

962/1

STPM 2006

**CHEMISTRY**

**PAPER 1**

**(One hour and forty-five minutes)**

**TRIAL STPM EXAMINATIONS**

**JOHOR BAHRU DISTRICT**

**Instructions to candidates:**

**DO NOT OPEN THIS BOOKLET UNTIL YOU ARE TOLD TO DO SO.**

There are **fifty** questions in this paper. For each question, four suggested answers are given. Choose **one** correct answer and indicate it on the multiple-choice answer sheet provided.

Read the instructions on the multiple-choice answer sheet very carefully.

Answer **all** questions. Marks will not be deducted for wrong answers.

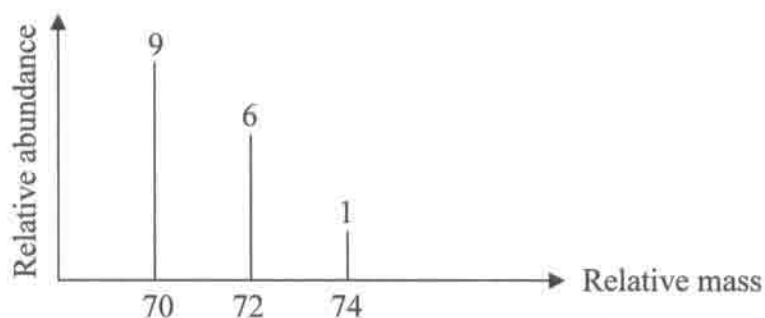
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(This question paper consists of 14 printed pages.)

## SECTION A

Four suggested answers labelled **A**, **B**, **C** and **D** are given for each question. Choose **one** correct answer.

1. Chlorine has two isotopes  $^{35}\text{Cl}$  and  $^{37}\text{Cl}$ . The mass spectrum of chlorine which is given below, shows three peaks with a relative abundance ratio of 9:6:1. What is the ratio of relative abundance of isotope  $^{35}\text{Cl}$  to isotope  $^{37}\text{Cl}$ ?

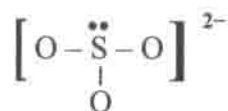


- A. 1 : 1  
 B. 2 : 1  
 C. 1 : 3  
 D. 3 : 1
2. Which of the following species does not produce a peak in the mass spectrum of propan-2-ol?
- A.  $\text{CH}_3\text{CHOH}^+$   
 B.  $\text{CH}_3\text{CH}_2\text{OH}^+$   
 C.  $\text{CH}_3\text{CH}(\text{OH})\text{CH}^+$   
 D.  $\text{CH}_3\text{C}(\text{OH})\text{CH}_2^+$
3. The ionization energy of the hydrogen atom can be calculated from the Lyman series in the hydrogen emission spectrum by determining the frequency of the
- A. spectral line with shortest wavelength  
 B. spectral line with longest wavelength  
 C. spectral line with highest intensity  
 D. first spectral line in the series.
4. The ionic radii of ions of sodium, magnesium and aluminium are 0.098 nm, 0.065 nm and 0.045 nm respectively. The decrease in atomic radii from sodium to aluminium is due to
- A. the increase in nuclear charge and increase in the number of electrons.  
 B. the increase in nuclear charge while the number of electrons remains constant.  
 C. the increase in number of electrons while the nuclear charge remains constant.  
 D. the increase in number of electrons and protons in the nucleus.

5. Which of the following element will form both ionic and covalent compounds?

- A. Sodium
- B. Potassium
- C. Aluminium
- D. Magnesium

6. The structural formula of the sulphite ion is shown below.



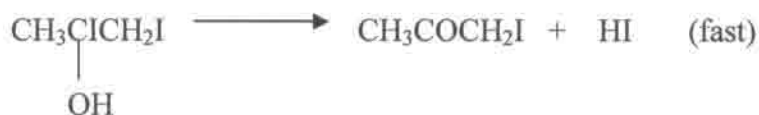
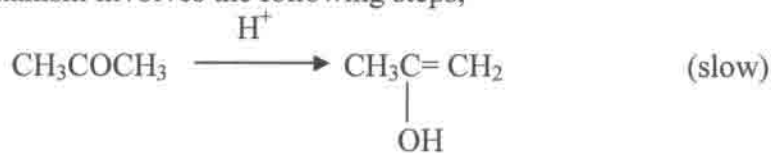
What is the angle of the O – S – O bond?

