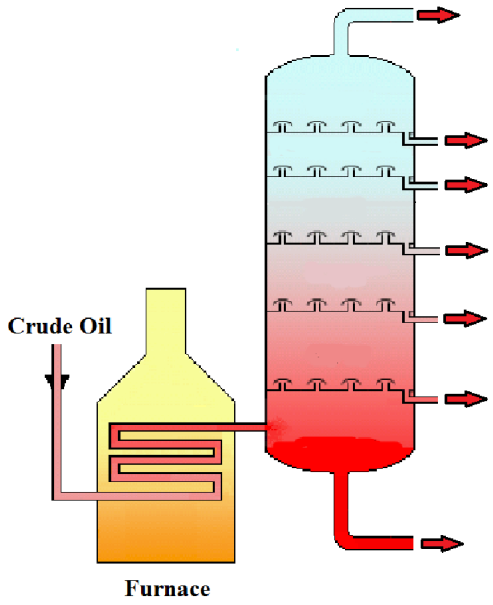
National 5

Chemistry

Unit 2 Past Paper Questions



Section 1

1. The molecular formula for cyclohexane is

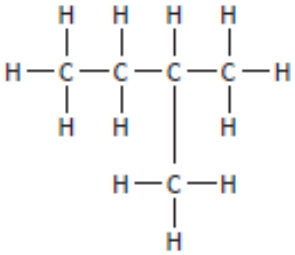
A C_6H_6

B C_6H_{10}

C C_6H_{12}

D C_6H_{14}.

2.



The systematic name for the structure shown is

A 1,1-dimethylpropane

B 2-methylbutane

C 3-methylbutane

D 2-methylpentane.

3. Petrol is a mixture of hydrocarbons.

The tendency of a hydrocarbon to ignite spontaneously is measured by its octane number.

	Hydrocarbon	*Octane number*
1	3-methylpentane	74·5
2	butane	93·6
3	pentane	61·7
4	2-methylpentane	73·4
5	hexane	24·8
6	methylcyclopentane	91·3

A student made the hypothesis that as the chain length of a hydrocarbon increases, the octane number decreases.

Which set of three hydrocarbons should have their octane numbers compared in order to test this hypothesis?

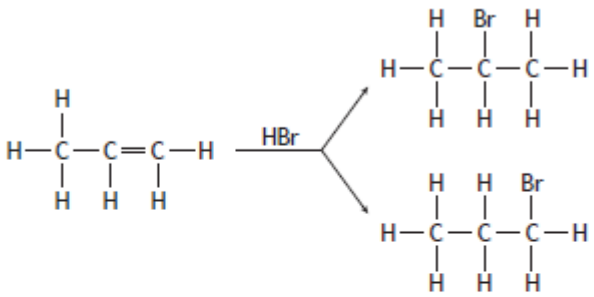
A 1, 4, 6

B 1, 2, 4

C 2, 3, 5

D 3, 4, 5

4. Propene reacts with hydrogen bromide to form two products.



Which of the following alkenes does **not** form two products on reaction with hydrogen bromide?

A But-1-ene

B But-2-ene

C Pent-1-ene

D Pent-2-ene

5. Which of the following alcohols has the highest boiling point?

You may wish to use your data booklet to help you.

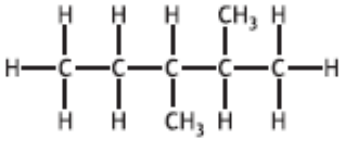
A Propan-1-ol

B Propan-2-ol

C Butan-1-ol

D Butan-2-ol

6.



The name of the above compound is

A 2,3-dimethylpropane

B 3,4-dimethylpropane

C 2,3-dimethylpentane

D 3,4-dimethylpentane.

7. When methane burns in a plentiful supply of air, the products are

A carbon and water

B carbon dioxide and water

C carbon monoxide and water

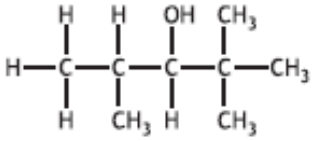
D carbon dioxide and hydrogen.

8. The shortened structural formula for an organic compound is

$CH_3CH(CH_3)CH(OH)C(CH_3)_3$

Which of the following is another way of representing this structure?

A



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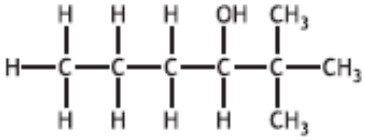

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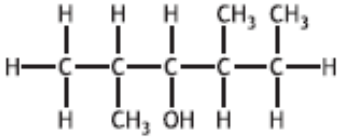
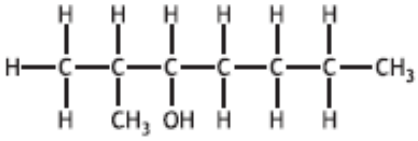
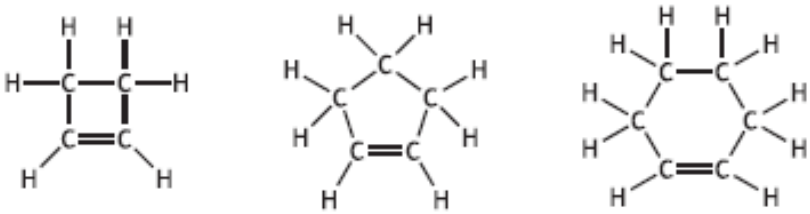


D



9. Three members of the cycloalkene homologous series are



Which of the following is the general formula for this homologous series?

A C_nH_{2n-4}

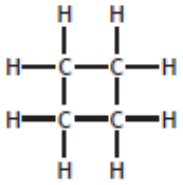
B C_nH_{2n+2}

C C_nH_{2n}

D C_nH_{2n-2}

10. Which of the following compounds belongs to the same homologous series as the compound with the molecular formula C_3H_8?

A



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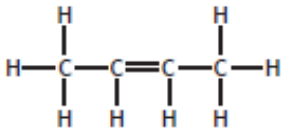

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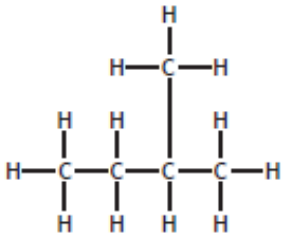

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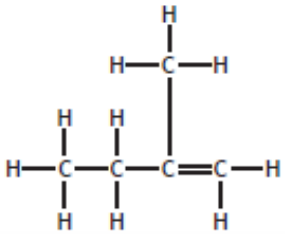

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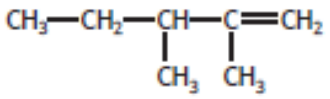


The systematic name for the structure shown is

A 1,2-dimethylpent-1-ene

B 2,3-dimethylpent-1-ene

C 3,4-dimethylpent-4-ene

D 3,4-dimethylpent-1-ene.

12. Which of the following could be the molecular formula for an alkane?

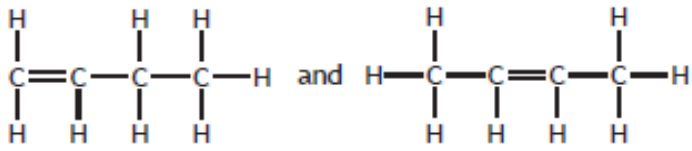
A C_7H_{16}

B C_7H_{14}

C C_7H_{12}

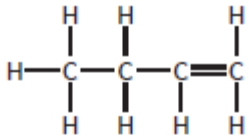
D C_7H_{10}

13. Two isomers of butene are



Which of the following structures represents a third isomer of butene?

