

C.4 Solar Energy

From page 678 of your IB textbook:

Questions

- 1 Write the equation for photosynthesis.
- 2 Explain why ethanol-based fuels are said to have a lower carbon footprint than petroleum-based fuels, even though they both release similar amounts of carbon dioxide on combustion.
- 3 Outline the reagents and conditions necessary to convert a vegetable oil to a usable fuel for a vehicle such as a car.
- 4 Explain why the transesterification process is necessary in producing biodiesel. Describe the disadvantages of using vegetable oils as fuels without processing them.
- 5 Outline what is meant by a system of conjugated double bonds.
- 6 Identify from section 35 of the *Data booklet* which of vitamins A, C, or D is most likely to appear as a coloured compound. Explain your answer.
- 7 Write an equation for the fermentation of glucose.
- 8 Write the general equation for transesterification.
- 9 Deduce the number of molecules of ester and glycerol produced per molecule of a triglyceride undergoing transesterification.
- 10 Discuss the advantages and disadvantages of the use of biofuels commercially.

(answers on back)

Answers:

1. $6\text{CO}_2 + 6\text{H}_2\text{O} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2$
2. ethanol produced from fermentation by plants which absorb CO_2 in growing
3. in transesterification, a methyl ester is typically produced to be used as the biodiesel; a vegetable oil is heated with methanol to produce the methyl ester, or heated with ethanol to produce the ethyl ester; in both cases they need to be heated with a catalyst, such as sodium or potassium hydroxide; vegetable oil is a triglyceride, so three of the methyl or ethyl esters are produced as well as glycerol;
4. vegetable oils can produce similar energy when burned but because they are so viscous, they are unable to flow easily and can clog fuel injectors; high viscosity implies large intermolecular forces; this means these oils do not readily vaporize and often undergo incomplete combustion which further damages engines; this problem is overcome by converting them to a more viscous form with fewer IMF; a triglyceride is converted to an ester and glycerol; this is a transesterification process;
5. an extended system of alternating single and multiple bonds
6. vitamin A as it has the highest degree of conjugation
7. $\text{C}_6\text{H}_{12}\text{O}_6 \rightarrow 2\text{C}_2\text{H}_5\text{OH} + 2\text{CO}_2$
8. $\text{RCOOR}' + \text{R}''\text{OH} \rightarrow \text{RCOOR}'' + \text{R}'\text{OH}$
9. 3 molecules of ester and glycerol per molecule of triglyceride
10. see chart on page 677