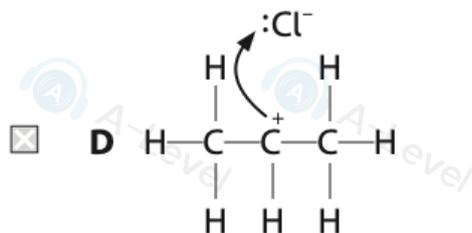
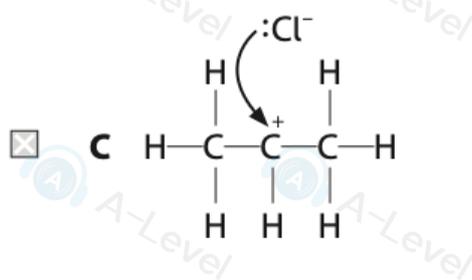
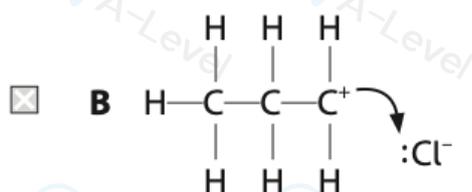
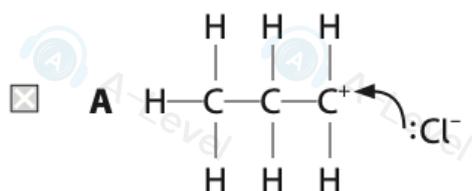


10 Propene,  $\text{CH}_3\text{CH}=\text{CH}_2$ , reacts with hydrogen chloride,  $\text{HCl}$ , to form halogenoalkanes.

(a) Which of these steps is most likely to occur in the reaction?



(1)

(b) The reaction of propene with hydrogen chloride is an example of

(1)

- A** free radical substitution
- B** free radical addition
- C** electrophilic substitution
- D** electrophilic addition

(Total for Question 10 = 2 marks)

19 Why does free radical substitution have limited use in industrial chemistry?

- A the reactions only occur in the upper atmosphere
- B initiation requires ultraviolet radiation
- C further substitution products are formed
- D termination reactions produce unwanted products

(Total for Question 19 = 1 mark)

18 Which is **not** a step in the reaction of chlorine with propane in ultraviolet radiation?

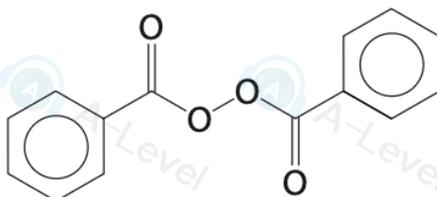
- A  $C_3H_7\cdot + Cl\cdot \rightarrow C_3H_7Cl$
- B  $C_3H_7\cdot + C_3H_7\cdot \rightarrow C_6H_{14}$
- C  $C_3H_7\cdot + Cl_2 \rightarrow C_3H_7Cl + Cl\cdot$
- D  $C_3H_7\cdot + HCl \rightarrow C_3H_7Cl + H\cdot$

(Total for Question 18 = 1 mark)

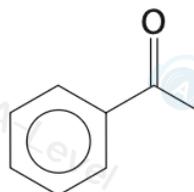
14 Polymerisation of alkenes occurs via a free radical mechanism.

This reaction is started by the addition of small amounts of another compound.

The structure of one of these compounds is shown.



This can be represented as R—O—O—R where R— is



Which step in the mechanism is an initiation step?

- A  $R-O-O-R \rightarrow 2R-O\cdot$
- B  $R-O-CH_2-CH_2\cdot + CH_2=CH_2 \rightarrow R-O-CH_2-CH_2-CH_2-CH_2\cdot$
- C  $2R-O-CH_2-CH_2\cdot \rightarrow R-O-CH_2-CH_2-CH_2-CH_2-O-R$
- D  $R-O\cdot + CH_2=CH_2 \rightarrow R-O-CH_2-CH_2\cdot$

(Total for Question 14 = 1 mark)

15 The reaction of methane with chlorine is a free radical substitution.

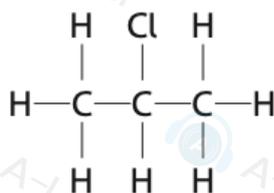
Which termination step does **not** occur?