A



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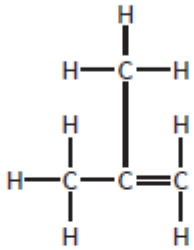

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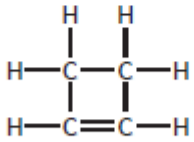

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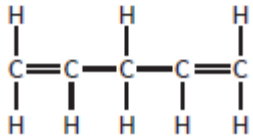


14. The lowest temperature at which a hydrocarbon ignites is called its flash point.

Hydrocarbon	*Formula*	*Boiling point (°C)*	*Flash point (°C)*
hexene	C_6H_{12}	63	−25
hexane	C_6H_{14}	69	−23
cyclohexane	C_6H_{12}	81	−20
heptane	C_7H_{16}	98	−1
octane	C_8H_{18}	126	15

Using information in the table, identify the correct statement.

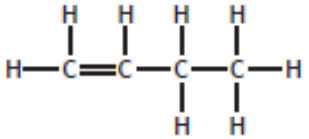
A Octane will ignite at 0 °C.

B Hydrocarbons with the same molecular mass have the same flash point.

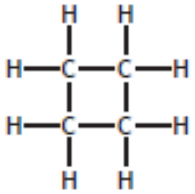
C The flash point of a hydrocarbon increases as the boiling point increases.

D In a homologous series the flash point decreases as the number of carbon atoms increases.

15. A student added bromine solution to compound **X** and compound **Y**.



Compound **X**



Compound **Y**

Which line in the table is correct?

	Decolourises bromine solution immediately	
	Compound **X**	Compound **Y**
A	no	no
B	no	yes
C	yes	yes
D	yes	no

16. A compound burns in air. The only products of the reaction are carbon dioxide, sulfur dioxide and water.

The compound **must** contain

A carbon and sulfur only

B carbon and hydrogen only

C carbon, hydrogen and sulfur

D carbon, hydrogen, sulfur and oxygen.

17. Vinegar is a solution of

A ethanol

B methanol

C ethanoic acid

D methanoic acid.

Which of the following could be the molecular formula for a cycloalkane?

18.

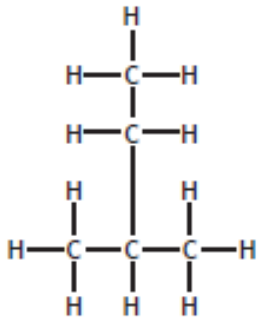
A C_6H_8

B C_6H_{10}

C C_6H_{12}

D C_6H_{14}

19.



The name of the above compound is

A 2-ethylpropane

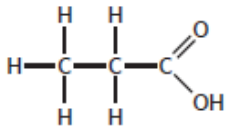
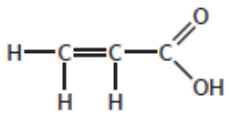
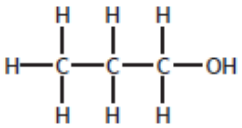
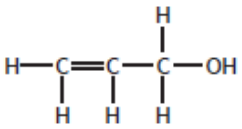
B 1,1-dimethylpropane

C 2-methylbutane

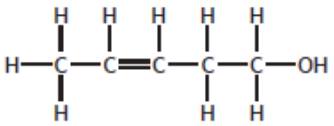
D 3-methylbutane.

20.

A student tested some compounds. The results are given in the table.

Compound	*pH of aqueous solution*	*Effect on bromine solution*
	4	no effect
	4	decolourised
	7	no effect
	7	decolourised

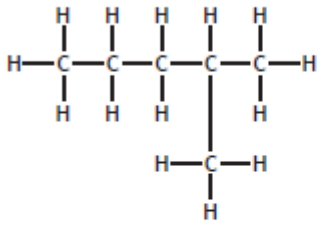
Which line in the table below shows the correct results for the following compound?



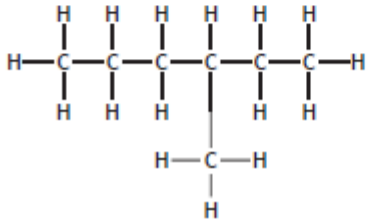
	pH of aqueous solution	*Effect on bromine solution*
A	4	decolourised
B	7	decolourised
C	4	no effect
D	7	no effect

21. Which of the following molecules is an isomer of hept-2-ene?

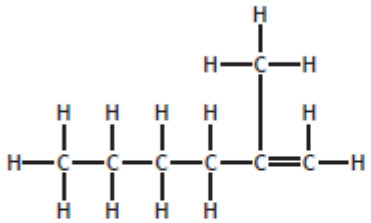
A



B



C



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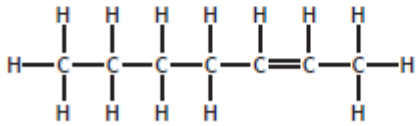


22. In which of the following types of reaction is oxygen a reactant?

A Combustion

B Neutralisation

C Polymerisation

D Precipitation

1. Liquefied petroleum gas (LPG), which can be used as a fuel for heating, is a mixture of propane and butane.

(a) Propane and butane are members of the homologous series of alkanes.

Tick (✓) the two boxes that correctly describe members of the same homologous series. 1

	Tick (✓)
They have similar chemical properties.	
They have the same molecular formula.	
They have the same general formula.	
They have the same physical properties.	
They have the same formula mass.	

(b) The table gives some information about propane and butane.

Alkane	*Boiling Point (°C)*
propane	−42
butane	−1

Explain why butane has a higher boiling point than propane. 2

(c) 25 kg of water at 10 °C is heated by burning some LPG.

Calculate the energy, in kJ, required to increase the temperature of the water to 30 °C. 3

You may wish to use the data booklet to help you.

Show your working clearly.

2. The lowest temperature at which a hydrocarbon ignites is called its flash point.

Hydrocarbon	*Flash point (°C)*
hexane	−23
heptane	−4
octane	13
nonane	31

(a) (i) Using the information in the table, make a general statement linking the flash point to the number of carbon atoms. 1

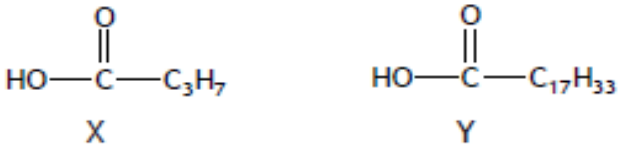
(ii) Predict the flash point, in °C, of decane, $C_{10}H_{22}$.

3. Butter contains different triglyceride molecules.

(a) A triglyceride molecule is made when the alcohol glycerol reacts with carboxylic acids.

(i) Name the functional group present in glycerol. **1**

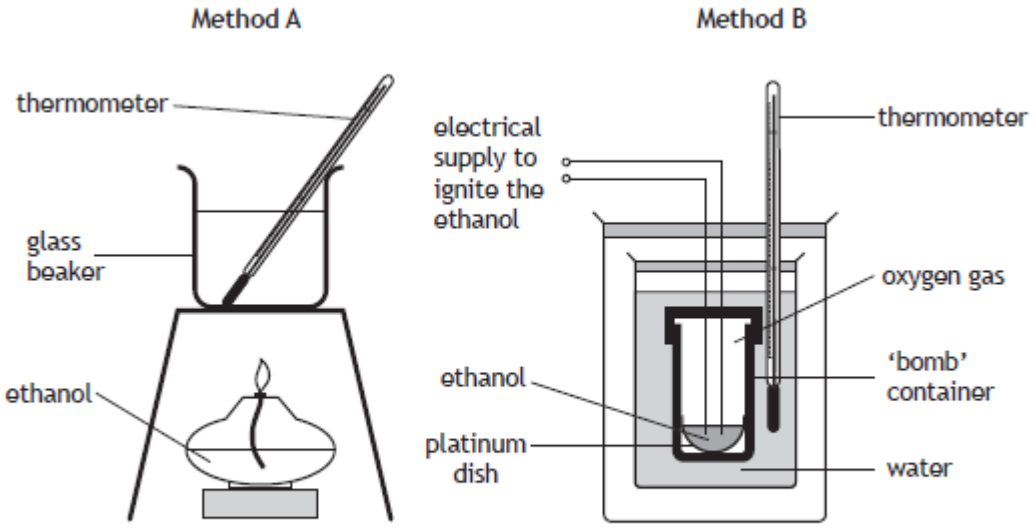
(b) When butter goes off, a triglyceride molecule is broken down, producing compounds X and Y.



