InkChemistry

QUESTION WORKBOOK

# Time-of-flight mass spectrometry and relative atomic mass

Atomic structure · Unit C01

AQA 3.1.1.2 · OCR A 2.1.1

14 questions · 46 marks

NAVY SCREEN EDITION

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## SECTION B · Standard, 3 to 5 marks

**B1** TFM-Q1

State, in order, the four stages of a time-of-flight mass spectrometer, and explain why the instrument is kept under a high vacuum. [4]

**B2** TFM-Q10

Calculate the flight time of a $^{24}Mg^{+}$ ion in a spectrometer that gives every ion $2.00 \times 10^{-16}$ J of kinetic energy and has a flight tube 1.50 m long. $L = 6.022 \times 10^{23}$ $mol^{-1}$. [4]

**B3** TFM-Q16

Compare electron impact ionisation with electrospray ionisation. [4]

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**B4** TFM-Q19 Calculate the number of carbon atoms in one molecule of a compound whose mass spectrum has a molecular ion peak of relative height 62.0 and an M+1 peak of relative height 3.41, and explain why the M+1 peak exists. [4]

**B5** TFM-Q2 Describe how a sample of krypton is ionised by electron impact, and give an equation for the ionisation. [3]

**B6** TFM-Q3 Describe how a sample is ionised by electrospray ionisation, and give the equation for the ionisation of a molecule X. [3]

**B7** TFM-Q4 Explain why all the 1+ ions leave the acceleration stage with the same kinetic energy but reach the detector at different times. [3]

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**B8** TFM-Q5 Explain how the detector of a time-of-flight mass spectrometer produces a signal that measures the abundance of each ion. [3]

**B9** TFM-Q9 Calculate the percentage abundance of boron-10 in boron, given that Ar of boron is 10.8 and its only isotopes are boron-10 and boron-11. [3]

**B10** TFM-Q11 Calculate the flight time of an $^{81}Br^{+}$ ion in a spectrometer in which a $^{79}Br^{+}$ ion takes $1.54 \times 10^{-5}$ s, all ions having the same kinetic energy. [3]

**B11** TFM-Q14 Suggest the relative molecular mass of a protein whose largest peak in an electrospray spectrum is at m/z = 14306, and suggest why electrospray is used for it rather than electron impact. [3]

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**B12** TFM-Q15 Suggest why the mass spectrum of sulfur shows a small peak at m/z = 16, although no isotope of sulfur has a mass number of 16. [3]

**B13** TFM-Q17 Evaluate the statement that the relative atomic mass of bromine, 79.9, is the mass of a bromine atom. [3]

**B14** TFM-Q21 Suggest which halogen is present in a halogenoalkane whose mass spectrum shows two molecular ion peaks of almost equal height, at m/z = 122 and 124, and suggest its molecular formula. [3]

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