

Option C.4 Solar energy

Understandings:

- Light can be absorbed by chlorophyll and other pigments with a conjugated electronic structure.
- Photosynthesis converts light energy into chemical energy:
$$6\text{CO}_2 + 6\text{H}_2\text{O} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2$$
- Fermentation of glucose produces ethanol which can be used as a biofuel:
$$\text{C}_6\text{H}_{12}\text{O}_6 \rightarrow 2\text{C}_2\text{H}_5\text{OH} + 2\text{CO}_2$$
- Energy content of vegetable oils is similar to that of diesel fuel but they are not used in internal combustion engines as they are too viscous.
- Transesterification between an ester and an alcohol with a strong acid or base catalyst produces a different ester:
$$\text{RCOOR}^1 + \text{R}^2\text{OH} \rightarrow \text{RCOOR}^2 + \text{R}^1\text{OH}$$
- In the transesterification process, involving a reaction with an alcohol in the presence of a strong acid or base, the triglyceride vegetable oils are converted to a mixture mainly comprising of alkyl esters and glycerol, but with some fatty acids.
- Transesterification with ethanol or methanol produces oils with lower viscosity that can be used in diesel engines.

Applications and skills:

- Identification of features of the molecules that allow them to absorb visible light.
- Explanation of the reduced viscosity of esters produced with methanol and ethanol.
- Evaluation of the advantages and disadvantages of the use of biofuels.
- Deduction of equations for transesterification reactions.