

Kiểm tra 30 phút

Làm vào giấy và nộp

1. Problem

(sắp xếp theo thứ tự ưu tiên các nhóm thế)

PROBLEM 5-7

Which member in each of the following sets ranks higher?

(a) $-H$ or $-Br$

(b) $-Cl$ or $-Br$

(c) $-CH_3$ or $-CH_2CH_3$

(d) $-NH_2$ or $-OH$

(e) $-CH_2OH$ or $-CH_3$

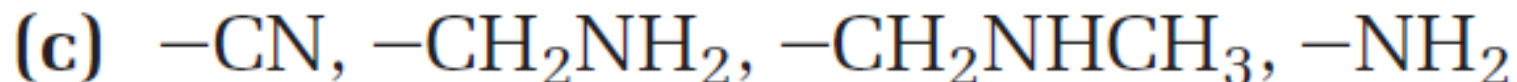
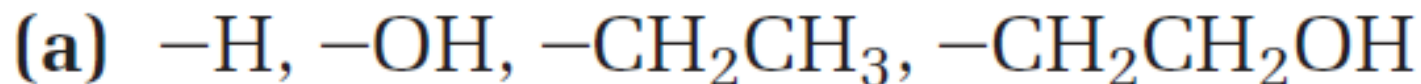
(f) $-CH_2OH$ or $-CH=O$

2. Problem

(sắp xếp theo thứ tự ưu tiên các nhóm thế)

PROBLEM 5-8

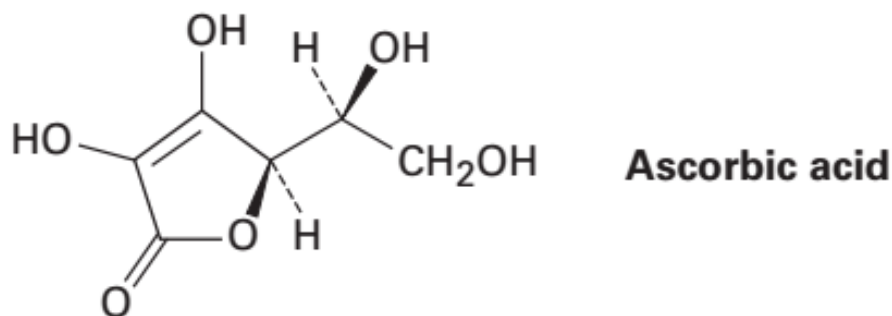
Rank the following sets of substituents:



3. Problem

(xác định cấu hình R hay S của tâm C đối xứng trong vitamin C)

- 5-48 Assign *R* or *S* configurations to the chirality centers in ascorbic acid (vitamin C).



4. Problem

(vẽ chất sau theo cấu hình R, S cho sẵn)

5-65 Draw tetrahedral representations of the following molecules:

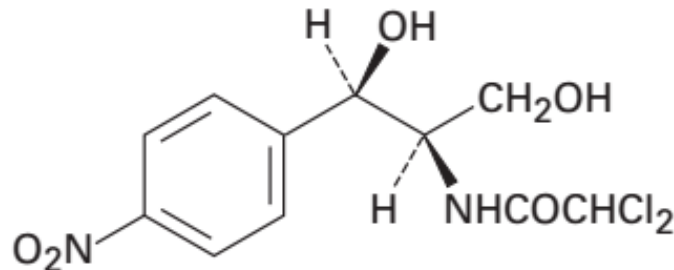
(a) The $2S,3R$ enantiomer of 2,3-dibromopentane

(b) The meso form of 3,5-heptanediol

5. Problem

Hãy xác định cấu hình R, S của các tâm carbon bất đối xứng.

- 5-67** Chloramphenicol, a powerful antibiotic isolated in 1947 from the *Streptomyces venezuelae* bacterium, is active against a broad spectrum of bacterial infections and is particularly valuable against typhoid fever. Assign *R* or *S* configurations to the chirality centers in chloramphenicol.



Chloramphenicol

Typhoid fever: thương hàn

Comment on the lectures

(nêu ý kiến của em về những bài giảng vừa qua)

1. Những bài giảng vừa qua em hiểu bao nhiêu phần trăm? (vd: 20%, 50%, 100%)
2. Em có thích thú không? Tại sao (thích hoặc không thích)?
3. Giảng bài như thế nào thì em sẽ dễ hiểu hơn?

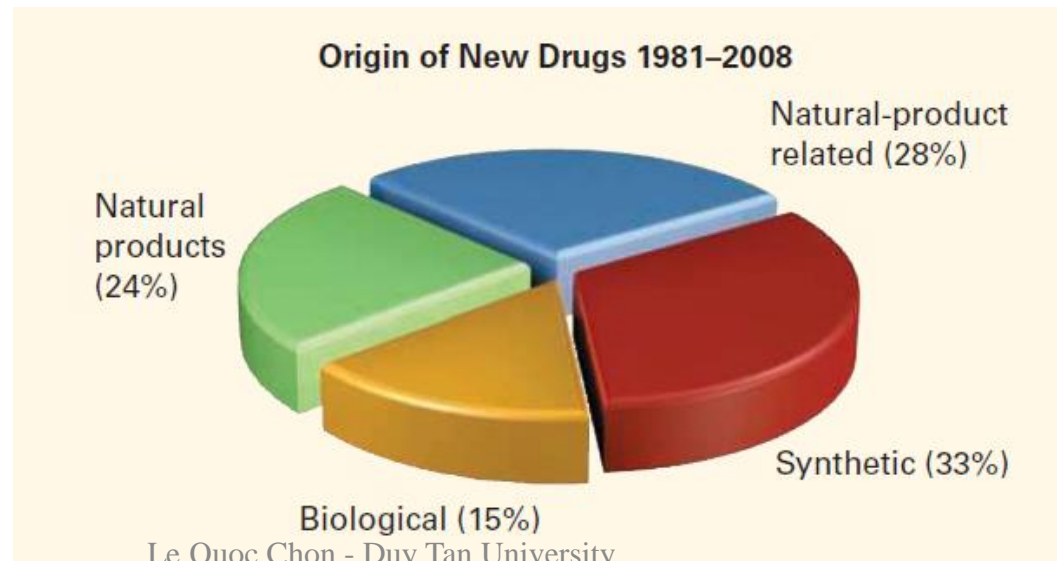
Some info

In USA \$61 billions invest per year on drug research and developments

20 - 35 new drugs approved/year

33 % of new drugs from entirely synthesis

67 % from nature (bacteria, plants, other living organisms)



According to US National Institute of Cancer

Key concepts

Important concepts (các khái niệm quan trọng)

1. Addition

2. Elimination

3. Substitution

4. Rearrangement

5. Organic redox reaction

6. Nucleophile

7. Electrophile

8. Curve arrow

Mechanism

Transition state

Carbocation

Carbanion

Free Radical

Resonance

Inductive effect

Oxidizing agent

Reducing agent

Organic Chemistry

CHE 203

Lecture 6: Organic reactions

Le Quoc Chon – Duy Tan University

Organic reactions

(phản ứng trong hóa hữu cơ)

- In laboratory (trong phòng thí nghiệm)
- In living organism (more complex) (trong cơ thể)

The same rules

Learn what, why and how?

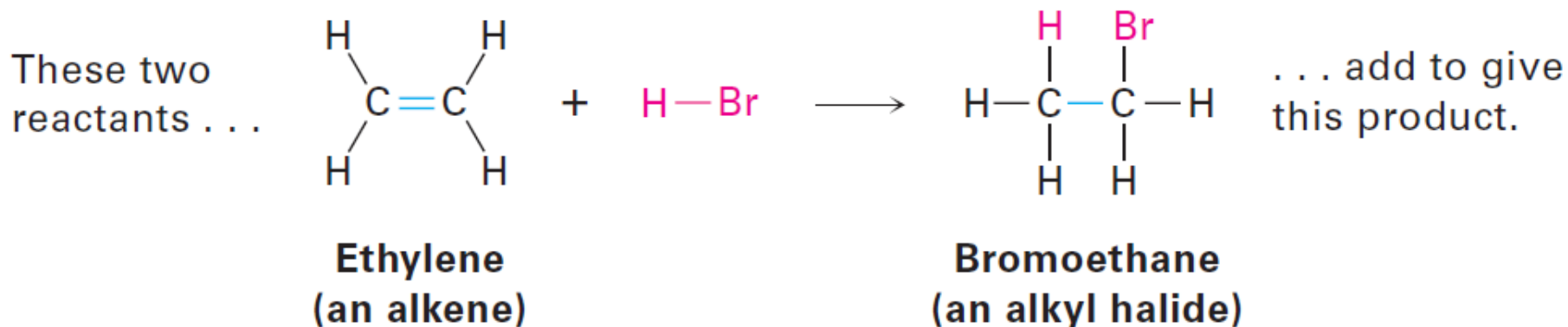
Kinds of reactions

(các loại phản ứng)

