



Our country, our future

525/1

S6 CHEMISTRY

Exam 28

PAPER 1

DURATION: 2 HOUR 45 MINUTES

Instructions:

- This paper consists of two sections A and B
- Section A is compulsory.
- Attempt **only six** questions in section B
- Answers must be written in the spaces provided **only**

For Examiner's Use Only																
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17

SECTION A
(All questions are compulsory)

1. (a) The freezing point of a solution containing 3.294g of sulphur in 100g of naphthalene was found to be -0.830°C and another solution containing 1.67g of iodine in the same mass of naphthalene froze at -0.84°C .

Calculate

- (i) The freezing point depression constant for naphthalene
(molar mass of iodine is 127) (02 marks)

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- (ii) The molar mass of sulphur in naphthalene. (02 marks)

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- (b) (i) Determine the molecular formula of sulphur. (1 ½ marks)

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- (ii) Draw the structure of sulphur. (01 mark)

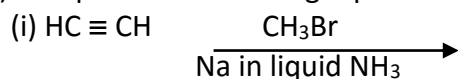
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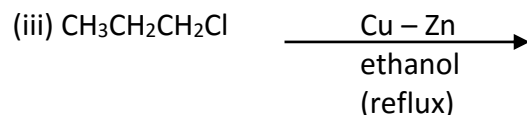
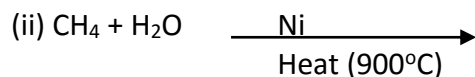
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2. (a) Complete the following equations





(b) Write the mechanism for the reaction in (iv)

(02 marks)

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3. (a) State three properties in which carbon differs from the rest of group (iv) elements.
(1 ½ marks)

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(b) Write equations for the reaction between concentrated sulphuric acid and

(i) carbon

Equation

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(ii) Tin

Equation

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4. (a) Explain why hydrogen fluoride is a weaker acid than hydrogen chloride. (02 marks)

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(b) Molar conductivities at infinite dilution at 25°C for some compounds are shown on the table below.

Compound	Λ_0 (ohm ⁻¹ m ² mol ⁻¹)
Nitric acid	0.0421
Potassium nitrate	0.0145
Potassium fluoride	0.0129

The conductivity of a 0.1 moldm⁻³ aqueous solution of hydrogen fluoride is 3.15 x 10⁻³ ohm⁻¹ m⁻¹.

Calculate the:

- (i) Molar conductivity of solution (1 ½ marks)

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- (ii) Degree of ionization of hydrogen fluoride. (2 ½ marks)

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5. (a) Draw the structures and name the shapes of the following species. (4 ½ marks)

Species	Structure	Shape
$(\text{CH}_3)_3\text{N}$		
BF_3		
NO_2^-		

- (b) Write equation for the reaction between

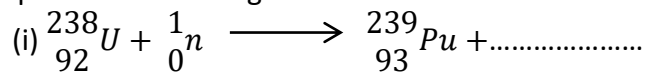
(i) Trimethylamine and borontrifluoride

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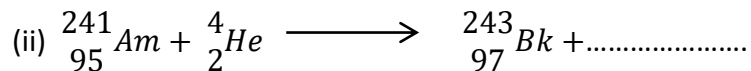
(ii) Acidified potassium manganate (VII) and nitrate ions.

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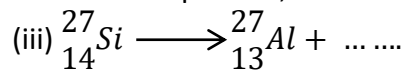
6. (a) Complete the following nuclear reactions and name the particles emitted in each case



Name of particle;



Name of particle;



Name of particle;

- (b) The mass of a radioisotope, T, reduced by 32% in 40 days. Calculate the half life of T.

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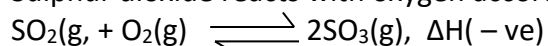
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(2 ½ marks)

7. Sulphur dioxide reacts with oxygen according to the following equation



(a) State conditions for the maximum yield of sulphur trioxide.

