

Do three of #'s 5-8. Clearly mark the problem you do not want graded. (16 pts each)

5. In the EDTA experiment, we use a solution of zinc ion to standardize a solution of EDTA. The data below was obtained for such a titration. Based on this information, calculate the concentration of EDTA in moles per liter (with its associated uncertainty) in the solution.

NOTE: EDTA and zinc react in a one to one stoichiometric ratio.

| | |
|--------------------------------|-------------------------|
| Concentration of zinc standard | 0.01117 ± 0.00001 M |
| Volume of zinc solution used | 20.00 ± 0.03 mL |
| Initial buret reading | 1.46 ± 0.05 mL |
| Final buret reading | 23.54 ± 0.05 mL |

6. A 5.24 g sample of a solid containing Ni is dissolved in 20.0 mL water. A 5.00 mL aliquot of this solution is diluted to 100.0 mL and analyzed in the lab. The analyzed solution was determined to contain 6.16 ppm Ni.
- Determine the molar concentration (molarity) of Ni in the sample.

- Determine the weight percent (% w/w) of Ni in the sample.

7. You have run a series of titrations to determine the unknown concentration of KHP in a solid sample. The results of titrations indicate KHP concentrations of 35.69%, 30.03%, 35.55%, 36.07%, 35.98%. The "true" value for KHP in this sample is 36.29%. Evaluate the data and determine if your results differ from the true value at the 95% confidence level.

8. Nitrite (NO_2^-) was measured in rainwater and unchlorinated drinking water using U by an established spectrophotometric method. Based on the results below, does drinking water sample contain significantly more nitrite than rainwater sample (at the 95% confidence level)?

| Replicate | 1 | 2 | 3 | 4 | 5 |
|-----------------------------|----------|----------|----------|----------|----------|
| Rainwater (ppb) | 55.1 | 59.6 | 63.1 | 66.4 | 71.5 |
| Drinking Water (ppb) | 74.6 | 81.0 | 87.3 | 91.8 | 93.2 |

Note that the question was worded poorly. I intended for it to read: "Nitrite (NO_2^-) was measured in rainwater and unchlorinated drinking water using an established spectrophotometric method, measuring replicates of a single sample of each water type. Based on the results below, does drinking water sample contain significantly more nitrite than rainwater sample (at the 95% confidence level)?"

Possibly Useful Information

| | |
|---------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|
| $m = \frac{m' \left(1 - \frac{d_a}{d_w}\right)}{\left(1 - \frac{d_a}{d}\right)}$ | <p>Density of air = 0.012 g/ml Density of balance weights = 8.0 g/ml</p> |
| $\mu = \bar{x} \pm \frac{ts}{\sqrt{n}}$ | $y = \frac{1}{\sigma\sqrt{2\pi}} e^{-(x-\mu)^2/2\sigma^2}$ |
| $e_C = \sqrt{e_A^2 + e_B^2}$ | $e_C = C \sqrt{\left(\frac{e_A}{A}\right)^2 + \left(\frac{e_B}{B}\right)^2}$ |
| $t_{\text{calculated}} = \frac{ \text{known value} - \bar{x} }{s} \sqrt{n}$ | $s = \sqrt{\frac{\sum_i (x_i - \bar{x})^2}{n-1}}$ |
| $t_{\text{calculated}} = \frac{ \bar{x}_1 - \bar{x}_2 }{s_{\text{pooled}}} \sqrt{\frac{n_1 n_2}{n_1 + n_2}}$ | $s_{\text{pooled}} = \sqrt{\frac{s_1^2(n_1 - 1) + s_2^2(n_2 - 1)}{n_1 + n_2 - 2}}$ |
| $t_{\text{calculated}} = \frac{\bar{d}}{s_d} \sqrt{n}$ | $s_d = \sqrt{\frac{\sum_i (d_i - \bar{d})^2}{n-1}}$ |
| $s_x = \frac{s_y}{ m } \sqrt{\frac{1}{k} + \frac{1}{n} + \frac{(y - \bar{y})^2}{m^2 \sum (x_i - \bar{x})^2}}$ | $s_y = \sqrt{\frac{\sum (d_i - \bar{d})^2}{n-2}} = \sqrt{\frac{\sum d_i^2}{n-2}}$ |
| $s_m^2 = \frac{s_y^2 \times n}{D}$ | $s_b^2 = \frac{s_y^2 \sum x_i^2}{D}$ |
| $y_{\text{LOD}} = y_{\text{blank}} + 3s$ | $F_{\text{calculated}} = \frac{(s_1)^2}{(s_2)^2}$ |
| $Q_{\text{calculated}} = \frac{\text{gap}}{\text{range}}$ | $G_{\text{calculated}} = \frac{ \text{suspect value} - \bar{x} }{s}$ |