1. **Addition** (phản cộng)
2. **Elimination** (phản tách)
3. **Substitution** (phản thế)
4. **Rearrangement** (phản sắp xếp lại)
5. **Organic redox reaction**
(phản oxy hóa khử hữu cơ)

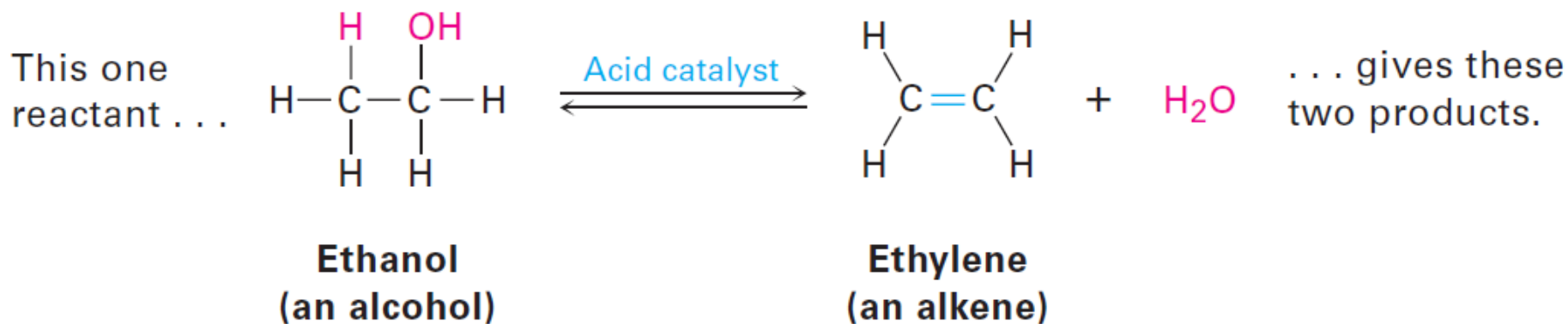
Kinds of reactions

1. Addition (phản ứng cộng)



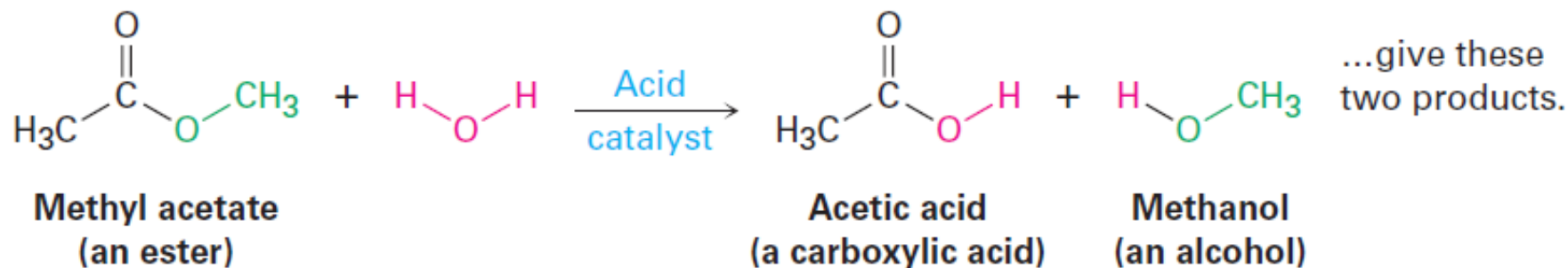
Kinds of reactions

2. Elimination (phản ứng tách)



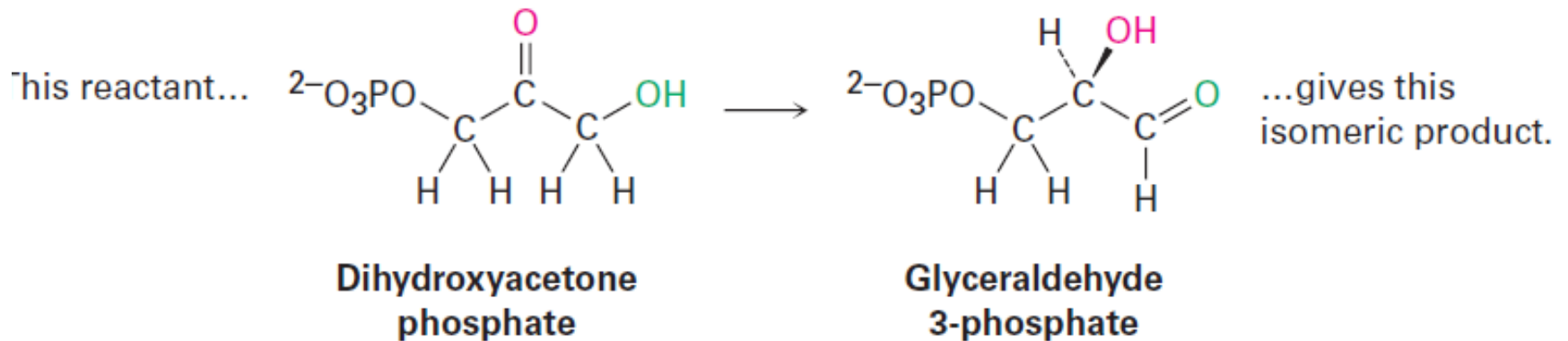
Kinds of reactions

3. Substitution (phản ứng thế)



Kinds of reactions

4. Rearrangement (phản ứng sắp xếp lại)

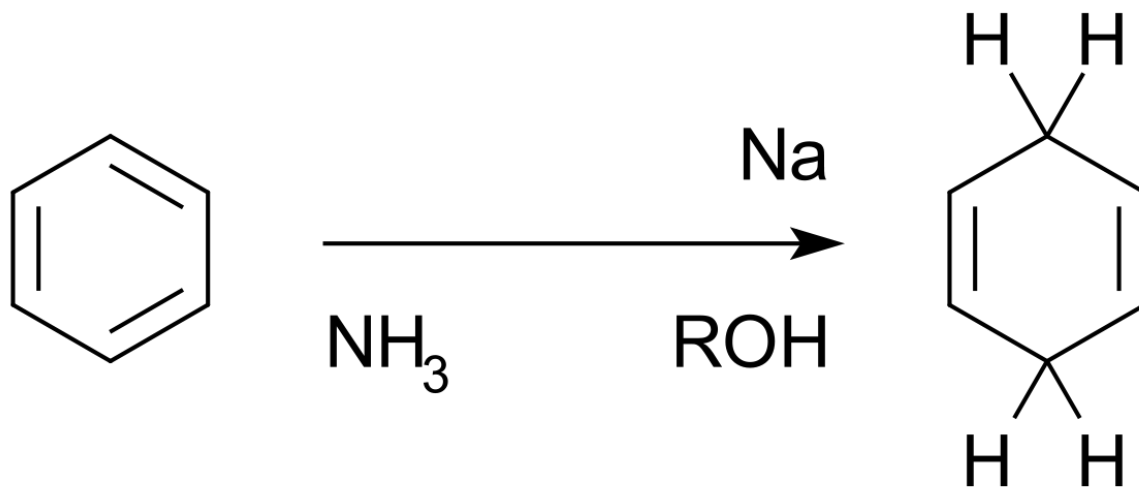


Kinds of reactions

5. Organic Redox reaction

(phản ứng oxy hóa khử trong hóa hữu cơ)

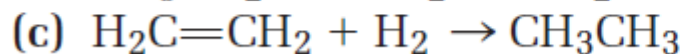
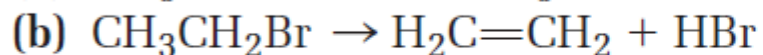
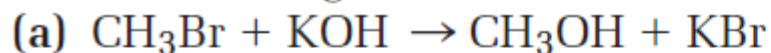
Example: Birch reduction (direct electron transfer)



