

SL Paper 2

Chloroethene, $\text{C}_2\text{H}_3\text{Cl}$, is an important organic compound used to manufacture the polymer poly(chloroethene).

a.i. Draw the Lewis structure for chloroethene and predict the $\text{H}-\text{C}-\text{Cl}$ bond angle. [2]

a.ii. Draw a section of poly(chloroethene) containing six carbon atoms. [1]

a.iii. Outline why the polymerization of alkenes is of economic importance and why the disposal of plastics is a problem. [2]

b.i. Chloroethene can be converted to ethanol in two steps. For each step deduce an overall equation for the reaction taking place. [2]

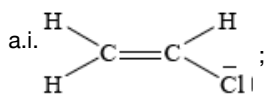
Step 1:

Step 2:

b.ii. State the reagents and conditions necessary to prepare ethanoic acid from ethanol in the laboratory. [2]

b.iii. State an equation, including state symbols, for the reaction of ethanoic acid with water. Identify a Brønsted-Lowry acid in the equation and its conjugate base. [3]

Markscheme

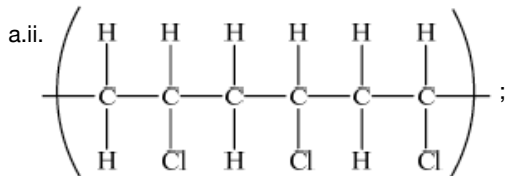


Accept lines, dots or crosses for electron pairs.

Lone pairs required on chlorine.

(approximately) 120° ;

Accept any bond angle in the range $113-120^\circ$.



Brackets not required for mark.

Continuation bonds from each carbon are required.

Cl atoms can be above or below carbon spine or alternating above and below.

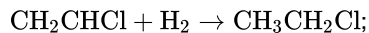
a.iii. plastics are cheap/versatile/a large industry / plastics have many uses / OWTTE;

plastics are not biodegradable / plastics take up large amounts of space in landfill / pollution caused by burning of plastics / OWTTE;

Do not accept plastics cause litter.

Allow plastics don't decompose quickly / OWTTE.

b.i.(i) Step 1:



Step 2:



Allow NaOH or NaCl etc. instead of OH⁻ and Cl⁻.

Allow abbreviated formulas C₂H₃Cl, C₂H₅Cl, C₂H₅OH.

b.ii.H₂SO₄/H⁺/acidified **and** Cr₂O₇²⁻/(potassium/sodium) dichromate;

Accept suitable oxidizing agents (e.g. KMnO₄ etc.) but only with acid.

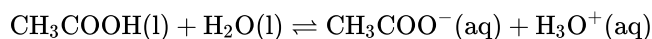
Ignore missing or incorrect oxidation states in reagents.

(heat under) reflux;

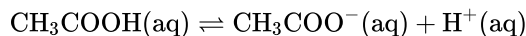
Second mark can be scored even if reagent is incorrect.

b.iii.CH₃COOH(aq) + H₂O(l) ⇌ CH₃COO⁻(aq) + H₃O⁺(aq)

OR



OR



correct equation;

state symbols **and** ⇌;

BL acid is CH₃COOH and cb is CH₃COO⁻ / BL acid is H₃O⁺ and cb is H₂O;

Examiners report

a.i. The main G2 comments on this question related to the inclusion of organic chemistry in Section A. It should be noted that ANY Topic can be asked in Section A of P2, and there is no set-formula in relation to question setting. Organic chemistry is an integral part of the IB SL Chemistry programme, and is covered in Topic 10 of the guide (12 hours in total). Hence, candidates should be adequately prepared for questions on this topic, even in Section A. In 3(a), the Lewis structure of chloroethene was generally drawn correctly, though the weaker candidates often omitted the lone pairs on the chlorine. The bond angle was usually predicted, although right angles and 109.5° were often given. Even some of the better candidates explained their choice of bond angle, based on the fact that the double bond occupies more space causing the HCCl bond angle to drop less than 120°.

a.ii. Many candidates gave double bonds and some forgot to include continuation bonds.

a.iii. The Aim 8 question in part (iii) was very well answered this session. Almost all candidates scored the disposal problem of plastics mark and many achieved the economics importance mark also.

b.i. In general (b) was very poorly answered, again showing a clear weakness in organic chemistry, which is an area of major concern. (i) was poorly done. Candidates who managed a correct reaction for the first step often used water instead of hydroxide ion for the second step.

b.ii. In general (b) was very poorly answered, again showing a clear weakness in organic chemistry, which is an area of major concern. In (ii), candidates who mentioned dichromate(VI) or permanganate(VIII) often omitted the acid. In addition, reflux was often missing.

b.iii In general (b) was very poorly answered, again showing a clear weakness in organic chemistry, which is an area of major concern. In (iii), very few candidates scored all three marks here, even though the question itself was easy. The equation was often correct, but the equilibrium arrow was rarely given. Some candidates did not know the formula for ethanoic acid which was surprising.
