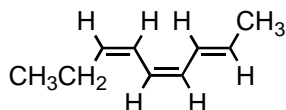


MULTIPLE CHOICE QUESTIONS

Topic: Nomenclature

2. What is an IUPAC name for this triene?

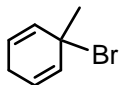


- A) (2E,4Z,6E)-2,4,6-Nonatriene
 B) (2Z,4E,6Z)-2,4,6-Nonatriene
 C) (2E,4Z,6Z)-2,4,6-Nonatriene
 D) (3Z,5Z,7E)-3,5,7-Nonatriene
 E) (3Z,5E,7E)-3,5,7-Nonatriene

Ans: C

Topic: Nomenclature

4. A correct IUPAC name of the compound below is:



- A) 1-Bromo-1-methyl-2,5-cyclohexadiene
 B) 3-Bromo-3-methyl-1,4-cyclohexadiene
 C) 6-Bromo-6-methyl-1,4-cyclohexadiene
 D) 2-Bromo-2-methyl-1,3-cyclohexadiene
 E) None of these

Ans: B

Topic: Stability (Alkenes, Cations, Radicals)

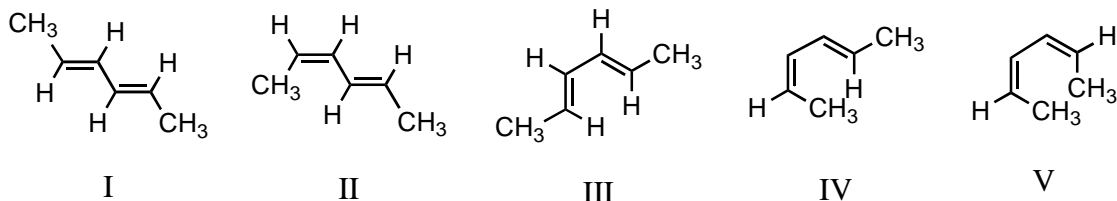
5. Which of the following dienes would you expect to be the most stable?

- A) $\text{CH}_3\text{CH}=\text{CHCH}=\text{CHCH}_3$
 B) $\text{CH}_3\text{CH}=\text{CHCH}_2\text{CH}=\text{CH}_2$
 C) $\text{CH}_2=\text{CHCH}_2\text{CH}_2\text{CH}=\text{CH}_2$
 D) $\text{CH}_2=\text{CHCH}(\text{CH}_3)\text{CH}=\text{CH}_2$
 E) $\text{CH}_3\text{CH}=\text{C}=\text{CHCH}_2\text{CH}_3$

Ans: A

Topic: Stability (Alkenes, Cations, Radicals)

8. Considering both configurational and conformational factors, select the most stable form of 2,4-hexadiene.



- A) I
B) II
C) III
D) IV
E) V

Ans: A

Topic: Stability (Alkenes, Cations, Radicals)

12. Which carbocation would be most stable?

- A) $\text{CH}_3-\text{CH}^+-\text{CH}_2-\text{CH}=\text{CH}_2$
 B) $\text{CH}_2-\text{CH}_2-\text{CH}=\text{CH}-\text{CH}_3$
 C) $\begin{array}{c} \text{CH}_3 \\ | \\ \text{CH}_3-\text{C}-\text{CH}=\text{CH}_2 \\ + \end{array}$
 D) $\begin{array}{c} \text{CH}_3 \\ | \\ \text{CH}_3-\text{CH}-\text{CH}_2-\text{CH}_2^+ \end{array}$
 E) $\begin{array}{c} \text{CH}_3 \\ | \\ \text{CH}_2=\text{C}-\text{CH}_2-\text{CH}_2^+ \end{array}$

Ans: C

Topic: Stability (Alkenes, Cations, Radicals)

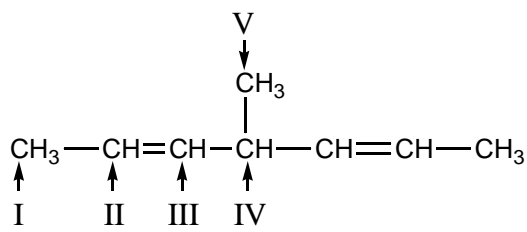
14. Which free radical would be most stable?

