G621: Analysis at Work – Sample Assignment C

Unit Name: Analysis at Work	**Unit Number:** G621
Assignment Title: Finding the Percentage of Copper in a Brass Alloy	**Assignment:** G620 Sample Assignment C
Date Set:	**Due Date:**
Assessment Objective(s): AO3	

Vocational Brief:

Brass is an alloy of copper and zinc. This alloy has many uses ranging from coinage to non-ferrous fittings on ships. Many domestic taps use brass where contact with water occurs. You are provided with a sample of brass which is about 150 years old and you are asked to quantitatively analyse it, using colorimetry, to find the percentage of copper present. Your results will be used to compare the composition of antique brass with modern brass.

Task:

Finding the Percentage of Copper in a Brass Alloy

The aim of this task is to safely complete the analysis of the antique brass alloy, using colorimetry and to produce a report.

Carry out the analysis:

- identify hazards and carry out a risk assessment
- follow the Practical Instructions given – *Finding the Percentage of Copper in a Brass Alloy.*

Produce a report that shows:

- an introduction to your analysis - to include some research that shows the vocational context of your work
- the risk assessment you have used
- all your calibration work and the outcome of your analysis
- any graphs you have plotted
- the concentration of copper in your 'brass' solution by mass in 250 cm^3 of solution
- a calculation of the percentage of copper, by mass, in the antique brass sample
- comments on the safety and the accuracy of the method
- an evaluation of the method and results.

[Max marks possible for this task: 7]

Resources / Notes:

- Class notes on colorimetric procedures and the instruction manual for the colorimeter used.
- You will also need to use ‘Hazcards’ or similar materials.
- *Practical Instructions:* Finding the Percentage of Copper in a Brass Alloy

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Practical Instructions

Finding the Percentage of Copper in a Brass Alloy

Practical Instructions - AO3

Read through the instructions below and complete a risk assessment for the procedure outlined.

1. You are provided with a sample of brass that has been filed from a piece of antique brass.
2. Using a fume cupboard, place 30 cm^3 of distilled water into a 250 cm^3 conical flask and slowly add 15 cm^3 of concentrated nitric acid to it. Stir the mixture using a glass rod.
3. Weigh out, accurately known to 2 decimal places, about 1.50 g of the antique brass filings.
4. Add these slowly to the diluted nitric acid in the fume cupboard.
5. Leave the mixture for some minutes until all the brass has 'dissolved'. During this procedure, poisonous nitrogen dioxide gas is given off and a blue solution containing copper (Cu^{2+}) and zinc (Zn^{2+}) ions is produced.
6. Remove the solution from the flask and quantitatively add it to some distilled water in a 250 cm^3 volumetric flask. Make the flask up to the mark using distilled water and mix well.
7. You are provided with around 100 cm^3 of a copper sulphate solution. This solution contains 1.6 g of copper (as Cu^{2+} ions) in 250 cm^3 of solution.
8. Dilute this copper sulphate solution with distilled water to make the solutions labelled **A** to **F** in the table below. This dilution is to be done accurately using appropriate apparatus, with mixing.

solution	copper sulphate (aq) / cm^3	water / cm^3	concentration of solution g Cu / 250 cm^3
A	10	0	1.60
B	8	2	1.28
C	6	4	0.96
D	4	6	0.64
E	2	8	0.32
F	1	9	0.16

9. Switch on your colorimeter and allow it warm up for five minutes.
10. Place a 700 nm filter in the colorimeter and zero the instrument using a cuvette filled with distilled water.
11. Fill six cuvettes with solutions **A** to **F** and find the absorption values for each of them in turn; record your results in a suitable way.
12. Fill another cuvette with the 'brass solution' and measure the absorption of this solution too.

Processing Results

13. Plot a graph of absorption (y axis) against concentration of copper ions (x axis). Your graph should be a straight line that passes through the origin (0,0).

14. Use your graph to measure the concentration of copper ions in your ‘brass’ solution. The value that you obtain will give you the mass of copper in your ‘brass solution’.

15. Use this value to calculate the percentage of copper in your antique brass sample.

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Technicians' Guidance

Finding the Percentage of Copper in a Brass Alloy

Technicians' Guidance:

Please read this guidance before issuing the practical.

Calibration

- Copper sulphate 0.1 mol dm^{-3} can be used – as indicated in experimental details Assignment C.
- However, $Cu(NO_3)_2$ (aq) rather than $CuSO_4$ could be used in the calibration in case of a colour difference of the hydrated copper ions in the two solutions.

Antique Brass

- Small brass screws can be used (washed with alcohol / acetone and dried).
- 1.5 g will give a concentration of about 1 g / 250 cm^3, which fits onto the graph.

Reaction with Nitric Acid

- Note that the brass takes time to dissolve.
- It is the responsibility of the Centre to ensure that correct health and safety regulations are adhered to. Please refer to www.cleapss.org.uk for further details.
- Ratio 1:1 HNO_3 : H_2O could be used, but it is advisable that the teacher completes this.