

AMMONIA TOXICITY
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ENVIRONMENTAL PROTECTION AGENCY

ABSTRACT

Several authors have reported that the harmful effects of ammonia are primarily related to the pH and temperature of the water because only the un-ionized ammonia is toxic. The un-ionized fraction increases with rising pH values and with rising temperature.

Other factors such as dissolved oxygen, alkalinity, free carbon dioxide, sodium ions, total dissolved solids, prior exposure to ammonia, physical stress, general physiological status, and the presence of other additive toxins or other mitigating parameters will have a great effect on the overall toxicity of ammonia to aquatic organisms. .

The actual reported toxic concentrations of ammonia vary from 0.16 mg/l to 16.5 mg/l $\text{NH}_3\text{-N}$. This apparent variability often resulted from the investigator's failure to report pH and temperature values as well as other factors which may have biased their results. It appears that the highest concentration of un-ionized ammonia which apparently will not cause any adverse effects is 0.02 mg/l $\text{NH}_3\text{-N}$.

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INTRODUCTION

This document summarizes some of the present knowledge on the effect of ammonia on fish and establishes the maximum permissible concentration limit which shall be applicable to those waters classified for fisheries use.

Ammonia is present in most waters at varying concentrations. It appears that several of the reported high concentrations are due primarily to municipal sewage effluents and, to a lesser degree, certain industrial discharges. Some agricultural discharges, such as feedlot runoffs, may also contain high concentrations of ammonia. In some areas, especially in winter, fish rearing facilities may contribute to the total load.

Some investigators, as early as 1913, observed that the toxic effect of ammonia could be related to the pH of a solution. It was not until 1947 that Wuhrmann, et al. (1947) demonstrated that it was the un-ionized ammonia that was the toxic agent and that the ionized ammonia had very little or no toxic effect. Table I summarizes some of the un-ionized ammonia toxicity data reported in the literature.

The terms ammonia, ammonium, ionized and un-ionized ammonia have been a point of confusion within the literature. Lloyd and Herbert (1960) indicated that for purposes of clarity and uniformity, the terms "ionized ammonia" (NH_4^+) and "un-ionized ammonia" (NH_3) should be adopted to describe the two forms of ammonia and that "ammonia" would include both forms ($\text{NH}_4^+ + \text{NH}_3$). These terms will be used in this document. Reported toxic values for ammonia either as ionized or un-ionized, are normally expressed as either mg/l NH_3 or mg/l $\text{NH}_3\text{-N}$. To be consistent with the current method of reporting ammonia, concentrations of un-ionized and ionized ammonia as well as ammonia will be expressed as mg/l $\text{NH}_3\text{-N}$.

Table I. Summary of Toxicity Data

<u>Organism</u>	<u>Toxicity mg/l as N Un-ionized Ammonia</u>	<u>Source</u>
Trout spawn	0.25-0.33 LC ₅₀	Wuhrmann and Woker (1948)
Brown trout fry	0.33 10 hr. LC ₆₀	Penaz (1965)
Rainbow trout	0.4 LC ₅₀	Lloyd and Herbert (1960)
Rainbow trout	1.5 LC ₅₀	Merkens and Downing (1957)
Rainbow trout	0.4 24 hr. LC ₅₀	Ball (1967)
Rainbow trout	0.5 LC ₅₀	Herbert and Shurben (1963)
Rainbow trout	0.4-0.58 24 hr. LC ₅₀	Herbert and Shurben (1965)
Rainbow trout	0.39 24 hr. LC ₅₀	Lloyd and Orr (1969)
Rainbow trout	0.16 24 hr. LC ₅₀	Liebmann (1960)
Rainbow trout	0.18 48 hr. LC ₁₅	Ball (1967)
Rainbow trout	0.09 48 hr. LC ₅	Ball (1967)
Rainbow trout	0.55 44 hr. LC ₅	Ball (1967)
Rainbow trout	6 weeks exposure to 0.005 caused gill hyperplasia	Burrows (1964)
Atlantic salmon smolt	0.23 24 hr. LC ₅₀	Herbert and Shurben (1965)
Roach	0.35 96 hr. LC ₅₀	Ball (1968)
Rudd	0.36 96 hr. LC ₅₀	Ball (1968)
Bream	0.4 96 hr. LC ₅₀	Ball (1968)
Perch	0.29 96 hr. LC ₅₀	Ball (1968)
Common carp	0.74-1.1 10-day LC ₁₇	Ball (1968)
Common carp	0.09 35-day LC ₈	Flis (1968)
Gold fish	1.6-2.0 LC ₁₀₀	McKee & Wolf (1963)
Brook trout	2.5 24 hr. LC ₁₀₀	McKee & Wolf (1963)

Table I. Summary of Toxicity Data

<u>Organism</u>	<u>Toxicity mg/l as N Un-ionized Ammonia</u>	<u>Source</u>
Carp, Shiner	4.0 LC ₁₀₀	McKee & Wolf (1963)
Suckers, Trout	4.0 LC ₁₀₀	McKee & Wolf (1963)
Creek chub	4.0 24 hr. LC , 15-21C	McKee & Wolf (1963)
Suckers, Shiner, Carp	5.2 24 hr LC ₁₀₀	McKee & Wolf (1963)
Bluegill, Sunfish	6.0 48 hr. LC ₅₀	McKee & Wolf (1963)
Fathead minnows	7.0 48 hr. LC ₅₀	McKee & Wolf (1963)
Bluegill, Sunfish	7.4 48 hr. LC ₅₀	McKee & Wolf (1963)
Sucker, Shiner, Carp	8.0 15 min. LC ₁₀₀	McKee & Wolf (1963)
Small fish	12.0 24 hr. LC ₁₀₀	McKee & Wolf (1963)
Creek chub	12.0 24 hr. LC ₁₀₀	McKee & Wolf (1963)
Perch	12.0 LC ₁₀₀	McKee & Wolf (1963)
Mosquitofish	14.8 96 hr. LC ₅₀	McKee & Wolf (1963)

From a review of the literature regarding the toxicity of ammonia to aquatic biota, the European Inland Fisheries Advisory Commission (1970) concluded that it was unlikely that concentrations lower than those adversely affecting fish would be toxic to other organisms. Therefore, it appears that fish will be the critical organisms when establishing an in-stream limitation and although it may appear that different species of fish exhibit dissimilar susceptibilities to un-ionized ammonia, such is not the case. Trout and carp are equally susceptible to un-ionized ammonia given time to react; although time-based responses are different, the ultimate response to a given concentration of un-ionized ammonia is the same (Ball, 1967).

Personal communications from Drs. Donald I. Mount and William A. Brungs, National Water Quality Laboratory, Duluth, indicate that the, as yet unpublished, U. S. Environmental Protection Agency's "Criteria for Water Quality" recommends that, for freshwater aquatic life, un-ionized ammonia not exceed 0.025 mg/l as NH_3 (0.02 mg/l $\text{NH}_3\text{-N}$). The European Inland Fisheries Advisory Commission (EIFAC) has recommended the same concentration for their inland fisheries. These recommendations have been supported by the National Water Quality Laboratory, Duluth.

CRITICAL VARIABLES AFFECTING AMMONIA TOXICITY

pH Values

Several investigators have reported values for toxic concentrations of ammonia which appear to be at variance. Wuhrmann and Woker (1948) demonstrated that it was the un-ionized ammonia molecule that was the toxic agent and that as the pH of the solution increased, the fraction of un-ionized ammonia increased correspondingly. Later studies by Downing and Merkens (1955) confirmed that the toxicity of ammonia could be directly related to the concentration of un-ionized ammonia present and that the apparent discrepancies which had appeared in some earlier reports were not at variance, but could be compatible when adjusted to concentrations of un-ionized ammonia. In more recent work, Tabata (1962) found that the ionized ammonia fraction could be toxic. He concluded, however, that it was only one-fiftieth as toxic as the un-ionized fraction. Tabata's conclusion is at variance with that of Downing and Merkens who indicated that only the un-ionized fraction was toxic.

Temperature

Generally, the toxicity of ammonia decreases with lower temperatures, due mainly to decreasing fractions of un-ionized ammonia present. However, in addition to its affect on the dissociation of ammonia, temperature extremes also have a demonstrated affect on the performance, survival and toxicant susceptibility of fish. This effect was borne out by studies done by Woker (1949). He demonstrated that, although the survival time of chub (Squalius cephalus) at constant levels of un-ionized ammonia decreased with rising temperatures, the LC₅₀ remained constant. Burrows (1964), in his observations of the toxicity of ammonia to hatchery reared salmonids, demonstrated that the mitigating affects of lower temperatures may hold true only to about 10 C. Burrows reported that un-ionized ammonia was more toxic to chinook salmon below 10 C. Work done by Brown (1969) suggests that at 3 C, the LC₅₀ of un-ionized ammonia for rainbow trout is about half that found at 10 C. It appears, therefore, that the affect which temperature has on the dissociation of ammonia could be negated by the stress induced by lower critical temperatures. The EIFAC (1970) has indicated that for temperatures below 5 C, the maximum permissible concentration of un-ionized ammonia may be less than 0.02 mg/l NH₃-N.

Figure 1 demonstrates the affect which temperature and pH have on the dissociation of ammonia. For practical purposes, the method for calculating the percentages of un-ionized ammonia as suggested by the European Inland Fisheries Advisory Commission (1970) will be used as shown in Table II.

Figure 1. Percentage of Un-ionized Ammonia in Ammonia-Water Solutions at Various pH and Temperature Values

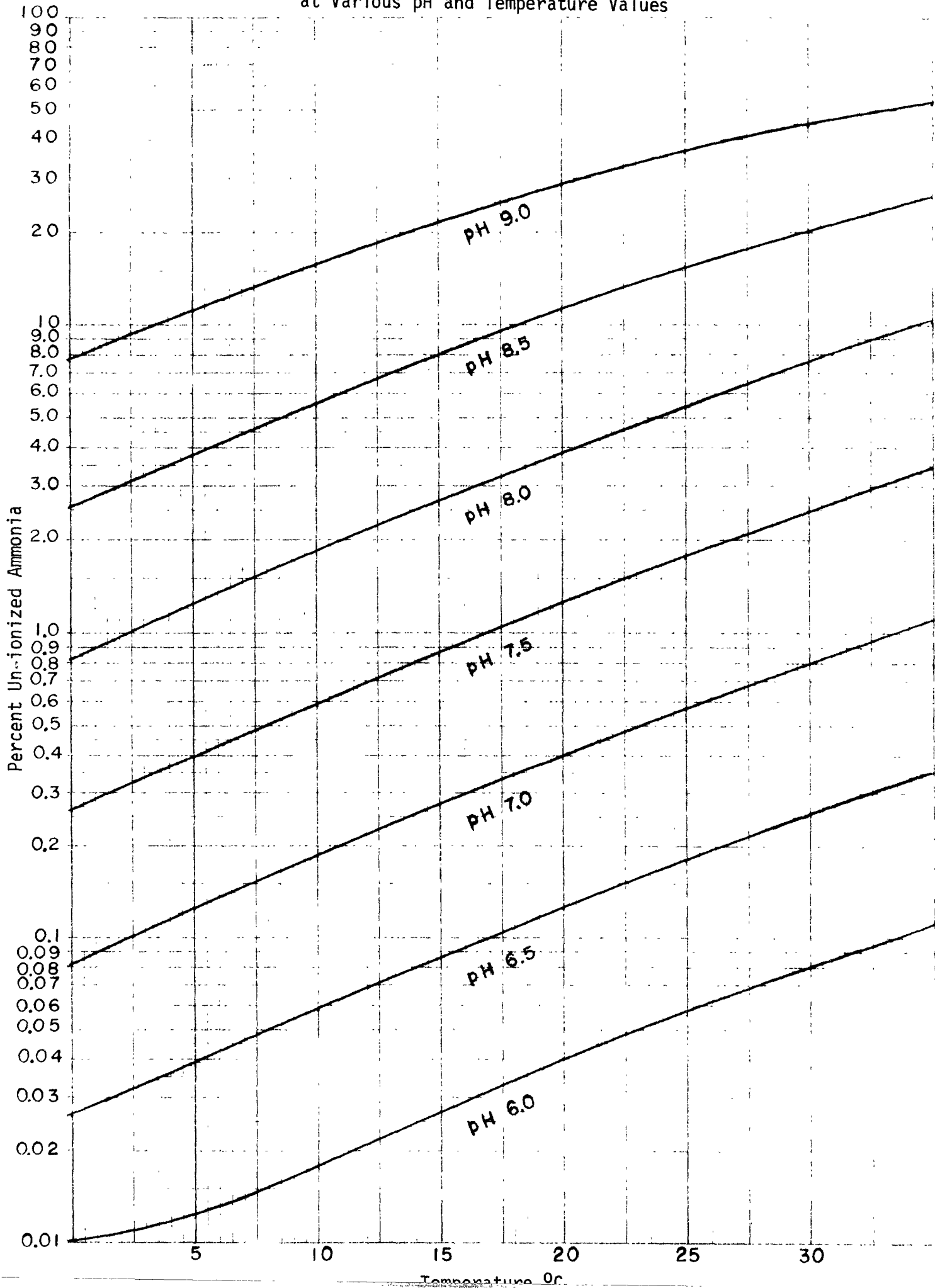
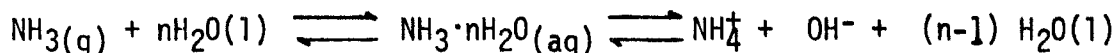


Table II. Method for calculating the percentages of un-ionized ammonia present in ammonia-water solutions.

In ammonia-water solutions, un-ionized ammonia exists in equilibrium with the ammonium ion and hydroxide ion. Butler (1964) shows the equation expressing this equilibrium as:



Derivation formula:
$$\frac{(\text{NH}_4^+) (\text{OH}^-)}{(\text{NH}_3 \cdot \text{H}_2\text{O})} = \text{Kb}$$

<u>Temperature °C</u>	<u>pK_w(a)</u>	<u>pK_b(b)</u>	<u>pK_a(c)</u>
0	14.944	4.862	10.082
5	14.734	4.830	9.904
10	14.535	4.804	9.731
15	14.346	4.782	9.564
20	14.167	4.767	9.400
25	13.997	4.751	9.246
30	13.833	4.740	9.093
35	13.680	4.733	8.947

(a) pK_w values from the Handbook of Chemistry and Physics 50th edition, 1969, page D-120. The Chemical Rubber Company.

(b) R.G. Bates and G.D. Pinching, J. Am. Chem. Soc., 1950, 72:1393.

(c) Bates and Pinching (1949) critically evaluated the constants for the dissociation of the ammonium ion at five-degree intervals from 0 to 50 C. In determining the constants at intermediate temperatures, the temperature dependence of the pK values must be established. In a recent excellent analysis of the literature data on the ammonia-water equilibrium system, Thurston, Russo, and Emerson (1974) devised such a calculated coefficient utilizing computer techniques which statistically represent a completely adequate fit to the Bates and Pinching data. Thurston, Russo and Emerson have suggested the following equation to calculate pK_a at all temperatures, in ammonia-water solutions of zero salinity:

$$\text{pK}_a = 0.09018 + 2729.92/\text{T}$$

$$\text{Where } \text{T} = ^\circ\text{C} + 273.2$$

This equation has been used in this document.

$$(1) \quad \frac{(\text{NH}_4^+) (\text{OH}^-)}{(\text{NH}_3 \cdot \text{H}_2\text{O})} = K_b, \text{ where } K_b \text{ is the dissociation constant for ammonia}$$

$$(2) \quad \frac{(\text{NH}_4^+)}{(\text{NH}_3 \cdot \text{H}_2\text{O})} = \frac{K_b}{(\text{OH}^-)}$$

$$(3) \quad (\text{NH}_4^+) = \frac{K_b}{(\text{OH}^-)} (\text{NH}_3 \cdot \text{H}_2\text{O})$$

$$(4) \quad (\text{NH}_4^+) + (\text{NH}_3 \cdot \text{H}_2\text{O}) = \text{ammonia}$$

$$(5) \quad \text{Substituting the value for } (\text{NH}_4^+) \text{ from equation (3) into equation (4),}$$

$$\frac{K_b (\text{NH}_3 \cdot \text{H}_2\text{O})}{(\text{OH}^-)} + (\text{NH}_3 \cdot \text{H}_2\text{O}) = \text{ammonia}$$

$$(6) \quad \text{By factoring out } (\text{NH}_3 \cdot \text{H}_2\text{O})$$

$$\text{NH}_3 \cdot \text{H}_2\text{O} \left(1 + \frac{K_b}{(\text{OH}^-)}\right) = \text{ammonia}$$

$$(7) \quad \frac{\text{NH}_3 \cdot \text{H}_2\text{O} \times 100}{\text{ammonia}} = \frac{100}{1 + \frac{K_b}{(\text{OH}^-)}} = \text{Percent un-ionized ammonia}$$

$$(a) \quad K_w = K_a K_b$$

$$(b) \quad K_b = \frac{K_w}{K_a}$$

$$(c) \quad \frac{K_b}{(\text{OH}^-) K_a (\text{OH}^-)} = \frac{K_w}{K_a (\text{OH}^-)} = \frac{(\text{H}^+)}{K_a} = \text{antilog} (pK_a - pH)$$

$$(8) \quad \text{Percent un-ionized ammonia} = \frac{100}{1 + \text{antilog} (pK_a - pH)}$$

Given a maximum permissible in-stream concentration of un-ionized ammonia of 0.02 mg/l $\text{NH}_3\text{-N}$,

$$(9) \quad \text{Then, } \frac{0.02 \text{ mg/l } \text{NH}_3\text{-N} \times 100}{\text{percent un-ionized ammonia}} = \text{ammonia - N}$$

Total Dissolved Solids - Salinity

Herbert and Shurben (1965) reported that, under experimentally controlled conditions of constant pH, the LC_{50} 's of ammonia to rainbow trout in solutions nearly isotonic with fish blood (.9%) were approximately twice those observed in freshwater (.05%). Thurston, Russo and Emerson (1974) indicate that an increase in solution ionic strength results in a concomitant decrease in the un-ionized ammonia fraction of ammonia. This, in part, could rationalize that data reported by Herbert and Shurben. However, further work is needed to clarify the observed mitigating affects of total dissolved solids.

Free Carbon Dioxide

Lloyd and Herbert (1960) showed that the toxicity of ammonia is not entirely dependent on the pH value of the bulk of the solution, but on that of the water at the gill surface. Lloyd (1961) indicated that this value can be readily calculated from the bicarbonate alkalinity, temperature, and free carbon dioxide concentration in the water, and the free carbon dioxide excreted by the gills of the fish. He estimated the concentration of excreted carbon dioxide in the respired water (as mg. carbon dioxide/liter) by using the formula,

$$\text{D.O.} \times \text{R.Q.} \times \frac{\text{mol. wt. CO}_2}{\text{mol. wt. O}_2} \times \frac{P}{100},$$

where D.O. is the dissolved oxygen concentration of the water in

mg/l, R.Q. the respiratory quotient of the fish (assumed to be 0.8), and P the percentage removal of oxygen from the respired water. Lloyd (1961) stated that "as the oxygen concentration of the water is reduced, the concentration of excreted carbon dioxide at the gill surface is also reduced and the pH value of the water at this surface rises, resulting in an apparent increase in the toxicity of ammonia. This increase in toxicity will become greater as the concentration of free carbon dioxide in the bulk of the solution is reduced." However EIFAC (1970) points out that under conditions where dissolved oxygen concentrations are adequate, free carbon dioxide levels very low and pH values high, the level of un-ionized ammonia which is toxic to fish may be about five times greater than those indicated for polluted waters where free carbon dioxide is high and pH lower. This manifest reduction in toxicity is possibly due to an increased pressure gradient across the respiratory membrane, which would facilitate the rapid excretion of carbon dioxide.

Dissolved Oxygen

Several investigators have found that lower concentrations of dissolved oxygen can greatly affect the toxicity of several toxins. Downing and Merkens (1955) and Lloyd (1961) found this effect to be quite evident with ammonia. Lloyd felt that a reduction in dissolved oxygen concentration would be accompanied by an increased rate in ventilation by fish. This could then increase the toxicity of ammonia in two ways. First, the increased rate of ventilation would effect a greater rate of exposure to the un-ionized ammonia molecule. Secondly, increased respiration would effectively reduce the concentration of

carbon dioxide being excreted at the gill surface, thereby increasing the pH at that surface. The effects of varying concentrations of both dissolved oxygen and carbon dioxide are obviously related.

Bicarbonate Alkalinity

The most pronounced effect which bicarbonate alkalinity has on the toxicity of ammonia is associated with the affect which it has on the pH of the solution in conjunction with the concentration of free carbon dioxide present. This effect has been demonstrated by Lloyd (1961).

Prior Exposure

Lloyd and Orr (1969) demonstrated that rainbow trout exposed to sub-lethal concentrations of ammonia could then be exposed to lethal concentrations with no apparent harm. This ability to acclimate was retained for about one day but was lost after about three days. However, no estimates of the maximum concentration in which a fish could survive were given.

TOXICITY OF AMMONIA IN THE PRESENCE OF OTHER POISONS

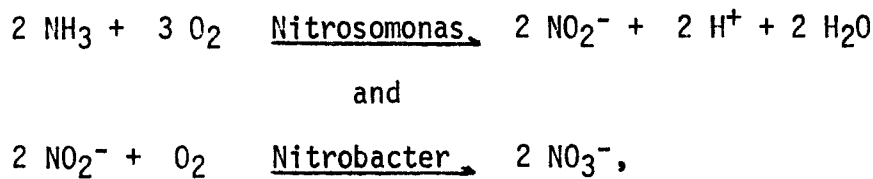
The European Inland Fisheries Advisory Commission's "Report on Ammonia and Inland Fisheries" (1970) states that "several tests have been made with rainbow trout on the toxicity of mixtures of ammonia with other poisons. Experiments with solutions containing both ammonia and cyanide showed that the combination was more toxic than either substance alone (Wuhrmann and Woker, 1948). Herbert (1962) showed that the threshold LC₅₀ of a mixture of ammonia and phenol was obtained when the sum of the individual concentrations, expressed as the proportion of their separate threshold LC₅₀ values, equalled unity. Further tests with zinc and ammonia (Herbert and Shurben, 1964), and copper and ammonia (Herbert and Van Dyke, 1964) gave similar results, in that the toxicity of the individual poisons could be added together in this manner." However, Brown, Jordan and Tiller (1969) showed that mixtures of zinc, phenol, and ammonia, in which the proportion of the total toxicity contributed by zinc was predominate, were significantly less toxic than the expected values. It may be possible that this method of summing toxicities is not valid for all concentrations of poisons.

