

2.1 Atomic & Electronic Structure

Question Paper

Course	DPIB Chemistry
Section	2. Atomic Structure
Topic	2.1 Atomic & Electronic Structure
Difficulty	Hard

Time allowed: 40
Score: /30
Percentage: /100

Question 1a

a)

Give the full electron configuration of the following atoms and ions.

ii) Zinc (II) ion, Zn^{2+}

[1]

iii) Copper (II) ion, Cu^{2+}

[1]

[2 marks]

Question 1b

b)

Chlorine has two naturally occurring isotopes, ^{35}Cl with a mass of 34.969 and ^{37}Cl with a mass of 36.966. The relative atomic mass of Cl is 35.5. Calculate the percentage abundance of each isotope.

[3]

[3 marks]

Question 1c

c)

Predict whether the atomic radius of ^{35}Cl or ^{37}Cl would be the greater and give a reason for your answer.

[2]

[2 marks]

Question 1d

d)

A sample of cerium, Ce, was analysed in a mass spectrometer. The relative abundances of three of the four main isotopes that were identified are shown in the table below.

A sample of cerium, Ce, has four isotopes that have a known relative abundance. This sample has an A_r of 140.12.

Isotope	^{136}Ce	^{138}Ce	^{140}Ce	^mCe
Abundance (%)	0.19	0.25	88.45	To be calculated

Use the data from the table to calculate m , the mass number and the percentage abundance of isotope ^mCe .

[4]

[4 marks]

Question 2a

a)

A sample of element Z was extracted from a meteorite. The table shows the relative abundance of each isotope in a mass spectrum of this sample of Z. Calculate the relative atomic mass of Z and suggest an identity of Z. Give your answer to 1 d.p.

m/z value	64	66	67	68
Relative abundance (%)	38.9	27.8	14.7	18.6

[3]

[3 marks]

Question 2b

b)

A naturally occurring sample of the element boron, B, has two isotopes of mass 10 and 11, and a relative atomic mass of 10.8.

Calculate the relative abundances of both isotopes in the sample of boron, B.

[3]

[3 marks]

Question 2c

c) Give the full electron configuration of the Cu^+ ion.

[1]

[1 mark]

Question 2d

d)

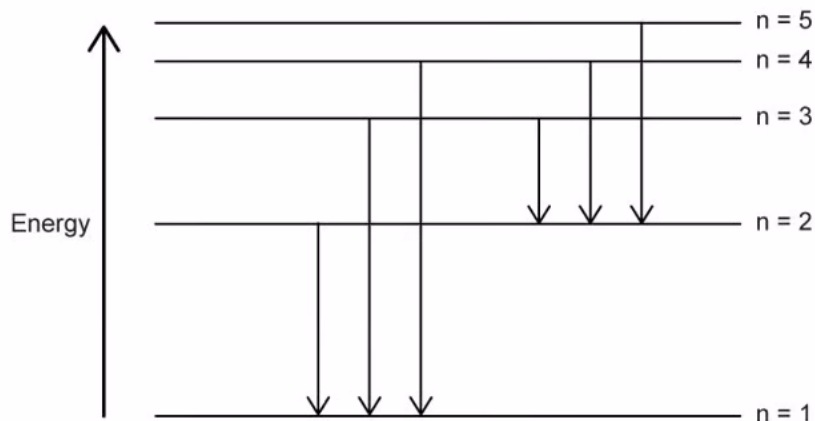
Calculate the percentage abundance of ^{63}Cu with a mass of 62.9296 and ^{65}Cu with a mass of 64.9278, when the average mass of the Cu isotope is 63.546. Give your answer to an appropriate number of significant figures.

[3 marks]

Question 3a

a)

The diagram below shows electron transitions in a hydrogen atom in two regions of the electromagnetic spectrum.



Using section 3 of the Data booklet, predict which electron transition is most likely to correspond to the emission of red light.

[1]

[1 mark]

Question 3b

b)

Using sections 1 and 3 of the data booklet, predict which electron transition will correspond to the greatest frequency of light emitted.

[1 mark]

Question 3c

c)

The wavelengths of the first four lines for the Balmer series are shown below.

Balmer spectral line	Wavelength in nm	Colour
H_{α}	656	red
H_{β}	486	cyan(blue)
H_{γ}	434	blue
H_{δ}	410	violet

Using section 1 of the Data booklet, determine the ratio of the frequencies H_{α} to H_{γ} to 2 decimal places.

[1]

[1 mark]

Question 3d

d)

2-chloro-2-methylbutane contains some molecules with a molar mass of approximately 106 g mol^{-1} and some with a molar mass of approximately 108 g mol^{-1} .

Outline why there are molecules with different molar masses.

[1 mark]

Question 4a

a)

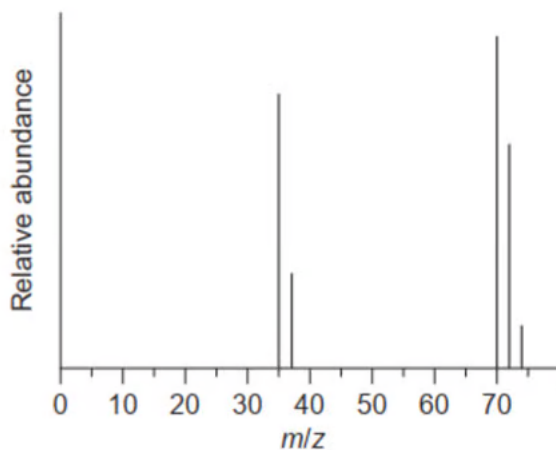
Outline why the chlorine atom has a smaller atomic radius than the sulfur atom.

[2 marks]

Question 4b

b)

The mass spectrum of chlorine gas is shown.



Outline the reason for the two peaks at $m/z=35$ and 37 .

[1 mark]

Question 4c

c)

Explain the presence and relative abundance of the peak at $m/z=74$.**[2 marks]**