

IB Chemistry HL - R3.3

Electron sharing reactions

Exercises + Practice questions

Official answers appended at the end

Exercise

Q1. Which of the following species is a radical?

A F

B Cl^-

C Ne

D Li^+

Q2. Which of the following molecules is a radical?

A CO_2

B NO_2

C CH_4

D NH_3

Q3. Which of the following ions is a radical?

A Cl^-

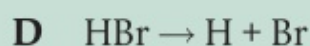
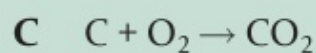
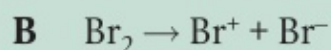
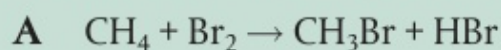
B NO_3^-

C Mg^{2+}

D CH_4^+

Exercise

Q4. Which of the following reactions involves homolytic fission?



Q5. The homolytic fission of a Cl–Cl bond:

A is exothermic

B forms two ions

C always requires heat

D is endothermic

Q6. Use curly arrows to illustrate the homolytic fission of the covalent bond in iodine, I_2 .

Q7. Explain the difference between homolytic fission that occurs thermolytically or photolytically.

Exercise

- Q8.** What are the three stages of a radical mechanism? Use the reaction of methane, CH_4 , with bromine, Br_2 , to explain your answer, giving relevant equations for each stage.
- Q9.** Alkanes react with halogens in the presence of UV light to form halogenoalkanes.
- (a) Write equations showing the possible steps leading to the formation of bromoethane, $\text{C}_2\text{H}_5\text{Br}$, when bromine, Br_2 , and ethane, C_2H_6 , react together in UV light.
 - (b) Explain, using equations, how this reaction also leads to the formation of trace amounts of butane, C_4H_{10} .
 - (c) If the reaction is allowed to proceed for a sufficient length of time, large amounts of dibromoethane products can be formed. Draw and name the structures of possible dibromoethane products in this reaction.
- Q10.** State and explain what would be observed during the following experiments carried out at room temperature.
- (a) Bromine water is added to hexane in a test tube exposed to UV light.
 - (b) Bromine water is added to hexane in a test tube that is covered in foil.
- Q11.** Chlorofluorocarbons (CFCs) such as trichlorofluoromethane, CFCl_3 , are ozone-depleting substances.
- (a) Explain, using curly arrows, how trichlorofluoromethane reacts with UV light to produce chlorine radicals.
 - (b) Provide chemical equations showing how chlorine radicals catalyse the decomposition of ozone, O_3 .

Practice questions

- Which reaction occurs via a radical mechanism?
 - $\text{C}_2\text{H}_6 + \text{Br}_2 \rightarrow \text{C}_2\text{H}_5\text{Br} + \text{HBr}$
 - $\text{C}_2\text{H}_4 + \text{Br}_2 \rightarrow \text{C}_2\text{H}_4\text{Br}_2$
 - $\text{C}_4\text{H}_9\text{I} + \text{OH}^- \rightarrow \text{C}_4\text{H}_9\text{OH} + \text{I}^-$
 - $(\text{CH}_3)_3\text{CI} + \text{H}_2\text{O} \rightarrow (\text{CH}_3)_3\text{COH} + \text{HI}$
- Which statement is true about radical mechanisms?
 - Radical mechanisms involve four stages.
 - Radicals form spontaneously in the initiation stage.
 - Radicals react with non-radical species in the termination stage.
 - Radicals react with other radicals in the termination stage.
- Under the correct conditions, pentane reacts with bromine to form a number of different products. The reaction can be represented by the equation

$$\text{C}_5\text{H}_{12} + \text{Br}_2 \rightarrow \text{C}_5\text{H}_{11}\text{Br} + \text{Y}$$
 - Identify the product Y. (1)
 - State the essential condition for this reaction. (1)
 - The reaction takes place through a stepwise mechanism with three stages. Give the names of these stages along with one equation for each stage. (3)
 - The reaction can form three different products with the formula $\text{C}_5\text{H}_{11}\text{Br}$.
 - State the relationship between these products. (1)
 - Draw and name the structures of the three products. (3)

(Total 9 marks)
- Propane, C_3H_8 , reacts with chlorine, Cl_2 , in the presence of UV light.
 - State the type of reaction that occurs. (1)
 - Give equations to explain how this reaction occurs through a stepwise mechanism. (3)
 - Draw and name two possible monosubstituted products of the reaction. (2)
 - Explain why propane is regarded as kinetically stable but thermodynamically unstable. (2)

(Total 8 marks)
- Explain, using equations, how ethane can be converted to chloroethane. (4)
 - Identify a possible alkane, other than ethane, that can be found in the product mixture. Give an equation that explains the formation of this alkane. (2)

(Total 6 marks)

R3.3 - Official Answers

Pearson answer pages from the back of the textbook