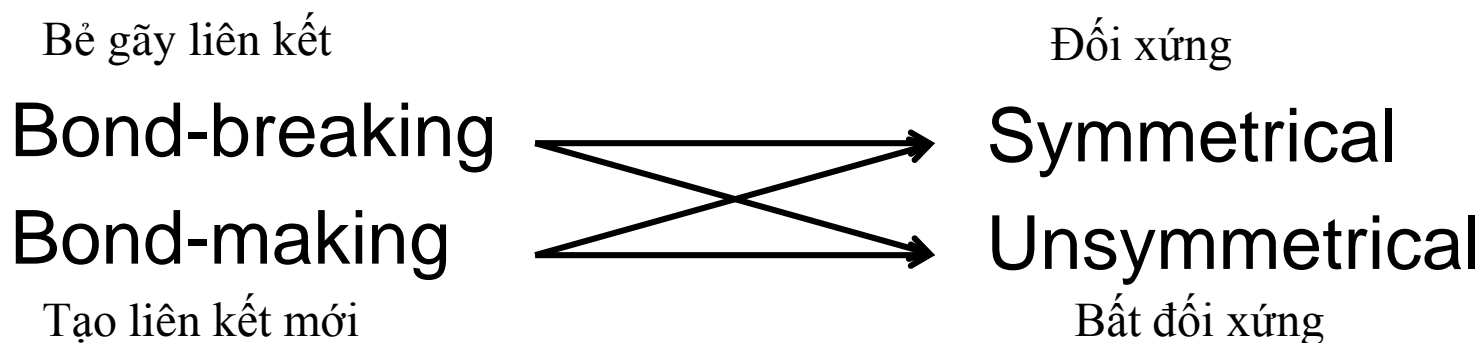
Problem

PROBLEM 6-1 (Các phản ứng sau thuộc loại nào)

Classify each of the following reactions as an addition, elimination, substitution, or rearrangement:



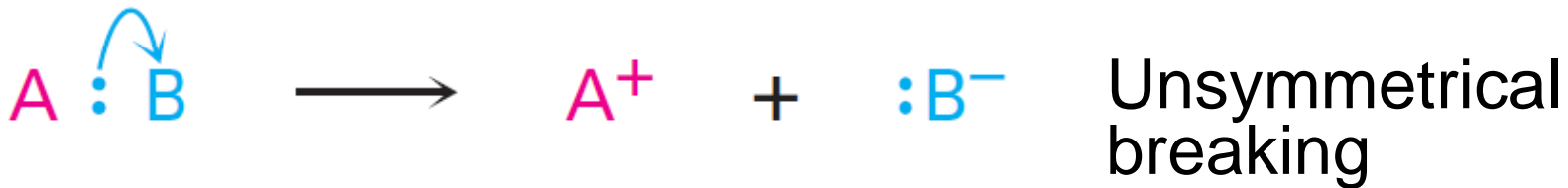
Mechanism of organic reactions (cơ chế phản ứng)



- **Radical** reactions (neutral species contains odd number of electrons, has a single unpaired electron in one of its orbitals).
- **Polar** reactions (more common): involve unsymmetrical bond-breaking or unsymmetrical bond-making.

Bond breaking

Bẻ gãy liên kết



Bond making

Tạo liên kết mới



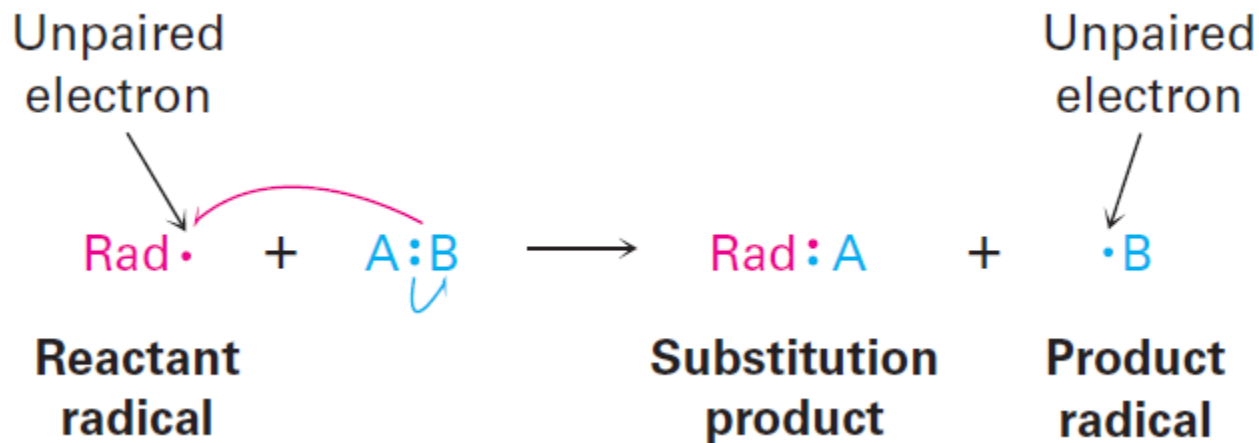
Symmetrical
bond-making



Unsymmetrical
bond-making

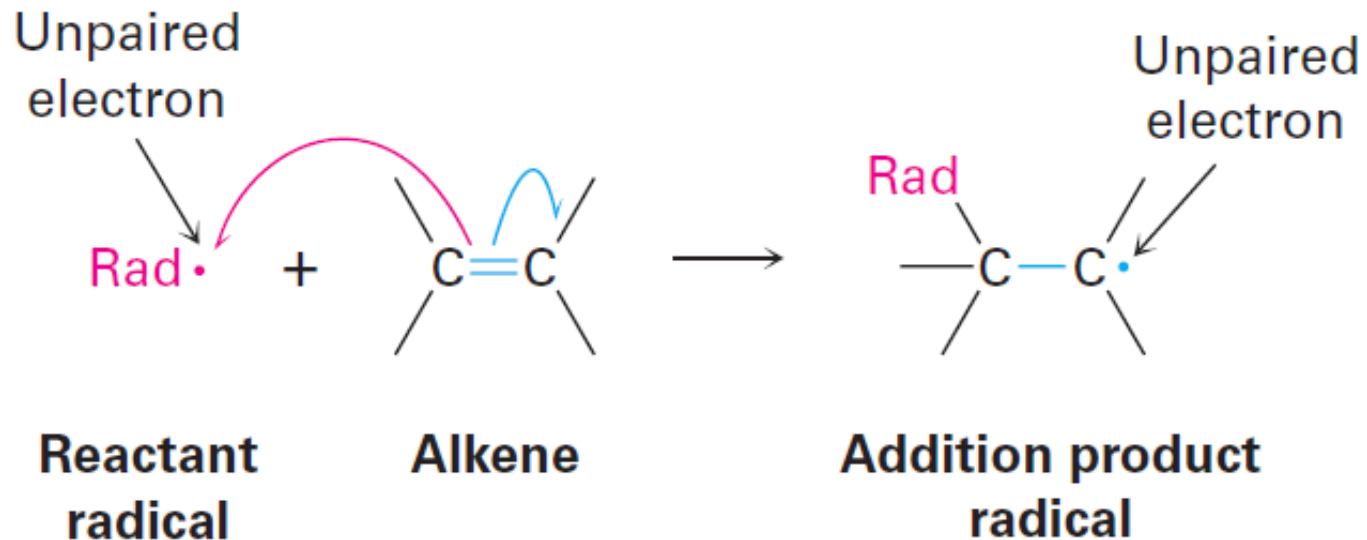
Radical reactions

Phản ứng gốc tự do



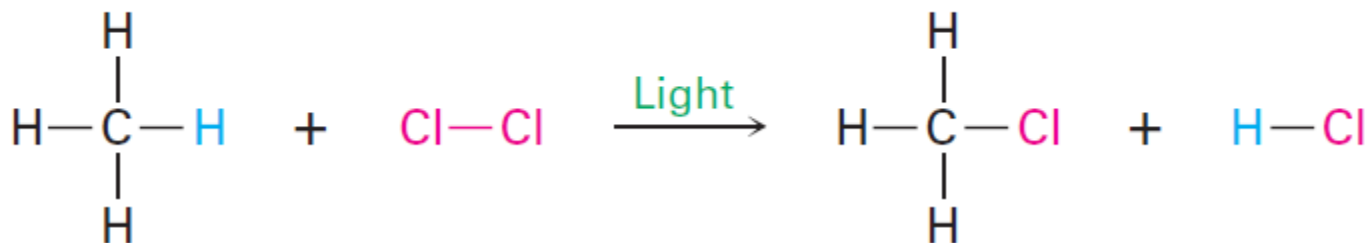
Radical reactions

Phản ứng gốc tự do



Radical reaction: industrial applications

(ứng dụng phản ứng gốc tự do trong công nghiệp)



Methane

Chlorine

Chloromethane



CH₂Cl₂ (dichloromethane)



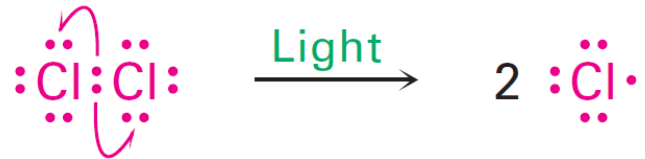
CHCl₃ (chloroform)

