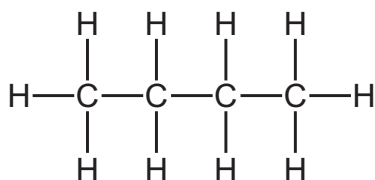
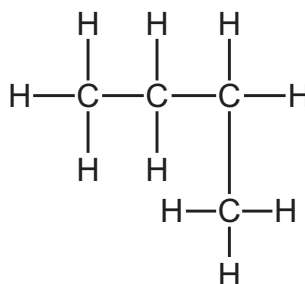


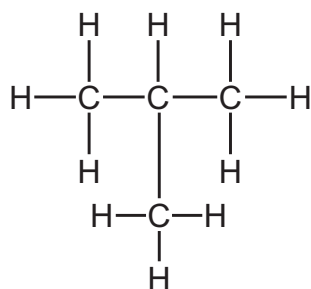
34 Which structures are structural isomers of each other?



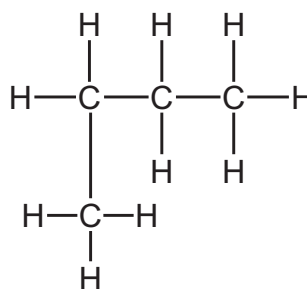
1



2



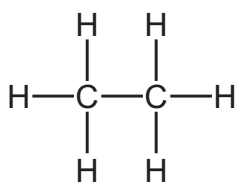
3



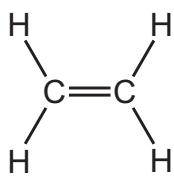
4

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

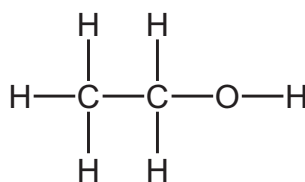
37 The structures of four compounds are shown.



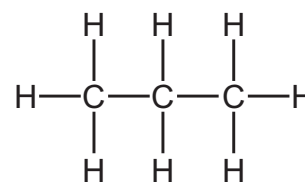
1



2



3



4

Which compounds are members of the same homologous series?

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

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]

6 Compound **E** shown in Fig. 6.1 is an ester.

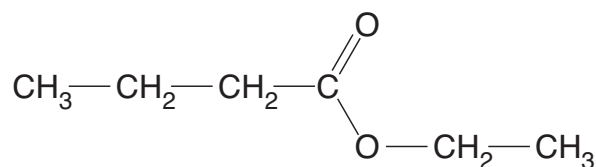


Fig. 6.1

(a) On Fig. 6.1, draw a circle around all the atoms which make up the ester linkage. [1]

(b) Name compound **E**.

..... [1]

(c) Deduce the empirical formula of compound **E**.

..... [1]

(d) Compound **E** is produced when two different compounds react together in the presence of a catalyst.

(i) Name the **two** compounds that react together to produce compound **E**.

1

2

[2]

(ii) Suggest a suitable catalyst for this reaction.

..... [1]

(e) Determine the number of unbranched esters which have the molecular formula $\text{C}_5\text{H}_{10}\text{O}_2$.

..... [1]

(f) All unbranched esters with the molecular formula $\text{C}_5\text{H}_{10}\text{O}_2$ combust completely to form carbon dioxide and water only.

Write the symbol equation for the complete combustion of $\text{C}_5\text{H}_{10}\text{O}_2$.

..... [1]

[Total: 8]

The Periodic Table of Elements

Group																	
I	II											III	IV	V	VI	VII	VIII
		1 H hydrogen 1															
		Key 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	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.).

6 This question is about organic compounds.

(a) Organic compound **Q** has the following composition by mass.

C, 50.00%; H, 5.56%; O, 44.44%

Calculate the empirical formula of compound **Q**.

empirical formula = [3]

(b) Organic compound **R** has the empirical formula CHO and a relative molecular mass of 116.

Determine the molecular formula of compound **R**.

molecular formula = [1]

(c) Carboxylic acids react with alcohols to form esters.

(i) Name the other product that is formed when a carboxylic acid reacts with an alcohol.

..... [1]

(ii) Name the **type** of catalyst that is used when a carboxylic acid reacts with an alcohol.

..... [1]

(iii) Ester **S** has the structural formula $\text{CH}_3\text{CH}_2\text{COOCH}_2\text{CH}_2\text{CH}_2\text{CH}_3$.

Name the carboxylic acid and the alcohol which react together to form ester **S**.

carboxylic acid

alcohol

[2]

(d) Fig. 6.1 shows part of a polymer structure.

