Name:..... Class:.....

966/2
2006

STPM TRIAL

MUAR DISTRICT LEVEL

STPM TRIAL EXAMINATION

CHEMISTRY

PAPER 2

(TWO AND A HALF HOURS)

Instructions to candidates:

Answer **all** questions in **section A** in the space provided. All working must be shown. For numerical answers, units must be quoted wherever they are appropriate.

Answer **any four** questions from **section B** on your answer sheets. Begin each answer on a fresh sheet of paper and arrange your answers in numerical order.

Answer can be written in either Malay or English.

A Data Booklet is provided.

For examiner's use	
1	
2	
3	
4	
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6	
7	
8	
9	
10	
Total	

This question paper consists of 12 printed pages.
This question paper is confidential until the examination is over.

SECTION A

Structured Questions.

1. (a) A proton, a neutron and an electron all traveling at same velocity enter a magnetic field. State which particle is deflected the most and explain your answer.

.....

....

[2]

(b) i. State the full electronic configuration of copper, Cu.

.....

[1]

ii. Define the term 'Isotope'.

.....

[1]

iii. Natural samples of krypton consist of mixtures of isotopes with relative abundance as given in the table below.

Nucleon number	Relative abundance(%)
80	2.4
82	11.7
83	11.6
84	56.9
85	17.4

Calculate the relative atomic mass of krypton.

[2]

1. (c) Oxygen is in the same group as sulphur.

(i) Write the valence electron configuration of oxygen.

.....

[1]

(ii) Sulphur shows oxidation numbers of +4 and +6. Suggest and explain whether oxygen will show similar oxidation numbers.

.....

.....

[1]

(d) Nitrous oxide, N_2O, is an anesthetic known as 'laughing gas'. What is the pressure of 0.35 mole of N_2O at 22°C contained in a 5.0 dm^3 tank?

[2]

2. (a) Ammonia gas forms dense white clouds of ammonium chloride when reacted with hydrogen chloride gas.

(i) Write an equation for the reaction.

..... [1]

(ii) Draw Lewis structures and indicate the shape of the following species.

Species	NH_3	NH_4^+
Lewis structure		
Shape		

[4]

(iii) Propose a hybridization scheme for the nitrogen atom in ammonia and ammonium chloride.

ammonia.....

ammonium chloride.....

[2]

(iv) State all the possible types of bonds found in ammonium chloride.

.....

..... [2]

(v) Explain why ammonia can act as a ligand in complex ion where else ammonium ion cannot.

.....

....[1]

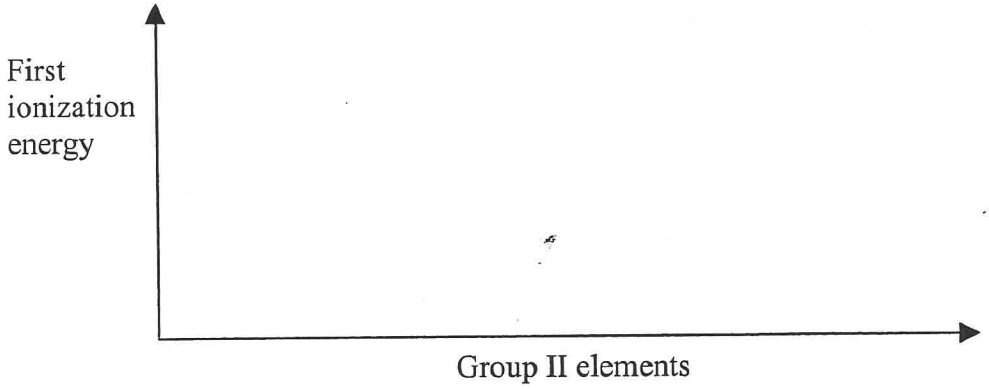
3. (a) State what is meant by the first ionization energy of an element.

.....

.....

[1]

(b) (i) Sketch how the first ionization energies of the elements change from Beryllium to Barium. [1]



(ii) Explain the trend of the first ionization energies for the Group II elements (Beryllium to Barium).

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.....

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.....

.....

[2]

3. (c) Magnesium carbonate and barium carbonate decompose similarly when heated.

(i) Write a balanced equation for the decomposition of one of the carbonate.

.....

(ii) Which of the nitrate will decompose at a lower temperature? Explain your answer base on the ionic radii of the cations.

.....

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.....

.....

.....

(d) (i) Magnesium is used in the extraction of titanium. In this process, titanium(IV) chloride reacts with magnesium to form magnesium chloride and titanium.
Write a balanced equation for the reaction.