Vamos and Tasnadi (1967) reported using copper sulfate to reduce the toxicity of ammonia in carp ponds. It was suggested that, on a short exposure basis, the copper-ammonia compounds formed were not toxic, a finding opposite to that of Herbert and Van Dyke (1964) in laboratory experiments. It is possible, then, that in situ bioassays will have to be conducted to arrive at a more valid acceptable ammonia concentration for a particular situation, especially when other additive toxins are present in relatively high concentrations.

OTHER EFFECTS OF AMMONIA

Indirectly, ammonia can have adverse impacts on fish. Ammonia, either ionized or un-ionized can have a direct influence on the dissolved oxygen concentrations of water.

Under aerobic conditions, ammonia is readily oxidized to nitrite by Nitrosomonas bacteria. Nitrite can be, in turn, oxidized to nitrates by Nitrobacter. Sawyer and McCarty (1967) show the reactions,



whereby 2 moles of ammonia will consume 4 moles of oxygen. Ammonia, then, could theoretically have an ultimate oxygen demand of 4.57 mg O₂/mg NH₃-N.

Nitrates, as such, may act to increase the net productivity of aquatic systems. To a certain extent this may be quite beneficial to the entire aquatic community. However, when nitrate levels become excessive, and assuming that the other nutrient factors are present, eutrophication and associated algal blooms can become a severe problem.

MECHANISM OF TOXIC ACTION

Fromm (1970) noted that rainbow trout excrete ninety-four percent of their total nitrogen as ammonia, urea and protein nitrogen. Ammonia is produced endogenously by fish primarily via the degradation of protein, more specifically the deamination of various amino acids. Most authors indicate that teleost fish, unlike mammals, synthesize urea via the purine pathway. Prosser and Brown (1961) indicate that pyrimidine nucleic acids are generally excreted as either ammonia or urea by teleosts.

Of those possible nitrogenous excretory products, ammonia is the smallest and simplest. It is extremely soluble in water and is, normally, easily excreted by fish across the lipid soluble cell membranes of the gills. Except for the toxicity of ammonia, there are advantages over urea as the chief product of nitrogen metabolism. The conversion of protein nitrogen to ammonia requires substantially less energy than urea production. Actually, some deamination reactions lead to the production and capture of free energy (Figure 2).

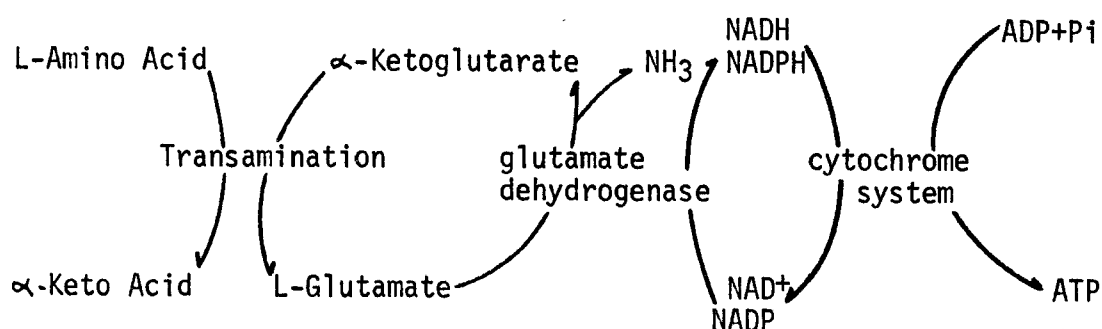


Figure 2. Deamination of amino acids and production of ATP via coupled transamination of glutamate dehydrogenase. (Forster and Goldstein, 1969)

Mammals normally synthesize urea via the ornithine urea cycle (Forster and Goldstein, 1969). However, teleost fish lack two enzymes involved in the first two steps of the ornithine cycle, carbamyl phosphate synthetase and ornithine transcarbamylase. Forster and Goldstein (1969) indicate that urea is probably synthesized from purines and, in some instances, from amino acids by teleosts (Figure 3).

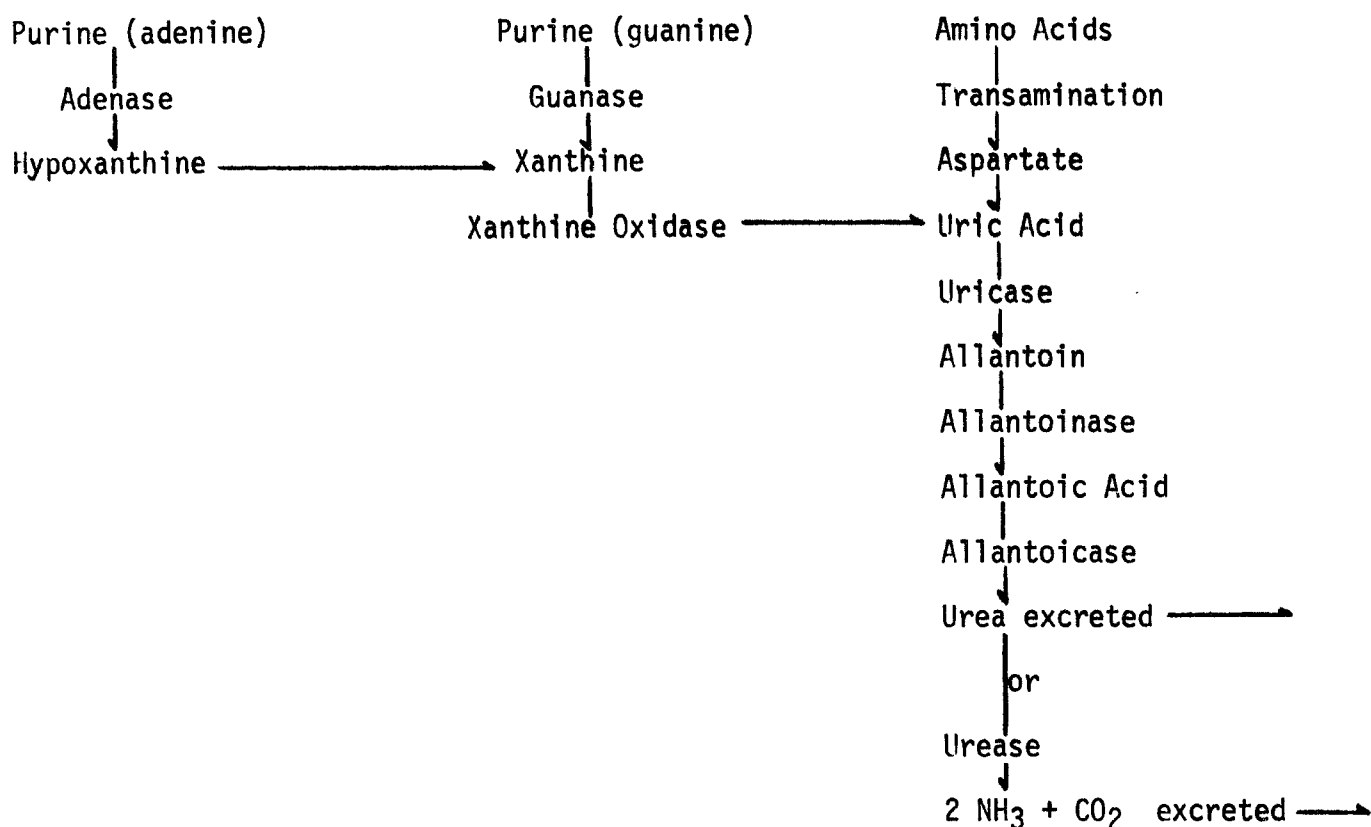


Figure 3. Urea and ammonia production via and purine pathway. (modified from Forster and Goldstein, 1969 and Prosser and Brown, 1961)

Ammonia is a toxic substance. An animal must either excrete it or detoxify it. Most fish, because of their aqueous environment will excrete ammonia rather than detoxify it. Some authors feel that teleost fish are obligated to excrete ammonia rather than detoxify it because they lack the specific enzymes necessary for this process (Forster and Goldstein, 1969).

The excretion of ammonia is extremely dependent upon the pH of both the plasma fluid and water at the gill surface. Normally, only un-ionized ammonia (NH₃) is excreted through the lipid soluble membrane. At the pH of body fluids less than one percent of the ammonia exists as un-ionized ammonia but the conversion of NH₄⁺ to NH₃ is instantaneous and hence probably not a rate limiting step in its elimination (Forster and Goldstein, 1969).

to kill fish by preventing exchange of the respiratory gases at the gill surface or by inhibiting transport of oxygen in combination with hemoglobin.

Studies conducted by Burrows (1964) indicate that continuous exposure to low levels of un-ionized ammonia greatly affected the physiology of salmonids. He noted that exposure to as little as 0.3 mg/l ammonia-NH₄ (0.002 mg/l un-ionized ammonia as N) for six weeks greatly reduced the stamina, performance and growth of salmon. Histological examination of the gill lamella showed extensive hyperplasia of the gill epithelium. Similar examinations of salmon exposed to 0.70 mg/l ammonia-NH₄ (0.005 mg/l un-ionized ammonia as N) for six weeks showed even more extensive hyperplasia, to the extent that there was fusion of the lamella. Obviously, this pathological condition could effectively reduce the surface area of the gills for gas exchange, which would explain the effected physiology. Burrows indicated that this condition would make the fish highly susceptible to gill infections, a problem common to fish rearing units.

Burrows noted that the principal nitrogenous excretory product was greatly dependent upon age, sex, species and stress placed upon fish. Under low loading conditions in the raceways, as well as at night under average loading rates, urea was the primary nitrogenous excretory product. Under higher loading rates and during periods of daylight activity, ammonia became the primary nitrogenous excretory product. Burrows did not offer an explanation for urea suppression, but it appears likely when salmonids are stressed, from either increased physical activity or high hatchery loading rates, they would tend to conserve as much energy as possible and since, as pointed out earlier, urea synthesis requires substantially more energy than ammonia synthesis, the production of ammonia would be favored.

CONCLUSIONS AND RECOMMENDATIONS

1. The effect of ammonia on inland fisheries is an important factor to be considered when establishing water quality criteria.

The presence of ammonia is due primarily to municipal sewage effluents and, to a lesser degree, certain industrial discharges. Certain agricultural discharges, such as feedlot runoffs, may also contain high concentrations of ammonia.

2. The mechanism of toxicity of un-ionized ammonia is highly debatable and should be investigated further. It appears likely to be twofold, depending on the concentration. High concentrations appear to limit the excretion of metabolic ammonia, inducing hyperammonemia and subsequent histologic insult. Continuous exposure to low levels induce histopathologic aberrations of gill epithelia, stressing the animal and making it less resistant to subsequent pathological conditions.

3. Many factors such as pH, temperature, alkalinity, dissolved oxygen, free carbon dioxide, sodium ions, total dissolved solids, presence of other toxins and other factors will greatly affect the toxicity of ammonia. Once a 96-hour LC_{50} has been determined using the receiving water in question and the most sensitive species, in the most sensitive portion of its life cycle in the locality as the test organisms, a concentration of un-ionized ammonia safe to aquatic life in that water can be estimated by multiplying the 96-hour LC_{50} by a determined application factor; but, in general, the maximum permissible in-stream concentration of un-ionized ammonia should be $0.02 \text{ mg/l NH}_3\text{-N}$ for waters classified for fisheries use.

Table III shows the calculated values, based on pH and temperature, for ammonia as N which would give an un-ionized ammonia concentration of $0.02 \text{ mg/l NH}_3\text{-N}$. Further, more extensive values are given in Appendix A.

Table III. Concentrations of ammonia ($\text{NH}_4^+ + \text{NH}_3$) which contain an un-ionized ammonia concentration of 0.02 mg/l $\text{NH}_3\text{-N}$.

		<u>pH Value</u>					
<u>Temperature</u>							
$^{\circ}\text{C}$	6.0	6.5	7.0	7.5	8.0	8.5	9.0*
5	165	52.3	16.6	5.25	1.67	.543	.186
10	111	35.1	11.1	3.53	1.13	.371	.131
15	75.5	23.9	7.57	2.41	.775	.259	.0961
20	51.0	16.5	5.22	1.67	.541	.185	.0726
25	36.3	11.5	3.65	1.17	.384	.135	.0569
30	25.7	8.13	2.58	.832	.277	.102	.0462

*The European Inland Fisheries Advisory Commission (EIFAC), reports that criteria under this heading may be unduly low if there is little free carbon dioxide in the water.

The range of limitations for ammonia are based on pH and temperature variations and assume an activity coefficient of 1.0. For example, at a pH of 7.5 and a temperature of 15 C, the maximum permissible ammonia concentration is 2.41 mg/l as N. This concentration of ammonia would produce an un-ionized ammonia concentration of 0.02 mg/l $\text{NH}_3\text{-N}$. Concentrations of maximum permissible ammonia for pH and temperature values outside of those in Table III are not necessarily valid for reasons explained in the text of this document.

APPENDIX A

Calculations of Percentages of Ionized and Un-ionized Ammonia in Ammonia-Water Solutions

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0001      DIMENSION TTEMP(8),TKB(8),TPKW(8)
0002      DATATEMP/0.0,5.0,10.0,15.0,20.0,25.0,30.0,35.0/
0003      DATATKB/1.374E-5,1.479E-5,1.570E-5,1.652E-5,1.710E-5,1.774E-5,
          *1.820E-5,1.849E-5/
0004      DATATPKW/14.9435,14.7338,14.5344,14.3463,14.1669,13.9965,13.8330,
          *13.6801/
0005      REAL KB,KW
0006      DO 20 J=1,82
0007      PRINT 99
0008      99 FORMAT(1.9X,'** ',
          * 'CONCENTRATIONS OF AMMONIA(NH4+NH3) WHICH CONTAIN ',
          * 'AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH3-N')
0009      PRINT 100
0010      100 FORMAT(1H1,T4,'TEMP C',T13,'PH',,T26,
          1' PKA ',T42,'RATIO',,T55,
          2' % UNIONIZED % IONIZED CONCENTRATION %',
          3' T57,'AMMONIA', T71,'AMMONIA',,NH4+NH3 '** '/)
0011      TEMP=J-1
0012      TEMP=TEMP*0.5
0013      PH=5.0
0014      6 DO 31=1,8
0015      IF (TEMP.EQ.TTEMP(I))GO TO 10
0016      IF (TEMP.GT.TTEMP(I))GO TO 3
0017      GO TO 11
0018      3 CONTINUE
0019      STOP
0020      10 KB=TKB(I)
0021      PKW=TPKW(I)
0022      GO TO 33
0023      11 X1=TTEMP(I-1)
0024      X2=TTEMP(I)
0025      Y1=TKB(I-1)
0026      Y2=TKB(I)
0027      Y11=TPKW(I-1)
0028      Y22=TPKW(I)
0029      KB=Y1+(TEMP-X1)/(X2-X1)*(Y2-Y1)
0030      PKW=Y11+(TEMP-X1)/(X2-X1)*(Y22-Y11)
0031      33 KW=10.0**(-PKW)
0032      PKB=-ALOG10(KB)
0033      PKA=0.09018 + 2729.92 / (TEMP+273.2)
0034      OH=KW/(10.0**(-PH))
0035      PCTU=100.0/(1.0+10.0** (PKA-PH))
0036      RATIO=10.0** (PKA-PH)
0037      TOTAL=0.02059/PCTU*100.0
0038      PCTI=100.0-PCTU
0039      PKW=PKW+0.00005
0040      PRINT 1000,TEMP,PH,PKA,RATIO,PCTU,PCTI,TOTAL
0041      PH=PH+0.1
0042      IF (PH.GT.10.1)GO TO 20
0043      GO TO 6
0044      20 CONTINUE
0045      1000 FORMAT(2X,F5.1,4X,F4.1,3X,
          * F14.4,5X,
          10PF10.2,5X,2(F10.6,5X),F11.6)
0046      STOP
0047      END

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A-2

A-3

TEMP C	PH	PKA	RATIO	% UNIONIZED AMMONIA	% IONIZED AMMONIA	CONCENTRATION (NH ₄ +NH ₃) **
0.0	5.0	10.0826	120938.94	0.000827	99.999161	2490.15312
0.0	5.1	10.0826	96365.37	0.001041	99.998947	1978.00586
0.0	5.2	10.0826	76307.44	0.001310	99.998688	1571.19067
0.0	5.3	10.0826	60613.27	0.001650	99.998337	1248.04761
0.0	5.4	10.0826	48146.90	0.002077	99.997910	991.365234
0.0	5.5	10.0826	38244.50	0.002615	99.997375	787.474609
0.0	5.6	10.0826	30376.73	0.003292	99.996704	625.518711
0.0	5.7	10.0826	24130.72	0.004144	99.995850	496.871826
0.0	5.8	10.0826	19167.74	0.005217	99.994781	394.684326
0.0	5.9	10.0826	15225.50	0.006567	99.993423	313.513428
0.0	6.0	10.0826	12094.05	0.008264	99.991730	249.037064
0.0	6.1	10.0826	9606.66	0.010408	99.989578	197.821701
0.0	6.2	10.0826	7630.85	0.013103	99.986893	157.139771
0.0	6.3	10.0826	6061.41	0.016495	99.983505	124.824997
0.0	6.4	10.0826	4814.76	0.020765	99.979233	99.156448
0.0	6.5	10.0826	3824.50	0.026140	99.973846	78.767090
0.0	6.6	10.0826	3037.91	0.032906	99.967087	62.571243
0.0	6.7	10.0826	2413.10	0.041423	99.958572	49.706421
0.0	6.8	10.0826	1916.80	0.052143	99.947845	39.487503
0.0	6.9	10.0826	1522.57	0.065635	99.934357	31.370285
0.0	7.0	10.0826	1209.42	0.082616	99.917374	24.922577
0.0	7.1	10.0826	960.68	0.103985	99.896011	19.800964
0.0	7.2	10.0826	763.10	0.130874	99.869125	15.732729
0.0	7.3	10.0826	606.15	0.164704	99.835297	12.501204
0.0	7.4	10.0826	481.48	0.207262	99.792725	9.934306
0.0	7.5	10.0826	382.46	0.260785	99.739212	7.895350
0.0	7.6	10.0826	303.80	0.328089	99.671906	6.275737
0.0	7.7	10.0826	241.31	0.412685	99.587311	4.989237
0.0	7.8	10.0826	191.68	0.518988	99.481003	3.967332
0.0	7.9	10.0826	152.26	0.652490	99.347504	3.155602
0.0	8.0	10.0826	120.94	0.820050	99.179947	2.510823
0.0	8.1	10.0826	96.07	1.030192	98.969803	1.998655
0.0	8.2	10.0826	76.31	1.293483	98.706512	1.591825
0.0	8.3	10.0826	60.62	1.622961	98.377029	1.264668
0.0	8.4	10.0826	48.15	2.034634	97.965363	1.011975
0.0	8.5	10.0826	38.25	2.548025	97.451965	0.808077
0.0	8.6	10.0826	30.38	3.186747	96.813248	0.646113
0.0	8.7	10.0826	24.13	3.979038	96.020950	0.517461
0.0	8.8	10.0826	19.17	4.958222	95.041763	0.415270
0.0	8.9	10.0826	15.23	6.162909	93.837082	0.334095
0.0	9.0	10.0826	12.09	7.636765	92.363235	0.269617
0.0	9.1	10.0826	9.61	9.427685	90.572311	0.218399
0.0	9.2	10.0826	7.63	11.585917	88.414078	0.177716
0.0	9.3	10.0826	6.06	14.160975	85.839020	0.145400
0.0	9.4	10.0826	4.81	17.197037	82.802963	0.119730
0.0	9.5	10.0826	3.82	20.726852	79.273148	0.099340
0.0	9.6	10.0826	3.04	24.764496	75.235504	0.083143
0.0	9.7	10.0826	2.41	29.297974	70.702026	0.070278
0.0	9.8	10.0826	1.92	34.283218	65.716782	0.060059
0.0	9.9	10.0826	1.52	39.641113	60.358887	0.051941
0.0	10.0	10.0826	1.21	45.259674	54.740326	0.045493
0.0	10.1	10.0826	0.96	51.001709	48.998291	0.040371

** CONCENTRATIONS OF AMMONIA(NH₄+NH₃) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH₃-N

A-4

TEMP C	PH	PKA	RATIO	% UNIONIZED AMMONIA	% IONIZED AMMONIA	CONCENTRATION NH4+NH3 **
0.5	5.0	10.0643	115960.94	0.000862	99.999130	2387.65552
0.5	5.1	10.0643	92111.19	0.001085	99.998901	1896.58960
0.5	5.2	10.0643	73166.62	0.001367	99.998627	1506.52148
0.5	5.3	10.0643	58118.41	0.001721	99.998276	1196.67871
0.5	5.4	10.0643	46165.12	0.002166	99.997833	950.560303
0.5	5.5	10.0643	36670.31	0.002727	99.997269	755.062012
0.5	5.6	10.0643	29128.30	0.003433	99.996567	599.772217
0.5	5.7	10.0643	23137.47	0.004322	99.995667	476.421143
0.5	5.8	10.0643	18378.77	0.005441	99.994553	378.439597
0.5	5.9	10.0643	14598.80	0.006847	99.993149	300.609863
0.5	6.0	10.0643	11596.25	0.008623	99.991364	238.787460
0.5	6.1	10.0643	9211.25	0.010855	99.989136	189.680099
0.5	6.2	10.0643	7316.76	0.013665	99.986328	150.672623
0.5	6.3	10.0643	5811.91	0.017203	99.982788	119.687836
0.5	6.4	10.0643	4616.57	0.021656	99.978333	95.075851
0.5	6.5	10.0643	3667.08	0.027262	99.972733	75.525787
0.5	6.6	10.0643	2912.87	0.034319	99.965668	59.996597
0.5	6.7	10.0643	2313.78	0.043201	99.956787	47.661285
0.5	6.8	10.0643	1837.90	0.054380	99.945618	37.862991
0.5	6.9	10.0643	1459.90	0.068451	99.931549	30.079926
0.5	7.0	10.0643	1159.64	0.086159	99.913834	23.897598
0.5	7.1	10.0643	921.14	0.108444	99.891556	18.986786
0.5	7.2	10.0643	731.69	0.136484	99.863510	15.085995
0.5	7.3	10.0643	581.20	0.171762	99.828232	11.987483
0.5	7.4	10.0643	461.66	0.216140	99.783859	9.526246
0.5	7.5	10.0643	366.71	0.271951	99.728043	7.571214
0.5	7.6	10.0643	291.29	0.342125	99.657867	6.018271
0.5	7.7	10.0643	231.38	0.430325	99.569672	4.794726
0.5	7.8	10.0643	183.79	0.541147	99.458847	3.804883
0.5	7.9	10.0643	145.99	0.680310	99.319687	3.026563
0.5	8.0	10.0643	115.97	0.854952	99.145035	2.408322
0.5	8.1	10.0643	92.11	1.073941	98.926056	1.917236
0.5	8.2	10.0643	73.17	1.348261	98.651733	1.527152
0.5	8.3	10.0643	58.12	1.691453	98.308533	1.217296
0.5	8.4	10.0643	46.17	2.120125	97.879868	0.971169
0.5	8.5	10.0643	36.67	2.654503	97.345490	0.775663
0.5	8.6	10.0643	29.13	3.319004	96.680984	0.620367
0.5	8.7	10.0643	23.14	4.142772	95.857224	0.497010
0.5	8.8	10.0643	18.38	5.160087	94.839905	0.399024
0.5	8.9	10.0643	14.60	6.410505	93.589493	0.321191
0.5	9.0	10.0643	11.60	7.938571	92.061417	0.259367
0.5	9.1	10.0643	9.21	9.792766	90.207230	0.210257
0.5	9.2	10.0643	7.32	12.023479	87.976517	0.171248
0.5	9.3	10.0643	5.81	14.679641	85.320358	0.140262
0.5	9.4	10.0643	4.62	17.803833	82.196167	0.115649
0.5	9.5	10.0643	3.67	21.425964	78.574036	0.096098
0.5	9.6	10.0643	2.91	25.555908	74.444092	0.080568
0.5	9.7	10.0643	2.31	30.176147	69.823853	0.068233
0.5	9.8	10.0643	1.84	35.236343	64.763657	0.058434
0.5	9.9	10.0643	1.46	40.651062	59.348938	0.050651
0.5	10.0	10.0643	1.16	46.302963	53.697037	0.044468
0.5	10.1	10.0643	0.92	52.051498	47.948502	0.039557

