Introduction to

Organic Chemistry

Program in General Science, Faculty of Education,
Suan Sunandha Rajabhat University

Semester 1 Academic year 2025

This presentation was modified and used for academic purpose only. Picture and material were taken from references shown in the last page

OUTLINE

Organic Chemistry

- Hydrocarbon
  - Alkane, Alkene, Alkyen
  - Aromatic compound
- Functional group
  - Alcohol, ether,
  - aldehyde, ketone,
  - carboxylic acid, ester
  - Amine, amide

Introduction of Organic Chemistry

organic chemistry is *the chemistry of carbon compounds*

Organic compounds is divided into three classes:

(1) hydrocarbons,

(2) compounds containing oxygen, and

(3) Compounds containing nitrogen

Wade, L. G. *Organic Chemistry*; Pearson Education, Inc., 2013.

A simple classification of organic compounds

Organic compounds

Hydrocarbons
(contain only C and H)

- **Aliphatic**
  - Alkanes (C–C)
  - Alkenes (C=C)
  - Alkynes (C≡C)
- **Aromatic**

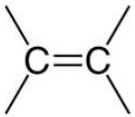
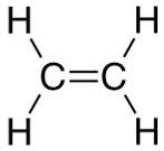
Contain C, H and O
(Functional groups)

- Alcohol & ether
- Aldehyde & Ketone
- Carboxylic acid & ester

Contain C, H and N
(Functional groups)

- amines
- Amide

Table 3.1 Hydrocarbons

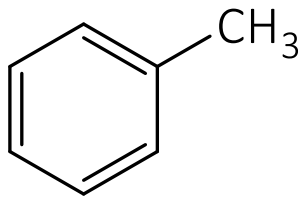
Type of compound	General structure	Example	Functional group
Alkane $[C_nH_{2n+2}]$	R—H	CH_3CH_3	—
Alkene $[C_nH_{2n}]$			double bond
Alkyne $[C_nH_{2n-2}]$	—C≡C—	H—C≡C—H	triple bond
Aromatic compound			phenyl group

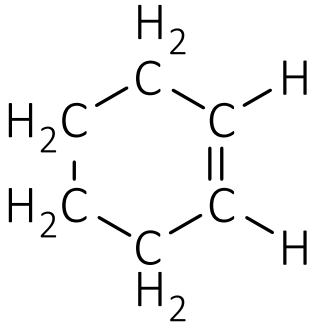
Smith, J. (2010). *Organic Chemistry*: McGraw-Hill Education.

Sample Problem 1.1 **Classifying Organic compounds**

PROBLEM: Classify each of the following compounds as an alkane, alkene, alkyne, aromatic.

(a) $CH_3-CH_2-CH_2-CH_3$

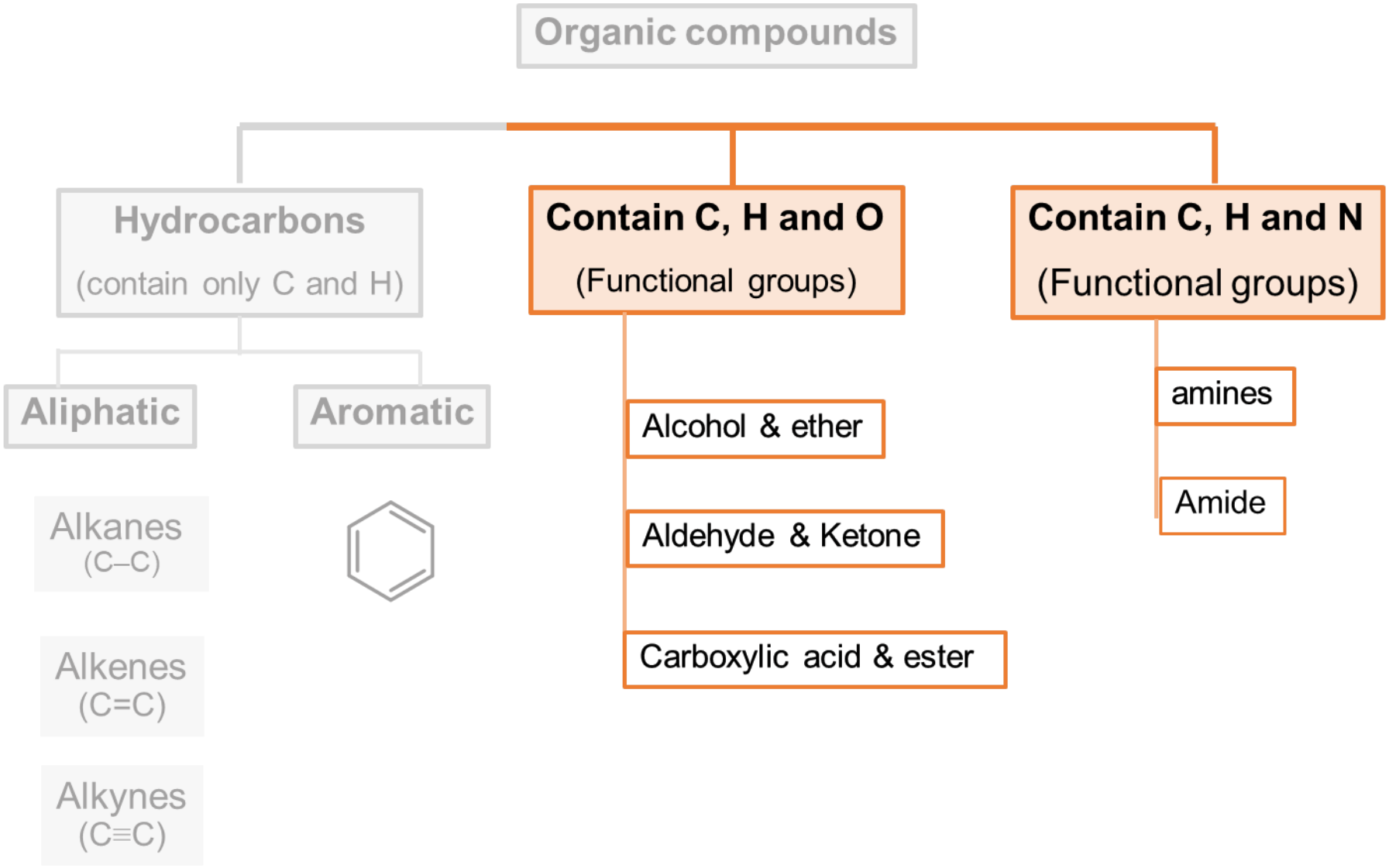
(c) 

(b) 

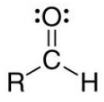
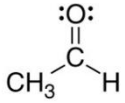
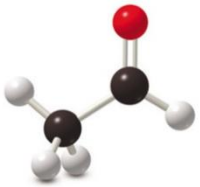
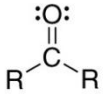
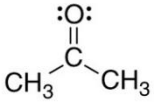
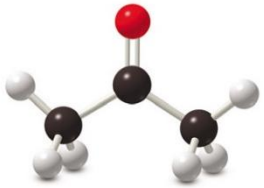
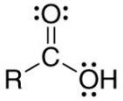
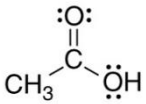
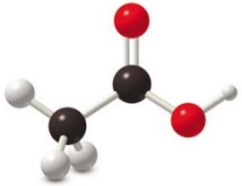
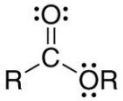
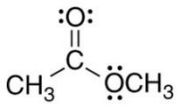
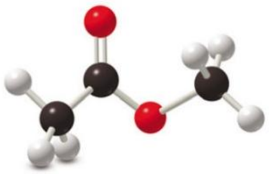
(d) $CH_3-C\equiv C-H$

Smith, J. (2010). *Organic Chemistry*: McGraw-Hill Education.

A simple classification of organic compounds

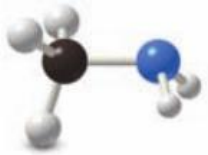
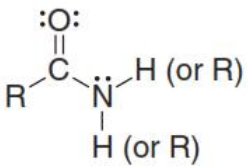
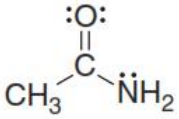
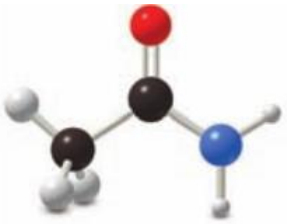


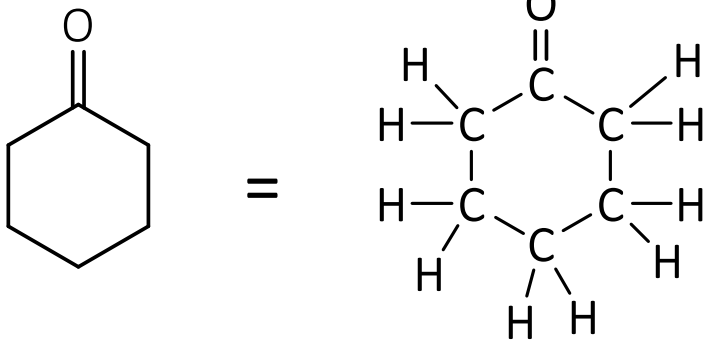
Organic Compounds containing oxygen

Type of compound	General structure	Example	3-D structure	Functional group
Alcohol	R–Ö–H	CH_3–Ö–H		**–OH** hydroxy group
Ether	R–Ö–R	CH_3–Ö–CH_3		**–OR** alkoxy group
Aldehyde				C=O carbonyl group
Ketone				C=O carbonyl group
Carboxylic acid				–COOH carboxy group
Ester				–COOR

Smith, J. (2010). *Organic Chemistry*: McGraw-Hill Education.

Organic Compounds containing nitrogen

Type of compound	General structure	Example	3-D structure	Functional group
Amine	$R-\ddot{N}H_2$ or $R_2\ddot{N}H$ or $R_3\ddot{N}$	$CH_3-\ddot{N}H_2$		**$-NH_2$** amino group
Amide				$-CONH_2$, $-CONHR$, or $-CONR_2$

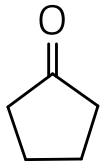


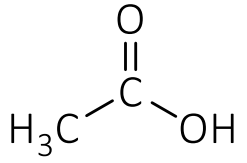
Smith, J. (2010). *Organic Chemistry*: McGraw-Hill Education.

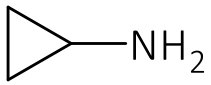
Sample Problem 1.2 **Classifying Organic compounds**

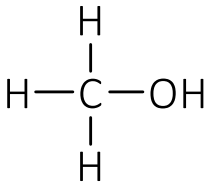
PROBLEM: Classify each of the following compounds as alcohol, ether, carboxylic, ester, amine, amide.

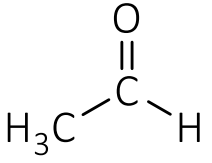
(a) $CH_3-CH_2-CH_2-CH_2-OH$

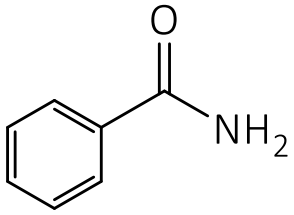
(b) 

(c) 

(d) 

(e) 

(f) 

(g) 

A simple classification of organic compounds

Organic compounds

Hydrocarbons
(contain only C and H)

Aliphatic

Alkanes
(C–C)

Alkenes
(C=C)

Alkynes
(C≡C)

Aromatic

Contain C, H and O
(Functional groups)

Alcohol & ether

Aldehyde & Ketone

Carboxylic acid & ester

Contain C, H and N
(Functional groups)

amines

Amide

Hydrocarbon

The **hydrocarbons** are compounds composed entirely of **carbon** and **hydrogen**. [C_nH_x]

The major classes of hydrocarbons are;

alkanes,
alkenes,
alkynes, and
aromatic hydrocarbons

C_1—C_4 เป็นแก๊ส C_5—C_{17} เป็นของเหลว C_{18} เป็นของแข็ง

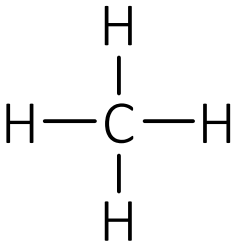
สารประกอบไฮโดรคาร์บอนเป็นสารไม่มีขั่วจึงมักไม่ละลายน้ำ

Alkanes

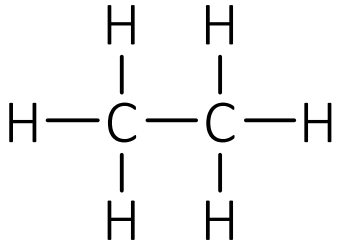
Alkanes have the general formula: C_nH_{2n+2} where n = 1,2,3,…

Essential characteristic

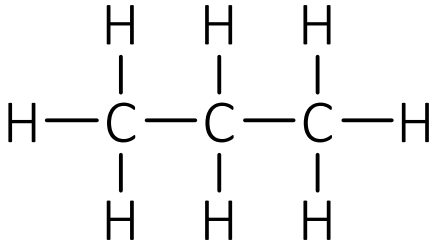
- only **single covalent** bonds
- saturated hydrocarbons because they contain the maximum number of hydrogen atoms that can bond with the number of carbon atoms in the molecule
- The C-C bond allows rotation of bonded groups



CH_4



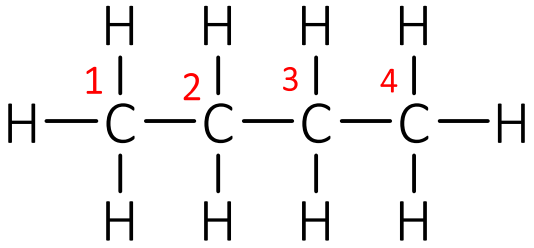
C_2H_6



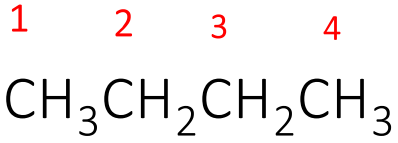
C_3H_8

Chang, R. (2010). *Chemistry:* McGraw-Hill.