(i) Name compound X. **1**

(ii) Describe the chemical test, including the result, to show that compound Y is unsaturated. **1**

4. A student calculated the energy absorbed by water when ethanol is burned using two different methods.



The student recorded the following data.

The student recorded the following data.

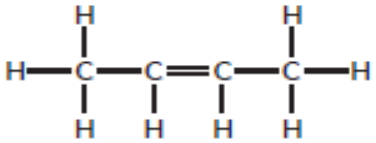
	Method	
	A	B
Mass of ethanol burned (g)	0·5	0·5
Mass of water heated (g)	100	100
Initial temperature of water (°C)	24	24
Final temperature of water (°C)	32	58

(a) The final temperature of water in method B is higher than in method A.
Suggest why there is a difference in the energy absorbed by the water. **1**

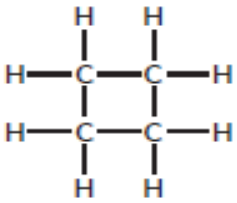
(continued)

(b) Calculate the energy, in kJ, absorbed by the water in method B. 3
You may wish to use the data booklet to help you.
Show your working clearly.

5. The structural formulae of two hydrocarbons are shown.



A



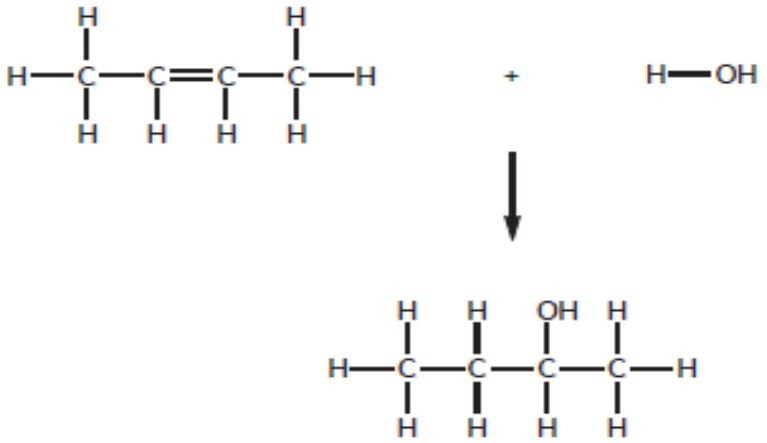
B

(a) Name hydrocarbon A. **1**

(b) Hydrocarbons A and B can be described as isomers.
State what is meant by the term isomer. **1**

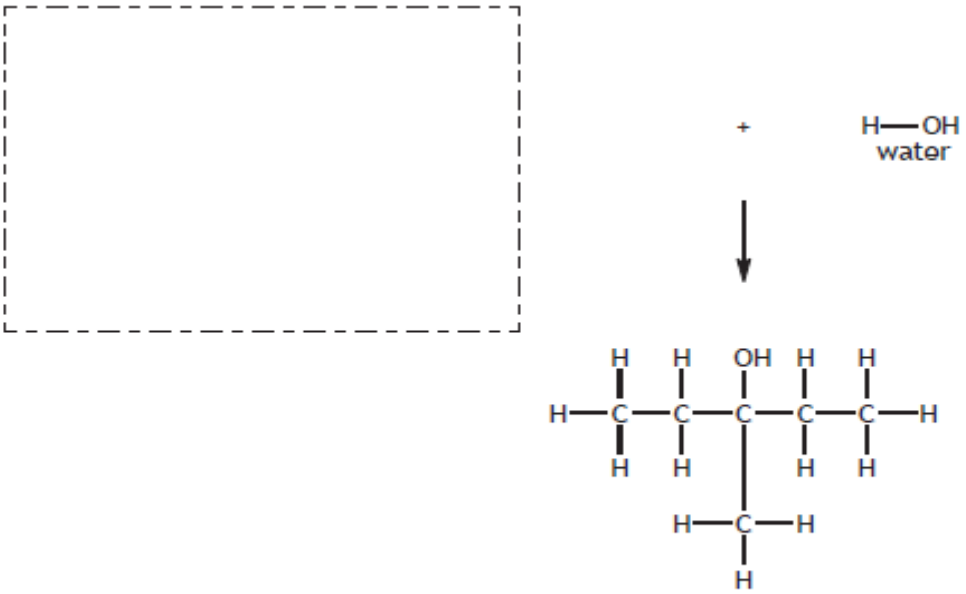
(continued)

(c) Hydrocarbon A can undergo an addition reaction with water to form butan-2-ol as shown.



A similar reaction can be used to produce 3-methylpentan-3-ol.

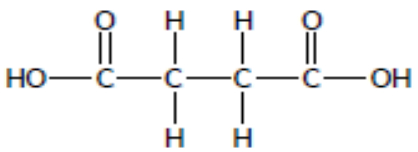
Draw a structural formula for the hydrocarbon used to form this molecule. **1**



3-methylpentan-3-ol

6. Succinic acid is a natural antibiotic.

The structure of succinic acid is shown.



(a) Name the functional group present in succinic acid. **1**

7. Essential oils can be extracted from plants and used in perfumes and food flavourings.

(a) Essential oils contain compounds called terpenes.

A terpene is a chemical made up of a number of isoprene molecules joined together.

The shortened structural formula of isoprene is $CH_2C(CH_3)CHCH_2$.

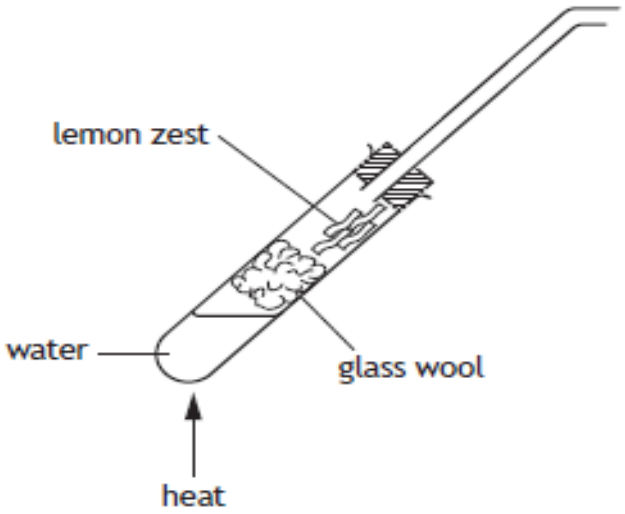
Draw the full structural formula for isoprene. **1**

(b) Essential oils can be extracted from the zest of lemons in the laboratory by steam distillation.

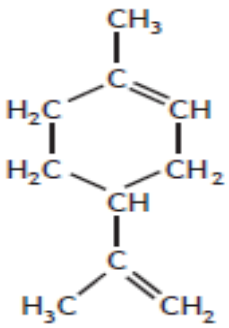
The process involves heating up water in a boiling tube until it boils. The steam produced then passes over the lemon zest which is separated from the water by glass wool. As the steam passes over the lemon zest it carries the essential oils into a delivery tube. The condensed liquids (essential oils and water) are collected in a test tube placed in a cold water bath.

