USE OF PHLOGISTON TO OBTAIN GOLD FROM AQUEOUS COPPER(II) ION

(Sample Report with *Italicized Instructions*)

Report	*SINGLE SIDED*
Margins	*T, L, R: 0.8 to 0.9" ; -0.7 B so page number is at 1" margin*
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Font Type	*Times New Roman, CG Times, Arial*
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Sections (in order)	*Title page, Abstract, Materials and Methods, Results, Discussion, References, Figures, Appendices (Start each section on a separate page with subtitle at top centered)*
Tenses	*Consult Robert Day's article on scientific writing for tenses*
References	*Single spaced within; double-spaced between; number in parentheses at appropriate location. *Use Insert/Endnote if expert. Use titles of articles and the format as outlined in examples; format is journal-dependent. (* Endnote will add Reference list after Appendix, so put Appendix in a separate file and number pages accordingly.*)

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ABSTRACT

The reaction of phlogiston with copper(II) acetate to form gold was studied in 0.050 M MOPS buffers (： = 0.10, NaCl) from pH 6.2 to 7.8 using a standard turbidometric assay. The reaction rate was found to be directly proportional to the amount of copper(II) acetate but hyperbolic with respect to the phlogiston when the phlogiston was used in excess. The reaction, however, was not dependent upon pH. The copper was quantitatively converted to gold which was later recovered as a fine powder that settled out at the end of the reaction. These results suggest a mechanism in which one molecule of copper(II) acetate reversibly binds to the phlogiston forming a complex. At high phlogiston, all the copper(II) is bound in the complex and the rate is maximal and therefore insensitive to the concentration of phlogiston. This study is the first to use phlogiston to convert an aqueous ion into gold. Applications of this reaction to sea water are in progress.

The abstract should start with a brief introductory sentence describing the work. This sentence is followed by a summary of the results. Do not discuss methodology unless new techniques were developed. The length of the abstract depends upon how much work was accomplished and the applications or importance of that work. A brief statement can be added at the end of the abstract to indicate how the work accomplished makes a contribution to science.

INTRODUCTION

Phlogiston (A)[1] was first reported by Jupiter and Venus (1) and it has been used to over 100 years to convert solid metals to gold (2). Although the yields have been poor, the gold recovered from this process is of high purity. This supply of high pure gold has been instrumental in providing material for the computer industry (3), space travel (4), and for shields to survive on the Moon and Mars (5). The work presented here is the first of its type using an aqueous ion to form gold using phlogiston. The methodology promises to makes a significant contribution to 100% recovery of gold from sea water using phlogiston and therefore promises to improve the standard of living of people living off the Earth.

This section should give the relevant literature background with references. A sentence or paragraph at the end can be added to summarizes how the current study fits into the literature with a brief summary of the results.

Note: Abbreviations are defined in one of two ways:
As a footnote in this section
In parentheses in Materials and Methods
(DO NOT USE BOTH WAYS AS IS DONE IN THIS SAMPLE)
Symbols for the elements are accepted without defining!

1. Abbreviations used in this report are as follows: phlogiston, A; 3-[N-morpholino]-propanesulfonic acid, MOPS.

MATERIALS AND METHODS

Phlogiston (A) was obtained from MagmaChem as a 30.0% percent solution of 99.9% pure phlogiston. 3-[N-morpholino]-propanesulfonic acid (MOPS) and copper(II) acetate monohydrate were obtained from Sigma Chemical Company and used without further purification. Sodium chloride was obtained from Johnson-Matthey Incorporated. Water was deionized giving a resistance of greater than 2 MS.

MOPS buffers (0.20 M) were prepared at pH values from 6.2 to 7.8 with sodium chloride (1.0 M) added to each to maintain an ionic strength of 0.20 M. Measurements of pH were performed with a Beckman Φ34 pH meter with a Corning semi-micro combination electrode equilibrated to 25°C. Stock solutions of phlogiston (in 0.100 M HCl) were made daily and kept on ice. The stock solution of 0.20 M copper(II) acetate, made in the beginning of the study and stored refrigerated throughout, was standardized according to the method of Hubble (6). All buffers were equilibrated to 25°C before use.

