Organic reactions: classify the change

Student activity • observation and reasoning

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The question

What changes in addition, substitution and combustion?

Track atoms and bonds in three written reaction models. Classify each by the structural change rather than by memorising a reagent name.

Equipment

• Booklet, pencil, periodic table and optional molecular model kit

Desk activity only; keep small model pieces away from mouths.

Course coverage: Shared core: 4.6 with supporting alkane/alkene examples. No reaction mechanisms required.

Plan, model or apparatus sketch

Draw a labelled structure or model to explain your reasoning for this lesson.

Method and reasoning

Read the whole sequence before starting

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1. Model $CH_4 + Cl_2 \rightarrow CH_3Cl + HCl$ under ultraviolet light. Track which methane atom is replaced and where it goes.

2. Model $CH_2{=}CH_2 + Br_2 \rightarrow CH_2BrCH_2Br$. Track the C=C bond and both bromine atoms.

3. Balance complete combustion of ethane to carbon dioxide and water. Distinguish this from the other two transformations.

4. Count C, H and halogen atoms on both sides of each model; correct coefficients without changing species.

5. Match each process to substitution, addition or combustion and justify the classification with connectivity.

6. Explain why these paper equations do not authorise handling chlorine, bromine or flammable hydrocarbons.

Cleanup

- Return shared equipment and retain corrected reasoning.

Record your evidence

Blank spaces are for your own work

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Reference and task data

Written examples only: methane + chlorine (UV, monosubstitution); ethene + bromine (addition across C=C); ethane + oxygen (complete combustion). Addition can replace a double bond with a single bond while atoms join the molecule. Substitution replaces an atom/group. No radicals, mechanisms or experimental measurements are required.

Task	My structure / working	Reason / correction
Methane + chlorine		
Ethene + bromine		
Ethane combustion		

Show your calculations, labelled model or correction here.

Explain and evaluate

Use evidence and show calculation steps where relevant

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1. Classify methane reacting with chlorine under UV and identify both products.

2. Classify ethene + Br_2 and name the product.

3. Balance complete combustion of ethane.

4. What happens to the C=C bond in bromine addition?

5. Explain why HCl is needed in the methane substitution equation.

6. Does the presence of oxygen alone classify a reaction as combustion?