

Arrange the mechanism steps in order:

### Radical Chlorination of Methane

|                                                      |                                                                                                                                                                            |                                                                                                                           |
|------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------|
| Reaction                                             | $\text{CH}_4 + \text{Cl}_2 \xrightarrow[\text{or light}]{\text{heat}} \text{CH}_3\text{Cl} + \text{HCl}$                                                                   |                                                                                                                           |
| Steps                                                | Mechanism: Free radical substitution reaction                                                                                                                              |                                                                                                                           |
| Chain Initiation<br>Step 1:<br>Halogen dissociation  |                                                                                                                                                                            |                                                                                                                           |
|                                                      | Under the influence of heat or light a molecule of chlorine dissociates; each atom takes one of the bonding electrons                                                      | This step produces two highly reactive chlorine atoms.                                                                    |
| Chain Propagation<br>Step 2:<br>Hydrogen abstraction |                                                                                                                                                                            |                                                                                                                           |
|                                                      | A chlorine atom abstracts a hydrogen atom from a methane molecule                                                                                                          | This step produces a molecule of hydrogen chloride and a methyl radical                                                   |
| Step 3:<br>Halogen abstraction                       |                                                                                                                                                                            |                                                                                                                           |
|                                                      | A methyl radical abstracts a chlorine atom from a chlorine molecule                                                                                                        | This step produces a molecule of chloromethane and a chlorine atom. The chlorine atom can now cause repetition of step 2. |
| Chain Termination                                    |                                                                                                                                                                            |                                                                                                                           |
|                                                      | Coupling of any two radicals depletes the supply of reactive intermediates and terminates the chain. Several pairings are possible for radical coupling termination steps. |                                                                                                                           |