Reaction mixtures (1.00 mL) were prepared by maintaining the phlogiston concentration in excess over the copper(II) acetate and in a range of 0.200 to 10.0 mM. The copper(II) acetate was added to 0.050 mM or 0.100 mM. The conversion of copper(II) ion into gold was followed by measuring the apparent increase in absorbance due to light scattering at 300 nm as a function of time. Data was collected on a Shimadzu Biospec 1601 spectrophotometer interfaced with a ACER laptop using UVPC software. Linear regression analyses for all kinetic assays were performed on data in EXCEL using the following equation:

$$-\ln \frac{(A_4 - A_t)}{(A_4 - A_o)} = k_{obs}\, t \qquad [1]$$

where A is the absorbance at the end of the reaction, A_o is the absorbance at time 0, and A_t is the absorbance at time t. Values for k_{obs} were obtained from the slopes of logarithm plots of equation 1 versus time. Data was linear to 2.5 half lives confirming that the formation of gold versus time (G_t) is exponential with time according to equation 2:

$$G_t = G_4 (1-e^{-k_{obs}t}) \quad [2]$$

where G_t %A_t and G_4 %A_4. The linear relationship between apparent absorbance and the amount of gold formed (A_4 = ,N@ c @ l, where ,N is an apparent extinction coefficient) was confirmed by independent measurements described as follows. The apparent absorbance at the end of a series of reactions was recorded after which the solid gold was allowed to settle out of solution and was recovered by filtration, dried, and weighed on a 460C Mettler microelectronic balance (see Figure 5 Appendix).

This section describes all the materials used in the experiments with their sources. This includes all special chemicals and/or special reagents and any additional purification techniques or assays of that material. Standard chemicals are often referred to in the following way: "All common chemicals were used without further purification".

Methodology is described in several ways. For accepted methodology, use a sentence briefly describing the methodology with a reference number. Other methods related to how the new experiments were carried out should be summarized only. Detailed lists of laboratory procedures including all volumes, etc., are not shown. The final reaction volume can be given once so that along with the stock solution concentrations, a scientist attempting to duplicate the experiments can determine independently how the final molarities of reactants were achieved. No "trivial" details like "reactions were mixed thoroughly" or "reactions mixtures were vortexed" or "buffers were put into a water bath to equilibrate at 25° C" are included. It is assumed that the experimenter has carried out these important procedures correctly.

Simple equations describing how data was analyzed should be incorporated into a sentence. Any equations used should be discussed or references found that describes them. Equations are numbered if there are two or more. If only one equation is used, it can be introduced with "as follows:"

Note that final concentrations are given along with stock solution concentrations; no reaction volumes are given in detail. Numbers are reported in proper number of significant figures.

RESULTS

A sample absorbance at 300 nm versus time plot is shown in Figure 1 for the formation of gold in the reaction of copper(II) acetate with excess phlogiston. Data of this type were replotted according to equation 1 (see sample in Figure 2) and found to be linear to 2.5 half lives. The k_{obs} values obtained from the slope of the ln plot were replotted as a function of phlogiston as shown in the example in Figure 3 and a double reciprocal plot of this data is shown in Figure 4. These latter two plots indicate a hyperbolic dependence of the rate of gold production on the concentration of the phlogiston. The maximum rate of production of gold under the pH-independent conditions chosen was 0.45 min^{-1}. The copper was converted quantitatively to gold (Table I), the phlogiston to phlogistonium ion after which it combined with the acetate ion.

Table I. Quantitative Conversion of Aquo Copper(II) into Gold by Phlogiston

Phlogiston	Copper(II) Acetate	Gold	% Gold
mM	mM	mM	Recovered
0.200	0.050	0.0492	98.5
0.200	0.100	0.0996	99.6
10.0	0.050	0.0502	100.5
10.0	0.100	0.104	103.4

The Results section should contain statements relating only to the results and <u>not</u> to the interpretation of the results. Data is introduced with Figure # and other data is incorporated into the sentence/paragraph format. Numbers are reported in proper number of significant figures. This section is NEVER presented in outline format. Tables should be used sparingly. Most data can be presented in sentence/paragraph format. Never put in a table with one or two entries. In this sample, the table above should be omitted because the data can be summarized with a simple sentence without the table.