(Total for Question 15 = 1 mark)

---

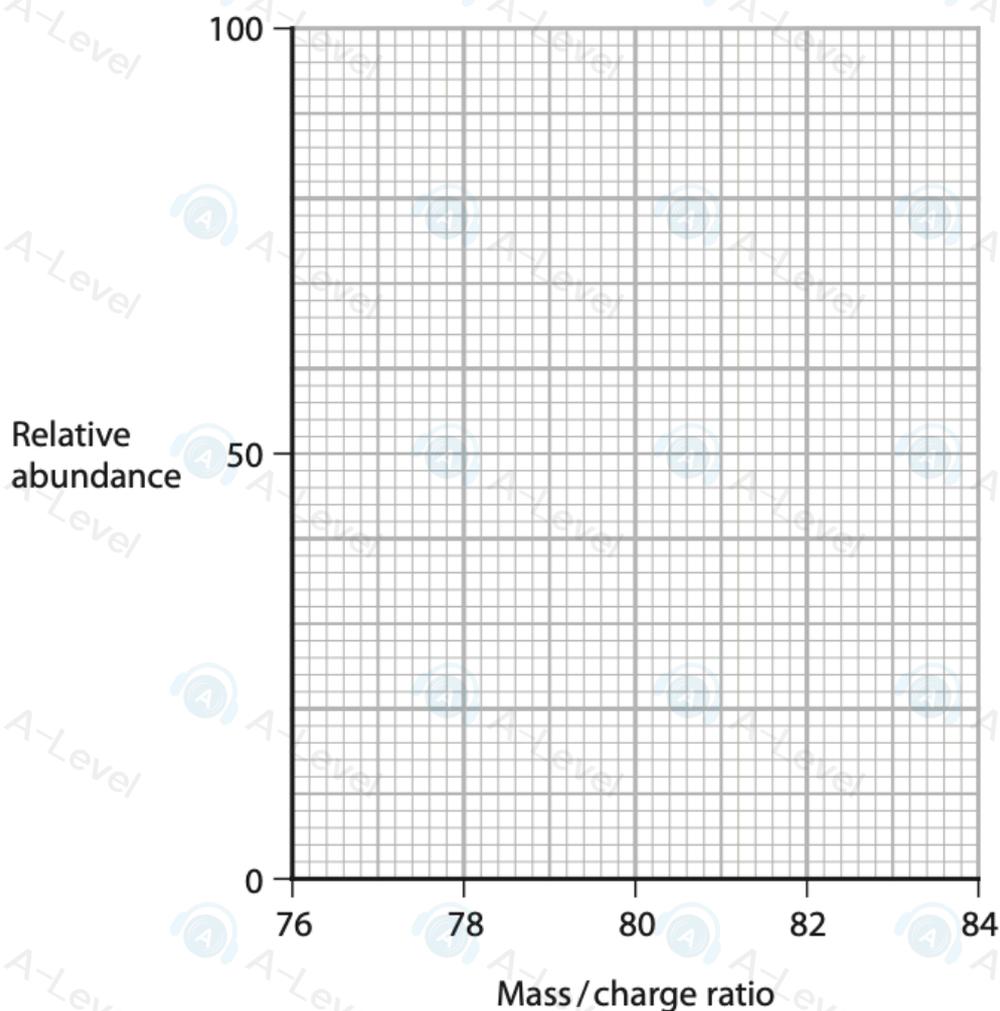
19 This question is about 2-Chloropropane.



- (a) 2-Chloropropane has a relative molecular mass of  $78.5 \text{ g mol}^{-1}$ .  
Chlorine has two common isotopes,  $^{35}\text{Cl}$  and  $^{37}\text{Cl}$ .  
There are three times more  $^{35}\text{Cl}$  atoms than  $^{37}\text{Cl}$  atoms.  
The main isotope of hydrogen is  $^1\text{H}$  and that of carbon is  $^{12}\text{C}$ .  
The diagram shows a mass spectrum grid.

Draw the peaks for the molecular ions of 2-Chloropropane resulting from these isotopes.

(2)



(b) 2-Chloropropane can be produced by reacting propane with chlorine in a homolytic free radical reaction.



(i) Show the initiation step of this reaction.  
Include appropriate arrows and the conditions necessary for this step.

(2)

(ii) Using your answer to (b)(i), state what is meant by the terms homolytic and free radical.

(2)

homolytic

free radical

(iii) Suggest why this method has limited use in the synthesis of organic compounds.

(1)

**22:** This question is about alkanes and halogens.

Alkanes can react with halogens to form halogenoalkanes.

(a) Name the type and mechanism for the reaction between halogens and alkanes.

(1)

(b) Chlorine reacts with butane.

(i) Give the equation for the initiation step.

Include appropriate arrows and electrons.

(2)

(ii) Give an equation for each of the first two propagation steps.

(2)

First propagation step

Second propagation step

(iii) Give the equation for the termination step to form an alkane.

(1)