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Structure 1.2 HL

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Mass spectra of elements

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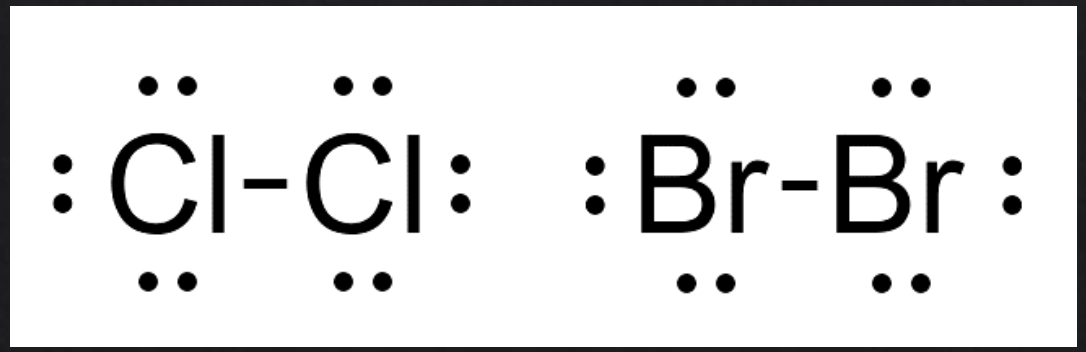
Mass spectra

- Mass spectra of elements such as boron, iron and lead.

5	26	82
B	**Fe**	**Pb**
10.81	55.85	207.20

- Mass spectra of diatomic elements such as chlorine, Cl_2, and bromine, Br_2.



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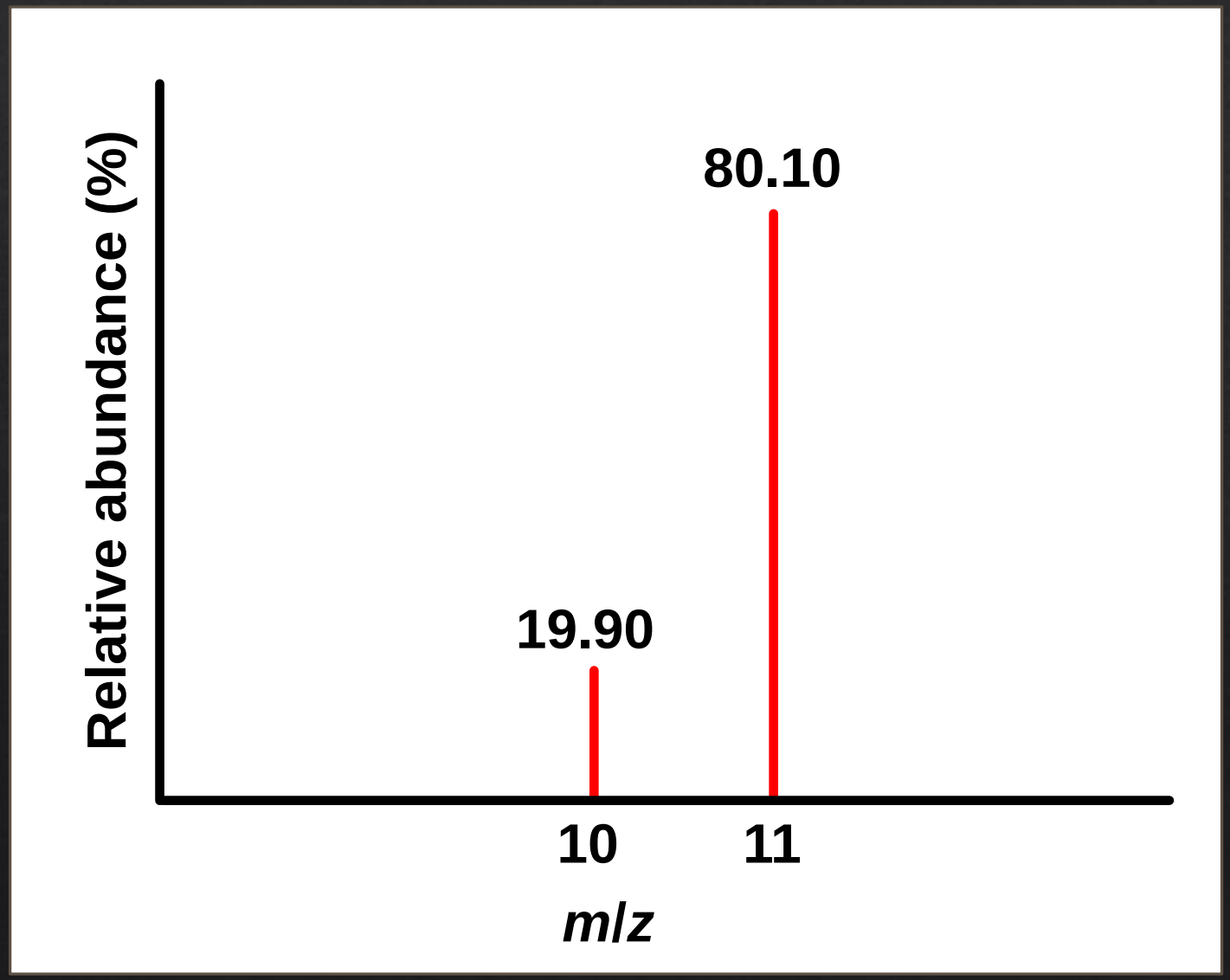
Mass spectra

