PROBLEM 1

Determine the number of protons, neutrons, and electrons in the following isotopes that are used in medical diagnoses:

(a) atomic number 9, mass number 18, charge of 1−
(b) atomic number 43, mass number 99, charge of 7+
(c) atomic number 53, atomic mass number 131, charge of 1−
(d) atomic number 81, atomic mass number 201, charge of 1+

(e) Name the elements in parts (a), (b), (c), and (d)

Answer a

p: 9; n: 9; e: 10

Answer b

p: 43; n: 56; e: 36

Answer c

p: 53; n: 78; e: 54

Answer d

p: 81; n: 120; e: 80

Answer e

a - F; b - Tc; c - I; d - Tl
PROBLEM \(\PageIndex{2}\)

Give the number of protons, electrons, and neutrons in neutral atoms of each of the following isotopes:

(a) \(\ce{^{10}_5B}\)
(b) \(\ce{^{199}_{80}Hg}\)
(c) \(\ce{^{63}_{29}Cu}\)
(d) \(\ce{^{13}_6C}\)
(e) \(\ce{^{77}_{34}Se}\)

**Answer a**

p&e: 5; n: 5

**Answer b**

p&e: 80; n: 119
PROBLEM \(\PageIndex{3}\)

An element has the following natural abundances and isotopic masses: 90.92% abundance with 19.99 amu, 0.26% abundance with 20.99 amu, and 8.82% abundance with 21.99 amu. Calculate the average atomic mass of this element.

Answer

20.16 amu

Click here to see a video of the solution.

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PROBLEM \(\PageIndex{4}\)

Average atomic masses listed by IUPAC are based on a study of experimental results. Bromine has two isotopes, \(^{79}\text{Br}\) and \(^{81}\text{Br}\), whose masses (78.9183 and 80.9163 amu) and abundances (50.69% and 49.31%) were determined in earlier
experiments. Calculate the average atomic mass of Br based on these experiments. How does this compare to the value given on the periodic table?

**Answer**

79.90 amu; this matches the value on the periodic table

**PROBLEM \( \PageIndex{5} \)**

The \({}^{18}\text{O}:{}^{16}\text{O}\) abundance ratio in some meteorites is greater than that used to calculate the average atomic mass of oxygen on earth. Is the average atomic mass of an oxygen atom in these meteorites greater than, less than, or equal to a terrestrial oxygen atom?

**Answer**

Greater, since the contribution to the average atomic mass of \({}^{18}\text{O}\) is greater, that will raise the average atomic mass in meteorites compared to on earth.

**PROBLEM \( \PageIndex{6} \)**

Compare 1 mole of \( \text{H}_2 \), 1 mole of \( \text{O}_2 \), and 1 mole of \( \text{F}_2 \).

(a) Which has the largest number of molecules? Explain why.

(b) Which has the greatest mass? Explain why.

**Answer a**

1 mole is always \( 6.022 \times 10^{23} \) molecules. They have the same number of molecules.

**Answer b**

\( \text{F}_2 \); it has the highest molar mass.

**PROBLEM \( \PageIndex{7} \)**

Which contains the greatest mass of oxygen: 0.75 mol of ethanol (\( \text{C}_2\text{H}_5\text{OH} \)), 0.60 mol of formic acid (\( \text{HCO}_2\text{H} \)), or 1.0 mol of water (\( \text{H}_2\text{O} \))? Explain why.

**Answer**

Formic acid. Its formula has twice as many oxygen atoms as the other two compounds (one each). Therefore, 0.60 mol of formic acid would be equivalent to 1.20 mol of a compound containing a single oxygen atom.

**PROBLEM \( \PageIndex{8} \)**

Determine the mass of each of the following:

(a) 0.0146 mol \( \text{KOH} \)
(b) 10.2 mol ethane, \( \text{C}_2\text{H}_6 \)
(c) \( 1.6 \times 10^{-3} \) mol \( \text{Na}_2\text{SO}_4 \)
(d) $6.854 \times 10^3$ mol glucose, $C_6H_12O_6$
(e) 2.86 mol Co(NH$_3$)$_6$Cl$_3$

Answer a
0.819 g

Answer b
307 g

Answer c
0.23 g

Answer d
$1.235 \times 10^6$ g (1235 kg)

Answer e
765 g

PROBLEM \(\PageIndex{9}\)

Which of the following represents the least number of molecules?

a. 20.0 g of H$_2$O (18.02 g/mol)
b. 77.0 g of CH$_4$ (16.06 g/mol)
c. 68.0 g of CaH$_2$ (42.09 g/mol)
d. 100.0 g of N$_2$O (44.02 g/mol)
e. 84.0 g of HF (20.01 g/mol)

Answer

20.0 g of H$_2$O represents the smallest number of moles, meaning the least number of molecules present. Since 1 mole = $6.022 \times 10^{23}$ molecules (or atoms) regardless of identity, the least number of moles will equal the least number of molecules.
Click here to see a video of the solution.

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