DISCUSSION

The conversion of aquo copper(II) ion by phlogiston into gold was demonstrated to occur under mild conditions of neutral pH and ambient temperatures. This is the first such report indicating the 100% conversion of an aqueous ion into gold by phlogiston and it is in marked contrast to poor yields found by Rojas *et al.*[2] with metals (7). The formation of gold measured by a turbidometric assay was found to be first order in copper(II) acetate because the apparent absorbance versus time data replotted according to equation 1 was linear to 2.5 half lives (see sample plot in Figure 2). The formation of gold, however, was hyperbolic with respect to phlogiston as shown in Figure 3 and 4, suggesting that a complex is forming between the copper(II) acetate and the phlogiston before reaction takes place. A chemical scheme that summarizes this is shown as follows:

$$Cu^{2+}_{(aq)} + 2\,CH_3CO_2^-{}_{(aq)} + A_{(aq)} \rightleftharpoons Cu^{2+}@A_{(aq)} + 2\,CH_3CO_2^-{}_{(aq)}$$

$$\downarrow$$

$$Au + A^{2+}_{(aq)} + 2\,CH_3CO_2^-{}_{(aq)}$$

The reaction is not pH dependent in the range studied but might be expected to decrease as the pH is lowered into the region of the acetate pK_a. Further studies will have to be carried out to determined the pH dependence.

The fact that the quantitative conversion of aqueous copper(II) ion into gold occurs pH in a neutral pH range suggests that this process can take place in the treatment of sea water with phlogiston. Sea water is slightly above neutral pH and varies from region to region, however, these studies suggest that the recovery of gold from sea water will not be strongly affected by the pH differences in the neutral pH region.

The Discussion section 1) summarizes the conclusions that are dictated by the analysis of the results; 2) elaborates on important aspects of analysis; and 3) suggests future work; 4) elaborates on literature if appropriate . For continuity and clarity, it is a good policy to present the discussion of data in the same order as data is presented in the Results section.

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2. *The "et al." is italicized (note period location). It used only for three or more authors. Use both names for two authors (see reference #1 as cited in the Introduction section).*

REFERENCES[3]

1. Jupiter, J. B. and Venus, A. M (1888). Phlogiston: A Miracle Substance that Converts Metals to Gold. J. Amer. Chem Soc. 2: 13-25.

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7. Rojas, F., Silva, K, McEliese, Olmsted, H. (1905). Examination of the Yield of Gold from the Phlogiston Reaction with Lead and Aluminum. J. Irreprod. Res. 3: 25-35.

ACKNOWLEDGMENT

I would like to acknowledge the help of Dr. Knowitall whose expertise was greatly appreciated in the preparation of this manuscript. I would also like to acknowledge the critical evaluation of the data by Dr. Strangelove.

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3. *Reference list format includes all the authors names with initials. Do not use "et al. in references*

