

OLABISI ONABANJO UNIVERSITY

DEPARTMENT OF CHEMICAL SCIENCES.

2009/2010 HARMATTAN SEMESTER CONTINUOUS ASSESSMENT

CHM 201: INORGANIC CHEMISTRY I

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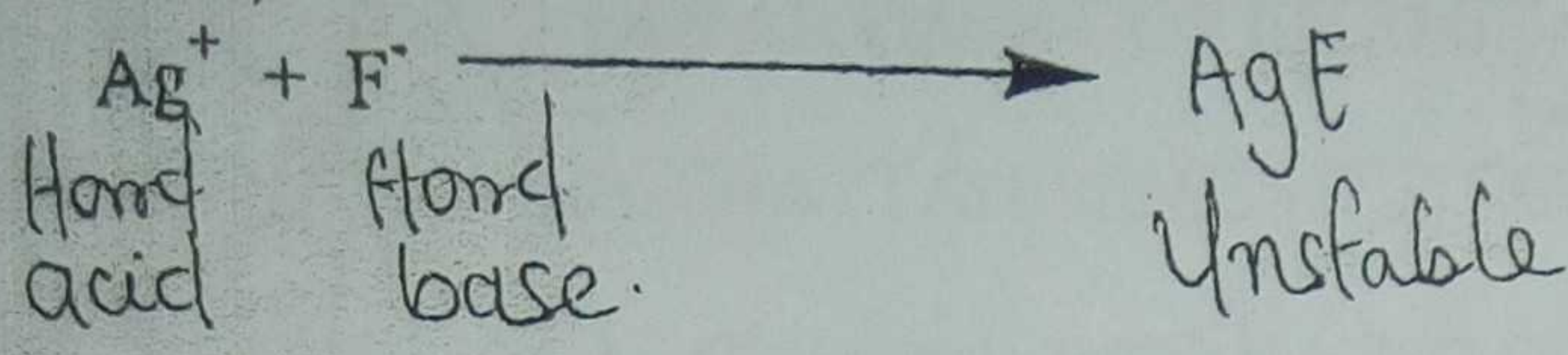
Instruction: Attempt all questions. Questions 1-10 carry one mark each

- Group V halides are extremely toxic except: (a)  ~~$\text{NH}_3$~~  (b)  $\text{PH}_3$  (c)  $\text{AsH}_3$  (d)  $\text{SbH}_3$  (e) none of the above.
- Which of the following group V elements does not exhibit allotropy: (a) phosphorus (b) arsenic (c) phosphorus and arsenic (d) antimony (e) ~~bismuth~~
- Which of the following is not a binary compound of sulphur with oxygen? (a)  $\text{S}_2\text{O}$  (b)  $\text{S}_2\text{O}_3$  (c)  ~~$\text{S}_2\text{O}_5$~~  (d)  $\text{SO}_2$  (e)  $\text{SO}_3$
- Oxygen can be obtained in the laboratory by any one of the following methods except: (a) ~~the thermal decomposition of higher oxides~~ (b) ~~the chemical oxidation of the metals low in the electrode potential series~~ (c) ~~the decomposition of peroxides~~ (d) ~~the thermal decomposition of the oxides of metals low in the electrode potential series~~ (e) electrolysis of aqueous solutions of alkalis and acids.
- Group VII elements are: (a) diatomic molecules (b) ~~mono-atomic elements~~ (c) diatomic in gas phase only (d) diatomic in liquid phase only (e) diatomic in solid phase only.
- Which of the following group VII element cannot be formed by chemical oxidation method? (a) fluorine (b) chlorine (c) bromine (d) iodine (e) ~~astatine~~
- The pentahalides of phosphorus results from a ~~.....~~ hybridization. (a)  $\text{sp}^3$  (b)  $\text{sp}^2$  (c)  ~~$\text{sp}^3\text{d}$~~  (d)  $\text{sp}$  (e)  $\text{sp}^3\text{d}^5$
- Which of the following anions would be highly polarizable? (a)  $\text{F}^-$  (b)  $\text{Cl}^-$  (c)  $\text{Br}^-$  (d)  ~~$\text{I}^-$~~  (e) none of the above
- Which of the following is not a known oxide of chlorine? (a) chlorine monoxide (b) chlorine dioxide (c) ~~chlorine pentoxide~~ (d) chlorine hexoxide (e) chlorine heptoxide.
- Which of the following hydrides of group VII elements are readily oxidized by concentrated  $\text{H}_2\text{SO}_4$  to the free halogen? (a)  $\text{HF}$  and  $\text{HCl}$  (b)  $\text{HCl}$  and  $\text{HBr}$  (c)  $\text{HF}$  and  $\text{HBr}$  (d)  ~~$\text{HBr}$  and  $\text{HI}$~~  (e)  $\text{HF}$  and  $\text{HI}$ .
- State the Hard and Soft Acid and Base (HSAB) principle. (1/2 mark)

Hard and Soft Acid and Base principle states that Hard acid will combine with hard base and soft acid will combine with soft base. i.e.