Complete the diagram to show the apparatus required to collect the essential oils. **1**

(An additional diagram, if required, can be found on Page 29.)



(c) Limonene, $C_{10}H_{16}$, is an essential oil which is added to some cleaning products to give them a lemon scent.



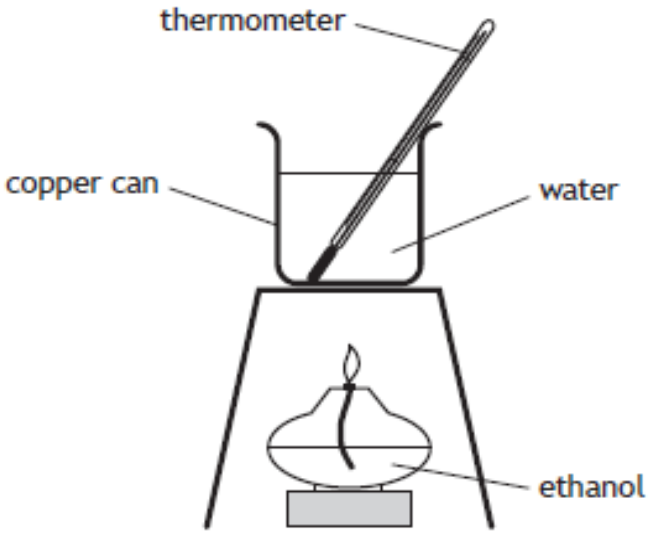
The concentration of limonene present in a cleaning product can be determined by titrating with bromine solution.

(i) Name the type of chemical reaction taking place when limonene reacts with bromine solution. **1**

(ii) Write the molecular formula for the product formed when limonene, $C_{10}H_{16}$, reacts completely with bromine solution. 1

8. Ethanol can be used as an alternative fuel for cars.

(a) A student considered two methods to confirm the amount of energy released when ethanol burns.



Method A	*Method B*
1. Record the initial temperature of the water.	1. Record the initial temperature of the water.
2. Weigh the burner containing the fuel.	2. Weigh the burner containing the fuel.
3. Place the burner under the copper can and then light the burner.	3. Light the burner and then place it under the copper can.
4. Extinguish the flame after 2 minutes.	4. Extinguish the flame after 2 minutes.
5. Record the final temperature and reweigh the burner.	5. Record the final temperature and reweigh the burner.

Explain which method would give a more accurate result. 2

(continued)

(b) The table gives information about the amount of energy released when 1 mole of some alcohols are burned.

Name of alcohol	*Energy released when one mole of alcohol is burned* (kJ)
propan-1-ol	2021
propan-2-ol	2005
butan-1-ol	2676
butan-2-ol	2661
pentan-1-ol	3329
pentan-2-ol	3315
hexan-1-ol	3984

(i) Write a statement linking the amount of energy released to the position of the functional group in an alcohol molecule. 1

(ii) Predict the amount of energy released, in kJ, when 1 mole of hexan-2-ol is burned. 1

(c) Ethanol can also be used in portable camping stoves.

The chemical reaction in a camping stove releases 23 kJ of energy. If 100 g of water is heated using this stove, calculate the rise in temperature of the water, in °C. 3

You may wish to use the data booklet to help you.

Show your working clearly.

9. Ethers are a group of compounds containing carbon, hydrogen and oxygen.

Name of ether	*Structural formula*	*Boiling point* (°C)
methoxyethane	$CH_3-O-CH_2CH_3$	7
ethoxyethane	$CH_3CH_2-O-CH_2CH_3$	35
X	$CH_3-O-CH_2CH_2CH_3$	39
propoxybutane	$CH_3CH_2CH_2-O-CH_2CH_2CH_2CH_3$	117

(a) Name ether X. 1

(b) Suggest a general formula for this homologous series. **1**

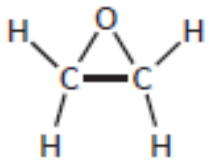
(c) Methoxyethane is a covalent molecular substance. It has a low boiling point and is a gas at room temperature.

Circle the correct words to complete the sentence. **1**

The bonds between the molecules are { weak / strong } and the bonds within the molecule are { weak / strong }.

(d) Epoxides are a family of cyclic ethers.

The full structural formula for the first member of this family is shown.



(i) Epoxides can be produced by reacting an alkene with oxygen.

Name the alkene which would be used to produce the epoxide shown. **1**

(ii) Epoxides have three atoms in a ring, one of which is oxygen.

Draw a structural formula for the epoxide with the chemical formula C_3H_6O. **1**

10. Carboxylic acids can be used in household cleaning products.

(a) Name the functional group found in all carboxylic acids. **1**

(b) Carboxylic acids have a range of physical and chemical properties. Melting point is an example of a physical property.

The table gives information about propanoic acid and butanoic acid.

Carboxylic acid	*Melting point* (°C)
propanoic acid	–21
butanoic acid	–5

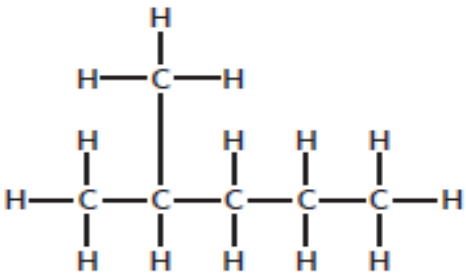
(i) Draw a structural formula for butanoic acid. **1**

(ii) Explain why butanoic acid has a higher melting point than propanoic acid. **2**

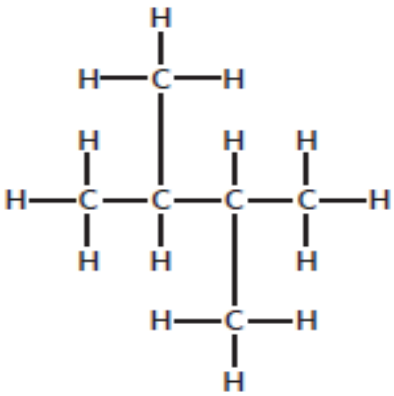
11. The alkanes are a homologous series of saturated hydrocarbons.

(a) State what is meant by the term homologous series. **1**

(b) The structural formula of two alkanes is shown.