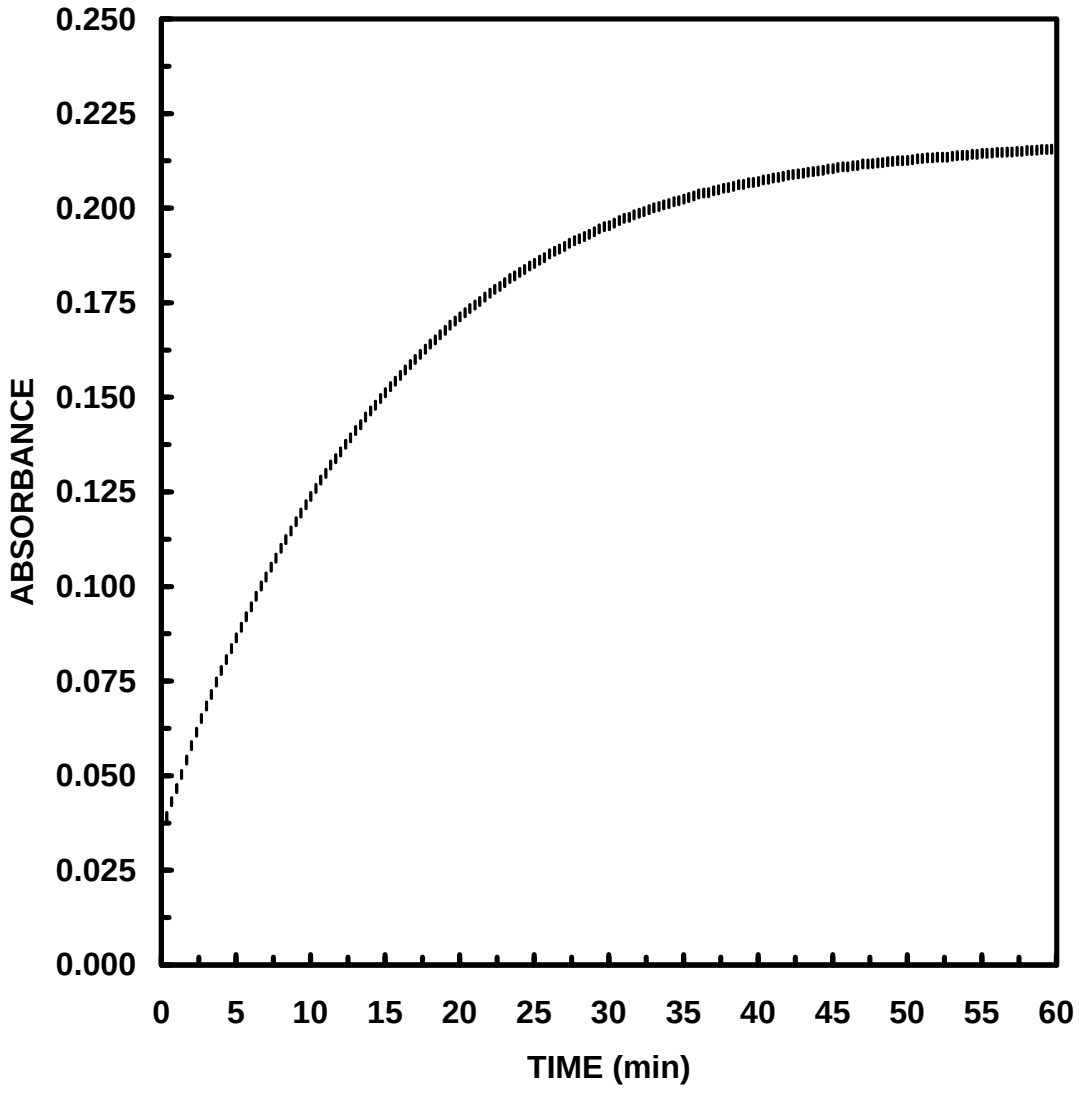

Figure 1. **Sample apparent absorbance at 300 nm versus time curve for the formation of gold from reaction of phlogiston (5.00 mM) with copper(II) acetate (0.050 mM) in 0.200 M MOPS buffer at pH 7.4 (m = 0.200, NaCl).**

