

# 2.1 Atomic & Electronic Structure

# **Question Paper**

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

Time allowed: 40

Score: /30

Percentage: /100



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#### Question la

a)

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

ii) Zinc (II) ion, Zn<sup>2+</sup>

[1]

iii) Copper (II) ion, Cu<sup>2+</sup>

[1]

[2 marks]

## Question 1b

b)

Chlorine has two naturally occurring isotopes, <sup>35</sup>Cl with a mass of 34.969 and <sup>37</sup>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 <sup>35</sup>Cl or <sup>37</sup>Cl would be the greater and give a reason for your answer.

[2]

[2 marks]



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#### 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	<sup>136</sup> Ce	<sup>138</sup> Ce	<sup>140</sup> Ce	<sup>m</sup> Ce
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]



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Qu	est	ion	2b
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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<sup>+</sup>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]

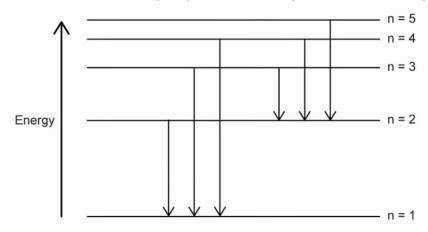


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#### Question 3a

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
$H_{\alpha}$	656	red
Нβ	486	cyan(blue)
H <sub>γ</sub>	434	blue
$H_{\delta}$	410	violet

Using section 1 of the Data booklet, determine the ratio of the frequencies  $H_{\alpha}$  to  $H_{\gamma}$  to 2 decimal places.

[1 mark]

## Question 3d

d)

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

Outline why there are molecules with different molar masses.

[1 mark]

#### Question 4a

a)

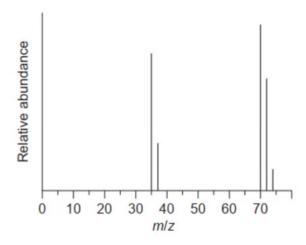
Outline why the chlorine atom has a smaller atomic radius than the sulfur atom.

[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]



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# Question 4c

c)

Explain the presence and relative abundance of the peak at m/z=74.

[2 marks]