2-methylpentane

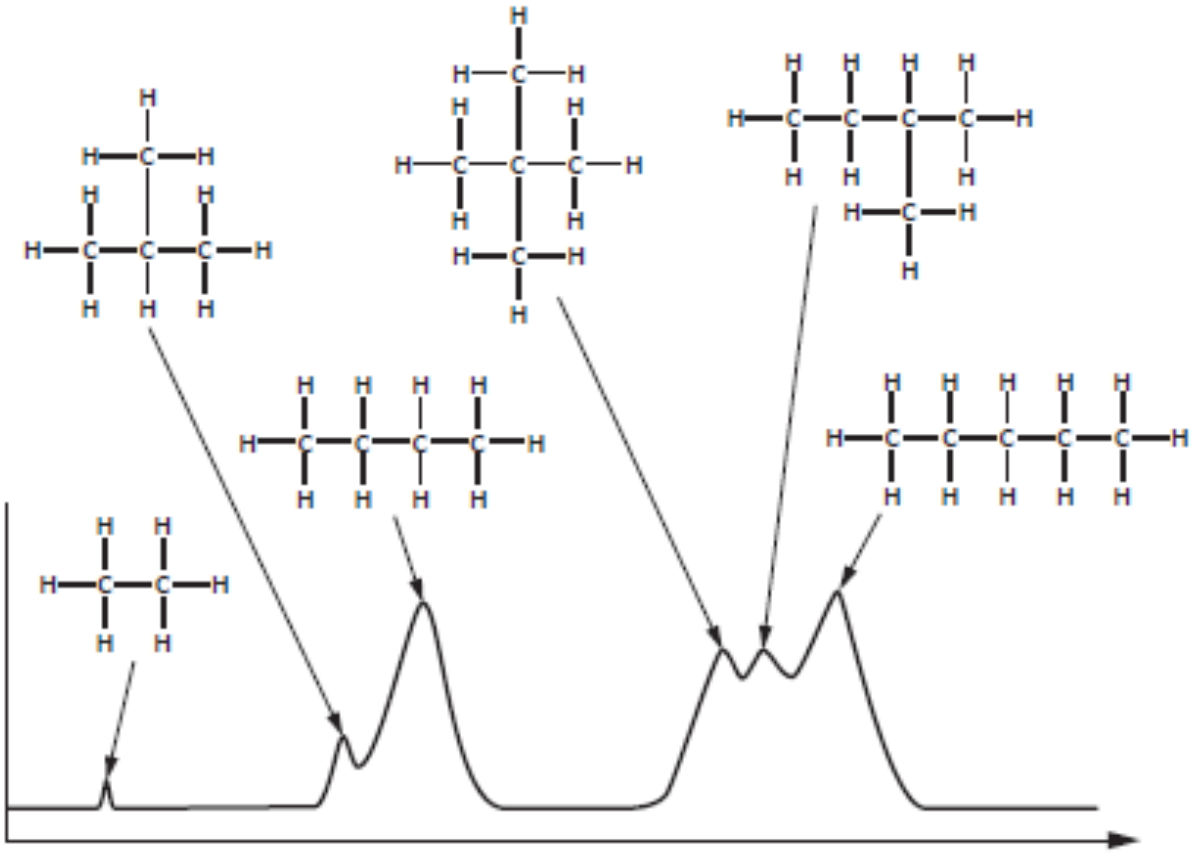


2,3-dimethylbutane

State the term used to describe a pair of alkanes such as 2-methylpentane and 2,3-dimethylbutane. **1**

(c) The alkanes present in a mixture were separated using a technique known as HPLC. The mixture was vaporised and then passed through a special column. Different alkanes take different amounts of time to pass through the column.

The results are shown.



Time taken to pass through the column

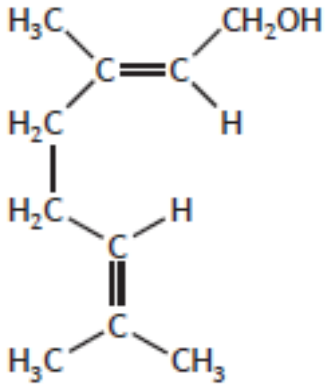
(i) Write a general statement linking the structure of the alkane to the length of time taken to pass through the column. 1

(ii) Propane was added to the mixture and the HPLC technique was repeated.

Draw an arrow on the graph to show the expected time taken for propane to pass through the column. 1

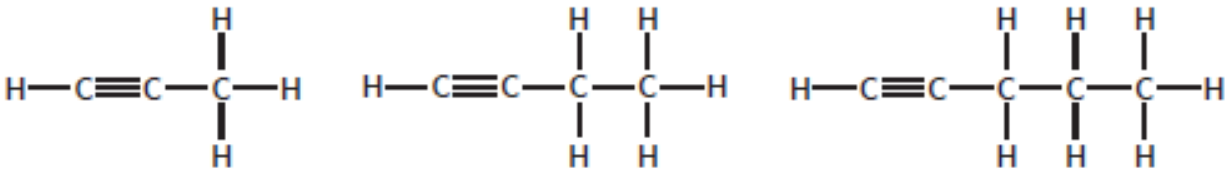
(An additional diagram, if required, can be found on *Page 27*.)

12. Geraniol is an essential oil known to have anti-inflammatory properties. A structure for the geraniol molecule is shown.



(a) Circle a functional group found in the geraniol molecule. **1**

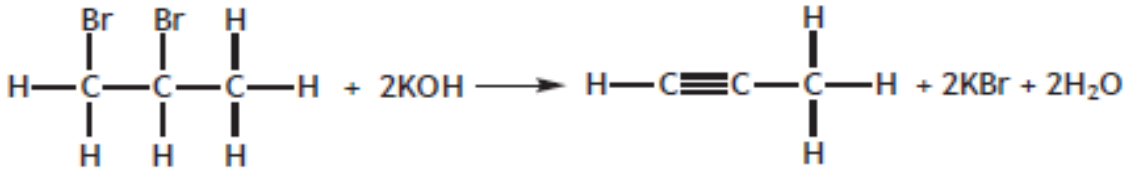
13. The alkynes are a family of hydrocarbons which contain a carbon to carbon triple bond. Three members of this family are shown.



propyne but-1-yne pent-1-yne

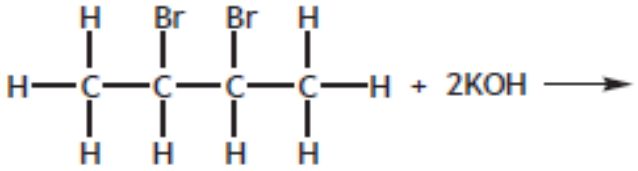
(a) Suggest a general formula for the alkyne family. **1**

(c) Alkynes can be prepared by reacting a dibromoalkane with potassium hydroxide solution.



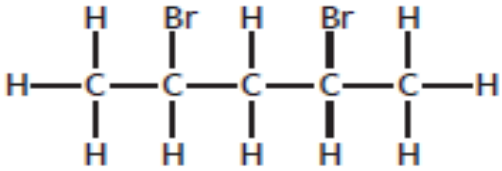
1,2-dibromopropane propyne

(i) Draw the full structural formula for the alkyne formed when 2,3-dibromobutane reacts with potassium hydroxide. **1**



2,3-dibromobutane

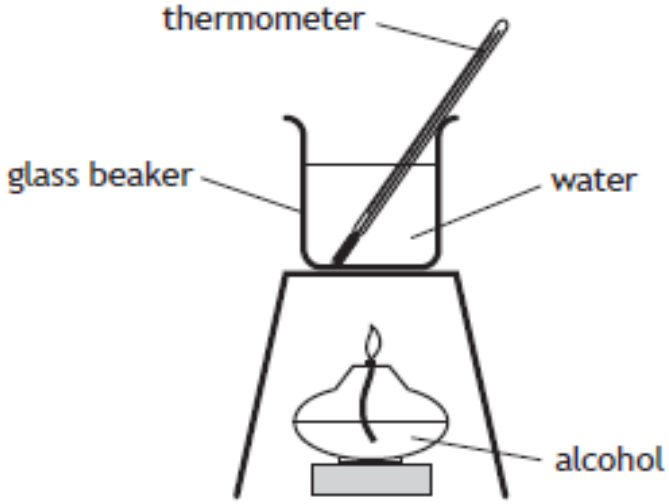
(ii) The structure for 2,4-dibromopentane is shown below.



2,4-dibromopentane

Suggest a reason why 2,4-dibromopentane does not form an alkyne when it is added to potassium hydroxide solution. **1**

14. (a) A group of students carried out an experiment to measure the energy produced when 5 g samples of different alcohols were burned.



The results are shown.