Điều chế chloroform
dùng phổ biến làm dung môi

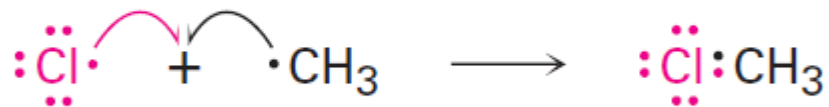
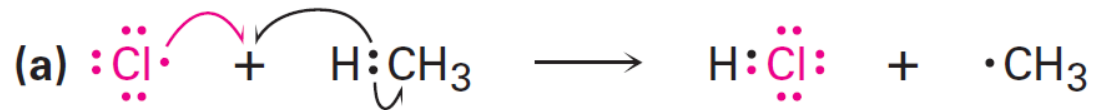
3 bước phản ứng

Radical reaction: 3 steps

Initiation
(khởi mào)



Propagation
(cycle of repeating steps a & b)
(tiếp diễn)

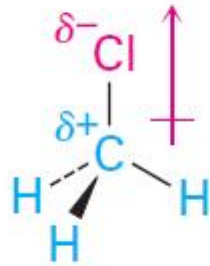
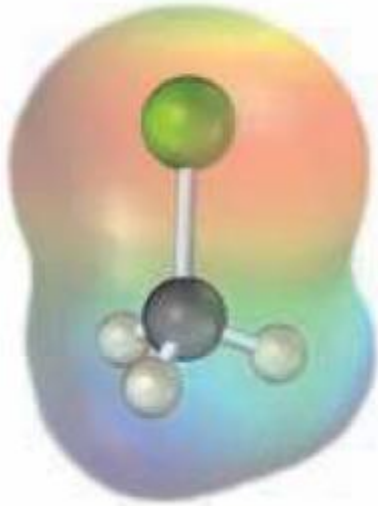


Termination
(kết thúc)

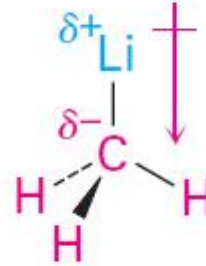


Bond polarity

(độ phân cực của liên kết)



Chloromethane



Methyllithium

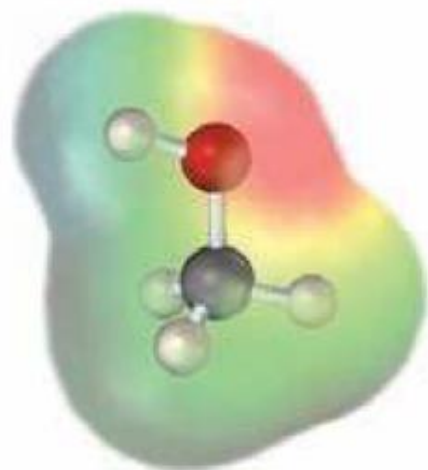


Bond polarity caused by electronegativity differences

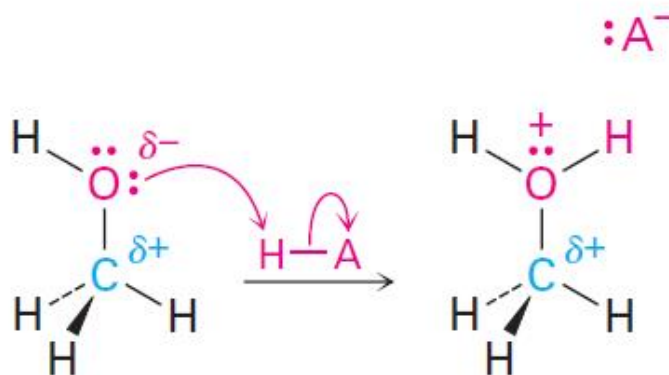
(Độ phân cực của liên kết tạo ra bởi sự khác nhau về độ âm điện của các nguyên tố ở hai đầu liên kết)

Bond polarity

(độ phân cực của liên kết)



**Methanol—weakly
electron-poor carbon**



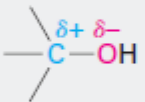
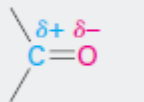
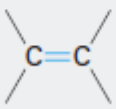
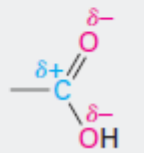
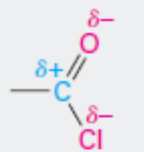
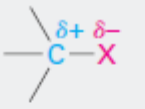
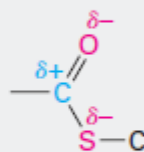
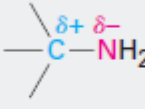
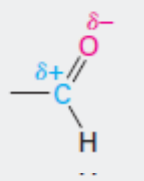
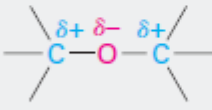
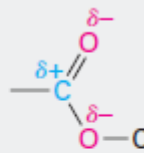
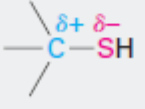
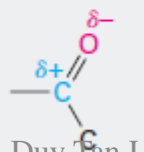
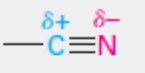
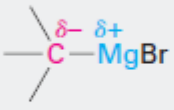
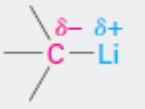
**Protonated methanol—
strongly electron-poor carbon**



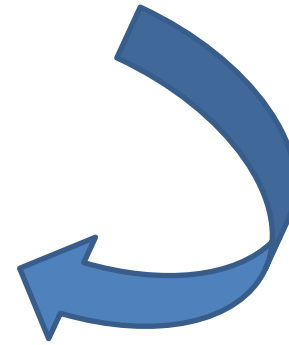
Protonation make bond more polarized

(proton hóa làm tăng độ phân cực của liên kết)

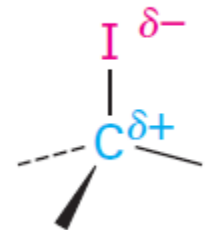
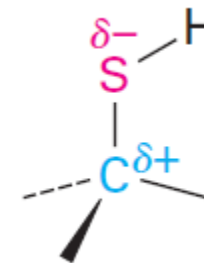
TABLE 6-1 Polarity Patterns in Some Common Functional Groups

Compound type	Functional group structure	Compound type	Functional group structure
Alcohol		Carbonyl	
Alkene		Carboxylic acid	
	Symmetrical, nonpolar	Carboxylic acid chloride	
Alkyl halide		Thioester	
Amine		Aldehyde	
Ether		Ester	
Thiol		Ketone	
Nitrile			
Grignard reagent			
Alkyl lithium			

Sự phân cực trong một số nhóm chức phổ biến



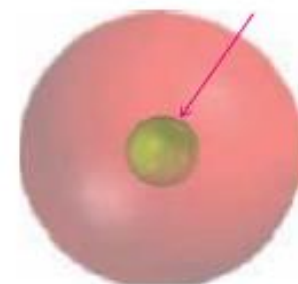
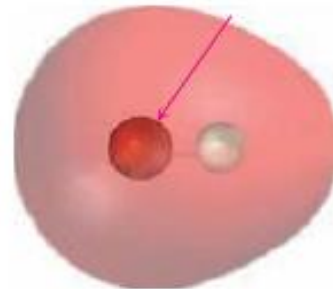
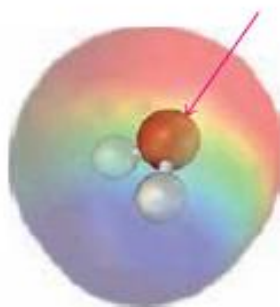
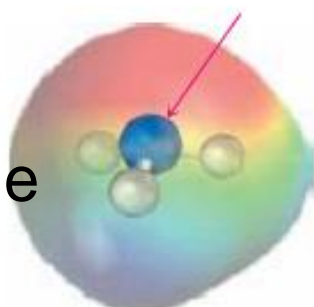
Polarizability of atoms



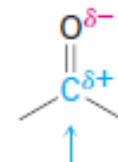
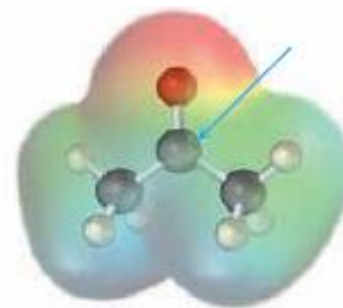
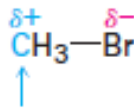
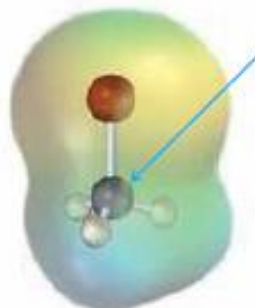
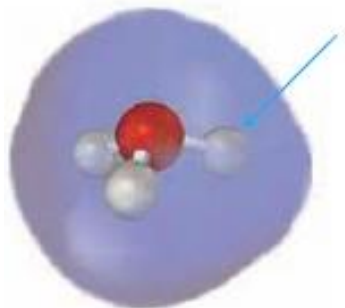
Nucleophile & electrophile