** CONCENTRATIONS OF AMMONIA(NH4+NH3) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH3-N

A-5

TEMP C	PH	PKA	RATIO	% UNIONIZED AMMONIA	% IONIZED AMMONIA	CONCENTRATION NH4+NH3 **
1.0	5.0	10.0461	111204.94	0.000899	99.999100	2289.72925
1.0	5.1	10.0461	86333.37	0.001132	99.998856	1818.80493
1.0	5.2	10.0461	70165.81	0.001425	99.998566	1444.73462
1.0	5.3	10.0461	55734.75	0.001744	99.998199	1147.59888
1.0	5.4	10.0461	44271.75	0.002259	99.997742	911.575684
1.0	5.5	10.0461	35166.35	0.002844	99.997147	724.095703
1.0	5.6	10.0461	27933.67	0.003580	99.996414	575.174805
1.0	5.7	10.0461	22188.51	0.004507	99.995483	456.842080
1.0	5.8	10.0461	17624.99	0.005673	99.994324	362.919189
1.0	5.9	10.0461	14000.05	0.007142	99.992844	288.281494
1.0	6.0	10.0461	11120.65	0.008991	99.990997	228.994644
1.0	6.1	10.0461	8633.46	0.011319	99.988678	181.901443
1.0	6.2	10.0461	7016.68	0.014250	99.985748	144.493866
1.0	6.3	10.0461	5573.55	0.017939	99.982056	114.779938
1.0	6.4	10.0461	4427.23	0.022582	99.977417	91.177338
1.0	6.5	10.0461	3516.68	0.028424	99.971573	72.429092
1.0	6.6	10.0461	2793.40	0.035765	99.964203	57.536743
1.0	6.7	10.0461	2218.88	0.045047	99.954941	45.707367
1.0	6.8	10.0461	1762.52	0.056705	99.943283	36.310928
1.0	6.9	10.0461	1400.02	0.071370	99.928619	28.847092
1.0	7.0	10.0461	1112.08	0.089841	99.910156	22.918320
1.0	7.1	10.0461	863.36	0.113075	99.886917	18.208923
1.0	7.2	10.0461	701.68	0.142313	99.857681	14.466122
1.0	7.3	10.0461	557.36	0.179095	99.820892	11.496693
1.0	7.4	10.0461	442.73	0.225363	99.774628	9.136384
1.0	7.5	10.0461	351.67	0.283549	99.716446	7.261532
1.0	7.6	10.0461	279.34	0.356705	99.643295	5.772283
1.0	7.7	10.0461	221.89	0.448649	99.551346	4.589331
1.0	7.8	10.0461	176.25	0.564160	99.435837	3.649674
1.0	7.9	10.0461	140.00	0.709198	99.290802	2.903278
1.0	8.0	10.0461	111.21	0.891190	99.108810	2.310394
1.0	8.1	10.0461	86.34	1.119356	98.880630	1.839450
1.0	8.2	10.0461	70.17	1.405112	98.594879	1.465363
1.0	8.3	10.0461	55.74	1.762518	98.237473	1.168215
1.0	8.4	10.0461	44.27	2.208795	97.791199	0.932182
1.0	8.5	10.0461	35.17	2.764893	97.235107	0.744694
1.0	8.6	10.0461	27.93	3.456045	96.543945	0.595767
1.0	8.7	10.0461	22.19	4.312310	95.687683	0.477470
1.0	8.8	10.0461	17.63	5.368920	94.631073	0.383503
1.0	8.9	10.0461	14.00	6.666389	93.333603	0.308863
1.0	9.0	10.0461	11.12	8.250071	91.749924	0.249574
1.0	9.1	10.0461	8.83	10.168993	89.830994	0.202478
1.0	9.2	10.0461	7.02	12.473557	87.526443	0.165069
1.0	9.3	10.0461	5.57	15.211954	84.788040	0.135354
1.0	9.4	10.0461	4.43	18.424973	81.575027	0.111750
1.0	9.5	10.0461	3.52	22.139435	77.860565	0.093001
1.0	9.6	10.0461	2.79	26.360744	73.639252	0.078108
1.0	9.7	10.0461	2.22	31.065796	68.934204	0.066279
1.0	9.8	10.0461	1.76	36.197830	63.802170	0.056882
1.0	9.9	10.0461	1.40	41.665237	58.334763	0.049418
1.0	10.0	10.0461	1.11	47.345642	52.654358	0.043489
1.0	10.1	10.0461	0.88	53.095627	46.904373	0.038779

** CONCENTRATIONS OF AMMONIA(NH4+NH3) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH3-N

A-6

TEMP C	PH	PKA	RATIO	% UNIONIZED AMMONIA	% IONIZED AMMONIA	CONCENTRATION NH4+NH3 **
1.5	5.0	10.0240	106660.25	0.000938	99.999054	2196.15479
1.5	5.1	10.0240	84723.31	0.001180	99.998810	1744.47314
1.5	5.2	10.0240	67298.19	0.001485	99.998505	1385.69019
1.5	5.3	10.0240	53455.95	0.001871	99.998123	1100.64922
1.5	5.4	10.0240	42462.43	0.002355	99.997635	874.322021
1.5	5.5	10.0240	33729.16	0.002965	99.997025	694.503662
1.5	5.6	10.0240	26742.06	0.003732	99.996262	551.668445
1.5	5.7	10.0240	21241.72	0.004691	99.995300	438.211142
1.5	5.8	10.0240	16904.70	0.005915	99.994080	348.088135
1.5	5.9	10.0240	13427.90	0.007447	99.992554	276.500977
1.5	6.0	10.0240	10666.16	0.009375	99.990616	219.636810
1.5	6.1	10.0240	8472.45	0.011802	99.988190	174.468323
1.5	6.2	10.0240	6729.91	0.014857	99.985138	138.589478
1.5	6.3	10.0240	5345.77	0.018703	99.981293	110.049966
1.5	6.4	10.0240	4246.30	0.023544	99.976456	87.451920
1.5	6.5	10.0240	3372.46	0.029639	99.970352	69.469879
1.5	6.6	10.0240	2674.24	0.037310	99.962677	55.186188
1.5	6.7	10.0240	2128.20	0.046955	99.953033	43.840240
1.5	6.8	10.0240	1690.49	0.059119	99.940872	34.827805
1.5	6.9	10.0240	1342.81	0.074415	99.925583	27.669006
1.5	7.0	10.0240	1066.63	0.093665	99.906326	21.942513
1.5	7.1	10.0240	847.26	0.117889	99.882111	17.465591
1.5	7.2	10.0240	673.00	0.148368	99.851624	13.877671
1.5	7.3	10.0240	534.58	0.186712	99.813278	11.027676
1.5	7.4	10.0240	424.64	0.234942	99.765045	8.763844
1.5	7.5	10.0240	337.30	0.295595	99.704391	6.965607
1.5	7.6	10.0240	267.93	0.371847	99.628143	5.537227
1.5	7.7	10.0240	212.82	0.467677	99.532318	4.402613
1.5	7.8	10.0240	169.05	0.588057	99.411942	3.501359
1.5	7.9	10.0240	134.28	0.739194	99.260803	2.785467
1.5	8.0	10.0240	106.66	0.928811	99.071182	2.216413
1.5	8.1	10.0240	84.73	1.166495	98.833496	1.765116
1.5	8.2	10.0240	67.30	1.464108	98.535889	1.406317
1.5	8.3	10.0240	53.46	1.836235	98.163757	1.121314
1.5	8.4	10.0240	42.46	2.300744	97.699249	0.894928
1.5	8.5	10.0240	33.73	2.879312	97.120682	0.715101
1.5	8.6	10.0240	26.79	3.598010	96.401978	0.572260
1.5	8.7	10.0240	21.28	4.487811	95.512177	0.458798
1.5	8.8	10.0240	16.91	5.584913	94.415085	0.368672
1.5	8.9	10.0240	13.43	6.930756	93.069244	0.297082
1.5	9.0	10.0240	10.67	8.571473	91.428513	0.240215
1.5	9.1	10.0240	8.47	10.556542	89.443451	0.195045
1.5	9.2	10.0240	6.73	12.936287	87.063705	0.159165
1.5	9.3	10.0240	5.35	15.757981	84.242004	0.130664
1.5	9.4	10.0240	4.25	19.060410	80.939590	0.108025
1.5	9.5	10.0240	3.37	22.867081	77.132919	0.090042
1.5	9.6	10.0240	2.68	27.178680	72.821320	0.075758
1.5	9.7	10.0240	2.13	31.956354	68.033646	0.064411
1.5	9.8	10.0240	1.69	37.166946	62.833054	0.055399
1.5	9.9	10.0240	1.34	42.682816	57.317184	0.048240
1.5	10.0	10.0240	1.07	48.386887	51.613113	0.042553
1.5	10.1	10.0240	0.85	54.133316	45.866684	0.038036

** CONCENTRATIONS OF AMMONIA(NH4+NH3) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH3-N

TEMP C	PH	PKA	RATIO	% UNIONIZED AMMONIA	% IONIZED AMMONIA	CONCENTRATION NH ₄ +NH ₃ **
2.0	5.0	10.0099	102316.75	0.000977	99.999023	2106.72144
2.0	5.1	10.0099	81273.19	0.001230	99.998764	1673.43433
2.0	5.2	10.0099	64557.69	0.001547	99.998444	1329.26343
2.0	5.3	10.0099	51240.02	0.001950	99.998047	1055.87622
2.0	5.4	10.0099	40733.23	0.002455	99.997543	838.717529
2.0	5.5	10.0099	32355.60	0.003091	99.996902	666.222168
2.0	5.6	10.0099	25701.01	0.003891	99.996109	529.204102
2.0	5.7	10.0099	20415.07	0.004898	99.995102	420.366943
2.0	5.8	10.0099	16216.29	0.006165	99.993820	333.913818
2.0	5.9	10.0099	12841.07	0.007763	99.992233	265.241699
2.0	6.0	10.0099	10231.82	0.009772	99.990219	210.693634
2.0	6.1	10.0099	8127.43	0.012303	99.987686	167.364304
2.0	6.2	10.0099	6455.85	0.015487	99.984512	132.946579
2.0	6.3	10.0099	5128.07	0.019497	99.980499	105.607605
2.0	6.4	10.0099	4073.38	0.024544	99.975444	83.891464
2.0	6.5	10.0099	3235.60	0.030897	99.969101	66.641693
2.0	6.6	10.0099	2570.14	0.038493	99.961105	52.939682
2.0	6.7	10.0099	2041.53	0.048459	99.951035	42.055771
2.0	6.8	10.0099	1621.65	0.061629	99.938370	33.410370
2.0	6.9	10.0099	1284.12	0.077572	99.922424	26.543076
2.0	7.0	10.0099	1023.19	0.097639	99.902359	21.084165
2.0	7.1	10.0099	812.75	0.122887	99.877106	16.755184
2.0	7.2	10.0099	645.59	0.154657	99.845337	13.313371
2.0	7.3	10.0099	512.81	0.194623	99.805374	10.579436
2.0	7.4	10.0099	407.34	0.244892	99.755096	8.407789
2.0	7.5	10.0099	323.56	0.308105	99.691895	6.682789
2.0	7.6	10.0099	257.02	0.387571	99.612427	5.312572
2.0	7.7	10.0099	204.16	0.487433	99.512558	4.224167
2.0	7.8	10.0099	162.17	0.612868	99.387131	3.359612
2.0	7.9	10.0099	128.81	0.770332	99.229660	2.672473
2.0	8.0	10.0099	102.32	0.967859	99.032135	2.127377
2.0	8.1	10.0099	81.28	1.215413	98.784576	1.694074
2.0	8.2	10.0099	64.56	1.525312	98.474686	1.349887
2.0	8.3	10.0099	51.28	1.912698	98.087296	1.076489
2.0	8.4	10.0099	40.73	2.396075	97.603912	0.854322
2.0	8.5	10.0099	32.36	2.997875	97.002121	0.686819
2.0	8.6	10.0099	25.70	3.745031	96.254959	0.549795
2.0	8.7	10.0099	20.42	4.669427	95.330566	0.440953
2.0	8.8	10.0099	16.22	5.804229	94.191757	0.354497
2.0	8.9	10.0099	12.88	7.203783	92.796204	0.285822
2.0	9.0	10.0099	10.23	8.902952	91.097046	0.231272
2.0	9.1	10.0099	8.13	10.955589	89.044403	0.187941
2.0	9.2	10.0099	6.46	13.411801	86.588196	0.153521
2.0	9.3	10.0099	5.13	16.317764	83.682236	0.126181
2.0	9.4	10.0099	4.07	19.710668	80.289932	0.104464
2.0	9.5	10.0099	3.24	23.608643	76.391357	0.087214
2.0	9.6	10.0099	2.57	28.009293	71.990707	0.073511
2.0	9.7	10.0099	2.04	32.877224	67.122772	0.062627
2.0	9.8	10.0099	1.62	38.142929	61.857071	0.053981
2.0	9.9	10.0099	1.29	43.702896	56.297104	0.047114
2.0	10.0	10.0099	1.02	49.425735	50.574265	0.041658
2.0	10.1	10.0099	0.81	55.163660	44.836334	0.037325

** CONCENTRATIONS OF AMMONIA(NH₄+NH₃) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH₃-N

A-8

TEMP C	PH	PKA	RATIO	% UNIONIZED AMMONIA	% IONIZED AMMONIA	CONCENTRATION NH4+NH3 **
2.5	5.0	9.9920	98165.00	0.001017	99.998978	2021.23706
2.5	5.1	9.9920	77975.31	0.001282	99.998718	1605.53125
2.5	5.2	9.9920	61938.10	0.001614	99.998383	1275.32543
2.5	5.3	9.9920	49197.20	0.002033	99.997955	1013.03198
2.5	5.4	9.9920	39040.37	0.002557	99.997437	804.685303
2.5	5.5	9.9920	31042.69	0.003221	99.996765	639.189453
2.5	5.6	9.9920	24658.12	0.004055	99.995941	507.731445
2.5	5.7	9.9920	19586.67	0.005105	99.994888	403.310059
2.5	5.8	9.9920	15558.27	0.006427	99.993561	320.365234
2.5	5.9	9.9920	12358.39	0.008091	99.991898	254.479874
2.5	6.0	9.9920	9816.63	0.010186	99.989807	202.145096
2.5	6.1	9.9920	7797.64	0.012623	99.987167	160.573959
2.5	6.2	9.9920	6193.89	0.016142	99.983856	127.552795
2.5	6.3	9.9920	4919.99	0.020321	99.979675	101.323120
2.5	6.4	9.9920	3908.09	0.025581	99.974411	80.466190
2.5	6.5	9.9920	3104.31	0.032203	99.967789	63.938370
2.5	6.6	9.9920	2465.65	0.040538	99.959457	50.792358
2.5	6.7	9.9920	1958.69	0.051028	99.948959	40.350042
2.5	6.8	9.9920	1555.85	0.064232	99.935760	32.055527
2.5	6.9	9.9920	1235.86	0.080850	99.919144	25.466858
2.5	7.0	9.9920	981.63	0.101763	99.898224	20.233292
2.5	7.1	9.9920	779.77	0.128073	99.871918	16.076141
2.5	7.2	9.9920	619.40	0.161187	99.838806	12.773964
2.5	7.3	9.9920	492.01	0.202837	99.797150	10.150987
2.5	7.4	9.9920	390.81	0.255223	99.744766	8.067458
2.5	7.5	9.9920	310.44	0.321094	99.678894	6.412458
2.5	7.6	9.9920	246.59	0.403897	99.596100	5.097836
2.5	7.7	9.9920	195.87	0.507944	99.492050	4.053596
2.5	7.8	9.9920	155.59	0.638623	99.361374	3.224122
2.5	7.9	9.9920	123.59	0.802651	99.197342	2.565250
2.5	8.0	9.9920	98.17	1.003380	98.991608	2.041888
2.5	8.1	9.9920	77.98	1.266167	98.733826	1.626167
2.5	8.2	9.9920	61.94	1.588799	98.411194	1.295946
2.5	8.3	9.9920	49.20	1.991982	98.008011	1.013644
2.5	8.4	9.9920	39.08	2.494885	97.505112	0.825288
2.5	8.5	9.9920	31.04	3.120711	96.879288	0.659785
2.5	8.6	9.9920	24.66	3.897244	96.102753	0.526322
2.5	8.7	9.9920	19.59	4.857325	95.142670	0.423896
2.5	8.8	9.9920	15.56	6.039048	93.960938	0.340948
2.5	8.9	9.9920	12.36	7.485651	92.514343	0.275060
2.5	9.0	9.9920	9.82	9.244661	90.755310	0.222723
2.5	9.1	9.9920	7.80	11.366277	88.633713	0.181150
2.5	9.2	9.9920	6.19	13.900191	86.099808	0.148127
2.5	9.3	9.9920	4.92	16.891342	83.108658	0.121897
2.5	9.4	9.9920	3.91	20.373840	79.626160	0.101061
2.5	9.5	9.9920	3.10	24.363861	75.636139	0.084510
2.5	9.6	9.9920	2.47	28.852127	71.147873	0.071364
2.5	9.7	9.9920	1.96	33.797775	66.202225	0.060921
2.5	9.8	9.9920	1.56	39.124969	60.875031	0.052626
2.5	9.9	9.9920	1.24	44.724579	55.275421	0.046037
2.5	10.0	9.9920	0.98	50.461304	49.538696	0.040804
2.5	10.1	9.9920	0.78	56.185883	43.814117	0.036646

** CONCENTRATIONS OF AMMONIA(NH4+NH3) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH3-N

A-9

TEMP C	PH	PKA	RATIO	% UNIONIZED AMMONIA	% IONIZED AMMONIA	CONCENTRATION NH ₄ +NH ₃ **
3.0	5.0	9.9740	94195.69	0.001062	99.998932	1939.50952
3.0	5.1	9.9740	74822.44	0.001335	99.998657	1540.61450
3.0	5.2	9.9740	59433.64	0.001683	99.998306	1223.75903
3.0	5.3	9.9740	47209.89	0.002115	99.997879	972.372266
3.0	5.4	9.9740	37500.20	0.002667	99.997330	772.149658
3.0	5.5	9.9740	29787.52	0.003357	99.996643	613.345459
3.0	5.6	9.9740	23661.10	0.004226	99.995773	487.202637
3.0	5.7	9.9740	18744.71	0.005320	99.994675	387.003418
3.0	5.8	9.9740	14929.17	0.006643	99.993301	307.412109
3.0	5.9	9.9740	11855.68	0.008432	99.991562	244.190872
3.0	6.0	9.9740	9419.70	0.010615	99.989380	193.972198
3.0	6.1	9.9740	7482.34	0.013363	99.986633	154.042001
3.0	6.2	9.9740	5943.45	0.016822	99.983170	122.796088
3.0	6.3	9.9740	4721.05	0.021177	99.978821	97.277097
3.0	6.4	9.9740	3750.07	0.026659	99.973328	77.234558
3.0	6.5	9.9740	2978.79	0.033559	99.966431	61.353428
3.0	6.6	9.9740	2366.14	0.042245	99.957748	48.739456
3.0	6.7	9.9740	1874.49	0.053177	99.946823	38.719376
3.0	6.8	9.9740	1492.94	0.066937	99.933060	30.760193
3.0	6.9	9.9740	1185.48	0.084254	99.915741	24.437958
3.0	7.0	9.9740	941.98	0.106046	99.893951	19.416016
3.0	7.1	9.9740	748.24	0.133463	99.866531	15.426951
3.0	7.2	9.9740	594.35	0.167963	99.832031	12.258315
3.0	7.3	9.9740	472.11	0.211365	99.788620	9.741371
3.0	7.4	9.9740	375.01	0.265949	99.734039	7.742095
3.0	7.5	9.9740	297.88	0.334579	99.665421	6.154002
3.0	7.6	9.9740	236.62	0.420845	99.579147	4.892540
3.0	7.7	9.9740	187.95	0.524235	99.470764	3.890523
3.0	7.8	9.9740	149.30	0.665354	99.334641	3.094591
3.0	7.9	9.9740	118.59	0.836190	99.163803	2.462359
3.0	8.0	9.9740	94.20	1.050425	99.949570	1.960159
3.0	8.1	9.9740	74.83	1.318817	99.681183	1.561247
3.0	8.2	9.9740	59.44	1.654640	99.345352	1.244379
3.0	8.3	9.9740	47.21	2.074179	97.925812	0.992682
3.0	8.4	9.9740	37.50	2.597285	97.402710	0.792750
3.0	8.5	9.9740	29.79	3.247943	96.752045	0.633939
3.0	8.6	9.9740	23.66	4.054812	95.945175	0.507791
3.0	8.7	9.9740	18.80	5.051660	94.948334	0.407588
3.0	8.8	9.9740	14.93	6.277546	93.722443	0.327994
3.0	8.9	9.9740	11.86	7.776549	92.223450	0.264770
3.0	9.0	9.9740	9.42	9.546845	90.403152	0.214550
3.0	9.1	9.9740	7.48	11.788762	88.211227	0.174658
3.0	9.2	9.9740	5.94	14.401571	85.598419	0.142970
3.0	9.3	9.9740	4.72	17.478699	82.521301	0.117800
3.0	9.4	9.9740	3.75	21.051636	78.948364	0.097807
3.0	9.5	9.9740	2.98	25.132477	74.867523	0.081926
3.0	9.6	9.9740	2.37	29.706725	70.293274	0.069311
3.0	9.7	9.9740	1.88	34.727371	65.272629	0.059290
3.0	9.8	9.9740	1.49	40.112305	59.887695	0.051331
3.0	9.9	9.9740	1.19	45.747025	54.252975	0.045008
3.0	10.0	9.9740	0.94	51.492737	48.507263	0.039986
3.0	10.1	9.9740	0.75	57.199234	42.800766	0.035997