- A.  $90^\circ$
- B.  $107^\circ$
- C.  $109^\circ 28'$
- D.  $120^\circ$

7 Propanone reacts with iodine in the presence of an acid according to the reaction:



The mechanism involves the following steps,



Which conclusion **cannot** be drawn from this information?

- A Iodine is not involved in the rate determining step.
- B The acid acts as a catalyst.
- C The overall order of the reaction is three.
- D The rate of reaction is not affected by a change in the iodine concentration.

- 8 The table shows experimental results obtained for the following reaction:



Partial pressure of XO/Pa	100	100	50	50
Partial pressure of O <sub>2</sub> /Pa	100	25	100	-
Relative rate	1.0	0.25	0.50	0.125

What is the missing value of the partial pressure of O<sub>2</sub> in the table?

- A 50  
 B 25  
 C 40  
 D 12.5
- 9 Known amounts of hydrogen and iodine are allowed to come to equilibrium at 500<sup>o</sup>C in a vessel of known volume.



From which experimental method can K<sub>c</sub> be found?

- A measuring the total pressure in the vessel.  
 B slow cooling to 20<sup>o</sup>C, breaking open the vessel under aqueous potassium iodide, and titrating the iodine present with aqueous sodium thiosulphate.  
 C rapid cooling to 20<sup>o</sup> C, breaking open the vessel under aqueous potassium iodide, and titrating the iodine present with aqueous sodium thiosulphate.  
 D withdrawal of a measured sample of the equilibrium mixture, followed by complete decomposition of the hydrogen iodide present, and then titrating the total amount of iodine with aqueous sodium thiosulphate.
- 10 Butanoic acid, a monobasic acid, is formed in rancid butter. 0.20 moles of the acid are dissolved in water to give 500 cm<sup>3</sup> of a solution whose pH is 2.60. Calculate the acid dissociation constant, K<sub>a</sub>, for the acid.

- A  $1.58 \times 10^{-5} \text{ mol dm}^{-3}$   
 B  $3.12 \times 10^{-5} \text{ mol dm}^{-3}$   
 C  $6.25 \times 10^{-5} \text{ mol dm}^{-3}$   
 D  $6.25 \times 10^{-3} \text{ mol dm}^{-3}$

- 11 Which statement explains the observation that magnesium hydroxide dissolves in aqueous ammonium chloride but not in aqueous sodium chloride?
- A Ammonium chloride dissolves less fully than sodium chloride.  
 B The ion  $\text{NH}_4^+$  acts as an acid  
 C The ammonium ion changes the solubility product of magnesium hydroxide  
 D Ammonium hydroxide is first formed and then acts through a common ion effect.
- 12 In the construction of heart 'pacemakers' it is possible to use a tiny magnesium electrode which creates an electrical cell with the inhaled oxygen. The relevant half-cells are as follows:
- $$\begin{array}{l} \text{Mg}^{2+} + 2\text{e} \rightleftharpoons \text{Mg} \qquad E^\theta = -2.38 \text{ V} \\ \frac{1}{2} \text{O}_2 + 2\text{H}^+ + 2\text{e} \rightleftharpoons \text{H}_2\text{O} \qquad E^\theta = 1.23 \text{ V} \end{array}$$
- Under standard conditions the cell e.m.f would be 3.61V, but in the body a potential of 3.25V is more usual. What is the best explanation for the lower e.m.f?
- A the small size of the magnesium electrode  
 B the low concentration of  $\text{Mg}^{2+}$  ions surrounding the magnesium electrode.  
 C the high resistance of the body fluids surrounding the electrodes.  
 D the pH of between 7 and 8 of the body fluid surrounding the electrodes.
- 13 The table below shows the enthalpies of the elements potassium and bromine, and potassium bromide.

Ionization energy of K = 496 kJ mol <sup>-1</sup> Electron affinity of Br = -349 kJ mol <sup>-1</sup> Enthalpy of atomization of Br = 121 kJ mol <sup>-1</sup> Enthalpy of atomization of K = 108 kJ mol <sup>-1</sup> Enthalpy of formation of KBr = -411 kJ mol <sup>-1</sup>
---

What is the  $\Delta H^\theta$  value for the reaction below?



