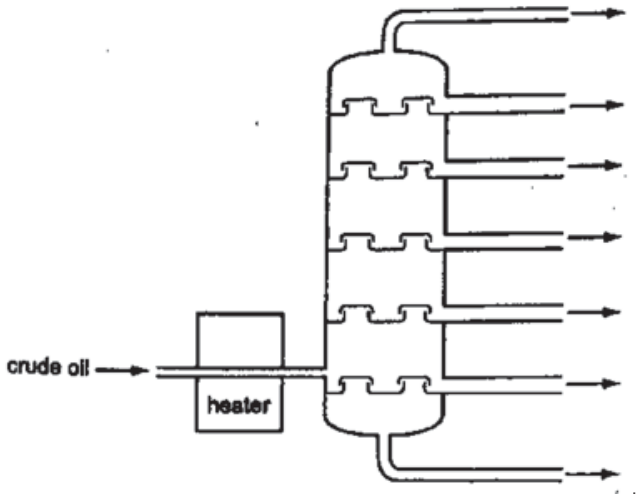
……...

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……..[2]

[Total: 6 marks]

A8 The diagram below shows how petroleum can be refined.



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(a) Briefly describe how fractions can be separated through the fractional distillation of crude oil.

……...

……...

……...

……...

……...

……..[3]

(b) The flow chart below shows how a sweet smelling compound **Y** can be formed from petroleum (crude oil).



(i) Explain why Stage **A** is an important process in the energy industry.

……...

……...

……..[1]

(ii) A long chain alkane, $C_{12}H_{26}$, undergoes Stage **A** to form ethene, butane and an unsaturated compound **Z**.

Draw the structure of compound Z in the space given below.

[1]

[Total: 5 marks]

---End of Section A---

[Turn Over

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Section B [30 Marks]

Answer **all** questions. **Question B11** has a choice of section to answer. Write your answers on the spaces provided.

B9 Fig 9.1 shows the set-up for the electrolysis of a chloride solution containing two metal ions, copper(II) and iron(II).

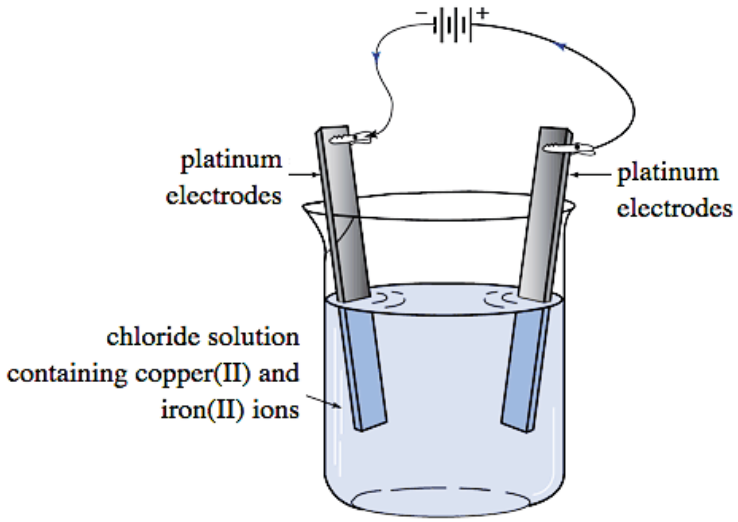


Fig 9.1

An electric current was passed through the cell for a period of time.
The observations at different stages were recorded in the table.

Table 9.2

stage	observations
stage 1 – after 10 mins	A yellowish-green gas is observed at one of the electrodes while a brown solid is deposited at the other electrode. There was no visible change to the electrolyte.
stage 2 – after 1 hour	The same observations in stage 1 at the anode and cathode. The electrolyte became pale green.
stage 3 – after 2 hours	Colourless gases are both evolved at the anode and cathode. The pale green of the electrolyte becomes more visible.

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(a) **(i)** Write the equations for the reactions taking place at the respective electrodes in stage 1.

……...

……..[2]

(ii) The total mass of the brown solid deposited was 0.584 g.

Calculate the volume of the yellowish-green gas produced at the other electrode.

[2]

(b) Explain why the electrolyte becomes pale green in stage 2 and then darker in stage 3.

……...

……...

……...