- A) $\begin{array}{c} \text{CH}_3 \\ | \\ \text{CH}_3\dot{\text{C}}=\text{CH}_2 \end{array}$
- B) $\begin{array}{c} \text{CH}_3 \\ | \\ \text{CH}_2=\text{CCH}_2\text{CH}_2\cdot \end{array}$
- C) $\begin{array}{c} \text{CH}_3 \\ | \\ \text{CH}_3\dot{\text{C}}\text{CH}_2\text{CH}_3 \end{array}$
- D) $\begin{array}{c} \text{CH}_3 \\ | \\ \cdot\text{CH}_2\text{CHC}=\text{CH}_2 \end{array}$
- E) $\begin{array}{c} \text{CH}_3 \\ | \\ \text{CH}_3\text{CH}\dot{\text{C}}\text{HCH}_3 \end{array}$

Ans: A

Topic: Stability (Alkenes, Cations, Radicals)

15.



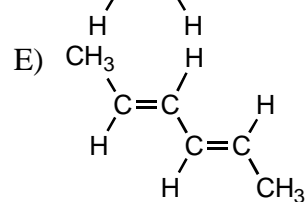
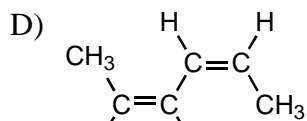
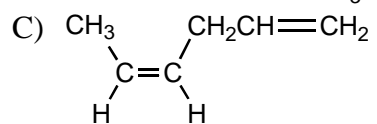
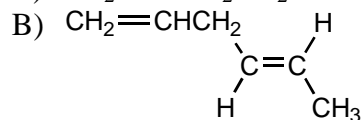
Which hydrogen atom(s) of I II III IV is/are most susceptible to abstraction by free radicals?

- A) I
B) II
C) III
D) IV
E) V

Ans: D

Topic: Heat of Hydrogenation

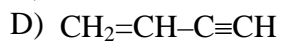
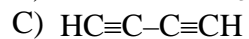
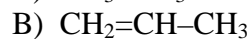
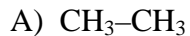
16. Which alkene would you expect to have the smallest heat of hydrogenation?



Ans: E

Topic: Bond Lengths

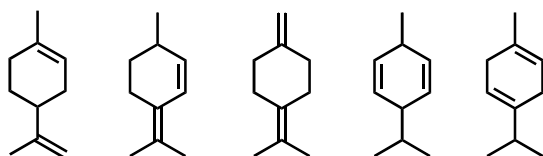
17. Which compound would have the shortest carbon-carbon single bond?



Ans: C

Topic: Alkene Classification

21. Select the structure of the conjugated diene.



- I II III IV V
- A) I
B) II
C) III
D) IV
E) V

Ans: B

Topic: Alkene Classification

23. Which of the following dienes is a cumulated diene?

- A) $\text{CH}_2=\text{CHCH}_2\text{CH}_2\text{CH}=\text{CH}_2$
B) $\text{CH}_2=\text{CHCH}=\text{CHCH}_2\text{CH}_3$
C) $\text{CH}_3\text{CH}=\text{C}=\text{CHCH}_2\text{CH}_3$
D) $\text{CH}_3\text{CH}=\text{CHCH}=\text{CHCH}_3$
E) $\text{CH}_3\text{CH}=\text{CHCH}_2\text{CH}=\text{CH}_2$

Ans: C

Topic: Resonance

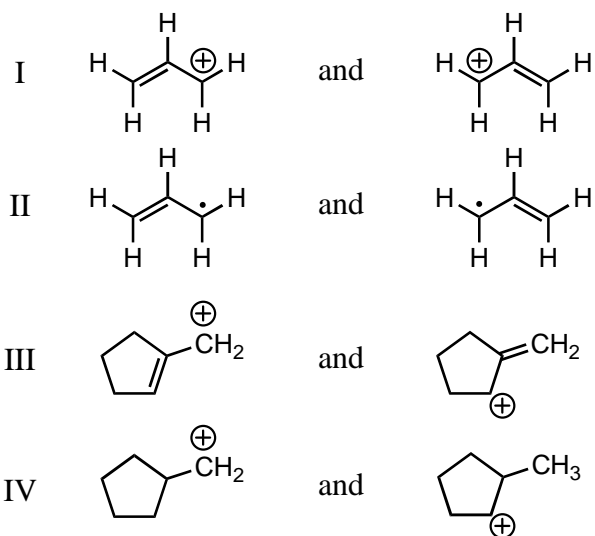
30. Which is not a proper resonance structure for 1,3-butadiene?