- A +133 kJ mol<sup>-1</sup>  
 B -414 kJ mol<sup>-1</sup>  
 C +787 kJ mol<sup>-1</sup>  
 D -787 kJ mol<sup>-1</sup>

- 14 Which of the following ions has the most exothermic enthalpy of hydration?
- A  $\text{Na}^+$
  - B  $\text{Al}^{3+}$
  - C  $\text{Mg}^{2+}$
  - D  $\text{Ca}^{2+}$
- 15 Which statement about the oxides of Period 3 is **not** correct?
- A  $\text{SiO}_2$  exists as a giant covalent molecule.
  - B  $\text{P}_4\text{O}_{10}$  exists as a solid under room condition.
  - C  $\text{MgO}$  is not soluble in water but reacts with dilute acids.
  - D  $\text{Al}_2\text{O}_3$  and  $\text{SiO}_2$  are amphoteric oxides.
- 16 Which oxide can form a solution with the lowest pH when 1 mole of the oxide is dissolved in  $1 \text{ dm}^3$  of distilled water?
- A  $\text{P}_4\text{O}_{10}$
  - B  $\text{Cl}_2\text{O}_7$
  - C  $\text{SO}_3$
  - D  $\text{MgO}$
- 17 The same amount of an electric current flow through molten sodium chloride and molten aluminium oxide mixed with molten cryolite. If 4.6 g of sodium is produced in one cell, what is the mass of aluminium produced in the other cell?  
[relative atomic mass : Al:27; Na:23]
- A 0.9 g
  - B 1.8 g
  - C 2.7 g
  - D 3.6 g
- 18 Which of the following is **not true** regarding aluminium chloride?
- A It exists as a dimer in the solid state.
  - B It fumes in moist air.
  - C It acts as a Lewis acid in its reaction with ammonium chloride.
  - D It is an ionic compound.
19. Which of the following statements about the oxides of nitrogen is **not correct**?
- A  $\text{N}_2\text{O}_4$  is colourless.
  - B  $\text{NO}_2$  is a brown gas.
  - C  $\text{NO}$  has a lone electron in its structure.
  - D The hybridisation of nitrogen atom in  $\text{NO}_2$  is  $sp^3$ .



25. Give the IUPAC name for  $(\text{CH}_3)_3\text{CCH}_2\text{CH}_3$
- A 1,1,1 - trimethylpropane
  - B 1,1,2 - trimethylpropane
  - C 2 - methylpentane
  - D 2,2 - dimethylbutane
26. Which of the following statements about geometrical isomerism is true?
- A The molecule must be planar.
  - B The melting point of the *cis* and *trans* isomers is different.
  - C The chemical properties of the *cis* and *trans* isomers are different.
  - D Two groups of atoms must be on each carbon atom that is covalently bonded by a single bond.
27. Monosubstituted benzene has the formula  $\text{C}_6\text{H}_5\text{X}$ . When  $\text{C}_6\text{H}_5\text{X}$  reacts with an electrophile Y, a trisubstituted benzene compound, Z is formed. Which of the following statements is correct?
- A The molecular formula of Z is  $\text{C}_6\text{H}_4\text{XY}_2$
  - B The molecular formula of Z is  $\text{C}_6\text{H}_3\text{XY}_2$
  - C The number of isomers of Z is 3
  - D The number of isomers of Z is 7
28.  $240 \text{ cm}^3$  of a gaseous hydrocarbon burns in excess oxygen to produce  $720 \text{ cm}^3$  of carbon dioxide and 0.030 moles of water. What is the molecular formula of the hydrocarbon?
- [All volumes are measured at room conditions. The molar volume of a gas at room conditions is  $24\,000 \text{ cm}^3$ . Relative atomic mass : C = 12, H = 1, O = 16]
- A  $\text{C}_2\text{H}_4$
  - B  $\text{C}_2\text{H}_6$
  - C  $\text{C}_3\text{H}_6$
  - D  $\text{C}_3\text{H}_8$

