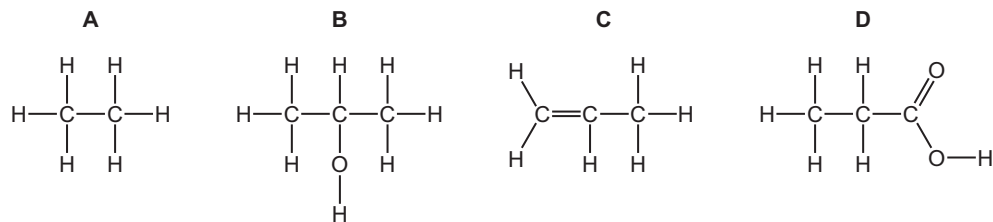


33 Which structure represents a compound in the alcohol homologous series?



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		
		1 H hydrogen 1																	
		atomic number atomic symbol name relative atomic mass																	
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		
37 Rb rubidium 85.468	38 Sr strontium 87.62	39 Y yttrium 88.906	40 Zr zirconium 91.224	41 Nb niobium 92.906	42 Mo molybdenum 95.94	43 Tc technetium —	44 Ru ruthenium 101.07	45 Rh rhodium 102.905	46 Pd palladium 106.36	47 Ag silver 107.868	48 Cd cadmium 112.411	49 In indium 114.818	50 Sn tin 118.710	51 Sb antimony 121.757	52 Te tellurium 127.6	53 I iodine 126.905	54 Xe xenon 131.29		
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 —		
lanthanoids																			
57 La lanthanum 138.905	58 Ce cerium 140.12	59 Pr praseodymium 140.908	60 Nd neodymium 144.24	61 Pm promethium —	62 Sm samarium 150.36	63 Eu europium 151.964	64 Gd gadolinium 157.25	65 Tb terbium 158.925	66 Dy dysprosium 162.50	67 Ho holmium 164.930	68 Er erbium 167.259	69 Tm thulium 168.934	70 Yb ytterbium 173.054	71 Lu lutetium 174.967					
89 Ac actinium —	90 Th thorium 232.038	91 Pa protactinium 231.036	92 U uranium 238.029	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 —					
actinoids																			

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