** CONCENTRATIONS OF AMMONIA(NH₄+NH₃) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH₃-N

A-10

TEMP C	PH	PKA	RATIO	% UNIONIZED AMMONIA	% IONIZED AMMONIA	CONCENTRATION NH ₄ +NH ₃ **
3.5	5.0	9.9562	90400.69	0.001106	99.998896	1861.37085
3.5	5.1	9.9562	71807.94	0.001393	99.998596	1478.54590
3.5	5.2	9.9562	57039.16	0.001753	99.998245	1174.45679
3.5	5.3	9.9562	45307.88	0.002207	99.997787	932.909668
3.5	5.4	9.9562	35959.35	0.002777	99.997208	741.041016
3.5	5.5	9.9562	28587.39	0.003478	99.996520	588.634766
3.5	5.6	9.9562	22707.81	0.004404	99.995590	467.574463
3.5	5.7	9.9562	18037.48	0.005544	99.994446	371.412354
3.5	5.8	9.9562	14327.70	0.006977	99.993011	295.027832
3.5	5.9	9.9562	11380.91	0.008786	99.991211	234.353638
3.5	6.0	9.9562	9040.20	0.011060	99.988937	186.158173
3.5	6.1	9.9562	7180.89	0.013924	99.986069	147.875107
3.5	6.2	9.9562	5703.99	0.017529	99.982468	117.465683
3.5	6.3	9.9562	4530.45	0.022065	99.977921	93.316745
3.5	6.4	9.9562	3596.98	0.027773	99.972214	74.123672
3.5	6.5	9.9562	2859.78	0.034964	99.965027	58.882843
3.5	6.6	9.9562	2270.81	0.044018	99.955978	46.776596
3.5	6.7	9.9562	1803.77	0.055407	99.944580	37.160263
3.5	6.8	9.9562	1432.79	0.069745	99.930252	29.521744
3.5	6.9	9.9562	1138.11	0.087783	99.912201	23.454208
3.5	7.0	9.9562	904.03	0.110493	99.889496	18.634598
3.5	7.1	9.9562	718.10	0.139063	99.860931	14.406234
3.5	7.2	9.9562	570.41	0.175007	99.824982	11.765265
3.5	7.3	9.9562	453.09	0.220220	99.779770	9.349728
3.5	7.4	9.9562	359.90	0.277083	99.722916	7.430994
3.5	7.5	9.9562	285.88	0.348576	99.651413	5.906897
3.5	7.6	9.9562	227.08	0.438434	99.561554	4.596257
3.5	7.7	9.9562	180.38	0.551329	99.448669	3.734610
3.5	7.8	9.9562	143.28	0.693092	99.306900	2.970744
3.5	7.9	9.9562	113.31	0.870988	99.129013	2.363982
3.5	8.0	9.9562	90.40	1.094039	99.905960	1.882016
3.5	8.1	9.9562	71.81	1.373422	99.626572	1.499175
3.5	8.2	9.9562	57.04	1.722906	99.277084	1.195073
3.5	8.3	9.9562	45.31	2.159374	97.840622	0.953517
3.5	8.4	9.9562	35.99	2.703372	97.296616	0.761641
3.5	8.5	9.9562	28.59	3.379683	96.620316	0.609229
3.5	8.6	9.9562	22.71	4.217851	95.782135	0.488163
3.5	8.7	9.9562	18.04	5.252590	94.747406	0.391997
3.5	8.8	9.9562	14.33	6.523887	93.476105	0.315609
3.5	8.9	9.9562	11.38	8.076643	91.923340	0.254932
3.5	9.0	9.9562	9.04	9.959602	90.040390	0.206735
3.5	9.1	9.9562	7.18	12.223171	87.776825	0.168451
3.5	9.2	9.9562	5.70	14.915968	85.084030	0.138040
3.5	9.3	9.9562	4.53	18.079803	81.920197	0.113884
3.5	9.4	9.9562	3.60	21.743225	78.256775	0.094696
3.5	9.5	9.9562	2.86	25.914139	74.085861	0.079455
3.5	9.6	9.9562	2.27	30.572556	69.427444	0.067348
3.5	9.7	9.9562	1.80	35.565268	64.434732	0.057731
3.5	9.8	9.9562	1.43	41.104063	58.895935	0.050092
3.5	9.9	9.9562	1.14	47.769302	52.230698	0.044025
3.5	10.0	9.9562	0.90	52.519104	47.480896	0.039205
3.5	10.1	9.9562	0.72	58.202866	41.797134	0.035376

** CONCENTRATIONS OF AMMONIA(NH₄+NH₃) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH₃-N

TEMP C	PH	PKA	RATIO	% UNIONIZED AMMONIA	% IONIZED AMMONIA	CONCENTRATION NH4+NH3 **
4.0	5.0	9.9384	86771.12	0.001152	99.998840	1786.63770
4.0	5.1	9.9384	68424.81	0.001451	99.998535	1419.18237
4.0	5.2	9.9384	54749.02	0.001820	99.998169	1127.30298
4.0	5.3	9.9384	43488.76	0.002299	99.997696	845.454102
4.0	5.4	9.9384	34544.40	0.002895	99.997101	711.289551
4.0	5.5	9.9384	27439.53	0.003644	99.996353	565.002441
4.0	5.6	9.9384	21746.11	0.004530	99.995407	448.802490
4.0	5.7	9.9384	17313.29	0.005776	99.994217	356.501221
4.0	5.8	9.9384	13752.44	0.007271	99.992722	283.183350
4.0	5.9	9.9384	10923.97	0.009153	99.990845	224.945068
4.0	6.0	9.9384	8677.23	0.011523	99.988464	178.684799
4.0	6.1	9.9384	6842.58	0.014506	99.985489	141.938675
4.0	6.2	9.9384	5474.98	0.018262	99.981735	112.750336
4.0	6.3	9.9384	4348.94	0.022989	99.977005	89.565216
4.0	6.4	9.9384	3454.49	0.028939	99.971054	71.148483
4.0	6.5	9.9384	2744.00	0.036430	99.963562	56.519562
4.0	6.6	9.9384	2174.64	0.045854	99.954132	44.899338
4.0	6.7	9.9384	1731.35	0.057725	99.942261	35.669098
4.0	6.8	9.9384	1375.26	0.072661	99.927338	28.337250
4.0	6.9	9.9384	1092.41	0.091457	99.908539	22.513351
4.0	7.0	9.9384	867.73	0.115119	99.884888	17.887253
4.0	7.1	9.9384	684.27	0.144871	99.855118	14.212608
4.0	7.2	9.9384	547.51	0.182314	99.817673	11.293727
4.0	7.3	9.9384	434.90	0.229411	99.770584	8.975172
4.0	7.4	9.9384	345.45	0.288639	99.711349	7.133477
4.0	7.5	9.9384	274.40	0.363103	99.636887	5.670560
4.0	7.6	9.9384	217.97	0.456690	99.543304	4.508528
4.0	7.7	9.9384	173.14	0.574259	99.425735	3.585491
4.0	7.8	9.9384	137.53	0.721875	99.278122	2.852295
4.0	7.9	9.9384	109.24	0.907089	99.092911	2.269897
4.0	8.0	9.9384	86.77	1.139280	98.860718	1.807281
4.0	8.1	9.9384	68.93	1.430044	98.569946	1.439811
4.0	8.2	9.9384	54.75	1.793680	98.206314	1.147919
4.0	8.3	9.9384	43.49	2.247669	97.752319	0.916060
4.0	8.4	9.9384	34.55	2.813272	97.186722	0.731888
4.0	8.5	9.9384	27.44	3.516081	96.483917	0.585595
4.0	8.6	9.9384	21.80	4.386545	95.613449	0.469390
4.0	8.7	9.9384	17.31	5.460304	94.539688	0.377085
4.0	8.8	9.9384	13.75	6.778277	93.221710	0.303764
4.0	8.9	9.9384	10.92	8.386150	91.613846	0.245524
4.0	9.0	9.9384	8.68	10.333151	89.666840	0.199262
4.0	9.1	9.9384	6.89	12.665671	87.330322	0.162514
4.0	9.2	9.9384	5.48	15.443539	84.556458	0.133324
4.0	9.3	9.9384	4.35	18.694687	81.305313	0.110138
4.0	9.4	9.9384	3.45	22.448563	77.551437	0.091721
4.0	9.5	9.9384	2.74	26.708588	73.291412	0.077091
4.0	9.6	9.9384	2.18	31.449203	68.550797	0.065471
4.0	9.7	9.9384	1.73	36.610947	63.389053	0.056240
4.0	9.8	9.9384	1.38	42.049579	57.900421	0.048908
4.0	9.9	9.9384	1.09	47.790710	52.209290	0.043084
4.0	10.0	9.9384	0.87	53.539764	46.460236	0.038457
4.0	10.1	9.9384	0.69	59.196259	40.803741	0.034783

** CONCENTRATIONS OF AMMONIA(NH4+NH3) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH3-N

TEMP C	PH	PKA	RATIO	% UNIONIZED AMMONIA	% IONIZED AMMONIA	CONCENTRATION NH ₄ +NH ₃ **
4.5	5.0	9.9206	83299.69	0.001200	99.998795	1715.16113
4.5	5.1	9.9206	66167.37	0.001511	99.998489	1362.40674
4.5	5.2	9.9206	52558.71	0.001903	99.998093	1042.20435
4.5	5.3	9.9206	41748.93	0.002395	99.997604	859.630859
4.5	5.4	9.9206	33162.40	0.003015	99.996979	682.834229
4.5	5.5	9.9206	26341.87	0.003795	99.996201	542.399658
4.5	5.6	9.9206	20924.12	0.004779	99.995209	430.848145
4.5	5.7	9.9206	16620.65	0.006015	99.993973	342.239746
4.5	5.8	9.9206	13202.25	0.007574	99.992416	271.854980
4.5	5.9	9.9206	10486.94	0.009535	99.990463	215.946671
4.5	6.0	9.9206	8330.09	0.012003	99.987991	171.537018
4.5	6.1	9.9206	6616.83	0.015111	99.984879	136.261169
4.5	6.2	9.9206	5255.95	0.019022	99.980972	108.240402
4.5	6.3	9.9206	4174.95	0.023947	99.976044	85.982788
4.5	6.4	9.9206	3316.29	0.030145	99.969849	68.302917
4.5	6.5	9.9206	2634.22	0.037947	99.962051	54.259232
4.5	6.6	9.9206	2092.44	0.047763	99.952225	43.103943
4.5	6.7	9.9206	1662.09	0.060129	99.939865	34.242935
4.5	6.8	9.9206	1320.24	0.075685	99.924301	27.204422
4.5	6.9	9.9206	1048.71	0.095264	99.904724	21.613495
4.5	7.0	9.9206	833.02	0.119901	99.880096	17.172470
4.5	7.1	9.9206	661.69	0.150900	99.849091	13.644832
4.5	7.2	9.9206	525.60	0.189897	99.810089	10.842722
4.5	7.3	9.9206	417.50	0.238948	99.761047	8.616930
4.5	7.4	9.9206	331.63	0.300632	99.699356	6.848913
4.5	7.5	9.9206	263.43	0.378178	99.621811	5.444527
4.5	7.6	9.9206	209.25	0.475631	99.524368	4.328981
4.5	7.7	9.9206	166.21	0.598047	99.401947	3.442872
4.5	7.8	9.9206	132.03	0.751732	99.248260	2.739009
4.5	7.9	9.9206	104.87	0.944534	99.055466	2.179910
4.5	8.0	9.9206	83.30	1.186194	98.813797	1.735803
4.5	8.1	9.9206	66.17	1.498755	98.511230	1.383033
4.5	8.2	9.9206	52.56	1.867034	98.132965	1.102818
4.5	8.3	9.9206	41.75	2.339145	97.660843	0.880236
4.5	8.4	9.9206	33.16	2.927079	97.072906	0.703431
4.5	8.5	9.9206	26.34	3.657250	96.342743	0.562991
4.5	8.6	9.9206	20.92	4.561008	95.438980	0.451435
4.5	8.7	9.9206	16.62	5.674942	94.325058	0.362823
4.5	8.8	9.9206	13.20	7.040864	92.959122	0.292436
4.5	8.9	9.9206	10.49	8.705209	91.294785	0.236525
4.5	9.0	9.9206	8.33	10.717620	89.282379	0.192114
4.5	9.1	9.9206	6.62	13.128346	86.871643	0.156436
4.5	9.2	9.9206	5.26	15.984256	84.015732	0.128814
4.5	9.3	9.9206	4.18	19.323212	80.676788	0.106556
4.5	9.4	9.9206	3.32	23.167343	76.832657	0.088875
4.5	9.5	9.9206	2.63	27.515365	72.484634	0.074831
4.5	9.6	9.9206	2.09	32.336014	67.663986	0.063675
4.5	9.7	9.9206	1.66	37.563538	62.436462	0.054814
4.5	9.8	9.9206	1.32	43.097900	56.902100	0.047775
4.5	9.9	9.9206	1.05	48.810198	51.189804	0.042184
4.5	10.0	9.9206	0.83	54.553772	45.446228	0.037743
4.5	10.1	9.9206	0.66	60.178635	39.821365	0.034215

** CONCENTRATIONS OF AMMONIA(NH₄+NH₃) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH₃-N

TEMP C	PH	PKA	RATIO	% UNIONIZED AMMONIA	% IONIZED AMMONIA	CONCENTRATION NH ₄ +NH ₃ **
5.0	5.0	9.9030	79979.00	0.001250	99.998749	1646.78784
5.0	5.1	9.9030	63529.67	0.001574	99.998413	1308.09644
5.0	5.2	9.9030	50463.48	0.001942	99.998016	1039.06372
5.0	5.3	9.9030	40044.53	0.002495	99.997498	825.362061
5.0	5.4	9.9030	31840.37	0.003141	99.996857	655.613525
5.0	5.5	9.9030	25291.74	0.003954	99.996033	520.777588
5.0	5.6	9.9030	20089.97	0.004977	99.995010	413.673096
5.0	5.7	9.9030	15958.06	0.006266	99.993729	328.596924
5.0	5.8	9.9030	12675.95	0.007884	99.992111	261.018311
5.0	5.9	9.9030	10068.48	0.009931	99.990067	207.338898
5.0	6.0	9.9030	7998.01	0.012502	99.987488	164.699646
5.0	6.1	9.9030	6353.05	0.015733	99.984253	130.829803
5.0	6.2	9.9030	5046.41	0.019812	99.980179	103.926178
5.0	6.3	9.9030	4004.51	0.024941	99.975052	82.555893
5.0	6.4	9.9030	3184.08	0.031396	99.968597	65.580811
5.0	6.5	9.9030	2529.21	0.039522	99.960464	52.097000
5.0	6.6	9.9030	2009.03	0.049751	99.950241	41.386414
5.0	6.7	9.9030	1595.83	0.062624	99.937363	32.878677
5.0	6.8	9.9030	1267.61	0.078826	99.921173	26.120728
5.0	6.9	9.9030	1006.90	0.099216	99.900772	20.752686
5.0	7.0	9.9030	799.81	0.124873	99.875122	16.488693
5.0	7.1	9.9030	635.31	0.157155	99.842834	13.101690
5.0	7.2	9.9030	504.65	0.197766	99.802231	10.411292
5.0	7.3	9.9030	400.86	0.248845	99.751144	8.274233
5.0	7.4	9.9030	318.41	0.313075	99.686920	6.576698
5.0	7.5	9.9030	252.92	0.393818	99.606171	5.228303
5.0	7.6	9.9030	200.91	0.495282	99.504715	4.157229
5.0	7.7	9.9030	159.58	0.622723	99.377274	3.305444
5.0	7.8	9.9030	126.76	0.782700	99.217300	2.630637
5.0	7.9	9.9030	100.69	0.983360	99.016632	2.093427
5.0	8.0	9.9030	79.98	1.234638	98.765152	1.667424
5.0	8.1	9.9030	63.53	1.549612	98.450378	1.328719
5.0	8.2	9.9030	50.47	1.943048	98.056946	1.059675
5.0	8.3	9.9030	40.09	2.433905	97.566086	0.845966
5.0	8.4	9.9030	31.84	3.044909	96.955078	0.676210
5.0	8.5	9.9030	25.29	3.803324	96.196671	0.541368
5.0	8.6	9.9030	20.09	4.741405	95.258591	0.434259
5.0	8.7	9.9030	15.96	5.896680	94.103317	0.349180
5.0	8.8	9.9030	12.68	7.311833	92.688156	0.281598
5.0	8.9	9.9030	10.07	9.034002	90.965948	0.227917
5.0	9.0	9.9030	8.00	11.113169	88.886826	0.185276
5.0	9.1	9.9030	6.35	13.549315	86.400681	0.151405
5.0	9.2	9.9030	5.05	16.538147	83.461853	0.124500
5.0	9.3	9.9030	4.01	19.965332	80.034668	0.103129
5.0	9.4	9.9030	3.18	23.899353	76.100647	0.086153
5.0	9.5	9.9030	2.53	28.334122	71.665878	0.072669
5.0	9.6	9.9030	2.01	33.232437	66.767563	0.061958
5.0	9.7	9.9030	1.60	38.522385	61.477615	0.053449
5.0	9.8	9.9030	1.27	44.098221	55.901779	0.046691
5.0	9.9	9.9030	1.01	49.826996	50.173004	0.041323
5.0	10.0	9.9030	0.80	55.560364	44.439636	0.037059
5.0	10.1	9.9030	0.64	61.149368	38.850632	0.033672

** CONCENTRATIONS OF AMMONIA(NH₄+NH₃) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH₃-N

TEMP C	PH	PKA	RATIO	* UNIONIZED AMMONIA	* IONIZED AMMONIA	CONCENTRATION NH ₄ +NH ₃ **
5.5	5.0	9.8854	76801.75	0.001302	99.998688	1581.36841
5.5	5.1	9.8854	61005.87	0.001639	99.998352	1256.13135
5.5	5.2	9.8854	48458.76	0.002064	99.997925	997.786377
5.5	5.3	9.8854	38492.21	0.002598	99.997391	792.575195
5.5	5.4	9.8854	30575.50	0.003270	99.996719	629.570068
5.5	5.5	9.8854	24287.00	0.004117	99.995880	500.089844
5.5	5.6	9.8854	19291.87	0.005183	99.994812	397.240479
5.5	5.7	9.8854	15324.10	0.006525	99.993469	315.543701
5.5	5.8	9.8854	12172.39	0.008213	99.991776	250.650116
5.5	5.9	9.8854	9668.88	0.010341	99.989655	199.102875
5.5	6.0	9.8854	7680.28	0.013019	99.986969	158.157440
5.5	6.1	9.8854	6100.67	0.016389	99.983597	125.633423
5.5	6.2	9.8854	4845.94	0.020632	99.979355	99.798523
5.5	6.3	9.8854	3849.27	0.025972	99.974014	79.277084
5.5	6.4	9.8854	3057.59	0.032695	99.967300	62.976334
5.5	6.5	9.8854	2428.73	0.041157	99.958832	50.028198
5.5	6.6	9.8854	1929.21	0.051808	99.948181	39.743103
5.5	6.7	9.8854	1532.43	0.065213	99.934784	31.573349
5.5	6.8	9.8854	1217.26	0.082085	99.917908	25.083893
5.5	6.9	9.8854	966.90	0.103316	99.896683	19.929092
5.5	7.0	9.8854	768.04	0.130032	99.869965	15.834504
5.5	7.1	9.8854	610.08	0.163646	99.836349	12.582046
5.5	7.2	9.8854	484.60	0.205931	99.794067	9.998512
5.5	7.3	9.8854	384.93	0.259113	99.740875	7.946348
5.5	7.4	9.8854	305.76	0.325984	99.674011	6.316250
5.5	7.5	9.8854	242.88	0.410043	99.589951	5.021420
5.5	7.6	9.8854	192.92	0.515666	99.484329	3.992896
5.5	7.7	9.8854	153.25	0.648318	99.351669	3.175909
5.5	7.8	9.8854	121.73	0.814815	99.185181	2.524953
5.5	7.9	9.8854	96.69	1.023630	99.976364	2.011468
5.5	8.0	9.8854	76.80	1.285267	98.714722	1.602001
5.5	8.1	9.8854	61.01	1.612686	98.387314	1.276752
5.5	8.2	9.8854	48.46	2.021806	97.978180	1.018396
5.5	8.3	9.8854	38.49	2.532044	97.467941	0.813177
5.5	8.4	9.8854	30.58	3.156888	96.833099	0.650165
5.5	8.5	9.8854	24.29	3.954445	96.045547	0.520680
5.5	8.6	9.8854	19.29	4.927885	95.072113	0.417826
5.5	8.7	9.8854	15.32	6.125672	93.874313	0.336126
5.5	8.8	9.8854	12.17	7.591349	92.408646	0.271230
5.5	8.9	9.8854	9.67	9.372707	90.627289	0.219880
5.5	9.0	9.8854	7.68	11.519955	88.480042	0.178733
5.5	9.1	9.8854	6.10	14.082686	85.917313	0.146208
5.5	9.2	9.8854	4.85	17.105301	82.894699	0.120372
5.5	9.3	9.8854	3.85	20.620972	79.379028	0.099850
5.5	9.4	9.8854	3.06	24.644409	75.355591	0.083548
5.5	9.5	9.8854	2.43	29.164429	70.835571	0.070600
5.5	9.6	9.8854	1.93	34.137909	65.862091	0.060314
5.5	9.7	9.8854	1.53	39.486755	60.513245	0.052144
5.5	9.8	9.8854	1.22	45.099777	54.900223	0.045654
5.5	9.9	9.8854	0.97	50.840363	49.159637	0.040499
5.5	10.0	9.8854	0.77	56.558868	43.441132	0.036405
5.5	10.1	9.8854	0.61	62.107941	37.892059	0.033152