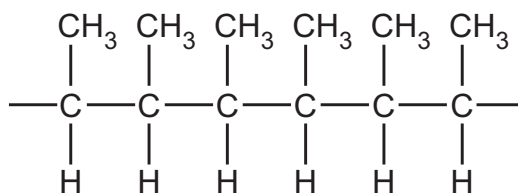


Fig. 6.1

(i) Name the type of polymerisation that is used to produce this polymer.

..... [1]

(ii) Suggest why it is **not** possible to write the molecular formula of this polymer.

..... [1]

(iii) State the number of monomer units that are needed to make the part of the polymer structure shown in Fig. 6.1.

..... [1]

(iv) Draw the displayed formula of the monomer used to make this polymer.

[2]

(e) Fig. 6.2 shows part of the general structure of an amino acid.

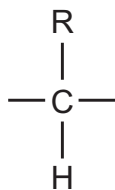


Fig. 6.2

(i) Complete Fig. 6.2 to show all the atoms and all the bonds in the two functional groups of the amino acid. [2]

(ii) Part of a natural polyamide structure is shown in Fig. 6.3.

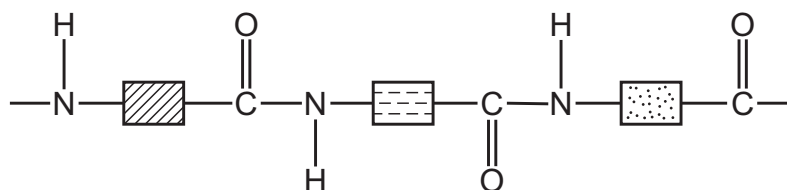


Fig. 6.3

On Fig. 6.3, draw a circle around **one** amide linkage.

[1]

(iii) State the name given to natural polyamides made from amino acids.

..... [1]

[Total: 17]

The Periodic Table of Elements

Group																				
I	II													III	IV	V	VI	VII	VIII	
		1 H hydrogen 1																		
		Key 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	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 —			

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
	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.).

33 The structural formula of methyl ethanoate is $\text{CH}_3\text{COOCH}_3$.

Which compounds are structural isomers of methyl ethanoate?

- 1 $\text{HCOOCH}_2\text{CH}_3$
- 2 $\text{CH}_3\text{CH}_2\text{COOH}$
- 3 $\text{HOCH}_2\text{CH}_2\text{CH}_2\text{OH}$

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

34 Which row describes two characteristics of members of the same homologous series?

	characteristic 1	characteristic 2
A	same functional group	trend in physical properties
B	same physical properties	same functional group
C	same general formula	different chemical properties
D	differing from one member to the next by a CH_3 unit	similar chemical properties

6 The structural formulae of two compounds, **A** and **B**, are shown.

A	B
$\text{CH}_2=\text{CHCH}_3$	$\text{CH}_3\text{CH}=\text{CHCH}_3$

A and **B** are members of the same homologous series.

(a) Give **two** reasons why the structural formulae of **A** and **B** show they are members of the same homologous series.

1

2 [2]

(b) Explain why **A** and **B** are both hydrocarbons.

..... [1]

(c) Write the symbol equation for the complete combustion of **A**.

..... [2]

(d) Deduce the empirical formula of **A**.

..... [1]

(e) Name compound **B**.

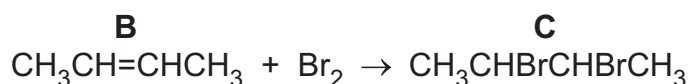
..... [1]

(f) A structural isomer of **B** is a member of the same homologous series.

Draw the displayed formula of this structural isomer of **B**.

[1]

- (g) Compound **B** reacts with aqueous bromine at room temperature to form product **C**.
The equation is shown.



- (i) State why this is an addition reaction.

..... [1]

- (ii) Describe the colour change in aqueous bromine during this reaction.

from to [1]

- (iii) Name product **C**.

..... [1]

- (h) Under certain conditions, **one** mole of **B** reacts with oxygen to form **two** moles of carboxylic acid **D**.

Carboxylic acid **D** has **two** carbon atoms.

- (i) Draw the displayed formula of carboxylic acid **D**.

[1]

- (ii) Name carboxylic acid **D**.

..... [1]

- (iii) Complete the symbol equation for this reaction.



[1]

[Total: 14]

The Periodic Table of Elements

Group																			
I	II											III	IV	V	VI	VII	VIII		
		1 H hydrogen 1																	
		Key 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	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 —		

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.).