(*a*) **A** and **B** are **complex ions**, (i.e. metal ion and ligands coordinated to it) with an octahedral geometry. They have the same atomic composition of $MnC_5H_3N_6$. In each complex ion, **two** types of ligands are coordinated to the metal ion. When an aqueous solution containing **A** is treated with a potassium salt, the **coordination compound C** is formed. **C** gives four ions in aqueous solution. When an aqueous solution containing **B** is treated with a potassium salt the **coordination compound D** is formed. **D** gives three ions in aqueous solution. Both **C** and **D** have an octahedral geometry.

(**Note**: The oxidation states of manganese in **A** and **B** do not change on treatment with the potassium salt).

(i) Identify the ligands coordinated to manganese in **A** and **B**.

(ii) Give the structures of **A**, **B**, **C** and **D**.

(iii) Write the electronic configurations of the manganese ions in **A** and **B**.

(iv) Write the IUPAC names of **C** and **D**.

(*b*) (i) **A**, **B** and **C** are coordination compounds. They have an octahedral geometry. In each compound, **two types** of ligands are coordinated to the metal ion. The molecular formulae of the compounds are (**not** in order): $NiCl_2H_{12}N_4$, $NiI_2H_{16}N_4O_2$ and $NiCl_2H_{15}N_3O_3$.

Given below are the observations when aqueous solutions of the compounds are treated with $Pb(CH_3COO)_2(aq)$.

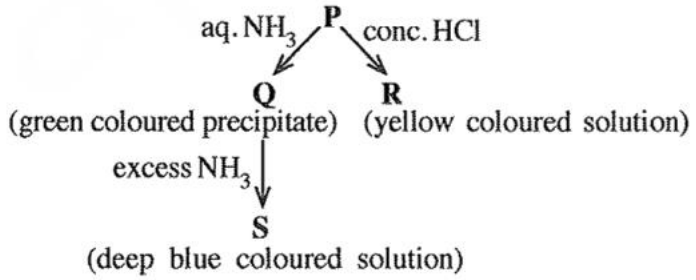
Compound	$Pb(CH_3COO)_2(aq)$
A	A white precipitate that is soluble in hot water
B	No precipitate
C	A yellow precipitate that is soluble in hot water

I. Give the structures of **A**, **B** and **C**.

II. Write the chemical formulae of the precipitates formed on treatment of the compounds with $Pb(CH_3COO)_2(aq)$.
(**Note**: Indicate compound and reagent)

III. State a chemical test, together with the observation, to identify each of the anion/s if present, that is/are not coordinated to the metal ion in the compounds given above.
(**Note**: The tests given by you should not be a test stated here.)

(ii) A transition metal **M** forms a coloured complex ion **P** in aqueous medium. It has the general formula $[M(H_2O)_n]^{m+}$. It undergoes the reactions given below.



I. Identify the metal **M**. Give the oxidation state of **M** in complex ion **P**.

II. Give the electronic configuration of **M** in the complex ion **P**.

III. Give the values of n and m.

IV. Give the geometry of **P**.

V. Give the structures of **Q**, **R** and **S**.

VI. Give the IUPAC names of the complex ions, **P**, **R** and **S**. ***(75 marks)***