

32 Petroleum is separated by fractional distillation.

Which statement about the fractions produced is correct?

- A** Bottled gas for heating and cooking is obtained from the naphtha fraction.
- B** Diesel oil is used as a fuel for jet aircraft.
- C** Substances used to make polishes are obtained from the lubricating fraction.
- D** The kerosene fraction contains many useful waxes.

34 Ethane reacts with chlorine.

Which row identifies the type of reaction and the formulae of the products formed?

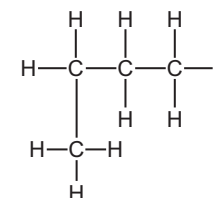
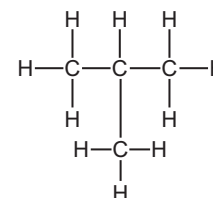
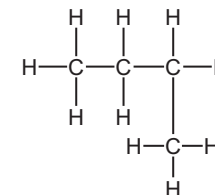
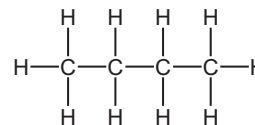
	reaction	products
A	addition	$\text{CH}_3\text{CH}_2\text{Cl} + \text{H}_2$
B	addition	$\text{CH}_3\text{CH}_2\text{Cl} + \text{HCl}$
C	substitution	$\text{CH}_3\text{CH}_2\text{Cl} + \text{HCl}$
D	substitution	$\text{CH}_3\text{CH}_2\text{Cl} + \text{H}_2$

36 Ethene reacts with hydrogen in an addition reaction to form ethane.

Which catalyst is used for this reaction?

- A** iron
- B** nickel
- C** vanadium(V) oxide
- D** yeast

34 Which structures are structural isomers of each other?



- A** 1, 2, 3 and 4
- B** 1, 2 and 4 only
- C** 1 and 3 only
- D** 2 and 4 only

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]

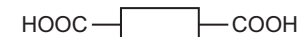
(ii) Name the gas formed when butanedioic acid reacts with sodium.

..... [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	
3 Li lithium 7	4 Be beryllium 9	atomic number atomic symbol name relative atomic mass										1 H hydrogen 1	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	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 —	

anthanoids

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
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 —

actinoids

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

5 This question is about the homologous series of alkanes.

Three general characteristics of alkanes are:

- they are generally unreactive because they do **not** have a functional group
- they show trends in their physical properties, such as melting points and boiling points
- they have similar chemical properties.

(a) Describe **two other** general characteristics of the homologous series of alkanes.

1.....
2..... [2]

(b) (i) State the trend in the boiling points of the alkanes as the carbon chain length increases.

..... [1]

(ii) Name **one other** physical property of alkanes that shows a trend, other than melting points and boiling points.

Describe this trend as the carbon chain length of alkanes increases.

name
description..... [2]

(c) State why alkanes are described as saturated.

..... [1]

(d) Propane has the structural formula $\text{CH}_3\text{CH}_2\text{CH}_3$.

When propane undergoes a monosubstitution reaction with chlorine at room temperature, **two** organic products can be formed.

(i) State **one** condition needed for this substitution reaction to take place.

..... [1]

(ii) Give the structural formula and state the name of each organic product formed.

- structural formula of product 1

name of product 1

- structural formula of product 2

name of product 2 [4]

(iii) The two products formed are structural isomers of each other.

Define the term structural isomers.

.....
..... [1]

[Total: 12]

35 Propan-1-ol is oxidised by acidified aqueous potassium manganate(VII) in a similar way to ethanol.

Which compound is produced by the oxidation of propan-1-ol with acidified aqueous potassium manganate(VII)?

- A** $\text{CH}_3\text{CH}_2\text{OH}$
B $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$
C CH_3COOH
D $\text{CH}_3\text{CH}_2\text{COOH}$