- A) $\text{CH}_2=\text{CH}-\text{CH}=\text{CH}_2$
B) $\cdot\text{CH}_2-\text{CH}=\text{CH}-\dot{\text{C}}\text{H}_2$
C) $\ominus \quad \quad \quad \oplus$
 $:\text{CH}_2-\text{CH}=\text{CH}-\text{CH}_2$
D) $\oplus \quad \quad \quad \cdot\cdot\ominus$
 $\text{CH}_2-\text{CH}=\text{CH}-\dot{\text{C}}\text{H}_2$
E) All are correct

Ans: B

Topic: Resonance

31. Which pair does not represent a pair of resonance structures?



- A) I
 B) II
 C) III
 D) IV
 E) All of these represent pairs of resonance structures.

Ans: D

Topic: Reaction Mechanisms and Control

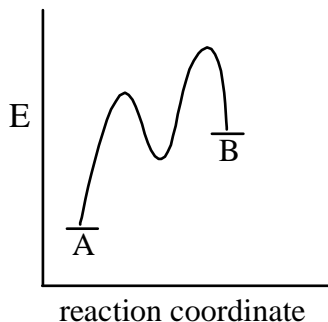
32. A thermodynamically-controlled reaction will yield predominantly:

- A) the more/most stable product.
 B) the product whose formation requires the smallest free energy of activation.
 C) the product that can be formed in the fewest steps.
 D) the product that is formed at the fastest rate.
 E) the product which possesses the greatest potential energy.

Ans: A

Topic: Reaction Mechanisms and Control

34. The accompanying diagram, which describes the fate of the intermediate in a reversible reaction, implies that:



- A) the less stable product forms more rapidly.
 B) the more stable product forms more rapidly.
 C) product B will predominate at equilibrium.
 D) the intermediate has a short lifetime.
 E) No conclusions can be drawn as to either reaction rate or product stability.

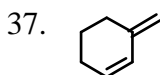
Ans: B

Topic: Diels-Alder Reaction

36. Which is an untrue statement concerning the Diels-Alder reaction?
 A) The reaction is a syn addition.
 B) The diene must be in the s-cis conformation to react.
 C) Most Diels-Alder reactions are reversible.
 D) Generally, the adduct formed most rapidly is the exo product.
 E) Depending on the nature of the dienophile, both electron-releasing and electron-withdrawing groups in the diene can favor adduct formation.

Ans: D

Topic: Diels-Alder Reaction



does not undergo the Diels-Alder reaction because:

- A) ring systems cannot function as the diene component.
 B) it cannot adopt the s-cis conformation.
 C) it lacks electron-withdrawing groups.
 D) it lacks strong electron-releasing groups.
 E) the two double bonds are further apart than in a non-cyclic conjugated system.

Ans: B

Topic: Diels-Alder Reaction

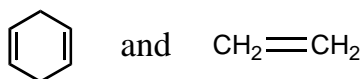
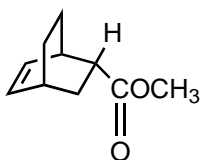
39. Which of these dienes is the most reactive in the Diels-Alder reaction?

- A) 1,3-Butadiene
- B) 1,4-Pentadiene
- C) Cyclopentadiene
- D) 1,2-Butadiene
- E) 1,4-Cyclohexadiene

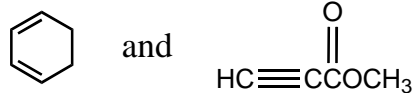
Ans: C

Topic: Diels-Alder Reaction

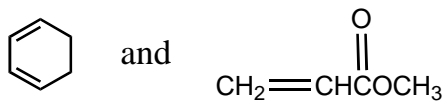
42. Which diene and dienophile would you choose to synthesize the following compound?