Mass spectrum of boron (B)



y-axis: relative abundance (%)

x-axis: mass to charge ratio (*m*/*z*)

Mass spectra

Relative abundance (%)

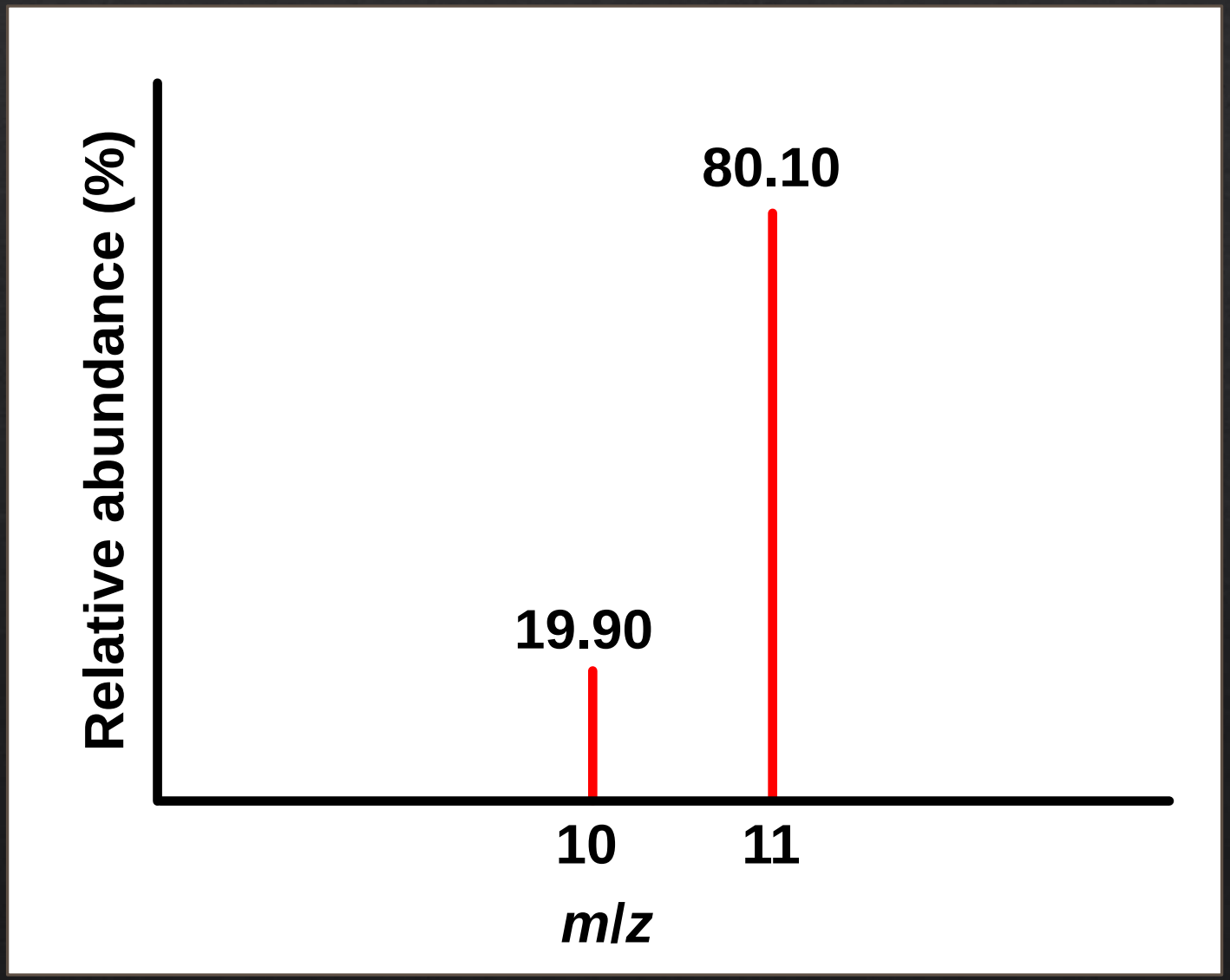
- The percentage of an isotope in a naturally occurring sample of the element.

Mass to charge ratio (*m*/*z*)

- The mass of an ion divided by its charge (tells us the mass number of the isotope).