29. 2.30 g of methylbenzene (relative molecular mass = 92) reacts with chlorine to produce X. Hydrolysis of X in the presence of aqueous silver nitrate produces 7.18 g of silver chloride. What is X? [relative atomic mass : Ag = 108, Cl = 35.5]

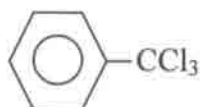
A



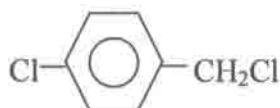
B



C



D



30. Which one of the following pairs of reagents cannot be used to prepare  $\text{CH}_3\text{CH}_2\text{Cl}$ ?

- A.  $\text{CH}_2 = \text{CH}_2 + \text{HCl}$   
 B.  $\text{CH}_2 = \text{CHCl} + \text{H}_2$   
 C.  $\text{CH}_3\text{CH}_2\text{OH} + \text{HCl}$   
 D.  $\text{CH}_3\text{CH}_2\text{OH} + \text{Cl}_2$

31. Ethene reacts with aqueous bromine to give the two products,  $\text{CH}_2\text{BrCH}_2\text{Br}$  and  $\text{CH}_2\text{BrCH}_2\text{OH}$ . Which statement is correct for these products?

- A. Both products possess an overall dipole.  
 B. Both products can be hydrolysed to form the same diol.  
 C. Both products are obtained in this reaction by electrophilic substitution.  
 D. Both products are obtained in this reaction by nucleophilic addition.

32. Which one of the following compounds will give a precipitate of triiodomethane (iodoform) when reacted with iodine and aqueous sodium hydroxide?

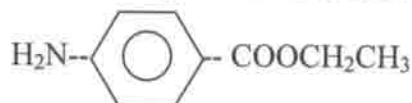
- A.  $\text{C}_6\text{H}_5\text{CHO}$   
 B.  $(\text{CH}_3)_3\text{COH}$   
 C.  $\text{CH}_3\text{CH}_2\text{CH}(\text{OH})\text{CH}_3$   
 D.  $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$

33. A compound X,  $C_4H_{10}O$  gives the compound Y,  $C_4H_8O$  on oxidation. Y gives a yellow precipitate on warming with alkaline aqueous iodine. Which of the following could be X?
- $CH_3CH_2CH_2CH_2OH$
  - $(CH_3)_2CHCH_2OH$
  - $CH_3CH_2CH(OH)CH_3$
  - $(CH_3)_3COH$

34. Which one of the following gives the correct order of acid strength for ethanoic acid, chloroethanoic acid and phenol?

- |   |         |
|---|---------|
| Strongest                               | Weakest |
| A. $CH_3CO_2H > C_6H_5OH > CH_2ClCO_2H$ |         |
| B. $C_6H_5OH > CH_2ClCO_2H > CH_3CO_2H$ |         |
| C. $CH_2ClCO_2H > C_6H_5OH > CH_3CO_2H$ |         |
| D. $CH_2ClCO_2H > CH_3CO_2H > C_6H_5OH$ |         |

35. Benzocaine is a local anaesthetic, often used to relieve pain from sunburn.



Which of the following is a possible means of its preparation?

- A.  $NH_2-\text{C}_6\text{H}_5-\text{COOH} + CH_3CH_2OH \xrightarrow[\text{heat}]{H^+}$
- B.  $NH_2-\text{C}_6\text{H}_5-\text{OH} + CH_3CH_2\text{COOH} \xrightarrow[\text{heat}]{H^+}$
- C.  $NH_2-\text{C}_6\text{H}_5-\text{OH} + CH_3CH_2\text{COCl} \xrightarrow{\text{room temperature}}$
- D.  $NC-\text{C}_6\text{H}_5-\text{COOCH}_2\text{CH}_3 \xrightarrow[\text{heat}]{H_2/\text{Pt catalyst}}$

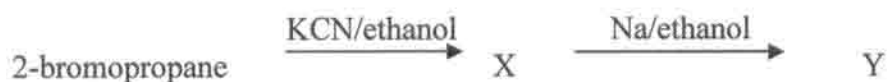
36. Paracetamol is a pain-killing drug:



What are the products from its reaction with an excess of boiling aqueous NaOH?