Alcohol	*Energy released* (kJ)
propan-1-ol	158
butan-1-ol	170
pentan-1-ol	179
hexan-1-ol	185

(i) Draw a structural formula for hexan-1-ol. **1**

(ii) Predict the energy released, in kJ, if the same mass of heptan-1-ol was burned. **1**

(b) The energy released when an alcohol burns can be used to heat liquids other than water.

The data below was collected when the energy released, by burning an alcohol, was used to heat a sodium chloride solution.

Energy released when the alcohol was burned (kJ)	13·3
Initial temperature of sodium chloride solution (°C)	15
Final temperature of sodium chloride solution (°C)	49
Mass of sodium chloride solution heated (g)	100

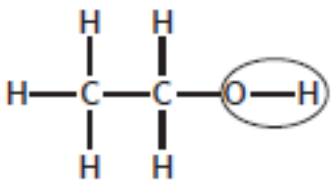
Calculate the specific heat capacity, in $kJ\,kg^{-1}\,°C^{-1}$, of the sodium chloride solution. 3

You may wish to use the data booklet to help you.

Show your working clearly.

15. Car manufacturers have developed vehicles that use ethanol as fuel.

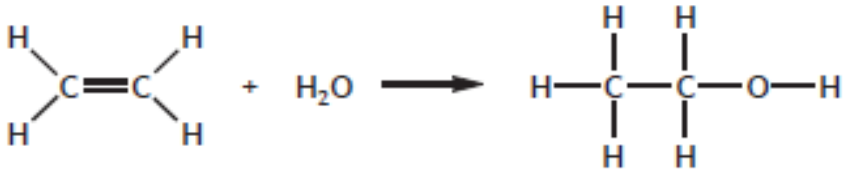
(a) The structure of ethanol is shown below.



Name the functional group circled in the diagram. 1

(b) Name the two substances produced when ethanol burns in a plentiful supply of oxygen. 1

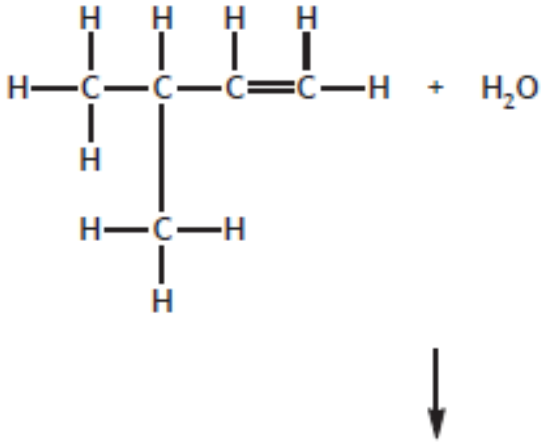
(c) Ethanol can be produced from ethene as shown.



ethene ethanol

(i) Name the type of chemical reaction taking place. **1**

(ii) Draw a structural formula for a product of the following reaction. **1**



(d) Ethanol can be used to produce ethanoic acid.

(i) Draw a structural formula for ethanoic acid. **1**

(ii) Name the family of compounds to which ethanoic acid belongs. **1**

Section 1 Answers

1	**C**	**7**	**B**	**13**	**B**	**19**	**C**
2	**B**	**8**	**A**	**14**	**C**	**20**	**B**
3	**C**	**9**	**D**	**15**	**D**	**21**	**C**
4	**B**	**10**	**C**	**16**	**C**	**22**	**A**
5	**C**	**11**	**B**	**17**	**C**		
6	**C**	**12**	**A**	**18**	**C**		

Section 2 Answers

1.

(a)		They have similar chemical properties and They have the same general formula. Both required for 1 mark	1	Correct answers can be ticked, circled or highlighted in some other way. If more than two boxes ticked zero marks awarded.
(b)		Butane, or it, has stronger / more / bigger forces of attraction (1) between molecules or mention of intermolecular attractions (1) If neither of these two points are given a maximum of one mark can be awarded for Butane is bigger / has more carbon or hydrogens / longer carbon chain	2	The term bond is only acceptable if it is specifically identified as between the molecules or used with the term intermolecular. Mention of breaking bonds/bonds within molecule or chain/ breaking carbon to carbon or carbon to hydrogen bonds or more bonds cannot gain the second mark but does not negate the first mark 2 marks can be awarded if candidate explains why propane has a lower boiling point but they must state propane in answer. 1 mark - propane is smaller / has less carbon or hydrogens / smaller carbon chain. Propane must be stated to gain the mark
(c)		2090 with no working = (3) $E_H = cm\Delta T = 4{\cdot}18 \times 25 \times 20 = 2090$ (3) using concept $cm\Delta T$ with $c = 4{\cdot}18$ (1) using correct data ie 25 and 20 (1) final answer 2090 (1) If awarding partial marks, the mark for the final answer can only be awarded if the concept mark has been awarded.	3	Ignore negative sign if present. Unit not required however if wrong unit given do not award mark for final answer.eg kJ^{-1} or kg. Accept kj, kJ, Kj or KJ. If 25 is divided by 1000 = 0·025 maximum 2 marks Answer in joules is accepted but the units must be given. ie 2 090 000 J is acceptable. 2 090 000 on its own is not acceptable.

2.

(a)	(i)	The higher/lower the number of carbon atoms the higher/lower the flash point The flash point increases/decreases as the number of carbon atoms increases/decreases	1	Cause and effect must be stated correctly Zero marks for: The higher/lower the flash point the higher/lower the number of carbons The number of carbons increases/decreases as the flash point increases/decreases Accept as alternatives increases - goes up/gets higher decreases - goes down/gets lower/less Answer must specifically relate to the number of carbon atoms or length of carbon chain, not to the size of the hydrocarbon molecule. eg accept as the length of the carbon chain increases.... Do not accept as the hydrocarbon gets bigger....
(a)	(ii)	47 - 51 inclusive (units not required)	1	

3.

(a)	(i)	Hydroxyl or OH or -OH	1	Zero marks awarded for hydroxide/OH^- Refer to General Marking Principle (m) for guidance. Zero marks awarded if hydroxide is given along with hydroxyl. Refer to General Marking Principle (g) for guidance.
(b)	(i)	Butanoic acid or methylpropanoic acid or 2-methylpropanoic acid or butyric acid	1	Spelling must be correct and the word acid must be included. If candidate draws a structure that is incorrect then this does not negate. Refer to General Marking Principles (b) and (f) for guidance.

	(ii)	Bromine/Br_2 decolourised/discolourised or bromine/Br_2 goes colourless	1	Accept bromine/bromine water/bromine solution but do not accept bromide or Br. Zero marks awarded for 'goes clear' however if given in addition to a correct answer it does not negate. Award zero marks if candidate explicitly states compound Y is decolourised or the unsaturated compound is decolourised. If starting colour is given it must be correct e.g. orange/yellow/red-brown or brown. If candidate states correct answer followed by incorrect statement such as because it has a carbon to carbon single bond zero marks are awarded. Refer to General Marking Principle (g) for guidance.

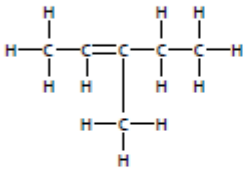
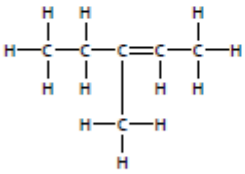
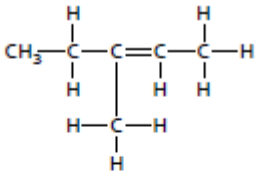
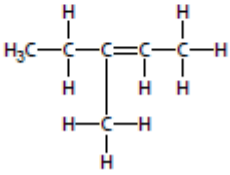
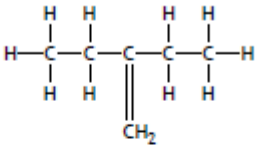
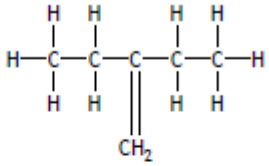
4.