Tác nhân ái nhân & ái điện tử

Some nucleophile
(electron-rich)

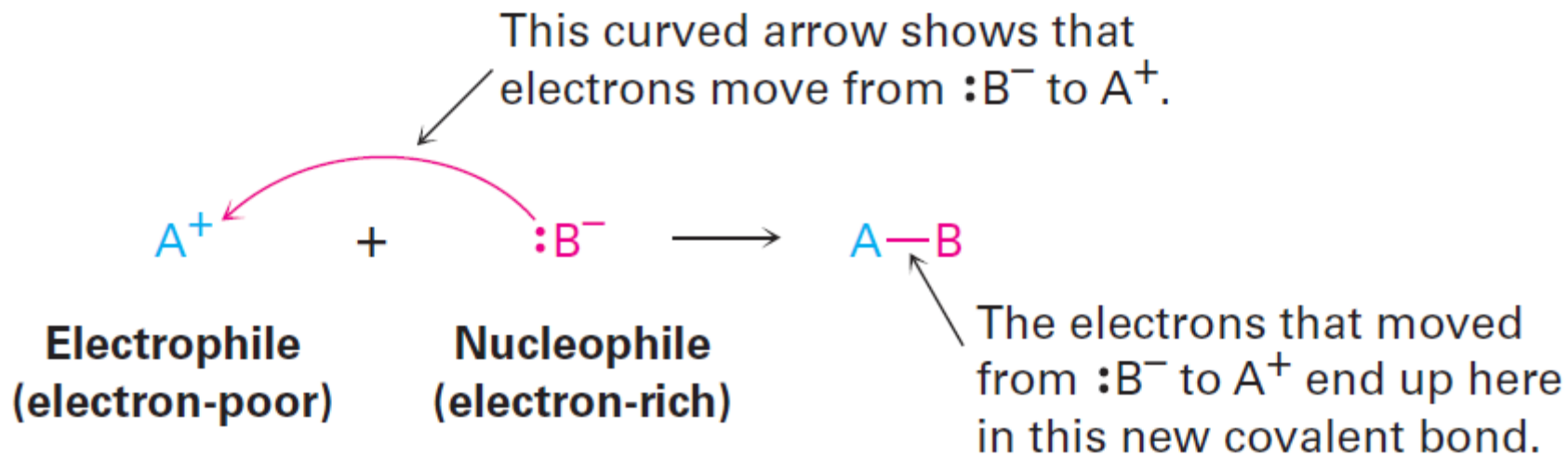


Some electrophile
(electron-poor)



Movement of electrons

(sự di chuyển của electron)



Quan trọng: Mũi tên cong chỉ sự di chuyển của electrons

Remind: Lewis acids/bases

Lewis acid and Lewis bases

versus

Nucleophile and Electrophile

Problem

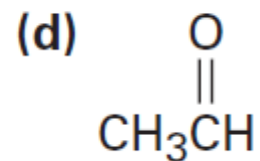
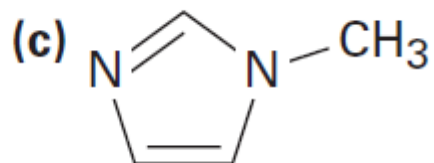
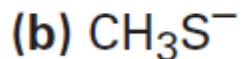
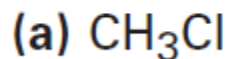
(chỉ ra các nhóm sau là tác nhân gì, ái nhân hay ái điện tử)

Which of the following species is likely a nucleophile or an electrophile?

(a) NO_2^+ **(b)** CN^- **(c)** CH_3NH_2 **(d)** $(\text{CH}_3)_3\text{S}^+$

Problem

Which of the following species is likely a nucleophile or an electrophile? Which may be both?

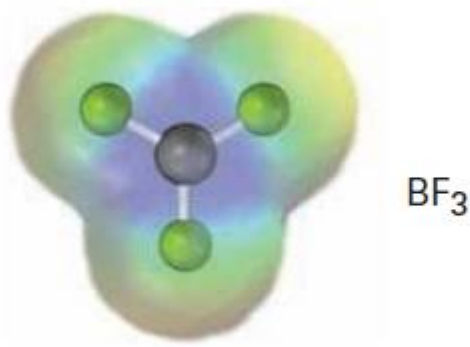


Problem

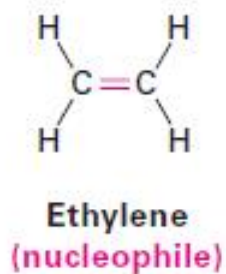
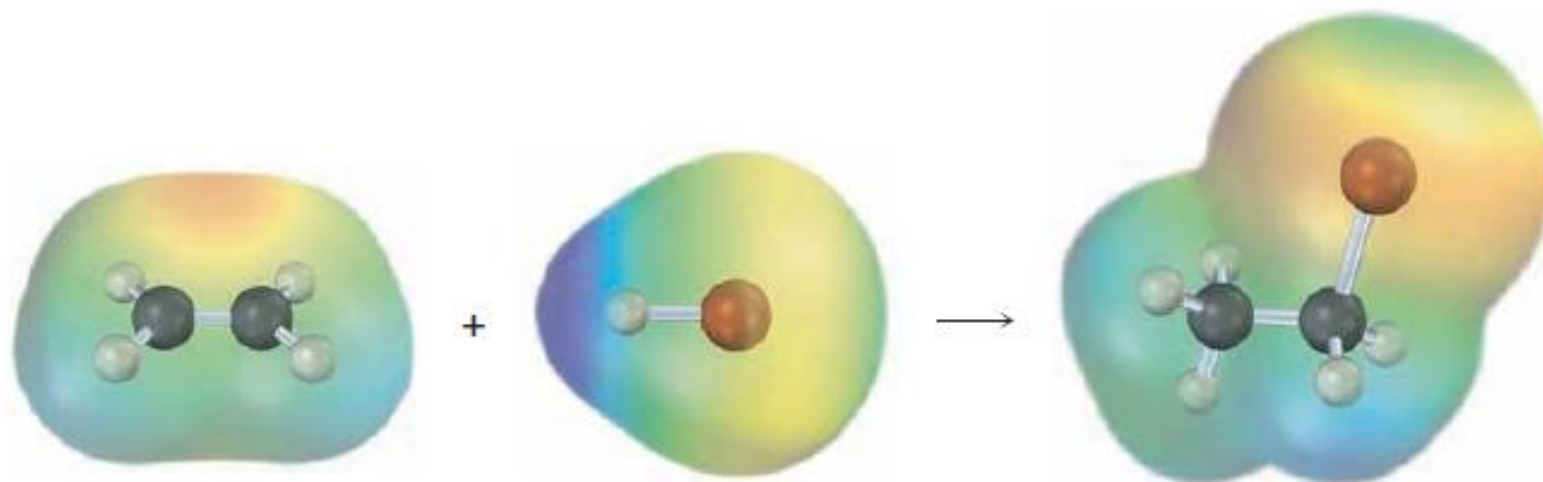
BF_3 là nucleophile hay là electrophile, vẽ công thức lewis

PROBLEM 6-5

An electrostatic potential map of boron trifluoride is shown. Is BF_3 likely to be a nucleophile or an electrophile? Draw a Lewis structure for BF_3 , and explain your answer.