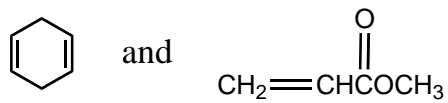
I



II



III



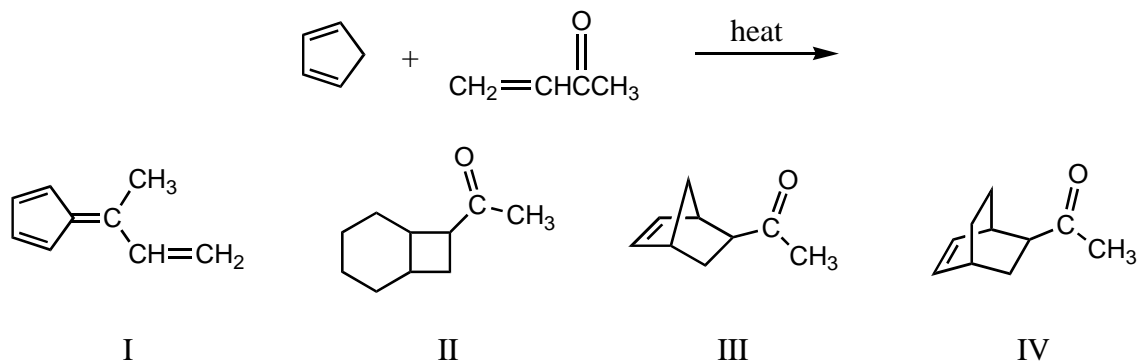
IV

- A) I
- B) II
- C) III
- D) IV
- E) None of these

Ans: C

Topic: Diels-Alder Reaction

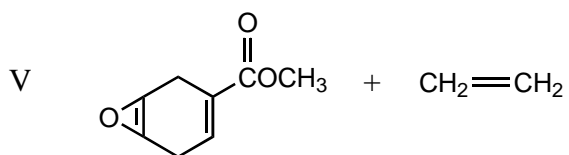
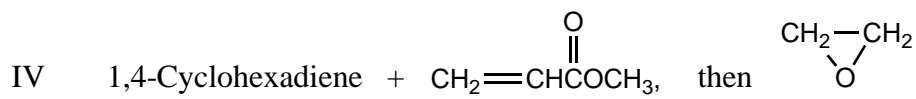
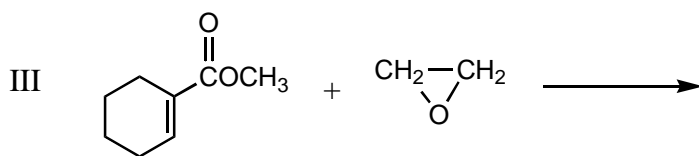
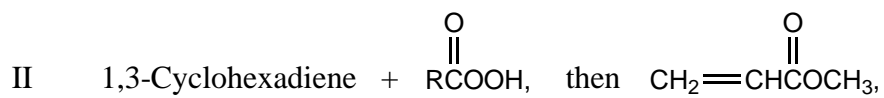
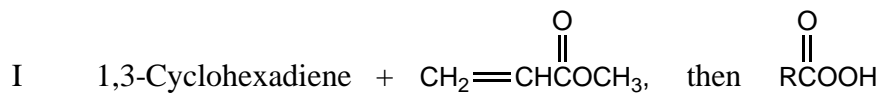
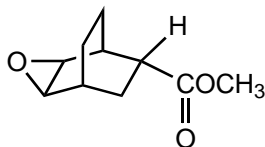
44. What would be the product of the following reaction?



