Muhammad Ahsan

Aim:-

To find out if Chlorides of metallic elements have a higher melting point than Bromides of metallic elements.

Hypothesis:-

I think the statement that Metal Chlorides have a higher melting point than Metal Bromides is true because chlorides of metallic elements have greater ionic strength then metallic bromides. The reasons for this can be that bromine is below chlorine in the same group and as you go down a group the atomic radii increases and the force of attraction of the protons on the electrons decreases so the elements down a group from weak bonds with elements in this case metals so have a lower melting point as compared to the compounds formed by elements above it in the same group and metals.

Plan:-

I will kick off my investigation with the collection of data. I will collect my data using a Random sampling method. I will collect about 50 samples for metal chlorides and metal bromides so that my data is reasonable and will be more spread out than 20 or 30 data samples which would not only make this investigation more effective but also more reliable. To help me conclude my investigation I will make diagrams such as Cumulative frequency graphs and Box and Whisker Diagrams. I will analyze my data and calculate the mean of the melting points of metal chlorides and metal bromides which will give me an average of the melting points of metal chlorides and metal bromides which will help me compare my data easily and conclude my investigation.

Data Collection Process: -

I will collect my data using a Random sampling method because this way the calculator will choose the atomic numbers for me and this will be a fair investigation. I pressed the

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buttons to get the numbers for my data. All numbers that were grater than 118 were ignored so were the non-metallic elements and metalloids. I decided to have 50 samples for both metal chlorides and metal bromides so that the investigation, the data and the conclusion is not only right but also reliable.
For Example: - the first number I got off my calculator was 0.026 which meant element number 26 which is iron so I added iron to my list of data and found out the melting point of iron chloride and iron bromide using the website

www.webelements.com . I used this website because it is easy to use and the information is reliable because the website is owned by The University Of Sheffield and is used by professional scientists and students at school interested in chemistry and incorrect information would earn the University a bad name. I did the same thing for the rest of my data. I used this method so my data was fair and reasonable and the investigation was not unfair.
My data is given on the next page.

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Table for Melting Points of Metal Chlorides and Metal Bromides

	Chlorides **(Centigrade)**	***Bromides*** **(Centigrade)**
Aluminium(III)	192.6	97.5
Rhenium(V)	220	110
Gold(I)	420	165
Platinum(III)	400	200
Tin(II)	247	216
Mercury(II)	280	238
Palladium(II)	675	250
Tantalum(V)	210	280
Inidium(I)	211	285
Osmium(III)	450	340
Lead(II)	500	367
zinc(II)	275	394
Tungsten(II)	500	400
Titanium(II)	1035	400
Hafnium(IV)	432	425
Silver(I)	455	430
Zicronium(IV)	437	450
Thallium(I)	430	460
Neptunium(IV)	517	464
Copper(I)	422	504
Lithium(I)	610	552
Curium(III)	695	625
Caesium(I)	646	636
Caesium(I)	646	636
Strontium(II)	874	657
Promethium(III)	737	660
Californium(III)	575	675
Cobalt(II)	724	678
Plutonium(III)	767	681
Europium(II)	731	683
Iron(II)	674	684
Rubidium(I)	718	693
Manganese(II)	654	698
Cerium(III)	817	722
Neodynium(II)	841	725
Uranium(III)	837	727
Radium(I)	1000	728
Potasium(I)	771	734
Calcium	782	742
Sodium(I)	801	747
Rhodium(III)	450	805
Terbium(III)	582	828
Chromium(II)	815	842
Barium(II)	962	857
Dysprosium(III)	647	879
Molbdenum(II)	530	900
Thulium(III)	824	954
Nickel(II)	1001	965
Scandium(III)	967	970
Actinium(III)	1051	1049

Analyzing the data: -

Below are tables for Metal chlorides and Metal bromides with information regarding temperature intervals, tally, frequency and cumulative frequency. I have also calculated statistics such as Mean, Median, Upper Quartile, Lower Quartile and Average Mean. These Statistics will help me compare the data and find out if my hypothesis is true or not. The mean will tell me average temperatures of Metal Chlorides and Metal bromides. The median, upper and lower Quartiles will help me make Box and Whisker Diagrams, I will also compare these statistics in order to prove my hypothesis and draw my conclusion.

