

2. A neutral (uncharged) molecule containing only carbon, hydrogen, oxygen, and nitrogen gives a molecular ion shown below in the ESI (electrospray ionization) mass spectrum. The molecule contains 66 carbons, a number of hydrogens, 16 nitrogens, and 14 oxygens. No other elements are present. (5 points).

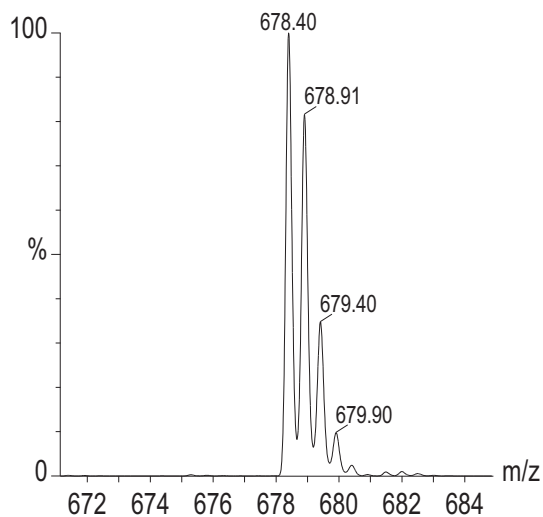


TABLE 1.4 Exact Masses of Isotopes.

Element	Atomic Weight	Nuclide	Mass
Hydrogen	1.00794	$^1\text{H}$	1.00783
		$\text{D}(^2\text{H})$	2.01410
Carbon	12.01115	$^{12}\text{C}$	12.00000 (std)
		$^{13}\text{C}$	13.00336
Nitrogen	14.0067	$^{14}\text{N}$	14.0031
		$^{15}\text{N}$	15.0001
Oxygen	15.9994	$^{16}\text{O}$	15.9949
		$^{17}\text{O}$	16.9991
		$^{18}\text{O}$	17.9992
Fluorine	18.9984	$^{19}\text{F}$	18.9984
Silicon	28.0855	$^{28}\text{Si}$	27.9769
		$^{29}\text{Si}$	28.9765
		$^{30}\text{Si}$	29.9738
Phosphorus	30.9738	$^{31}\text{P}$	30.9738
Sulfur	32.0660	$^{32}\text{S}$	31.9721
		$^{33}\text{S}$	32.9715
		$^{34}\text{S}$	33.9679
		$^{36}\text{S}$	35.9671
Chlorine	35.4527	$^{35}\text{Cl}$	34.9689
		$^{37}\text{Cl}$	36.9659
Bromine	79.9094	$^{79}\text{Br}$	78.9183
		$^{81}\text{Br}$	80.9163
Iodine	126.9045	$^{127}\text{I}$	126.9045

TABLE 1.3 Relative Isotope Abundances of Common Elements.

Elements	Isotope	Relative Abundance	Isotope	Relative Abundance	Isotope	Relative Abundance
Carbon	$^{12}\text{C}$	100	$^{13}\text{C}$	1.11		
Hydrogen	$^1\text{H}$	100	$^2\text{H}$	0.016		
Nitrogen	$^{14}\text{N}$	100	$^{15}\text{N}$	0.38		
Oxygen	$^{16}\text{O}$	100	$^{17}\text{O}$	0.04	$^{18}\text{O}$	0.2
Fluorine	$^{19}\text{F}$	100				
Silicon	$^{28}\text{Si}$	100	$^{29}\text{Si}$	5.1	$^{30}\text{Si}$	3.35
Phosphorus	$^{31}\text{P}$	100				
Sulfur	$^{32}\text{S}$	100	$^{33}\text{S}$	0.78	$^{34}\text{S}$	4.4
Chlorine	$^{35}\text{Cl}$	100			$^{37}\text{Cl}$	32.5
Bromine	$^{79}\text{Br}$	100			$^{81}\text{Br}$	98
Iodine	$^{127}\text{I}$	100				

a. What is the charge of the ion at m/z 678.40? \_\_\_\_\_

b. What is the mass of the ion at m/z 678.40? \_\_\_\_\_

c. How many hydrogens are present in the ion at m/z 678.40? \_\_\_\_\_

d. What is the molecular formula of the neutral (uncharged) molecule? \_\_\_\_\_