1 **(a)** $5Fe^{2+} + MnO_4^- + 8H^+ \rightarrow 5Fe^{3+} + Mn^{2+} + 4H_2O$

[1]

(b) If volume of titre is assumed to be 25 cm^3:

Amount of $KMnO_4$ required = 0.5 x 0.025 = 0.0125 mol

Amount of Fe^{2+} = 0.0125 x 5 = 0.0625 mol

Mass of Fe^{2+} = 0.0625 x 55.8 = 3.4875 g

Maximum mass of tablet = (100/80) x 3.4875 = 4.36 g

Minimum mass of tablet = (100/90) x 3.4875 = 3.88 g

[2]

(c)

- Weigh a dry and clean weighing bottle.
- Add iron supplement tablet into the weighing bottle and weigh the bottle + tablet.
- Tip the tablet into a small beaker and reweigh the emptied weighing bottle to determine the actual mass of tablet used.
- Add excess dilute sulfuric acid to the small beaker containing the tablet.
- Stir with a glass rod to dissolve the tablet.
- Transfer the solution with several washings into a clean 250 cm^3 volumetric flask.
- Make up to the mark with distilled water.
- Stopper the volumetric flask and shake well to obtain a homogeneous solution.
- Pipette 25.0 cm^3 of the iron solution prepared into a 250 cm^3 conical flask.
- Fill the burette the standard solution of $KMnO_4$.
- Titrate the iron solution against $KMnO_4$ from the burette, with continuous swirling.
- Stop when one drop of solution from the burette causes a colour change from colourless to pale pink.

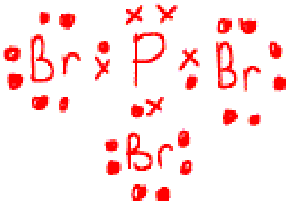
[6]

(d)

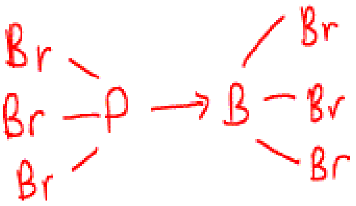
Step	Expected observation	Identity of cation in ppt
Pour 2 cm^3 of the solution into a test tube. Add NaOH(aq) dropwise until excess.	Pale blue ppt formed in colourless solution.	Cu^{2+}
Filter the mixture into a separate test tube. Add excess H_2SO_4(aq) to the filtrate.	White ppt formed. [½]	Ba^{2+}
* Can identify Ba^{2+} first		

[3]

2 a) i)



ii)



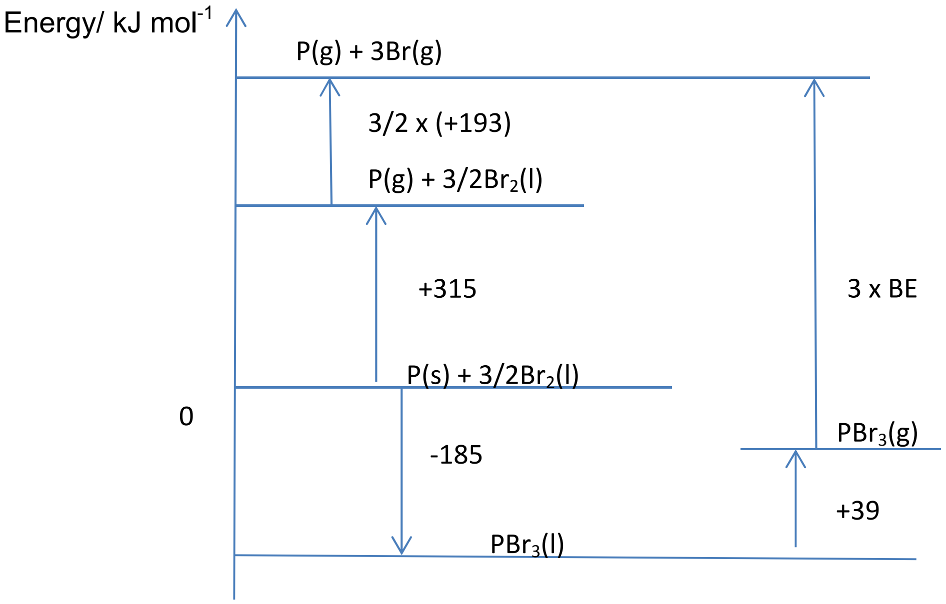
iii) Both compounds are simple covalent. Phosphorus tribromide is polar with permanent dipole-permanent dipole while boron tribromide is non polar with induced dipole-induced dipole. More energy required to break the stronger pd-pd interactions of phosphorus tribromide so PBr_3 has a higher boiling point.

