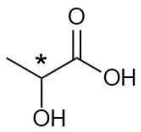
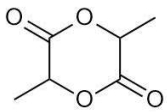
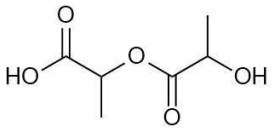
5.	This question is about a biodegradable plastic	Mark
(a)	 *One mark for structure. One mark for correct marking of chiral centre with asterisk.*	☑ ☑
(b)	☐ addition ☑ condensation ☐ neutralisation ☐ oxidation ☐ reduction *No marks if more than one box ticked.*	☑
(c)	Compound **A**  *No stereochemistry required.*	☑
(d)	amount of KOH = 0.0400 mol dm^{-3} × 0.00681 dm^3 = 2.72 × 10^{-4} mol amount of -COOH residues = 2.72 × 10^{-4} mol = amount of chains average molar mass of chain = total mass / amount of chains average molar mass of chain = 0.1619 g / 2.72 × 10^{-4} mol = 595 g mol^{-1} *Correct answer required for mark. No credit for working only.*	☑
(e)	molar mass of polymer = molar mass of n repeat units + molar mass of H_2O number of repeat units = (595 – 18) g mol^{-1} / 72 g mol^{-1} number of repeat units = 8 *Correct answer scores two marks. One mark can be awarded if working is correct and only one of the following errors has been made: leaving out the factor of −18 for water/getting the value of this factor wrong; OR using an incorrect repeat unit molar mass; OR all values correct but a calculator error has been made. Two or more errors scores no marks.* *Answer based on using incorrect value of 306 g mol^{-1} = 4* *ECF answer = (answer to part (d) – 18) / 72*	☑ ☑
(f)	one mol of repeat unit reacts with one mole of NaOH mass = 286,000 tonnes × 40 g mol^{-1} / 72 g mol^{-1} = 159,000 tonnes *Correct answer required for mark. No credit for working only.*	☑
(g)	amount of acid = 0.100 mol dm^{-3} × 0.0194 dm^{-3} × 5 = 9.70 × 10^{-3} mol *Correct answer required for mark. No credit for working only.*	☑

(h) Compound **B** (dimer)



No stereochemistry required.

(i) mass of dimer = 0.1701 g; mass of lactic acid = 0.7785 g

Three marks for both masses correct. First mark for calculation of amount of repeat unit. Second mark for mass of dimer. Third mark for mass of lactic acid.

amount of HCl used = 0.100 mol dm^{-3} × 0.01850 dm^3 = 1.85×10^{-3} mol

amount of NaOH in aliquot that had reacted with PLA

= (0.04000 dm^3 × 0.100 mol dm^{-3}) − 1.85×10^{-3} mol

= 2.15×10^{-3} mol

amount of NaOH that had reacted with PLA in stock solution = 2.15×10^{-3} mol × 5

= 1.075×10^{-2} mol

amount of repeat unit = 1.075×10^{-2} mol *First mark awarded for this*

amount of dimer = amount of repeat unit – amount of acid needed in *part (g)*

= 1.075×10^{-2} mol − 9.7×10^{-3} mol = 1.05×10^{-3} mol

molar mass of dimer = 162 g mol^{-1}

mass of dimer = 162 g mol^{-1} × 1.05×10^{-3} mol = 0.1701 g *Second mark awarded for this*

amount of monomer = amount of repeat unit – 2 × amount of dimer

= 1.075×10^{-2} mol – (2 × 1.05×10^{-3} mol) = 8.65×10^{-3} mol

molar mass of lactic acid = 90 g mol^{-1}

mass of lactic acid = 90 g mol^{-1} × 8.65×10^{-3} mol = 0.7785 g *Third mark awarded for this*

ECF answer: mass of dimer = (162 × (1.075 × 10^{-2} – answer to part (g))) g

ECF answer: mass of lactic acid = (90 × (1.075 × 10^{-2} – 2 × amount of dimer)) g

Answers based on using incorrect value of 8.60 × 10^{-3} mol

mass of dimer = 0.348 g; mass of lactic acid = 0.581 g

Total out of 13 **13**