……..[2]

(c) A few drops of Universal Indicator were added **at the cathode** in stage 3.

State and explain the result of the test.

……...

……...

……...

……..[2]

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(d) A total of three different substances were produced at the cathode throughout the whole electrolysis process.

Identify and list the three substances in order of which they are produced. Explain your answer.

……...

……...

……...

……..[2]

[Total: 10 marks]

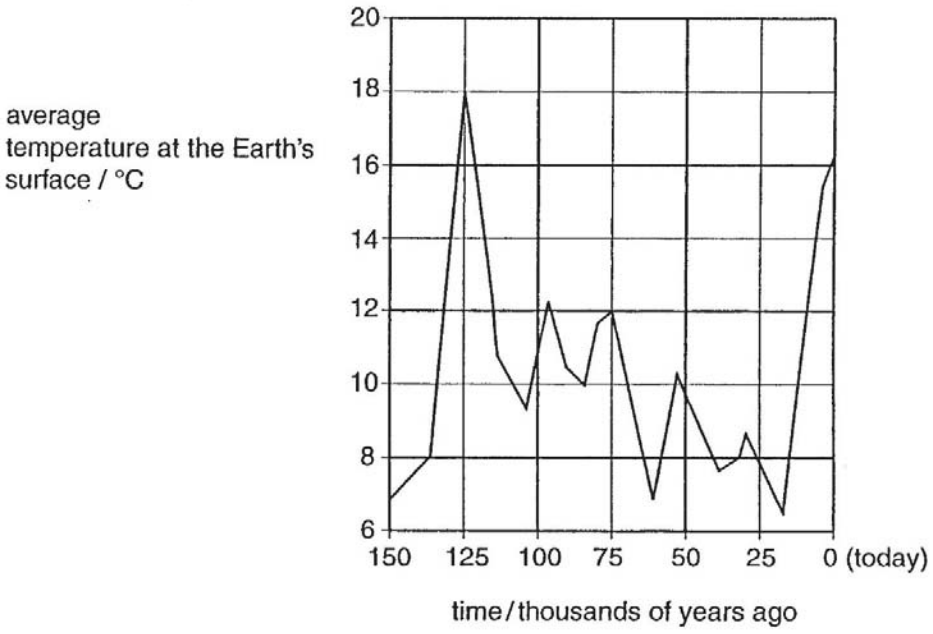
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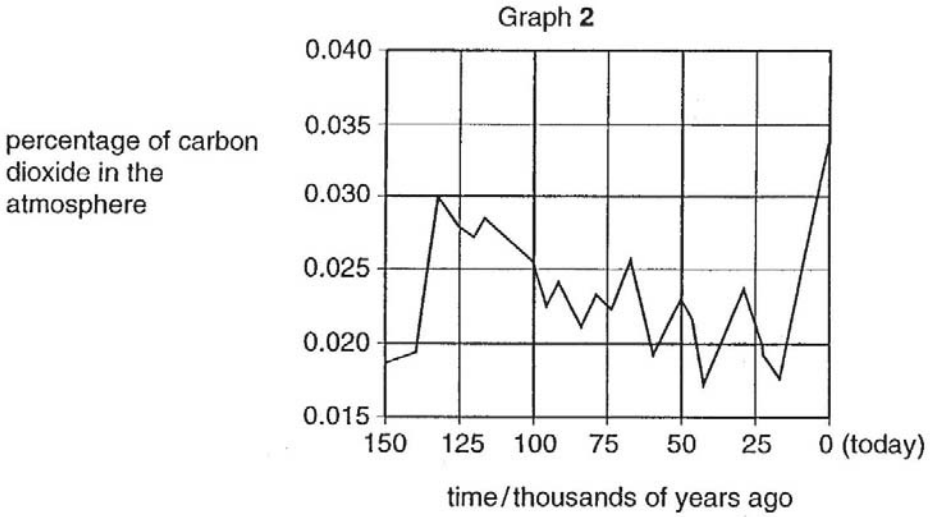
B10 Graph 1 shows how the average temperature of the Earth's surface may have changed over the last 150 thousand years.

Graph 2 shows how the percentage of carbon dioxide in the atmosphere may have changed over the last 150 thousand years.