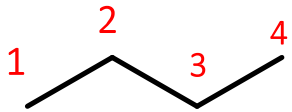
Shorthand Formulae



structural formula



condensed formula



bond-line formula

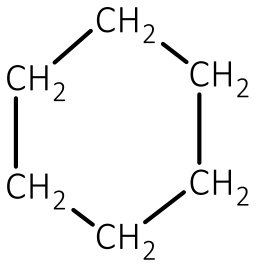
shorthand formula

- There is a carbon atom at every bend.
- There is a carbon at the end of every line
- All non-carbon and non-hydrogen atoms are shown.
- to produce the full formula, add hydrogen atoms to every carbon atom to produce 4 bonds

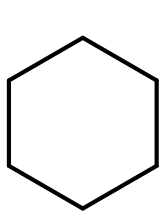
Tay, B., Hoh, Y. K., Briggs, J. G. R., Heyworth, R. M., & Tay, M. K. (2015). *Elective Chemistry: Secondary 6.*

Shorthand Formulae

The shorthand formulae for benzene and cyclohexane



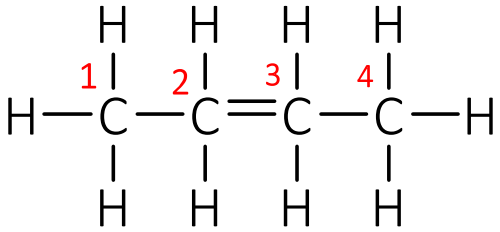
structural formula



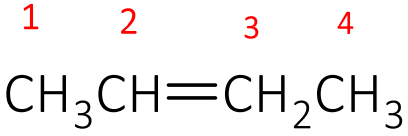
2 H atoms

shorthand formula
(bond-line formula)

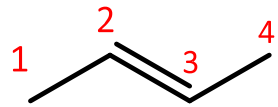
3 H atoms



structural formula



condensed formula



bond-line formula

shorthand formula

Sample Problem 1.3A

PROBLEM: Write each of the following condensed structural formulas as a bond-line formula:

(a) $(CH_3)_2CHCH_2CH_3$

(b) $(CH_3)_2CHCH_2CH_2OH$

(c) $(CH_3)_2C{=}CHCH_2CH_3$

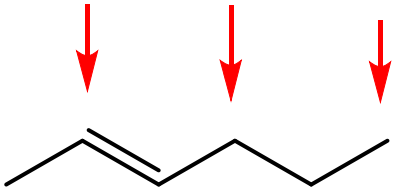
(d) $CH_3CH_2CH_2CH_2CH_3$

(e) $CH_3CH_2CH(OH)CH_2CH_3$

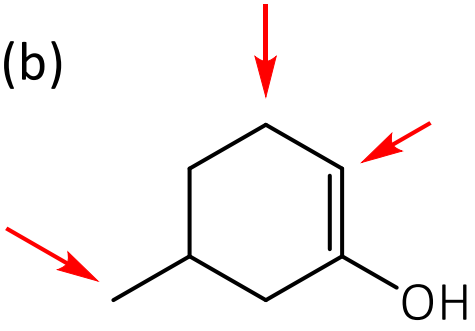
Sample Problem 1.3B

PROBLEM: จงระบุจำนวน H ตรงจุดที่ลูกศรชี้

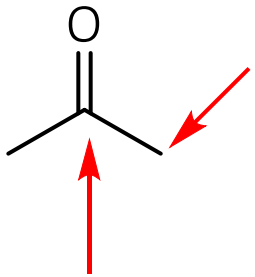
(a)



(b)



(c)



Nomenclature of Alkanes [C_nH_{2n+2}]

- To name an alkane, the root name is determined by the number of C atoms
- The name of alkane end in –***ane***.

Roots	Number of C Atoms
meth-	1
eth-	2
prop-	3
but-	4
pent-	5
hex-	6
hept-	7
oct-	8
non-	9
dec-	10

NO. of C + *ane*

CH_4 meth- + ane = *methane*

C_2H_6 eth + ane = ethane

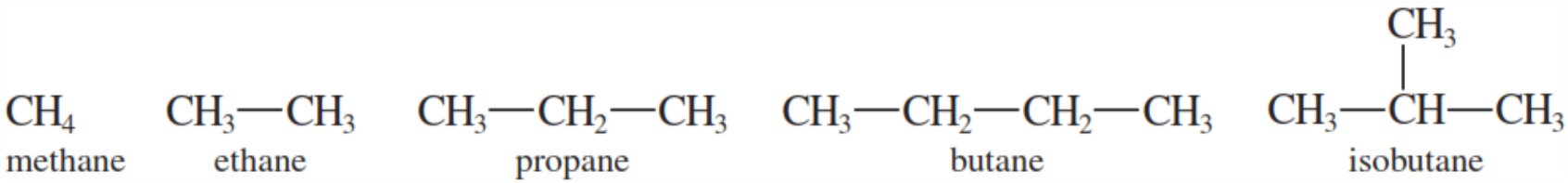
C_3H_8 prop + ane = propane

C_4H_{10} but + ane = butane

Alkane

TABLE 2-2 Correspondence of Prefixes and Numbers of Carbon Atoms

Alkane Name	Number of Carbons	Alkane Name	Number of Carbons
*meth*ane	1	*hex*ane	6
*eth*ane	2	*hept*ane	7
*prop*ane	3	*oct*ane	8
*but*ane	4	*non*ane	9
*pent*ane	5	*dec*ane	10

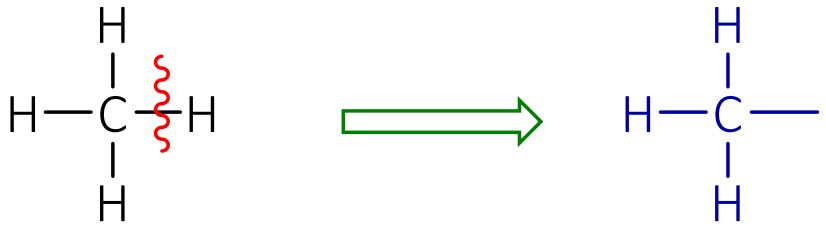


C_1—C_4 เป็นแก๊ส C_5—C_{17} เป็นของเหลว C_{18} เป็นของแข็ง

Wade, L. G. *Organic Chemistry*; Pearson Education, Inc., 2013.

Alkyl group [C_nH_{2n+1}]

- **An alkyl group (R group)** is an alkane portion of a molecule, with one hydrogen atom removed to allow bonding to the rest of the molecule
- **Alkyl groups** are named like the alkanes they are derived from, witha -yl suffix



methane methyl

ethane ethyl

Wade, L. G. *Organic Chemistry*; Pearson Education, Inc., 2013.

Simple branched alkyl groups

One carbon

CH_3-

methyl group

Two carbons

CH_3-CH_2-

ethyl group

Three carbons

$CH_3-CH_2-CH_2-$

propyl group
(or "*n*-propyl group")

$CH_3-CH(CH_3)-$

isopropyl group

Four carbons

$CH_3-CH_2-CH_2-CH_2-$

butyl group
(or "*n*-butyl group")

$CH_3-CH(CH_3)-CH_2-$

isobutyl group

$CH_3-CH_2-CH(CH_3)-$

sec-butyl group

$CH_3-C(CH_3)_2-$

tert-butyl group
(or "*t*-butyl group")

Wade, L. G. *Organic Chemistry*; Pearson Education, Inc., 2013.

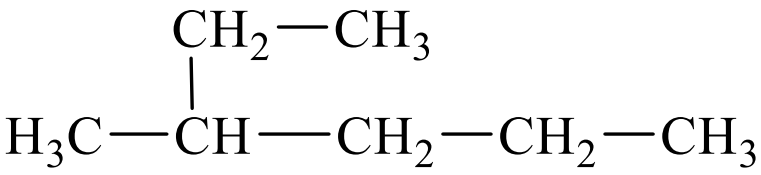
Nomenclature of Alkanes : IUPAC systems

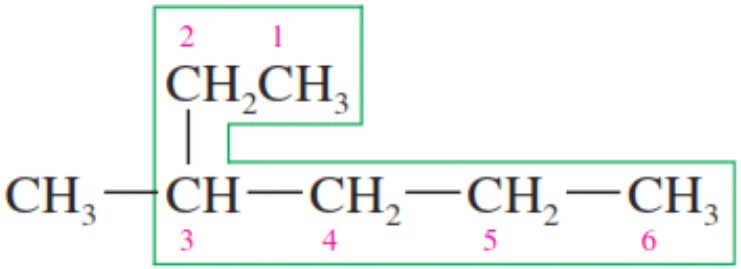
STEP 1 **THE MAIN CHAIN**

Find the longest continuous chain of carbon atoms, and use the name of this chain as the base name of the compound.

STEP 2 **NUMBERING THE MAIN CHAIN**

Number the longest chain, beginning with the end of the chain nearest a substituent.





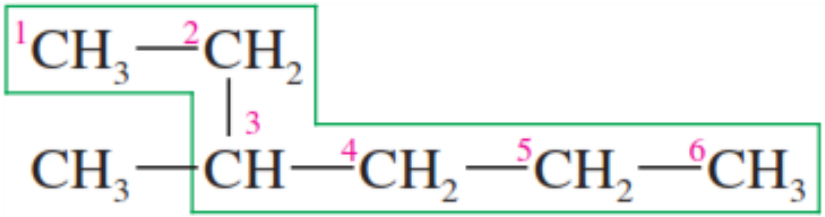
hexane

Wade, L. G. *Organic Chemistry*; Pearson Education, Inc., 2013.

Nomenclature of Alkanes : IUPAC systems

STEP 3 **NAMING ALKYL GROUPS Name the substituent groups.**

- ✓ Name the substituent groups attached to the longest chain as alkyl groups.
- ✓ Give the location of each alkyl group by the number of the main-chain carbon atom to which it is attached.



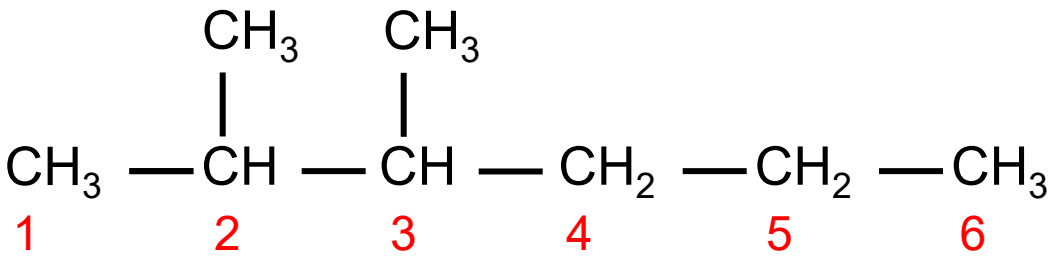
3-methylhexane

Wade, L. G. *Organic Chemistry*; Pearson Education, Inc., 2013.

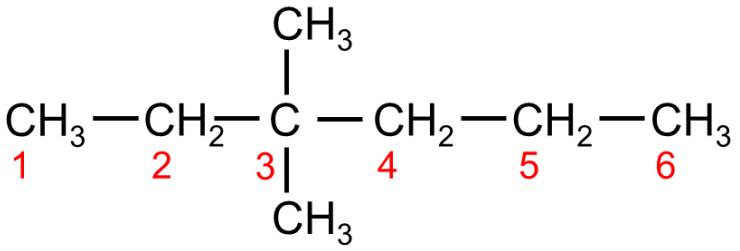
Nomenclature of Alkanes : IUPAC systems

STEP 4 **Use prefixes di, tri, tetra**

✓ Use prefixes di-, tri-, tetra-, when there is more than one alkyl branch of the same kind.



2,3-dimethylhexane

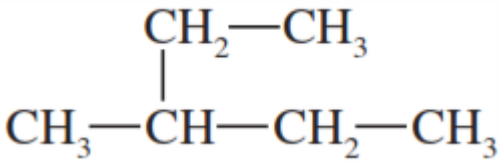


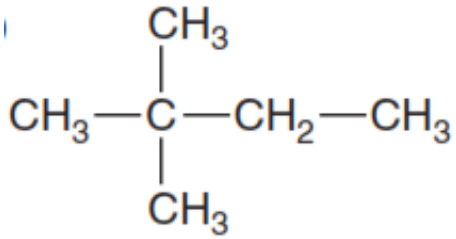
3,3-dimethylhexane

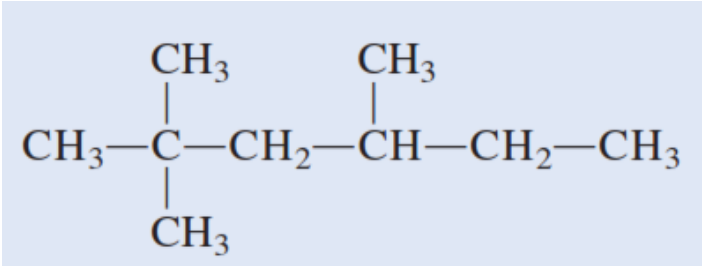
Chang, R. (2010). *Chemistry:* McGraw-Hill.