** CONCENTRATIONS OF AMMONIA(NH₄+NH₃) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH₃-N

TEMP C	PH	PKA	RATIO	% UNIONIZED AMMONIA	% IONIZED AMMONIA	CONCENTRATION NH ₄ +NH ₃ **
6.0	5.0	9.8678	73761.56	0.001356	99.998642	1518.77124
6.0	5.1	9.8678	58590.94	0.001707	99.998291	1206.40746
6.0	5.2	9.8678	46540.51	0.002147	99.997849	958.284551
6.0	5.3	9.8678	36958.49	0.002705	99.997284	761.201660
6.0	5.4	9.8678	29365.16	0.003405	99.996582	604.648926
6.0	5.5	9.8678	23325.61	0.004287	99.995712	480.244922
6.0	5.6	9.8678	18528.22	0.005397	99.994598	381.516602
6.0	5.7	9.8678	14717.51	0.006794	99.993195	303.053955
6.0	5.8	9.8678	11690.55	0.008553	99.991440	240.729034
6.0	5.9	9.8678	9265.15	0.010768	99.989227	191.222382
6.0	6.0	9.8678	7376.25	0.013555	99.986435	151.897614
6.0	6.1	9.8678	5859.18	0.017064	99.982925	120.660965
6.0	6.2	9.8678	4654.11	0.021482	99.978516	95.848785
6.0	6.3	9.8678	3696.90	0.027042	99.972946	76.139771
6.0	6.4	9.8678	2936.56	0.034042	99.965958	60.484283
6.0	6.5	9.8678	2332.59	0.042852	99.957138	48.048676
6.0	6.6	9.8678	1852.85	0.053942	99.946045	38.170700
6.0	6.7	9.8678	1471.77	0.067899	99.932098	30.324371
6.0	6.8	9.8678	1169.07	0.085465	99.914536	24.091736
6.0	6.9	9.8678	926.63	0.107570	99.892426	19.141006
6.0	7.0	9.8678	737.64	0.135385	99.864609	15.208507
6.0	7.1	9.8678	585.93	0.170379	99.829620	12.084794
6.0	7.2	9.8678	465.42	0.214400	99.785599	9.603541
6.0	7.3	9.8678	369.70	0.269763	99.730225	7.632607
6.0	7.4	9.8678	293.66	0.339375	99.660614	6.067042
6.0	7.5	9.8678	233.26	0.426871	99.573120	4.823466
6.0	7.6	9.8678	185.29	0.536805	99.463181	3.835655
6.0	7.7	9.8678	147.18	0.674859	99.325134	3.051005
6.0	7.8	9.8678	116.91	0.848114	99.151886	2.427737
6.0	7.9	9.8678	92.86	1.065372	98.934616	1.932658
6.0	8.0	9.8678	73.76	1.337531	98.662460	1.539403
6.0	8.1	9.8678	58.59	1.678037	98.321960	1.227027
6.0	8.2	9.8678	46.54	2.103384	97.896606	0.978899
6.0	8.3	9.8678	36.97	2.633657	97.366333	0.781802
6.0	8.4	9.8678	29.37	3.293116	96.706879	0.625243
6.0	8.5	9.8678	23.33	4.110734	95.889252	0.500884
6.0	8.6	9.8678	18.53	5.120600	94.879395	0.402101
6.0	8.7	9.8678	14.72	6.362090	93.637909	0.323636
6.0	8.8	9.8678	11.69	7.879585	92.120407	0.261308
6.0	8.9	9.8678	9.29	9.721457	90.278534	0.211800
6.0	9.0	9.8678	7.38	11.938077	88.061920	0.172473
6.0	9.1	9.8678	5.86	14.578496	85.421494	0.141235
6.0	9.2	9.8678	4.65	17.685623	82.314377	0.116422
6.0	9.3	9.8678	3.70	21.284932	78.710068	0.096712
6.0	9.4	9.8678	2.94	25.402145	74.597855	0.081956
6.0	9.5	9.8678	2.33	30.005783	69.994217	0.068620
6.0	9.6	9.8678	1.85	35.051758	64.948242	0.058742
6.0	9.7	9.8678	1.47	40.455826	59.544174	0.050895
6.0	9.8	9.8678	1.17	46.101654	53.898346	0.044662
6.0	9.9	9.8678	0.93	51.849319	48.150681	0.039711
6.0	10.0	9.8678	0.74	57.548447	42.451553	0.035779
6.0	10.1	9.8678	0.59	63.053726	36.946274	0.032655

** CONCENTRATIONS OF AMMONIA(NH₄+NH₃) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH₃-N

TEMP C	PH	PKA	RATIO	% UNIONIZED AMMONIA	% IONIZED AMMONIA	CONCENTRATION NH ₄ +NH ₃ **
6.5	5.0	9.8504	70851.87	0.001411	99.998541	1458.86084
6.5	5.1	9.8504	56279.71	0.001777	99.998215	1158.41982
6.5	5.2	9.8504	44704.63	0.002237	99.997757	920.488770
6.5	5.3	9.8504	35510.17	0.002816	99.997177	731.174405
6.5	5.4	9.8504	28206.77	0.003543	99.996445	580.797852
6.5	5.5	9.8504	22405.47	0.004463	99.995529	461.349365
6.5	5.6	9.8504	17797.32	0.005619	99.994370	366.467529
6.5	5.7	9.8504	14136.94	0.007073	99.992920	291.100098
6.5	5.8	9.8504	11229.38	0.008904	99.991089	231.233597
6.5	5.9	9.8504	8919.83	0.011210	99.988785	183.679855
6.5	6.0	9.8504	7085.28	0.014112	99.985886	145.906540
6.5	6.1	9.8504	5628.05	0.017763	99.982224	115.907039
6.5	6.2	9.8504	4470.52	0.022364	99.977631	92.068588
6.5	6.3	9.8504	3551.07	0.028153	99.971848	73.137024
6.5	6.4	9.8504	2820.72	0.035439	99.964554	58.099121
6.5	6.5	9.8504	2240.58	0.044611	99.955383	46.154068
6.5	6.6	9.8504	1779.76	0.056156	99.943832	36.665771
6.5	6.7	9.8504	1413.71	0.070686	99.929306	29.128937
6.5	6.8	9.8504	1122.95	0.088972	99.911026	23.142197
6.5	6.9	9.8504	892.00	0.111983	99.888016	18.386765
6.5	7.0	9.8504	708.54	0.140937	99.859055	14.609378
6.5	7.1	9.8504	562.81	0.177364	99.822632	11.608887
6.5	7.2	9.8504	447.06	0.223185	99.776810	9.225517
6.5	7.3	9.8504	355.11	0.280811	99.719177	7.332336
6.5	7.4	9.8504	282.08	0.353263	99.646729	5.828524
6.5	7.5	9.8504	224.06	0.444324	99.555664	4.634003
6.5	7.6	9.8504	177.98	0.558728	99.441269	3.685159
6.5	7.7	9.8504	141.37	0.702379	99.297607	2.931465
6.5	7.8	9.8504	112.30	0.882636	99.117355	2.332784
6.5	7.9	9.8504	89.20	1.108639	98.891357	1.857232
6.5	8.0	9.8504	70.85	1.391697	98.608292	1.479489
6.5	8.1	9.8504	56.28	1.745749	98.254242	1.179436
6.5	8.2	9.8504	44.71	2.187875	97.812119	0.941096
6.5	8.3	9.8504	35.51	2.738852	97.261139	0.751775
6.5	8.4	9.8504	28.21	3.423727	96.576263	0.601391
6.5	8.5	9.8504	22.41	4.272338	95.727661	0.481937
6.5	8.6	9.8504	17.80	5.319695	94.680298	0.387052
6.5	8.7	9.8504	14.14	6.606107	93.393890	0.311681
6.5	8.8	9.8504	11.23	8.176723	91.823273	0.251812
6.5	8.9	9.8504	8.92	10.080451	89.919540	0.204257
6.5	9.0	9.8504	7.09	12.367712	87.632278	0.166482
6.5	9.1	9.8504	5.63	15.086879	84.913116	0.136476
6.5	9.2	9.8504	4.47	18.279175	81.720825	0.112642
6.5	9.3	9.8504	3.55	21.972153	78.027847	0.093709
6.5	9.4	9.8504	2.82	26.172302	73.827698	0.078671
6.5	9.5	9.8504	2.24	30.857803	69.142197	0.066725
6.5	9.6	9.8504	1.78	35.973419	64.026581	0.057237
6.5	9.7	9.8504	1.41	41.428940	58.571060	0.049700
6.5	9.8	9.8504	1.12	47.103149	52.896851	0.043713
6.5	9.9	9.8504	0.89	52.853225	47.146774	0.038957
6.5	10.0	9.8504	0.71	58.528580	41.471420	0.035179
6.5	10.1	9.8504	0.56	63.986282	36.013718	0.032179

** CONCENTRATIONS OF AMMONIA(NH₄+NH₃) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH₃-N

A-17

TEMP C	PH	PKA	RATIO	% UNIONIZED AMMONIA	% IONIZED AMMONIA	CONCENTRATION NH ₄ +NH ₃ **
7.0	5.0	9.8329	68066.62	0.001469	99.998520	1401.51221
7.0	5.1	9.8329	54067.33	0.001850	99.998138	1113.26655
7.0	5.2	9.8329	42947.23	0.002323	99.997665	884.303955
7.0	5.3	9.8329	34114.25	0.002931	99.997055	702.432861
7.0	5.4	9.8329	27097.95	0.003690	99.996307	557.967285
7.0	5.5	9.8329	21524.70	0.004645	99.995346	443.214111
7.0	5.6	9.8329	17097.70	0.005845	99.994141	352.062012
7.0	5.7	9.8329	13581.21	0.007363	99.992630	279.657715
7.0	5.8	9.8329	10787.45	0.009269	99.990723	222.144501
7.0	5.9	9.8329	8569.19	0.011663	99.988327	176.460159
7.0	6.0	9.8329	6806.76	0.014683	99.985306	140.171707
7.0	6.1	9.8329	5406.60	0.018492	99.981505	111.346619
7.0	6.2	9.8329	4294.78	0.023279	99.976715	88.450134
7.0	6.3	9.8329	3411.47	0.029304	99.970688	70.262787
7.0	6.4	9.8329	2709.83	0.036889	99.963104	55.816040
7.0	6.5	9.8329	2152.50	0.046436	99.953552	44.340546
7.0	6.6	9.8329	1709.79	0.058452	99.941544	35.275235
7.0	6.7	9.8329	1358.14	0.073575	99.926422	27.984695
7.0	6.8	9.8329	1078.81	0.092609	99.907379	22.233276
7.0	6.9	9.8329	856.93	0.116560	99.883438	17.664764
7.0	7.0	9.8329	680.68	0.146645	99.853302	14.035886
7.0	7.1	9.8329	540.69	0.184608	99.815394	11.153352
7.0	7.2	9.8329	429.48	0.232297	99.767700	8.863664
7.0	7.3	9.8329	341.15	0.292268	99.707718	7.644905
7.0	7.4	9.8329	270.99	0.367665	99.632324	5.606214
7.0	7.5	9.8329	215.25	0.462421	99.537567	4.452647
7.0	7.6	9.8329	170.98	0.581457	99.418533	3.541103
7.0	7.7	9.8329	135.82	0.730910	99.269089	2.817038
7.0	7.8	9.8329	107.88	0.918422	99.081573	2.241888
7.0	7.9	9.8329	85.69	1.153480	98.846512	1.785033
7.0	8.0	9.8329	68.07	1.447819	98.552170	1.422139
7.0	8.1	9.8329	54.07	1.815880	98.184113	1.133881
7.0	8.2	9.8329	42.95	2.275364	97.724625	0.904910
7.0	8.3	9.8329	34.12	2.847732	97.152267	0.723032
7.0	8.4	9.8329	27.10	3.558835	96.441162	0.578560
7.0	8.5	9.8329	21.53	4.439395	95.560593	0.463802
7.0	8.6	9.8329	17.10	5.525353	94.474640	0.372646
7.0	8.7	9.8329	13.58	6.857883	93.142105	0.300238
7.0	8.8	9.8329	10.79	8.482924	91.517075	0.242723
7.0	8.9	9.8329	8.57	10.449829	89.550171	0.197037
7.0	9.0	9.8329	6.81	12.808962	87.191025	0.160747
7.0	9.1	9.8329	5.41	15.607864	84.392136	0.131921
7.0	9.2	9.8329	4.29	18.885880	81.114120	0.109023
7.0	9.3	9.8329	3.41	22.667435	77.332565	0.090835
7.0	9.4	9.8329	2.71	26.954575	73.045425	0.076388
7.0	9.5	9.8329	2.15	31.719955	68.280045	0.064912
7.0	9.6	9.8329	1.71	36.902222	63.097778	0.055796
7.0	9.7	9.8329	1.36	42.405304	57.594696	0.048555
7.0	9.8	9.8329	1.08	48.103409	51.896591	0.042804
7.0	9.9	9.8329	0.86	53.851303	46.148697	0.038235
7.0	10.0	9.8329	0.68	59.498566	40.501434	0.034606
7.0	10.1	9.8329	0.54	64.905151	35.094849	0.031723

** CONCENTRATIONS OF AMMONIA(NH₄+NH₃) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH₃-N

A-18

TEMP C	PH	PKA	RATIO	% UNIONIZED AMMONIA	% IONIZED AMMONIA	CONCENTRATION NH4+NH3 **
7.5	5.0	9.8156	65400.39	0.001529	99.998459	1346.61450
7.5	5.1	9.8156	51949.41	0.001925	99.998002	1069.65869
7.5	5.2	9.8156	41254.94	0.002423	99.997574	849.665527
7.5	5.3	9.8156	32777.96	0.003051	99.996948	674.918701
7.5	5.4	9.8156	26036.49	0.003841	99.996155	536.111816
7.5	5.5	9.8156	20681.55	0.004835	99.995163	425.853760
7.5	5.6	9.8156	16427.96	0.006067	99.993912	338.272461
7.5	5.7	9.8156	13049.21	0.007663	99.992325	268.703857
7.5	5.8	9.8156	10365.37	0.009647	99.990341	213.443649
7.5	5.9	9.8156	8233.52	0.012144	99.987854	169.548798
7.5	6.0	9.8156	6540.12	0.015288	99.984711	134.641702
7.5	6.1	9.8156	5195.01	0.019246	99.980743	106.985855
7.5	6.2	9.8156	4126.55	0.024227	99.975769	84.986267
7.5	6.3	9.8156	3277.84	0.030499	99.969498	67.511322
7.5	6.4	9.8156	2603.69	0.038392	99.961594	53.630463
7.5	6.5	9.8156	2068.18	0.048328	99.951660	42.604492
7.5	6.6	9.8156	1642.82	0.060834	99.939163	33.846222
7.5	6.7	9.8156	1304.94	0.076573	99.923416	26.889297
7.5	6.8	9.8156	1036.55	0.096381	99.903610	21.363174
7.5	6.9	9.8156	823.36	0.121306	99.878693	16.973618
7.5	7.0	9.8156	654.02	0.152667	99.847321	13.486892
7.5	7.1	9.8156	519.51	0.192120	99.807877	10.717266
7.5	7.2	9.8156	412.66	0.241744	99.758255	8.517277
7.5	7.3	9.8156	327.79	0.304147	99.695847	6.769753
7.5	7.4	9.8156	260.37	0.382596	99.617401	5.381651
7.5	7.5	9.8156	206.82	0.481183	99.518814	4.279039
7.5	7.6	9.8156	164.28	0.605018	99.394974	3.403201
7.5	7.7	9.8156	130.50	0.760481	99.239517	2.707495
7.5	7.8	9.8156	103.66	0.955507	99.044479	2.154878
7.5	7.9	9.8156	82.34	1.199941	98.800049	1.715918
7.5	8.0	9.8156	65.40	1.505955	98.494034	1.367238
7.5	8.1	9.8156	51.95	1.888518	98.111481	1.090272
7.5	8.2	9.8156	41.27	2.365932	97.634064	0.870270
7.5	8.3	9.8156	32.78	2.960391	97.039597	0.695516
7.5	8.4	9.8156	26.04	3.698557	96.301437	0.556703
7.5	8.5	9.8156	20.68	4.612038	95.387955	0.446440
7.5	8.6	9.8156	16.43	5.737683	94.262314	0.358856
7.5	8.7	9.8156	13.05	7.117567	92.882431	0.289284
7.5	8.8	9.8156	10.37	8.798328	91.201660	0.234022
7.5	8.9	9.8156	8.23	10.829711	89.170288	0.190125
7.5	9.0	9.8156	6.54	13.261907	86.738083	0.155257
7.5	9.1	9.8156	5.20	16.141449	83.858551	0.127560
7.5	9.2	9.8156	4.13	19.505630	80.494370	0.105559
7.5	9.3	9.8156	3.28	23.375549	76.624451	0.088083
7.5	9.4	9.8156	2.60	27.748535	72.251465	0.074202
7.5	9.5	9.8156	2.07	32.591660	67.408340	0.063176
7.5	9.6	9.8156	1.64	37.837402	62.162598	0.054417
7.5	9.7	9.8156	1.30	43.384079	56.615921	0.047460
7.5	9.8	9.8156	1.04	49.101578	50.898422	0.041933
7.5	9.9	9.8156	0.82	54.842697	45.157303	0.037544
7.5	10.0	9.8156	0.65	60.457733	39.542267	0.034057
7.5	10.1	9.8156	0.52	65.809845	34.190155	0.031287

** CONCENTRATIONS OF AMMONIA(NH4+NH3) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH3-N

TEMP C	PH	PKA	RATIO	% UNIONIZED AMMONIA	% IONIZED AMMONIA	CONCENTRATION NH4+NH3 **
8.0	5.0	9.7983	62847.39	0.001591	99.998398	1294.04834
8.0	5.1	9.7983	49921.54	0.002003	99.997996	1027.90479
8.0	5.2	9.7983	39654.14	0.002522	99.997467	816.499268
8.0	5.3	9.7983	31498.42	0.003175	99.996826	648.572998
8.0	5.4	9.7983	25020.12	0.003997	99.996002	515.185059
8.0	5.5	9.7983	19874.22	0.005031	99.994965	409.230713
8.0	5.6	9.7983	15785.68	0.006334	99.993652	325.068359
8.0	5.7	9.7983	12539.82	0.007974	99.992020	258.215332
8.0	5.8	9.7983	9960.75	0.010038	99.989960	205.112457
8.0	5.9	9.7983	7912.12	0.012637	99.987350	162.931061
8.0	6.0	9.7983	6284.83	0.015909	99.984085	129.425140
8.0	6.1	9.7983	4992.22	0.020027	99.979965	102.810379
8.0	6.2	9.7983	3965.47	0.025211	99.974777	81.669510
8.0	6.3	9.7983	3149.89	0.031737	99.968262	64.876740
8.0	6.4	9.7983	2502.05	0.039951	99.960037	51.537720
8.0	6.5	9.7983	1987.45	0.050290	99.949707	40.942154
8.0	6.6	9.7983	1578.69	0.063304	99.936691	32.525814
8.0	6.7	9.7983	1254.00	0.079681	99.920319	25.840439
8.0	6.8	9.7983	996.09	0.100292	99.899704	20.530045
8.0	6.9	9.7983	791.22	0.126227	99.873764	16.311859
8.0	7.0	9.7983	628.49	0.158859	99.841141	12.961214
8.0	7.1	9.7983	499.23	0.199908	99.800079	10.299706
8.0	7.2	9.7983	396.55	0.251539	99.748459	8.185595
8.0	7.3	9.7983	314.99	0.316463	99.683533	6.506293
8.0	7.4	9.7983	250.21	0.398070	99.601913	5.172376
8.0	7.5	9.7983	198.75	0.500632	99.499359	4.112804
8.0	7.6	9.7983	157.87	0.629441	99.370560	3.271156
8.0	7.7	9.7983	125.40	0.791129	99.208862	2.602610
8.0	7.8	9.7983	99.61	0.993935	99.006058	2.071565
8.0	7.9	9.7983	79.12	1.248076	98.751923	1.649738
8.0	8.0	9.7983	62.85	1.566172	98.433823	1.314671
8.0	8.1	9.7983	49.92	1.963727	98.036270	1.048515
8.0	8.2	9.7983	39.66	2.459677	97.540314	0.837102
8.0	8.3	9.7983	31.50	3.076948	96.923050	0.649169
8.0	8.4	9.7983	25.02	3.843025	96.156967	0.535776
8.0	8.5	9.7983	19.88	4.790408	95.209579	0.429817
8.0	8.6	9.7983	15.79	5.956876	94.043121	0.345651
8.0	8.7	9.7983	12.54	7.385345	92.614655	0.278795
8.0	8.8	9.7983	9.96	9.123128	90.876862	0.225690
8.0	8.9	9.7983	7.91	11.220277	88.779709	0.183507
8.0	9.0	9.7983	6.29	13.726683	86.273315	0.150000
8.0	9.1	9.7983	4.99	16.687729	83.312271	0.123384
8.0	9.2	9.7983	3.97	20.134428	79.861572	0.102242
8.0	9.3	9.7983	3.15	24.096283	75.903717	0.085449
8.0	9.4	9.7983	2.50	28.553879	71.446121	0.072109
8.0	9.5	9.7983	1.99	33.472443	66.527557	0.061513
8.0	9.6	9.7983	1.58	38.778397	61.221603	0.053097
8.0	9.7	9.7983	1.25	44.364563	55.635437	0.046411
8.0	9.8	9.7983	1.00	50.096954	49.903046	0.041100
8.0	9.9	9.7983	0.79	55.826797	44.173203	0.036882
8.0	10.0	9.7983	0.63	61.405579	38.594421	0.033531
8.0	10.1	9.7983	0.50	66.700027	33.299973	0.030870