Graph **1**



Graph **2**



[Turn Over

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(a) Describe and explain the relationship between graph 1 and graph 2.

……...

……...

……...

……..[2]

(b) State **two** consequences as a result of the changes in temperature levels shown in graph 1?

……...

……...

……...

……..[2]

(c) Explain how the carbon cycle regulates the level of carbon dioxide in the atmosphere.

……...

……...

……...

……..[2]

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(d) Two most polluting emissions from cars are nitrogen monoxide and carbon monoxide. The actual concentration of each of these components depends on the mode of operation of the vehicle and the proportion of air present in the fuel mixture that is used.

Some typical figures are given in the table [ppm = parts per million].

mode of operation	**proportion of air present in fuel mixture**	**nitrogen monoxide emissions / ppm**	**carbon monoxide emissions / ppm**
idling engine	high	14	2000
Accelerating engine	high	3700	1000
idling engine	low	10	8000
accelerating engine	low	1000	5000

(i) Suggest why

(1) the concentration of nitrogen monoxide is high when the engine is in the accelerating mode; and

(2) the concentration of carbon monoxide is low when the proportion of air present in the fuel mixture is high.

……...

……...

……...

……...

……...

……..[2]

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(ii) Catalytic converters help reduce pollution by converting pollutants to non-polluting products.

The equation shows a typical reaction in a catalytic converter.

$$NO + CO \rightarrow$$

Complete and balance the equation. Explain why this equation represents a redox reaction.

……...

……...

……..[2]

[Total: 10 marks]

EITHER

B11 (a) Citric acid is a white crystalline powder with formula $C_5H_7O_5COOH$
Two samples of 0.1 mol/dm^3 citric acid was prepared, one in water and the other in propanol. It was noticed that when the acid dissolved in water, the solution felt cold.

Dissociation of citric acid in water: $C_5H_7O_5COOH \rightarrow C_5H_7O_5COO^- + H^+$

A piece of magnesium ribbon was added to each of the two solutions. The results are summarised in Table 11.1

Table 11.1

solution	action on magnesium ribbon
citric acid in water	slow but steady formation of gas bubbles
citric acid in propanol	no reaction

(i) What type of energy change takes place when citric acid was dissolved in water?

……..[1]

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(ii) Explain the **observations** for the reaction between a solution of citric acid in water and magnesium.

……...

……...

……..[2]

(iii) Write a balanced chemical equation to show the reaction between magnesium and citric acid in water.

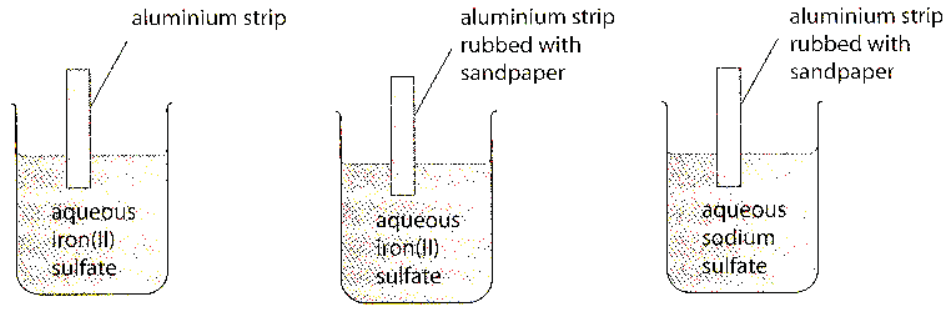
……..[1]

(iv) Explain why there was no reaction between magnesium and a solution of citric acid in propanol.

……...

……..[1]

(b) Fig 11.2 shows three experiments involving aluminium that were set up in the laboratory.



Experiment 1 **Experiment 2** **Experiment 3**

Fig 11.2

(i) Explain why a reaction occurred in Experiment **2** but not in **1**.

……...

……...

……...

……..[3]

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(ii) State and explain the observation(s) if any, that will be seen in Experiment **3**.

……...

……...

……..[2]

[Total: 10 marks]

OR

B11 **(a)** The information in Fig 11.3 is about the elements in Period **3** of the Periodic Table.