แบบฝึกหัด

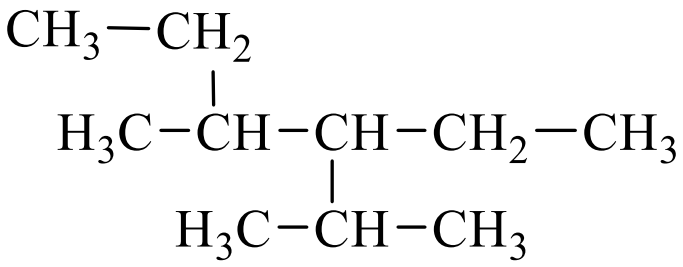
จงอ่านชื่อสารต่อไปนี้

1) 

2) 

3) 

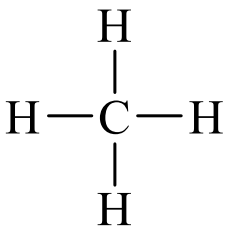
4) จงอ่านชื่อสารที่แสดงด้านล่างต่อไปนี้

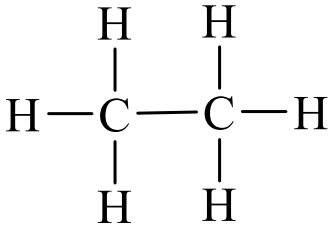


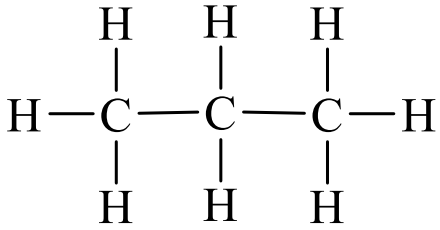
5) จงวาดโครงสร้างสารทั้งแบบเส้นและแบบย่อของสาร 2,3,4-trimethylpentane

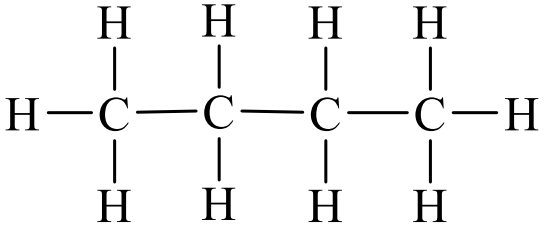
Structural Isomers (Constitutional isomers)

Structural isomers are molecules that have the same molecular formula but different structures.

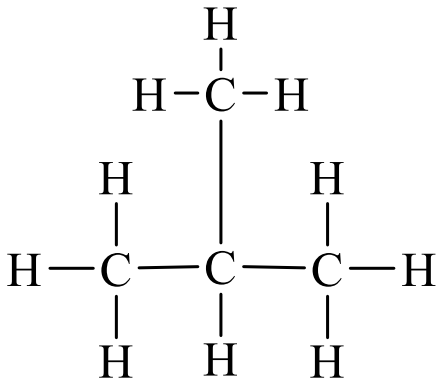








C_4H_{10}



C_4H_{10}

Chang, R. *Chemistry*; McGraw-Hill, 2010.

Example 1: How many structural isomers can be identified for pentane, C_5H_{12}?

Strategy For small hydrocarbon molecules (eight or fewer C atoms), it is relatively easy to determine the number of structural isomers by trial and error.

Chang, R. *Chemistry*; McGraw-Hill, 2010.

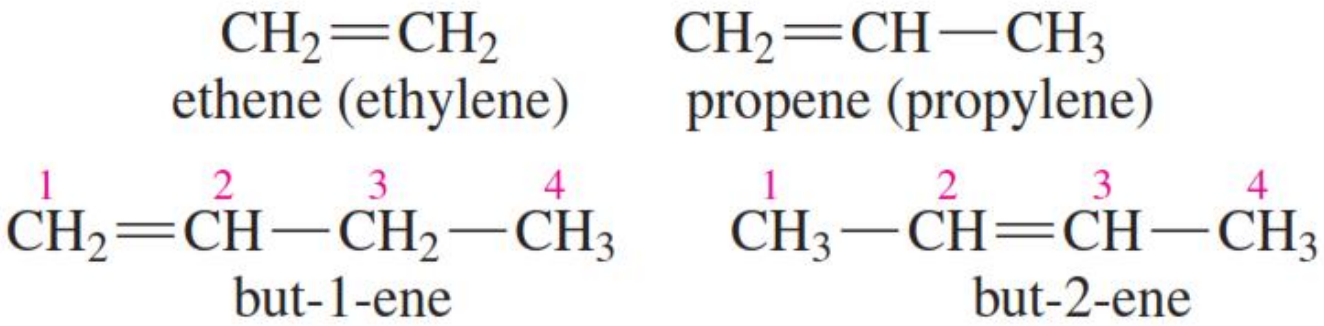
Question

Example 2: How many structural isomers can be identified for pentane, C_6H_{14}*? (Hint 5 isomers)*

Chang, R. *Chemistry*; McGraw-Hill, 2010.

Alkenes [C_nH_{2n}]

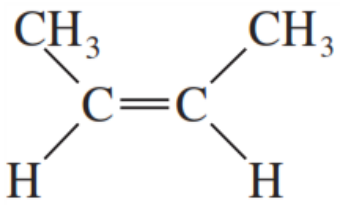
- Alkenes are hydrocarbons that contain carbon–carbon double bonds.
- Alkene names end in the -ene suffix.
- If the double bond might be in more than one position, then the chain is numbered and the lower number of the two double-bonded carbons is added to the name to indicate the position of the double bond.



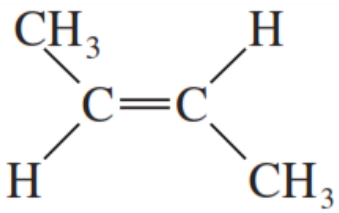
Wade, L. G. *Organic Chemistry*; Pearson Education, Inc., 2013.

Alkenes [C_nH_{2n}]

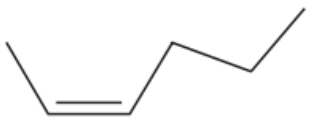
- many alkenes show geometric (cis-trans) isomerism



cis-but-2-ene

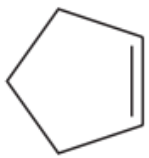


trans-but-2-ene

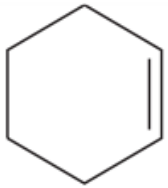


cis-hex-2-ene

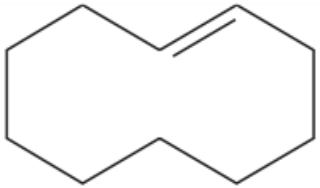
trans-hex-2-ene



cyclopentene



cyclohexene



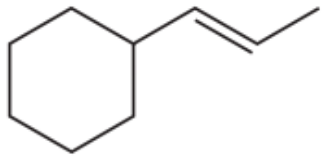
trans-cyclodecene

Wade, L. G. *Organic Chemistry*; Pearson Education, Inc., 2013.

Sample Problem 1.6

PROBLEM: Which of the following structures exhibit geometric isomerism? Draw the two isomers in each case and determine which isomer are cis/trans:

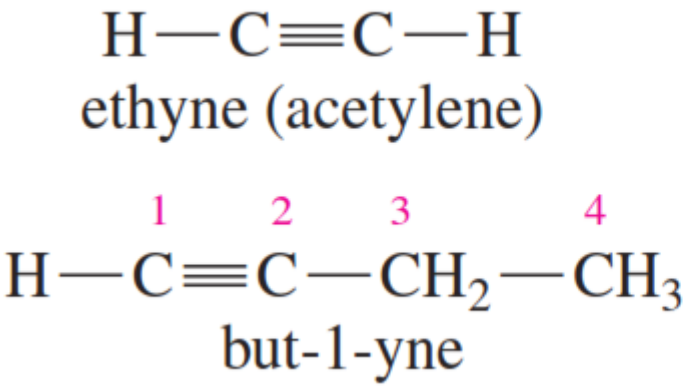
(a) $CH_3-CH_2-CH=CH-CH_3$

(b) 

(c) $CH_3-C(CH_3)=CH-CH(CH_3)-CH_2-CH_3$

Alkynes [C_nH_{2n-2}]

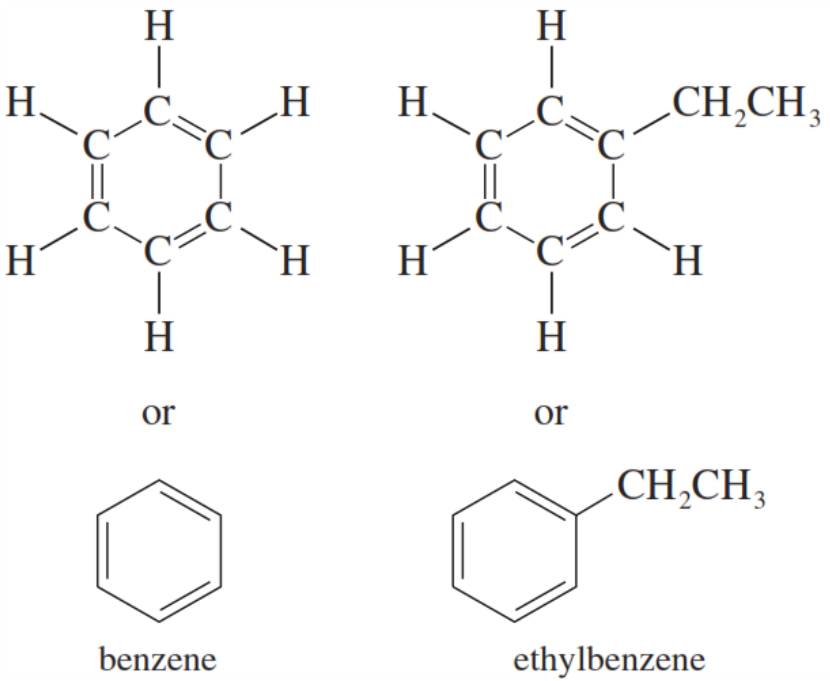
- Alkynes are hydrocarbons with carbon–carbon triple bonds as their functional group.
- Alkyne names generally have the *-yne suffix,*



Wade, L. G. *Organic Chemistry*; Pearson Education, Inc., 2013.

Aromatic Hydrocarbons

These aromatic hydrocarbons (also called arenes) are all derivatives of benzene, represented by a six-membered ring with three double bonds.



Wade, L. G. *Organic Chemistry*; Pearson Education, Inc., 2013.

Reaction of Hydrocarbon

1) Reaction of Alkane
2) Reaction of Alkene
3) Reaction of Alkyne
4) Reaction of Aromatic

Chang, R. *Chemistry*; McGraw-Hill, 2010.

Reactions of Alkanes

Combustion

$CH_4\ (g) + 2O_2\ (g) \longrightarrow CO_2\ (g) + 2H_2O\ (l)$ $\Delta H^0 = -890.4$ kJ/mol

$C_3H_8\ (g) + 5O_2\ (g) \longrightarrow 3CO_2\ (g) + 4H_2O\ (l)$

- The main use of alkanes is in combustion to produce energy.

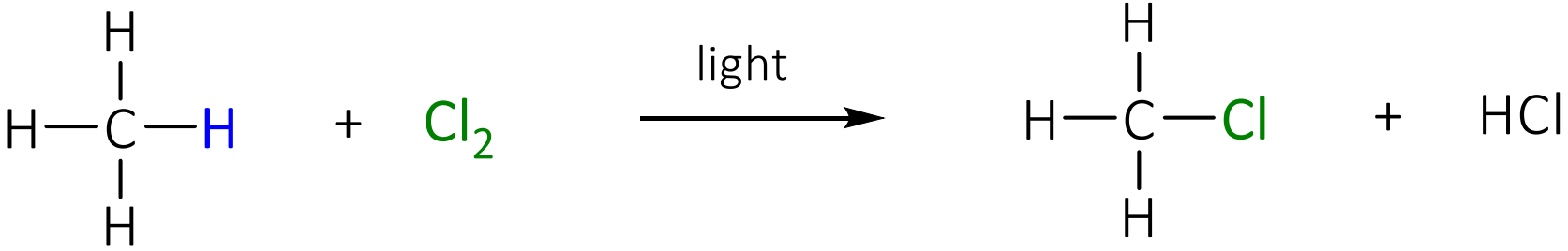
Tay, B., Hoh, Y. K., Briggs, J. G. R., Heyworth, R. M., & Tay, M. K. (2015). *Elective Chemistry: Secondary 6*.

Reaction with chlorine (Halogenation)

Halogenation (*Substitution*)

- Alkanes react with chlorine in the presence of light.
- A H-atom is replaced by Cl-atom. This is called ***substitution reaction.***

$$CH_4 + X_2 \xrightarrow{\text{light}} CH_3X\ (g) + HX$$

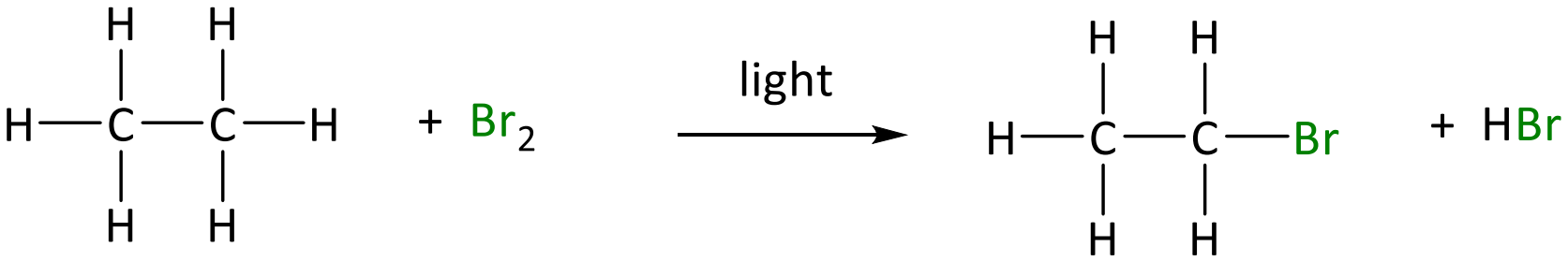


Tay, B., Hoh, Y. K., Briggs, J. G. R., Heyworth, R. M., & Tay, M. K. (2015). *Elective Chemistry: Secondary 6*.