Mass spectra

Mass spectrum of boron (B)



Isotope	Relative abundance (%)
^{10}B	19.90
^{11}B	80.10

Mass spectra

Isotope	Relative abundance (%)
^{10}B	19.90
^{11}B	80.10

$$A_r = \frac{(10 \times 19.90) + (11 \times 80.10)}{100} = 10.80$$

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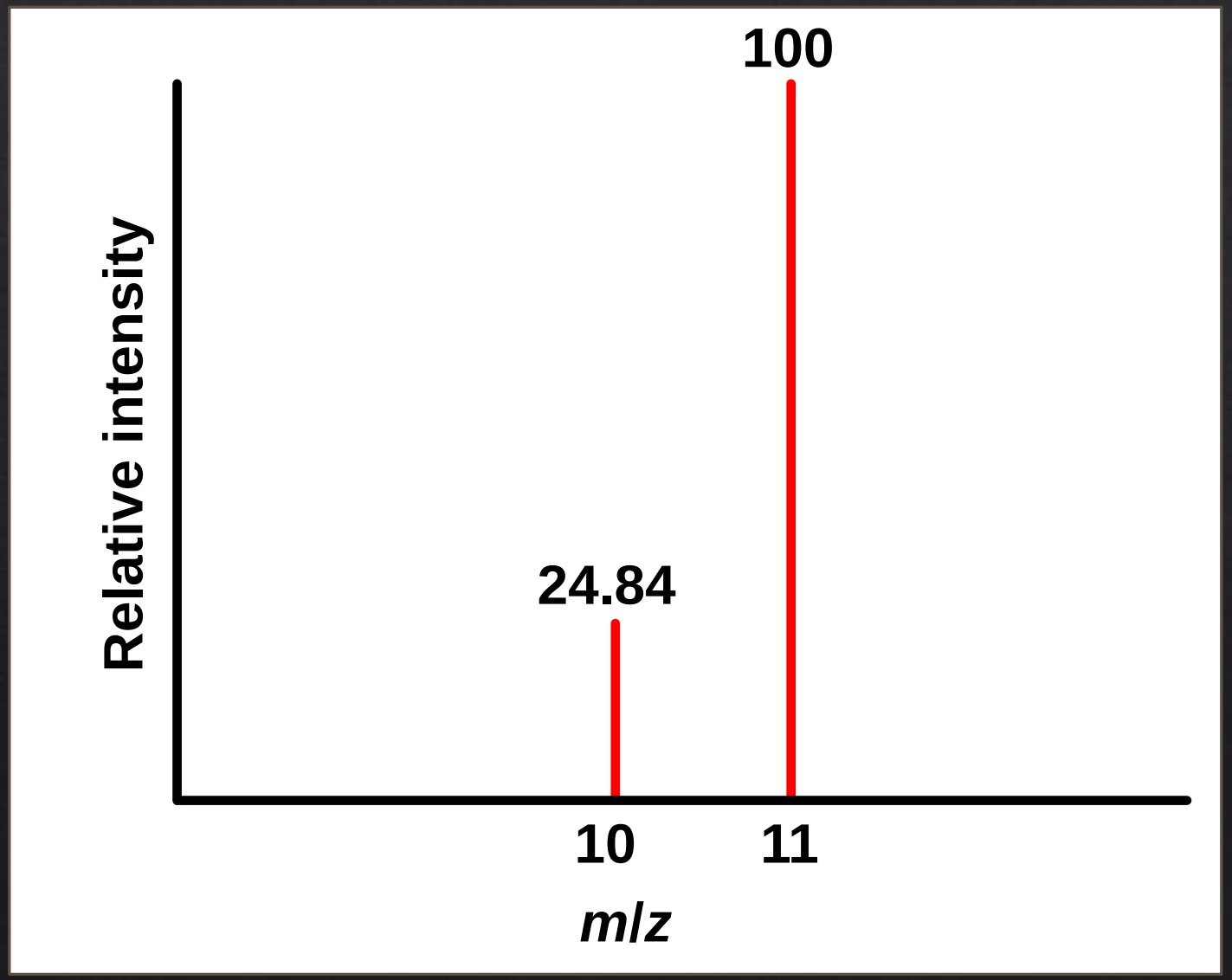
Mass spectra

Mass spectrum of boron (B)



y-axis: relative intensity

x-axis: mass to charge ratio (*m*/*z*)

Mass spectra

Relative intensity

The amount of an ion produced in relation to the amount of the most abundant ion (the base peak) which is assigned a relative intensity of 100.

