

REMEDIAL GUIDES
THE SCIENCE SCRIBE
LEVEL II ORGANIC CHEMISTRY

BOOK TEN: ANSWERS
BY LIAN SOH

DEAR READER,

The **REMEDIAL GUIDES** are a set of notes with practice questions which aims to scaffold gaps in content knowledge. They have been called *remedial* booklets because they have been published with the intention of filling/fixing gaps in content knowledge. For example, you might have been away for 2 days and completely missed out on a small block of work (or maybe you just fell behind) so you might decide to only download the relevant booklet which will catch you up.

Regardless, I hope you find this resource useful to you in some way. I appreciate any feedback (especially corrections to errors).

Lian Soh

The Science Scribe

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DOCUMENT PROPERTIES

This document has been created using a *2 page per sheet* format, where each sheet is an *A4 size* in *landscape* format.

ANSWER BOOKLET

BOOK I: “HOW DO I LOVE ORGANIC? LET ME COUNT THE WAYS”I CAN USE PREFIXES TO DETERMINE THE NUMBER OF CARBON ATOMS PRESENT

Write the number of carbon atoms present in each of the following molecules. **Four have been completed for you.** Try these without looking at the previous page.

Methane	1	Heptene	7
Decane	10	Butane	4
Nonane	9	Hexene	6
Ethane	2	Propanol	3
Butene	4	Propyne	3
Methanamine	1	Butanoic Acid	4
Butanol	4	Decene	10
Octanol	8	Octane	8
Ethanamine	2	Propane	3
Heptane	7	Hexanamine	6
Ethene	2	Ethyne	2
Hexanoic Acid	6	Hexane	6
Butyne	4	Propanamine	3
Octanol	8	Pentyne	5
Hexyne	6	Butanamine	4
Octane	8	Hexanol	6
Pentane	5	Ethanoic Acid	2
Pentanamine	5	Nonanamine	9
Pentene	5	Nonanol	9
Decanamine	10	Propene	3
Pentanol	5	Propanoic Acid	3
Butanoic Acid	4	Heptanamine	7
Decanol	10	Butane	4

BOOK I: "NAMING ALKANES"

I CAN SYSTEMATICALLY NAME ALKANES

Write the systematic name for the following alkanes.

- | | |
|---------------------------------|---------------------------------------|
| 1. ethane | 2. propane |
| 3. butane | 4. methylpropane |
| 5. 2,2-dimethylpropane | 6. 2,3-dimethylbutane |
| 7. methane | 8. pentane |
| 9. 3-methylpentane | 10. 3-ethylpentane |
| 11. 2-methylpentane | 12. 2,3-dimethylpentane |
| 13. methylbutane | 14. 2-methylpentane |
| 15. 3-ethyl-2-methylpentane | 16. 3-ethyl-3-methylpentane |
| 17. 3-ethyl-2,4-dimethylpentane | 18. hexane |
| 19. 2-methylhexane | 20. 3-ethylhexane |
| 21. 3,4-diethylhexane | 22. 3,4-diethyl-2,3,5-trimethylhexane |

BOOK I: "I LIKE TO READ, THEN DRAW"

Write extended, partially extended, or compressed structural formulae for the following alkanes. Do this on refill.

- | | |
|--|--|
| 1. CH_4 | 2. $\text{CH}_3 - \text{CH}_3$ |
| 3. $\text{CH}_3 - \text{CH}_2 - \text{CH}_3$ | 4. $\text{CH}_3 - \text{CH}_2 - \text{CH}_2 - \text{CH}_3$ |