[5]

b) $PBr_3(l) + 3H_2O(l) \rightarrow H_3PO_3(aq) + 3HBr(aq)$

[1]

c)

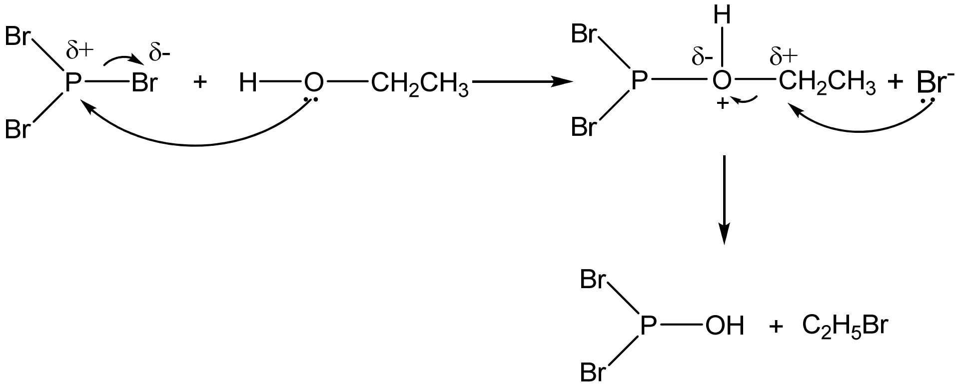


BE = +250 kJmol^{-1}

[4]

d) i) Nucleophilic substitution

ii)

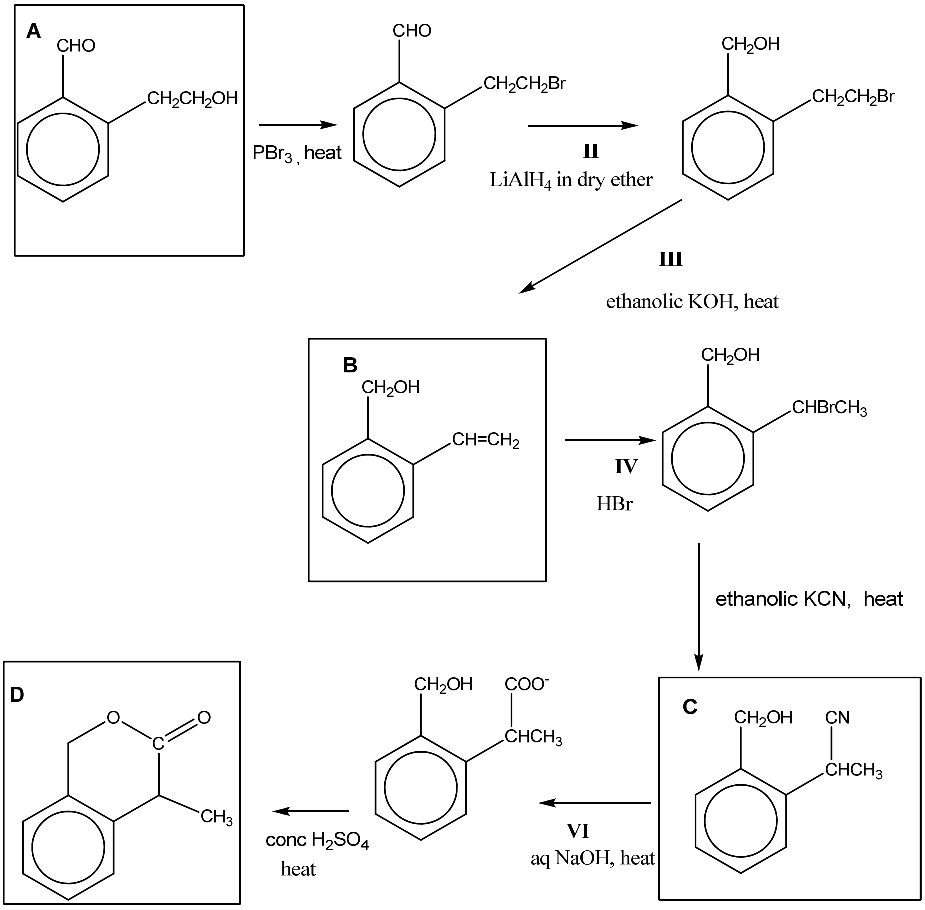


iii) To form $C(CH_3)_3Br$ would require the starting alcohol to be a tertiary alcohol which is not feasible for a SN2 reaction due to steric hindrance/large bulky groups/electron donating methyl groups.

iv) CH_3COBr **[7]**

e) **(i)**

(ii)



[8]

Total: 25 marks

3

a) $H_2O_2 + 2I^- + 2H^+ \rightarrow 2H_2O + I_2$

b) From graph 1, since graph is a straight line graph, rate of reaction is constant when $[H^+]$ changes. Therefore zero order wrt $[H^+]$.

From graph 1, when $[I^-]$ is constant, $[H_2O_2]$ is doubled, rate (gradient) is doubled from 0.02/2s to 0.02/s.

Therefore first order wrt $[H_2O_2]$.

From graph 2,

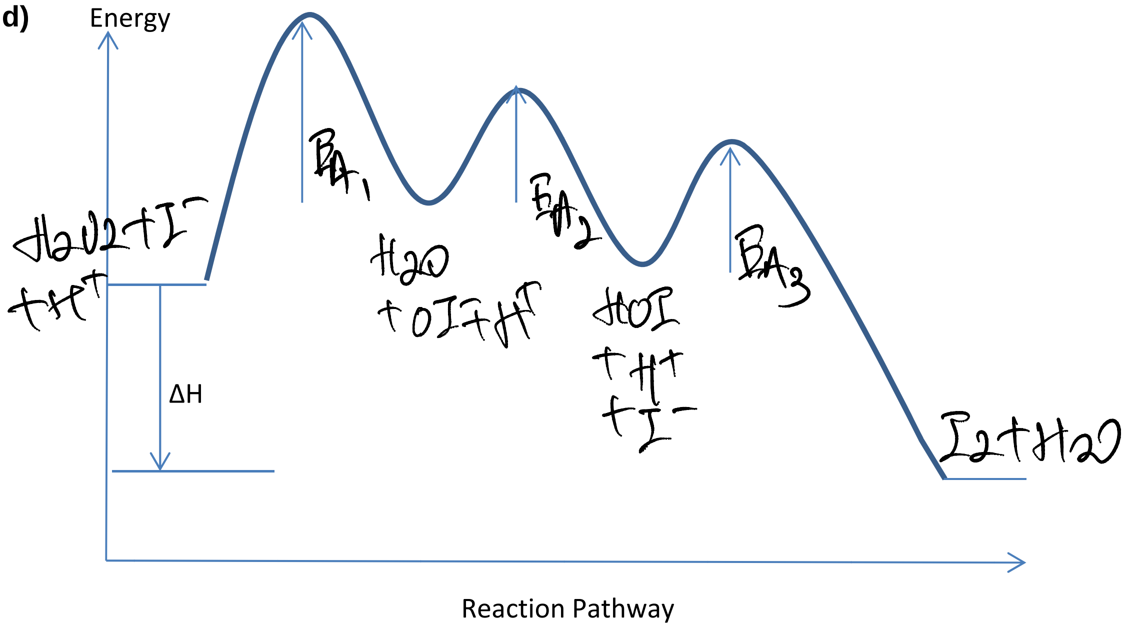
When $[H^+] = 1.0$ mol dm^{-3}, $[H_2O_2] = 2.0$ mol dm^{-3}, $t_{1/2}$ is constant at ½ t.
Therefore first order wrt $[I^-]$.