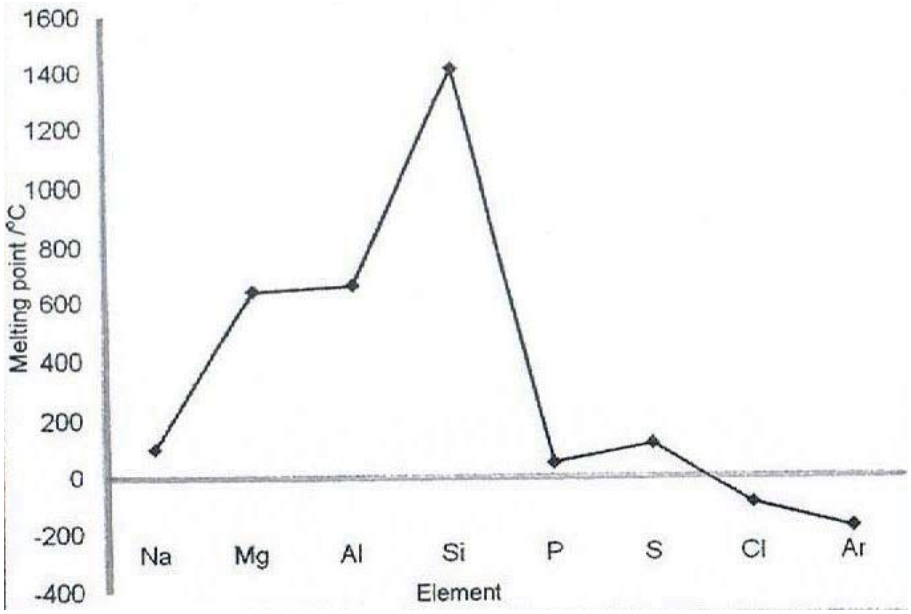


Fig 11.3

(i) Describe the general trends in melting point across Period **3**.

……...

……...

……...

……...

……..[3]

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(ii) How does the data show that the first four elements in Period **3** are solids at room temperature and pressure?

……...

……..[1]

(b) Silicon has a structure similar to that of diamond. Explain in terms of structure and bonding why silicon has such a high melting point in Period **3**.

……...

……...

……...

……..[2]

(c) Sketch a graph to show how proton number changes across Period **3**.

[1]

(d) Fluorine, chlorine, bromine and iodine are halogens found in Group VII of the Periodic Table. Table 11.4 lists the bond lengths and average bond energies of the halogens.

Table 11.4

covalent bond	bond length/ nm (1nm = 10^{-9}m)	average bond energy (kJ/mol)
F – F	0.142	158
C*l* – C*l*	0.199	242
Br – Br	0.228	193
I – I	0.267	151

[Turn Over

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(i) Describe the **general** relationship between bond length and the average bond energy within Group VII molecules.

……...

……..[1]

(ii) A student made the following comment about the reaction of gaseous propane, gaseous chlorine and gaseous bromine.

"When the same number of moles of gaseous propane is reacted with both gaseous bromine and gaseous chlorine, the rates for the two reactions will be the same."

Do you agree with the student's comment? Explain your reasoning.

……...

……...

……..[2]

[Total: 10 marks]

---End of Section B---

---End of Paper 2---

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

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

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

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

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Answers for Sec 4EX Chemistry SA1 EXAMINATION Paper 2018

Paper 1 MCQ: *40 MCQs (40 marks)*

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

Paper 2 Section A:

Answer all questions (50 marks)

Qn	Part	Answers	Mark allocated	Markers Feedback
1	**(a)**	neutralization	[1 mark]	Very
	(b)	precipitation	[1 mark]	
	(c)	oxidation	[1 mark]	
	(e)	displacement / redox	[1 mark]	
	(f)	thermal decomposition / decomposition	[1 mark]	
A2	**(a)**	Any appropriate compound 1 mark for correct number of electrons on carbon atom 1 mark for correct number of electrons on the other atom(s) Explanation: the carbon atom and X atom share a pair of electrons to attain a noble gas electronic configuration [1]	[3 mark]	