- A. + CH<sub>3</sub>COO<sup>-</sup> Na<sup>+</sup>
- B. + CH<sub>3</sub>COO<sup>-</sup> Na<sup>+</sup>
- C. + CH<sub>3</sub>COO<sup>-</sup> Na<sup>+</sup>
- D. + CH<sub>3</sub>OH

37. X and Y are the products in a two steps reaction with 2-bromopropane, as shown below.



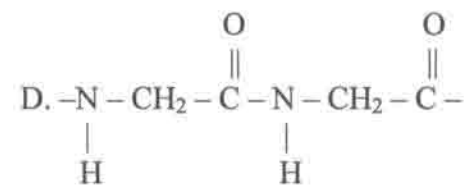
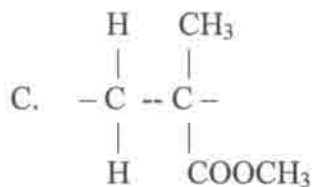
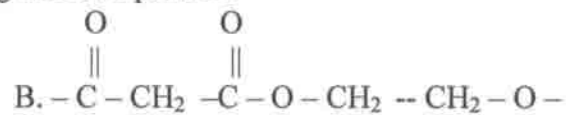
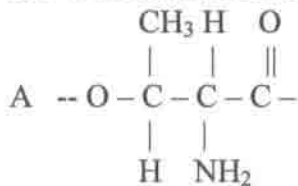
X and Y are most likely


- |                           |                      |
|---------------------------|----------------------|
| <u>X</u>                  | <u>Y</u>             |
| A. 2-butanitrile          | butyl ethanoate      |
| B. 2-methylpropanonitrile | 2-methyl propanamine |
| C. 2-methylpropanonitrile | buthanamine          |
| D. ethyl propoxide        | pentanamine          |

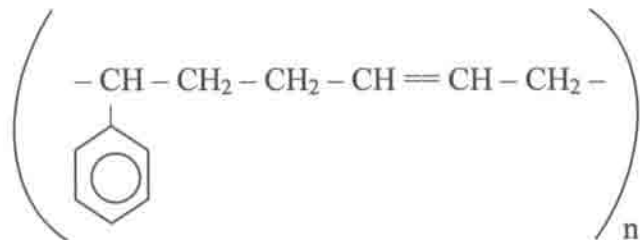
38. Which reagent could be used to separate a mixture of phenylamine, C<sub>6</sub>H<sub>5</sub>NH<sub>2</sub>, and methylbenzene, C<sub>6</sub>H<sub>5</sub>CH<sub>3</sub>?

- A. dilute aqueous sodium hydrogencarbonate  
 B. dilute aqueous sodium hydroxide  
 C. dilute hydrochloric acid  
 D. propanone

39. Which structure represents the repeating unit of a protein?



40. Which monomer co-polymerises with   $\text{CH}=\text{CH}_2$  to give a polymer with the repeating unit shown?



- A.  $\text{CH}_3 \text{--CH}=\text{CH--CH}_3$   
 B.  $\text{CH}_2=\text{CH--CH}_2 \text{--CH}_3$   
 C.  $\text{CH}_2=\text{CH--CH}=\text{CH}_2$   
 D.  $(\text{CH}_3)_2 \text{C}=\text{CH}_2$

**SECTION B**

For each of the questions this section, one or more of the three numbered statements 1 to 3 may be correct. The responses A to D should be selected as follows.

A	B	C	D
Only 1 is correct.	Only 1 and 2 are correct.	Only 2 and 3 are correct.	1, 2 and 3 are correct.

41. Three elements from period 3 phosphorus, sulphur and chlorine form three ions namely:  $P^{3-}$ ,  $S^{2-}$  and  $Cl^{-}$ . It can be concluded that, all these ions have,
1. same valence electrons arrangement.
  2. same electron charge density
  3. same ionic radii.
42. When ammonia gas reacts with hydrogen chloride gas, white fumes of ammonium chloride is formed. Which of the following statements is true of ammonium chloride?
- 1 It has both covalent and ionic bonds.
  - 2 It is soluble in water.
  - 3 The cation is tetrahedral in shape.
43. An aqueous copper(II) salt is electrolysed between copper electrodes, using a constant current. What affects the mass of copper deposited on the cathode?
- 1 the time taken
  - 2 the concentration of the solution
  - 3 the nature of the anion present
44. An oxide Q gives off chlorine gas when heated with concentrated hydrochloric acid. When all of the chlorine gas has evolved, the remaining solution is mixed with dilute sulphuric acid. A white precipitate is formed. Q is probably
- 1  $PbO_2$
  - 2  $SnO_2$
  - 3  $PbO$
45. Going down Group 14,
- 1 the stability of the +2 oxidation states increases
  - 2 the atomic radius increases
  - 3 the first ionization energy decreases

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NAME..... CLASS.....

