

Monopoly Problems

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May 2024

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1 Unit 1: Atomic Structure and Properties

Problem 1

Calculate the number of moles in a 7.89kg sample of $\text{C}_9\text{H}_8\text{O}_4$

Problem 2

Given this graph, what is true about the element depicted



- (a) In an average sample of the element, less than 20% of the atoms have an atomic mass of $66u$.
- (b) The most abundant isotope of the element has an atomic mass of $64u$.
- (c) The element has an average atomic mass of $64u$.
- (d) The element has an average atomic mass between 66 and $68u$.

Problem 3

What is the percent composition of Carbon in $\text{C}_{13}\text{H}_{18}\text{O}_2$?

Problem 4

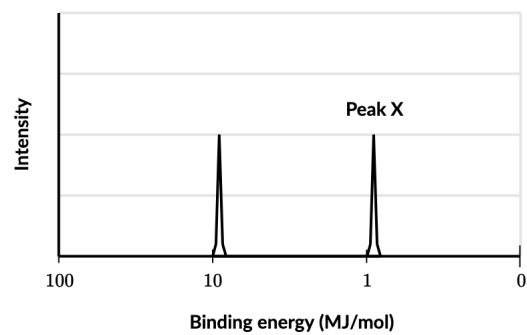
A compound contains 32.38% sodium, 22.65% sulfur, and 44.99% oxygen. What is the empirical formula.

Problem 5

What is the full electron configuration of mercury?

Problem 6

Below, the photoelectron spectra of the 2s electrons of Be and Mg are shown.



Is peak *X* the peak associated with Be or Mg?

2 Answers

2.1 Unit 1

Problem 1

The molar mass of $C_9H_8O_4$ is $1.008 * 8 + 12.01 * 9 + 16.00 * 4 = 180.2 \frac{g}{mol}$

$$7.89kg \times \frac{1g}{10^{-3}kg} \times \frac{1mol}{180.2g} = 43.8mol \quad (1)$$

Problem 2

(b), the tallest peak of the graph is the one at $64u$.

Problem 3

In one mole of $C_{13}H_{18}O_2$ is $206.31g$.

$$1mol C_{13}H_{18}O_2 \times \frac{13mol C}{1mol C_{13}H_{18}O_2} \times \frac{12.01g}{1mol C} = 156.31g \quad (2)$$

Thus, the percent composition by weight is $\frac{156.31}{206.31} = 75.764\%$

Problem 4

Take $100g$ of the substance such that there are $32.38g$ sodium, $22.65g$ sulfur, and $44.99g$ oxygen.

$$\begin{aligned} 32.38g Na \times \frac{1mol Na}{22.99g} &= 1.408mol Na \\ 22.65g S \times \frac{1mol S}{32.07g} &= 0.7063mol S \\ 44.99g O \times \frac{1mol O}{16g} &= 2.812mol O \end{aligned} \quad (3)$$

Take the ratio of each compound with the smallest quantity.

$$\begin{aligned} S : \frac{0.7063}{0.7063} &= 1 \\ Na : \frac{1.408}{0.7063} &= 2 \\ O : \frac{2.812}{0.7063} &= 4 \end{aligned} \quad (4)$$

Therefore, the empirical formula is Na_2SO_4

Problem 5

$$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6 5s^2 4d^{10} 5p^6 6s^2 4f^{14} 5d^{10}$$

Problem 6

Be. The peak location of the peak on the x-axis means that there is less binding energy for the electrons in element X . Be has fewer protons and both electrons are in the same shell, so its peak must belong to Be.