Catholic High School
Sec 4 Chemistry
Worksheet 21/22 – Alkanes, Alkenes & Isomerism

/ 50

Name: _____ ( ) Mark:

Class: _____ Date: _____

(A) Multiple-Choice Questions [15 marks]

1. Octane is an eight carbon alkane found in petrol. Which statement about octane is correct?

A It cannot be obtained via cracking of petroleum. ✓
B It has a lower boiling point than ethane. ✗
C It reacts with bromine by substitution.
D It differs from methane by a $-CH_2$ group. ✗

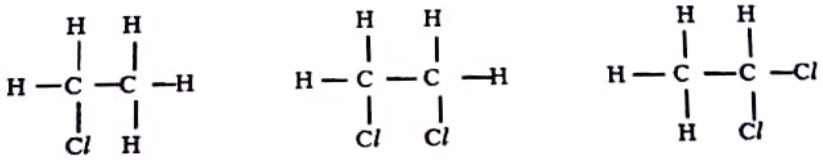
[C]

2. Methane, the first member of the alkane homologous series, has a boiling point of -161 °C. Which of the following statements is true?

A The second member of the alkane homologous series is C_2H_6 with a boiling point of -88 °C.
B Some alkanes are saturated hydrocarbons.
C All alkanes have the same physical properties.
D All alkanes contain -C-C- bond.

[ ]

3. The diagrams show the structures of three compounds.



1 2 3

Which compounds can be products of substitution reactions of ethane with excess chlorine?

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

[ ]

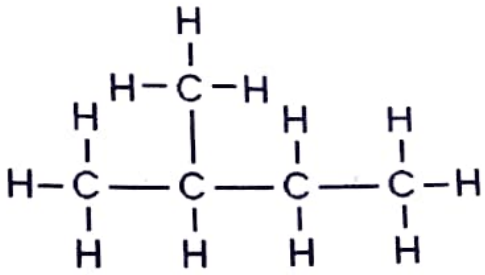
4. Which of the following compounds may be produced from incomplete combustion of propane?

1 Soot
2 Hydrogen
3 Carbon monoxide
4 Water

A 2 and 4 only.
B 1, 3 and 4 only.
C 1, 2 and 4 only.
D 1, 2, 3 and 4.

[ ]

5. When 2-methylbutane reacts with chlorine in the presence of UV light, four different monochlorinated products are formed.



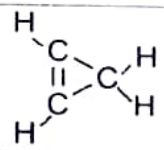
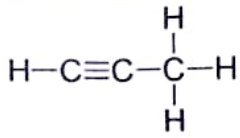
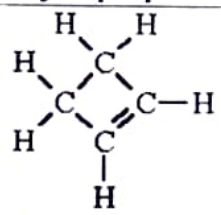
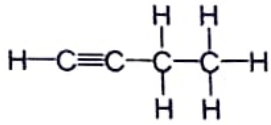
(a) Draw the full structural formula of each of the products.

[4]

(b) Suggest with a reason, why four different monochlorinated products might be formed.

[1]

6. The table shows the names and structures of some hydrocarbons.

Number of carbon atoms	Cycloalkene	Alkyne
3	 Cyclopropene	 Propyne
4	 Cyclobutene	 Butyne
5		

(a) In the table above, give the full structural formula and chemical name of the next member of the cycloalkane and alkyne homologous series containing 5 carbon atoms. [4]

(b) Are cycloalkenes isomers of alkynes? Explain your reasoning.

.....

.....

[2]

(c) Describe and explain the trend in boiling points as the number of carbon atoms increase in the alkynes.

.....

.....

[2]

(d) Similar to propenes, propynes also takes part in addition reactions. One such reaction is the addition of bromine across the carbon-carbon triple bond. For halogenation, the halogen atoms add to an alkyne molecule in a stepwise fashion, leading to the formation of an alkene, which can undergo further reaction to form an alkane.

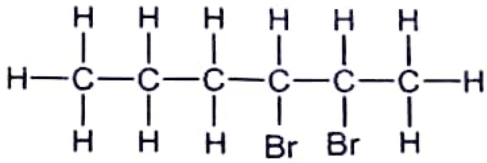
(i) Draw the product of the reaction when 1 mole of propyne reacts with **2 moles of aqueous bromine** under an addition reaction.

[1]

(ii) Draw the product of the reaction when 1 mole of propyne reacts with **1 mole of aqueous bromine** in another addition reaction.

[1]

2. An alkene has the molecular formula C_6H_{12}. The following shows the full structural formula of the compound when this alkene reacts with bromine.



(a) Draw the full structural formula of two isomers of the structure above.

[2]

(b) Draw the full structural formula of the starting alkene.

[1]

(c) Explain why the reaction between the alkene and bromine is called an addition reaction.

[2]

3. The table shows some data about some hydrocarbons.

Hydrocarbon	Empirical formula	Molecular formula	Melting point / °C	Boiling point / °C	Energy change of combustion/ kJ/mol
Ethane	CH_3	C_2H_6	-183	-89	-1560
Propane	C_3H_8	C_3H_8	-188	-42	-2220
Propene	CH_2	C_3H_6	-185.2	-47.6	-1911

(a) Identify which hydrocarbons belong to the same homologous series. Use the information in the table to give **two** pieces of evidence to show they belong to the same homologous series.

[3]

(b) The enthalpy change of combustion in kJ/mol increases from ethane to propane. Suggest a reason why.

.....

[1]

.....

4. A student collects some data about the fat content of some margarines. The margarines tested contain a mixture of saturated fat, A, unsaturated fat, B, and water. He conducts an experiment to determine the number of drops of bromine water that will react with 10 g of each type of margarine. The table shows his results.

Margarine	Percentage by mass of saturated fat	Percentage by mass of unsaturated fat	Number of drops of bromine water per 10 g
1	10	80	12
2	20	60	9
3	60	20	3

(a) Describe the colour change observed when bromine reacts with margarine **1**.

[1]

.....

(b) Describe how margarine **2** can be converted to margarine **3**, stating clearly, the name of the reaction, reagents and the conditions required.

.....

[2]

.....

(c) A fourth type of margarine, contains 30% by mass of saturated fat and 30% by mass of water. Estimate the number of drops of bromine water that reacts with 10 g of this margarine.

[1]

.....

(d) Pure fat has a molecular mass of 600. 100 g of pure fat reacts with 254 g of iodine. How many double bonds are there in each molecule of the fat? Show your working clearly.

[3]

15. Which of the following would **not** be a likely product on cracking the hydrocarbon octadecane, $C_{18}H_{38}$?

1 H_2 2 C_9H_{18} 3 C_9H_{20} 4 C_9H_{22} 5 $C_{18}H_{36}$

A 4 only.
B 1 and 5 only.
C 1, 2 and 4 only.
D 1, 3 and 5 only.

[ ]

(B) Structured Questions [35 marks]

1. Two possible fuels for use in car engines are octane and butane. The table gives some data about these two fuels.

Fuel	Molecular formula	Melting point / °C	Boiling point / °C	Energy change of combustion/ kJ/mol
Octane	C_8H_{18}	-57	125	-5460
Butane	C_4H_{10}	-140	-1	-2874

(a) The table gives value for the energy change of combustion for each fuel in kJ/mol. Calculate the energy output for 1 g of each fuel.

[2]

(b) Use the values you have calculated and information in the table to discuss the advantages and disadvantages of using each fuel in cars.

[2]

10. When 1 mole of hydrocarbon **X** burns completely in excess oxygen, it produces 18 g of water and 88 g of carbon dioxide. What is the formula of the hydrocarbon **X**?

A CH_4 **B** C_2H_4 **C** C_2H_2 **D** C_2H_6

[ ]

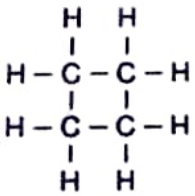
11. Which of these statements comparing alkanes and alkenes is true?

A Alkanes are more reactive than alkenes.
B Alkenes decolourise bromine water rapidly under room temperature conditions but alkanes do not.
C Alkenes undergo substitution reactions, but alkanes undergo addition reactions.
D Alkanes are flammable, but alkenes are not.

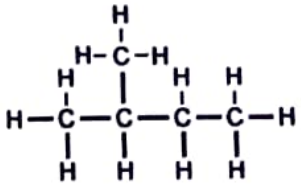
[ ]

12. Which of the following structural formulae is **not** an isomer of the others?

A



B



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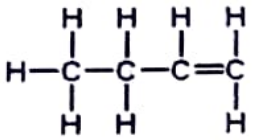
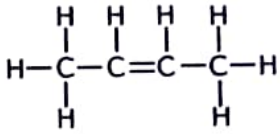


D



[ ]

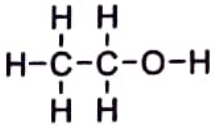
13. Which of these statements about structural isomers are correct?

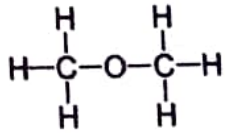
1 Isomers are compounds with different structural formula.
2 Isomers are compounds with different molecular formula.
3 Isomers have the same relative molecular mass.
4 Isomers have similar chemical properties.
5 Isomers belong to the same homologous series.

A 1 and 3 only. **B** 2 and 3 only. **C** 3, 4 and 5 only. **D** 1, 3, 4 and 5 only.

[ ]

14. Which properties will be the same for both molecules shown below?



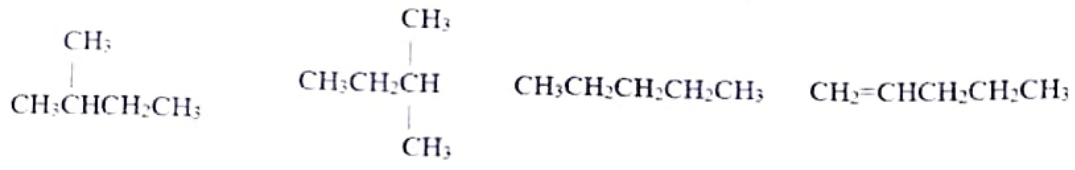


1 Empirical formula
2 Functional group
3 Molecular formula
4 Structural formula
5 Boiling point

A 1, 2, 3 and 4 only
B 1 and 3 only.
C 1, 3 and 5 only
D 2 and 3 only

[ ]

5. Which of these molecules are structural isomers of each other?

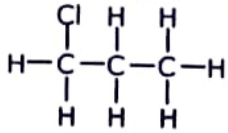


1 2 3 4

A 1 and 2 only.
B 1 and 3 only.
C 2 and 4 only.
D 3 and 4 only.

[ ]

6. How many other isomers does the molecule below have?



A 0
B 1
C 2
D 3

[ ]

7. The general formula of alkenes is C_nH_{2n}. Which physical property decreases as n increases?

A Boiling point
B Flammability
C Melting point
D Viscosity

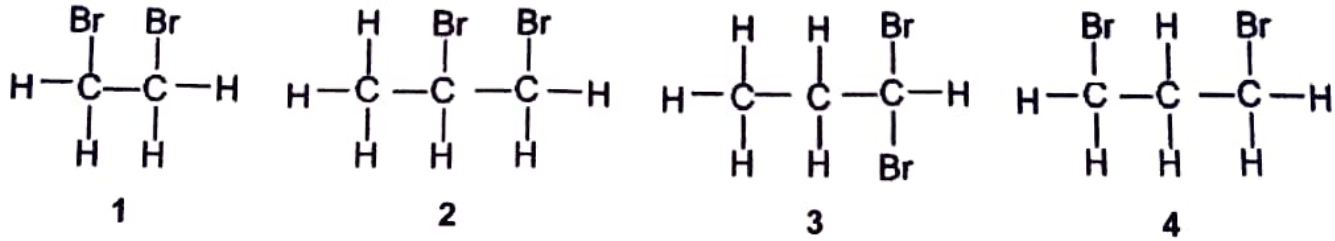
[ ]

8. Which one of these equations does **not** show an addition reaction?

A $CH_3Cl + Cl_2 \rightarrow CH_2Cl_2 + HCl$
B $C_3H_6 + Br_2 \rightarrow C_3H_6Br_2$
C $C_4H_8 + H_2O \rightarrow C_4H_9OH$
D $C_2H_4 + H_2 \rightarrow C_2H_6$

[ ]

9. The diagrams show the structures of four compounds.



1 2 3 4

Which compounds can be products of addition reactions of an alkene with liquid bromine?

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

[ ]