CHEMISTRY DEPARTMENT 2023
S.6 BRAINSTORMING TEST
TOPIC; PHYSICAL EQUILIBRIA
SUB-TOPIC; IMMISCIBLE LIQUID MIXTURES
PART TWO; DISTRIBUTION COEFFICIENT

NAME……**INDEX number**……..……

Signature …… **expected score(%)**…….

Instructions; *Attempt all questions in this paper*.

SECTION A

1. (a) Explain the partition law (01 mark)

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(ii) State two conditions under which the law is valid? (01 mark)

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(ii) Define the term partition coefficient. (01 mark)

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(b) State one application of the partition coefficient other than solvent extraction. (01mark)

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(c) Describe an experiment to determine the partition coefficient of ammonia between water and trichloromethane. (05 marks)

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(d) **50cm^3** of **1.5M** ammonia solution was shaken with **50cm^3** trichloromethane in a separating funnel.
After the layers had settled, **20cm^3** of the trichloromethane layer was pipetted and titrated with **0.05M** hydrochloric acid. **22.90cm^3** of the acid was required for complete neutralisation.

(i) Write the expression for the partition coefficient, K_D, for ammonia between water and trichloromethane. (01 mark)

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ii) Calculate the value of the partition coefficient. (04 marks)

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2. (a) The table below shows the concentrations of iodine in the two layers shaken with a mixture of carbon tetrachloride and water at 25^0c.

Concentration of iodine in CCl_4 ($moldm^3$)	6.12	12.24	15.20	22.38
Concentration of water in CCl_4 ($moldm^3$)	0.072	0.143	0.178	0.260

(i) Plot a graph of concentration of iodine in carbon tetrachloride against concentration of iodine in water. (03 marks)
(ii) From the graph determine the partition coefficient for iodine distributed between carbon tetrachloride and water. (02 marks)

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3. (a) (i) What is meant by the term **solvent extraction** (01 mark)

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(ii) State two limitations of solvent extraction (01 mark)

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(iii) Explain why small portions of solvent are preferred to large portions in solvent extraction of solute. (01 mark)

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(iv)State two applications of solvent extraction. (01 mark)

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4. Calculate the mass of an organic compound, Q that can be extracted from 100cm^3 of an aqueous solution containing 5.0g of Q by using; (K_D of **Q** between **ether** and **water** is **3**)

a) 100cm^3 of ether (02 marks)

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b) two successive portions of 50cm^3 of ether. (04 marks)

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(c) Comment on your results above. (01 mark)

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(d) State two reasons why **Ether** is usually preferred as an extracting solvent in solvent extraction experiments. (01 mark)

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5. Excess ammonia was shaken with equal volume of trichloromethane and a 0.05M aqueous solution of copper (II) sulphate and allowed to stand. Some ammonia reacted with copper (II) ions to form a complex, $[(NH3)]^{2+}$.
At equilibrium, the concentrations of ammonia in the trichloromethane and aqueous layers were 0.021M and 0.725M respectively.
(KD for ammonia between water and trichloromethane = 25)

(a) Calculate the concentration of;

(i) free ammonia in the aqueous layer. (02 marks)

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(ii) ammonia that formed a complex with copper(II) ions. (02mks)

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(b) Determine the value of n in the complex. (02 marks)

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6. Cobalt (II) ions form a complex, $[Co(NH3)n]^{2+}$, with ammonia solution. The table below shows the results of partition of ammonia between 0.1M cobalt (II) sulphate and trichloromethane.

Concentration of NH_3 in **0.1M** $CoSO_4$	0.72	0.94	1.19	1.43	1.70	1.92
Concentration of NH_3 in $CHCl_3$	0.01	0.03	0.05	0.07	0.09	0.11

(i) Plot a graph of [NH3] in 0.1M CoSO4 against [NH3] in $CHCl_3$ (03 marks)

(ii) Determine the value of n in the complex. (02 marks)

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6. **8g** of an ore of zinc was dissolved in excess ammonia and the resultant solution was diluted to one litre with water, shaken with trichloromethane and left to settle.

$50cm^3$ of the trichloromethane layer required $25cm^3$ of 0.05M hydrochloric acid for complete neutralisation, while $25cm^3$ of the aqueous layer required $40cm^3$ of 0.5M hydrochloric acid.
(The partition coefficient for ammonia between water and CHCl3 is 25)

Calculate the

(i) Concentration of zinc ions in the complex

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(ii) Percentage of zinc in the ore

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END.