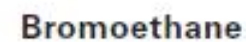
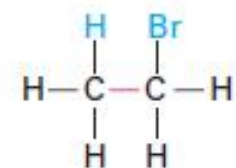
Examples: polar reactions



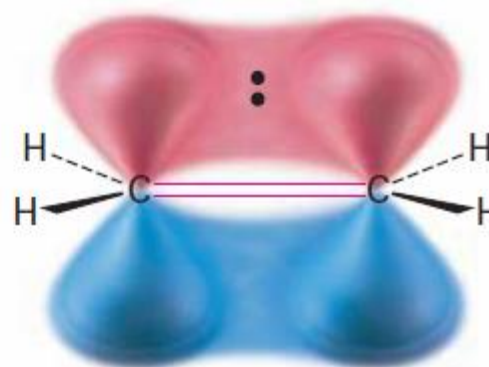
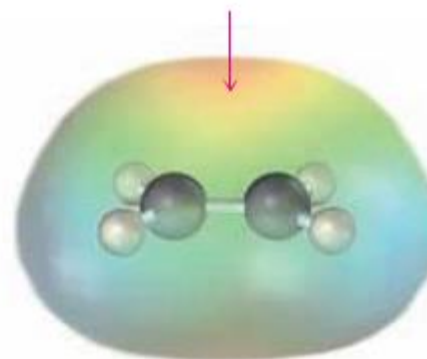
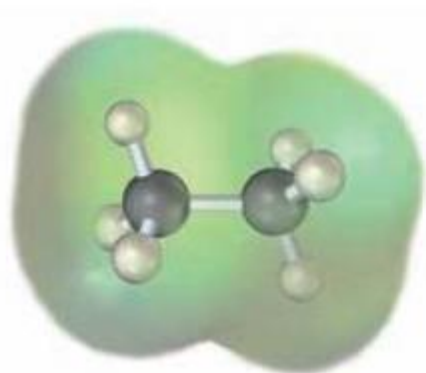
+



→



Examples: polar reactions



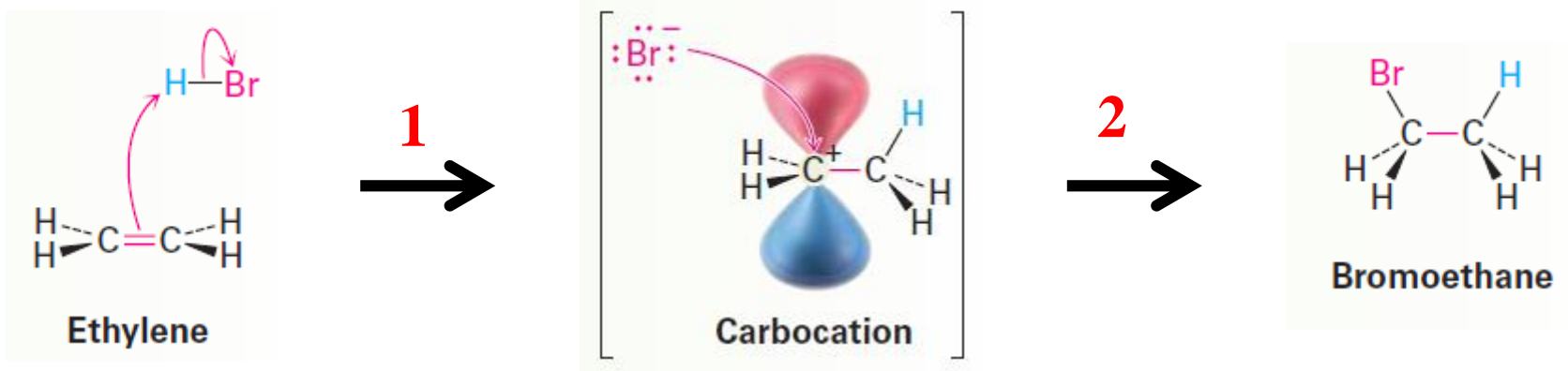
Carbon-carbon σ bond:
stronger; less accessible
bonding electrons

Carbon-carbon π bond:
weaker; more accessible
electrons

The availability of electrons for reaction.

Polar reaction: mechanism

2 Bromide ion donates an electron pair to the positively charged carbon atom, forming a C-Br bond and yielding the neutral addition product.



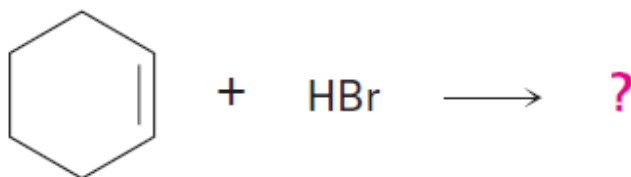
1 A hydrogen atom on the electrophile HBr is attacked by π electrons from the nucleophilic double bond, forming a new C-H bond. This leaves the other carbon atom with a + charge and a vacant p orbital. Simultaneously, two electrons from the H-Br bond move onto bromine, giving bromide anion.

Problem

PROBLEM 6-6

Phản ứng này có thể tạo ra sản phẩm nào?

What product would you expect from reaction of cyclohexene with HBr?
With HCl?

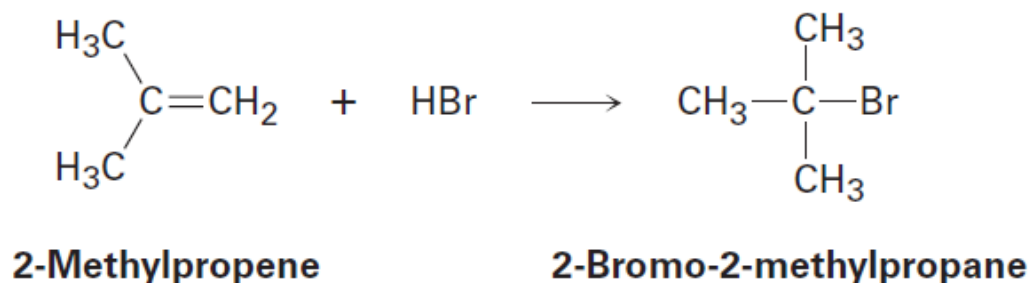


Problem

Phản ứng bên dưới tạo ra carbocation nào trong quá trình phản ứng?

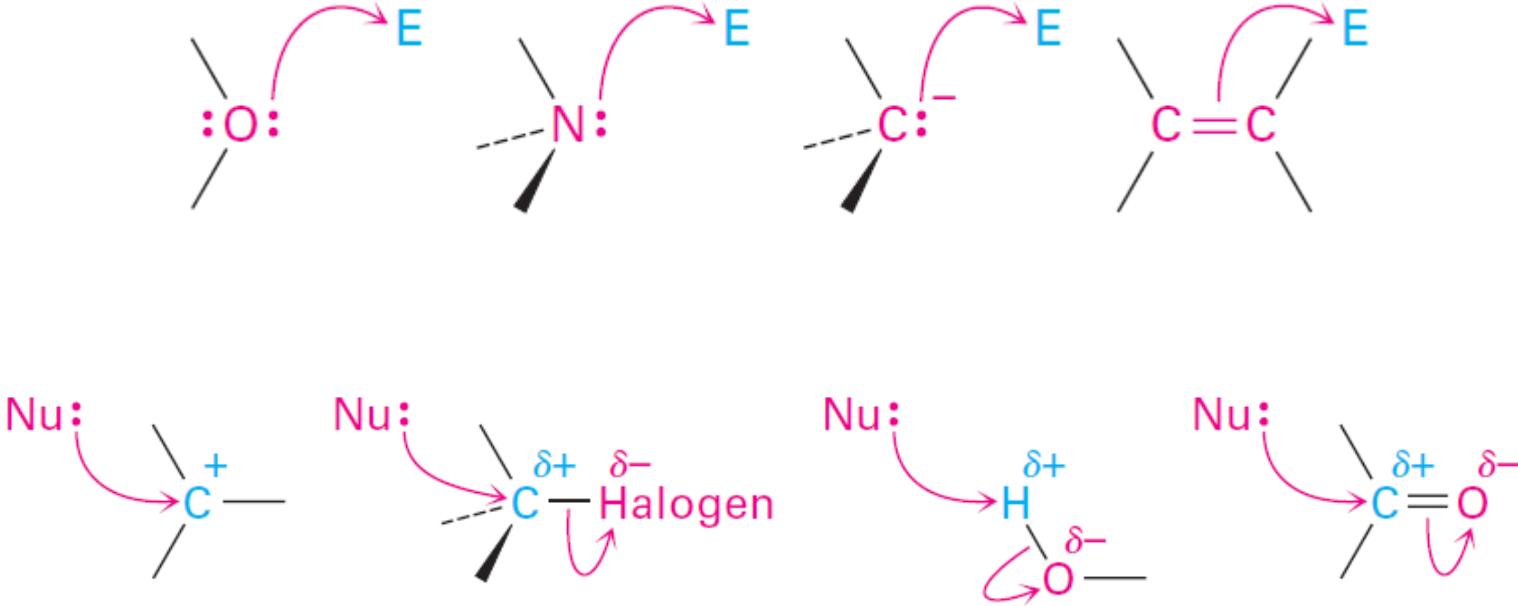
PROBLEM 6-7

Reaction of HBr with 2-methylpropene yields 2-bromo-2-methylpropane. What is the structure of the carbocation formed during the reaction? Show the mechanism of the reaction.