Values of Student's t

| Degrees of Freedom | Confidence Level (%) | | | |
|--------------------|----------------------|--------|--------|--------|
| | 90 | 95 | 99.5 | 99.9 |
| 1 | 6.314 | 12.706 | 127.32 | 636.61 |
| 2 | 2.920 | 4.303 | 14.089 | 31.598 |
| 3 | 2.353 | 3.182 | 7.453 | 12.924 |
| 4 | 2.132 | 2.776 | 5.598 | 8.610 |
| 5 | 2.015 | 2.571 | 4.773 | 6.869 |
| 6 | 1.943 | 2.447 | 4.317 | 5.959 |
| 7 | 1.895 | 2.365 | 4.029 | 5.408 |
| 8 | 1.860 | 2.306 | 3.832 | 5.041 |
| 9 | 1.833 | 2.262 | 3.690 | 4.781 |
| 10 | 1.812 | 2.228 | 3.581 | 4.587 |
| ∞ | 1.645 | 1.960 | 2.807 | 3.291 |

Values of Q for rejection of data

| # of Observations | Q (90% Confidence) |
|-------------------|--------------------|
| 4 | 0.76 |
| 5 | 0.64 |
| 6 | 0.56 |

Grubbs Test for Outliers

| # of Observations | G _{critical} At 95% confidence |
|-------------------|-----------------------------------------|
| 4 | 1.463 |
| 5 | 1.672 |
| 6 | 1.822 |

Critical Values of F at the 95% Confidence Level

| Degrees of freedom for s ₂ | Degrees of freedom for s ₁ | | | | | | | | | |
|---------------------------------------|---------------------------------------|------|------|------|------|------|------|------|------|------|
| | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | |
| 2 | 19.0 | 19.2 | 19.2 | 19.3 | 19.3 | 19.4 | 19.4 | 19.4 | 19.4 | 19.4 |
| 3 | 9.55 | 9.28 | 9.12 | 9.01 | 8.94 | 8.89 | 8.84 | 8.81 | 8.79 | 8.79 |
| 4 | 6.94 | 6.59 | 6.39 | 6.26 | 6.16 | 6.09 | 6.04 | 6.00 | 5.96 | 5.96 |
| 5 | 5.79 | 5.41 | 5.19 | 5.05 | 4.95 | 4.88 | 4.82 | 4.77 | 4.74 | 4.74 |