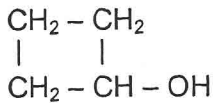
.....

(ii) What is the mass of magnesium that is required to react with 3.8 kg of titanium(IV) chloride?

[6]

4. (a) Suggest a chemical test by which the following compounds could be distinguish from each other.

$CH_3CH=CHCH_2OH$ and



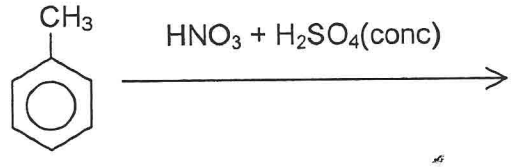
Reagent: ..... Condition: .....

Observations: .....

..... [2]

(b) Predict the products of the following reactions.

(i)



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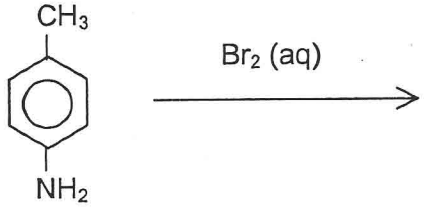
(ii)



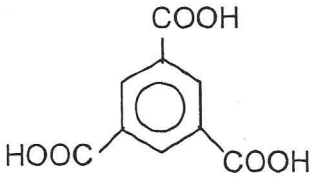
..... [2]

(c) The aromatic compounds, **H, J, K** and **L** are isomers with the molecular formula $C_9H_{12}O$. All four react with sodium metal. Compound K also reacts with aqueous sodium hydroxide, and with aqueous bromine.

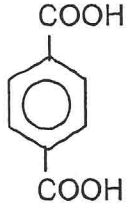
On warming with acidified $K_2Cr_2O_7$ the reagent does not change colour with isomers **K** and **L,** but turns green with **H** and **J** producing compounds **M**($C_9H_{10}O_2$) and **N**($C_9H_{10}O$) respectively.

Only isomer **J** reacts with alkaline aqueous iodine.

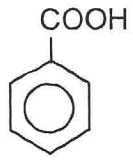
When heated with alkaline $KMnO_4$, isomers **H, J** and **L** give the acids **P, Q** and **R** respectively.



P



Q



R

Suggest a structure for **H, J, K, L, M** and **N.**

H	**J**	**K**
L	**M**	**N**

[6]

SECTION B

Essay(Answer **any four** questions):

5. (a). The variation of pH against the volume of NaOH (V cm^3) when 25.0 cm^3 of a weak organic acid, HA, is titrated against 0.10 mol dm^{-3} sodium hydroxide is given in the table below.

Volume of NaOH(cm^3)	0	2	4	6	8	10	12	14	16	18	20
pH	2.5	3.1	3.4	3.7	3.9	4.1	4.4	4.7	9.1	11.6	11.9

Plot a graph of pH against volume of NaOH(V). Use your graph to calculate the molarity of the acid. [5]

(b) A buffer solution is prepared by dissolving 0.20 mol of sodium ethanoate in 1.0 dm^3 of aqueous ethanoic acid of 0.10 mol dm^{-3}. Calculate the pH of the buffer solution. [2]

(c) 20.0 cm^3 of a saturated calcium hydroxide solution requires 18.50 cm^3 of 0.050 mol dm^{-3} hydrochloric acid for complete neutralization.

i. Calculate the OH^- concentration in saturated calcium hydroxide.

ii. Calculate the solubility product of calcium hydroxide at the temperature of the experiment. [4]

(d) Heptane and hexane form an ideal solution. The vapour pressure of heptane and hexane at 25 °C is 12.8 kPa and 4.0 kPa respectively.

i. Explain why a mixture of heptane and hexane shows ideal behaviour.

ii. Calculate the total pressure of a mixture containing 2.0 mol of heptane and 4.0 mol hexane at 25°C. [4]

6. (a) Aluminium chloride, $AlCl_3$, is an important industrial chemical. Aluminium chloride acts as a lewis acid with ammonia.

(i) explain what is meant by lewis acid

(ii) explain the acid properties of aluminium chloride in ammonia. [6]

(b) Aluminium oxide and aluminium chloride have different chemical properties. With reference to the bonding in aluminium oxide and aluminium chloride, explain

(i) the amphoteric nature of aluminium oxide

(ii) the reaction between aluminium chloride and water [9]

7. (a) What do you understand by the term transition element ?

[1]

(b) Using chromium and iron as examples describe three physical or chemical properties in which transition metals and their compounds differ from those of magnesium, aluminium and their compounds.