962/2

2006

TRIAL EXAMINATIONS  
UPPER 6  
PANITIA DAERAH  
JOHOR BAHRU

CHEMISTRY  
PAPER 2

(2 ½ hours)

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

Answer any **four** questions from Section B. For this section, write your answers on your own examination sheets. Begin each answer on a fresh sheet of paper, and arrange your answers in numerical order. Tie your answer sheet to this booklet.

Answers may be written in either Malay or English.

A Data Booklet can be used.

For examiner's use	
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
Total	

**Section A**

Answer **all** questions in this section.

1. (a) When a container was connected to a manometer, it was observed that the pressure of the gas in the container was 5.24 kPa at the temperature 28.0 °C.  
[Volume of manometer:  $1.00 \times 10^{-3} \text{ m}^3$  ]

(i) Assuming that the vapour of X behaves ideally, calculate the number of moles of X in the container.

(ii) Given that the mass of the gas is 0.27g. Determine the relative molecular mass of X

(iii) Calculate the number of molecules of X in the container.

[6 marks]

- (b) (i) Sketch the energy level diagram for an atom with the principal quantum number of  $n = 1$  to  $n = 3$ . By using arrows to represent electrons, show on the diagram the electronic configuration of oxygen.

- (ii) Explain why oxygen forms negative ions but not positive ions in simple compounds?

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[4 marks]

2. (a) Complete the table below

Ions	Ca <sup>2+</sup>	Mn <sup>2+</sup>	Ni <sup>2+</sup>
Number of electrons in 3d shells in ions			

(i) Define, in terms of an element M, what is meant by the third ionisation energy.

---

---

(ii) Why is the third ionisation energy of calcium so much higher than those of the other elements?

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[5 marks]

(b) (i) The relative molecular mass of ethane is 30, and that of sodium hydride is 24. Why is ethane a gas, whereas sodium hydride is a solid ?

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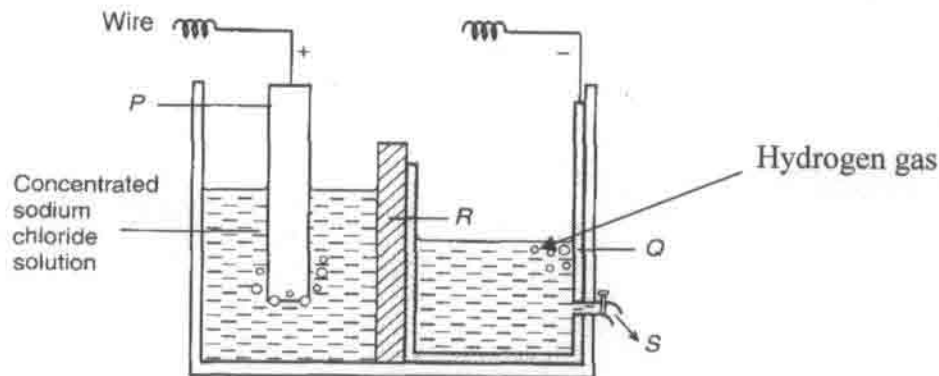
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(ii) Draw the Lewis structure and state the shape of the molecule/ion in the table below

Molecule/ion	Lewis structure	Shape of molecule/ion
$\text{BF}_3$		
$\text{NH}_4^+$		
$\text{SF}_6$		

[5 marks]

3



(a) The figure above shows the Chlor-alkali cell used to manufacture chlorine.

(i) Write balanced equations for the reactions occurring at electrodes P and Q.

P : \_\_\_\_\_

Q : \_\_\_\_\_

(ii) Why is the electrolyte in the left compartment placed higher than the electrolyte in the right compartment?