(1 ½ marks)

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(b) Write equation (s) to show the conversion of

(i) Sulphur trioxide to sulphuric acid

(03 marks)

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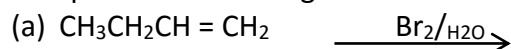
(ii) Sulphuric acid to calcium superphosphate

(1 ½ marks)

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8. Complete the following reactions and write the accepted mechanism



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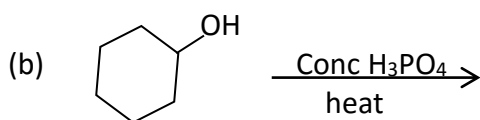
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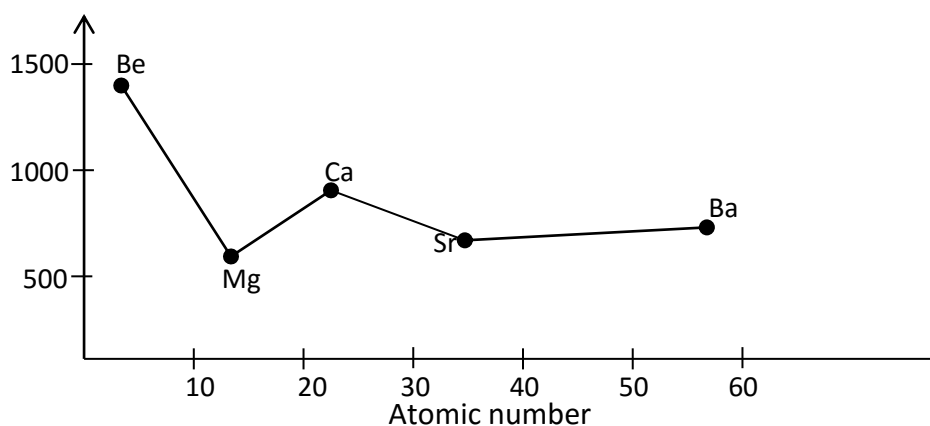
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9. The graph below shows the variation of melting points of group (II) elements in the periodic table with atomic number



Explain why

(i) The melting points decrease from Be to Ba

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- (ii) The melting point of calcium is higher than that of magnesium.

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SECTION B:

Attempt only **six** question

10. (a) Compare the reactivity of ethanol and phenol with phosphorus penta chloride. (Include equations for reactions if any) (03 marks)

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- (b) Write equations to show how the following conversions can be effected.
(include conditions for the reactions)

- (i) Ethanol to benzene

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(ii) 2 – phenyl propane to hydroxybenzene.

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11. State what would be observed and in each case write equation for the reaction that would take place if

(a) Hydrogen peroxide is added to a mixture acidified barium chromate solution and ether observation

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Equation:

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(b) Excess chlorine is dissolved in aqueous sodium thiosulphate solution

Observation

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Equation

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(c) Aqueous potassium iodide is added to potassium peroxodisulphate;

Observation

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Equation

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(d) Neutral iron (III) chloride solution is added to hydroxybenzene

Observation

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Equation
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12. (a) An aqueous solution containing 2.8gdm^{-3} of R exerts an osmotic pressure of 380mmHg at stp.

Calculate the molar mass of R

(02 marks)

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- (b) An organic compound R contains carbon, oxygen. 3.4g of R burns with a sooty flame producing 5.04 dm^3 of carbon dioxide and 2.70g of water at stp.

(i) Calculate the empirical formula of R

(2 ½ marks)

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(ii) Hence determine the molecular formula of R

(01 marks)

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(c) R reacts with a mixture of anhydrous zinc chloride and concentrated hydrochloric acid but does not react with acidified potassium dichromate (VII)

(i) Identify R (01 mark)

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(ii) Write equation of reaction between R and a mixture of anhydrous zinc chloride and concentrated hydrochloric acid. (01 mark)

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(d) Write equations to show how R can be converted to an alkyne. (1 ½ marks)

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13. (a) Explain what is meant by the term acid-base indicator. (1 mark)

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(b) Explain how phenolphthalein acts as an indicator. (02 marks)

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(c) 25cm³ of a solution containing a mixture of sodium hydroxide and sodium carbonate required 22.5cm³ of 0.1M hydrochloric acid in the presence of phenolphthalein indicator. Another 25cm³ of the same mixture required 36.5cm³ of the same acid in the presence of methyl orange indicator.