- A) I
 B) II
 C) III
 D) IV
 E) All of these
 Ans: C

Topic: Diels-Alder Reaction

45. How would you synthesize:

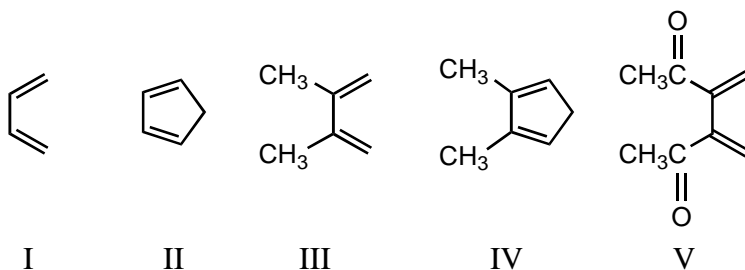


- A) I
B) II
C) III
D) IV
E) V

Ans: A

Topic: Diels-Alder Reaction

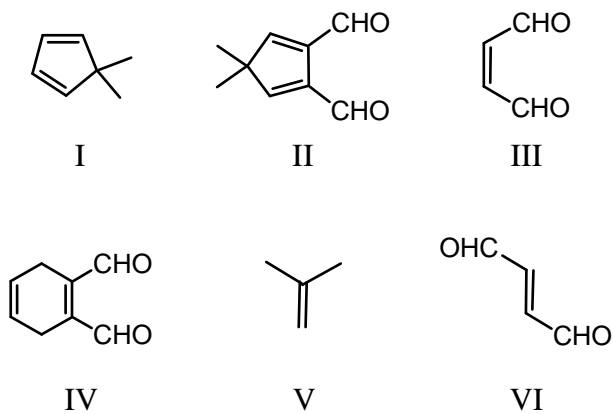
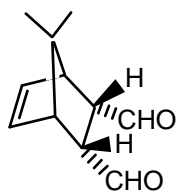
47. Which diene would you expect to react most rapidly with maleic anhydride?



- A) I
B) II
C) III
D) IV
E) V

Ans: D

51. Which diene and dienophile would you choose to synthesize the following compound?

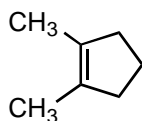
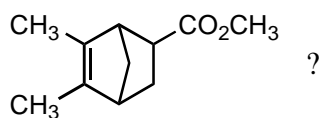


- A) I and VI
B) II and V
C) III and IV
D) IV and V
E) I and III

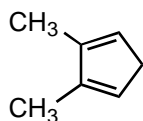
Ans: E

Topic: Diels-Alder Reaction

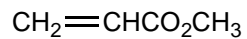
52. Which compounds could be used in a Diels-Alder synthesis of



I



II



III



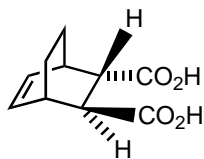
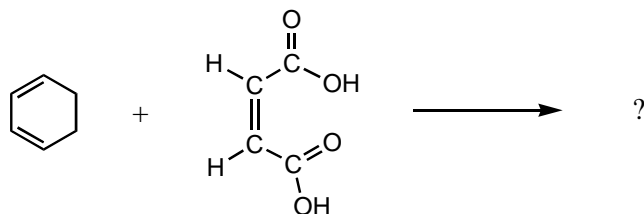
IV

- A) I and III
 B) I and IV
 C) II and III
 D) II and IV

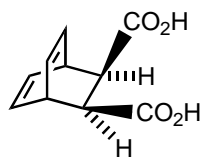
Ans: C

Topic: Diels-Alder Reaction

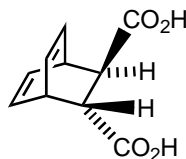
53. Which is the major product of the following reaction?



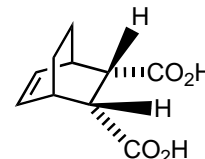
I



II



III



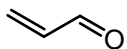
IV

- A) I
 B) II
 C) III
 D) IV
 E) None of these

Ans: D

Topic: Diels-Alder Reaction

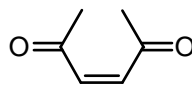
59. From the standpoint of reactivity, which is the poorest choice of dienophile to react with 2,3-dimethyl-1,3-butadiene in a Diels-Alder reaction?



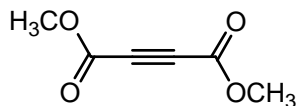
I



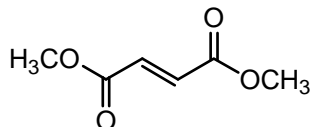
II



III



IV



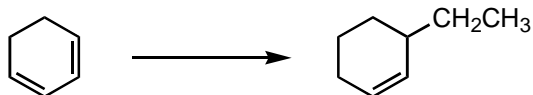
V

- A) I
- B) II
- C) III
- D) IV
- E) V

Ans: B

Topic: Multi-step Synthesis

64. How could the following synthesis be carried out?

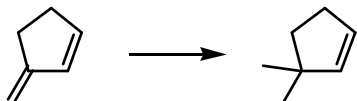


- A) (1) Br_2/CCl_4 ; (2) $\text{CH}_3\text{CH}_2\text{MgCl}$, ether; (3) $\text{CH}_3\text{ONa}/\text{CH}_3\text{OH}$
- B) (1) HBr , 80°C ; (2) $(\text{CH}_3\text{CH}_2)_2\text{CuLi}$, ether
- C) (1) HBr , 80°C ; (2) Mg , ether; (3) $\text{CH}_3\text{CH}_2\text{OH}$, then H_3O^+
- D) More than one of the above
- E) All of the above

