SECTION A (46 MARKS)

*Answer **all** questions from this Section.*

1. Uranium undergoes nuclear decay according to the following equation

$$^{238}_{92}U \xrightarrow{\alpha} X \xrightarrow{\beta} Y \xrightarrow{\beta} Z$$

a) Identify the species X, Y and Z *(03 marks)*

X. .....

Y. .....

Z. .....

b) 10g of Uranium was left to decay. Calculate the mass of Uranium that remained after 2.5×10^9 years. (The half-life of Uranium 238 is 4.5×10^9 years) *(03 marks)*

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2. Complete the equations and write the accepted mechanism in each case.

a) $CH_3CH_2\underset{\underset{OH}{|}}{C}HCH_3 \xrightarrow[180^0C]{Conc.H_2SO_4}$ *(2½ marks)*

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b)  $\xrightarrow[heat]{Conc.H_2SO_4}$ *(2½ marks)*

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3. Draw the structure and name the shape of the following species. *(04 marks)*

Species	Structure	Shape
NO_2^-		
SF_4		
H_3O^+		
PCl_5		

4. Write equation for the reaction between aqueous sodium hydroxide and

a) Beryllium oxide *(1½ marks)*

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b) Chromium (III) oxide *(1½ marks)*

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c) Sulphur (IV) oxide *(1½ marks)*

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5. a) State

i) Raoults law *(01 mark)*

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ii) two conditions under which the law is valid. *(01 mark)*

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b) The vapour pressures of heptane and octane are 473.2Pa and 139.8Pa respectively at 20°C.
Calculate:

i) the vapour pressure of a mixture containing 0.5 moles of heptane and 0.25 moles of octane at 20°C. (Assume that the two liquids form an ideal solution). *(02 marks)*

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ii) the composition of the vapour. *(02 marks)*

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6. Compound Q is a green solid. P dissolves in water to give a pale green solution. The solution of Q formed a red precipitate when reacted with butanedionedioxime and a redish brown solution when a few drops of Iron (III) chloride were added to it.
When Q was heated propanone was formed.

a) Identify Q. *(01 mark)*

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b) Write equation for the reaction that took place when Q was heated.

(1½ marks)

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c) Write equation(s) for the reaction(s) that would take place when excess ammonia solution is added to a solution of Q. *(02 marks)*

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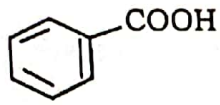
7. Write the equation in each case to show how the following conversions can be effected.

a)  from benzene

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b) $CH_3\overset{\overset{O}{\|}}{C}CH_3$ from Prop – I – ene *(03 marks)*

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8. State what would be observed and write an equation that takes place when

a) Excess concentrated hydrochloric acid is added to aqueous copper (II) sulphate solution *(2½ marks)*

Observation

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Equation

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b) Solid sodiumiodide is heated with concentrated sulphuric acid . *(02 marks)*

Observation

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Equation

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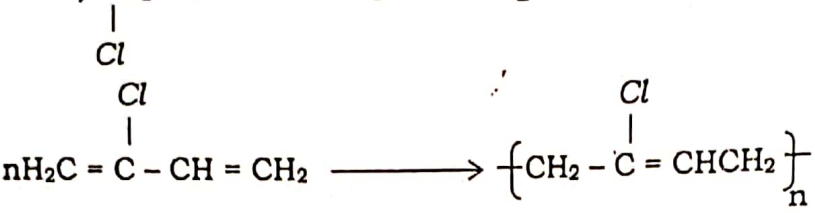
9. a) Synthetic rubber, neoprene, is made by polymerisation of 2–chlorobuta–1,3–diene, $CH_2 = C - CH = CH_2$ according to the following equation



i) State the conditions for the reaction *(01 mark)*

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ii) Name the type of polymerisation leading to the formation of polyneoprene

(0½ mark)

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b) A solution containing 2.8% of polyneoprene was found to have an osmotic pressure of 7.0×10^{-4} atmospheres at 25°C. Calculate the;

i) Molar mass of polyneoprene *(02 marks)*

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ii) Value of n *(1½ marks)*

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SECTION B (54 MARKS)

*Answer **six** questions from this Section.*

*Any additional question(s) answered will **not** be marked.*

10. a) Differentiate between order of a reaction and molecularity. *(02 marks)*

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b) The data in the table below was obtained for the reaction

$3C \rightarrow$ Products

Time (minutes)	0	60	120	180	240	320
$Log_{10}[A]$	-0.62	-0.80	-1.00	-1.14	-1.34	-1.47

Plot a graph of $log_{10}[C]$ against time. *(03 marks)*

c) From the graph determine the order of the reaction. *(01 mark)*

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d) Calculate

i) the rate constant for the reaction *(02 marks)*

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ii) the half-life of the reaction. *(01 mark)*