** CONCENTRATIONS OF AMMONIA(NH4+NH3) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH3-N

TEMP C	PH	PKA	RATIO	% UNIONIZED AMMONIA	% IONIZED AMMONIA	CONCENTRATION NH4+NH3 **
8.5	5.0	9.7811	60402.70	0.001656	99.998337	1243.71216
8.5	5.1	9.7811	47479.64	0.002084	99.997910	987.921387
8.5	5.2	9.7811	38111.60	0.002624	99.997375	784.738281
8.5	5.3	9.7811	30273.17	0.003303	99.996689	623.344971
8.5	5.4	9.7811	24046.87	0.004154	99.995834	495.145752
8.5	5.5	9.7811	19101.13	0.005235	99.994751	393.312744
8.5	5.6	9.7811	15172.59	0.006590	99.993408	312.424172
8.5	5.7	9.7811	12052.04	0.008297	99.991699	248.171997
8.5	5.8	9.7811	9573.29	0.010445	99.989548	197.134491
8.5	5.9	9.7811	7604.34	0.013149	99.986847	156.593979
8.5	6.0	9.7811	6040.35	0.016553	99.983444	124.391357
8.5	6.1	9.7811	4798.03	0.020438	99.979156	98.811981
8.5	6.2	9.7811	3811.21	0.026231	99.973755	78.493454
8.5	6.3	9.7811	3027.36	0.033021	99.966965	62.353897
8.5	6.4	9.7811	2404.72	0.041568	99.958420	49.533752
8.5	6.5	9.7811	1910.14	0.052325	99.947662	39.350357
8.5	6.6	9.7811	1517.28	0.065864	99.934128	31.261398
8.5	6.7	9.7811	1205.22	0.082904	99.917084	24.836075
8.5	6.8	9.7811	957.34	0.104347	99.895645	19.732254
8.5	6.9	9.7811	760.44	0.131329	99.868668	15.678137
8.5	7.0	9.7811	604.04	0.165277	99.834717	12.457835
8.5	7.1	9.7811	479.81	0.207983	99.792007	9.899860
8.5	7.2	9.7811	381.13	0.251693	99.738297	7.867980
8.5	7.3	9.7811	302.74	0.329229	99.670761	6.254005
8.5	7.4	9.7811	240.48	0.414121	99.585876	4.971975
8.5	7.5	9.7811	191.02	0.520788	99.479202	3.953622
8.5	7.6	9.7811	151.73	0.654750	99.345245	3.144712
8.5	7.7	9.7811	120.52	0.822885	99.177109	2.502172
8.5	7.8	9.7811	95.74	1.033747	98.966248	1.991783
8.5	7.9	9.7811	76.05	1.297935	98.702057	1.586366
8.5	8.0	9.7811	60.41	1.628528	98.371460	1.264332
8.5	8.1	9.7811	47.98	2.041583	97.958405	1.009531
8.5	8.2	9.7811	38.11	2.556683	97.443314	0.805340
8.5	8.3	9.7811	30.27	3.197501	96.802490	0.643940
8.5	8.4	9.7811	24.05	3.992355	96.007645	0.515736
8.5	8.5	9.7811	19.10	4.974647	95.025345	0.413898
8.5	8.6	9.7811	15.17	6.183067	93.816925	0.333006
8.5	8.7	9.7811	12.05	7.661354	92.338638	0.268751
8.5	8.8	9.7811	9.57	9.457451	90.542542	0.217712
8.5	8.9	9.7811	7.60	11.621622	88.378372	0.177170
8.5	9.0	9.7811	6.04	14.203341	85.796646	0.144966
8.5	9.1	9.7811	4.80	17.246658	82.753342	0.119385
8.5	9.2	9.7811	3.81	20.784088	79.215912	0.099066
8.5	9.3	9.7811	3.03	24.829391	75.170609	0.082926
8.5	9.4	9.7811	2.40	29.370132	70.629868	0.070105
8.5	9.5	9.7811	1.91	34.361679	65.638321	0.059921
8.5	9.6	9.7811	1.52	39.724426	60.275574	0.051832
8.5	9.7	9.7811	1.21	45.345917	54.654083	0.045406
8.5	9.8	9.7811	0.96	51.088684	48.911316	0.040302
8.5	9.9	9.7811	0.76	56.802841	43.197159	0.036248
8.5	10.0	9.7811	0.60	62.341492	37.658508	0.033028
8.5	10.1	9.7811	0.48	67.575378	32.424622	0.030470

** CONCENTRATIONS OF AMMONIA(NH4+NH3) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH3-N

TEMP C	PH	PKA	RATIO	% UNIONIZED AMMONIA	% IONIZED AMMONIA	CONCENTRATION NH4+NH3 **
9.0	5.0	9.7639	58061.24	0.001722	99.998276	1195.50146
9.0	5.1	9.7639	46114.75	0.002164	99.997818	949.625977
9.0	5.2	9.7639	36634.27	0.002730	99.997269	754.320068
9.0	5.3	9.7639	29099.68	0.003436	99.996552	599.182861
9.0	5.4	9.7639	23114.73	0.004326	99.995667	475.952881
9.0	5.5	9.7639	18360.69	0.005446	99.994553	378.067139
9.0	5.6	9.7639	14584.44	0.006856	99.993134	300.114209
9.0	5.7	9.7639	11584.35	0.008631	99.991364	238.552567
9.0	5.8	9.7639	9202.19	0.010665	99.989120	189.493561
9.0	5.9	9.7639	7309.57	0.013674	99.986313	150.524521
9.0	6.0	9.7639	5806.20	0.017220	99.982773	119.570251
9.0	6.1	9.7639	4612.04	0.021678	99.978317	94.982458
9.0	6.2	9.7639	3663.48	0.027284	99.972702	75.451599
9.0	6.3	9.7639	2910.01	0.034352	99.965637	59.937592
9.0	6.4	9.7639	2311.50	0.043243	99.956757	47.614410
9.0	6.5	9.7639	1836.09	0.054434	99.945557	37.825775
9.0	6.6	9.7639	1458.46	0.068514	99.931473	30.050369
9.0	6.7	9.7639	1158.50	0.086244	99.913742	23.874115
9.0	6.8	9.7639	920.23	0.108550	99.891449	18.968140
9.0	6.9	9.7639	730.97	0.136618	99.863373	15.071195
9.0	7.0	9.7639	580.63	0.171931	99.828064	11.975729
9.0	7.1	9.7639	461.21	0.216352	99.783646	9.516907
9.0	7.2	9.7639	366.35	0.272218	99.727768	7.563787
9.0	7.3	9.7639	291.00	0.342460	99.657532	6.012376
9.0	7.4	9.7639	231.15	0.430744	99.569244	4.780040
9.0	7.5	9.7639	183.61	0.541671	99.458313	3.801161
9.0	7.6	9.7639	145.85	0.680974	99.319016	3.023608
9.0	7.7	9.7639	115.85	0.855786	99.144211	2.405975
9.0	7.8	9.7639	92.02	1.074986	98.925003	1.915373
9.0	7.9	9.7639	73.10	1.349564	98.650421	1.525671
9.0	8.0	9.7639	58.06	1.693090	98.306900	1.216119
9.0	8.1	9.7639	46.12	2.122164	97.877823	0.970234
9.0	8.2	9.7639	36.64	2.657047	97.342941	0.774920
9.0	8.3	9.7639	29.10	3.322164	96.677826	0.619777
9.0	8.4	9.7639	23.12	4.146683	95.853317	0.496541
9.0	8.5	9.7639	18.36	5.164902	94.835098	0.398652
9.0	8.6	9.7639	14.59	6.416404	93.583588	0.320896
9.0	8.7	9.7639	11.59	7.945760	92.054230	0.259132
9.0	8.8	9.7639	9.20	9.801463	90.198532	0.210071
9.0	8.9	9.7639	7.31	12.033894	87.966095	0.171100
9.0	9.0	9.7639	5.81	14.691971	85.308029	0.140145
9.0	9.1	9.7639	4.61	17.818237	82.181763	0.115556
9.0	9.2	9.7639	3.66	21.442535	78.557465	0.096024
9.0	9.3	9.7639	2.91	25.574615	74.425385	0.080509
9.0	9.4	9.7639	2.31	30.146884	69.853116	0.068186
9.0	9.5	9.7639	1.84	35.258789	64.741211	0.058397
9.0	9.6	9.7639	1.46	40.674789	59.325211	0.050621
9.0	9.7	9.7639	1.16	46.327423	53.672577	0.044445
9.0	9.8	9.7639	0.92	52.076035	47.923965	0.039538
9.0	9.9	9.7639	0.73	57.770203	42.229797	0.035641
9.0	10.0	9.7639	0.58	63.265015	36.734985	0.032546
9.0	10.1	9.7639	0.46	68.435562	31.564438	0.030087

** CONCENTRATIONS OF AMMONIA(NH4+NH3) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH3-N

TEMP C	PH	PKA	RATIO	% UNIONIZED AMMONIA	% IONIZED AMMONIA	CONCENTRATION NH ₄ +NH ₃ **
9.5	5.0	9.7468	55818.26	0.001791	99.998199	1149.31836
9.5	5.1	9.7468	44338.08	0.002257	99.997742	912.941406
9.5	5.2	9.7468	35219.04	0.002839	99.997147	725.140664
9.5	5.3	9.7468	27975.52	0.003574	99.996414	576.036621
9.5	5.4	9.7468	22221.78	0.004500	99.995499	457.566895
9.5	5.5	9.7468	17651.41	0.005665	99.994324	363.463135
9.5	5.6	9.7468	14021.04	0.007132	99.992859	288.713623
9.5	5.7	9.7468	11137.31	0.008978	99.991013	229.337784
9.5	5.8	9.7468	8846.70	0.011302	99.988693	182.174011
9.5	5.9	9.7468	7027.19	0.014228	99.985764	144.710342
9.5	6.0	9.7468	5581.90	0.017912	99.982086	114.951889
9.5	6.1	9.7468	4433.87	0.022547	99.977448	91.313995
9.5	6.2	9.7468	3521.95	0.028385	99.971603	72.537598
9.5	6.3	9.7468	2797.59	0.035732	99.964264	57.622986
9.5	6.4	9.7468	2222.21	0.044980	99.955017	45.775864
9.5	6.5	9.7468	1765.17	0.056620	99.943375	36.365341
9.5	6.6	9.7468	1402.12	0.071270	99.928726	28.890274
9.5	6.7	9.7468	1113.75	0.089705	99.910294	22.952621
9.5	6.8	9.7468	884.68	0.112907	99.887085	18.236176
9.5	6.9	9.7468	702.73	0.142100	99.857895	14.489770
9.5	7.0	9.7468	558.20	0.178825	99.821167	11.513883
9.5	7.1	9.7468	443.39	0.225026	99.774963	9.150052
9.5	7.2	9.7468	352.20	0.283126	99.716873	7.272392
9.5	7.3	9.7468	279.76	0.356172	99.643814	5.780909
9.5	7.4	9.7468	222.22	0.447981	99.552017	4.596176
9.5	7.5	9.7468	176.52	0.563321	99.436676	3.655112
9.5	7.6	9.7468	140.21	0.708145	99.291855	2.907598
9.5	7.7	9.7468	111.38	0.889868	99.110123	2.313825
9.5	7.8	9.7468	88.47	1.117701	98.882294	1.842175
9.5	7.9	9.7468	70.27	1.403039	98.596954	1.467528
9.5	8.0	9.7468	55.82	1.759926	98.240067	1.169935
9.5	8.1	9.7468	44.34	2.205562	97.794434	0.933549
9.5	8.2	9.7468	35.22	2.760865	97.239120	0.745780
9.5	8.3	9.7468	27.98	3.451054	96.548935	0.596629
9.5	8.4	9.7468	22.22	4.306136	95.693863	0.478155
9.5	8.5	9.7468	17.65	5.361318	94.638672	0.384047
9.5	8.6	9.7468	14.02	6.657079	93.342911	0.309295
9.5	8.7	9.7468	11.14	8.238744	91.761246	0.249917
9.5	8.8	9.7468	8.85	10.155314	89.844681	0.202751
9.5	8.9	9.7468	7.03	12.457209	87.542786	0.165286
9.5	9.0	9.7468	5.58	15.192640	84.807358	0.135526
9.5	9.1	9.7468	4.43	18.402481	81.597519	0.111887
9.5	9.2	9.7468	3.52	22.113632	77.886368	0.093110
9.5	9.3	9.7468	2.80	26.331696	73.668304	0.078195
9.5	9.4	9.7468	2.22	31.033737	68.966263	0.066347
9.5	9.5	9.7468	1.77	36.163254	63.836746	0.056936
9.5	9.6	9.7468	1.40	41.628845	58.371155	0.049461
9.5	9.7	9.7468	1.11	47.308334	52.691666	0.043523
9.5	9.8	9.7468	0.88	53.058334	46.941666	0.038806
9.5	9.9	9.7468	0.70	58.728287	41.271713	0.035060
9.5	10.0	9.7468	0.56	64.175751	35.824249	0.032084
9.5	10.1	9.7468	0.44	69.280334	30.719666	0.029720

** CONCENTRATIONS OF AMMONIA(NH₄+NH₃) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH₃-N

TEMP C	PH	PKA	RATIO	* UNIONIZED AMMONIA	% IONIZED AMMONIA	CONCENTRATION NH4+NH3 **
10.0	5.0	9.7297	53669.50	0.001863	99.998123	1105.07544
10.0	5.1	9.7297	42631.27	0.002346	99.997650	877.798340
10.0	5.2	9.7297	33863.27	0.002953	99.997040	697.265137
10.0	5.3	9.7297	26898.59	0.003714	99.996277	553.862549
10.0	5.4	9.7297	21366.34	0.004680	99.995316	439.953613
10.0	5.5	9.7297	16971.89	0.005892	99.994095	349.471924
10.0	5.6	9.7297	13481.28	0.007417	99.992569	277.600098
10.0	5.7	9.7297	10708.57	0.009337	99.990662	220.510193
10.0	5.8	9.7297	8506.14	0.011755	99.988235	175.161926
10.0	5.9	9.7297	6756.67	0.014798	99.985199	139.140411
10.0	6.0	9.7297	5367.02	0.018629	99.981369	110.527603
10.0	6.1	9.7297	4263.18	0.023451	99.976547	87.799530
10.0	6.2	9.7297	3386.37	0.029521	99.970474	69.746017
10.0	6.3	9.7297	2689.89	0.037162	99.962830	55.405487
10.0	6.4	9.7297	2136.66	0.046780	99.953217	44.014435
10.0	6.5	9.7297	1697.21	0.058885	99.941101	34.966202
10.0	6.6	9.7297	1348.15	0.074121	99.925873	27.778915
10.0	6.7	9.7297	1070.87	0.093295	99.906693	22.069839
10.0	6.8	9.7297	850.63	0.117423	99.882568	17.534958
10.0	6.9	9.7297	675.68	0.147781	99.852219	13.932776
10.0	7.0	9.7297	536.71	0.185974	99.814026	11.071437
10.0	7.1	9.7297	426.32	0.234014	99.765976	8.798605
10.0	7.2	9.7297	338.64	0.294428	99.705566	6.993216
10.0	7.3	9.7297	268.99	0.370380	99.629609	5.559158
10.0	7.4	9.7297	213.67	0.465833	99.534164	4.420036
10.0	7.5	9.7297	169.72	0.585742	99.414246	3.515200
10.0	7.6	9.7297	134.82	0.736288	99.263702	2.796460
10.0	7.7	9.7297	107.09	0.925160	99.074829	2.225546
10.0	7.8	9.7297	85.06	1.161929	98.838058	1.772053
10.0	7.9	9.7297	67.57	1.458393	98.541595	1.411827
10.0	8.0	9.7297	53.67	1.829101	98.170898	1.125690
10.0	8.1	9.7297	42.63	2.291843	97.708145	0.898403
10.0	8.2	9.7297	33.86	2.868236	97.131760	0.717863
10.0	8.3	9.7297	26.90	3.584270	96.415726	0.574454
10.0	8.4	9.7297	21.37	4.470831	95.529160	0.460540
10.0	8.5	9.7297	16.97	5.564025	94.435974	0.370956
10.0	8.6	9.7297	13.48	6.905202	93.094788	0.298181
10.0	8.7	9.7297	10.71	8.540426	91.459564	0.241089
10.0	8.8	9.7297	8.51	10.519133	89.480865	0.195739
10.0	8.9	9.7297	6.76	12.891670	87.108322	0.159715
10.0	9.0	9.7297	5.37	15.705387	84.294601	0.131101
10.0	9.1	9.7297	4.26	18.999268	81.000732	0.108373
10.0	9.2	9.7297	3.39	22.797165	77.202835	0.090318
10.0	9.3	9.7297	2.69	27.100220	72.899780	0.075977
10.0	9.4	9.7297	2.14	31.880127	68.119873	0.064586
10.0	9.5	9.7297	1.70	37.074326	62.925674	0.055537
10.0	9.6	9.7297	1.35	42.585770	57.414230	0.048349
10.0	9.7	9.7297	1.07	48.287796	51.712204	0.042640
10.0	9.8	9.7297	0.85	54.034760	45.965240	0.038105
10.0	9.9	9.7297	0.68	59.676407	40.323593	0.034503
10.0	10.0	9.7297	0.54	65.073166	34.926834	0.031641
10.0	10.1	9.7297	0.43	70.109451	29.890549	0.029368

** CONCENTRATIONS OF AMMONIA(NH4+NH3) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH3-N

A-24

TEMP C	PH	PKA	RATIO	% UNIONIZED AMMONIA	% IONIZED AMMONIA	CONCENTRATION NH ₄ +NH ₃ **
10.5	5.0	9.7127	51610.45	0.001938	99.998062	1062.67969
10.5	5.1	9.7127	40995.70	0.002434	99.997566	844.122070
10.5	5.2	9.7127	32564.09	0.003071	99.996929	670.515137
10.5	5.3	9.7127	25866.62	0.003866	99.996134	532.614014
10.5	5.4	9.7127	20546.61	0.004867	99.995132	423.075439
10.5	5.5	9.7127	16320.74	0.006127	99.993866	336.065430
10.5	5.6	9.7127	12964.07	0.007713	99.992279	266.950684
10.5	5.7	9.7127	10297.75	0.009710	99.990280	212.051193
10.5	5.8	9.7127	8179.80	0.012224	99.987762	168.442719
10.5	5.9	9.7127	6497.45	0.015384	99.984604	133.803070
10.5	6.0	9.7127	5161.12	0.019372	99.980621	106.247949
10.5	6.1	9.7127	4099.62	0.024387	99.975601	84.431854
10.5	6.2	9.7127	3256.45	0.030699	99.969299	67.070984
10.5	6.3	9.7127	2586.70	0.038644	99.961349	53.280685
10.5	6.4	9.7127	2054.69	0.048645	99.951355	42.326645
10.5	6.5	9.7127	1632.10	0.061233	99.938766	33.625519
10.5	6.6	9.7127	1296.43	0.077076	99.922913	26.713974
10.5	6.7	9.7127	1029.79	0.097013	99.902985	21.223923
10.5	6.8	9.7127	817.99	0.122101	99.877899	16.863007
10.5	6.9	9.7127	649.75	0.153664	99.846329	13.39029
10.5	7.0	9.7127	516.12	0.193374	99.806610	10.647475
10.5	7.1	9.7127	409.97	0.243324	99.756668	8.461833
10.5	7.2	9.7127	325.65	0.306138	99.693848	6.725717
10.5	7.3	9.7127	258.67	0.385094	99.614899	5.346674
10.5	7.4	9.7127	205.47	0.484328	99.515671	4.251254
10.5	7.5	9.7127	163.21	0.608968	99.391022	3.381131
10.5	7.6	9.7127	129.64	0.765438	99.234558	2.689963
10.5	7.7	9.7127	102.98	0.961722	99.038269	2.140951
10.5	7.8	9.7127	81.80	1.207726	98.792267	1.704856
10.5	7.9	9.7127	64.98	1.515695	98.484294	1.358452
10.5	8.0	9.7127	51.61	1.900685	98.099304	1.083293
10.5	8.1	9.7127	41.00	2.381100	97.618896	0.864726
10.5	8.2	9.7127	32.57	2.979254	97.020737	0.691112
10.5	8.3	9.7127	25.87	3.721942	96.278046	0.553206
10.5	8.4	9.7127	20.55	4.640923	95.359070	0.443662
10.5	8.5	9.7127	16.32	5.773191	94.226807	0.356648
10.5	8.6	9.7127	12.96	7.160964	92.839035	0.287531
10.5	8.7	9.7127	10.30	8.850996	91.149002	0.232629
10.5	8.8	9.7127	8.18	10.893088	89.106903	0.189019
10.5	8.9	9.7127	6.50	13.337384	86.662598	0.154378
10.5	9.0	9.7127	5.16	16.230255	83.769745	0.126862
10.5	9.1	9.7127	4.10	19.608612	80.391388	0.105005
10.5	9.2	9.7127	3.26	23.492996	76.507004	0.087643
10.5	9.3	9.7127	2.59	27.879974	72.120026	0.073852
10.5	9.4	9.7127	2.05	32.735641	67.264359	0.062898
10.5	9.5	9.7127	1.63	37.991486	62.008514	0.054196
10.5	9.6	9.7127	1.30	43.544922	56.455078	0.047284
10.5	9.7	9.7127	1.03	49.265182	50.734818	0.041794
10.5	9.8	9.7127	0.82	55.004745	44.995255	0.037433
10.5	9.9	9.7127	0.65	60.614120	39.385880	0.033969
10.5	10.0	9.7127	0.52	65.956970	34.043030	0.031217
10.5	10.1	9.7127	0.41	70.922760	29.077240	0.029032

