

Atomic structure – AS Chemistry P1

1. No.3

0 3

This question is about structure and bonding.

0 3

1

Define electronegativity.

[1 mark]

It is the relative ability of an atom to attract electron density in a covalent bond.

0 3

2

Explain why the C-Cl bond is polar.

[2 marks]

Chlorine has a higher electronegativity than carbon. This means the shared electron pair is pulled closer to chlorine creating uneven distribution of electron density. Chlorine becomes δ^- and carbon δ^+ making the bond polar.

0 3

3

Although the C-Cl bond is polar, CCl_4 is a non-polar molecule.

Explain why.

[2 marks]

CCl_4 is a tetrahedral and symmetrical because the polar C-Cl bonds are arranged so that their dipole moments act in equal and opposite directions. As a result, the bond dipoles cancel out giving the molecule no overall dipole moment.

0 3 . 4

There are van der Waals forces between non-polar molecules.

Explain what causes these forces.

[3 marks]

In non polar molecule, the electrons are in constant random motion so at any instant the electron distribution may be uneven. This uneven distribution creates a temporary dipole in one molecule. This temporary dipole induces an opposite dipole in a neighbouring molecule. Electrostatic attraction occurs between the δ^+ of one molecule and the δ^- of another.

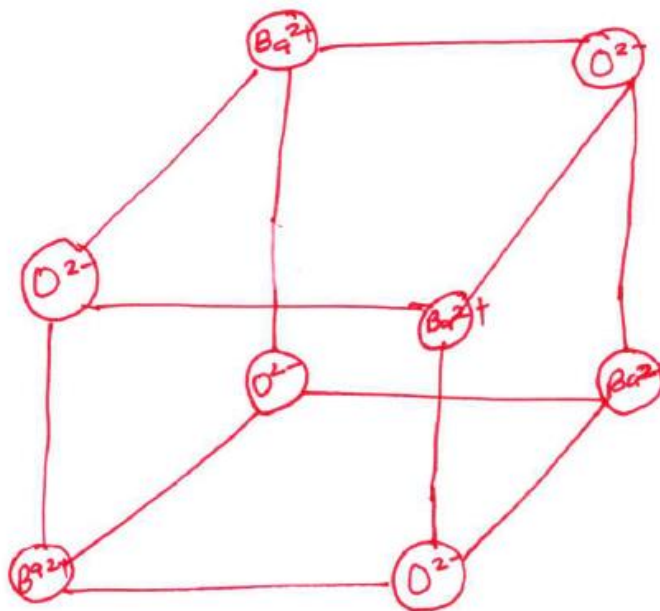
Barium reacts with oxygen to form barium oxide.

Barium oxide has a high melting point and an ionic lattice structure similar to that of sodium chloride.

0 3 . 5

Draw a 3D diagram to show how the particles are arranged in a barium oxide lattice. You should draw eight particles.

[2 marks]



2. No.6

0 6

This question is about atomic structure and mass spectrometry.

0 6 . 1

Give the **full** electron configuration for Br

[1 mark]

A sample of bromine (Br_2) is analysed in a mass spectrometer.

The sample is ionised using electron impact ionisation.

0 6 . 2

Give an equation, including state symbols, for the process that occurs during the ionisation of bromine.

[1 mark]

