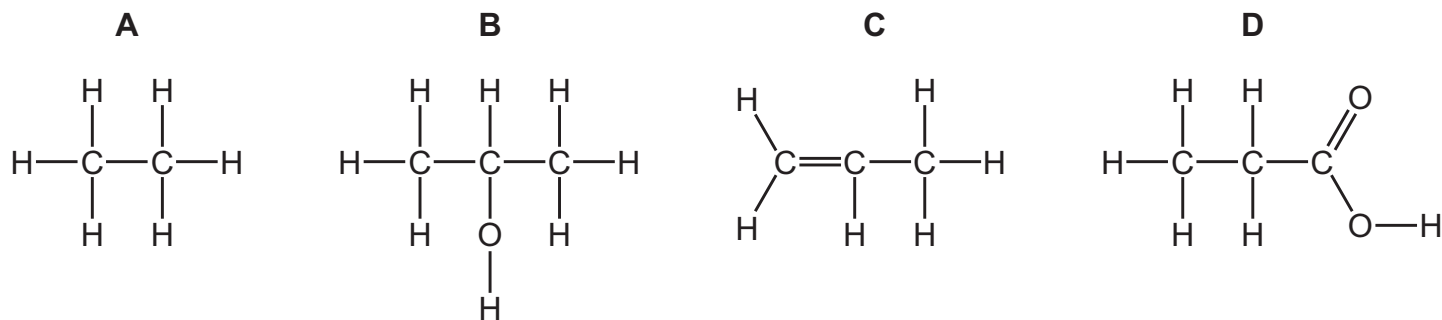


33 Which structure represents a compound in the alcohol homologous series?



37 Ethanol is produced by the fermentation of aqueous glucose or by the catalytic addition of steam to ethene.

Which row shows some advantages and disadvantages of these processes?

	fermentation of aqueous glucose		catalytic addition of steam to ethene	
	advantage	disadvantage	advantage	disadvantage
A	fast reaction	ethanol produced continuously	almost pure ethanol formed	renewable raw material
B	ethanol produced in batches	slow reaction	fast reaction	ethanol produced continuously
C	renewable raw material	ethanol produced in batches	almost pure ethanol formed	slow reaction
D	renewable raw material	dilute aqueous ethanol formed	fast reaction	non-renewable raw material

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 $\text{HO}-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{OH}$.

(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 $\text{HOOC}-\text{CH}_2-\text{CH}_2-\text{COOH}$.

(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	Key										III	IV	V	VI	VII	VIII	
		atomic number atomic symbol name relative atomic mass																
		1 H hydrogen 1																
3 Li lithium 7	4 Be beryllium 9											5 B boron 11	6 C carbon 12	7 N nitrogen 14	8 O oxygen 16	9 F fluorine 19	10 Ne neon 20	
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 oganeson —
lanthanoids																		
57 La lanthanum 139	58 Ce cerium 140	59 Pr praseodymium 141	60 Nd neodymium 144	61 Pm promethium —	62 Sm samarium 150	63 Eu europium 152	64 Gd gadolinium 157	65 Tb terbium 159	66 Dy dysprosium 163	67 Ho holmium 165	68 Er erbium 167	69 Tm thulium 169	70 Yb ytterbium 173	71 Lu lutetium 175				
actinoids																		
89 Ac actinium —	90 Th thorium 232	91 Pa protactinium 231	92 U uranium 238	93 Np neptunium —	94 Pu plutonium —	95 Am americium —	96 Cm curium —	97 Bk berkelium —	98 Cf californium —	99 Es einsteinium —	100 Fm fermium —	101 Md mendelevium —	102 No nobelium —	103 Lr lawrencium —				

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

17 Ethanol is warmed with acidified aqueous potassium manganate(VII).

Which row describes the type of reaction of the ethanol and the colour change observed in the reaction mixture?

	type of reaction	colour change
A	oxidation	colourless to purple
B	oxidation	purple to colourless
C	reduction	colourless to purple
D	reduction	purple to colourless

35 Industrially, ethanol is produced by fermentation or by the reaction of ethene with steam.

Which row is correct?

	fermentation	ethene + steam
A	uses a temperature of 100 °C	uses a temperature of 350 °C
B	needs the presence of yeast	does not need a catalyst
C	slow reaction	fast reaction
D	high yield of ethanol	low yield of ethanol

32 What is the structural formula of butan-2-ol?

- A** $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$
- B** $\text{CH}_3\text{CH}(\text{OH})\text{CH}_3$
- C** $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$
- D** $\text{CH}_3\text{CH}_2\text{CH}(\text{OH})\text{CH}_3$

36 Ethanol can be made by the fermentation of aqueous glucose and by the catalytic addition of steam to ethene.

What are two advantages of making ethanol by the catalytic addition of steam to ethene rather than by the fermentation of aqueous glucose?

- A** faster reaction and renewable raw materials
- B** purer product and faster reaction
- C** renewable raw materials and continuous process
- D** uses more energy and forms a purer product

37 Which statements describe disadvantages of manufacturing ethanol by fermentation?

- 1 The process uses a renewable resource.
- 2 The process produces impure ethanol.
- 3 The process requires a high temperature.
- 4 The process is slow.

A 1 and 3

B 1 and 4

C 2 and 3

D 2 and 4