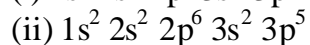
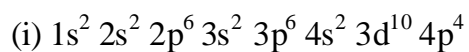


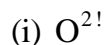
1. (5 marks) Complete the following table:

FORMULA	SYSTEMATIC NAME
	arsenic(III) oxide
$\text{KMnO}_4$	
	potassium acetate
$[\text{Fe}(\text{H}_2\text{O})_6]^{2+}$	
	sodium tetrachlorocuprate(II)
$\text{Na}[\text{Ag}(\text{CN})_2]$	
	triaquatrchlorochromium(III)
$\text{NH}_4\text{Cl}$	
	hexacyanoferrate(III) ion
$[\text{CuCl}(\text{H}_2\text{O})_3]^+$	

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



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



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

(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.

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4. (4½ marks) Complete the following table.

MOLECULE	LEWIS DIAGRAM	ARRANGEMENT OF ELECTRON PAIRS around the underlined atom	SHAPE OF MOLECULE
<u>N</u> H <sub>3</sub>			
<u>S</u> F <sub>6</sub>			
<u>Be</u> Cl <sub>2</sub>			

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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  $\text{Ag}^+$  ions, excess ammonia solution was added to silver nitrate solution. **Explain** how this lowers the silver ion concentration. Include 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,  $\text{H}^-$ , 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  $\text{pH} = 4.50$  is required, using  $\text{CH}_3\text{COOH}$  as the weak acid and its conjugate,  $\text{CH}_3\text{CO}_2^-$ , as the weak base. If the concentration of  $\text{CH}_3\text{COOH}$  used is 2.00 M, calculate the concentration of  $\text{CH}_3\text{CO}_2^-$  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
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15. (1½ marks) Explain why a solution of iron(III) chloride is acidic.

**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, $\text{CH}_3\text{COOH}$	4.76
ammonium ion, $\text{NH}_4^+$	9.24

**PERIODIC TABLE HERE MAYBE WARREN?**