Periodic Table of the Elements

| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------|--------------------------------------------|--------------------------------------------|------------------------------------------|-----------------------------------------|-----------------------------------------|-----------------------------------------|-----------------------------------------|-------------------------------------------|------------------------------------------|------------------------------------------|------------------------------------------|-----------------------------------------|-----------------------------------------|------------------------------------------|-----------------------------------------|----------------------------------------|-----------------------------------------|--------------------------------------|--------------------------------------------|-----------------------------------------|------------------------------------------|---------------------------------------|----------------------------------------|-----------------------------------------|---------------------------------------|------------------------------------------|---------------------------------------|--------------------------------------|---------------------------------------|-----------------------------------------|----------------------------------------|----------------------------------------|---------------------------------------|--------------------------------------------|--------------------------------------|-----------------------------------------|-----------------------------------------|-----------------------------------------|--------------------------------------|-----------------------------------------|-------------------------------------------|-----------------------------------------|----------------------------------------|------------------------------------------|-----------------------------------------|-----------------------------------------|
| 1 H Hydrogen 1.008 | 2 He Helium 4.003 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3 Li Lithium 6.941 | 4 Be Beryllium 9.012 | | | | | | | | | | | 5 B Boron 10.811 | 6 C Carbon 12.011 | 7 N Nitrogen 14.007 | 8 O Oxygen 15.999 | 9 F Fluorine 18.998 | 10 Ne Neon 20.180 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 11 Na Sodium 22.990 | 12 Mg Magnesium 24.305 | 13 Al Aluminum 26.982 | 14 Si Silicon 28.086 | 15 P Phosphorus 30.974 | 16 S Sulfur 32.066 | 17 Cl Chlorine 35.453 | 18 Ar Argon 39.948 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 19 K Potassium 39.098 | 20 Ca Calcium 40.078 | 21 Sc Scandium 44.956 | 22 Ti Titanium 47.867 | 23 V Vanadium 50.942 | 24 Cr Chromium 51.996 | 25 Mn Manganese 54.938 | 26 Fe Iron 55.845 | 27 Co Cobalt 58.933 | 28 Ni Nickel 58.693 | 29 Cu Copper 63.546 | 30 Zn Zinc 65.38 | 31 Ga Gallium 69.723 | 32 Ge Germanium 72.631 | 33 As Arsenic 74.922 | 34 Se Selenium 78.971 | 35 Br Bromine 79.904 | 36 Kr Krypton 83.798 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 37 Rb Rubidium 85.468 | 38 Sr Strontium 87.62 | 39 Y Yttrium 88.906 | 40 Zr Zirconium 91.224 | 41 Nb Niobium 92.906 | 42 Mo Molybdenum 95.95 | 43 Tc Technetium 98.907 | 44 Ru Ruthenium 101.07 | 45 Rh Rhodium 102.906 | 46 Pd Palladium 106.42 | 47 Ag Silver 107.868 | 48 Cd Cadmium 112.414 | 49 In Indium 114.818 | 50 Sn Tin 118.711 | 51 Sb Antimony 121.760 | 52 Te Tellurium 127.6 | 53 I Iodine 126.904 | 54 Xe Xenon 131.294 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 55 Cs Cesium 132.905 | 56 Ba Barium 137.328 | 57-71 Lanthanide Series | 72 Hf Hafnium 178.49 | 