Average Atomic Mass

Finding a weighted average

Relative Mass

- The relative mass of an atom is the sum of its protons and neutrons. (Note: Atomic masses are based on 12 C = 12 amu.)
- Examples:
 - Carbon 12 has 6 protons and 6 neutrons(6 + 6 = 12)
 - Carbon 14 has 6 protons and 8 neutrons(6 + 8 = 14)
- The relative mass of any isotope is an integer.

Average Atomic Mass

- The masses of the elements listed on the Periodic Table are NOT integers.
- The masses of the elements listed on the *Periodic Table* are the average masses of the isotopes of each element.
- The average mass of an element is a weighted average.
- Both the mass of the isotopes and the percentage of each effect the average mass.

The Average: The Did Way

Problem: Find the average of the following grades – 100, 100, 100, 100, 100, 90, 90, 90, 50

Old Way
100
100
100
100
100
100
90
90
90
50
920
92

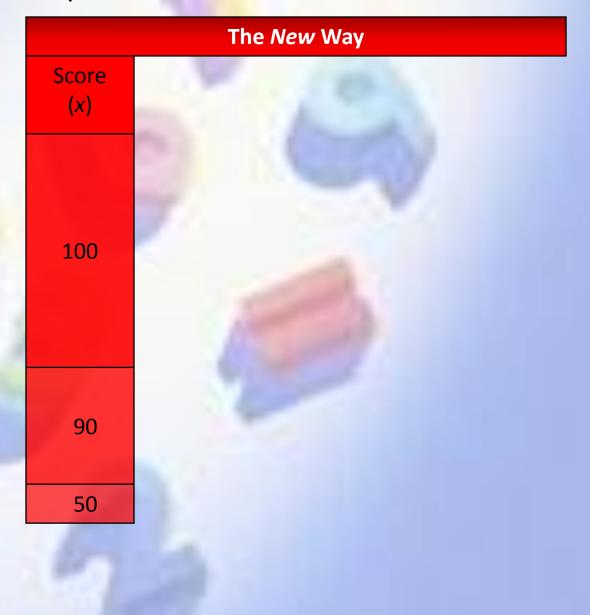
Total

The Average: *The New Way*

Group similar scores

The <i>Old</i> Way	
100	
100	
100	
100	
100	
100	
90	
90	
90	
50	
920	
92	

Total



The Average: *The New May*

Determine the frequency of each score and the total frequency

100 100 100 100 100 100 90 90 90 50 920	The <i>Old</i> Way
100 100 100 100 90 90 90 50 920	100
100 100 100 90 90 90 50 920	100
100 100 90 90 90 50 920	100
100 90 90 90 50 920	100
90 90 90 50 920	100
90 90 50 920	100
90 50 920	90
50 920	90
920	90
	50
92	920
	92

Total

The <i>New</i> Way			
Score (x)	Frequency (f)		
100	6		
90	3		
50	1		
Total	10		

The Average: *The New Way*

Find the product of the score and the frequency and add them up

The <i>Old</i> Way
100
100
100
100
100
100
90
90
90
50
920
92

Total

The <i>New</i> Wa				
Score (x)	Frequency (f)	Product (fx)		
100	6	600		
90	3	270		
50	1	50		
Total	10	920		

The Average: *The New Way*

Find the average by dividing the total product by the total frequency

The <i>Old</i> Way
100
100
100
100
100
100
90
90
90
50
920
92

Total

The <i>New</i> V			
Score (x)	Frequency (f)	Product (fx)	
100	6	600	
90	3	270	
50	1	50	
Total	10	920	
Average	92		

The Weighted Average

Find the percentage by dividing the frequency by the total frequency

The <i>Old</i> Way
100
100
100
100
100
100
90
90
90
50
920
92

Total

The Weighted Average				
Score (x)	Frequency (f)	Product (fx)	Percentage (p)	
100	6	600	0.6	
90	3	270	0.3	
50	1	50	0.1	
Total	10	920	1.0	
Average		92		

The Weighted Average

Find the product by multiplying the score by the percentage. Then, add them up to get the average!

The <i>Old</i> Way
100
100
100
100
100
100
90
90
90
50
920
92

Total

The Weighted Average				
Score (x)	Frequency (f)	Product (fx)	Percentage (p)	Product (px)
100	6	600	0.6	60
90	3	270	0.3	27
50	1	50	0.1	5
Total	10	920	1.0	92
Average	-	92		92

Summary

Find the weighted average as follows:

- Group the data
- Determine the frequency of each score
- Find the percentage of each score by dividing the frequency by the total frequency
- Find the average by multiplying each score by its percentage and adding up the products.

$$x_{AVG} = \sum_{y=1}^{n} p_y x_y = p_1 x_1 + p_2 x_2 + \ldots + p_n x_n$$

Finding Average Mass

Finding average mass is not so complex because the percentages and masses are given.

Problem: What is the average mass of nitrogen if a typical sample contains 99.63 % nitrogen-14 and 0.37 % nitrogen-15?

$$m_{AVG} = \sum_{y=1}^{n} p_y m_y = p_1 m_1 + p_2 m_2 + ... + p_n m_n$$

- Step 1: Convert the percentages to decimal values
- Step 2: Multiply the percentages by the masses
- Step 3: Add the products together

Average Mass of Nitrogen			
<u>Isotope</u>	<u>Percentage</u>	<u>Mass</u>	<u>Product</u>
Nitrogen-14	0.9963	14	13.95
Nitrogen-15	0.0037	15	<u>0.06</u>
			14.01