

1. This question is about sherbet lemons

Sherbet lemons are sweets which consist of a flavoured sugar shell filled with sherbet.

The sherbet contains sodium hydrogencarbonate and tartaric acid (2,3-dihydroxybutanedioic acid).



- (a) Assuming all the sugar present is sucrose, $C_{12}H_{22}O_{11}$, write an equation for the complete combustion of the sugar.
- (b) The standard enthalpy change of combustion of sucrose is $-5644 \text{ kJ mol}^{-1}$. Calculate the energy released when one sweet containing 6.70 g of sucrose is completely burnt.
- (c) A man needs to consume about 2500 dietary calories per day. Given that $1 \text{ kJ} \equiv 0.239$ dietary calories, how many sweets must a man consume in order to meet his daily calorific requirement?

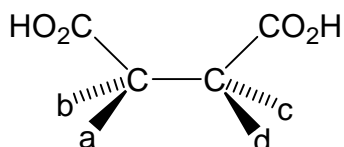
Sherbet produces a slight fizzing sensation in the mouth when the tartaric acid reacts with the sodium hydrogencarbonate to make carbon dioxide. In a laboratory experiment, one sherbet lemon sweet produced 6.00 cm^3 of carbon dioxide.

- (d) Calculate the minimum masses of tartaric acid and sodium hydrogencarbonate necessary to produce this volume of carbon dioxide.

[Assume 1 mol of any gas occupies 24.0 dm^3 at r.t.p.]

A carbon atom bonded to four different groups is called a chiral centre or an asymmetric carbon atom. A molecule which contains just one chiral centre exists as two stereoisomers (isomers containing the same groups attached to the same atoms). These stereoisomers are non-superimposable mirror images of each other called *enantiomers*. If a molecule contains more than one chiral centre, the number of stereoisomers increases and some of the stereoisomers may be superimposable on their mirror images.

- (e) By making the appropriate substitutions for **a**, **b**, **c**, and **d** in the structure shown below, draw all the different stereoisomers of tartaric acid, indicating clearly which (if any) are enantiomers.



- (f) Citric acid is used to flavour sherbet lemons. Its formula may be written $\text{HOOCCH}_2\text{C}(\text{OH})(\text{COOH})\text{CH}_2\text{COOH}$. How many asymmetric carbon atoms does this molecule contain?