Reaction with chlorine (Halogenation)

Halogenation (*Substitution*)

substitution reaction is one in which an atom or group of atoms replace other atoms in a molecules

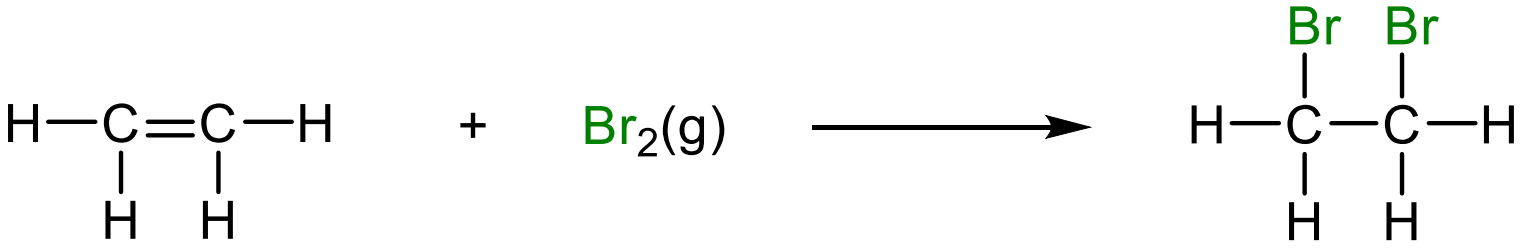


Tay, B., Hoh, Y. K., Briggs, J. G. R., Heyworth, R. M., & Tay, M. K. (2015). *Elective Chemistry: Secondary 6*.

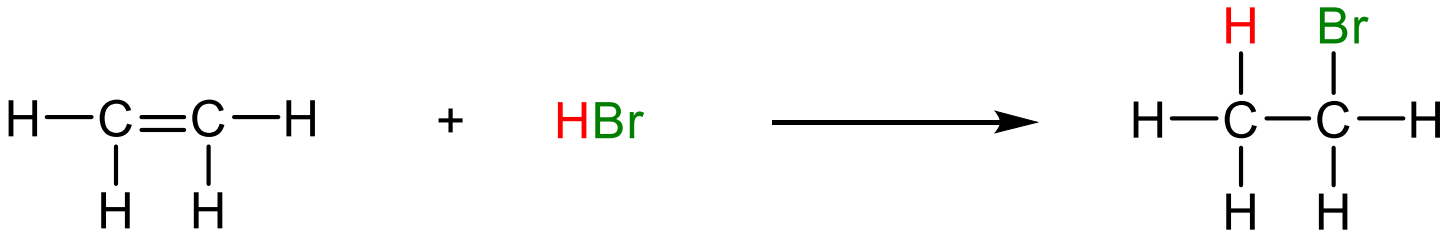
Reactions of Alkenes

Addition Reactions (ปฏิกิริยาการเติม)

- **Halogenation (Bromination reaction)**



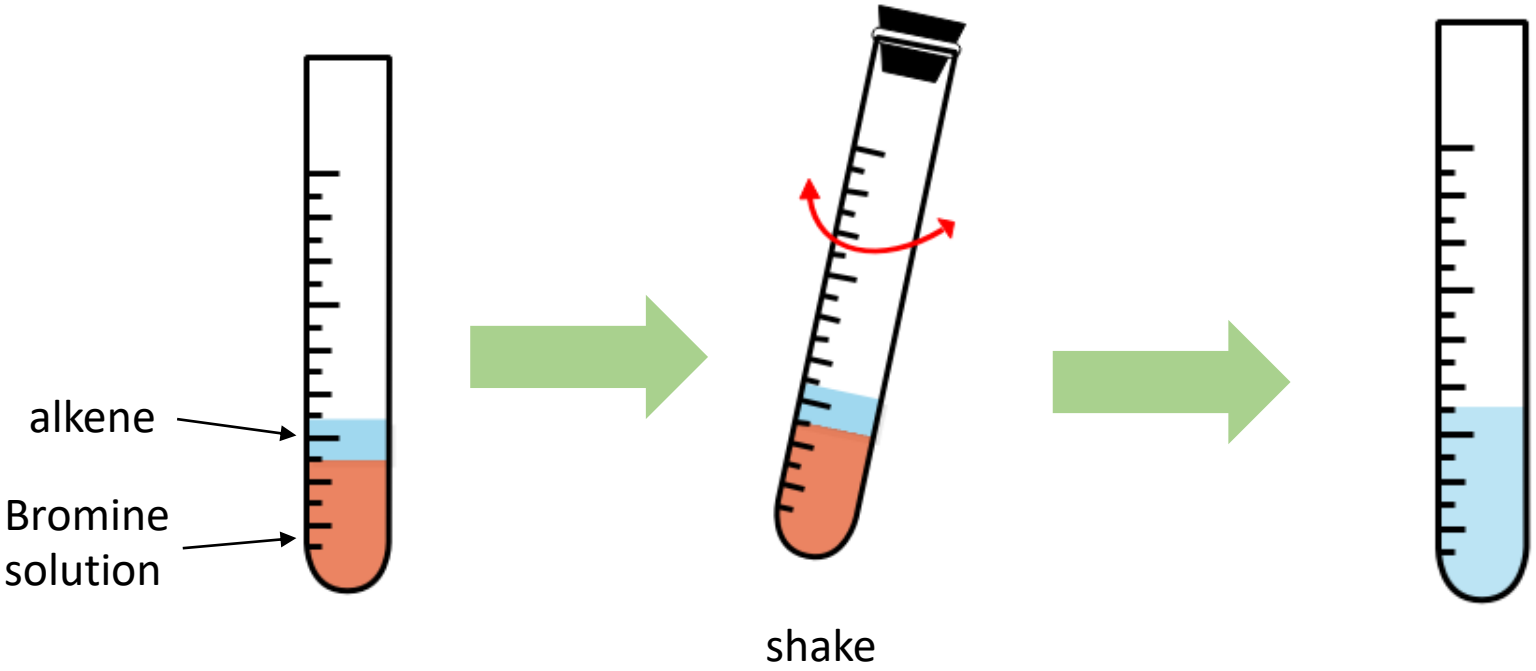
- **Hydrohalogenation (Hydrobromination)**



Tay, B., Hoh, Y. K., Briggs, J. G. R., Heyworth, R. M., & Tay, M. K. (2015). *Elective Chemistry: Secondary 6*.

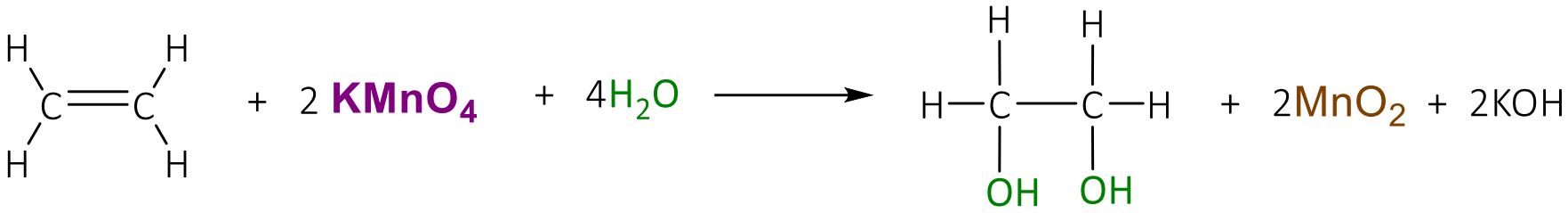
Testing for Unsaturated compound

- ❑ Alkenes react with bromine in **addition reactions**.
- ❑ The reddish-brown colour of the bromine quickly disappear.
- ❑ We say the bromines has been decolourized.



Tay, B., Hoh, Y. K., Briggs, J. G. R., Heyworth, R. M., & Tay, M. K. (2015). *Elective Chemistry: Secondary 6*.

Oxidation of alkenes with $KMnO_4$ solution



Alkene and $KMnO_4$

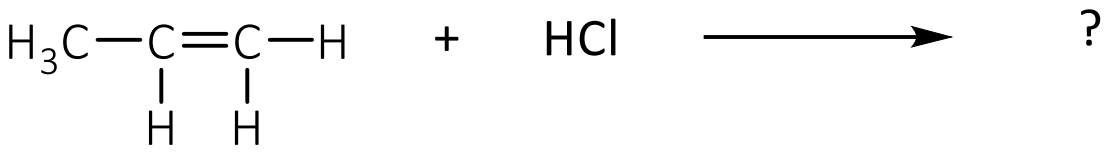
shake

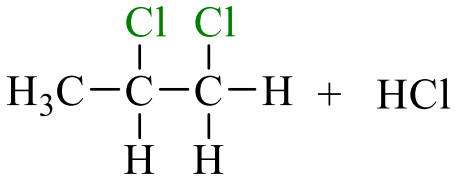
Dark brown precipitate

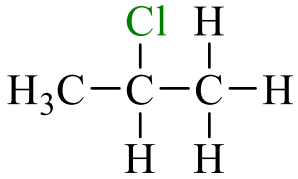
Tay, B., Hoh, Y. K., Briggs, J. G. R., Heyworth, R. M., & Tay, M. K. (2015). *Elective Chemistry: Secondary 6*.

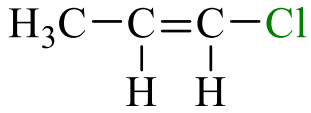
Sample Problem 1.7

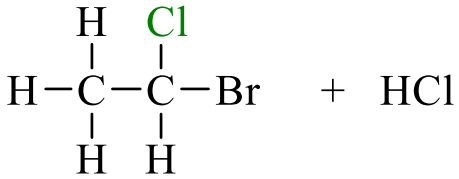
Question | ข้อใดแสดงสารผลิตภัณฑ์ของปฏิกิริยาที่แสดงด้านล่างได้ถูกต้อง

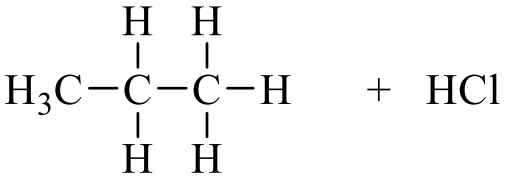


A. 

B. 

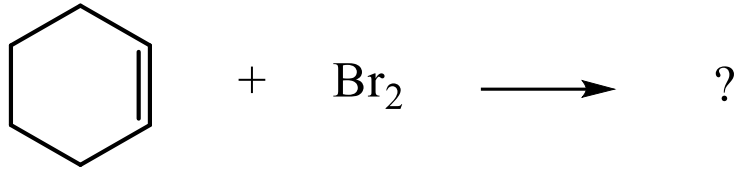
C. 

D. 

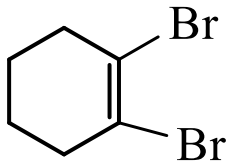
E. 

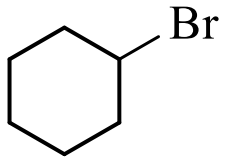
Sample Problem 1.8

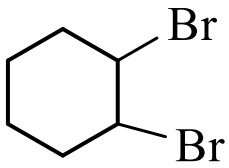
Question 1 | ข้อใดแสดงสารผลิตภัณฑ์ของปฏิกิริยาที่แสดงด้านล่างได้ถูกต้อง

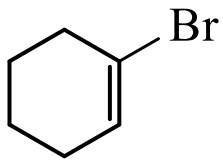


A. $C_6H_6Br_6$

B. 

C. 

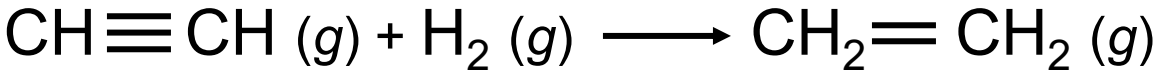
D. 

E. 

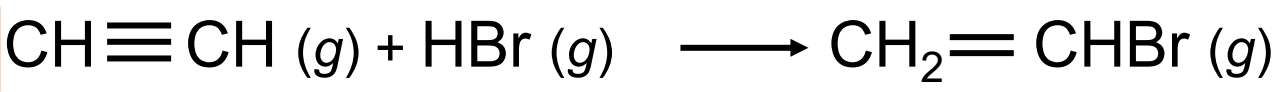
Reactions of Alkynes

❑ Addition Reactions

Hydrogenation



Hydrobromination

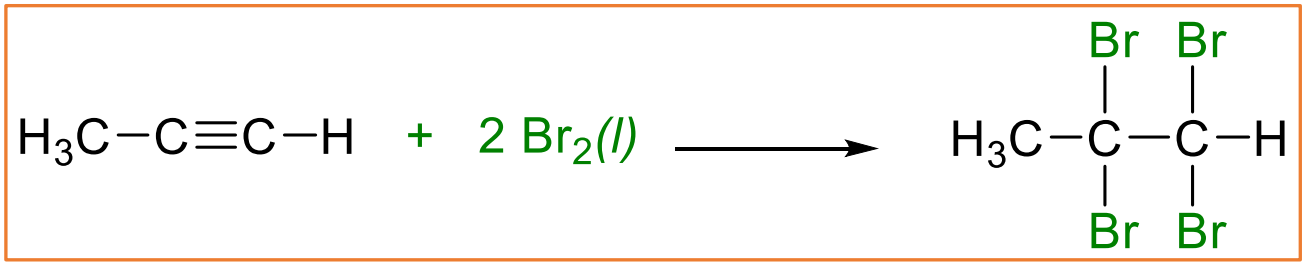


Tay, B., Hoh, Y. K., Briggs, J. G. R., Heyworth, R. M., & Tay, M. K. (2015). *Elective Chemistry: Secondary 6*.