Ans: B

Topic: Multi-step Reaction Sequence

65. How could the following synthesis be carried out?



- A) (1) Br_2/CCl_4 ; (2) CH_3MgCl , ether; (3) $\text{CH}_3\text{ONa}/\text{CH}_3\text{OH}$
 B) (1) HBr (1 eq); (2) $(\text{CH}_3)_2\text{CuLi}$, ether
 C) (1) HBr (1 eq); (2) Li , ether; (3) CuI ; (4) CH_3Br
 D) More than one of the above
 E) All of the above

Ans: C

Topic: Synthesis of Allylic Halides

68. Which of the following could be used to synthesize 3-bromopropene?

- A) $\text{CH}_3\text{CH}=\text{CH}_2 + \text{Br}_2 \xrightarrow[\text{CCl}_4]{25^\circ\text{C}}$
 B) $\text{CH}_3\text{CH}=\text{CH}_2 + \text{N-bromosuccinimide} \xrightarrow[\text{CCl}_4]{\text{ROOR}}$
 C) $\text{CH}_2=\text{CHCH}_2\text{OH} + \text{PBr}_3 \longrightarrow$
 D) More than one of these
 E) None of these

Ans: D

Topic: Synthesis of Allylic Halides

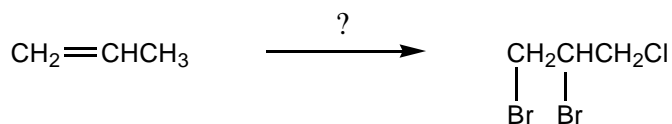
71. Treatment of 4-methylcyclohexene with N-bromosuccinimide in CCl_4 would yield mainly:

- A) I
 B) II
 C) III
 D) IV
 E) All of the above

Ans: E

Topic: Multistep Reactions

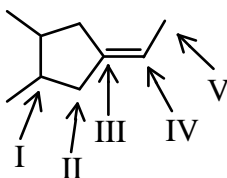
72. Which would be the best synthesis?



- A) Propene $\xrightarrow{\text{Br}_2, \text{CCl}_4}$ $\xrightarrow{\text{Cl}_2, \text{h}\nu}$
- B) Propene $\xrightarrow{\text{Cl}_2, 400^\circ\text{C}}$ $\xrightarrow{\text{Br}_2, \text{CCl}_4}$
- C) Propene $\xrightarrow{\text{HCl}}$ $\xrightarrow{\text{Br}_2, \text{h}\nu}$
- D) Propene $\xrightarrow{\text{NBS}, \text{CCl}_4}$ $\xrightarrow{\text{Cl}_2, \text{CCl}_4}$
- E) Propene $\xrightarrow{\text{Cl}_2, \text{CCl}_4}$ $\xrightarrow{\text{NBS}, \text{CCl}_4}$
- Ans: B

Topic: Allylic Halogenation

77. Which carbon is predicted to be the major site of substitution when this alkene reacts with NBS?



- A) I
- B) II
- C) III
- D) IV
- E) V
- Ans: B

Topic: Conjugate Addition Reactions

80. Which is the only compound which can be completely ruled out as a product of the reaction of 1,3-butadiene with HCl?
- A) (S)-3-chloro-1-butene
 - B) (R)-3-chloro-1-butene
 - C) (E)-1-chloro-2-butene
 - D) (Z)-1-chloro-2-butene
 - E) (Z)-2-chloro-2-butene
- Ans: E

Topic: Allylic Halogenation

82. An unsaturated product results from the reaction of cyclohexene with which of these?
- A) Br_2/CCl_4 at 25°C
 - B) NBS/ CCl_4 , ROOR
 - C) HCl, ROOR
 - D) HCl, no peroxides
 - E) More than one of these
- Ans: B

Topic: 1,2 Reactions of Conjugated Dienes

87. Which reagent would convert 1,3-pentadiene into 3-penten-2-ol?
- A) $\text{KMnO}_4/\text{OH}^-$
 - B) OsO_4
 - C) H_2O_2 , then H_3O^+
 - D) $\text{Cl}_2/\text{H}_2\text{O}$
 - E) H_3O^+
- Ans: E