73 Ta Tantalum 180.948 | 74 W Tungsten 183.84 | 75 Re Rhenium 186.207 | 76 Os Osmium 190.23 | 77 Ir Iridium 192.217 | 78 Pt Platinum 195.085 | 79 Au Gold 196.967 | 80 Hg Mercury 200.592 | 81 Tl Thallium 204.383 | 82 Pb Lead 207.2 | 83 Bi Bismuth 208.980 | 84 Po Polonium [208.982] | 85 At Astatine 209.987 | 86 Rn Radon 222.018 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 87 Fr Francium 223.020 | 88 Ra Radium 226.025 | 89-103 Actinide Series | 104 Rf Rutherfordium [261] | 105 Db Dubnium [262] | 106 Sg Seaborgium [266] | 107 Bh Bohrium [264] | 108 Hs Hassium [269] | 109 Mt Meitnerium [278] | 110 Ds Darmstadtium [281] | 111 Rg Roentgenium [280] | 112 Cn Copernicium [285] | 113 Nh Nihonium [286] | 114 Fl Flerovium [289] | 115 Mc Moscovium [289] | 116 Lv Livermorium [293] | 117 Ts Tennessine [294] | 118 Og Oganesson [294] | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <table border="1"> <tr> <td>57 La Lanthanum 138.905</td> <td>58 Ce Cerium 140.116</td> <td>59 Pr Praseodymium 140.908</td> <td>60 Nd Neodymium 144.243</td> <td>61 Pm Promethium 144.913</td> <td>62 Sm Samarium 150.36</td> <td>63 Eu Europium 151.964</td> <td>64 Gd Gadolinium 157.25</td> <td>65 Tb Terbium 158.925</td> <td>66 Dy Dysprosium 162.500</td> <td>67 Ho Holmium 164.930</td> <td>68 Er Erbium 167.259</td> <td>69 Tm Thulium 168.934</td> <td>70 Yb Ytterbium 173.055</td> <td>71 Lu Lutetium 174.967</td> </tr> <tr> <td>89 Ac Actinium 227.028</td> <td>90 Th Thorium 232.038</td> <td>91 Pa Protactinium 231.036</td> <td>92 U Uranium 238.029</td> <td>93 Np Neptunium 237.048</td> <td>94 Pu Plutonium 244.064</td> <td>95 Am Americium 243.061</td> <td>96 Cm Curium 247.070</td> <td>97 Bk Berkelium 247.070</td> <td>98 Cf Californium 251.080</td> <td>99 Es Einsteinium [254]</td> <td>100 Fm Fermium 257.095</td> <td>101 Md Mendelevium 258.1</td> <td>102 No Nobelium 259.101</td> <td>103 Lr Lawrencium [262]</td> </tr> </table> | | | | | | | | | | | | | | | | | | 57 La Lanthanum 138.905 | 58 Ce Cerium 140.116 | 59 Pr Praseodymium 140.908 | 60 Nd Neodymium 144.243 | 61 Pm Promethium 144.913 | 62 Sm Samarium 150.36 | 63 Eu Europium 151.964 | 64 Gd Gadolinium 157.25 | 65 Tb Terbium 158.925 | 66 Dy Dysprosium 162.500 | 67 Ho Holmium 164.930 | 68 Er Erbium 167.259 | 69 Tm Thulium 168.934 | 70 Yb Ytterbium 173.055 | 71 Lu Lutetium 174.967 | 89 Ac Actinium 227.028 | 90 Th Thorium 232.038 | 91 Pa Protactinium 231.036 | 92 U Uranium 238.029 | 93 Np Neptunium 237.048 | 94 Pu Plutonium 244.064 | 95 Am Americium 243.061 | 96 Cm Curium 247.070 | 97 Bk Berkelium 247.070 | 98 Cf Californium 251.080 | 99 Es Einsteinium [254] | 100 Fm Fermium 257.095 | 101 Md Mendelevium 258.1 | 102 No Nobelium 259.101 | 103 Lr Lawrencium [262] |
| 57 La Lanthanum 138.905 | 58 Ce Cerium 140.116 | 59 Pr Praseodymium 140.908 | 60 Nd Neodymium 144.243 | 61 Pm Promethium 144.913 | 62 Sm Samarium 150.36 | 63 Eu Europium 151.964 | 64 Gd Gadolinium 157.25 | 65 Tb Terbium 158.925 | 66 Dy Dysprosium 162.500 | 67 Ho Holmium 164.930 | 68 Er Erbium 167.259 | 69 Tm Thulium 168.934 | 70 Yb Ytterbium 173.055 | 71 Lu Lutetium 174.967 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 89 Ac Actinium 227.028 | 90 Th Thorium 232.038 | 91 Pa Protactinium 231.036 | 92 U Uranium 238.029 | 93 Np Neptunium 237.048 | 94 Pu Plutonium 244.064 | 95 Am Americium 243.061 | 96 Cm Curium 247.070 | 97 Bk Berkelium 247.070 | 98 Cf Californium 251.080 | 99 Es Einsteinium [254] | 100 Fm Fermium 257.095 | 101 Md Mendelevium 258.1 | 102 No Nobelium 259.101 | 103 Lr Lawrencium [262] | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

© 2017 Todd Holmenstone
sciencenotes.org