13.1 FORMULA, FG, NAMING OC

Learning outcomes

Candidates should be able to:

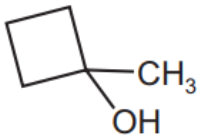
1. define the term hydrocarbon as a compound made up of C and H atoms only
2. understand that alkanes are simple hydrocarbons with no functional group
3. understand that the compounds in the table on page 26 and 27 contain a functional group that dictates their physical and chemical properties
4. interpret and use the general, structural, displayed, and skeletal formulae of the classes of compounds stated in the table on page 26 and 27
5. understand and use systematic nomenclature of simple aliphatic organic molecules with functional groups detailed in the table on page 26 and 27, up to six carbon atoms (six plus six for esters, straight chains only for esters and nitriles)
6. deduce the molecular and/or empirical formula of a compound, given its structural, displayed or skeletal formula

Introduction

1. C_{60} forms hydrocarbons with similar chemical properties to those of alkenes. One such hydrocarbon is $C_{60}H_{18}$.
   Define hydrocarbon. [1]

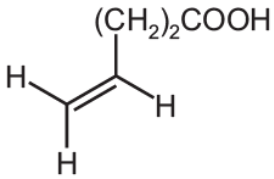
2. Deduce the molecular formula of **D1**.

D1



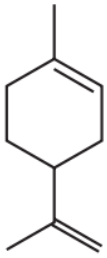
3. 4-pentenoic acid is an example of an unsaturated carboxylic acid.
   Give the molecular formula of 4-pentenoic acid.

4-pentenoic acid



1. Limonene is a hydrocarbon found in the rind of citrus fruits.

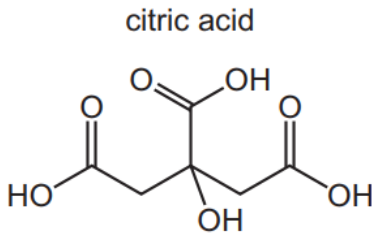
limonene



What is the molecular formula of limonene?

A $C_{10}H_{12}$ **B** $C_{10}H_{14}$ **C** $C_{10}H_{16}$ **D** $C_{10}H_{18}$

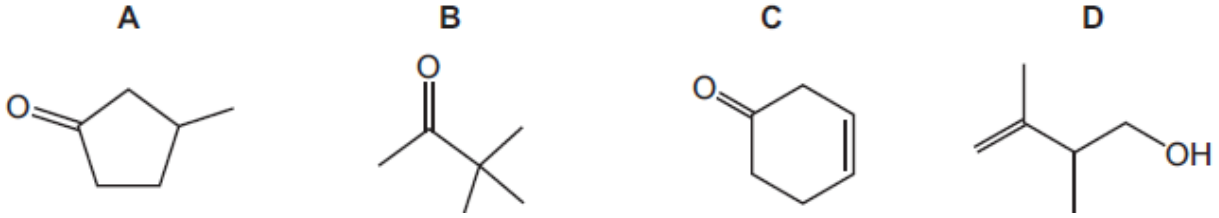
2. The diagram shows the skeletal formula of citric acid.



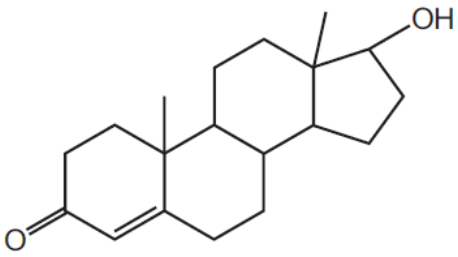
What is the molecular formula of citric acid?

A $C_6H_8O_7$ **B** $C_6H_4O_7$ **C** $C_8H_8O_7$ **D** $C_{10}H_8O_7$

3. Which compound has the molecular formula $C_6H_{10}O$?



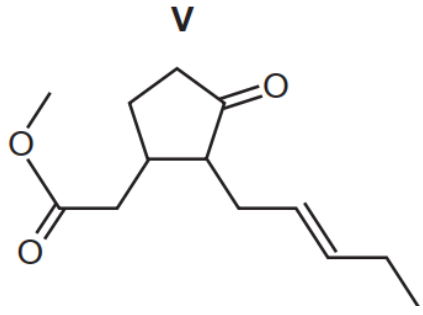
4. The diagram shows the skeletal formula of the hormone testosterone.



What is the molecular formula of testosterone?

A $C_{19}H_{28}O_2$ B $C_{17}H_{22}O_2$ C $C_{17}H_{24}O_2$ D $C_{19}H_{26}O_2$

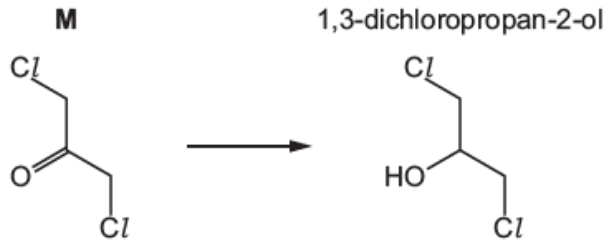
4. V shows stereoisomerism.