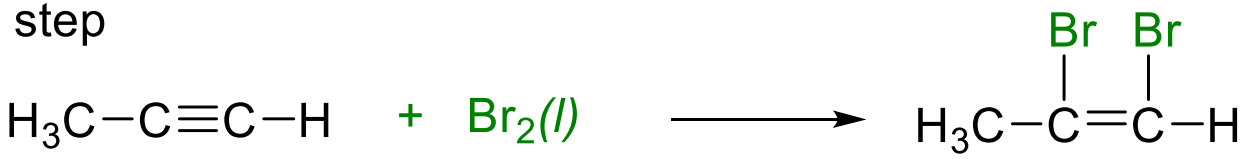
Reactions of Alkynes

❑ Addition Reactions

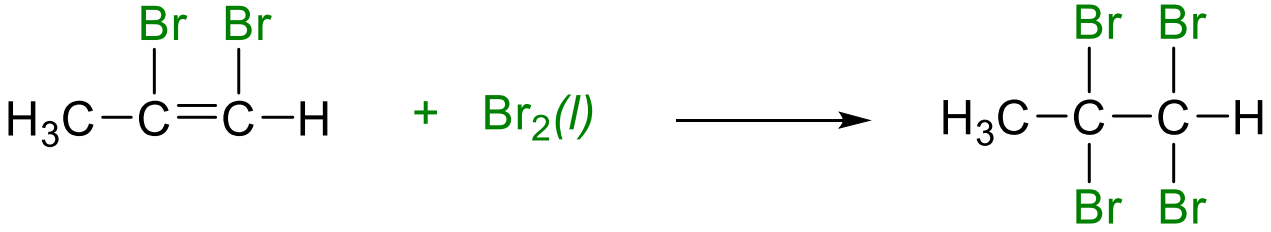
Bromination



1st step

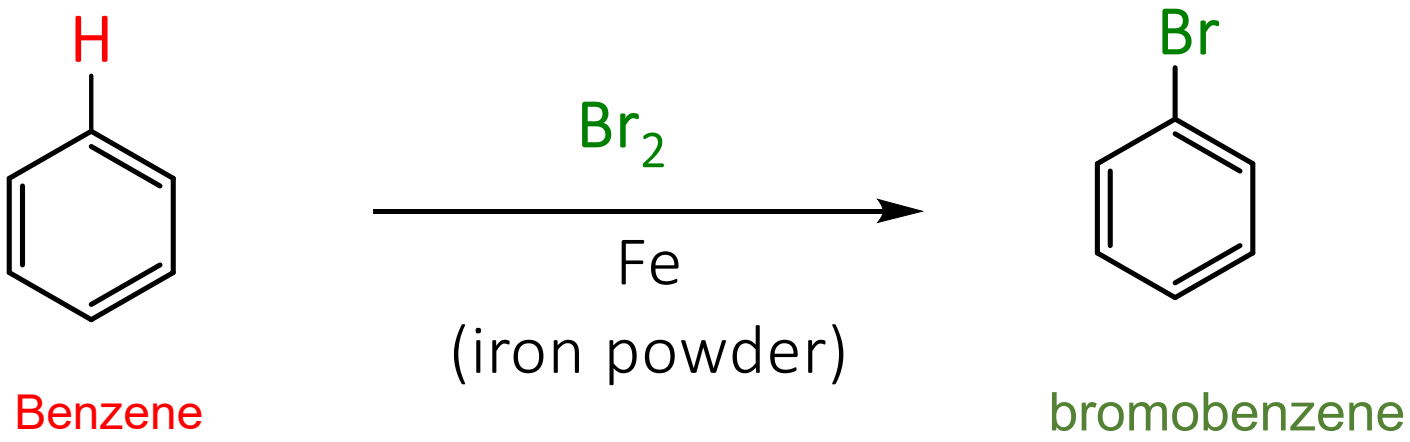


2nd step



Tay, B., Hoh, Y. K., Briggs, J. G. R., Heyworth, R. M., & Tay, M. K. (2015). *Elective Chemistry: Secondary 6*.

Reaction with Bromine

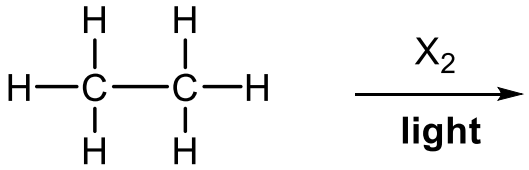


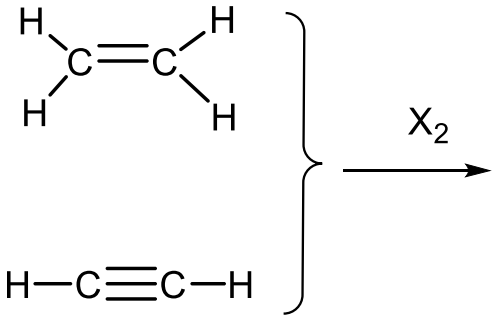
- Benzene reacts with bromine in the presence of catalyst.
- The catalyst can be iron powder (Fe) or $AlBr_3$
- **H**-atom is replaced with –*Br*

Tay, B., Hoh, Y. K., Briggs, J. G. R., Heyworth, R. M., & Tay, M. K. (2015). *Elective Chemistry: Secondary 6*.

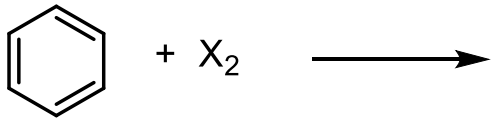
Summary | Hydrocarbon reaction

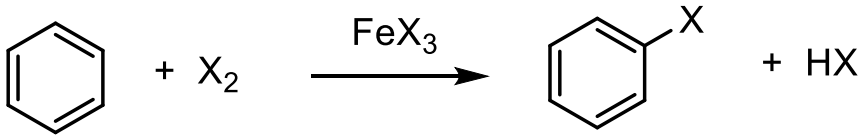
Hydrocarbon





Aromatic





Question

1. สาร X เป็นสารประกอบอินทรีย์ที่ไม่ละลายน้ำ สารนี้ฟอกจางสีสารละลายด่างทับทิมและสารละลายโบรมีนในคาร์บอนเตตระคลอไรด์ สาร X ควรเป็นสารใด

   1. carboxylic acid 2. ไซโคลเฮกซีน 3. เบนซีน 4. เฮกเซน

2. สารประกอบไฮโดรคาร์บอนชนิดหนึ่งมีคุณสมบัติดังนี้

   (I) เป็นของเหลวระเหยง่าย (II) ไม่ฟอกจางสีด่างทับทิม

   (III) ไม่ทำปฏิกิริยากับ Br_2 ในที่มืด (IV) ทำปฏิกิริยากับ Br_2 ในที่สว่าง

   สารประกอบนี้คือสารใด

   1. C_3H_6 2. C_3H_8 3. C_6H_{12} 4. C_6H_{14}

Question

3. ปฏิกิริยาต่อไปนี้ ข้อใดจัดเป็นปฏิกิริยาแทนที่ (Substitution)

1. $CH_2{=}CH_2 + HCl \longrightarrow CH_3{-}CH_2{-}Cl$

2. $CH_3{\cdot}CH_3 + Cl_2 \longrightarrow CH_3{-}CH_2{-}Cl + HCl$

3. $CH_3{-}\overset{\overset{H}{|}}{C}{=}CH_2 + HBr \longrightarrow CH_3{-}\underset{\underset{Br}{|}}{CH}{-}CH_3$

4. $CH_2{=}CH{-}Cl + HCl \longrightarrow CH_3{-}CHCl_2$

Question

4) X , Y , Z เป็นสารประกอบไฮโดรคาร์บอน เมื่อสาร X และ Y ทำปฏิกิริยากับสารละลายโบรมีน และสาร Z ทำปฏิกิริยากับออกซิเจนจะเกิดปฏิกิริยาดังสมการ

$$X + Br_2 \longrightarrow C_4H_9Br + HBr \quad \text{..... (1)}$$
$$Y + Br_2 \longrightarrow C_4H_8Br_2 \quad \text{..... (2)}$$
$$Z + 9O_2 \longrightarrow 6\,H_2O + 6\,CO_2 \quad \text{..... (3)}$$

สาร X คือ

สาร Y คือ

สาร Z คือ

Introduction of Organic Chemistry

organic chemistry is *the chemistry of carbon compounds*

Organic compounds is divided into three classes:

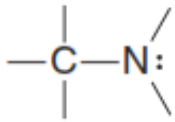
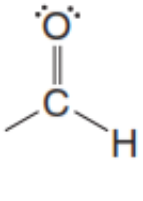
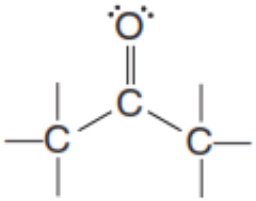
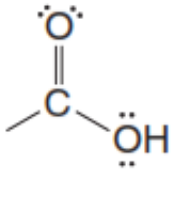
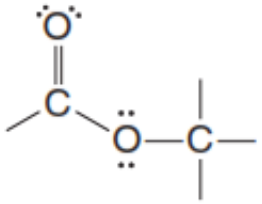
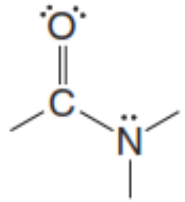
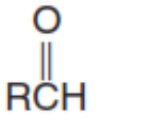
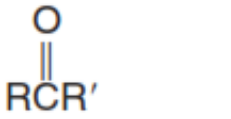
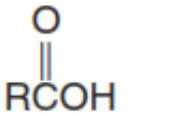
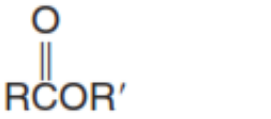
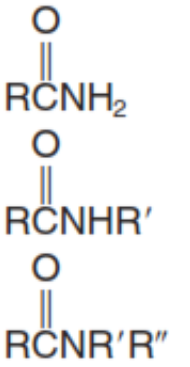
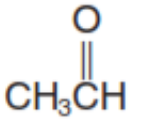
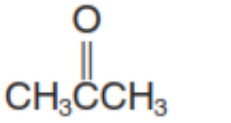
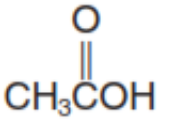
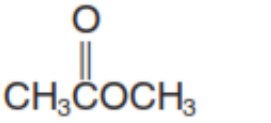
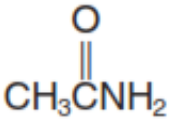
(1) hydrocarbons,

(2) compounds containing oxygen, and

(3) Compounds containing nitrogen

Wade, L. G. *Organic Chemistry*; Pearson Education, Inc., 2013.

Functional Groups

	Family					
	Amine	**Aldehyde**	**Ketone**	**Carboxylic Acid**	**Ester**	**Amide**
Functional group						
General formula	RNH_2 R_2NH R_3N					
Specific example	CH_3NH_2					

Alcohol [R—OH]

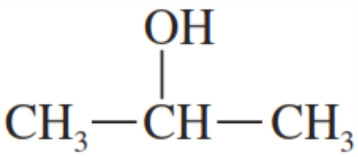
Alcohols are organic compounds that contain the **hydroxyl group (—OH)** as their functional group.

Names of alcohols end in the -***ol*** suffix

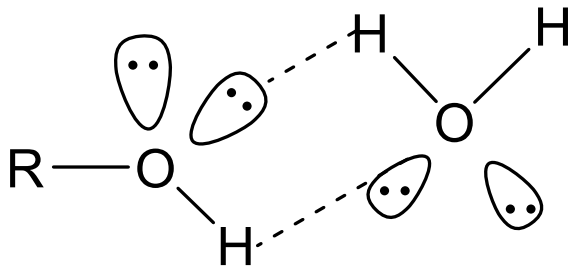
$CH_3—OH$
methanol
(methyl alcohol)

$CH_3CH_2—OH$
ethanol
(ethyl alcohol)

$CH_3—CH_2—CH_2—OH$
propan-1-ol
(*n*-propyl alcohol)



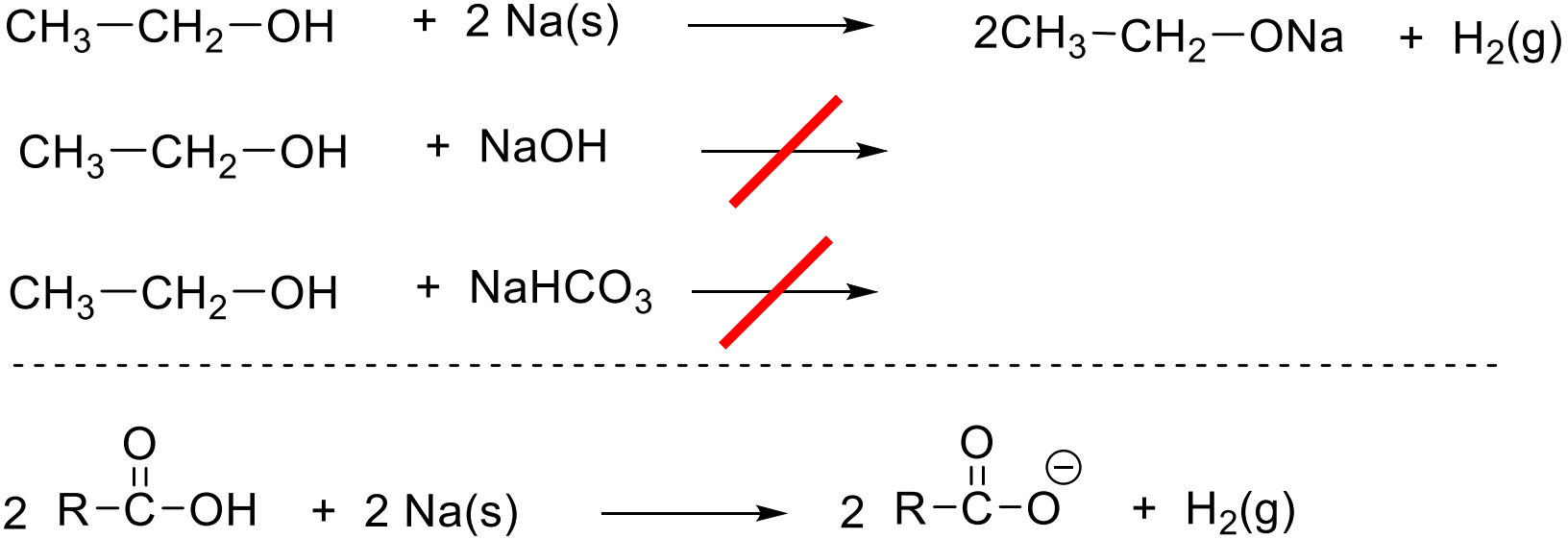
propan-2-ol

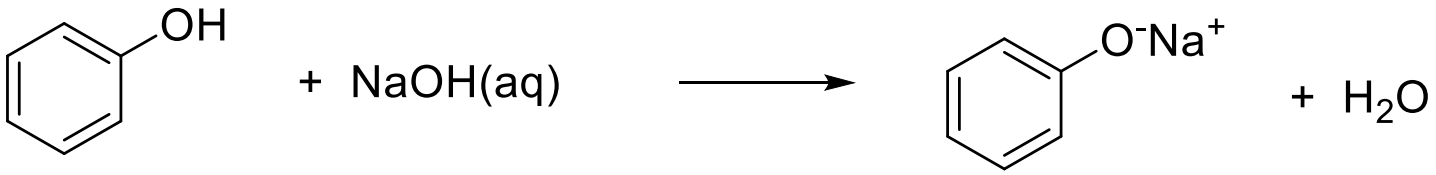


H bonding

Wade, L. G. *Organic Chemistry*; Pearson Education, Inc., 2013.

