Determining Concentration Worksheet Answers

Fill in this table with the reflected light values for standards A-G and the two unknown samples.

<table>
<thead>
<tr>
<th>Sample</th>
<th>Concentration (drops/20 ml)</th>
<th>Reflected light (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>50</td>
<td>31</td>
</tr>
<tr>
<td>B</td>
<td>30</td>
<td>36</td>
</tr>
<tr>
<td>C</td>
<td>20</td>
<td>38</td>
</tr>
<tr>
<td>D</td>
<td>10</td>
<td>40</td>
</tr>
<tr>
<td>E</td>
<td>5</td>
<td>43</td>
</tr>
<tr>
<td>F</td>
<td>1</td>
<td>44</td>
</tr>
<tr>
<td>G</td>
<td>0</td>
<td>45</td>
</tr>
</tbody>
</table>

| Ununknowns | 1 | ? | 40 |
| Ununknowns | 2 | ? | 33 |

Plot the reflected light values for the standards versus the concentration below.
Instructions for determining the concentrations of your unknown solutions:

1. Plot a straight line through as many of the points that you plotted for the standards as you can. Use a ruler to draw a line that best fits the data. Look at all the points and line up the ruler so that some of the points fall above the line, and some below. Draw a single line that that passes through the middle of the points.

2. Locate the reflected light value for Unknown 1 on the y-axis. Match it to the location on the standards line; then see what the corresponding concentration is.

   Concentration of Unknown 1: __________ 15 ___________ drops/vial

   Repeat for Unknown 2.

   Concentration of Unknown 2: __________ 40 ___________ drops/vial

Answer the following questions.

1. Determine the percent change between the reflected light value of Standard A and Standard D.

   \[
   \text{percent change} = \left( \frac{|\text{Reflected light}_{\text{Standard A}} - \text{Reflected light}_{\text{Standard D}}|}{\text{Reflected light}_{\text{Standard A}}} \right) \times 100
   \]

   \[
   \text{percent change} = \left( \frac{|A - D|}{A} \right) \times 100
   \]

   \[
   \text{percent change} = \left( \frac{|31 - 40|}{31} \right) \times 100 = \left( \frac{9}{31} \right) \times 100 = 0.2903 \times 100
   \]

   \[
   \text{percent change} = 29.0 \%
   \]

2. Determine the percent change between the concentration of Standard A and Standard D.

   \[
   \text{percent change} = \left( \frac{|\text{Concentration}_{\text{Standard A}} - \text{Concentration}_{\text{Standard D}}|}{\text{Concentration}_{\text{Standard A}}} \right) \times 100
   \]

   \[
   \text{percent change} = \left( \frac{|A - D|}{A} \right) \times 100
   \]

   \[
   \text{percent change} = \left( \frac{|50 - 10|}{50} \right) \times 100 = \left( \frac{40}{50} \right) \times 100 = 0.2000 \times 100
   \]

   \[
   \text{percent change} = 20.0 \%
   \]
3. Compare your answers to questions 1 and 2. What do you notice?

The percent change between reflectivity values and the concentrations are very similar, being 29% and 20%, respectively. (Ideally these values should be equal, but they are unequal due to experimental error.)

4. The actual concentration for Unknown 1 is 15 drops/cuvette, and the actual concentration for Unknown 2 is 40 drops/cuvette.

Calculate the percent error for the concentration you determined for your Unknowns. Use the following formula:

\[
\text{percent error} = \left(\frac{|\text{experimental} - \text{actual}|}{\text{actual}}\right) \times 100
\]

<table>
<thead>
<tr>
<th>Unknown 1</th>
<th>Unknown 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>% error = (15-15)/15 x 100</td>
<td>% error = (40-40)/40 x 100</td>
</tr>
<tr>
<td>= 0 x 100</td>
<td>= 0 x 100</td>
</tr>
<tr>
<td>= 0 %</td>
<td>= 0 %</td>
</tr>
</tbody>
</table>

(Expect students to obtain experimental errors not equal to 0 since their experimental values will differ from the actual values.)

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1 At this point (but not before), provide actual values to the class.