Curved arrow showing movement of electrons (mũi tên chỉ sự di chuyển của electron)

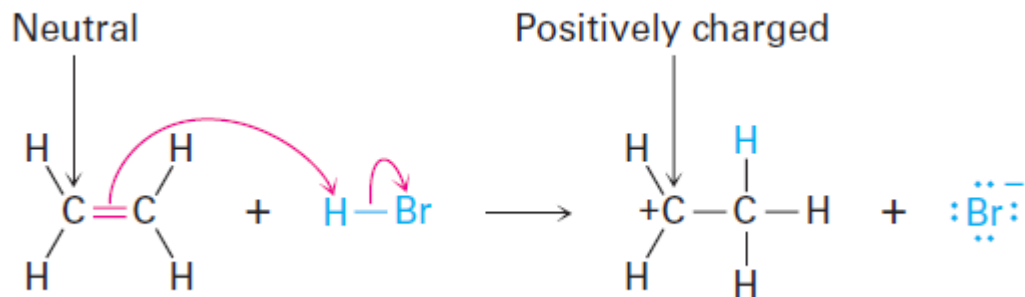
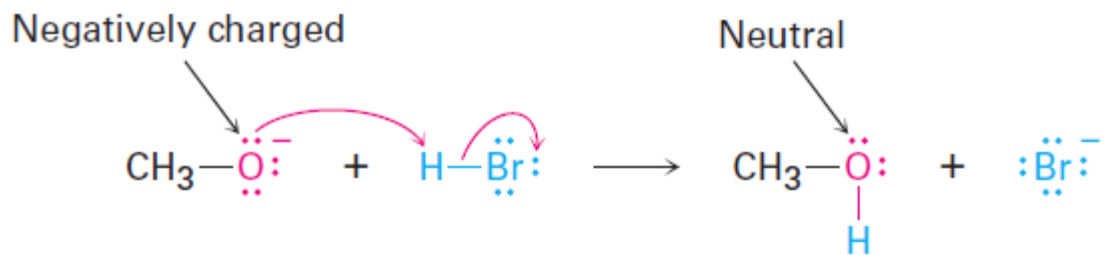
Rule 1. Electrons move from nucleophile sources to an electrophilic sink. (e di chuyển từ nucleophile tới electrophile)



Curved arrow showing movement of electrons

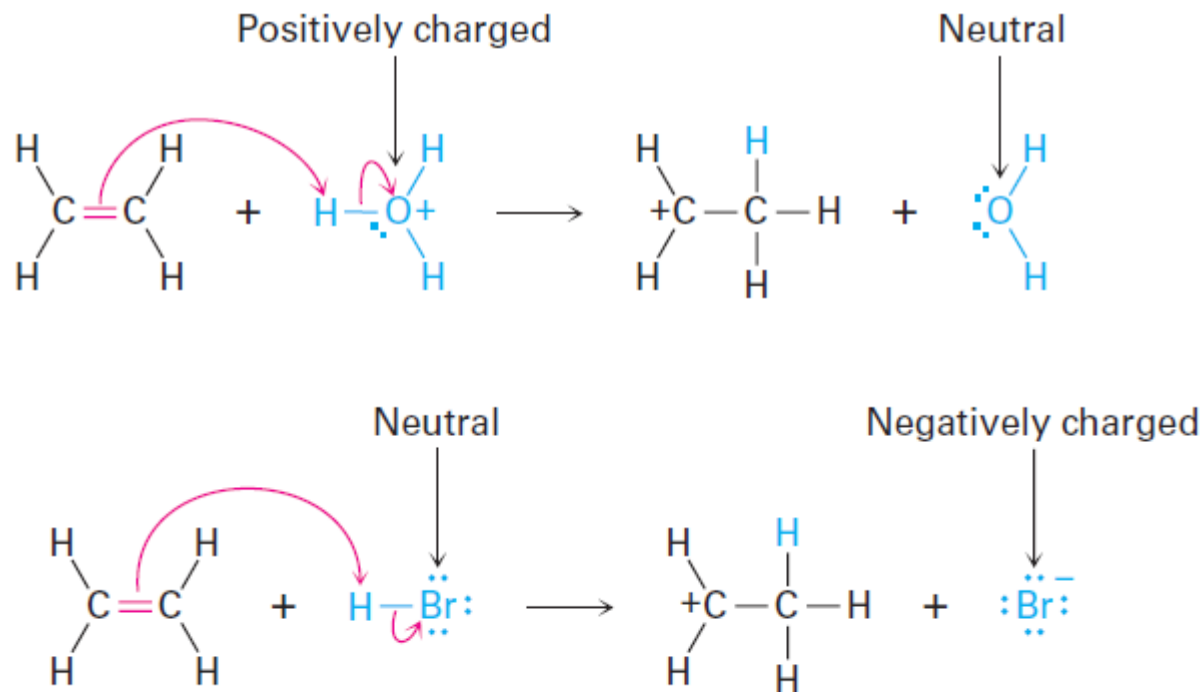
Rule 2. The nucleophile can be either negatively charged or neutral

(nucleophile có thể tích điện âm hay trung hòa).



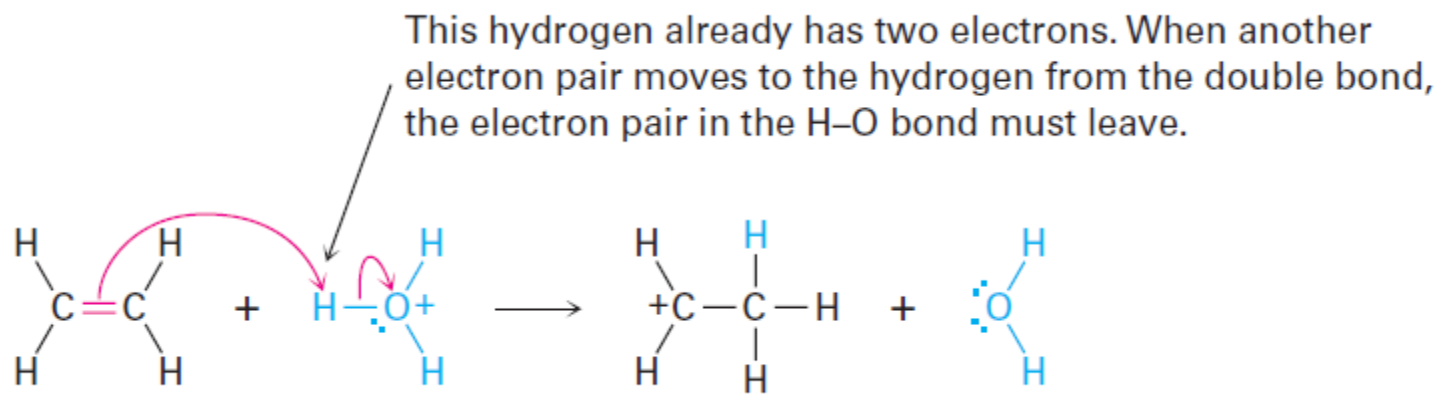
Curved arrow showing movement of electrons

Rule 3. The electrophile can be either positively charged or neutral
(electrophile có thể tích điện dương hay trung hòa).



Curved arrow showing movement of electrons

Rule 4. The octet rule must be followed



Curved arrow: movement of electrons

(tóm tắt sự di chuyển của electron)

Rule 1. Electrons move from nucleophile sources to an electrophilic sink.

Rule 2. The nucleophile can be either negatively charged or neutral

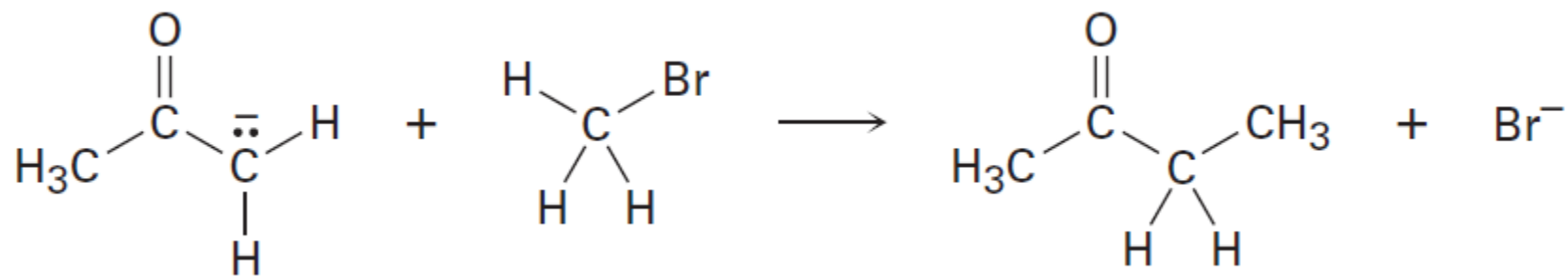
Rule 3. The electrophile can be either positively charged or neutral