(i) Deduce the molecular formula of **V**. [1]

(ii) Name **all** the functional groups present in **V**. [1]

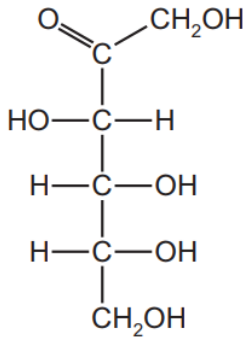
5. 1,3-dichloropropan-2-ol can be made by reacting M.



Name the functional group present in M that changes during this reaction. [1]

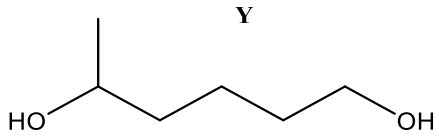
6. Determine the empirical formula of fructose.

fructose

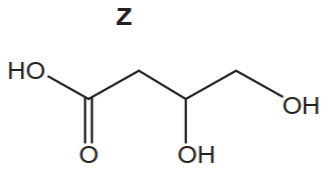


[1]

7. Deduce the empirical formula of **Y**. [1]



8. Deduce the empirical formula of **Z**. [1]

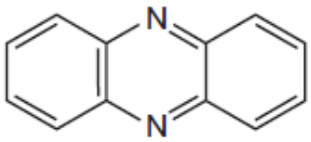


5. For which hydrocarbon are the molecular and empirical formulae the same?

A butane **B** ethane **C** pent-1-ene **D** propane

6. The diagram shows the skeletal formula of phenazine.

phenazine

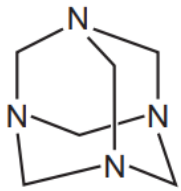


What is the empirical formula of phenazine?

A C_6H_4N **B** C_6H_6N **C** $C_{12}H_8N_2$ **D** $C_{12}H_{12}N_2$

7. Hexamine is a crystalline solid used as a fuel in portable stoves.
The diagram shows its skeletal structure.

hexamine

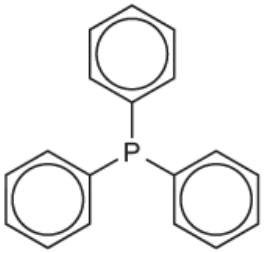


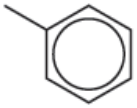
What is the empirical formula of hexamine?

A CH_2N **B** $C_3H_6N_2$ **C** $C_4H_8N_4$ **D** $C_6H_{12}N_4$

9. Triphenylphosphine is used in a type of reaction known as a *Wittig reaction*.

triphenylphosphine

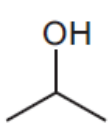


where  = $-C_6H_5$

Give the empirical formula of triphenylphosphine. [1]

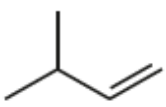
10. Name C. [1]

C



11. Give the systematic name of **D**.

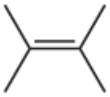
D



[1]

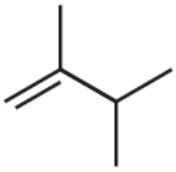
12. Name **T**. [1]

T

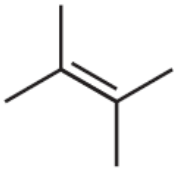


13. Under different conditions, two molecules of propene can combine to form compounds X and Y.
Name X and Y.

X



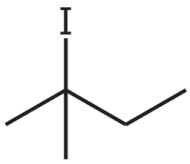
Y



..... [2]

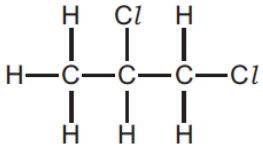
14. J reacts with NaOH, forming different products dependent on the conditions used.
Name J. [1]

J



15. Compound Q is a by-product of reaction 1. Name Q.

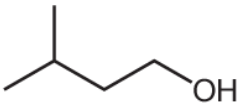
Q



..... [1]

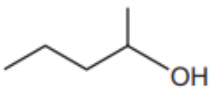
16. Give the name of **N**. [1]

N

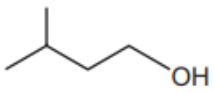


1. What is the skeletal formula of 2-methylpentan-1-ol?

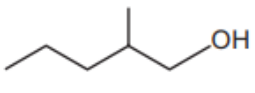
A



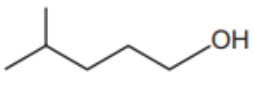
B



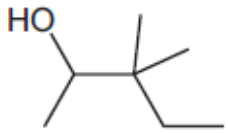
C



D



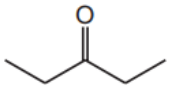
2. What is the correct name for the compound shown?