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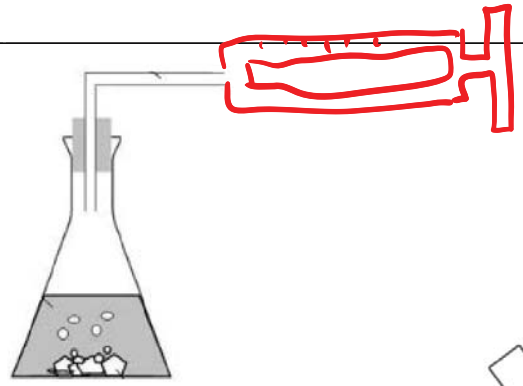
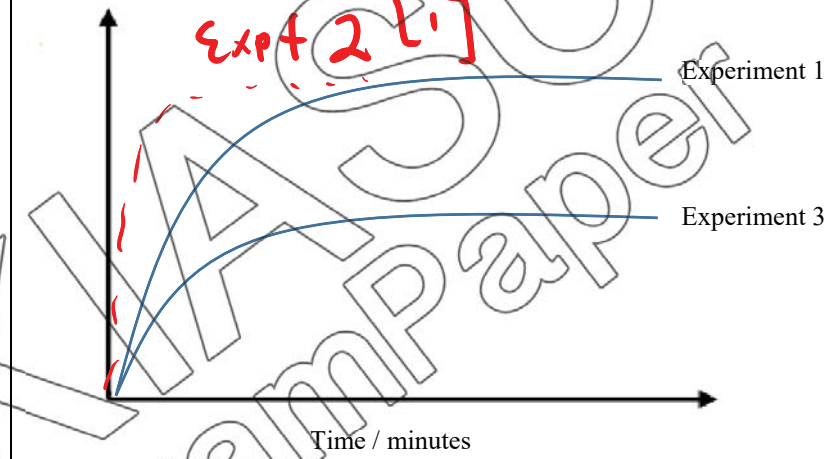
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	(b)	In allotrope A, <u>every carbon atom is bonded to 4 other carbon atoms by strong covalent bonds</u>. This makes the whole structure very hard. In allotrope B, <u>every carbon atom is bonded to 3 other carbon atoms in hexagonal layers</u>. Little force is needed to overcome these <u>weak intermolecular forces of attraction between layers</u>, making B slippery.	[1 mark] [1 mark]	
	(c)	Carbon causes the <u>oxidation state of zinc to decrease from +2 in ZnO to 0 in Zn</u>, hence reducing zinc oxide / C itself is oxidized. O.S of C increases from 0 to +2. Hence it's a reducing agent.	[1 mark]	
A3	**(a)**	A,C,D,B	[1 marks]	
	(b)	Metal A: No visible observation [1] Metal D: Metal D dissolves/brown solution becomes colourless/Grey solid produced (Any 2 for 2 marks)	[3 marks]	
	(ci)	$Fe_2O_3(s) + 3CO(g) \rightarrow 3CO_2(g) + 2Fe(l)$	[1 marks]	
	(cii)	Yes it is redox as Fe_2O_3 loses oxygen to form Fe and CO gains oxygen to form CO_2.	[1 marks]	
	(d)	Sacrificial Protection. A **<u>more reactive metal</u>** like magnesium or zinc can be **<u>placed beside iron.</u>** It will **<u>corrode in place of iron</u>**	[1 marks] [1 marks]	

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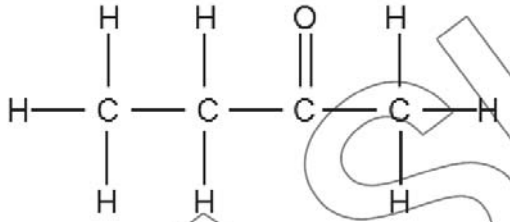
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A4	**(a)**		[1 marks]	
	(b)	$2HCl(aq) + Zn(s) \rightarrow ZnCl_2(aq) + H_2(g)$	[1 marks]	
	(c)		[1 marks]	
	(d)	Y = 30.0 cm^3 Z = 0.25 mo/dm^3 Or Y = 60.0 cm^3 Z = 0.125 mol/dm^3	[2 marks]	