Reaction of Alcohol



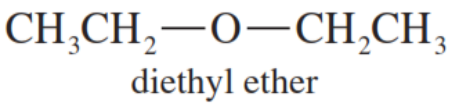


weak acid

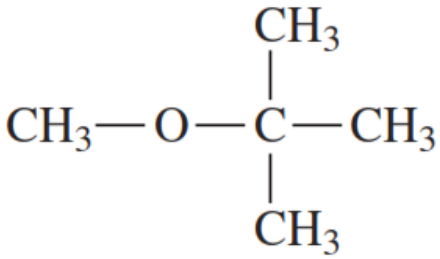
Wade, L. G. *Organic Chemistry*; Pearson Education, Inc., 2013.

Ether

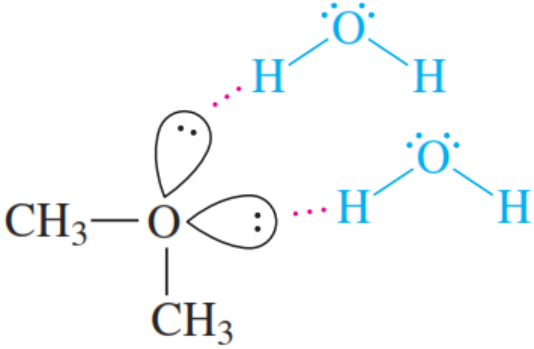
Ethers are composed of two alkyl groups bonded to an oxygen atom. The general formula for an ether is R—O—R’



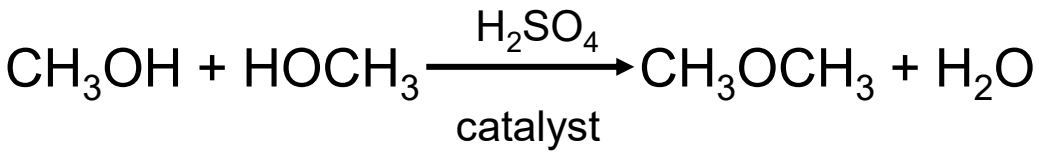
diethyl ether



methyl *tert*-butyl ether


hydrogen bonding of dimethyl ether with water

Condensation Reaction



Wade, L. G. *Organic Chemistry*; Pearson Education, Inc., 2013.

Sample Problem 1.8

1) **รีเอเจนต์ใดสามารถใช้แยกความแตกต่างระหว่างสาร alcohol กับ phenol ได้**

A. Na(s) B. NaOH C. yeast

D. $NaHCO_3$ E. $NaCO_3$

2) สารคู่ใดต่อไปนี้ สามารถใช้โลหะโซเดียมบอกความแตกต่างได้

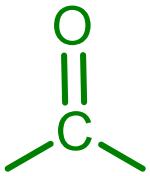
1. CH_3OH and CH_3COOH

2. $CH_3CH_2OCH_2CH_3$ and CH_3CH_2OH

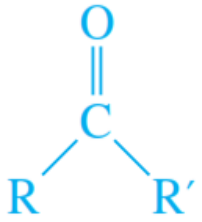
3. $CH_3CH_2CH_2CH_2OH$ and $CH_3\underset{\displaystyle OH}{\underset{|}{C}}HCH_3$

4. $CH_3COOC_2H_5$ and $C_2H_5CO_2CH_3$

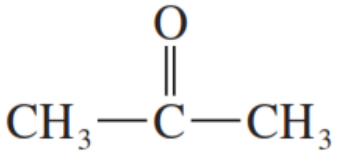
Aldehydes and Ketones



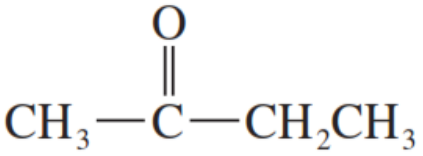
The carbonyl group, C=O , is the functional group for both aldehydes and ketones



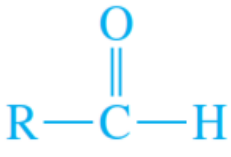
RCOR′, a ketone



propan-2-one (acetone)

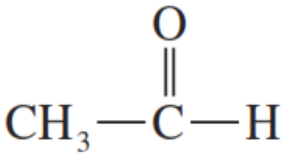


butan-2-one (methyl ethyl ketone)



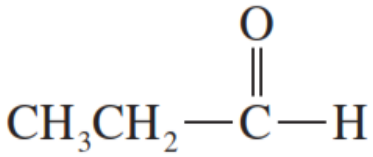
or RCHO

an aldehyde



or CH_3CHO

ethanal (acetaldehyde)

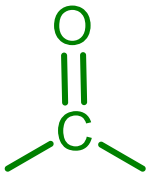


or CH_3CH_2CHO

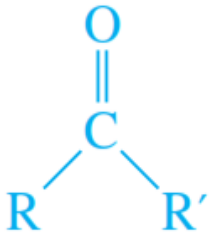
propanal (propionaldehyde)

Wade, L. G. *Organic Chemistry*; Pearson Education, Inc., 2013.

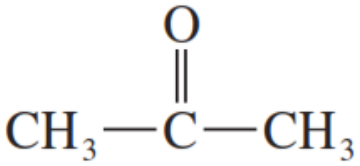
Aldehydes and Ketones



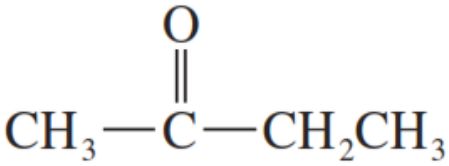
Ketone are named by numbering the carbonyl C, dropping the final -*e* from the alkane name, and adding -one.



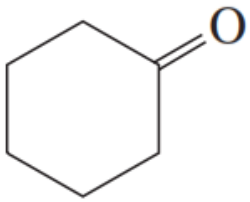
RCOR′, a ketone



propan-2-one (acetone)



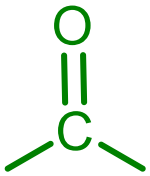
butan-2-one (methyl ethyl ketone)



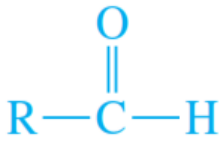
cyclohexanone

Wade, L. G. *Organic Chemistry*; Pearson Education, Inc., 2013.

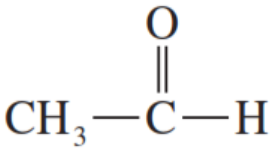
Aldehydes and Ketones



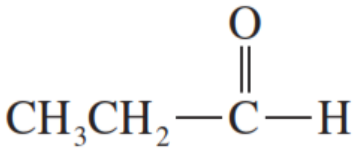
aldehyde names drop the final -e from the alkane name and add ***-al***



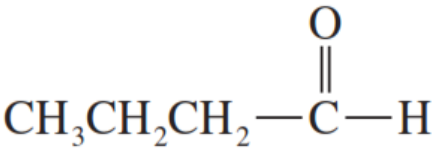
or RCHO
an aldehyde



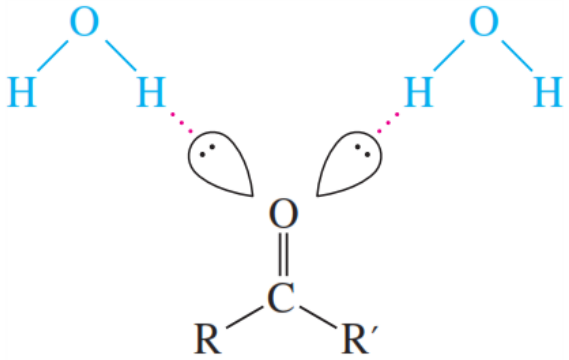
or CH_3CHO
ethanal (acetaldehyde)



or CH_3CH_2CHO
propanal (propionaldehyde)



or $CH_3CH_2CH_2CHO$
butanal (butyraldehyde)



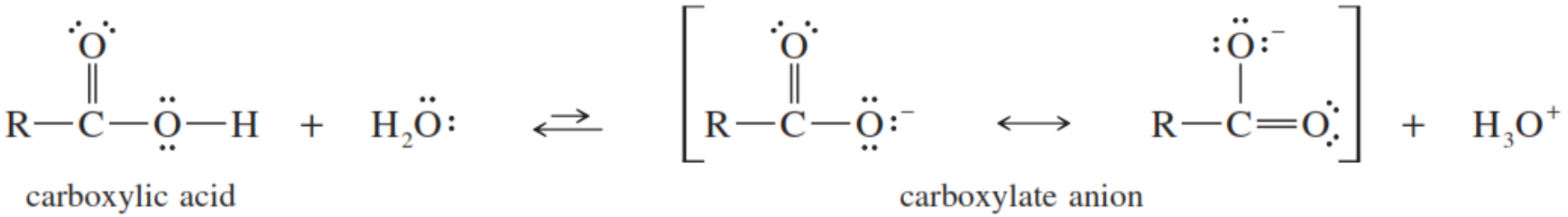
hydrogen bonding of
a ketone with water

Wade, L. G. *Organic Chemistry*; Pearson Education, Inc., 2013.

Carboxylic Acid

Carboxylic acids contain the carboxyl group [—COOH], as their functional group. The general formula for a carboxylic acid is R—COOH or RCO_2H

Carboxylic acids owe their acidity (pK_a of about 5) to the resonance-stabilized carboxylate anions formed by deprotonation

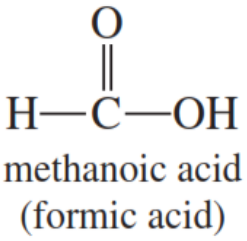


Wade, L. G. *Organic Chemistry*; Pearson Education, Inc., 2013.

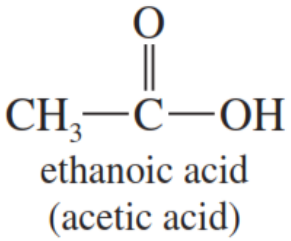
Carboxylic Acid

- Systematic names for carboxylic acids use the ***-oic acid*** suffix, but historical names are commonly used
- Carboxylic acid are named by dropping the ***–e*** from the alkane name and adding -oic acid;

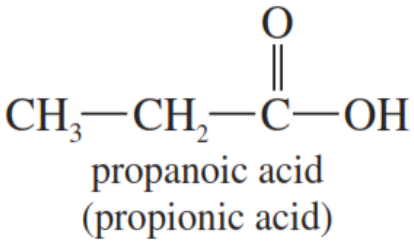
Methan~~e~~ → Methan + *oic acid* → **Methanoic acid**



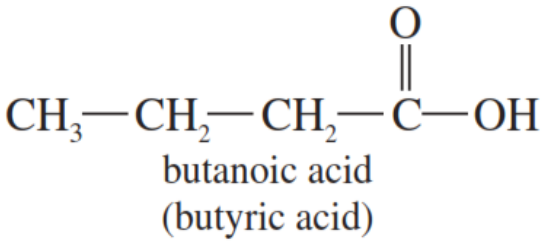
methanoic acid
(formic acid)



ethanoic acid
(acetic acid)



propanoic acid
(propionic acid)



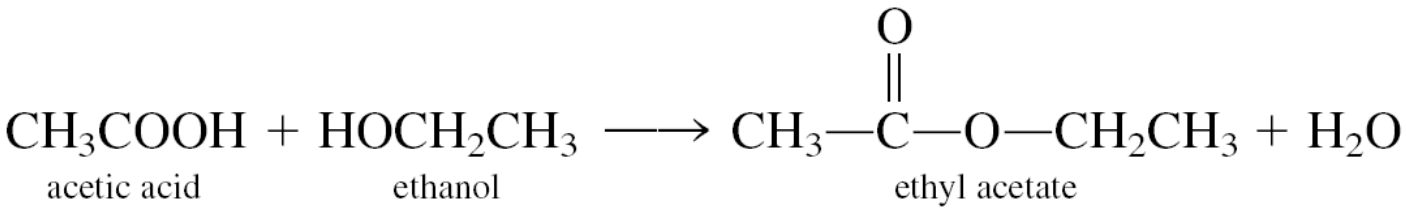
butanoic acid
(butyric acid)

Wade, L. G. *Organic Chemistry*; Pearson Education, Inc., 2013.