\_\_\_\_\_

\_\_\_\_\_

(iii) S represents the flow of sodium hydroxide. Explain what will happen if the chlorine gas is allowed to react with sodium hydroxide.

\_\_\_\_\_

\_\_\_\_\_

[5 marks]

(b)  $\text{CH}_2\text{Cl}_2$  has only one structural isomer whereas  $\text{PtCl}_2(\text{H}_2\text{O})_2$  has two isomers.

(i) Explain why this is so.

---

---

(ii) Give the IUPAC name for  $\text{PtCl}_2(\text{H}_2\text{O})_2$

---

(iii) Draw the isomeric structures that  $\text{PtCl}_2(\text{H}_2\text{O})_2$  exhibit.

[5 marks]

4. (a) Compound P undergoes the following reactions:



(i) Draw all possible structures for P and name them.

(ii) What type of reaction is step II?

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[5 marks]

(b) Chloroethene is the monomer from which the polymer PVC is produced. Chloroethene can be obtained from ethane in the laboratory by the following route:



(i) Suggest reagents and conditions for stage I and II.

I :

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II :

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(ii) Show the mechanism of stage I.

[5 marks]

### Section B

Answer any **four** questions from this section.

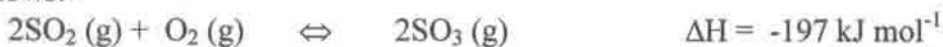
5. (a) A student investigated the rate of reaction between sodium and ethanol. A freshly cut piece of sodium was weighed and added to a large excess of ethanol.
- (i) Write an equation for the reaction between sodium and ethanol. [1 mark]
- (ii) Explain why sodium needs to be freshly cut. [1 mark]

The total volume of gas liberated was recorded every minute. The results are given in the table below.

Time/min	0	1	2	3	4	5	6	7
Total volume of gas/cm <sup>3</sup>	0	23.0	36.5	46.0	51.0	54.5	57.0	58.5

- (iii) Plot the results on a graph. Explain why the experimental results indicate that the overall kinetics is first order. [5 marks]
- (iv) In this experiment, the kinetics appears to be zero order with respect to ethanol. Suggest a reason for this. [1 mark]
- (b) When a current of 2.21A flows through an aqueous solution of copper(II) sulphate for 28 minutes, 1.22g of copper is deposited at the cathode. Calculate Avogadro constant from this experiment. [7 marks]

- 6 (a) The key reaction during the Contact process for manufacturing sulphuric acid is as follows:-



When a 2:1 ratio of sulphur dioxide and oxygen gas at an initial total pressure of 3.0 atm is passed over a catalyst at 430 °C, the partial pressure of sulphur trioxide at equilibrium is found to be 1.9 atm.

- (i) Calculate the partial pressure of SO<sub>2</sub> and O<sub>2</sub> at equilibrium and hence the new total pressure .
- (ii) Write an expression for the equilibrium constant, K<sub>p</sub>, and calculate its value. [6 marks]

(b) In the laboratory preparation of 2-nitrophenol, 4-nitrophenol is also formed. 2-nitrophenol may be separated from 4-nitrophenol by steam distillation. A sample of 2-nitrophenol is obtained by steam distillation at a pressure of 101 kPa.

- (i) Give an advantage of steam distillation over fractional distillation.
- (ii) Given that the vapour pressure of water at the temperature of the distillation is 95 kPa, calculate the mass of 2-nitrophenol present in 100g of distillate ( $M_r$  of nitrophenol is 139) [5 marks]
- (c) The solubility of lead (II) chloride decreases when dilute hydrochloric acid is added but solubility increases on adding concentrated hydrochloric acid. With the aid of equations, explain the observation. [4 marks]

7. (a) The table below gives some information about the sulphate(VI) ions of elements in Group 2


Sulphate	Solubility ( $\text{mol dm}^{-3}$ )	Lattice enthalpy ( $\text{kJ mol}^{-1}$ )	Hydration enthalpy of $M^{2+}$ ( $\text{kJ mol}^{-1}$ )
$\text{CaSO}_4$	$4.6 \times 10^{-2}$	-2480	-1650
$\text{SrSO}_4$	$7.1 \times 10^{-4}$	-2484	-1480
$\text{BaSO}_4$	$4.6 \times 10^{-6}$	-2374	-1360

Comment on the trend in the solubilities of these sulphate(VI) ions in relation to the lattice and hydration enthalpies given in the table. [ 5 marks]

(b)  $\text{Na}_2\text{O}$ ,  $\text{MgO}$ ,  $\text{Al}_2\text{O}_3$ ,  $\text{SiO}_2$  and  $\text{P}_4\text{O}_{10}$  differ in their physical and chemical properties.