Relative intensity $^{11}B^{+}$ = 100

Relative intensity $^{10}B^{+}$ = (100 / 80.10) × 19.90 = 24.84

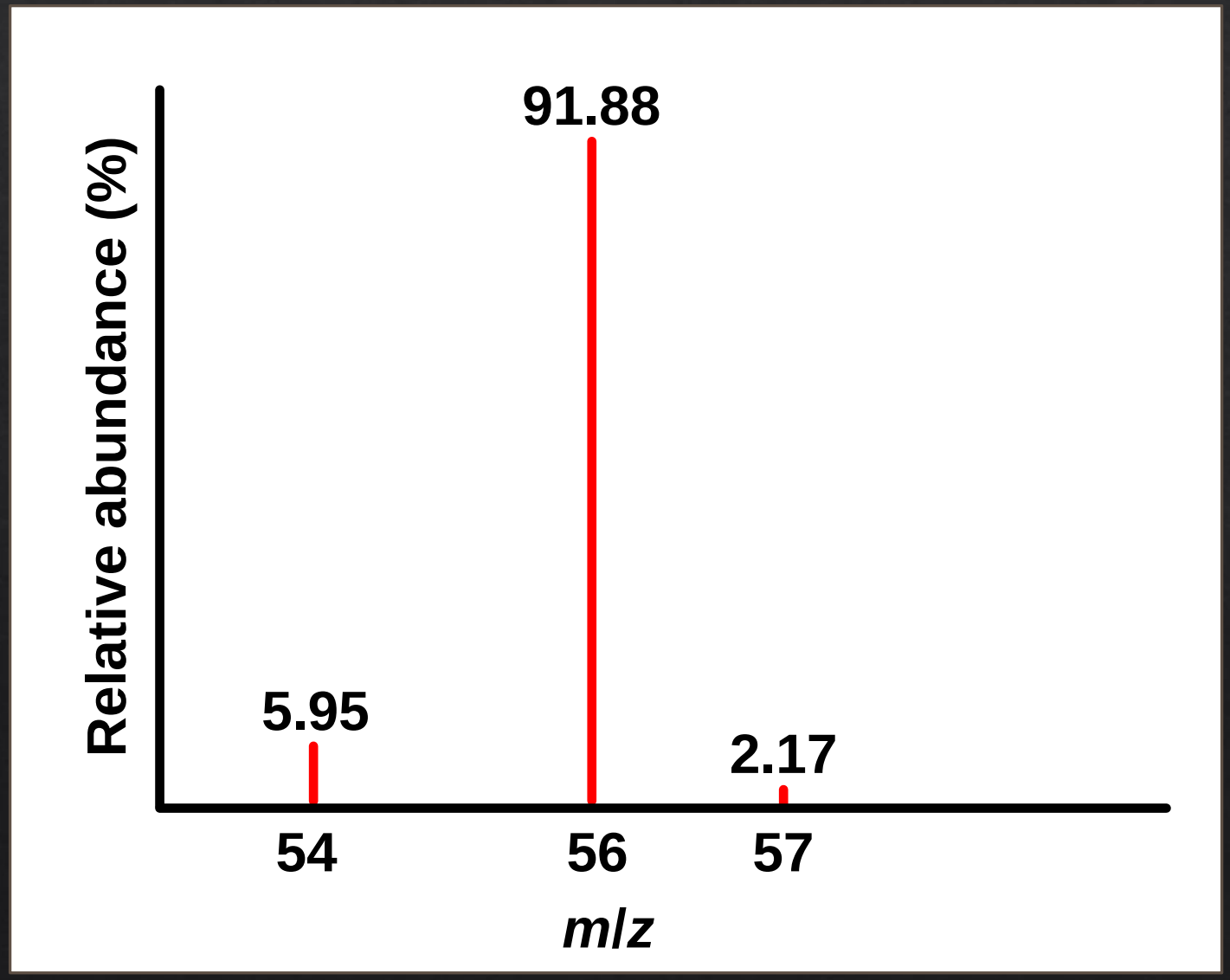
Mass spectra

Isotope	Relative intensity
^{10}B	24.84
^{11}B	100

$$A_r = \frac{(10 \times 24.84) + (11 \times 100)}{(24.84 + 100)} = 10.80$$

Mass spectra

Mass spectrum of iron (Fe)



