1. **(5 marks)** Complete the following table:

FORMULA	SYSTEMATIC NAME
	arsenic(III) oxide
$KMnO_4$	
	potassium acetate
$[Fe(H_2O)_6]^{2+}$	
	sodium tetrachlorocuprate(II)
$Na[Ag(CN)_2]$	
	triaquatrichlorochromium(III)
NH_4Cl	
	hexacyanoferrate(III) ion
$[CuCl(H_2O)_3]^{+}$	

2. **(6½ marks)** (a) For which atoms do each of the following ground state electron configurations apply:

(i) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^{10}\ 4p^4$
(ii) $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^5$

(b) Give the full ground state electron configurations for each of the following **species**:

(i) $O^{2!}$
(ii) K

(c) Compounds of d-block elements are frequently paramagnetic. Using the box notation to represent atomic orbitals, account for this property in compounds of Ni^{2+}.

(d) Write the equation that defines the first electron affinity of Cl.

3. **(2 marks)** Use the concepts of effective nuclear charge (core charge) and screening to explain why the atomic radii of atoms decrease across any given Period of the Table and increase down a Group.

4. **(4½ marks)** Complete the following table.

MOLECULE	LEWIS DIAGRAM	ARRANGEMENT OF ELECTRON PAIRS around the underlined atom	SHAPE OF MOLECULE
$\underline{N}H_3$			
$\underline{S}F_6$			
$\underline{Be}Cl_2$			

5. **(1½ marks)** Consider the hydrogen fluoride molecule, HF. Use the valence bond model to detail the occupancy of atomic orbitals by the valence shell electrons (**bonding and lone pairs**) for both atoms, and the bond type(s) resulting from any overlap of atomic orbitals.

6. **(1½ marks)** In the laboratory experiment investigating solubility of silver salts, in order to obtain a very low concentration of Ag^+ ions, excess ammonia solution was added to silver nitrate solution. **Explain** how this lowers the silver ion concentration. Iinclude an equation in your answer.

7. **(1½ marks)** Why does the "octet rule" apply only to some elements of Period 2 of the Periodic Table? Give two examples of compounds of elements from elsewhere in the Periodic Table where the central atom exceeds the octet of electrons in its valence level.

8. **(1 mark)** Explain why the hydride ion, H^-, is a stable species despite having twice as many electrons as protons.

9. **(2½ marks)** Write a short account of buffer solutions. Include in your answer the following:
What components are required and how does a buffer operate?
What factors determine the initial pH of the buffer and its capacity?
What is required to form the most effective buffer?

10. **(6½ marks) Relevant pK_a data is on the separate data sheet.**
(a) Calculate the pH of the following solutions in water at 298 K. Give your answer to 2 decimal places.

(i) Lactic acid (0.10 M)

(ii) Ammonia (0.10 M)

(b) A buffer of pH = 4.50 is required, using CH_3COOH as the weak acid and its conjugate, $CH_3CO_2^-$, as the weak base. If the concentration of CH_3COOH used is 2.00 M, calculate the concentration of $CH_3CO_2^-$ that would be needed in the buffer to give the desired pH. Give your answer to 2 significant figures.

11. **(1½ marks)** Explain why the equivalence point of a titration between acetic acid and sodium hydroxide occurs at a pH of about 8.5.

12. **(1½ marks)** Explain with the aid of a diagram how the K_a for a weak acid can

be obtained from a titration curve.

13. **(1½ marks)** How does one select an indicator so that the "end point" will correspond to the "equivalence point" in a titration?

14. **(1½ marks)** Use the pK_a data on the data page where relevant to rank the following acids in order of **increasing** strength:

nitrous acid, hydrogen chloride, ammonium ion, lactic acid

weakest acid strongest acid

15. **(1½ marks)** Explain why a solution of iron(III) chloride is acidic.

NOVEMBER 2001 PART A

CHEMISTRY 1002 SEMESTER 2 EXAMINATION

DATA PAGE, PART A

Acid dissociation constants, pK_a, at 298 K

nitrous acid	3.14
lactic acid	3.86
acetic acid, CH_3COOH	4.76
ammonium ion, NH_4^+	9.24

PERIODIC TABLE HERE MAYBE WARREN?