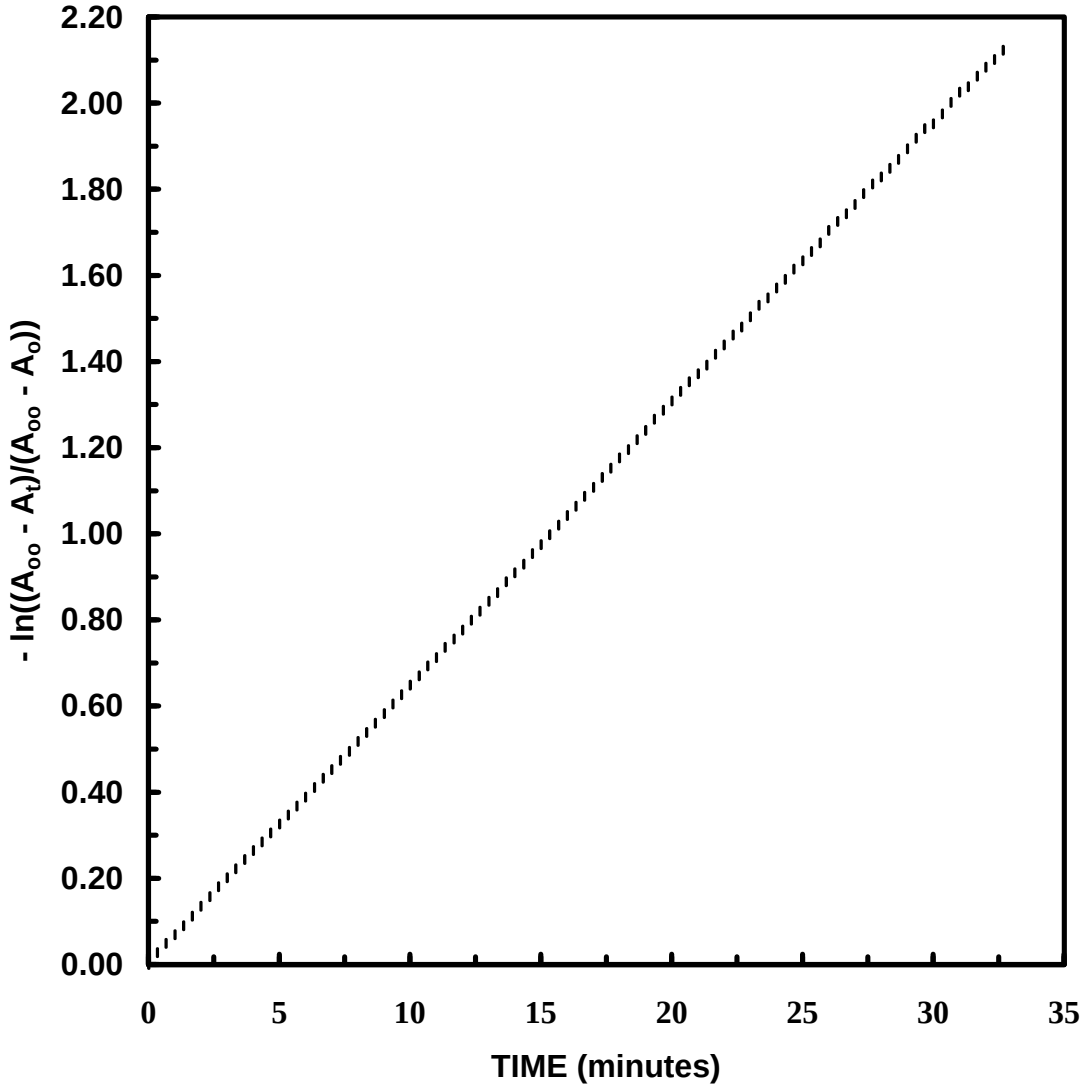

Figure 2. **Plot of -ln $((A_{oo} - A_t)/(A_{oo} - A_o))$ versus time for the data in Figure 1 indicating typical plots obtained in this study. The slope of this line is 0.0653 min^{-1} with an r^2 value of 0.9999.**