Isotope	Relative abundance (%)
^{54}Fe	5.95
^{56}Fe	91.88
^{57}Fe	2.17

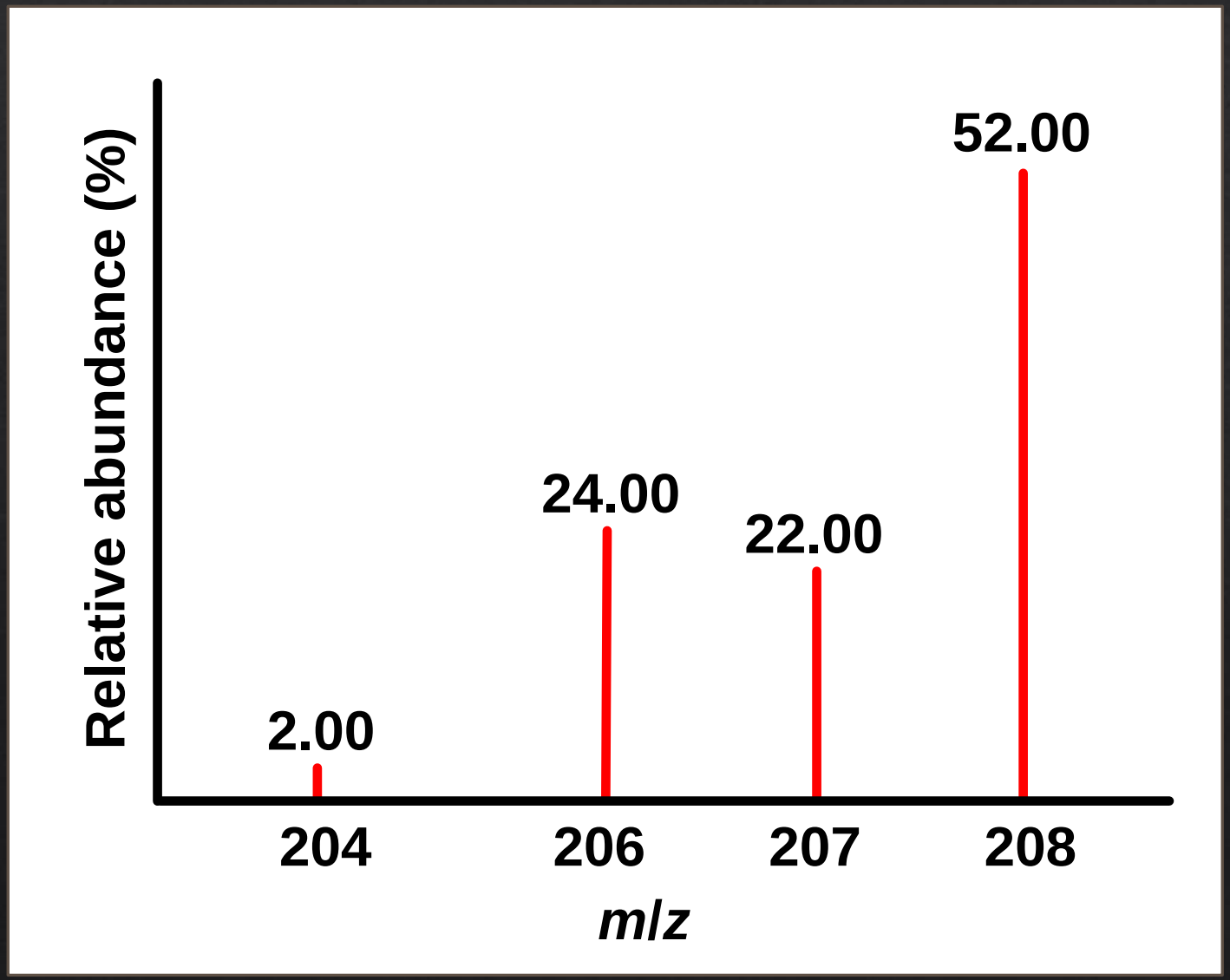
Mass spectra

Isotope	Relative abundance (%)
^{54}Fe	5.95
^{56}Fe	91.88
^{57}Fe	2.17

$$A_r = \frac{(54 \times 5.95) + (56 \times 91.88) + (57 \times 2.17)}{100} = 55.90$$

Mass spectra

Mass spectrum of lead (Pb)



Isotope	Relative abundance (%)
^{204}Pb	2.00
^{206}Pb	24.00
^{207}Pb	22.00
^{208}Pb	52.00

Mass spectra

Isotope	Relative abundance (%)
^{204}Pb	2.00
^{206}Pb	24.00
^{207}Pb	22.00
^{208}Pb	52.00

$$A_r = \frac{(204\times2.00)+(206\times24.00)+(207\times22.00)+(208\times52.00)}{100} = 207.20$$

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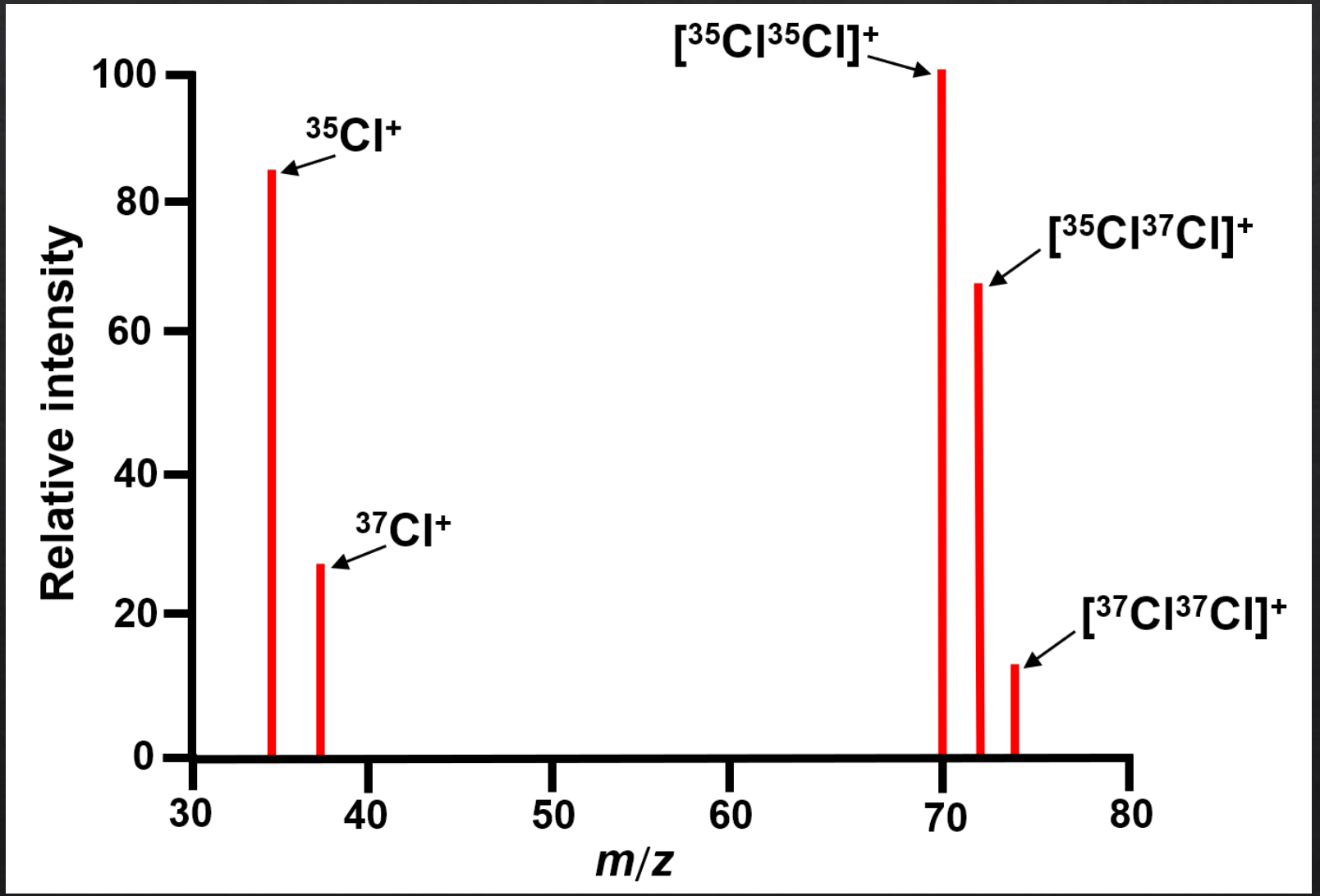
Mass spectra

