

Radical and nucleophilic substitution reactions

Chemistry grades 11-12 (A Level · IB · Class 11-12) · Test

Name: _____ Date: _____ Class: _____ Mark: ____ / 20

This test checks the mechanisms, reagents and rates of halogenoalkane reactions. Answer all questions, give state symbols and curly arrows where relevant, and show calculations. You have 45 minutes and 20 marks are available.

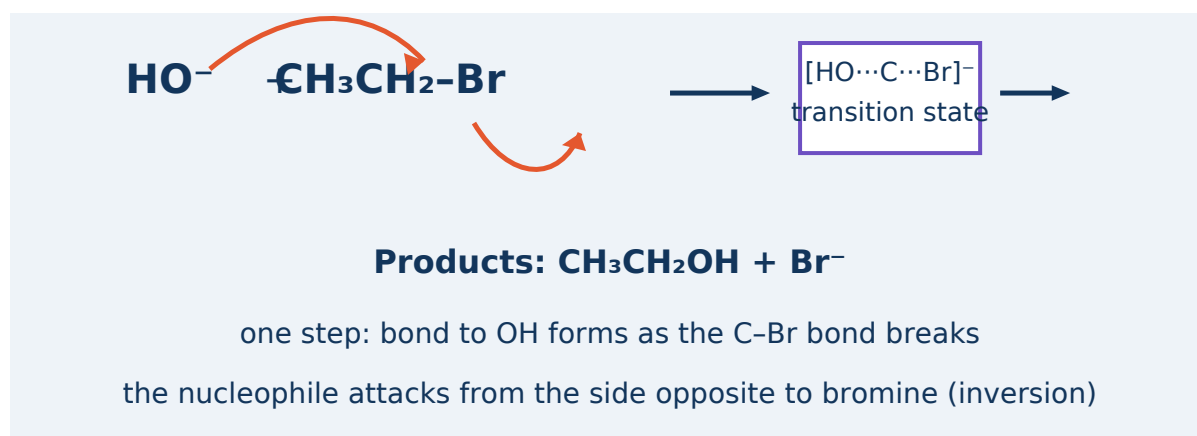
Level: Chemistry grades 11-12 (A Level · IB · Class 11-12) · **Curriculum:** IB R3.4

Time: 45 minutes · 8 questions · Total: 20 marks · Calculator allowed

Question 1 Radical substitution (3 marks)

- Write the equation for the initiation step in the reaction of chlorine with methane. (1 mark)
- Write the two propagation steps. (2 marks)
- Write one termination step. (1 mark)

Question 2 Mechanism (3 marks)



A mechanism for hydrolysis of bromoethane.

- Name the mechanism shown. (1 mark)
- State what the first curly arrow represents. (1 mark)
- State what happens to the configuration at a chiral carbon. (1 mark)

Question 3 Classify (1 mark)

- a. Classify 2-bromo-2-methylpropane as primary, secondary or tertiary. (1 mark)

Question 4 Comparing rates (3 marks)

- a. Place 1-chlorobutane, 1-bromobutane and 1-iodobutane in order of hydrolysis rate, fastest first. (1 mark)
- b. Explain the order using bond enthalpy. (2 marks)

Question 5 Reagents (2 marks)

- a. State the reagent and conditions to convert bromoethane to propanenitrile. (2 marks)

Question 6 Percentage yield (3 marks)

- a. 6.00 g of 1-chlorobutane ($M_r = 92.5$) gives 3.10 g of butan-1-ol ($M_r = 74.0$) on hydrolysis. Calculate the percentage yield. (3 marks)

Question 7 SN1 or SN2 (3 marks)

- a. 2-bromo-2-methylpropane reacts by SN1. Write its rate equation. (1 mark)
- b. Explain why the rate does not depend on $[\text{OH}^-]$. (2 marks)

Question 8 Ozone layer (2 marks)

- a. Write the two steps showing how $\text{Cl}\cdot$ acts as a catalyst in ozone destruction. (2 marks)