- (i)  $\text{Na}_2\text{O}$  and  $\text{P}_4\text{O}_{10}$  can dissolve in water whereas the other oxides cannot.
- (ii)  $\text{Na}_2\text{O}$ ,  $\text{MgO}$  and  $\text{Al}_2\text{O}_3$  react with acids whereas  $\text{P}_4\text{O}_{10}$ ,  $\text{SiO}_2$  and  $\text{Al}_2\text{O}_3$  react with alkalis.

Explain all the above observations. In your answer, show chemical equations wherever possible. [ 10 marks ]

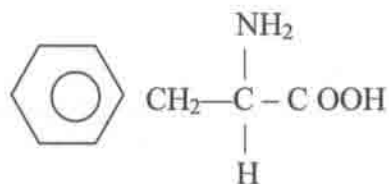
8. (a) Aluminium is used extensively to make cans for carbonated drinks. Due to the high cost involved in the electrolytic extraction of aluminium, the aluminium cans are recycled.
- State one property of aluminium that make it suitable for the above purpose.
  - Explain why the extraction of aluminium from bauxite is costly.
  - Give an important reason for recycling aluminium cans.
  - Explain briefly how the recycling process is carried out. [5 marks]
- (b) Explain the reactivity of carbon tetrachloride and silicon tetrachloride towards water. [5 marks]
- (c) Explain each of the following observations giving equations wherever necessary.
- Freshly prepared nitric acid is colourless but turns yellow-brown on standing.
  - When ammonium chloride is heated together with calcium oxide, a colourless gas is given off which forms white fumes with concentrated hydrochloric acid. [5 marks]
9. (a) An organic compound P with relative molecular mass of 58 has the following composition by mass: carbon, 62.07% ; oxygen, 27.59%; and hydrogen, 10.34%.
- Determine the empirical formula and molecular formula of P.
  - Draw one possible isomer for P. [5 marks]
- (b) Compound Z, HO  CH<sub>2</sub>CH<sub>2</sub>COCH<sub>3</sub> has been identified as being responsible for the distinctive aroma of raspberries.
- How would you expect Z to react with
- alkaline aqueous iodine
  - dilute nitric acid
  - hydrogen at atmospheric pressure, in the presence of nickel? [7 marks]
- (c) Phenylmethanol, C<sub>6</sub>H<sub>5</sub>CH<sub>2</sub>OH which is immiscible with water has a similar acidity to that of ethanol.
- Suggest a method by which you could compare the acidities of phenylmethanol and phenol. [3 marks]

10. (a) Lactic acid (2-hydroxypropanoic acid), J, occurs in soured milk. It can be synthesized from ethanol by the following series of reaction.



Compounds G and H both react with alkaline aqueous iodine. Compound G reacts with 2, 4-dinitrophenylhydrazine and also with Fehling's solution. Compound H reacts with sodium metal.

- (i) Identify G and H, explaining how the identities you suggest fit in with the test reactions described above.
- (ii) Suggest reagents and conditions for reactions I and III. [ 6 marks]
- (b) On heating in the absence of air, lactic acid loses water to give a single compound K,  $\text{C}_6\text{H}_8\text{O}_4$ . K is a neutral compound that does not react with sodium or with 2, 4-dinitrophenylhydrazine. Suggest the identity of K. [3 marks]
- (c) Compound A is phenylalanine which is an essential amino acid that must be provided in the diet for healthy growth. A can be synthesized from 3-phenylpropanoic acid. The structural formula of A is given below.



- (i) Name A according to the IUPAC system
- (ii) Give an equation for the formation of a tripeptide using only A.
- (iii) Give a chemical test to differentiate 3-phenylpropanoic acid from A.

[6 marks]