Mass spectrum of chlorine, Cl_2



Isotope	Relative abundance (%)
^{35}Cl	75
^{37}Cl	25

$^{35}Cl^+$: $^{37}Cl^+$

3 : 1

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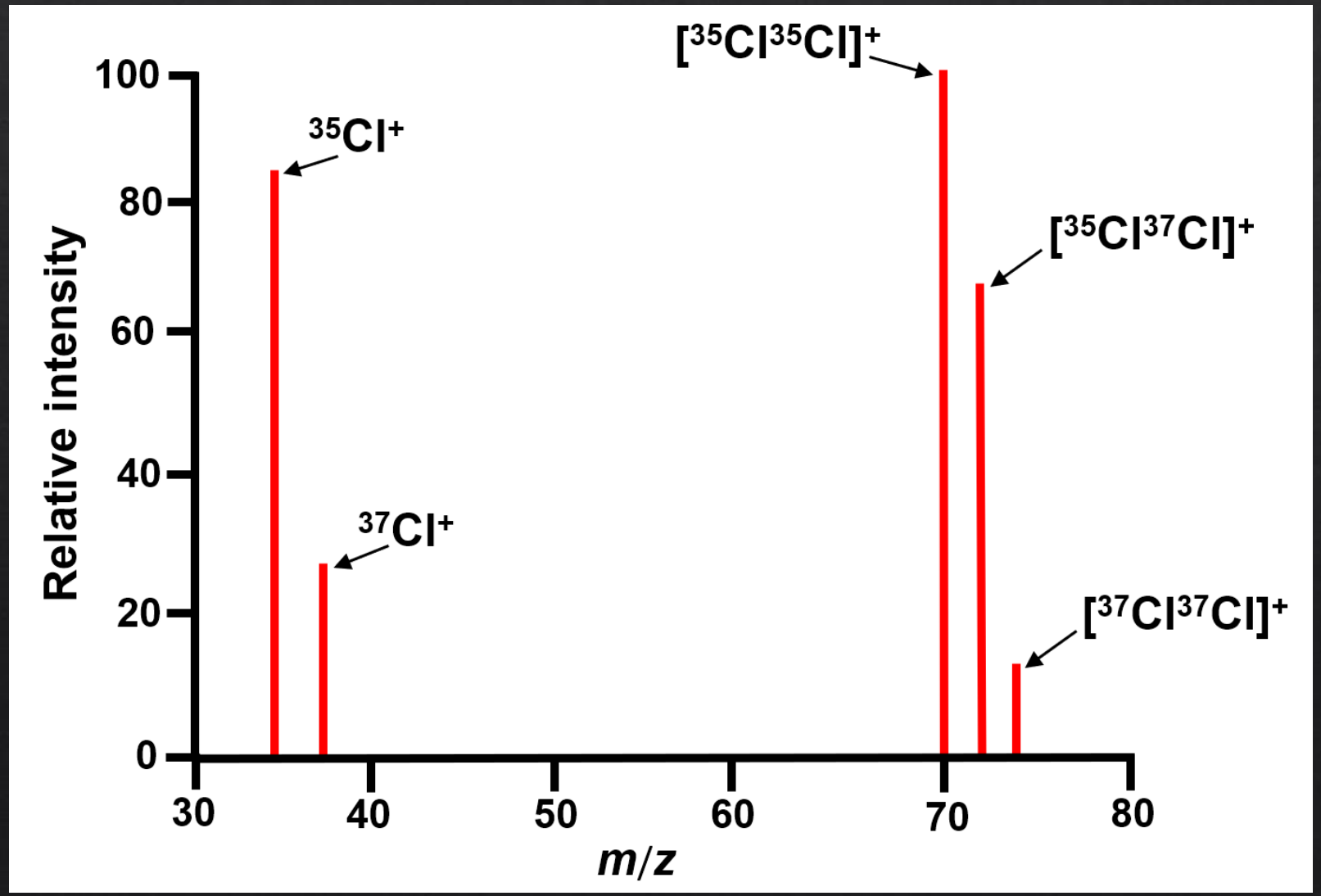
Mass spectra

