

5 This question is about the homologous series of alcohols.

(a) A homologous series is a family of organic compounds whose members have the same general formula.

(i) State the general formula for alcohols.

..... [1]

(ii) Give **one other** characteristic that is the same for all members of a homologous series.

..... [1]

(b) Ethanol can be manufactured by two methods:

- **method 1** uses glucose as the starting material
- **method 2** uses ethene as the starting material.

(i) Complete Table 5.1.

Table 5.1

	method 1 glucose as starting material	method 2 ethene as starting material
typical temperature used/°C		
two other essential conditions	1	1
	2	2

[6]

(ii) Write the symbol equation for the reaction in **method 1**.

..... [2]

(iii) Write the symbol equation for the reaction in **method 2**.

..... [2]

(c) Butane-1,4-diol has the structural formula HO—CH₂—CH₂—CH₂—CH₂—OH.

(i) Deduce the molecular formula of butane-1,4-diol.

..... [1]

(ii) Butane-1,4-diol reacts with ethanoic acid.

Determine the number of moles of ethanoic acid which react fully with **one** mole of butane-1,4-diol.

..... [1]

(d) Butanedioic acid has the structural formula HOOC—CH₂—CH₂—COOH.

(i) Deduce the empirical formula of butanedioic acid.

..... [1]

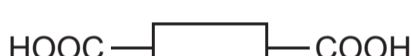
(ii) Name the gas formed when butanedioic acid reacts with sodium.

..... [1]

(e) Butane-1,4-diol can be represented as shown.



Butanedioic acid can be represented as shown.



Butane-1,4-diol reacts with butanedioic acid to form a polymer.

(i) Draw **two** repeat units of the polymer formed from the reaction of butane-1,4-diol with butanedioic acid.

Show all the atoms and all the bonds in the ester linkages.

[3]

(ii) State the type of polymerisation when butane-1,4-diol reacts with butanedioic acid.

..... [1]

[Total: 20]

The Periodic Table of Elements

		Group																																												
I	II	III	IV	V	VI	VII	VIII					VIII																																		
		1 H hydrogen 1											2 He helium 4																																	
3 Li lithium 7	4 Be beryllium 9	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 0 auto;"> Key atomic number atomic symbol name relative atomic mass </div>																																												
11 Na sodium 23	12 Mg magnesium 24	13 Al aluminium 27	14 Si silicon 28	15 P phosphorus 31	16 S sulfur 32	17 Cl chlorine 35.5	18 Ar argon 40	19 K potassium 39	20 Ca calcium 40	21 Sc scandium 45	22 Ti titanium 48	23 V vanadium 51	24 Cr chromium 52	25 Mn manganese 55	26 Fe iron 56	27 Co cobalt 59	28 Ni nickel 59	29 Cu copper 64	30 Zn zinc 65	31 Ga gallium 70	32 Ge germanium 73	33 As arsenic 75	34 Se selenium 79	35 Br bromine 80	36 Kr krypton 84																					
37 Rb rubidium 85	38 Sr strontium 88	39 Y yttrium 89	40 Zr zirconium 91	41 Nb niobium 93	42 Mo molybdenum 96	43 Tc technetium —	44 Ru ruthenium 101	45 Rh rhodium 103	46 Pd palladium 106	47 Ag silver 108	48 Cd cadmium 112	49 In indium 115	50 Sn tin 119	51 Sb antimony 122	52 Te tellurium 128	53 I iodine 127	54 Xe xenon 131	55 Cs caesium 133	56 Ba barium 137	57–71 lanthanoids	72 Hf hafnium 178	73 Ta tantalum 181	74 W tungsten 184	75 Re rhenium 186	76 Os osmium 190	77 Ir iridium 192	78 Pt platinum 195	79 Au gold 197	80 Hg mercury 201	81 Tl thallium 204	82 Pb lead 207	83 Bi bismuth 209	84 Po polonium —	85 At astatine —	86 Rn radon —											
87 Fr francium —	88 Ra radium —	89–103 actinoids	104 Rf rutherfordium —	105 Db dubnium —	106 Sg seaborgium —	107 Bh bohrium —	108 Hs hassium —	109 Mt meitnerium —	110 Ds darmstadtium —	111 Rg roentgenium —	112 Cn copernicium —	113 Nh nihonium —	114 Fl flerovium —	115 Mc moscovium —	116 Lv livermorium —	117 Ts tennessine —	118 Og oganesson —	109 La lanthanum 139	110 Ce cerium 140	111 Pr praseodymium 141	112 Nd neodymium 144	113 Pm promethium —	114 Sm samarium 150	115 Eu europium 152	116 Gd gadolinium 157	117 Tb terbium 159	118 Dy dysprosium 163	119 Ho holmium 165	120 Er erbium 167	121 Tm thulium 169	122 Yb ytterbium 173	123 Lu lutetium 175	124 Ac actinium —	125 Th thorium 232	126 Pa protactinium 231	127 U uranium 238	128 Np neptunium —	129 Pu plutonium —	130 Am americium —	131 Cm curium —	132 Bk berkelium —	133 Cf californium —	134 Fm fermium —	135 Md mendelevium —	136 No nobelium —	137 Lr lawrencium —

The volume of one mole of any gas is 24 dm³ at room temperature and pressure (r.t.p.).