**Q1.** (a) (i) The addition of aqueous silver nitrate, followed by concentrated aqueous ammonia, can be used to distinguish between separate aqueous solutions of sodium bromide and sodium iodide.
Record what is observed in the table below.

| | The addition of $AgNO_3(aq)$ | followed by | the addition of concentrated $NH_3(aq)$ |
|---|---|---|---|
| Observation with NaBr(aq) | | | |
| Observation with NaI(aq) | | | |

(ii) Explain why it is not possible to distinguish between separate solutions of sodium nitrate and sodium fluoride by the addition of silver nitrate solution.

.....

**(5)**

(b) When aqueous sodium thiosulphate is added to solid silver bromide a reaction occurs and a colourless solution is formed.

(i) Identify the silver-containing species present in the colourless solution.

.....

(ii) Write an equation for this reaction.

.....

(iii) Give **one** use of this reaction.

.....

**(3)**

(c) Aqueous silver nitrate can be used to distinguish between chloroethanoic acid and ethanoyl chloride.

(i) Draw the structure of ethanoyl chloride. Predict what, if anything, you would observe when ethanoyl chloride is added to aqueous silver nitrate.

*Structure of ethanoyl chloride*

*Observation* .....

.....

(ii) Draw the structure of chloroethanoic acid. Predict what, if anything, you would observe when chloroethanoic acid is added to aqueous silver nitrate.

*Structure of chloroethanoic acid*

*Observation* .....

.....

**(4)**

(d) (i) Tollens' reagent is formed by the addition of aqueous ammonia to aqueous silver nitrate. Identify the silver-containing complex present in Tollens' reagent and state its shape.

*Silver-containing complex* .....

*Shape*.....

.....

(ii) Draw the structure of methanoic acid. By reference to this structure, suggest why a silver mirror is formed when this acid reacts with Tollens' reagent.

*Structure* .....

*Explanation*.....

.....

(iii) Deduce the identity of a carbon-containing species formed when methanoic acid reacts with Tollens' reagent.

.....

**(5)**
**(Total 17 marks)**

**Q2.** Which one of the following reactions does **not** involve donation of an electron pair?

**A** $H^+ + CH_3NH_2 \rightarrow CH_3NH_3^+$

**B** $AlCl_3 + Cl^- \rightarrow A1C1_4^-$

**C** $CH_3Cl + CN^- \rightarrow CH_3CN + Cl^-$

**D** $\frac{1}{2}Cl_2 + I^- \rightarrow Cl^- + \frac{1}{2}I_2$

**(Total 1 mark)**

**Q3.** Chlorine and bromine are both oxidising agents.

(a) Define an *oxidising agent* in terms of electrons.

.....

**(1)**

(b) In aqueous solution, bromine oxidises sulphur dioxide, $SO_2$, to sulphate ions, $SO_4^{2-}$

(i) Deduce the oxidation state of sulphur in $SO_2$ and in $SO_4^{2-}$

$SO_2$ .....

$SO_4^{2-}$ .....

(ii) Deduce a half-equation for the reduction of bromine in aqueous solution.

.....

(iii) Deduce a half-equation for the oxidation of $SO_2$ in aqueous solution forming $SO_4^{2-}$ and $H^+$ ions.

.....

(iv) Use these two half-equations to construct an overall equation for the reaction between aqueous bromine and sulphur dioxide.

.....

**(5)**

(c) Write an equation for the reaction of chlorine with water. Below each of the chlorine-containing products in your equation, write the oxidation state of chlorine in that product.

.....

.....

**(3)**

(d) Give a reason why chlorine is not formed when solid potassium chloride reacts with concentrated sulphuric acid.

.....

**(1)**

(e) Write an equation for the reaction between solid potassium chloride and concentrated sulphuric acid.

.....

**(1)**

(f) Solid potassium bromide undergoes a redox reaction with concentrated sulphuric acid.

(i) Give the oxidation product formed from potassium bromide.

.....

(ii) Give the reduction product formed from sulphuric acid.

.....

**(2)**

**(Total 13 marks)**