Mass spectrum of chlorine, Cl_2



$[^{35}Cl^{35}Cl]^+$ $m/z = 70$

$[^{35}Cl^{37}Cl]^+$ $m/z = 72$

$[^{37}Cl^{37}Cl]^+$ $m/z = 74$

$[^{35}Cl^{35}Cl]^+ : 9$

$[^{35}Cl^{37}Cl]^+ : 6$

$[^{37}Cl^{37}Cl]^+ : 1$

Mass spectra

Molecular ions	*m/z*	Relative intensities
$[^{35}Cl^{35}Cl]^+$	70	100
$[^{37}Cl^{35}Cl]^+$	72	66.67
$[^{37}Cl^{37}Cl]^+$	74	11.11

$$M_r = \frac{(70\times100)+(72\times66.67)+(74\times11.11)}{(100+66.67+11.11)} = 71.00$$

Mass spectra

Chlorine has two isotopes, ^{35}Cl and ^{37}Cl, with abundances of 75 % and 25 % respectively (3:1 ratio).

m/z	^{35}Cl	^{35}Cl	^{35}Cl	^{37}Cl
^{35}Cl	70	70	70	72
^{35}Cl	70	70	70	72
^{35}Cl	70	70	70	72
^{37}Cl	72	72	72	74

$[^{35}Cl^{35}Cl]^+$: $[^{35}Cl^{37}Cl]^+$: $[^{37}Cl^{37}Cl]^+$

9 : 6 : 1

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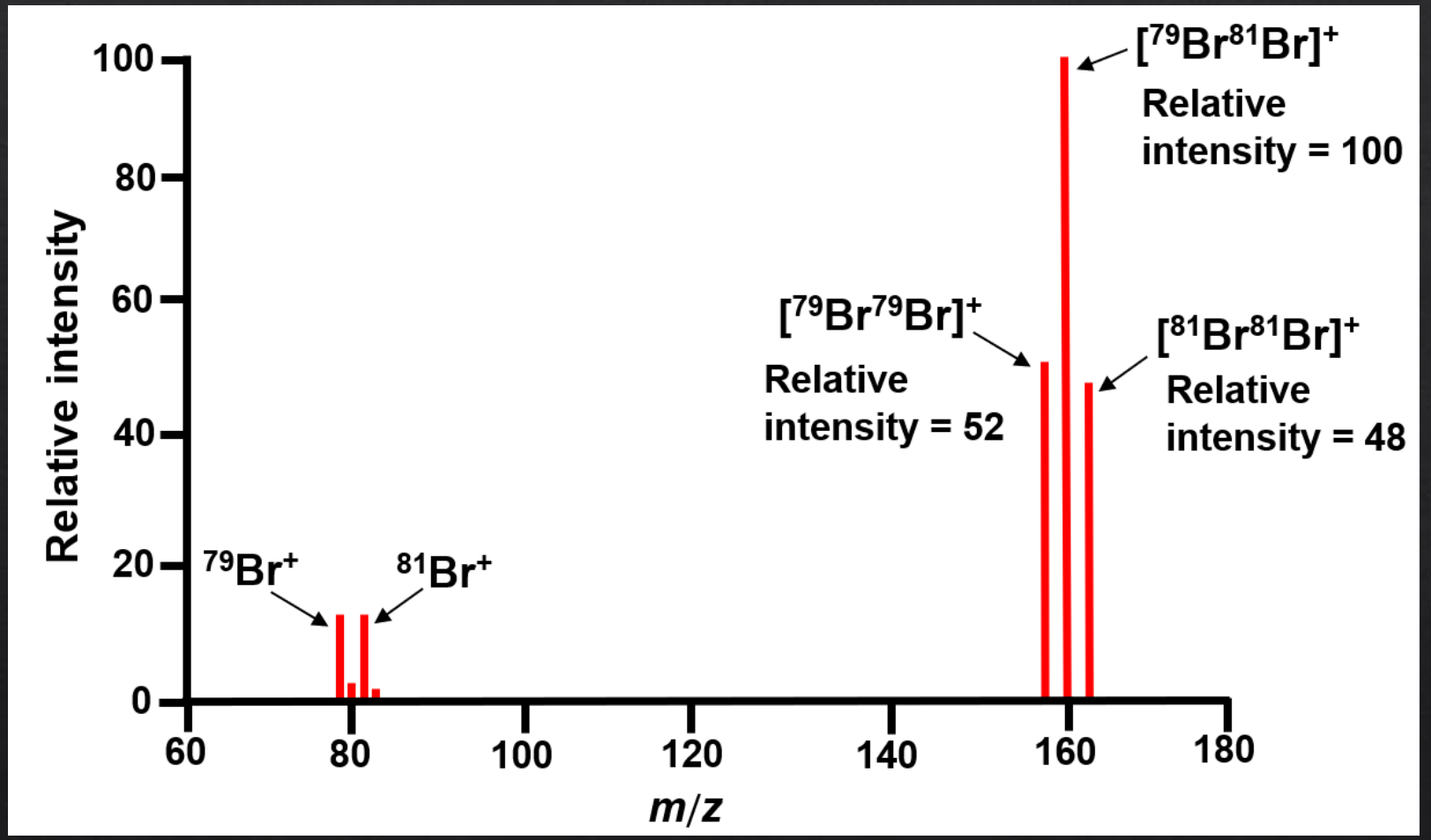
Mass spectra