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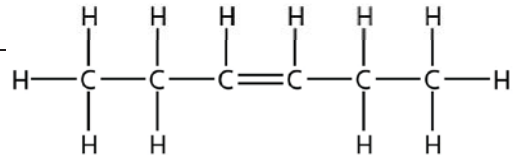
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	(e)	Increase in temperature, **<u>increases the kinetic energy of the particles [1]</u>**, **<u>more particles have energy greater or equal to the activation energy [1],</u>** **<u>higher frequency of effective collision</u>**,[1] increase speed of reaction	[3 marks]	
A5	**(a)**	name: hexanone formula: $C_4H_9COCH_3$	[1 marks] [1 marks]	
	(b)	$C_nH_{2n+1}COCH_3$	[1 marks]	
	(c)		[1 marks]	
	(d)	Bromine water remains brown in propanone. Bromine water decolourizes / turns colourless in propene.	[1 marks] [1 marks]	
A6	**(a)**	<u>Shields / filters out harmful UV rays from the sun</u> that can cause <u>skin cancer / genetic mutations / eye damage</u>. ;	[1 marks]	
	(b)	Forms photochemical smog which irritates the eyes and lungs which can cause breathing problems.	[1 marks]	
	(c)	<u>Chlorine</u> is oxidised. ; Its O.S. <u>increases</u> from <u>0 in *Cl*</u> to <u>+1 in Cl_2O</u>. ;	[1 marks] [1 marks]	
	d(i)	Pollutant reacts with rain water to form acid rain that corrodes buildings and harms aquatic life / plants.	[1 marks]	
	d(ii)	$2NO_2 + 4CO \rightarrow 4CO_2 + N_2$	[1 marks]	

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A7	**(a)**	The energy released in the formation of O-H and C=O bonds is larger; than the energy required to break the C-H, O-H, C-C and H-H bonds. ;	[1 marks] [1 marks]	
	(bi)	Moles of ethanol required to produce 100 kJ of energy 100 / 1370 = 0.07299 moles ; From the equation above, 1 mole of C_2H_5OH = 2 moles of CO_2 0.07299 moles of C_2H_5OH = 0.1460 moles of CO_2 Volume of CO_2 produced = 3.50 dm^3 ;	[1 marks] [1 marks]	
	(c)	Combustion of hydrogen produces water which does not contain carbon and produce carbon monoxide which is a pollutant or carbon dioxide which is responsible for global warming.	[1 marks] [1 marks]	
A8	**(a)**	Crude oil enters the heater and is heated up to form a gaseous mixture.; The gaseous mixture enters the distillation column and is cooled and then separated through condensation. ; The fractions with the lower boiling points / the lighter fractions will be collected at the top, while the fractions with the higher boiling points / the heavier fractions will be collected at the bottom of the distillation column.;	[1 marks] [1 marks] [1 marks]	
	(bi)	Longer hydrocarbons are cracked to produce shorter hydrocarbons / smaller molecules (e.g. petrol) that have higher demand in the industries.	[1 marks]	
	(bii)		[1 marks]	

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Paper 2 Section B: **(30 marks)**

B9ai	Cu^{2+} (aq) + $2e^-$ → Cu (s) $2Cl^-$ (aq) → Cl_2 (g) + $2e^-$	[1 mark] [1 mark]	
B9aii	Number of moles of Cu = 0.584 / 64 = **0.009125 mol** For the same amount of electricity (2 mol of e^-), 1 mol of Cu and 1 mol of Cl_2 are produced. Hence, number of moles of Cl_2 produced is also 0.009125 mol. Volume of Cl_2 produced **= 0.009125 x 24 = 0.219 dm^3**	[1 mark] [1 mark]	
B9b	At stage 2, **Cu^{2+} ions were preferentially discharged** leaving behind Fe^{2+} ions in the electrolyte which are pale green in colour. At stage 3, **H^+ and OH^- ions from water are discharged**. Hence the concentration of the electrolyte increases and the solution becomes darker due to the Fe^{2+}.	[1 mark] [1 mark]	
B9c	The Universal Indicator will change colour from **green to violet/ blue**. **H^+ ions are preferentially discharged** at the cathode **leaving behind OH^- ions in solution / concentration of H^+ decreases which thus increases the concentration of OH^- in electrolyte** which makes the solution around the cathode alkaline.	[1 mark] [1 mark]	