5. $\text{CH}_3 - \text{CH}_2 - \text{CH}_2 - \text{CH}_2 - \text{CH}_3$
6. $\begin{array}{c} \text{CH}_3 - \text{CH} - \text{CH}_2 - \text{CH}_2 - \text{CH}_3 \\ | \\ \text{CH}_3 \end{array}$
7. $\begin{array}{c} \text{CH}_3 - \text{CH}_2 - \text{CH} - \text{CH}_2 - \text{CH}_3 \\ | \\ \text{CH}_3 \end{array}$
8. $\begin{array}{c} \text{CH}_3 - \text{CH} - \text{CH}_3 \\ | \\ \text{CH}_3 \end{array}$
9. $\begin{array}{c} \text{CH}_3 - \text{CH} - \text{CH}_3 - \text{CH}_3 \\ | \\ \text{CH}_3 \end{array}$
10. $\text{CH}_3 - \text{CH}_2 - \text{CH}_2 - \text{CH}_2 - \text{CH}_2 - \text{CH}_3$
11. $\begin{array}{c} \text{CH}_3 - \text{CH} - \text{CH}_2 - \text{CH}_2 - \text{CH}_2 - \text{CH}_3 \\ | \\ \text{CH}_3 \end{array}$
12. $\begin{array}{c} \text{CH}_3 - \text{CH}_2 - \text{CH} - \text{CH}_2 - \text{CH}_2 - \text{CH}_3 \\ | \\ \text{CH}_3 \end{array}$
13. $\begin{array}{c} \text{CH}_3 - \text{CH} - \text{CH} - \text{CH}_2 - \text{CH}_2 - \text{CH}_3 \\ | \quad | \\ \text{CH}_3 \quad \text{CH}_3 \end{array}$
14. $\begin{array}{c} \text{CH}_3 \\ | \\ \text{CH}_3 - \text{C} - \text{CH}_2 - \text{CH}_2 - \text{CH}_2 - \text{CH} \\ | \\ \text{CH}_3 \end{array}$
15. $\begin{array}{c} \text{CH}_3 - \text{CH}_2 - \text{CH} - \text{CH}_2 - \text{CH}_2 - \text{CH}_3 \\ | \\ \text{CH}_2 \\ | \\ \text{CH}_3 \end{array}$
16. $\begin{array}{c} \text{CH}_3 - \text{CH} - \text{CH} - \text{CH}_2 - \text{CH}_2 - \text{CH}_3 \\ | \quad | \\ \text{CH}_3 \quad \text{CH}_2 \\ | \\ \text{CH}_3 \end{array}$
17. $\text{CH}_3 - \text{CH}_2 - \text{CH}_2 - \text{CH}_2 - \text{CH}_2 - \text{CH}_2 - \text{CH}_3$
18. $\begin{array}{c} \text{CH}_3 - \text{CH}_2 - \text{CH}_2 - \text{CH} - \text{CH}_2 - \text{CH}_2 - \text{CH}_3 \\ | \\ \text{CH}_2 \\ | \\ \text{CH}_2 \\ | \\ \text{CH}_3 \end{array}$
19. $\begin{array}{c} \text{CH}_3 \\ | \\ \text{CH}_3 - \text{C} - \text{CH} - \text{CH}_2 - \text{CH}_2 - \text{CH}_3 \\ | \quad | \\ \text{CH}_3 \quad \text{CH}_3 \end{array}$
20. $\begin{array}{c} \text{CH}_3 - \text{CH} - \text{CH} - \text{CH} - \text{CH}_2 - \text{CH}_3 \\ | \quad | \quad | \\ \text{CH}_3 \quad \text{CH}_3 \quad \text{CH}_3 \end{array}$
21. $\begin{array}{c} \text{CH}_3 \\ | \\ \text{CH}_3 - \text{C} - \text{CH} - \text{CH}_2 - \text{CH}_2 - \text{CH}_3 \\ | \quad | \\ \text{CH}_3 \quad \text{CH}_2 \\ | \\ \text{CH}_3 \end{array}$
22. $\begin{array}{c} \text{CH}_3 \\ | \\ \text{CH}_2 \\ | \\ \text{CH}_3 - \text{CH} - \text{C} - \text{CH}_2 - \text{CH}_2 - \text{CH}_3 \\ | \quad | \\ \text{CH}_3 \quad \text{CH}_3 \end{array}$

BOOK I: "A SYMPHONY OF FORMULAE AND ISOMERS"

Draw the structural isomers of hexane by writing/drawing their structural formula. Write the molecular formula, empirical formula and systematic name for each one.

Name: hexane

Structural Formula: $\text{CH}_3 - \text{CH}_2 - \text{CH}_2 - \text{CH}_2 - \text{CH}_2 - \text{CH}_3$

Molecular Formula: C_6H_{14}

Empirical Formula: CH_2

Name: 2-methylpentane

Structural Formula: $\text{CH}_3 - \text{CH}_2 - \text{CH}_2 - \underset{\text{CH}_3}{\text{CH}} - \text{CH}_3$

Molecular Formula: C_6H_{14}

Empirical Formula: CH_2

Name: 3-methylpentane

Structural Formula: $\text{CH}_3 - \text{CH}_2 - \underset{\text{CH}_3}{\text{CH}} - \text{CH}_2 - \text{CH}_3$

Molecular Formula: C_6H_{14}

Empirical Formula: CH_2

Name: 2,3-dimethylbutane

Structural Formula: $\text{CH}_3 - \underset{\text{CH}_3}{\text{CH}} - \underset{\text{CH}_3}{\text{CH}} - \text{CH}_3$

Molecular Formula: C_6H_{14}

Empirical Formula: CH_2

Name: 2,2-dimethylbutane

Structural Formula: $\text{CH}_3 - \text{CH} - \underset{\text{CH}_3}{\overset{\text{CH}_3}{\text{C}}} - \text{CH}_3$

Molecular Formula: C_6H_{14}

Empirical Formula: CH_2

BOOK I: “PHYSICAL PROPERTIES”

Give brief reasons for the following observations.

1. Hexane is sold in hardware stores. It is used to help clean greasy (non-polar) spills/stains.

Hexane is non-polar and will dissolve other non-polar substances such as grease.

