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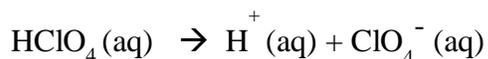
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QUESTION 2

Perchloric acid, HClO_4 (l), is a strong acid.

What is the hydrogen ion concentration (in mol litre^{-1}) when 0.15 g of Perchloric acid is dissolved in sufficient water to make 0.05 litres of final solution?

The equation for the dissociation is -



What is the pH of this solution (to the nearest integer)?

QUESTION 3

Iodine, I_2 , reacts with chlorine, Cl_2 , to form iodine monochloride, ICl . The molar bond enthalpies are as follows:

Bond	I-I	Cl-Cl	I-Cl
Molar bond enthalpy/kJ	151	242	211

(a) (10 marks) Use these values to *estimate* the overall enthalpy change for the reaction of one mole of iodine with one mole of chlorine (assume that the reactants and products are in the gas phase). You should include a balanced equation for this process in your answer, and you should show all the stages in your reasoning.

(b) (3marks) is the reaction endothermic or exothermic. *Explain* your answer.

(c) (2marks) *write down* a balanced thermo-chemical equation for this process.

(d) (12 marks) the reaction between iodine and chlorine is reversible and a chemical equilibrium is established. *Explain, in no more than 300 words in total:*

(i) What effect increasing the pressure will have on the equilibrium yield?

(ii) What effect increasing the temperature will have on the equilibrium yield.

(iii) What effect increasing the temperature will have on the rate of the reaction.

(iv) What effect the presence of a catalyst has on the equilibrium yield and on the rate of reaction.

Your answers to part (d) should include a clear statement of Le Chatelier's principle and in (i)

and (ii) your explanations should show a clear

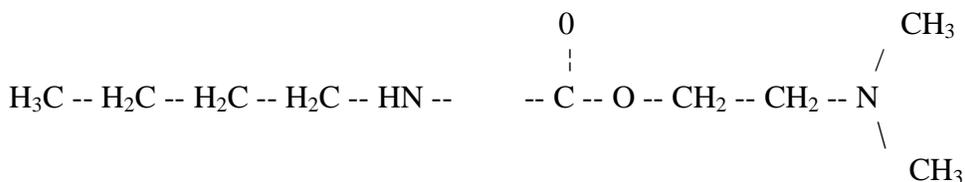
understanding of how Le Chatelier's principle applies to the

situations described. Two of the marks for this question will be awarded for the

overall clarity of your answers.

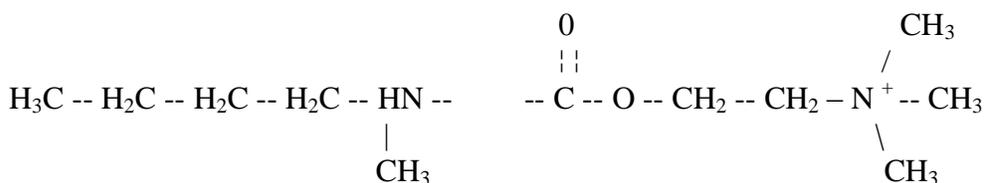
QUESTION 4

(a) (25 marks) this part of the question concerns compound **1**, tetracaine (see Figure 1), which is used as a spinal anaesthetic during lumbar punctures.



(i) *Identify two amine functional groups, one ester functional group and a benzene ring in compound 1 by circling them, and naming them clearly on the copy of compound 1.*

(ii) Draw the structural formulae of the products of the complete hydrolysis of 1, and circle and label the new functional groups formed in this reaction.



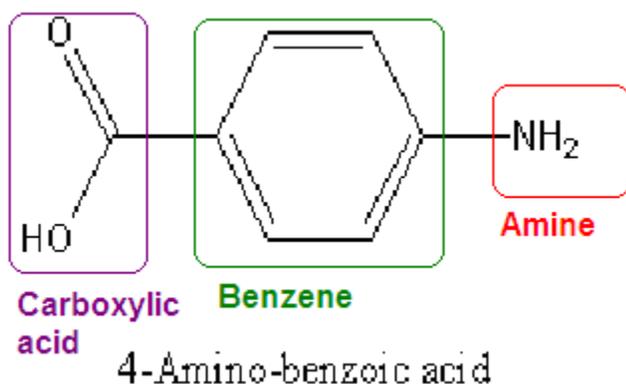


Figure 1 Structural formula of **compound 2**.

(iii) Tetracaine is thought to bind to receptors in its methylated form, **compound 2** (Figure 2). *Identify* the atoms or groups in **compound 2** that could be involved in its binding to a receptor via:

- hydrogen bonding;
- an ionic interaction.

Give the types of functional group that need to be present in the receptor sites in order for these forms of binding to take place.

(b) (6 marks) Butyl rubber is made from the polymerization of **compound 3** (Figure 3).

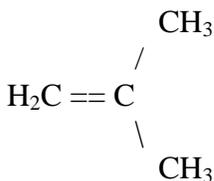
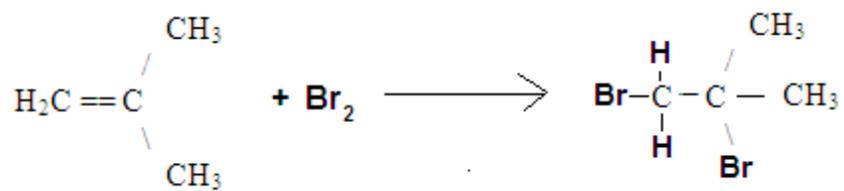


Figure 1 Structural formula of **compound 3**.

(i) **Compound 3** reacts with bromine, Br₂. *Write* a chemical equation for this reaction. The equation should show clearly the difference between the structures of the reactants and the structure of the product(s) of the reaction. *Describe* and *name* the type of reaction that is taking place between **compound 3** and bromine. (One or two sentences)



(ii) *Draw* the structure of the polymer formed from compound **3** and identify the monomer unit. Your drawing should show four monomer units. What type of polymerization is involved in forming this polymer?

This is a “chain-growth” or addition polymer.

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