Metal Chlorides

Melting Points **(Centigrade)**	***Tally***	***Frequency***	***Cumulative Frequency***
1 – 50		0	0
51-100		0	0
101-150		0	0
151-200	|	1	1
201-250	||||	4	5
251-300	||	2	7
301-350		0	7
351-400	|	1	8
401-450	|||| ||	7	15
451-500	|||	3	18
501-550	||	2	20
551-600	||	2	22
601-650	||||	4	26
651-700	||||	4	30
701-750	||||	4	34
751-800	|||	3	37
801-850	|||| |	6	43
851-900	|	1	44
901-950		0	44
951-1000	|||	3	47
1001-1050	||	2	49
1051-1100	|	1	50

Sum of all Temperatures: - 31037.6 Centigrade
Mean (use of exact melting point temperatures) = 31037.6 / 50
= 620.572 Centigrade
Average mean: - 611 Centigrade
Upper Quartile (obtained through graph):- 790 Centigrade
Median (obtained through graph):- 625 Centigrade
Lower Quartile (obtained through graph):- 430 Centigrade
Lowest Temperature: - 192.6 Centigrade
Highest Temperature: - 1051 Centigrade

b = lower class boundary
n = total number of observations
f = sum of the frequencies below median class
f_c = Frequency of the class
c.w. = class width of the class

Lower Quartile (through formula) = $b + (0.25n – F / f_c)$ c.w
= 400.5 + {(0.25 * 50 – 8 / 15) * 50
= 415.5 Centigrade

Upper Quartile (through formula) = $b + (0.75n – F / f_c)$ c.w
= 800.5 + {(0.75 * 50 – 37 / 6) * 50
= 804.7 Centigrade

Median (through formula) = $b + (0.50n – F / f_c)$ c.w
= 600.5 + { (0.50 * 50 – 22 / 4) * 50
= 638.0 Centigrade

Metal Bromides

Melting Points (Centigrade)	***Tally***	***Frequency***	***Cumulative Frequency***
0 - 50		0	0
51-100	|	1	1
101-150	|	1	2
151-200	||	2	4
201-250	|||	3	7
251-300	||	2	9
301-350	|	1	10
351-400	||||	4	14
401-450	|||	3	17
451-500	||	2	19
501-550	|	1	20
551-600	|	1	21
601-650	|||	3	24
651-700	|||| ||||	9	33
701-750	|||| ||	7	40
751-800		0	40
801-850	|||	3	43
851-900	|||	3	46
901-950		0	46
951-1000	|||	3	49
1001-1050	|	1	50

Sum of all Temperatures: - 29209.5 Centigrade
Mean (use of exact melting point temperatures) = 29209.5 / 50
= 584.19 Centigrade
Average mean: - 605 Centigrade
Upper Quartile (obtained through graph):- 760 Centigrade
Median (obtained through graph):- 600 Centigrade
Lower Quartile (obtained through graph):- 385 Centigrade
Lowest Temperature: - 97.5 Centigrade
Highest Temperature: - 1049 Centigrade

b = lower class boundary
n = total number of observations
f = sum of the frequencies below median class
f_c = Frequency of the class
c.w. = class width of the class

Lower Quartile (through formula) = $b + (0.25n – F / f_c)$ c.w
= 350.5 + {(0.25 * 50 – 10 / 4) * 50
= 381.75 Centigrade

Upper Quartile (through formula) = $b + (0.75n – F / f_c)$ c.w
= 700.5 + {(0.75 * 50 – 33 / 7) * 50
= 732.6 Centigrade

Median (through formula) = $b + (0.50n – F / f_c)$ c.w
= 600.5 + { (0.50 * 50 – 24 / 9) * 50
= 606.1 Centigrade

Interpreting Statistics and comparing results: -

The Statistics that I have calculated are Mean, Median, Upper Quartile and Lower Quartile. The statistics helped me make a Box and Whisker Diagram because this is the easiest and the most effective method that I know of to compare my statistics. The Mean that is the average temperature helps to compare the average temperature of the metal chlorides and metal bromides; in this case it shows that the metal chlorides have a higher average melting point than metal chlorides. The upper and lower quartile helped to compare the temperatures at 75% and 25% respectively. With the median the temperature was compared at 50%. According to my statistics the metal chlorides have a bigger upper and lower quartile than metal bromides but metal bromides have a higher median than metal chlorides. The statistics show that metal chlorides do have a higher melting point than metal bromides. This proves that my hypothesis was true and the fact that I took 50 data samples for each metal chloride and bromide not only proves my hypothesis is true

but also that the results are reliable. I have compared the upper quartile, lower quartile and median obtained through the graphs with the ones obtained through calculations, and these are fairly close to each other which shows that my investigation was successful.

Conclusion: -

I found out that my data was true because all of statistical evidence supports the fact that metal chlorides have a higher melting point than metal bromides. I could improve the method of doing this investigation by taking more samples than I previously did, this way I will have more metal chlorides to compare with metal bromides making my investigation more precise and accurate.