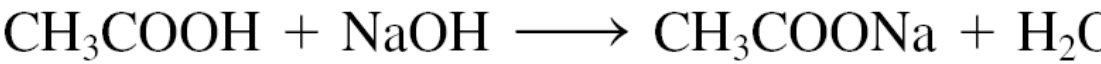
Properties and Reactions of Carboxylic Acids

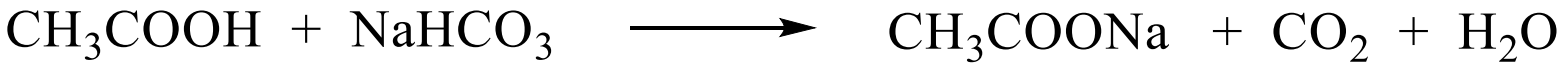
- Generally weak acids

- React with alcohols to form esters (Esterification)



- Neutralization

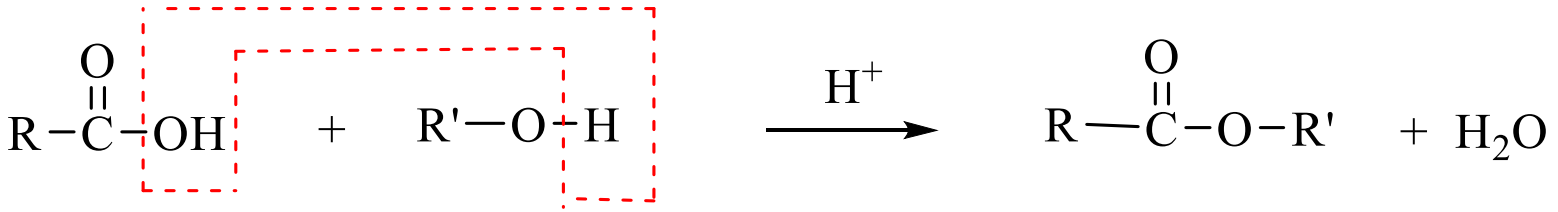




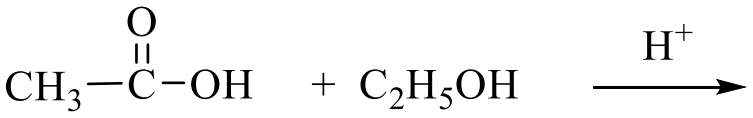
Chang, R. *Chemistry*; McGraw-Hill, 2010.

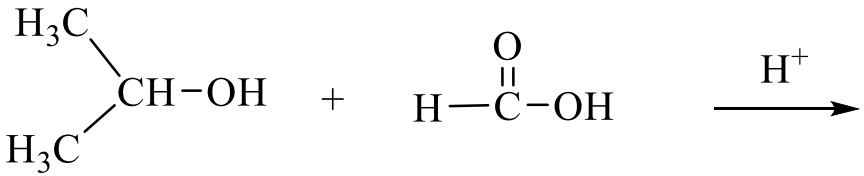
Properties and Reactions of Carboxylic Acids

❑ Esterification



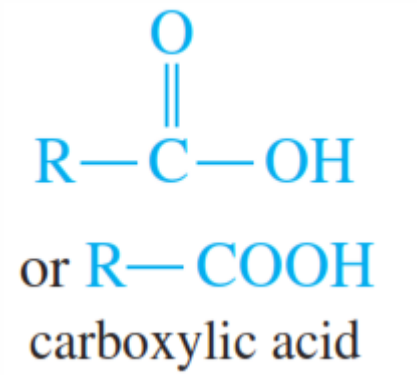
จงเขียนสมการ Esterification จากสารต่อไปนี้

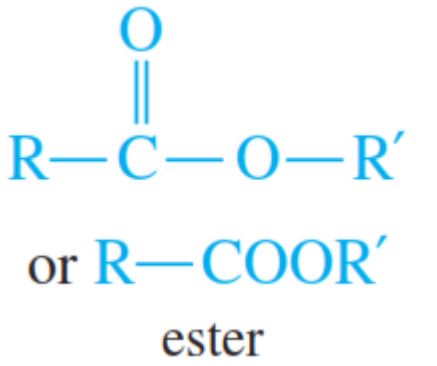


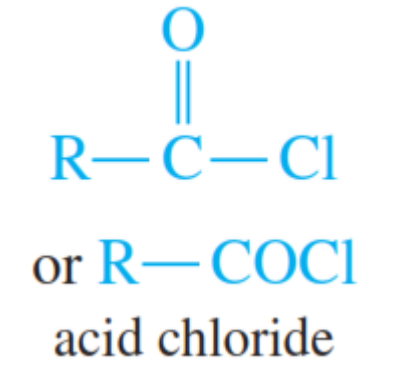


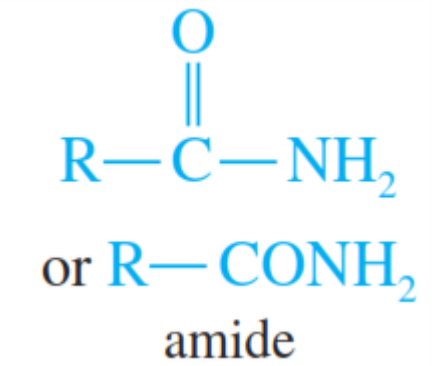
Chang, R. *Chemistry*; McGraw-Hill, 2010.

Carboxylic Acid Derivatives



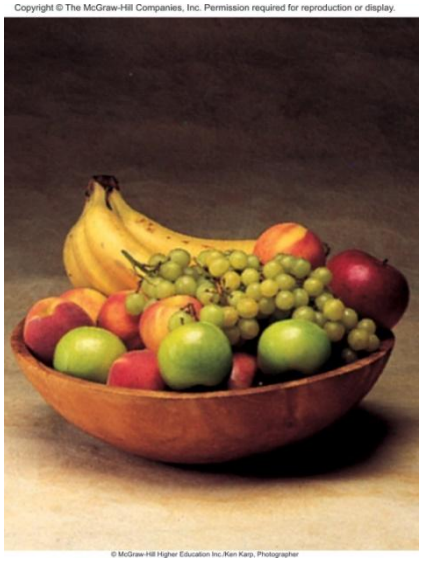






Wade, L. G. *Organic Chemistry*; Pearson Education, Inc., 2013.

Ester



Esters have the general formula R'COOR, where R is a hydrocarbon group.

Characteristic odors and flavors

Hydrolysis

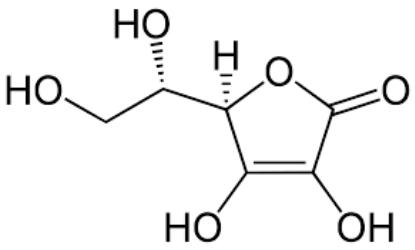
$$\underset{\text{ethyl acetate}}{CH_3COOC_2H_5} + H_2O \overset{H^+}{\rightleftharpoons} \underset{\text{acetic acid}}{CH_3COOH} + \underset{\text{ethanol}}{C_2H_5OH}$$

Alkaline hydrolysis (saponification)

$$\underset{\text{ethyl acetate}}{CH_3COOC_2H_5} + NaOH \longrightarrow \underset{\text{sodium acetate}}{CH_3COO^- Na^+} + \underset{\text{ethanol}}{C_2H_5OH}$$

$$\underset{\text{ethyl stearate}}{C_{17}H_{35}COOC_2H_5} + NaOH \longrightarrow \underset{\text{sodium stearate}}{C_{17}H_{35}COO^- Na^+} + C_2H_5OH$$

Applications of Ester

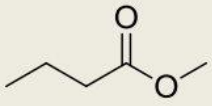


Ascorbic acid (Vitamin C)

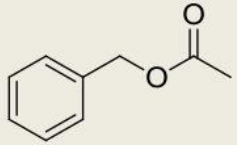
Ingredients:

water, ethoxydiglycol, **ascorbic acid (15%),** glycerin, propylene glycol, laureth-23, phenoxyethanol, tocopherol, triethanolamine, ferulic acid, panthenol, sodium hyaluronate

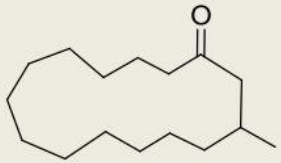
Below are examples of molecules that are commonly used as head, heart, and base notes



Methyl butyrate (apple)
- Head note
- Mass: 102.1 g/mol
- Weakest intermolecular forces
- Shortest evaporation rate



Benzyl acetate (jasmine)
- Heart note
- Mass: 150.2 g/mol
- Medium intermolecular forces
- Medium evaporation rate



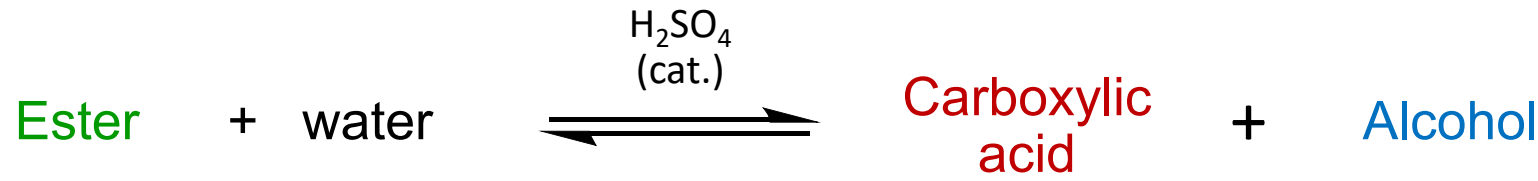
Muscone (musk)
- Base note
- Mass: 238.4 g/mol
- Strongest intermolecular forces
- Longest evaporation rate

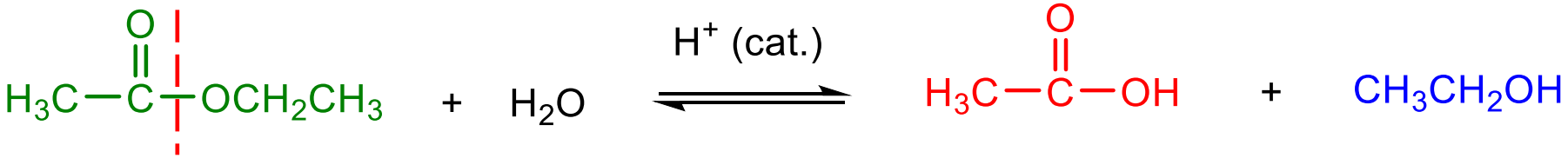
https://www.scimath.org/article-chemistry/item/7851-2018-02-22-02-20-01

Reaction of Esters

Ester undergo hydrolysis with *dilute ac*ids or *alkalis* as catalyst.

❑ Hydrolysis reaction



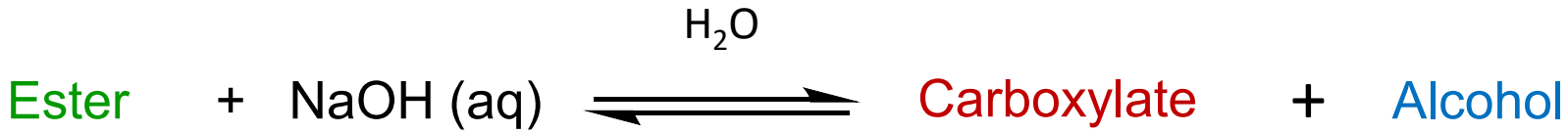


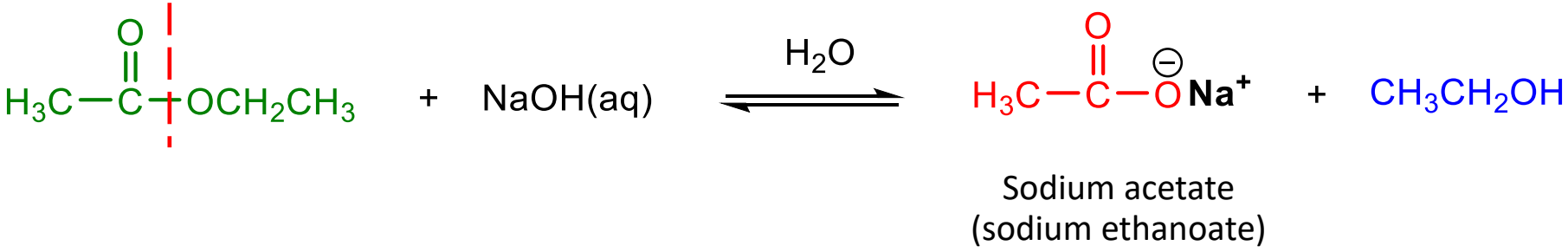
Tay, B., Hoh, Y. K., Briggs, J. G. R., Heyworth, R. M., & Tay, M. K. (2015). *Elective Chemistry: Secondary 6*.

Reaction of Esters

Ester undergo hydrolysis with *dilute ac*ids or *alkalis* as catalyst.

❑ Saponification reaction

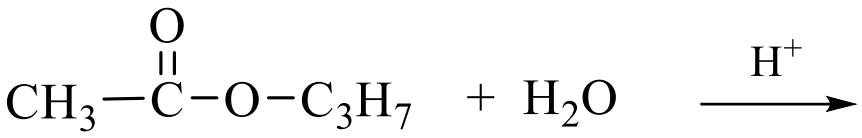


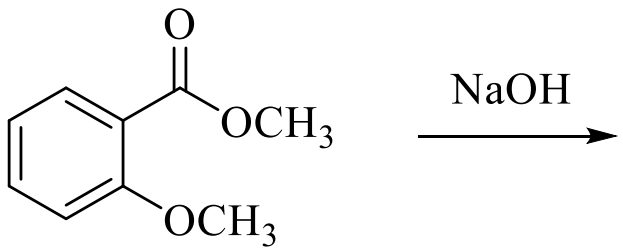


Tay, B., Hoh, Y. K., Briggs, J. G. R., Heyworth, R. M., & Tay, M. K. (2015). *Elective Chemistry: Secondary 6*.