** CONCENTRATIONS OF AMMONIA(NH₄+NH₃) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH₃-N

TEMP C	PH	PKA	RATIO	% UNIONIZED AMMONIA	% IONIZED AMMONIA	CONCENTRATION NH ₄ +NH ₃ **
11.0	5.0	9.6958	49637.41	0.002015	99.997986	1022.05469
11.0	5.1	9.6958	39428.45	0.002536	99.997452	811.852295
11.0	5.2	9.6958	31319.18	0.003193	99.996796	644.882324
11.0	5.3	9.6958	24877.75	0.004019	99.995972	512.253174
11.0	5.4	9.6958	19761.12	0.005060	99.994934	406.902344
11.0	5.5	9.6958	15696.84	0.006370	99.993622	323.218506
11.0	5.6	9.6958	12468.46	0.008020	99.991974	256.746094
11.0	5.7	9.6958	9904.06	0.010096	99.989844	203.945160
11.0	5.8	9.6958	7867.09	0.012710	99.987289	162.003891
11.0	5.9	9.6958	6249.05	0.016000	99.983994	128.688614
11.0	6.0	9.6958	4963.81	0.020142	99.979858	102.225388
11.0	6.1	9.6958	3942.90	0.025356	99.974640	81.204495
11.0	6.2	9.6958	3131.96	0.031919	99.968079	64.507675
11.0	6.3	9.6958	2487.81	0.040180	99.959808	51.244568
11.0	6.4	9.6958	1976.14	0.050578	99.949417	40.709305
11.0	6.5	9.6958	1569.71	0.063666	99.936325	32.340836
11.0	6.6	9.6958	1246.86	0.080137	99.919861	25.693481
11.0	6.7	9.6958	990.42	0.100865	99.899124	20.413330
11.0	6.8	9.6958	786.72	0.126949	99.873047	16.219131
11.0	6.9	9.6958	624.91	0.159765	99.840225	12.687573
11.0	7.0	9.6958	496.39	0.201050	99.798950	10.241210
11.0	7.1	9.6958	394.30	0.252975	99.747025	8.139127
11.0	7.2	9.6958	313.20	0.318268	99.681732	6.469386
11.0	7.3	9.6958	248.78	0.400345	99.599655	5.143059
11.0	7.4	9.6958	197.62	0.503483	99.496506	4.089514
11.0	7.5	9.6958	156.97	0.633021	99.366974	3.252655
11.0	7.6	9.6958	124.69	0.795621	99.204376	2.587914
11.0	7.7	9.6958	99.04	0.999567	99.000427	2.059891
11.0	7.8	9.6958	78.67	1.255130	98.744858	1.640468
11.0	7.9	9.6958	62.49	1.574994	98.425003	1.307306
11.0	8.0	9.6958	49.64	1.974744	98.025253	1.042666
11.0	8.1	9.6958	39.43	2.473405	97.526581	0.832456
11.0	8.2	9.6958	31.32	3.094016	96.905975	0.665478
11.0	8.3	9.6958	24.88	3.864173	96.135818	0.532844
11.0	8.4	9.6958	19.76	4.816510	95.183487	0.427488
11.0	8.5	9.6958	15.70	5.944933	94.011063	0.343801
11.0	8.6	9.6958	12.47	7.424474	92.575516	0.277326
11.0	8.7	9.6958	9.90	9.170552	90.829437	0.224523
11.0	8.8	9.6958	7.87	11.277250	88.722748	0.182580
11.0	8.9	9.6958	6.25	13.794400	86.205582	0.149263
11.0	9.0	9.6958	4.96	16.767227	83.232773	0.122799
11.0	9.1	9.6958	3.94	20.230377	79.769623	0.101778
11.0	9.2	9.6958	3.13	24.200830	75.799164	0.085080
11.0	9.3	9.6958	2.49	29.670441	71.329559	0.071816
11.0	9.4	9.6958	1.98	33.599640	66.400360	0.061280
11.0	9.5	9.6958	1.57	38.913986	61.086014	0.052912
11.0	9.6	9.6958	1.25	44.505478	55.494522	0.046264
11.0	9.7	9.6958	0.99	50.239624	49.760376	0.040984
11.0	9.8	9.6958	0.79	55.967484	44.032516	0.036789
11.0	9.9	9.6958	0.62	61.540725	38.459274	0.033458
11.0	10.0	9.6958	0.50	66.826706	33.173294	0.030611
11.0	10.1	9.6958	0.39	71.720001	28.279999	0.028709

** CONCENTRATIONS OF AMMONIA(NH₄+NH₃) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH₃-N

TEMP C	PH	PKA	RATIO	% UNIONIZED AMMONIA	% IONIZED AMMONIA	CONCENTRATION NH4+NH3 **
11.5	5.0	9.6789	47746.30	0.002094	99.997894	983.116699
11.5	5.1	9.6789	37926.29	0.002637	99.997360	780.922852
11.5	5.2	9.6789	30125.97	0.003319	99.996674	620.314209
11.5	5.3	9.6789	23929.94	0.004179	99.995819	492.735281
11.5	5.4	9.6789	19008.24	0.005261	99.994736	391.400146
11.5	5.5	9.6789	15098.80	0.006623	99.993378	310.904785
11.5	5.6	9.6789	11933.42	0.008337	99.991653	246.965118
11.5	5.7	9.6789	9526.73	0.010496	99.989502	196.175949
11.5	5.8	9.6789	7567.36	0.013213	99.986786	155.832474
11.5	5.9	9.6789	6010.98	0.016633	99.983353	123.786545
11.5	6.0	9.6789	4774.70	0.020939	99.979050	98.331558
11.5	6.1	9.6789	3792.69	0.026360	99.973633	78.111893
11.5	6.2	9.6789	3012.64	0.033183	99.966812	62.050751
11.5	6.3	9.6789	2393.02	0.041771	99.958221	49.292969
11.5	6.4	9.6789	1900.85	0.052580	99.947418	39.159088
11.5	6.5	9.6789	1509.90	0.066186	99.933807	31.109451
11.5	6.6	9.6789	1199.36	0.083303	99.916687	24.715393
11.5	6.7	9.6789	952.69	0.104856	99.895142	19.636398
11.5	6.8	9.6789	756.75	0.131970	99.868027	15.601998
11.5	6.9	9.6789	601.11	0.166084	99.833908	12.397361
11.5	7.0	9.6789	477.48	0.208997	99.791000	9.851813
11.5	7.1	9.6789	379.27	0.262969	99.737030	7.829821
11.5	7.2	9.6789	301.27	0.330833	99.669159	6.223690
11.5	7.3	9.6789	239.31	0.416136	99.583862	4.947896
11.5	7.4	9.6789	190.09	0.523320	99.476669	3.934494
11.5	7.5	9.6789	150.99	0.657929	99.342072	3.129519
11.5	7.6	9.6789	119.94	0.826873	99.173126	2.490104
11.5	7.7	9.6789	95.27	1.038746	98.961243	1.982198
11.5	7.8	9.6789	75.68	1.304193	98.695801	1.575753
11.5	7.9	9.6789	60.11	1.636356	98.363632	1.258283
11.5	8.0	9.6789	47.75	2.051356	97.948639	1.003725
11.5	8.1	9.6789	37.93	2.568856	97.431137	0.801524
11.5	8.2	9.6789	30.13	3.212626	96.787369	0.640909
11.5	8.3	9.6789	23.93	4.011085	95.988907	0.513327
11.5	8.4	9.6789	19.01	4.997746	95.002243	0.411985
11.5	8.5	9.6789	15.10	6.211401	93.788589	0.331487
11.5	8.6	9.6789	11.99	7.695907	92.304092	0.267545
11.5	8.7	9.6789	9.53	9.499279	90.500717	0.216753
11.5	8.8	9.6789	7.57	11.671788	88.328201	0.176408
11.5	8.9	9.6789	6.01	14.262853	85.737137	0.144361
11.5	9.0	9.6789	4.77	17.316345	82.683655	0.118905
11.5	9.1	9.6789	3.79	20.864471	79.135529	0.098684
11.5	9.2	9.6789	3.01	24.920502	75.079498	0.082623
11.5	9.3	9.6789	2.39	29.471359	70.528641	0.069864
11.5	9.4	9.6789	1.90	34.471710	65.528290	0.059730
11.5	9.5	9.6789	1.51	39.841202	60.158798	0.051680
11.5	9.6	9.6789	1.20	45.466766	54.533234	0.045286
11.5	9.7	9.6789	0.95	51.210495	48.789505	0.040207
11.5	9.8	9.6789	0.76	56.922424	43.077576	0.036172
11.5	9.9	9.6789	0.60	62.455872	37.544128	0.032967
11.5	10.0	9.6789	0.48	67.682114	32.317886	0.030422
11.5	10.1	9.6789	0.38	72.501129	27.498871	0.028400

** CONCENTRATIONS OF AMMONIA(NH4+NH3) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH3-N

TEMP C	PH	PKA	RATIO	% UNIONIZED AMMONIA	% IONIZED AMMONIA	CONCENTRATION NH ₄ +NH ₃ **
12.0	5.0	9.6621	45933.37	0.002177	99.997818	945.788574
12.0	5.1	9.6621	36486.23	0.002741	99.997253	751.271973
12.0	5.2	9.6621	28982.09	0.003450	99.996536	596.761475
12.0	5.3	9.6621	23021.32	0.004344	99.995651	474.029541
12.0	5.4	9.6621	18286.50	0.005468	99.994522	376.539551
12.0	5.5	9.6621	14525.50	0.006884	99.993103	299.100586
12.0	5.6	9.6621	11538.03	0.008666	99.991333	237.588684
12.0	5.7	9.6621	9165.00	0.010919	99.989090	188.727951
12.0	5.8	9.6621	7280.03	0.013734	99.986252	149.916351
12.0	5.9	9.6621	5782.74	0.017290	99.982697	119.087219
12.0	6.0	9.6621	4593.40	0.021765	99.978226	94.598740
12.0	6.1	9.6621	3648.67	0.027400	99.972595	75.146774
12.0	6.2	9.6621	2898.25	0.034492	99.965500	59.695465
12.0	6.3	9.6621	2302.16	0.043419	99.956573	47.422089
12.0	6.4	9.6621	1828.67	0.054655	99.945343	37.672989
12.0	6.5	9.6621	1452.57	0.068796	99.931198	29.929016
12.0	6.6	9.6621	1153.82	0.086594	99.913406	23.777725
12.0	6.7	9.6621	916.51	0.108990	99.891006	18.891571
12.0	6.8	9.6621	728.01	0.137172	99.862823	15.010374
12.0	6.9	9.6621	578.23	0.172627	99.827362	11.927414
12.0	7.0	9.6621	459.35	0.217228	99.782761	9.478533
12.0	7.1	9.6621	364.87	0.273320	99.726669	7.533305
12.0	7.2	9.6621	289.83	0.343845	99.656143	5.988161
12.0	7.3	9.6621	230.22	0.432490	99.567505	4.760806
12.0	7.4	9.6621	182.87	0.543863	99.456131	3.785882
12.0	7.5	9.6621	145.26	0.683719	99.316289	3.011473
12.0	7.6	9.6621	115.38	0.859228	99.140762	2.396337
12.0	7.7	9.6621	91.65	1.079301	98.920685	1.907716
12.0	7.8	9.6621	72.80	1.354971	98.645020	1.519589
12.0	7.9	9.6621	57.83	1.699842	98.300156	1.211288
12.0	8.0	9.6621	45.94	2.130595	97.869400	0.966397
12.0	8.1	9.6621	36.49	2.667542	97.332458	0.771872
12.0	8.2	9.6621	28.98	3.335194	96.664795	0.617355
12.0	8.3	9.6621	23.02	4.162807	95.837189	0.494618
12.0	8.4	9.6621	18.29	5.184772	94.815216	0.397124
12.0	8.5	9.6621	14.53	6.440766	93.559219	0.319682
12.0	8.6	9.6621	11.54	7.975429	92.024567	0.258168
12.0	8.7	9.6621	9.17	9.837313	90.162674	0.209305
12.0	8.8	9.6621	7.28	12.076824	87.923172	0.170492
12.0	8.9	9.6621	5.78	14.742795	85.257202	0.139661
12.0	9.0	9.6621	4.59	17.877609	82.122391	0.115172
12.0	9.1	9.6621	3.65	21.510818	78.489182	0.095719
12.0	9.2	9.6621	2.90	25.651764	74.348236	0.080267
12.0	9.3	9.6621	2.30	30.282303	69.717697	0.067993
12.0	9.4	9.6621	1.83	35.351288	64.648712	0.058244
12.0	9.5	9.6621	1.45	40.772552	59.227448	0.050500
12.0	9.6	9.6621	1.15	46.428116	53.571884	0.044348
12.0	9.7	9.6621	0.92	52.177094	47.822906	0.039462
12.0	9.8	9.6621	0.73	57.868942	42.131058	0.035580
12.0	9.9	9.6621	0.58	63.359085	36.640915	0.032497
12.0	10.0	9.6621	0.46	68.522949	31.477051	0.030048
12.0	10.1	9.6621	0.36	73.266113	26.733887	0.028103

** CONCENTRATIONS OF AMMONIA(NH₄+NH₃) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH₃-N

TEMP C	PH	PKA	RATIO	% UNIONIZED AMMONIA	% IONIZED AMMONIA	CONCENTRATION NH4+NH3 **
12.5	5.0	9.6454	44195.39	0.002263	99.997726	910.003662
12.5	5.1	9.6454	35105.70	0.002848	99.997147	722.846680
12.5	5.2	9.6454	27885.49	0.003586	99.996414	574.182861
12.5	5.3	9.6454	22150.27	0.004514	99.995483	456.094727
12.5	5.4	9.6454	17544.61	0.005683	99.994308	362.293457
12.5	5.5	9.6454	13975.90	0.007155	99.992844	287.744424
12.5	5.6	9.6454	11101.47	0.009007	99.990992	228.599823
12.5	5.7	9.6454	8818.22	0.011339	99.988667	181.547784
12.5	5.8	9.6454	7004.57	0.014274	99.985718	144.244766
12.5	5.9	9.6454	5563.94	0.017970	99.982025	114.582062
12.5	6.0	9.6454	4419.60	0.022621	99.977371	91.020187
12.5	6.1	9.6454	3510.62	0.028477	99.971512	72.304214
12.5	6.2	9.6454	2788.59	0.035848	99.964142	57.437607
12.5	6.3	9.6454	2215.05	0.045125	99.954865	45.628555
12.5	6.4	9.6454	1754.48	0.056803	99.943192	36.248337
12.5	6.5	9.6454	1397.61	0.071500	99.928497	28.797363
12.5	6.6	9.6454	1110.16	0.089996	99.910004	22.878815
12.5	6.7	9.6454	881.83	0.113271	99.886719	18.177551
12.5	6.8	9.6454	700.47	0.142555	99.857437	14.443207
12.5	6.9	9.6454	556.40	0.179404	99.820587	11.476898
12.5	7.0	9.6454	441.97	0.225751	99.774246	9.120667
12.5	7.1	9.6454	351.07	0.284037	99.715958	7.249051
12.5	7.2	9.6454	278.86	0.357319	99.642670	5.762365
12.5	7.3	9.6454	221.51	0.449421	99.550568	4.581450
12.5	7.4	9.6454	175.95	0.565129	99.434860	3.643415
12.5	7.5	9.6454	139.76	0.710415	99.289581	2.898307
12.5	7.6	9.6454	111.02	0.892716	99.107285	2.306445
12.5	7.7	9.6454	88.18	1.121268	98.878723	1.836313
12.5	7.8	9.6454	70.05	1.407505	98.592484	1.462872
12.5	7.9	9.6454	55.64	1.765508	98.234482	1.166236
12.5	8.0	9.6454	44.20	2.212527	97.787460	0.930610
12.5	8.1	9.6454	35.11	2.769537	97.230453	0.743445
12.5	8.2	9.6454	27.89	3.461811	96.538177	0.594775
12.5	8.3	9.6454	22.15	4.319439	95.680557	0.476682
12.5	8.4	9.6454	17.60	5.377696	94.622299	0.382878
12.5	8.5	9.6454	13.98	6.677136	93.322861	0.308366
12.5	8.6	9.6454	11.10	8.263145	91.736847	0.249179
12.5	8.7	9.6454	8.82	10.184763	89.815231	0.202165
12.5	8.8	9.6454	7.00	12.492405	87.507584	0.164820
12.5	8.9	9.6454	5.56	15.234232	84.765762	0.135156
12.5	9.0	9.6454	4.42	18.450928	81.549072	0.111593
12.5	9.1	9.6454	3.51	22.169205	77.830795	0.092877
12.5	9.2	9.6454	2.79	26.394272	73.605728	0.078009
12.5	9.3	9.6454	2.22	31.102768	68.897232	0.066200
12.5	9.4	9.6454	1.76	36.237701	63.762299	0.056819
12.5	9.5	9.6454	1.40	41.707199	58.292801	0.049368
12.5	9.6	9.6454	1.11	47.388672	52.611328	0.043449
12.5	9.7	9.6454	0.88	53.138611	46.861389	0.038748
12.5	9.8	9.6454	0.70	58.806381	41.193619	0.035013
12.5	9.9	9.6454	0.56	64.249832	35.750168	0.032047
12.5	10.0	9.6454	0.44	69.348877	30.651123	0.029690
12.5	10.1	9.6454	0.35	74.014801	25.985199	0.027819

** CONCENTRATIONS OF AMMONIA(NH4+NH3) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH3-N

TEMP C	PH	PKA	RATIO	% UNIONIZED AMMONIA	% IONIZED AMMONIA	CONCENTRATION NH ₄ +NH ₃ **
13.0	5.0	9.6287	42528.89	0.002351	99.997635	875.690430
13.0	5.1	9.6287	33781.92	0.002960	99.997040	695.590088
13.0	5.2	9.6287	26833.97	0.003720	99.996262	552.531982
13.0	5.3	9.6287	21315.01	0.004691	99.995300	438.896724
13.0	5.4	9.6287	16931.14	0.005906	99.994095	348.632812
13.0	5.5	9.6287	13448.90	0.007435	99.992554	276.933350
13.0	5.6	9.6287	10682.86	0.009360	99.990631	219.980713
13.0	5.7	9.6287	8485.71	0.011783	99.988205	174.741364
13.0	5.8	9.6287	6740.45	0.014834	99.985153	138.806427
13.0	5.9	9.6287	5354.13	0.018674	99.981323	110.242192
13.0	6.0	9.6287	4252.95	0.023508	99.976486	87.588730
13.0	6.1	9.6287	3378.24	0.029592	99.970398	69.578506
13.0	6.2	9.6287	2683.43	0.037252	99.962738	55.272491
13.0	6.3	9.6287	2131.53	0.046893	99.953094	43.908798
13.0	6.4	9.6287	1693.14	0.059027	99.940964	34.882278
13.0	6.5	9.6287	1344.91	0.074299	99.925690	27.712265
13.0	6.6	9.6287	1068.30	0.093519	99.906479	22.016907
13.0	6.7	9.6287	848.58	0.117705	99.882294	17.492689
13.0	6.8	9.6287	674.05	0.148136	99.851852	13.499350
13.0	6.9	9.6287	535.42	0.186421	99.813568	11.044895
13.0	7.0	9.6287	425.30	0.234576	99.765411	8.777523
13.0	7.1	9.6287	337.83	0.295134	99.704865	6.976479
13.0	7.2	9.6287	268.35	0.371268	99.628723	5.545857
13.0	7.3	9.6287	213.16	0.466949	99.533051	4.409472
13.0	7.4	9.6287	169.32	0.587144	99.412857	3.506807
13.0	7.5	9.6287	134.49	0.738047	99.261948	2.789795
13.0	7.6	9.6287	106.83	0.927373	99.072617	2.220249
13.0	7.7	9.6287	84.86	1.164695	98.835297	1.767844
13.0	7.8	9.6287	67.41	1.461854	98.538132	1.408484
13.0	7.9	9.6287	53.54	1.833423	98.166565	1.123035
13.0	8.0	9.6287	42.53	2.297234	97.702759	0.896295
13.0	8.1	9.6287	33.78	2.874942	97.125046	0.716188
13.0	8.2	9.6287	26.84	3.592588	96.407410	0.573124
13.0	8.3	9.6287	21.32	4.481112	95.518875	0.459484
13.0	8.4	9.6287	16.93	5.576673	94.423325	0.369217
13.0	8.5	9.6287	13.45	6.920680	93.079315	0.297514
13.0	8.6	9.6287	10.68	8.559232	91.440765	0.240559
13.0	8.7	9.6287	8.49	10.541792	89.458206	0.195318
13.0	8.8	9.6287	6.74	12.918694	87.081299	0.159381
13.0	8.9	9.6287	5.35	15.737243	84.262756	0.130836
13.0	9.0	9.6287	4.25	19.036301	80.963699	0.108162
13.0	9.1	9.6287	3.38	22.839508	77.160492	0.090151
13.0	9.2	9.6287	2.68	27.147751	72.852249	0.075844
13.0	9.3	9.6287	2.13	31.932358	68.067642	0.064480
13.0	9.4	9.6287	1.69	37.130447	62.869553	0.055453
13.0	9.5	9.6287	1.34	42.644577	57.355423	0.048283
13.0	9.6	9.6287	1.07	48.347839	51.652161	0.042587
13.0	9.7	9.6287	0.85	54.044498	45.905502	0.038063
13.0	9.8	9.6287	0.67	59.734268	40.265732	0.034469
13.0	9.9	9.6287	0.54	65.127808	34.872192	0.031615
13.0	10.0	9.6287	0.43	70.159790	29.840210	0.029347
13.0	10.1	9.6287	0.34	74.747238	25.252762	0.027546

** CONCENTRATIONS OF AMMONIA(NH₄+NH₃) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH₃-N

TEMP C	PH	PKA	RATIO	% UNIONIZED AMMONIA	% IONIZED AMMONIA	CONCENTRATION NH ₄ +NH ₃ **
13.5	5.0	9.6121	40930.70	0.002443	99.997543	842.783447
13.5	5.1	9.6121	32512.43	0.003076	99.996914	669.451416
13.5	5.2	9.6121	25825.57	0.003872	99.996124	531.769043
13.5	5.3	9.6121	20514.02	0.004874	99.995117	422.404297
13.5	5.4	9.6121	16294.88	0.006137	99.993851	335.532227
13.5	5.5	9.6121	12943.50	0.007725	99.992264	266.527344
13.5	5.6	9.6121	10281.41	0.009725	99.990265	211.714737
13.5	5.7	9.6121	8166.82	0.012243	99.987747	168.175507
13.5	5.8	9.6121	6487.15	0.015413	99.984573	133.590973
13.5	5.9	9.6121	5152.93	0.019403	99.980591	106.119431
13.5	6.0	9.6121	4093.12	0.024425	99.975571	84.297974
13.5	6.1	9.6121	3251.29	0.030744	99.969238	66.964584
13.5	6.2	9.6121	2582.59	0.038706	99.961288	53.196167
13.5	6.3	9.6121	2051.43	0.048723	99.951263	42.259521
13.5	6.4	9.6121	1629.51	0.061330	99.938660	33.572220
13.5	6.5	9.6121	1294.37	0.077198	99.922791	26.671631
13.5	6.6	9.6121	1028.16	0.097167	99.902832	21.190292
13.5	6.7	9.6121	816.69	0.122245	99.877701	16.936304
13.5	6.8	9.6121	648.72	0.153912	99.846085	13.377803
13.5	6.9	9.6121	515.30	0.193686	99.806305	10.630613
13.5	7.0	9.6121	409.32	0.243713	99.756287	8.448445
13.5	7.1	9.6121	325.13	0.306623	99.693375	6.715083
13.5	7.2	9.6121	258.26	0.385709	99.614288	5.338223
13.5	7.3	9.6121	205.15	0.485094	99.514893	4.244542
13.5	7.4	9.6121	162.95	0.609930	99.390060	3.375799
13.5	7.5	9.6121	129.44	0.766644	99.233353	2.685731
13.5	7.6	9.6121	102.82	0.963235	99.036758	2.137588
13.5	7.7	9.6121	81.67	1.209622	98.790375	1.702184
13.5	7.8	9.6121	64.87	1.518067	98.481918	1.356329
13.5	7.9	9.6121	51.53	1.903648	98.096344	1.081607
13.5	8.0	9.6121	40.93	2.384792	97.615204	0.863387
13.5	8.1	9.6121	32.51	2.983849	97.016144	0.690048
13.5	8.2	9.6121	25.83	3.727636	96.272354	0.552361
13.5	8.3	9.6121	20.51	4.647949	95.352051	0.442991
13.5	8.4	9.6121	16.30	5.781829	94.218170	0.356116
13.5	8.5	9.6121	12.94	7.171528	92.828461	0.287108
13.5	8.6	9.6121	10.28	8.863815	91.136185	0.232293
13.5	8.7	9.6121	8.17	10.908510	89.091476	0.188752
13.5	8.8	9.6121	6.49	13.355752	86.644241	0.154166
13.5	8.9	9.6121	5.15	16.251862	83.748138	0.126693
13.5	9.0	9.6121	4.09	19.633667	80.366333	0.104871
13.5	9.1	9.6121	3.25	23.521530	76.478470	0.087537
13.5	9.2	9.6121	2.58	27.911911	72.088089	0.073768
13.5	9.3	9.6121	2.05	32.770599	67.229401	0.062831
13.5	9.4	9.6121	1.63	38.028915	61.971085	0.054143
13.5	9.5	9.6121	1.29	43.583969	56.416031	0.047242
13.5	9.6	9.6121	1.03	49.304855	50.695145	0.041761
13.5	9.7	9.6121	0.82	55.044052	44.955948	0.037406
13.5	9.8	9.6121	0.65	60.651993	39.348007	0.033948
13.5	9.9	9.6121	0.52	65.992615	34.007385	0.031200
13.5	10.0	9.6121	0.41	70.955490	29.044510	0.029018
13.5	10.1	9.6121	0.33	75.463333	24.536667	0.027285