12. For the reaction below, state with reason whether or not the product would be stable (1/2 mark)



13. Distinguish between solvation and hydration. (1/2 mark)

Solvation is when the solute is surrounded by water molecules.  
 Hydration is when the solvent surrounding the solute molecules is water.

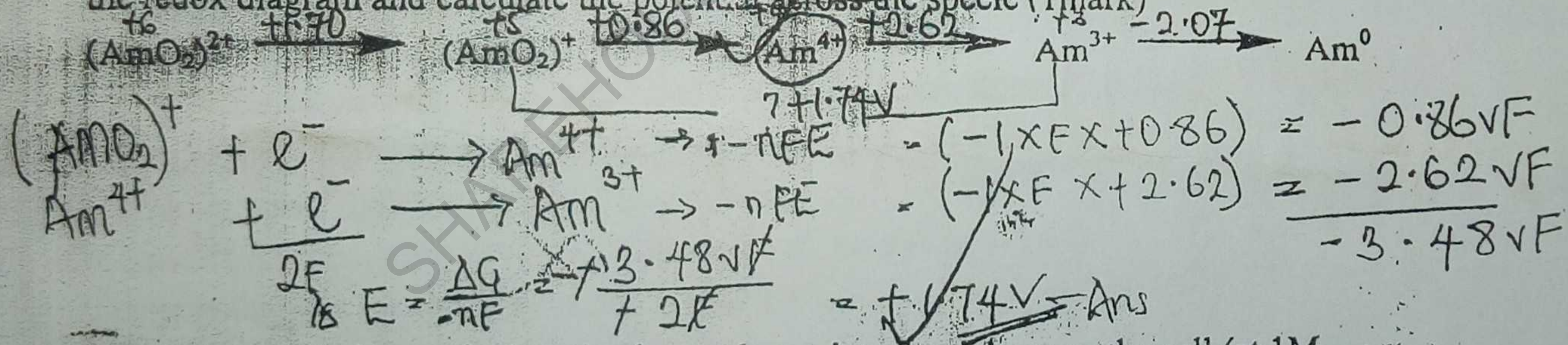
14. State any two factors that affect the rate of dissolution. (1/2 mark)

- 1) Temperature
- 2) Surface Area

15. Give that  $\Delta H^\circ$  and  $\Delta S^\circ$  for dissolution of  $\text{Ca}(\text{NO}_3)_2$  are  $-19\text{kJ/mol}$  and  $+45\text{J/mol}$  respectively. Calculate  $\Delta G$  (kJ/mol) and hence determine the spontaneity of the process at STP. (1 mark)

$\Delta G = \Delta H - T\Delta S$   
 $= -19 - (298 \times 45)$   
 $\Delta G = -13.429\text{ kJ/mol}$   
 $\therefore \Delta G = -13\text{ kJ/mol}$  — Ans.  
 Hence, it is Spontaneous.

16. Identify (by circling) the species which is unstable with respect to disproportionation in the redox diagram and calculate the potential across the species (1 mark)



17. For the couple below, calculate the thermodynamic potential across the cell (at 1M conc.), hence calculate the gibbs (kJ/mol) free energy of the system (2 marks)

$\text{Ag}^+ + e^- \rightleftharpoons \text{Ag(s)} \quad E^\circ = +0.799\text{V}$   
 $\text{Cu}^{2+} + 2e^- \rightleftharpoons \text{Cu(s)} \quad E^\circ = +0.337\text{V}$

Cathode:  $E_{\text{cathode}} = E^\circ - \frac{0.0591}{n} \log \left( \frac{[\text{Ag}]}{[\text{Ag}^+]}\right)$   
 $= +0.799 - \frac{0.0591}{1} = +0.7399$

Anode:  $E_{\text{anode}} = E^\circ - \frac{0.0591}{n} \log \left( \frac{[\text{Cu}]}{[\text{Cu}^{2+}]}\right)$   
 $= +0.337 - \frac{0.0591}{2} = +0.3074$

$E_{\text{cell}} = E_{\text{cathode}} - E_{\text{anode}} = +0.7399 - +0.3074 = +0.4325\text{V}$   
 $\Delta G = -nFE = -2 \times 96485 \times 0.4325 = -83700\text{ J/mol} = -83.7\text{ kJ/mol}$