2. Methane, ethane, propane, butane and pentane are gases at room temperature but hexane is a liquid.

As we go from methane to hexane, the molar mass and chain length increases. This means there are more atoms available in larger molecules such as hexane to form weak instantaneous dipole attractions between molecules meaning more heat is required to overcome them. This means that at room temperature there is not enough heat to break all the weak attractions between hexane molecules, but there is enough for methane, ethane, propane, butane and pentane.

3. Even though hexane is a liquid at room temperature, bottles of hexane have very noticeable odours when the lid is unscrewed.

Alkanes are non-polar and hexane is a relatively small molecule. Very little heat energy is required to overcome the attractive forces between hexane molecules and, even though most of the hexane may be a liquid at room temperature, some hexane molecules will have enough heat energy from ambient temperature to exist as gaseous hexane.

4. In some countries, where the ambient temperature is quite hot, candles will melt on a hot day.

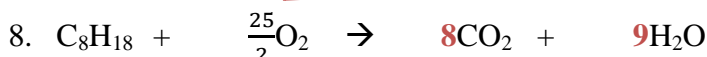
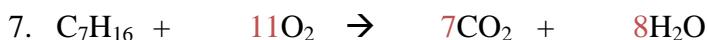
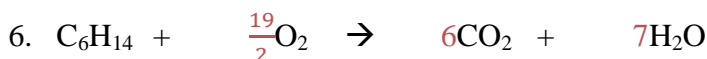
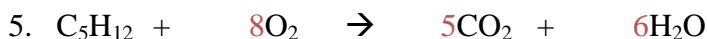
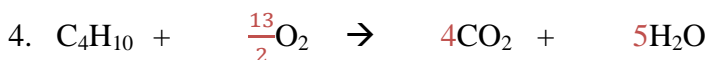
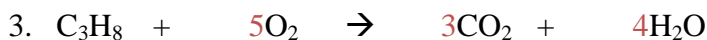
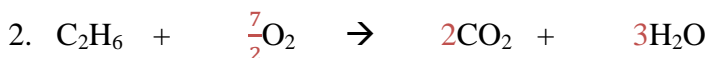
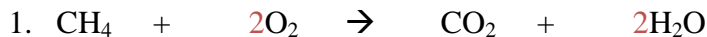
Candles are made of alkanes between 20-25 carbon atoms long. Even though they are large molecules, little heat energy is required to overcome the attractive forces between molecules.

5. Octane floats on water.

Octane is non-polar so it won't dissolve in water and will form layers. Octane is less dense than water so will float on top of the water.

USE: “FIRE!”

Write balanced full equations for the **complete combustion** of the following alkanes. One has been completed for you to show how to derive fractions (not all equations will need fractions).

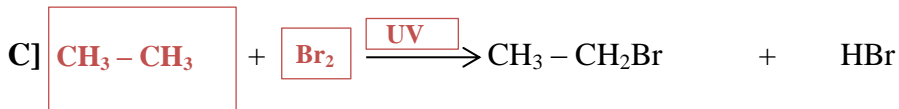
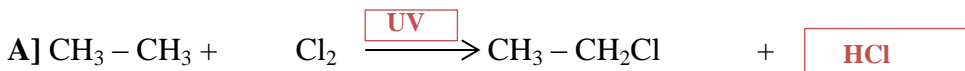


25 oxygen in total on right hand side of reaction arrow

2 oxygen in total on left hand side of arrow

USE: “THE CHEMICAL MASTER OF ALKANES”

1. Fill in the gaps/boxes for the following reactions:



2. Describe the expected observations for the reactions A to C above.

A] When clear colourless ethane is bubbled through a very pale green solution of chlorine water, the pale green colour decolourises.

B] When clear colourless propane is bubbled through brown iodine, the brown colour decolourises.

C] When ethane is bubbled through brown bromine water, the brown colour decolourises.

3. Label the following reactions as substitution or combustion reactions.

A) combustion

B) substitution

C) combustion

D) substitution

4. Using the example below, describe what is meant by the term *substitution reaction*.



A substitution reaction is when an atom or small group of atoms is replaced by a different atom or small group of atoms. In the example, a C-H bond in ethane is broken to substitute (replace) a hydrogen with a fluorine atom. The fluorine atom comes from breaking an F-F bond in F₂. This forms a haloalkane, CH₃CH₂F and hydrogen fluoride.

5. Suppose the following reaction was to be carried out:



A] Without the use of litmus paper, how could you verify that a reaction had taken place? **The brown bromine water would decolourise as the reaction proceeds.**

B] Describe how you would use litmus paper to test whether the final product was acidic or basic.

The reaction above produces hydrogen bromide. Hydrogen bromide is acidic. Therefore, it would turn damp (or moist) blue litmus paper red. Using damp/moist red litmus paper would give no colour change.

C] What is the function of U.V light?

Substitution reactions are slow and require the presence of U.V light.

NOTES/QUESTIONS FOR MYSELF OR MY TEACHER:

