

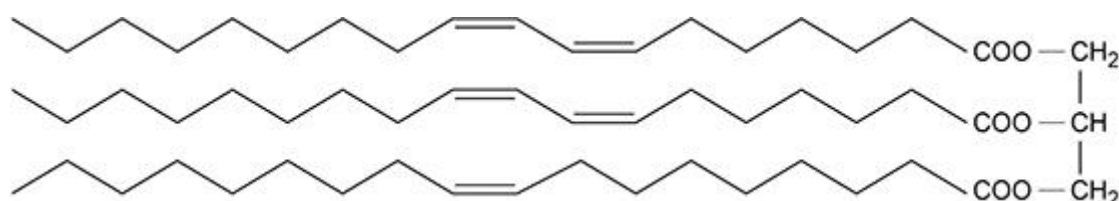
Name of the Student: _____

Max. Marks : 18 Marks

Time : 18 Minutes

Q1.

This question is about olive oil.

A sample of olive oil is mainly the unsaturated fat **Y** mixed with a small amount of inert impurity.The structure of **Y** in the olive oil is shown.**Y** has the molecular formula $C_{57}H_{100}O_6$ ($M_r = 880$).The amount of **Y** is found by measuring how much bromine water is decolourised by a sample of oil, using this method.

- Transfer a weighed sample of oil to a 250 cm^3 volumetric flask and make up to the mark with an inert organic solvent.
- Titrate 25.0 cm^3 samples of the olive oil solution with $0.025\text{ mol dm}^{-3}\text{ Br}_2(\text{aq})$.

(a) A suitable target titre for the titration is 30.0 cm^3 of $0.025\text{ mol dm}^{-3}\text{ Br}_2(\text{aq})$.Justify why a much smaller target titre would **not** be appropriate.

Calculate the amount, in moles, of bromine in the target titre.

Justification _____

Amount of bromine _____ mol

(2)

- (b) Calculate a suitable mass of olive oil to transfer to the volumetric flask using your answer to part (a) and the structure of **Y**.
Assume that the olive oil contains 85% of **Y** by mass.

(If you were unable to calculate the amount of bromine in the target titre, you should assume it is 6.25×10^{-4} mol. This is **not** the correct amount.)

Mass of olive oil _____ g

(5)

The olive oil solution can be prepared using this method.

- Place a weighing bottle on a balance and record the mass, in g, to 2 decimal places.
- Add olive oil to the weighing bottle until a suitable mass has been added.
- Record the mass of the weighing bottle and olive oil.
- Pour the olive oil into a 250 cm^3 volumetric flask.
- Add organic solvent to the volumetric flask until it is made up to the mark.
- Place a stopper in the flask and invert the flask several times.

- (c) Suggest an extra step to ensure that the mass of olive oil in the solution is recorded accurately.

Justify your suggestion.

Extra step _____

Justification _____

(2)

- (d) State the reason for inverting the flask several times.

(1)

- (e) A sample of the olive oil was dissolved in methanol and placed in a mass spectrometer. The sample was ionised using electrospray ionisation. Each molecule gained a hydrogen ion (H^+) during ionisation.

The spectrum showed a peak for an ion with $\frac{m}{z} = 345$ formed from an impurity in the olive oil. The ion with $\frac{m}{z} = 345$ was formed from a compound with the empirical formula $\text{C}_5\text{H}_{10}\text{O}$

Deduce the molecular formula of this compound.

Show your working.

Molecular formula _____

(2)

(Total 12 marks)

Q2.

Tschermigite is a hydrated, water-soluble mineral, with relative formula mass of 453.2

The formula of tschermigite can be represented as $M.xH_2O$, where M represents all the ions present.

The table below shows its composition by mass.

Element	% by mass
N	3.09
H	6.18
Al	5.96
S	14.16
O	70.61

In an analysis, it is found that the mineral contains the ions NH_4^+ , Al^{3+} and SO_4^{2-} .

Calculate the empirical formula of tschermigite and the value of x in $M \cdot xH_2O$

Describe the tests, with their results, including ionic equations, that would confirm the identities of the ions present.

[illegible]

(Total 6 marks)