Calculate the concentration in g l⁻¹ in the mixture of

(i) Sodium hydroxide (4½ marks)

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(ii) Sodium carbonate

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(d) Explain why aqueous solution of sodium carbonate has a pH slightly above 7. (1½ marks)

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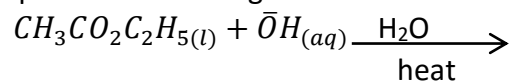
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14. (a) Complete the following reaction and write the accepted mechanism.



Mechanism

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(b) The results obtained for the Kinetics of the reaction in (a) above are shown in the table below.

Expt.	$[\text{CH}_3\text{CO}_2\text{C}_2\text{H}_5]$ mol dm^{-3}	$[\bar{O}H]$ mol dm^{-3}	Initial rate of reaction $\text{mol dm}^{-3} \text{ s}^{-1}$
1	0.076	0.076	1.13×10^{-3}
2	0.038	0.152	1.13×10^{-3}
3	0.019	0.152	5.65×10^{-4}

Deduce the order of reaction with respect to

(i) $\bar{O}H$ (1 ½ marks)

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(ii) $\text{CH}_3\text{CO}_2\text{C}_2\text{H}_5$

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(c) Write the rate equation for the reaction

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(d) Calculate the rate constant (K) for the reaction and state its units. (02 marks)

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15. The table below gives the first, second third and fourth ionization energies of elements P,Q and R

Element	Ionization energy (KJmol ⁻¹)			
	First	Second	Third	Fourth
P	800	2,400	3,700	25,000
Q	900	1,800	1,4800	21,000
R	500	4,600	6,900	9,500

(a) State and explain the general trend in variation of ionization energies. (03 marks)

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(b) State the group and period to which element P belongs. In each case give a reason for your answer

Group:

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Reason :

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Period:

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Reason:

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- (c) The wavelength at the start of the continuum in the sodium emission spectrum is 242nm. Calculate the first ionization energy of sodium in KJmol^{-1}
 (C = $3.0 \times 10^8 \text{ms}^{-1}$, Planks' constant = $6.626 \times 10^{-34} \text{Js}$ and Avogadro's constant (L) = $6.023 \times 10^{23} \text{mol}^{-1}$) (03 marks)

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16. A compound K is a colourless crystalline solid. When K was heated strongly it gave off brown fumes and a black residue. K dissolved in water to give a colourless solution.

The solution of K was divided into two portions.

- (a) To the first portion was added a few drops of concentrated nitric acid followed by a little solid lead (IV) oxide and then boiled.

- (i) Identify the cation in the solution of K (01 marks)

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- (ii) Write equation of reaction leading to the formation of the purple solution (1 ½ marks)

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- (b) To the second portion was added sodium carbonate solution state what was observed and write equation of reaction that took place. (2 marks)

Observation

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Equation

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(c) On further elemental analysis K was found to contain 19.1% of nitrogen and 43.6% oxygen.

(i) Determine the empirical formula of K. (02 marks)

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(ii) 10g of K dissolved in 1000g of water lowered the freezing point of solution by 0.127°C. Calculate the molecular formula of K.
(Kf for water is 1.86°C mol⁻¹ per 1000g) (2 ½ marks)

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17. Name the reagents that can be used to distinguish between the following pairs of ions. In each case state what is observed when each member of the pair is separately treated with the reagent. (3 marks)

(a) CrO₄²⁻ and Cr₂O₇²⁻

Reagent

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Observation

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(b) SO_3^{2-} and $\text{S}_2\text{O}_3^{2-}$

Reagent

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Observation

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(c) COO^-

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COO^-

and CH_3COO^-

Reagent

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Observation

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END