(a)		<u>Method B (it)</u> Complete combustion/more oxygen/pure oxygen Less/no heat loss (to surroundings) Better insulation Metal/platinum is a better conductor or <u>Method A</u> Incomplete combustion Less oxygen (More) heat loss to surroundings No draught shield/no insulation Glass is a poor conductor Flame too far away from beaker or Any other reasonable answer	1	If answer relates to method A it must be clear that it is method A they are referring to. If the method is not identified in the candidates answer as method A or method B then assume that the answer refers to method B. Award zero marks for the beaker is made from glass without the effect or the walls are thick without the effect or the water evaporates.

(b)		14 /14·2/14·21/14·212 with no working (3) Partial marking using concept cmΔT with c = 4·18 To be awarded the concept mark candidates do not specifically need to write cmΔT. The concept mark is awarded for using this relationship with values - three values, one of which must be 4·18 (1) using data correctly i.e. both 0·1 and 34 °C (1) final answer 14/14·2/14·21/14·212 (1) If awarding partial marks, the mark for the final answer can only be awarded if the concept mark has been awarded.	3	4·18 x 0·5 x 34 = 71·06 would be awarded 2 marks (concept mark and follow through) 4·18 x 0·5 x 58 = 121·22 would be awarded 2 marks (concept mark and follow through) If Method A data is used i.e. 0·1 x 8, a maximum of 2 marks can be awarded (1 for concept mark and 1 for final answer 3·344). If Method A data is used and no working shown award zero marks (for answer 3·344 with no working). Ignore negative sign if present. Unit is not required however if the wrong unit is given do not award mark for final answer e.g. kJ^{-1} or kg is incorrect Accept kj, kJ, Kj or KJ.
				4.18 x 100 x 34 = 14212(KJ) is worth 2 marks as it contains wrong data. The answer in joules is accepted but the units must be given. e.g. 14212 J is acceptable and would be awarded 3 marks. 14212 on its own is not acceptable without working.

5.

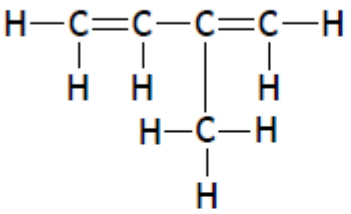
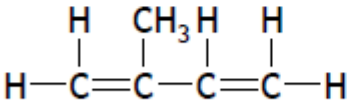
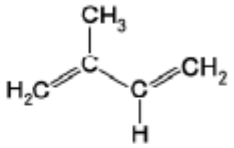
(a)		But-2-ene or 2-butene	1	Refer to General Marking Principle (b) for guidance. Zero marks awarded for butene or but-2-ane or butan-2-ene

(b)		(Molecules/compounds /hydrocarbons/alkenes) with same molecular/chemical formula but a different structural formula	1	The same number of carbons and hydrogens but different structure or atoms are arranged differently is acceptable. Different shape is not acceptable. Zero marks awarded for 'general formula' instead of 'molecular formula'. Zero marks awarded for elements with.....
(c)		Correct structural formula for 3-methylpent-2-ene or 2 ethyl but-1-ene eg      or mirror images or correct shortened structural formula e.g. $CH_3CHC(CH_3)CH_2CH_3$	1	Accept shortened structural formula or full structural formula or combination of both Allow one H bonded to a carbon to be missing as long as bond from carbon is shown. Allow one bond between a carbon and a hydrogen to be missing as long as hydrogen is shown. Refer to General Marking Principle (l) for guidance. As the vertical bond is not to the carbon, award zero marks for 

6.

(a)		Carboxyl	1	Zero marks awarded for carboxylic (acid). Zero marks awarded for -COOH circled or drawn but this does not negate the correct answer 'carboxyl'. Refer to General Marking Principle (h) for guidance.

7.

(a)		The correct structural formula for isoprene eg  OR  However if CH_3 is used the bond must be going to the carbon	1	Zero marks awarded for 
(b)		Diagram showing delivery tube passing into a test tube which is placed in a water/ice bath. Delivery tube must extend close enough to the neck of the test tube to ensure the vapour can enter the test tube.	1	Do not penalise if boiling tube/measuring cylinder etc has been used in place of test tube. Diagram does not need to be labelled. Delivery tube must be open and no lines drawn across it. Ignore a stopper as long as it does not close off the delivery tube.
(c)	(i)	Addition / additional OR bromination	1	Zero marks awarded for 'add.' Zero marks awarded for 'Addition' followed by incorrect answer eg 'polymerisation', 'distillation', 'combustion' etc.

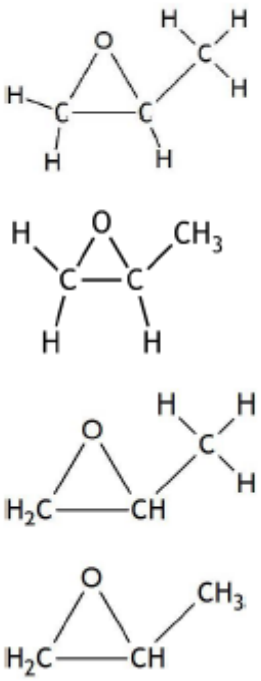
	(ii)	$C_{10}H_{16}Br_4$	1	Symbols can be in any order. Numbers must be smaller than symbol or subscript Symbols must be correct Zero marks awarded for: C10 H16 Br4 $C_{10}H_{16}br_4$ $C_{10}H_{16}BR_4$ $C_{10}H_{16} + Br_4$

8.

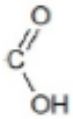
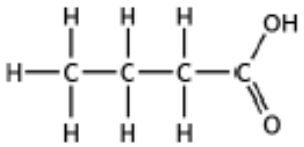
(a)		1 mark for Method A *The second mark for the explanation* ***cannot*** *be awarded if the first mark is not gained.* 1 mark for explanation of accuracy of A (or inaccuracy of B) based on • Heat loss • Heat transfer • Mass loss (due to ethanol being combusted/used up) eg - Method A because more heat is transferred to water - Method B because less heat is transferred to water - B releases more heat to the surroundings	2	Explanation is assumed to be for chosen method unless otherwise stated. The explanation mark cannot be awarded for restating or describing Step 3 eg • the fuel in A doesn't start to burn until it is under the (copper) can / water • the fuel in B starts to burn before it is under the (copper) can /water Zero marks awarded for an explanation in terms of evaporation of ethanol but does not negate a correct explanation.
(b)	(i)	A statement that identifies the effect of changing the position on the energy released. eg If the alcohol is 2-ol then less energy is released compared with 1-ol or vice versa. OR As you move from one to two (carbon/position) then the energy decreases or vice versa. OR As it (the position of the functional group) increases/gets higher, the energy released decreases or vice versa OR	1	Award zero marks for as the number of carbons increase/alcohol gets bigger the energy released also increases or vice versa.

