

Atomic structure – A2 2022 Chemistry P1&P3

1. June/2022/Paper_7405/1/No.2

0 2

Rhenium has an atomic number of 75

0 2 . 1

Define the term relative atomic mass.

[2 marks]

0 2 . 2

The relative atomic mass of a sample of rhenium is 186.3

Table 2 shows information about the two isotopes of rhenium in this sample.**Table 2**

Relative isotopic mass	Relative abundance
185	10
To be calculated	17

Calculate the relative isotopic mass of the other rhenium isotope.

Show your working.

[2 marks]

Relative isotopic mass _____

0 2 . 3

State why the isotopes of rhenium have the same chemical properties.

[1 mark]

A sample of rhenium is ionised by electron impact in a time of flight (TOF) mass spectrometer.

0 2 . 4

A $^{185}\text{Re}^+$ ion with a kinetic energy of $1.153 \times 10^{-13} \text{ J}$ travels through a 1.450 m flight tube.

The kinetic energy of the ion is given by the equation $KE = \frac{1}{2}mv^2$

where

m = mass / kg

v = speed / m s^{-1}

KE = kinetic energy / J

Calculate the time, in seconds, for the ion to reach the detector.

The Avogadro constant, $L = 6.022 \times 10^{23} \text{ mol}^{-1}$

[5 marks]

Time _____ s

0 2 . 5

State how the relative abundance of $^{185}\text{Re}^+$ is determined in a TOF mass spectrometer.

[2 marks]

2. *June/2022/Paper_7405/3/No.2*

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

The formula of tschermigite can be represented as $\text{M} \cdot x\text{H}_2\text{O}$, where M represents all the ions present.

Table 4 shows its composition by mass.

Table 4

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 $\text{M} \cdot x\text{H}_2\text{O}$

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

[6 marks]

3. June/2022/Paper_7405/3/No.6

Which atom in the ground state contains at least one unpaired p electron?

[1 mark]

A Na

B Ne

C O

D Sc

4. June/2022/Paper_7405/3/No.8

Which substance has no delocalised electrons?

[1 mark]

A graphite

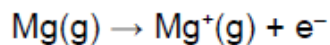
B methylbenzene

C poly(propene)

D sodium

5. June/2022/Paper_7405/3/No.16

Which ionisation needs less energy than this process?



[1 mark]

A $\text{Al(g)} \rightarrow \text{Al}^{\text{+}}(\text{g}) + \text{e}^{-}$

B $\text{Ar(g)} \rightarrow \text{Ar}^{\text{+}}(\text{g}) + \text{e}^{-}$

C $\text{Be(g)} \rightarrow \text{Be}^{\text{+}}(\text{g}) + \text{e}^{-}$

D $\text{Mg}^{\text{+}}(\text{g)} \rightarrow \text{Mg}^{\text{2+}}(\text{g}) + \text{e}^{-}$