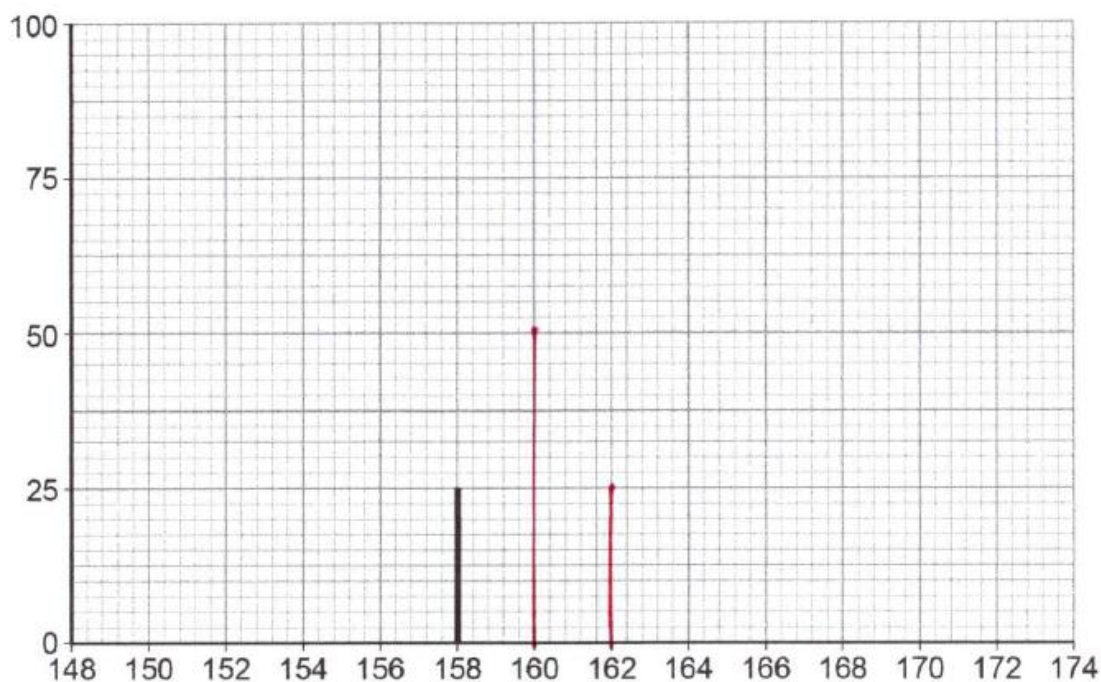


0 6 . 3

Bromine exists as two isotopes, ^{79}Br and ^{81}Br , which exist in equal abundance.

Figure 1 shows an incomplete mass spectrum for this sample of bromine.

Figure 1



Complete the spectrum by adding a label to each axis, and adding any further peaks you would expect to see.

[3 marks]

0 6 . 4

State how the detector enables the relative abundance of each ion to be determined.

[1 mark]

The relative abundance is proportional to size of the current.

3. No.20

Samples of four different substances are analysed using time of flight mass spectrometry.

$$TOF \propto \sqrt{\frac{m}{z}}$$

In each case, the samples are ionised to form ions with a single positive charge. The ions are accelerated to the same kinetic energy.

Which sample gives ions with the shortest time of flight?

[1 mark]

A A sample of ^{45}Sc that is ionised using electron impact ionisation.

☐

B A sample of C_3H_8 that is ionised using electrospray ionisation.

☐

C A sample of $\text{CH}_3\text{CH}_2\text{OH}$ that is ionised using electrospray ionisation.

☐

D A sample of CO_2 that is ionised using electron impact ionisation.

☒

$\text{M/z} = 45$ $^{45}\text{Sc}^+$ lower
 $3 \times 12 + 8 = 44$ $[\text{C}_3\text{H}_8 + \text{H}]^+ = 45$
 46 $\text{C}_2\text{H}_6\text{O}^+ 46 + 1 = 47$
 Heaviest ion.
 $\text{CO}_2^+ \rightarrow 44$ has lowest m/z and same charge so shortest TOF

4. June/2024/Paper_7404/1/No.21

Which isotope has 2 more protons and 3 more neutrons than an atom of ^{112}Cd ?

^{112}Cd proton = $112 - 48 = 64$ [1 mark]

A $^{115}_{48}\text{Cd}$

☐

$z = 48$

B $^{115}_{50}\text{Sn}$

☐

$z = 50$ neutron = 65. not 67

C $^{117}_{50}\text{Sn}$

☒

$z = 50$ neutron = 67

D $^{117}_{51}\text{Sb}$

☐

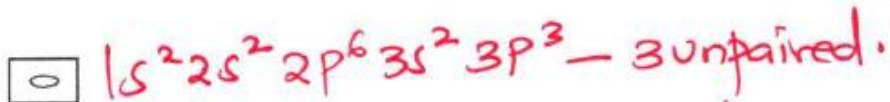
$z = 51$ neutron 66. not 67

5. No.24

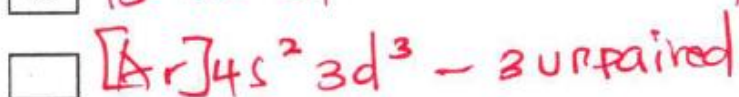
Which atom has the greatest number of unpaired electrons?

[1 mark]

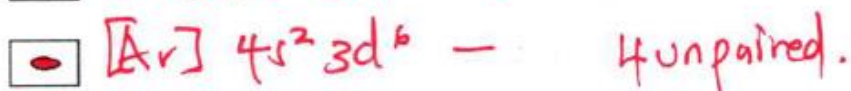
A P



B V



C Fe



D Cu