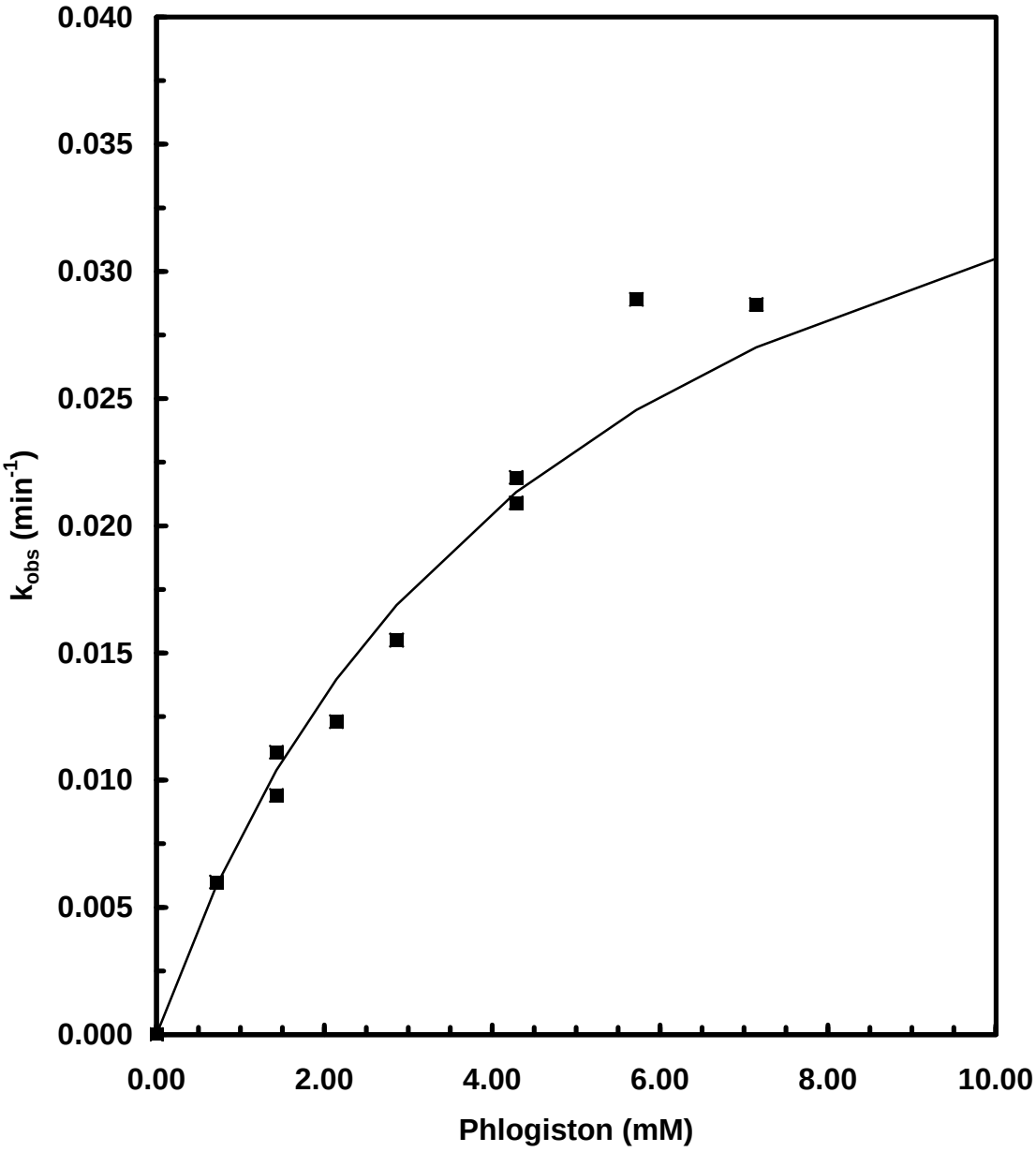

Figure 3. **Plot of k_{obs} versus phlogiston concentration for the formation of gold at pH 7.4 in 0.200 M MOPS buffer at pH 7.4 (m = 0.200, NaCl). The hyperbolic line is calculated from the slope and y-intercept parameters determined in Figure 4 (see equation 3 in Appendix). Copper(II) acetate was 0.050 mM for all runs.**