		As it (the position of the functional group) increases/gets higher, the energy released decreases or vice versa OR Functional group (or it/hydroxyl/–OH) on (position) 1/end carbon/first carbon - energy released is greater/higher/bigger/increases OR Functional group (or it/hydroxyl/–OH) on position 2/not on the end carbon energy released is smaller/lower/decreases OR As it/functional group goes further along/further down/further up the lower the energy or vice versa.		
	(ii)	3967 – 3971	1	Unit is not required however if the wrong unit is given do not award mark. Accept kj, kJ, Kj or KJ. Also accept kJ mol^{-1}or kJ/mol or kilo Joules per mole in words.
(c)		55 or 55·02 with no working 3 marks ——————————————— 1 mark for using the correct concept of $\Delta T = Eh / cm$ with both 4·18 and 23 correctly substituted 1 mark for 0·1 with or without concept 1 mark for correct arithmetic (this mark can only be awarded if the concept mark has been awarded).	3	Unit is not required however if the wrong unit is given do not award final mark. Do not accept ° on its own. 1 mark awarded if 23000 and 4180 are both used together in correct concept. If a mass of 100 is used then 23000 and 4·18 must be used to access all 3 marks.

9.

(a)		Methoxypropane (spelling must be correct)	1	Zero marks awarded for propoxymethane.
(b)		$C_nH_{2n+2}O$ OR $C_nH_{2n+2}O_1$ OR $C_nH_{n2+2}O$	1	Symbols can be in any order eg $H_{2n+2}OC_n$ Accept another letter in place of n eg $C_xH_{2x+2}O$ Zero marks awarded for CnH2n+2O C_nH_{2n+2} + O $C_nH_{2n+2}O_n$ Award zero marks for $C_nH_{2n+1}OH$, $C_nH_{2n+1}OC_nH_{2n+1}$
(c)		{WEAK / strong} {weak / STRONG} BOTH REQUIRED	1	
(d)	(i)	Ethene / Eth-1-ene OR Ethylene	1	Accept a correct molecular or structural formula for ethene. Incorrect formulae in addition to ethene negates. Mention of any other substance negates.
	(ii)	Any acceptable full, shortened or abbreviated structural formula e.g. 	1	Allow one carbon to hydrogen bond to be missing provided the hydrogen is shown. Allow one hydrogen to be missing provided the carbon to hydrogen bond is shown.

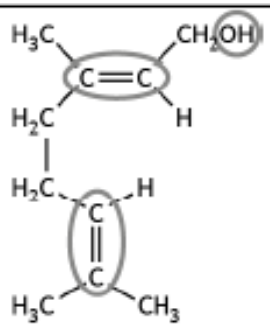
10.

(a)		Carboxyl **or**  **or** COOH	1	
(b)	(i)	Any acceptable structural formula for butanoic acid eg $CH_3CH_2CH_2COOH$ $CH_3(CH_2)_2COOH$ 	1	Accept mixture of shortened and full structural formula Ignore - the omission of one H atom (from a carbon atom) in full structural formula provided the bond is shown **or** - one carbon to hydrogen bond missing provided the hydrogen is shown. Award zero marks for C_3H_7COOH
(b)	(ii)	Butanoic acid or it has bigger / stronger / more forces (of attraction) **(1)** Between molecules or mention of intermolecular attractions **(1)**	2	The term bond is only acceptable if it is specifically identified as between the molecules or used with the term intermolecular. Mention of breaking bonds /bonds within molecule or chain / breaking carbon to carbon or carbon to hydrogen bonds or more bonds cannot gain the second mark but does not negate the first mark. Candidates can be awarded the full/partial marks if they correctly explain why propanoic acid has a lower melting point but propanoic acid **must** be stated in their answer.
		If neither of these two points are given, a maximum of 1 mark can be awarded for - butanoic acid or it is bigger has more carbons or hydrogens or atoms longer carbon chain		More bonds in the compound is not sufficient to imply a larger molecule but does not negate.

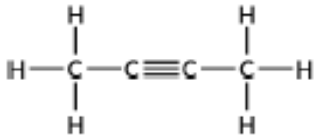
11.

(a)		They have the same general formula **AND** similar/same <u>chemical</u> properties **Both required for 1 mark**	1	Award zero marks for -molecular formula -structural formula -chemical formula Award zero marks for - physical properties in place of chemical properties however, it does not negate
(b)		Isomer(s)	1	
(c)	(i)	Increasing carbon chain length/ number of carbons takes more time (longer, slower) **or** Decreasing carbon chain length/ number of carbons takes less time (faster, quicker) **or** Straight chain takes more time (longer, slower) than branched chain **or** Branched chain takes less time (faster, quicker) than straight chain	1	
	(ii)	Indication that the expected position occurs anywhere on the horizontal line between ethene and 2-methylpropane.	1	

12.

(a)			1	Circling of either C=C or OH. Award zero marks for 

13.

(a)		C_nH_{2n-2} or C_nH_{n2-2} or $C_nH_{2(n-1)}$	1	Accept x etc in place of n
(c)	(i)		1	Ignore - the omission of one H atom (from a carbon atom) in full structural formula provided the bond is shown or - one carbon to hydrogen bond missing provided the hydrogen is shown.
	(ii)	The two bromine atoms are not next to one another. or The two bromines are separated by a hydrogen. or The two bromine branches are not next to one another.	1	Award zero marks for -bromide -bromine molecules. Accept words/phrases that imply not together or not next to each other.

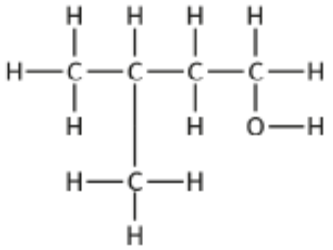
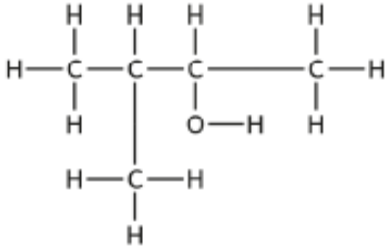
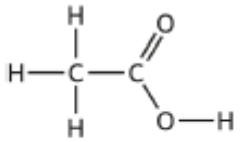
14.

(a)	(i)	Any correct shortened or full structural formula for hexan-1-ol	1	Bond to the hydroxyl group must be to the O of the OH. Ignore the omission of one H atom (from a carbon atom) in full structural formula provided the bond is shown or ignore one carbon to hydrogen bond missing provided the hydrogen is shown.
	(ii)	188 (kJ)	1	No units required but no mark is awarded if wrong unit is given. (Wrong units are only penalised once in any paper).

(b)		3·9 or 3·91 or 4 (kJ kg^{-1} $^{o}C^{-1}$) **(3)** Partial marking Using the correct concept of $c = E_h / m\,\Delta T$ with E_h = 13·3 **(1)** 0·1 and 34 **(1)** A further mark can be awarded for the candidate's calculated answer only if the mark for the concept has been awarded. **(1)**	3	No units required but a maximum of two marks can be awarded if wrong unit is given. (Wrong units are only penalised once in any paper) 13300 and 100 can be used if the calculation is carried out in J/g. (The final answer would be 3·9 and the unit is correct if given as J g^{-1} $^{o}C^{-1}$. or as kJ kg^{-1} $^{o}C^{-1}$) Alternatively -13300 and 0·1 can be used but the final answer should be 3912 J kg^{-1} $^{o}C^{-1}$ (units must be shown and correct for 3 marks to be awarded). If no unit, or the unit given in question is used then 2 marks are awarded as the mark for the final calculated answer is not awarded. Or alternatively - the answer, 3912, can be divided by 1000 to give the correct answer in kJ kg^{-1} $^{o}C^{-1}$.

15.

(a)		hydroxyl	1	
(b)		carbon dioxide and water	1	Both required for 1 mark Accept correct formulae.
(c)	(i)	addition or hydration	1	

	(ii)	 or 	1	Accept full or shortened structural formula
(d)	(i)		1	Accept full or shortened structural formula
	(ii)	carboxylic acid	1	Accept alkanoic acid