[6]

(c) By referring to element chromium ,

(i) Choose two common oxidation states and, for each one, write the formula of a compound that contains the element in that oxidation state,

(ii) By using appropriate data from the Data Booklet, choose a reducing agent that can reduce the higher oxidation state to the lower oxidation state. Write a balanced equation for the reaction.

(iii) Draw the possible structures of the isomers of the complex ion, $[Cr(NH_3)_4Cl_2]^+$.

[8]

8. (a) (i) Draw the Born-Haber cycle for the formation of calcium oxide.

(ii) By referring to the data given below, calculate the lattice energy of calcium oxide and iron(II) oxide.

Standard Enthalpy of formation	CaO : -635 kJ mol^{-1}	FeO : -278 kJ mol^{-1}
Standard Enthalpy of atomisation	Ca: + 178 kJ mol^{-1}	Fe: +416 kJ mol^{-1}
Standard Enthalpy of atomisation	O, atom: +249 kJ mol^{-1}	
First ionization energy + second ionisation energy	Ca : +1740 kJ mol^{-1}	Fe : +2322 kJ mol^{-1}
First affinity electron + second affinity electron	O, atom : +657 kJ mol^{-1}	

(iii) Base on the values of the lattice energy obtained, state whether the size of Ca^{2+} ion is bigger or smaller than the size of Fe^{2+} ion. Explain your answer.

[11]

(b) Calculate the enthalpy change of the following reaction:

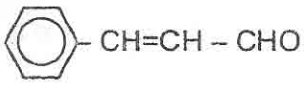
$$FeO\ (s) + Ca\ (s) \longrightarrow CaO\ (s) + Fe\ (s)$$

Is the above method suitable for the extraction of iron in industry? Explain your answer.

[4]

9. (a) Illustrate the various types of isomerism that can be shown by alkenes, using compounds with the molecular formula C_5H_{10} as examples. Include the structural formulae of all the possible isomers in your answer, and hence state the total number of alkenes with this formula. [5]

(b) The structure of compound A is given below:



Using A as the starting material, describe how the following reaction can be carried out.

(i) Reduction of the carbonyl group
(ii) Condensation
(iii) Oxidation of the carbonyl group [5]

(c) *Glyceryl trieleostearate* is an example of triglyceride.The structure of *Glyceryl trieleostearate* is given below.

$$CH_3(CH_2)_3CH = CHCH = CHCH = CH(CH_2)_7CO_2CH_2$$
$$\vert$$
$$CH_3(CH_2)_3CH = CHCH = CHCH = CH(CH_2)_7CO_2CH$$
$$\vert$$
$$CH_3(CH_2)_3CH = CHCH = CHCH = CH(CH_2)_7CO_2CH_2$$

(i) *Glyceryl trieleostearate* can be hydrolysed to fatty acid and glycerol by reflux with hydrochloric acid. Write a balanced equation for this hydrolysis.

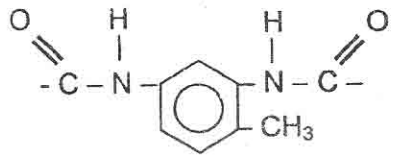
(ii) *Glyceryl trieleostearate* are often hydrogenated to make margarine. What reagent and condition are used for the hydrogenation? For complete hydrogenation, how many moles of hydrogen would react with one mole of *Glyceryl trieleostearate*? [5]

10. (a) Methylbenzene (toluene) is an important industrial chemical. One of its uses is in the production of fibres such as Lycra.

(i) The first stage of the manufacture involves the nitration of methylbenzene. Describe the mechanism of the nitration of methylbenzene to form 4-nitromethylbenzene.

(ii) 4-nitromethylbenzene can be reduced to 4-aminomethylbenzene. Write a balanced equation for this reduction. [5]

(b) Lycra is a polyamide, which is made from a diamine produced by a similar reduction. A small section of Lycra is shown below.



(i) There are six structural isomers of diaminomethylbenzene, $CH_3C_6H_3(NH_2)_2$. Draw the structure of **three** of the six isomers.

(ii) Draw the structure of the isomer of diaminomethylbenzene used in the manufacture of Lycra. [3]

(c) Animal fibres such as wool are made of protein. The synthetic polymer nylon-6,6 is used to blend the wool in clothes.

(i) Name the functional group common to both protein and nylon-6,6.

(ii) Draw two repeat units of

- A protein, using general formula for the amino acid residues ($NH_2CH(R)CO_2H$),
- Nylon-6,6. [5]

(d) Crystal of the simplest amino acid, glycine, NH_2CH_2COOH, melts between 230 – 235 °C. Explain the high melting point of glycine. [2]