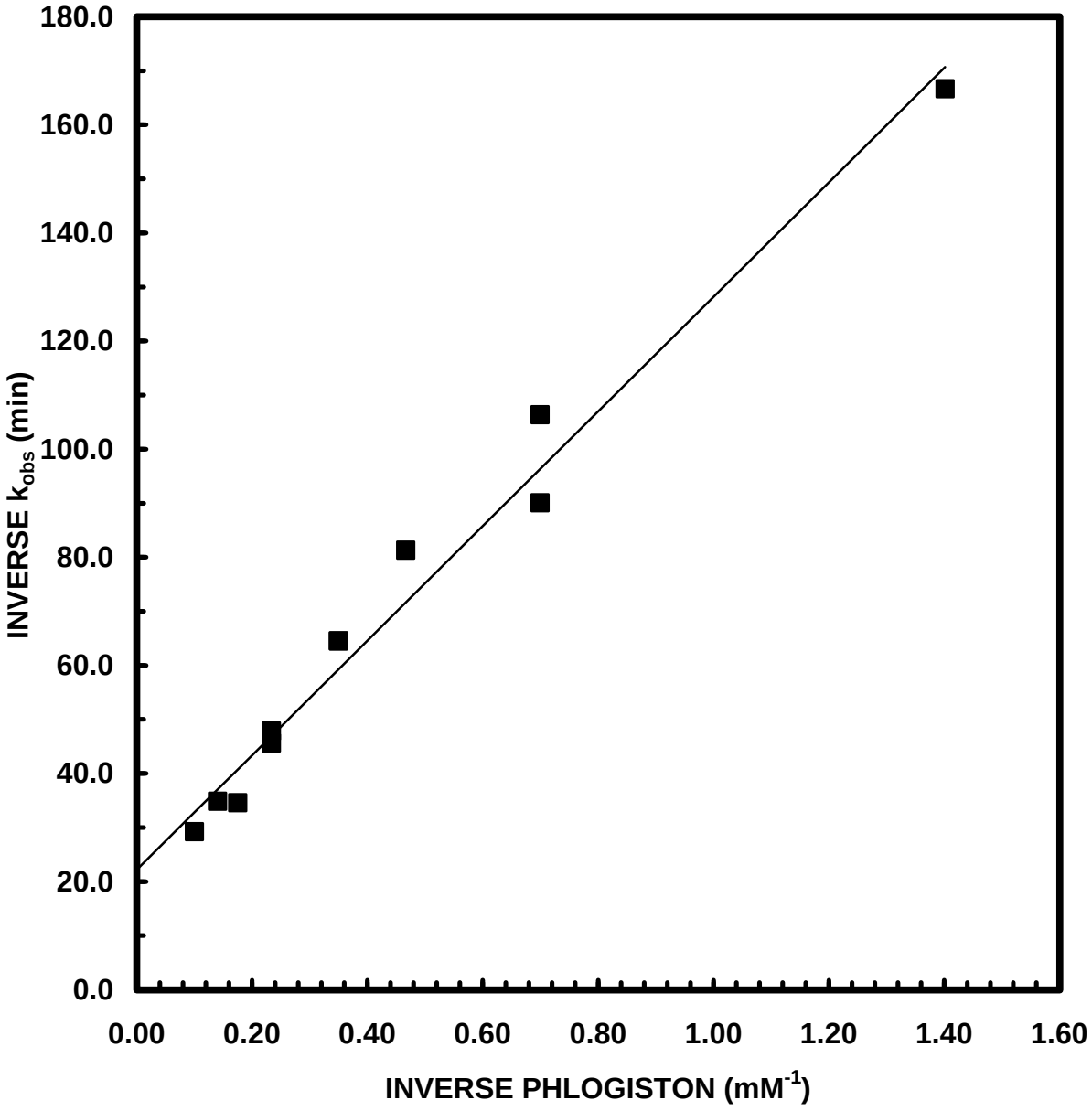

Figure 4. **Sample $\ln((A_{oo}-A_t)/(A_{oo}-A_o))$ plot of data from Figure 3 for the reaction of phlogiston and copper(II) acetate at pH 7.4. The line has slope of 106 mM min, y-intercept of 22.2 min with $r^2 = 0.978$. These parameters were used to calculate a theoretical hyperbolic line for Figure 3 (see Appendix equation 3).**

APPENDIX

The linear relationship between apparent absorbance and the amount of gold formed ($A_4 = \varepsilon_N c l$, where ε_N is an apparent extinction coefficient) was confirmed by measuring the apparent absorbance at the end of a series of reactions and the amount of solid gold formed under each condition. The Beer's Law plot obtained from data is shown in Figure 5 attached to this Appendix.

The hyperbolic line for Figure 3 was calculated from the slope (m) and y-intercept (b) values from the double reciprocal plot in Figure 4 as follows:

$$k_{obs} = \frac{[A]}{m + [A]b} \qquad [3]$$

Inverting this equation yields the linear form applicable to Figure 4:

$$\frac{1}{k_{obs}} = \frac{1}{m[A]} + b \qquad [4]$$

This section is used if there is extensive mathematical analysis that cannot be summarized simply in Materials and Methods or Results or Discussion sections. It is rarely allowed by journals but may be appropriate for student reports. The sample equations given here should be transferred to the Materials and Methods section and this Appendix eliminated.

Organize the Appendix according to the order in the Results section. Include any standard plots like Beer's Law plots or calibration plots that are not shown in the Results section. These typically are not allowed by journals, but often are required in student reports.