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B9d	The three substances are **copper, hydrogen gas and iron.** **Any one** of the following explanations : • Copper atoms are the least reactive, followed by hydrogen atoms, then iron atoms. Hence, • Copper(II) ions are preferentially discharged followed by hydrogen ions, then iron(II) ions • Copper(II) ions accept electrons most readily followed by hydrogen ions then iron(II) ions	[2 marks]	
B10a	When the percentage of carbon dioxide increases, the average temperature at the Earth's surface increases. Carbon dioxide is a greenhouse gas. It traps the infrared radiation from the sun and prevents it from going back to the atmosphere. This causes the earth's average temperature at the Earth's surface to increase.	[1 mark] [1 mark]	
b	More occurrences of unusual weather conditions such as warm spells, droughts and storms. Decrease in crop yields because areas covered by vegetation may become deserts. OR Melting of ice cap will cause ocean levels to rise and flood low-lying	[1 mark] [1 mark]	
c	Photosynthesis by plants lowers the level of carbon dioxide while combustion, respiration and decay increase the level of carbon dioxide.	[1 mark] [1 mark]	
di	When the engine is in the accelerating mode, the high temperature of the engine allows nitrogen in the air to react with oxygen to form nitrogen monoxide. When the proportion of air present in the fuel mixture is high, the fuel mixture will burn completely, there is less likelihood of incomplete combustion.	[1 mark] [1 mark]	
dii	$2NO + 2CO \rightarrow N_2 + 2CO_2$ NO loses oxygen and is reduced to N_2. CO gains oxygen and is oxidised to CO_2.	[1 mark] [1 mark]	

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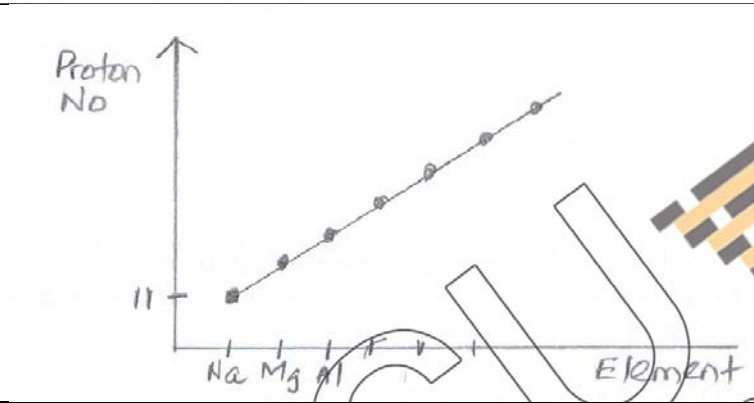
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Either B11ai	Exothermic		
aii	Formation of bubbles is due to the hydrogen gas evolved when acid react with magnesium metal to form salt and H_2. The reaction is slow as citric acid is a weak acid – less H^+ ions dissociated..	[1 mark] [1 mark]	
aiii	$Mg(s) + 2C_5H_7O_5COOH \rightarrow (C_5H_7O_5COO)_2Mg + H_2$	[1 mark]	
aiv	Propanol is an organic solvent which will not result in hydrogen ions being produced.	[1 mark]	
bi	A reaction occurred in Experiment 2 because the aluminium strip is rubbed with sandpaper to remove the oxide layer and aluminium is more reactive than iron so displacement of iron from its salt solution can occur. A reaction does not occur in Experiment 1 as the aluminium strip is still covered by an inert(unreactive) oxide layer.	[1 marks] [1 marks] [1 marks]	
bii	There will be no reaction seen in Experiment 3 as aluminium is less reactive than sodium. Hence no displacement reaction will take place despite the aluminium strip being rubbed with sandpaper.	[1 mark] [1 mark]	
OR B11ai	1. Melting point increases from Na to Si. 2. It drops drastically from Si to P. 3. There is a gradual drop in melting point from S to Cl.	[1 mark] [1 mark] [1 mark]	
aii	Their melting points are above room temperature.	[1 mark]	
b	Silicon has a giant molecular structure with all the silicon atoms joined together with strong covalent bonds. A lot of heat energy is needed to break the strong covalent bonds between the silicon atoms.	[1 mark] [1 mark]	

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c		[1 mark]	
di	as bond length **increases,** the bond energy **decreases**; (with the exception of fluorine).	[1 mark]	
ii	No. Chlorine is **more reactive** than bromine; the **reactivity decreases** down Group VII.	[1 mark] [1 mark]	

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