Rate = k $[H_2O_2][I^-]$ units for k: $mol^{-1}dm^3s^{-1}$

c) Mechanism A.

Step 1 is the rate determining step as the stoichiometric coefficient of the reactants matches the power of the $[H_2O_2]$ and $[I^-]$ in the rate equation.

d)



[Total: 11 marks]

4 a) i)

	Co	N	H	Cl
%	25.2	24.0	5.1	45.7
Mole ratio	0.428	1.71	5.1	1.29
Simplest ratio	1	4	12	3

n $(CoN_4H_{12}Cl_3)$ = 233.4,

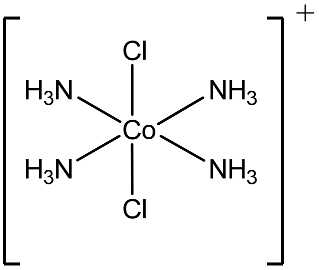
n = 1

molecular formula = $CoN_4H_{12}Cl_3$. Ligands: NH_3 and Cl^-

ii) 0.01 mol of P contains 9.965×10^{-3} mol of free chloride ions

1mol of P contains 1 mol of free chloride ions

formula of **P : [**$[Co(NH_3)_4Cl_2]^+ Cl^-$



[6]

b) **i)** Catalyst

The reaction becomes faster when it is added as seen from the vigorous effervescences

The solution turns from pink to green and back to pink colour as the catalyst is regenerated

4c) **i)** Violet

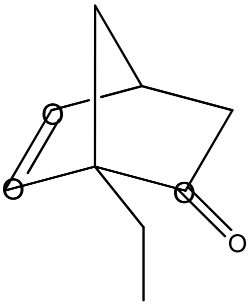
ii) In the isolated gas phase, the d orbitals of the Co^{2+} is degenerate. In the complex, partially filled 3d orbitals split into two groups with a small energy gap between them. When light shines, the complex absorbs light energy from the visible light spectrum to promote electrons from the lower to the higher energy group, (d-d transition). The light not absorbed will be reflected and seen as the colour of the complex.

[7]

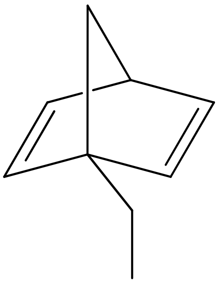
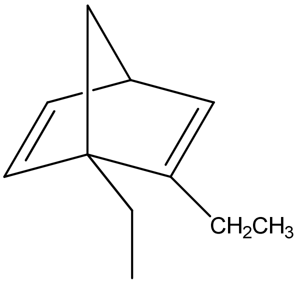
[Total: 13marks]

5 **a)** **i)** Number of chiral centers = 2

ii)



iii)

H_2O	Chloroethane
	

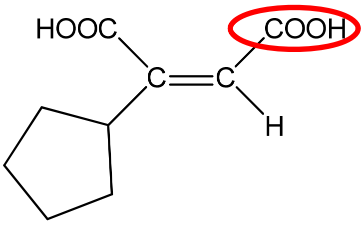
iv) Reagents and conditions: $KMnO_4$, aq. H_2SO_4, heat

Observations: S decolourise purple $KMnO_4$ but purple $KMnO_4$ remains in R

*$K_2Cr_2O_7$ accepted.

[6]

(b)

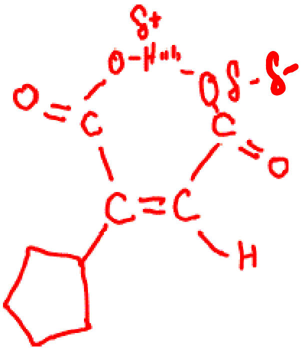


J

(i) It is further from the electron donating cyclopentane group which destabilise the carboxylate anion.

(ii) Geometric isomer/ cis-trans

5 (b) (iii)



Anion after dissociation is stabilised by intra hydrogen bonding of the carboxylate group with –OH

[5]

[Total: 11 marks]

~~~END~~~
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