Rule 4. The octet rule must be followed

Problem

Chỉ ra sự di chuyển của electron trong phản ứng sau

Show the movement of electrons in this reaction:

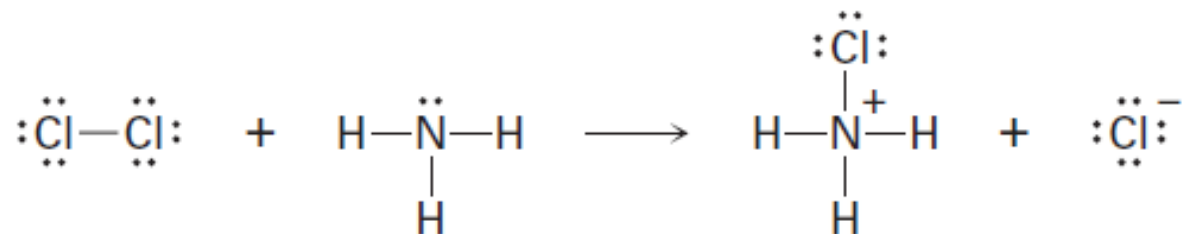


Problem 6.8

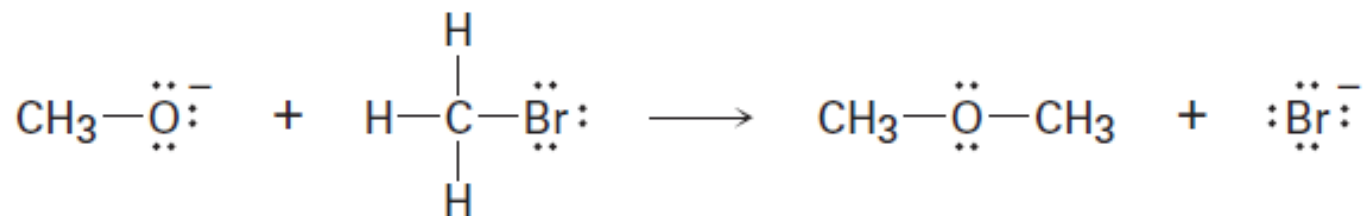
Chỉ ra sự di chuyển của electron trong phản ứng sau

Show the flow of electrons in these reactions:

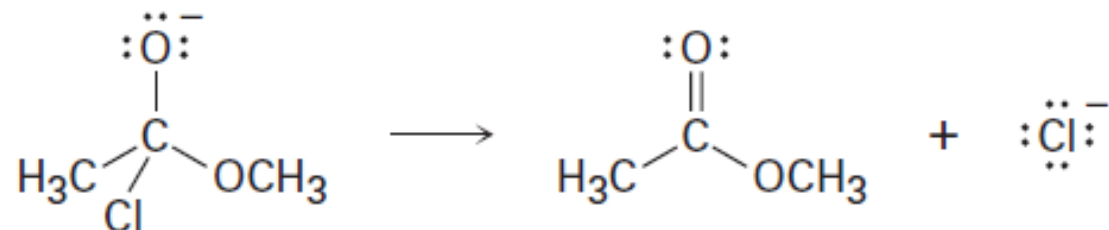
(a)



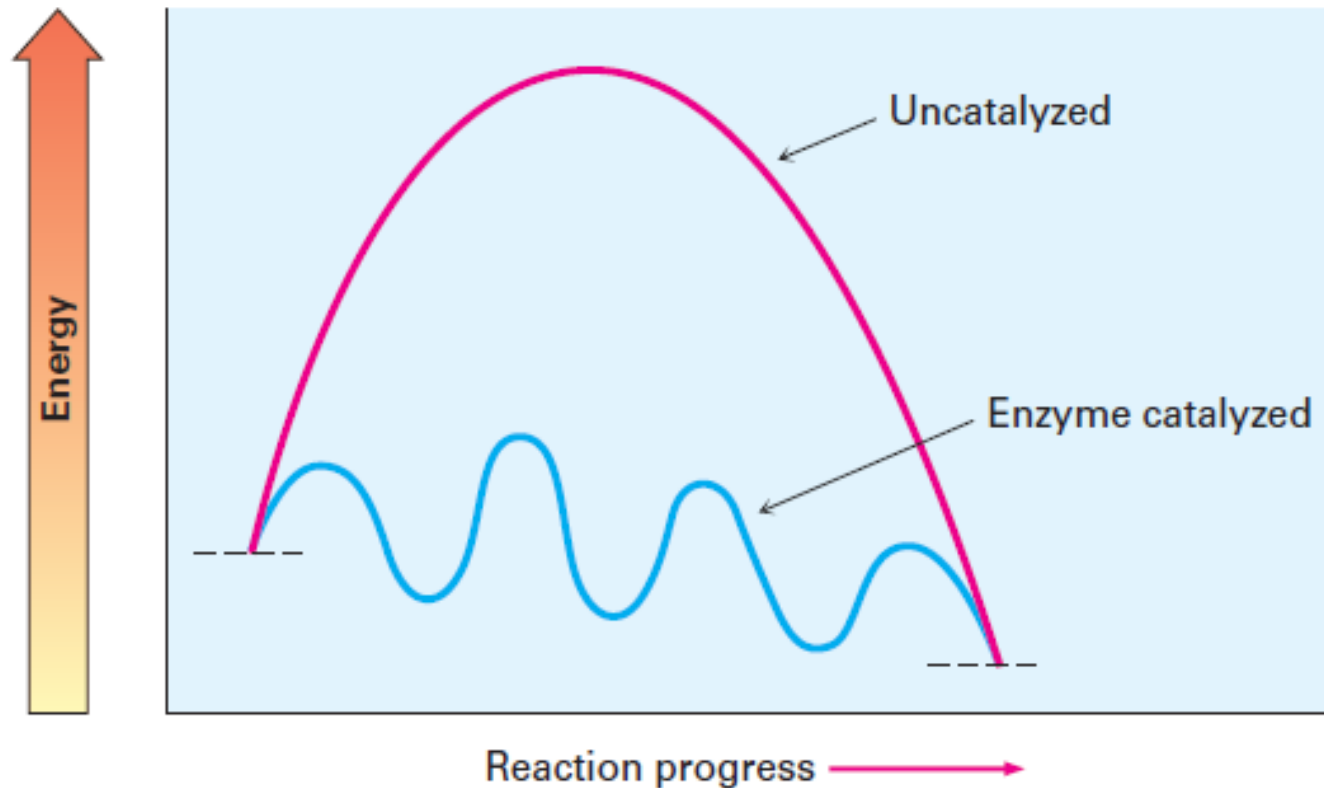
(b)



(c)



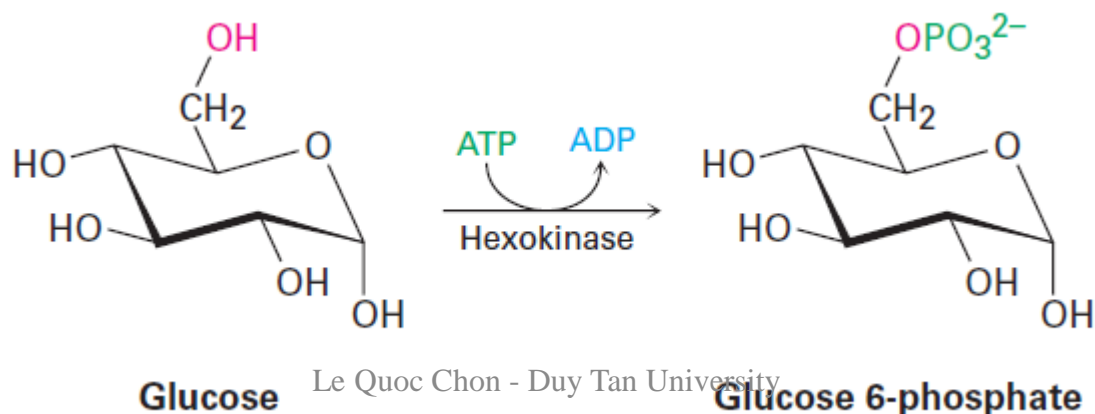
Enzyme-catalyzed reactions



Laboratory & biological reactions

TABLE 6-4 A Comparison of Typical Laboratory and Biological Reactions

	Laboratory reaction	Biological reaction
Solvent	Organic liquid, such as ether	Aqueous environment in cells
Temperature	Wide range; -80 to 150 °C	Temperature of organism
Catalyst	Either none, or very simple	Large, complex enzymes needed
Reagent size	Usually small and simple	Relatively complex coenzymes
Specificity	Little specificity for substrate	Very high specificity for substrate



Check it out

Key words:

Medicinal chemistry

Physical organic chemistry

Computational medicinal chemistry