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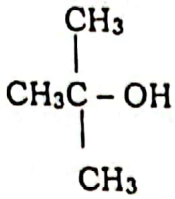
11. Name one reagent that can be used to distinguish between the following pairs of compounds. In each case, State what would be observed if each member of the pair is separately treated with the reagent you have named.

a)



and $CH_3CH_2CH_2CH_2OH$ *(03 marks)*

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b) CH_3CH_2CHO and $CH_3CH_2COCH_2CH_3$ *(03 marks)*

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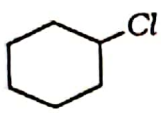
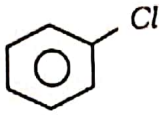
c)  and  *(03 marks)*

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12. a) i) Write the electronic configuration of chromium atom. *(01 mark)*

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ii) State why chromium is classified as a transition element. *(0½ mark)*

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b) Write the formula of all possible isomers of chromium (III) chloride – 6 – water $CrCl_3.6H_2O$. (03 marks)

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c) To an aqueous solution of chromium (III) chloride was added concentrated ammonia solution dropwise until in excess.

i) State what was observed. (1½ marks)

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ii) Write equation(s) for the reactions that took place. (03 marks)

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13. Compound Y consists of carbon 68.8%, hydrogen 4.92% and the rest being oxygen. The vapour density of the compound is 61.

a) Determine the:

i) empirical formula of Y. *(2½ marks)*

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j) molecular formula of Y *(1½ marks)*

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b) Compound Y burns with a sooty flame and the PH of its aqueous solution is less than 7. Write the structural formula of Y. *(2½ marks)*

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c) Write the equation and indicate the mechanism for the reaction between Y and ethanol in presence of concentrated sulphuric acid on heating.

(04 marks)

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14. a) Write the equation and state the condition(s) for the reaction leading to the formation of:

i) Iron (II) chloride *(2½ marks)*

Equation

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Condition(s)

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ii) Iron (III) chloride *(2½ marks)*

Equation

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Condition(s)

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b) Write equation for the reaction that takes place when Iron (III) chloride is dissolved in water. *(1½ marks)*

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c) Magnesium ribbon was added to the solution in (b).

i) State what was observed *(01 mark)*

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ii) Write equation for the reaction that took place. *(1½ marks)*

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15. The standard electrode potentials E^{θ} for some half-cell reactions are given below

	E^{θ}/V
$MnO^{-}_{4(aq)} + 8H^{+}_{(aq)} + 5e \rightarrow Mn^{2+}_{(aq)} + 4H_2O_{(l)}$	+1.52
$SO^{2-}_{4(aq)} + 2H^{+}_{(aq)} + 2e \rightarrow SO^{2-}_{3(aq)} + H_2O_{(l)}$	+0.20
$Br_{2(aq)} + 2e \rightarrow 2Br^{-}_{(aq)}$	+1.06
$Cl_{2(aq)} + 2e \rightarrow 2Cl^{-}_{(aq)}$	+1.36

a) Write the cell notation for the reaction between sulphite ions and acidified potassium manganate (VII) solution. *(1½ marks)*

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b) Write the ionic equation for the overall cell reaction. *(1½ marks)*

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c) i) Calculate the e.m.f of the cell. *(1½ marks)*

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ii) State whether the reaction is feasible or not and give a reason for your answer. *(01 mark)*

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d) Explain why hydrochloric acid is not used to acidify titrants in volumetric analysis involving potassium manganate (VII). *(2½ marks)*

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e) State which of bromine and chlorine in a stronger oxidising agent and give a reason for your answer. *(01 mark)*

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16. State what would be observed and write equation for the reaction that would take place if

a) Propene is bubbled through bromine water *(02 marks)*

Observation

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Equation

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b) A solution of iodine and sodium hydroxide is warmed with butanone *(02 marks)*

Observation

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Equation

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c) Sulphur (IV) oxide is bubbled through acidified Potassium dichromate solution *(2½ marks)*

Observation

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Equation

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d) Chlorine gas is bubbled through potassium manganate (VI) solution. *(2½ marks)*

Observation

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Equation

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17. a) Differentiate between soap and soapless detergents. *(02 marks)*

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b) Write equations to show how a soapless detergent can be prepared from dodecanol $CH_3(CH_2)_{10}CH_2OH$. *(02 marks)*

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c) Explain the cleansing action of soap. *(02 marks)*

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d) State the advantage and disadvantage of using a soapless detergent instead of soap in washing.

i) Advantage *(0½ mark)*

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ii) Disadvantage *(0½ mark)*

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e) Explain why aluminium utensils should not be washed with soap. *(02 marks)*

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