Mass spectrum of bromine, Br_2



Isotope	Relative abundance (%)
^{79}Br	50.69
^{81}Br	49.31

$^{79}Br^+$: $^{81}Br^+$

1 : 1

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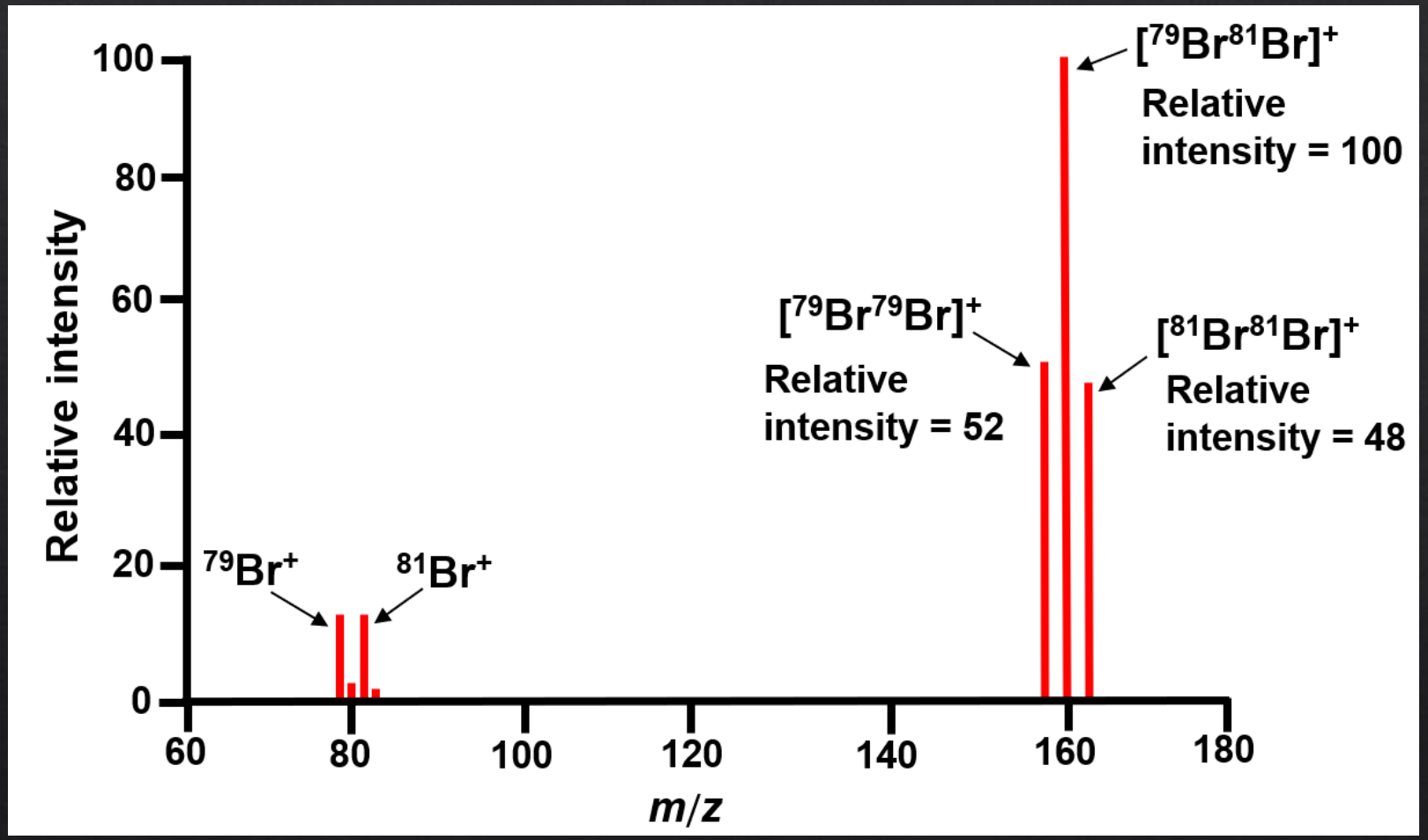
Mass spectra

Mass spectrum of bromine, Br_2



$[^{79}Br^{79}Br]^+$ $m/z = 158$

$[^{79}Br^{81}Br]^+$ $m/z = 160$

$[^{81}Br^{81}Br]^+$ $m/z = 162$

$[^{79}Br^{79}Br]^+ : 1$

$[^{79}Br^{81}Br]^+ : 2$

$[^{81}Br^{81}Br]^+ : 1$

Mass spectra

Molecular ions	*m*/*z*	Relative intensities
$[^{79}Br^{79}Br]^+$	158	52
$[^{79}Br^{81}Br]^+$	160	100
$[^{81}Br^{81}Br]^+$	162	48

$$M_r = \frac{(158\times52)+(160\times100)+(162\times48)}{(52+100+48)} = 159.96$$