Hydrolysis and Sponification

จงเขียนสมการ จากสารต่อไปนี้



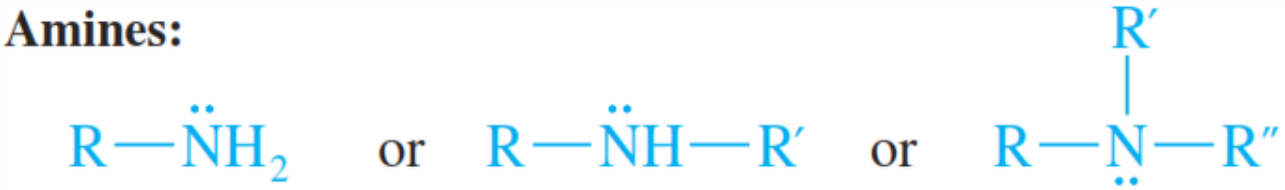


Chang, R. *Chemistry*; McGraw-Hill, 2010.

Amine

Amines are alkylated derivatives of ammonia

Amines:

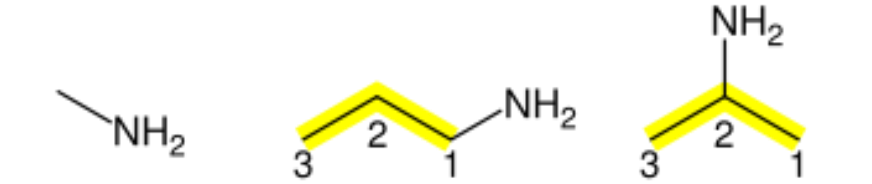


1° primary

2° secondary

3° tertiary

IUPAC: the "e" ending of the alkane name for the longest chain is replaced with –amine.



methanamine propan-1-amine propan-2-amine

Wade, L. G. *Organic Chemistry*; Pearson Education, Inc., 2013.

Amine

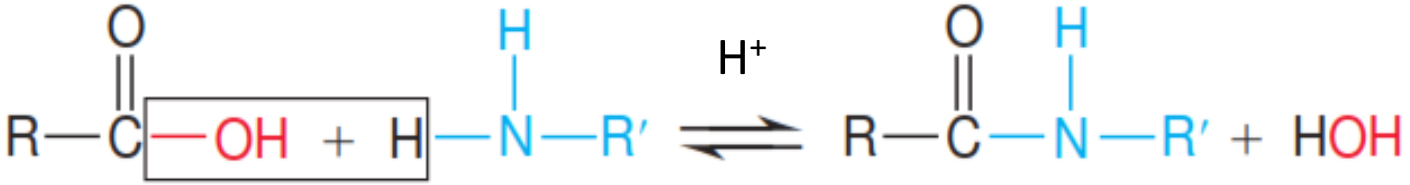
Neutralization

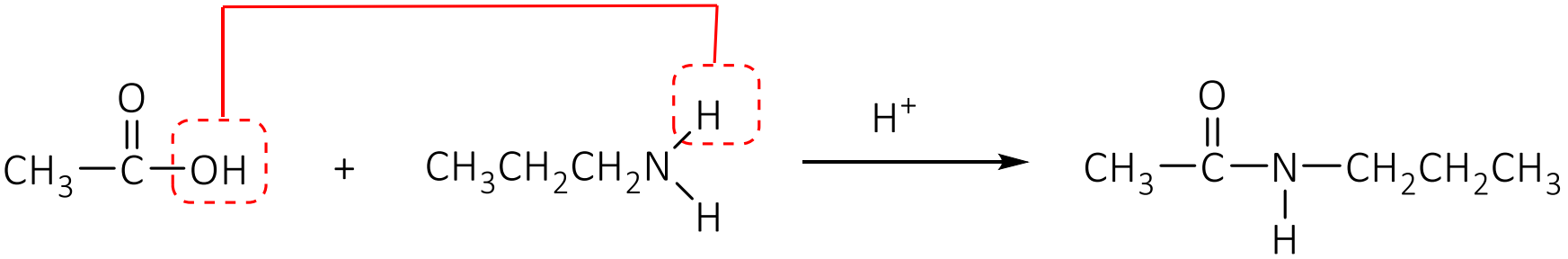
$$CH_3CH_2NH_2 + HCl \longrightarrow CH_3CH_2NH_3^+Cl^-$$

Wade, L. G. *Organic Chemistry*; Pearson Education, Inc., 2013.

Amides

Amides are acid derivatives that result from a combination of an carboxylic acid with amine (or NH_3).



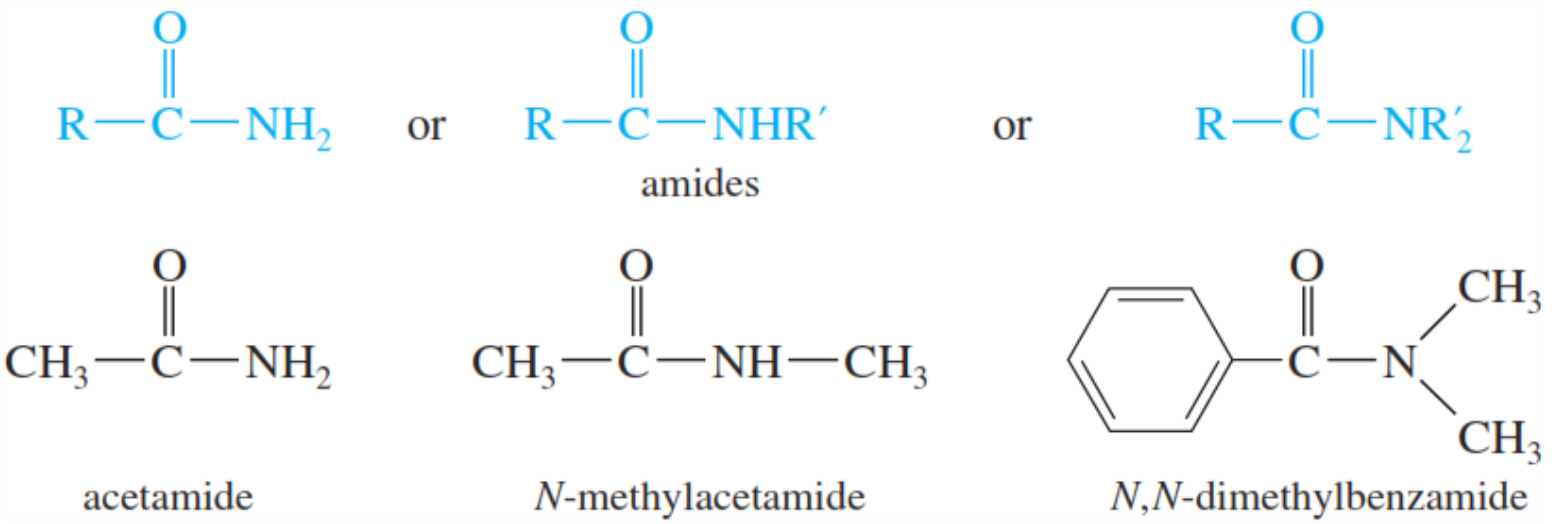


Wade, L. G. *Organic Chemistry*; Pearson Education, Inc., 2013.

Amides

- Amides are named by dropping the ***–e*** from the **alkane name** and adding ***–amide.***

ethane + amide = ethanamide

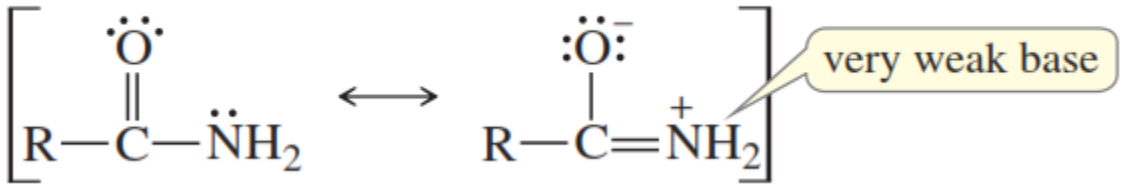


IUPAC ethanamide *N*-methylethanamide *N,N*-dimethylbenzamide

Wade, L. G. *Organic Chemistry*; Pearson Education, Inc., 2013.

Amides

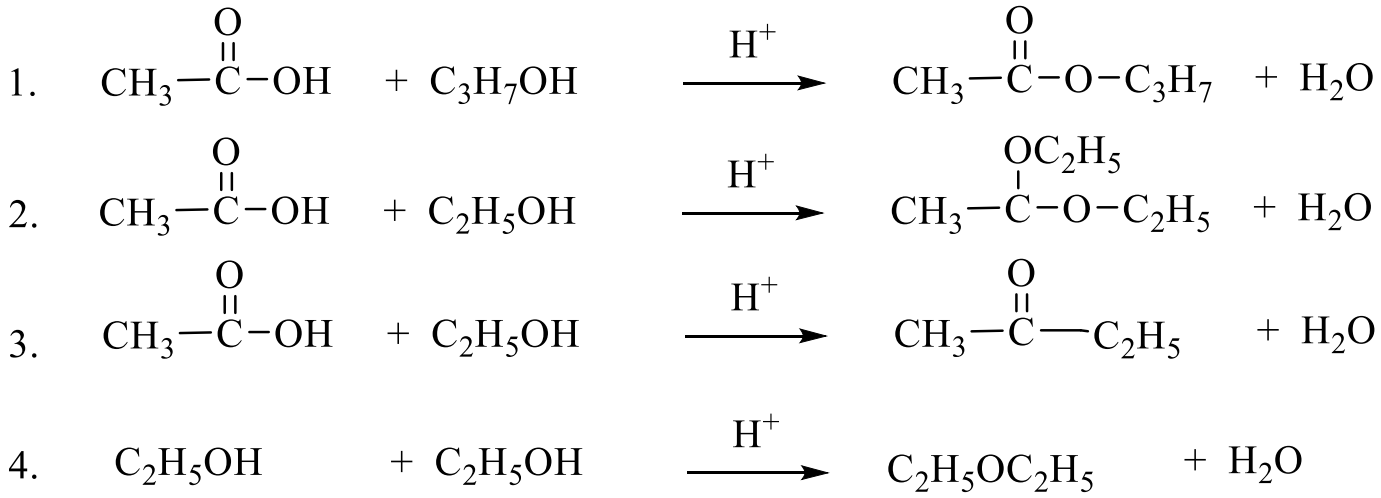
- Amides are among the most stable acid derivatives.
- The nitrogen atom of an amide is not as basic as the nitrogen of an amine because of the electron-withdrawing effect of the carbonyl group.
- The following resonance forms help to show why amides are very weak bases:



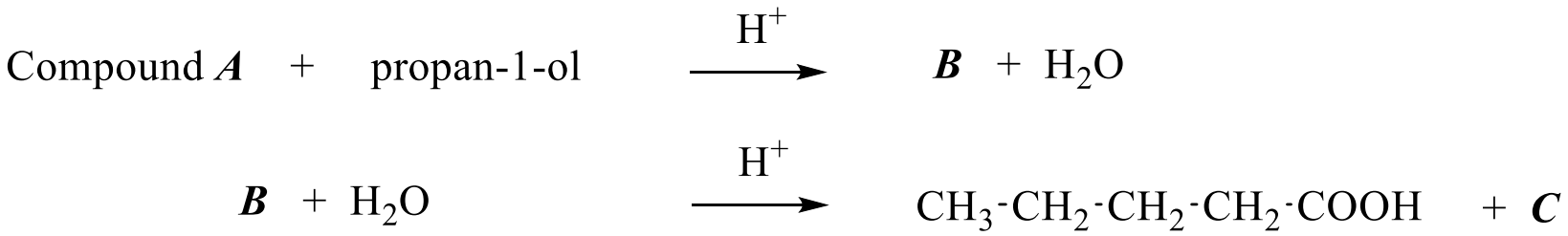
Wade, L. G. *Organic Chemistry*; Pearson Education, Inc., 2013.

Question

1. ปฏิกิริยาต่อไปนี้ ปฏิกิริยาใดจัดว่าเป็นปฏิกิริยาเอสเทอริฟิเคชั่น (Esterification)

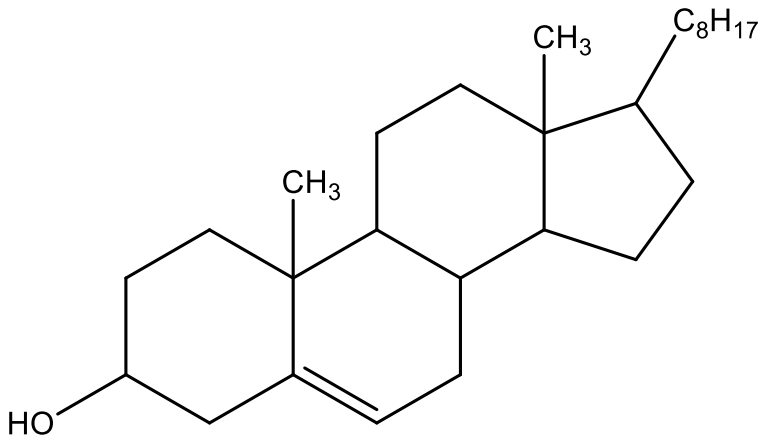


2. พิจารณา แผนภาพปฏิกิริยาเคมีต่อไปนี้



สาร A, B, และ C คือข้อใด

Question 3: Cholesterol is a major component of gallstones, and it is believed that the cholesterol level in the blood is a contributing factor in certain types of heart disease. From the following structure of the compound, predict its reaction with (a) Br_2, (b) H_2 (in the presence of a Pt catalyst), (c) CH_3COOH.



Cholesterol

References

1) Chang, R.; Overby, J. S. *General Chemistry: The Essential Concepts; McGraw-Hill, 2020.*
2) Gallagher, R.; Ingram, P. *Complete Science for Cambridge IGCSE Complete Chemistry for Cambridge IGCSE. Per Le Scuole Superiori; Oxford University Press, 2020.*
3) Silberberg, M. *Chemistry: The Molecular Nature of Matter and Change; McGraw-Hill Education, 2011.*
4) Zumdahl, S. S. *World of Chemistry; McDougal Littell, 20XX.*
5) Ebbing, D.; Gammon, S. D. *General Chemistry; Cengage Learning, 20XX.*