A 1,2,2-trimethylbutan-3-ol
B 2-ethyl-2-methylbutan-2-ol
C 3,3-dimethylpentan-2-ol
D 4-hydroxy-3,3-dimethylpentane

17. Give the systematic name of **B2**. [1]

B2

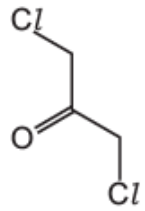


18. $(CH_3)_3CCHO$ is used in the synthesis of some antibiotics.
Give the name of $(CH_3)_3CCHO$.

..... [1]

19. Give the systematic name of M. [1]

M



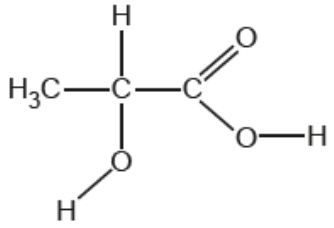
20. Give the systematic name for the organic product $CH_3CH(NH_2)C_2H_5$.

..... [1]

21. Give the systematic name of lactic acid.

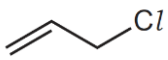
[1]

lactic acid



22. Allyl chloride is an important chemical used in the manufacture of plastics, pharmaceuticals and pesticides. Give the systematic name of allyl chloride. [1]

allyl chloride



23. Draw the skeletal formula of methylpropene. [1]

24. Draw the skeletal formula of 2-methylbut-1-ene. [1]

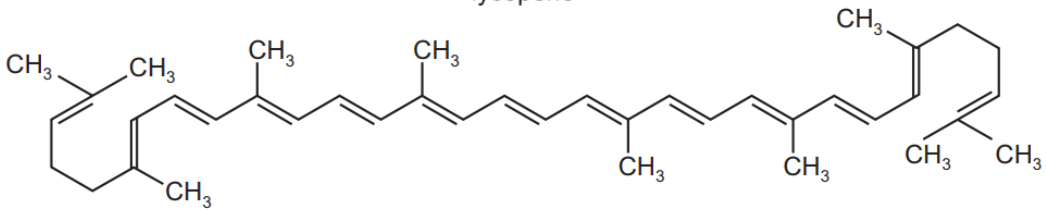
25. Draw the fully displayed formula of ethanedioic acid. [1]

3. What is the empirical formula of butanoic acid?

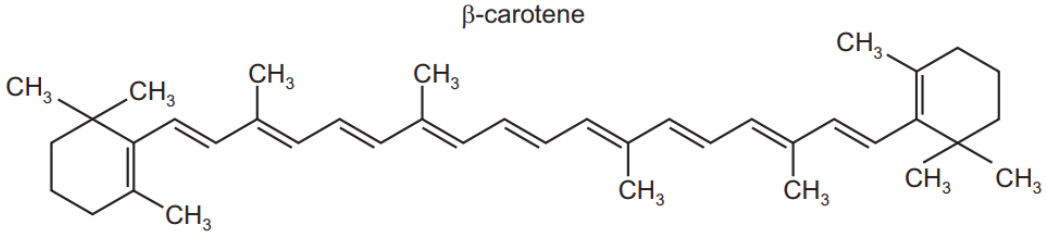
A C_2H_4O B C_3H_6O C C_4H_8O D $C_5H_{10}O$

4. The diagrams show the structures of lycopene and β-carotene.

lycopene



β-carotene



When lycopene is converted into β-carotene, what is the gain or loss of hydrogen atoms per molecule?

A 4 gained **B** 2 gained **C** no change **D** 2 lost

5. Ethanoic acid is mixed with ethanol.
The ethanol is contaminated with a small amount of methanol.
The following equilibria are established.

$CH_3CO_2H(l) + CH_3CH_2OH(l) \rightleftharpoons CH_3CO_2CH_2CH_3(l) + H_2O(l)$ $\mathbf{K_c = K_1}$
$CH_3CO_2H(l) + CH_3OH(l) \rightleftharpoons CH_3CO_2CH_3(l) + H_2O(l)$ $\mathbf{K_c = K_2}$

Which statement about the equilibrium mixture is correct?

A Only ethyl ethanoate will be formed because there is much more ethanol present than methanol.
B In this mixture $\frac{[CH_3CO_2CH_2CH_3]}{[CH_3CO_2CH_3]} = \frac{K_1}{K_2}$
C Adding water to the mixture will alter the mole ratio of the two esters.
D Adding methyl ethanoate to the mixture will increase the number of moles of ethyl ethanoate.

26. The alkanes are a homologous series of organic molecules. Alkanes are generally unreactive and are commonly used as fuels.
Define homologous series.

…….....

……..... [2]

27. P, Q and R are three different hydrocarbon molecules.
(i) Hydrocarbon P contains 85.7% by mass of carbon.
Calculate the empirical formula of P.
Show your working.

empirical formula of P = ... [2]

(iii) Molecules of P have straight chains.
Name the homologous series to which P belongs.

..... [1]

*****This is not a complete note. It is to guide you. It is recommended to study the prescribed textbooks along with this material. *****