** CONCENTRATIONS OF AMMONIA(NH₄+NH₃) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH₃-N

TEMP C	PH	PKA	RATIO	% UNIONIZED AMMONIA	% IONIZED AMMONIA	CONCENTRATION NH4+NH3 **
14.0	5.0	9.5955	39397.74	0.002538	99.997452	811.219971
14.0	5.1	9.5955	31294.79	0.003195	99.996796	644.380127
14.0	5.2	9.5955	24858.37	0.004023	99.995972	511.854248
14.0	5.3	9.5955	19745.71	0.005064	99.994934	406.584961
14.0	5.4	9.5955	15644.60	0.006375	99.993622	322.966553
14.0	5.5	9.5955	12458.74	0.008020	99.991974	256.545898
14.0	5.6	9.5955	9896.34	0.010104	99.989883	203.786362
14.0	5.7	9.5955	7860.96	0.012714	99.987274	161.877625
14.0	5.8	9.5955	6244.19	0.016012	99.983978	128.588379
14.0	5.9	9.5955	4959.94	0.020157	99.979843	102.145767
14.0	6.0	9.5955	3739.83	0.025375	99.974625	81.141647
14.0	6.1	9.5955	3129.52	0.031444	99.968048	64.457367
14.0	6.2	9.5955	2485.87	0.040211	99.959778	51.204620
14.0	6.3	9.5955	1974.60	0.050618	99.949371	40.677567
14.0	6.4	9.5955	1568.48	0.063715	99.936279	32.315628
14.0	6.5	9.5955	1245.89	0.080197	99.919800	25.673492
14.0	6.6	9.5955	989.65	0.100944	99.899048	20.397446
14.0	6.7	9.5955	786.11	0.127048	99.872940	16.206512
14.0	6.8	9.5955	624.43	0.159891	99.840103	12.877553
14.0	6.9	9.5955	496.00	0.201207	99.798782	10.233241
14.0	7.0	9.5955	393.99	0.253172	99.746826	8.132803
14.0	7.1	9.5955	312.96	0.318510	99.681473	6.464355
14.0	7.2	9.5955	248.59	0.400657	99.599335	5.139065
14.0	7.3	9.5955	197.46	0.503873	99.496124	4.086345
14.0	7.4	9.5955	156.85	0.633511	99.366486	3.250138
14.0	7.5	9.5955	124.59	0.796236	99.203751	2.585915
14.0	7.6	9.5955	98.97	1.000338	98.999649	2.058305
14.0	7.7	9.5955	78.61	1.255090	98.743896	1.639206
14.0	7.8	9.5955	62.44	1.576203	98.423782	1.306303
14.0	7.9	9.5955	49.60	1.976254	98.023743	1.041869
14.0	8.0	9.5955	39.40	2.475287	97.524704	0.831822
14.0	8.1	9.5955	31.30	3.046354	96.903641	0.664975
14.0	8.2	9.5955	24.86	3.867069	96.132919	0.532444
14.0	8.3	9.5955	19.75	4.820082	95.179916	0.427171
14.0	8.4	9.5955	15.69	5.993320	94.006668	0.343549
14.0	8.5	9.5955	12.46	7.429831	92.570160	0.277126
14.0	8.6	9.5955	9.90	9.177052	90.822937	0.224364
14.0	8.7	9.5955	7.86	11.285058	88.714935	0.182454
14.0	8.8	9.5955	6.24	13.803685	86.196304	0.149163
14.0	8.9	9.5955	4.96	16.778107	83.221893	0.122719
14.0	9.0	9.5955	3.94	20.242950	79.757050	0.101714
14.0	9.1	9.5955	3.13	24.215134	75.784866	0.085029
14.0	9.2	9.5955	2.49	28.686386	71.313614	0.071776
14.0	9.3	9.5955	1.97	33.617050	66.382950	0.061249
14.0	9.4	9.5955	1.57	38.932526	61.067474	0.052886
14.0	9.5	9.5955	1.25	44.524719	55.475281	0.046244
14.0	9.6	9.5955	0.99	50.259125	49.740875	0.040968
14.0	9.7	9.5955	0.79	55.986694	44.013306	0.036777
14.0	9.8	9.5955	0.62	61.559189	38.440811	0.033447
14.0	9.9	9.5955	0.50	66.843964	33.156036	0.030803
14.0	10.0	9.5955	0.39	71.735809	28.264191	0.028703
14.0	10.1	9.5955	0.31	76.163239	23.836761	0.027034

** CONCENTRATIONS OF AMMONIA(NH4+NH3) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH3-N

TEMP C	PH	PKA	RATIO	% UNIONIZED AMMONIA	% IONIZED AMMONIA	CONCENTRATION NH4+NH3 **
14.5	5.0	9.5790	37927.37	0.002537	99.997360	780.945068
14.5	5.1	9.5790	30126.83	0.003319	99.996674	620.331787
14.5	5.2	9.5790	23930.61	0.004179	99.995819	492.751953
14.5	5.3	9.5790	19008.78	0.005260	99.994736	391.411377
14.5	5.4	9.5790	15099.23	0.006622	99.993378	310.913818
14.5	5.5	9.5790	11993.77	0.008337	99.991653	246.972168
14.5	5.6	9.5790	9527.00	0.010495	99.989502	196.181488
14.5	5.7	9.5790	7567.58	0.013213	99.986786	155.836960
14.5	5.8	9.5790	6011.15	0.016633	99.983368	123.790070
14.5	5.9	9.5790	4774.83	0.020939	99.979050	98.334381
14.5	6.0	9.5790	3742.79	0.026359	99.973633	78.114044
14.5	6.1	9.5790	3012.72	0.033182	99.966812	62.052521
14.5	6.2	9.5790	2393.09	0.041769	99.958221	49.294373
14.5	6.3	9.5790	1900.90	0.052579	99.947418	39.160202
14.5	6.4	9.5790	1509.94	0.066144	99.933807	31.110352
14.5	6.5	9.5790	1199.39	0.083305	99.916687	24.716095
14.5	6.6	9.5790	952.71	0.104853	99.895142	19.676948
14.5	6.7	9.5790	756.77	0.131966	99.868027	15.602446
14.5	6.8	9.5790	601.12	0.166079	99.833908	12.357718
14.5	6.9	9.5790	477.49	0.208991	99.791000	9.852093
14.5	7.0	9.5790	374.28	0.262961	99.737030	7.830041
14.5	7.1	9.5790	301.28	0.330823	99.669174	6.223870
14.5	7.2	9.5790	239.31	0.416125	99.583862	4.948036
14.5	7.3	9.5790	190.09	0.523305	99.476685	3.934606
14.5	7.4	9.5790	151.00	0.657910	99.342087	3.129608
14.5	7.5	9.5790	119.94	0.826850	99.173141	2.490174
14.5	7.6	9.5790	95.27	1.038716	98.961273	1.982254
14.5	7.7	9.5790	75.68	1.304158	98.695831	1.578795
14.5	7.8	9.5790	60.11	1.636310	98.363678	1.258319
14.5	7.9	9.5790	47.75	2.051299	97.948700	1.003754
14.5	8.0	9.5790	37.93	2.568785	97.431213	0.801546
14.5	8.1	9.5790	30.13	3.212535	96.787460	0.640926
14.5	8.2	9.5790	23.93	4.010974	95.989014	0.513342
14.5	8.3	9.5790	19.01	4.997609	95.002380	0.411997
14.5	8.4	9.5790	15.10	6.211235	93.788757	0.331496
14.5	8.5	9.5790	11.99	7.695704	92.304291	0.267552
14.5	8.6	9.5790	9.53	9.499033	90.500961	0.216759
14.5	8.7	9.5790	7.57	11.671494	88.328506	0.176413
14.5	8.8	9.5790	6.01	14.252504	85.737488	0.144365
14.5	8.9	9.5790	4.78	17.315933	82.684067	0.118908
14.5	9.0	9.5790	3.79	20.863998	79.136002	0.098687
14.5	9.1	9.5790	3.01	24.919968	75.080032	0.082624
14.5	9.2	9.5790	2.39	29.470764	70.529236	0.069866
14.5	9.3	9.5790	1.90	34.471069	65.528931	0.059731
14.5	9.4	9.5790	1.51	39.840515	60.159485	0.051681
14.5	9.5	9.5790	1.20	45.466049	54.533951	0.045287
14.5	9.6	9.5790	0.95	51.209763	48.790237	0.040207
14.5	9.7	9.5790	0.76	56.921707	43.078293	0.036172
14.5	9.8	9.5790	0.60	62.455200	37.544800	0.032968
14.5	9.9	9.5790	0.48	67.681503	32.318497	0.030422
14.5	10.0	9.5790	0.38	72.500580	27.499420	0.028400
14.5	10.1	9.5790	0.30	76.846893	23.153107	0.026794

** CONCENTRATIONS OF AMMONIA(NH4+NH3) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH3-N

TEMP C	PH	PKA	RATIO	* UNIONIZED AMMONIA	* IONIZED AMMONIA	CONCENTRATION NH ₄ +NH ₃ **
15.0	5.0	9.5625	36516.58	0.002738	99.997253	751.446729
15.0	5.1	9.5625	29006.20	0.003447	99.996552	597.258057
15.0	5.2	9.5625	23040.47	0.004340	99.995651	474.424072
15.0	5.3	9.5625	18301.73	0.005464	99.994522	376.453271
15.0	5.4	9.5625	14537.60	0.006873	99.993118	299.349609
15.0	5.5	9.5625	11547.64	0.008659	99.991333	237.786575
15.0	5.6	9.5625	9172.63	0.010901	99.989099	188.445010
15.0	5.7	9.5625	7286.09	0.013723	99.986267	150.041199
15.0	5.8	9.5625	5787.56	0.017275	99.982712	119.186401
15.0	5.9	9.5625	4597.22	0.021748	99.978241	94.677414
15.0	6.0	9.5625	3651.71	0.027377	99.972610	75.209259
15.0	6.1	9.5625	2900.66	0.034463	99.965530	59.745163
15.0	6.2	9.5625	2304.08	0.043382	99.956604	47.441578
15.0	6.3	9.5625	1830.20	0.054609	99.945389	37.704361
15.0	6.4	9.5625	1453.78	0.068739	99.931259	29.953918
15.0	6.5	9.5625	1154.78	0.086522	99.913467	23.797516
15.0	6.6	9.5625	917.28	0.108900	99.891098	18.907288
15.0	6.7	9.5625	728.62	0.137053	99.862930	15.022843
15.0	6.8	9.5625	578.76	0.172484	99.827515	11.937320
15.0	6.9	9.5625	459.73	0.217048	99.782944	9.445401
15.0	7.0	9.5625	365.18	0.273043	99.726898	7.539564
15.0	7.1	9.5625	290.07	0.343560	99.656433	5.993133
15.0	7.2	9.5625	230.41	0.432131	99.567856	4.764754
15.0	7.3	9.5625	183.02	0.543412	99.456573	3.789020
15.0	7.4	9.5625	145.38	0.683153	99.316833	3.013964
15.0	7.5	9.5625	115.48	0.858519	99.141479	2.398314
15.0	7.6	9.5625	91.73	1.078414	98.921585	1.909285
15.0	7.7	9.5625	72.86	1.353860	98.646133	1.520836
15.0	7.8	9.5625	57.88	1.698453	98.301544	1.212279
15.0	7.9	9.5625	45.97	2.128860	97.871140	0.967184
15.0	8.0	9.5625	36.52	2.665380	97.334610	0.772498
15.0	8.1	9.5625	29.01	3.332511	96.667430	0.617852
15.0	8.2	9.5625	23.04	4.159480	95.840500	0.495013
15.0	8.3	9.5625	18.30	5.180678	94.819321	0.397438
15.0	8.4	9.5625	14.54	6.435757	93.564240	0.319931
15.0	8.5	9.5625	11.55	7.969327	92.030670	0.258366
15.0	8.6	9.5625	9.17	9.829939	90.170059	0.209462
15.0	8.7	9.5625	7.29	12.067985	87.932007	0.170617
15.0	8.8	9.5625	5.79	14.732332	85.267654	0.139761
15.0	8.9	9.5625	4.60	17.865387	82.134613	0.115251
15.0	9.0	9.5625	3.65	21.496765	78.503235	0.095782
15.0	9.1	9.5625	2.90	25.635895	74.364105	0.080317
15.0	9.2	9.5625	2.30	30.264743	69.735260	0.068033
15.0	9.3	9.5625	1.83	35.332260	64.667740	0.058275
15.0	9.4	9.5625	1.45	40.752441	59.247559	0.050525
15.0	9.5	9.5625	1.15	46.407425	53.592575	0.044368
15.0	9.6	9.5625	0.92	52.156326	47.843674	0.039477
15.0	9.7	9.5625	0.73	57.848663	42.151337	0.035593
15.0	9.8	9.5625	0.58	63.339767	36.660233	0.032507
15.0	9.9	9.5625	0.46	68.505005	31.494995	0.030056
15.0	10.0	9.5625	0.37	73.249847	26.750153	0.028109
15.0	10.1	9.5625	0.29	77.514450	22.485550	0.026563

** CONCENTRATIONS OF AMMONIA(NH₄+NH₃) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH₃-N

TEMP C	PH	PKA	RATIO	% UNIONIZED AMMONIA	% IONIZED AMMONIA	CONCENTRATION NH ₄ +NH ₃ **
15.5	5.0	9.5461	35162.93	0.002844	99.997147	724.025146
15.5	5.1	9.5461	27930.95	0.003590	99.996414	575.118652
15.5	5.2	9.5461	22186.37	0.004507	99.995493	456.838135
15.5	5.3	9.5461	17623.29	0.005674	99.994324	362.884033
15.5	5.4	9.5461	13998.70	0.007143	99.992844	288.253662
15.5	5.5	9.5461	11119.58	0.008992	99.990997	228.972717
15.5	5.6	9.5461	8832.61	0.011320	99.988678	181.883896
15.5	5.7	9.5461	7016.00	0.014251	99.985748	144.480026
15.5	5.8	9.5461	5573.01	0.017940	99.982056	114.768784
15.5	5.9	9.5461	4426.80	0.022585	99.977402	91.168488
15.5	6.0	9.5461	3516.34	0.028431	99.971558	72.422043
15.5	6.1	9.5461	2793.13	0.035789	99.964203	57.531204
15.5	6.2	9.5461	2218.67	0.045052	99.954941	45.702957
15.5	6.3	9.5461	1762.35	0.056710	99.943283	36.307434
15.5	6.4	9.5461	1399.89	0.071383	99.928604	28.844315
15.5	6.5	9.5461	1111.97	0.089849	99.910141	22.916107
15.5	6.6	9.5461	883.27	0.113087	99.886902	18.207169
15.5	6.7	9.5461	701.61	0.142327	99.857666	14.466721
15.5	6.8	9.5461	557.31	0.179112	99.820877	11.495572
15.5	6.9	9.5461	442.69	0.225384	99.774612	9.135502
15.5	7.0	9.5461	351.64	0.283575	99.716415	7.260435
15.5	7.1	9.5461	279.32	0.356739	99.643250	5.771730
15.5	7.2	9.5461	221.87	0.448692	99.551300	4.588891
15.5	7.3	9.5461	176.24	0.564214	99.435776	3.649325
15.5	7.4	9.5461	139.99	0.709266	99.290726	2.903001
15.5	7.5	9.5461	111.20	0.891276	99.108719	2.310171
15.5	7.6	9.5461	88.33	1.119464	98.880524	1.839272
15.5	7.7	9.5461	70.16	1.405247	98.594742	1.465222
15.5	7.8	9.5461	55.73	1.762685	98.237305	1.168104
15.5	7.9	9.5461	44.27	2.209003	97.790985	0.932094
15.5	8.0	9.5461	35.16	2.765151	97.234848	0.744624
15.5	8.1	9.5461	27.93	3.458369	96.543625	0.595712
15.5	8.2	9.5461	22.19	4.312708	95.687286	0.477426
15.5	8.3	9.5461	17.62	5.369413	94.630585	0.383468
15.5	8.4	9.5461	14.00	6.666994	93.332993	0.308835
15.5	8.5	9.5461	11.12	8.250807	91.749191	0.249551
15.5	8.6	9.5461	8.83	10.169873	89.830124	0.202461
15.5	8.7	9.5461	7.02	12.474609	87.525391	0.165055
15.5	8.8	9.5461	5.57	15.213197	84.786789	0.135343
15.5	8.9	9.5461	4.43	18.426422	81.573578	0.111742
15.5	9.0	9.5461	3.52	22.141098	77.858902	0.092994
15.5	9.1	9.5461	2.79	26.362610	73.637390	0.078103
15.5	9.2	9.5461	2.22	31.067855	68.932144	0.066274
15.5	9.3	9.5461	1.76	36.200058	63.799942	0.056278
15.5	9.4	9.5461	1.40	41.667587	58.332413	0.049415
15.5	9.5	9.5461	1.11	47.348053	52.651947	0.043486
15.5	9.6	9.5461	0.88	53.098038	46.901962	0.038777
15.5	9.7	9.5461	0.70	58.766891	41.233109	0.035037
15.5	9.8	9.5461	0.56	64.212418	35.787582	0.032065
15.5	9.9	9.5461	0.44	69.314270	30.685730	0.029705
15.5	10.0	9.5461	0.35	73.983475	26.016525	0.027831
15.5	10.1	9.5461	0.28	78.166016	21.833984	0.026341

** CONCENTRATIONS OF AMMONIA(NH₄+NH₃) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH₃-N

TEMP C	PH	PKA	RATIO	% UNIONIZED AMMONIA	% IONIZED AMMONIA	CONCENTRATION NH4+NH3 **
16.0	5.0	9.5297	33863.85	0.002953	99.997040	697.277100
16.0	5.1	9.5297	26899.05	0.003711	99.996277	553.871826
16.0	5.2	9.5297	21366.71	0.004600	99.995316	439.960937
16.0	5.3	9.5297	16972.20	0.005892	99.994095	349.478027
16.0	5.4	9.5297	13481.52	0.007411	99.992569	277.604480
16.0	5.5	9.5297	10708.77	0.009331	99.990662	220.514099
16.0	5.6	9.5297	8506.28	0.011755	99.988235	175.164886
16.0	5.7	9.5297	6755.79	0.014743	99.985199	139.142883
16.0	5.8	9.5297	5361.12	0.018629	99.981369	110.529510
16.0	5.9	9.5297	4263.26	0.023451	99.976547	87.801056
16.0	6.0	9.5297	3385.43	0.029521	99.970474	69.747208
16.0	6.1	9.5297	2689.94	0.037162	99.962830	55.406494
16.0	6.2	9.5297	2136.70	0.046779	99.953211	44.015244
16.0	6.3	9.5297	1697.24	0.058884	99.941115	34.966827
16.0	6.4	9.5297	1348.17	0.074120	99.925873	27.779434
16.0	6.5	9.5297	1070.89	0.093293	99.906708	22.070221
16.0	6.6	9.5297	850.54	0.117420	99.882548	17.535263
16.0	6.7	9.5297	675.69	0.147779	99.852219	13.933008
16.0	6.8	9.5297	536.72	0.185971	99.814026	11.071634
16.0	6.9	9.5297	426.33	0.234010	99.765976	8.798759
16.0	7.0	9.5297	338.65	0.294422	99.705566	6.993347
16.0	7.1	9.5297	269.00	0.370373	99.629623	5.559259
16.0	7.2	9.5297	213.67	0.465825	99.534164	4.420115
16.0	7.3	9.5297	169.73	0.585732	99.414261	3.515260
16.0	7.4	9.5297	134.82	0.736275	99.263718	2.796509
16.0	7.5	9.5297	107.09	0.925150	99.074844	2.225583
16.0	7.6	9.5297	85.07	1.161910	98.838049	1.772081
16.0	7.7	9.5297	67.57	1.458368	98.541626	1.411851
16.0	7.8	9.5297	53.67	1.829061	98.170929	1.125710
16.0	7.9	9.5297	42.63	2.291803	97.708191	0.898419
16.0	8.0	9.5297	33.87	2.868185	97.131805	0.717875
16.0	8.1	9.5297	26.90	3.584205	96.415787	0.574464
16.0	8.2	9.5297	21.37	4.470758	95.529236	0.460548
16.0	8.3	9.5297	16.97	5.563930	94.436050	0.370062
16.0	8.4	9.5297	13.48	6.905092	93.094894	0.298186
16.0	8.5	9.5297	10.71	8.540292	91.459702	0.241092
16.0	8.6	9.5297	8.51	10.518970	89.481018	0.195742
16.0	8.7	9.5297	6.76	12.891461	87.108521	0.159718
16.0	8.8	9.5297	5.37	15.705150	84.294846	0.131103
16.0	8.9	9.5297	4.26	18.998993	81.001007	0.108374
16.0	9.0	9.5297	3.39	22.796860	77.203140	0.090319
16.0	9.1	9.5297	2.69	27.099869	72.900131	0.075978
16.0	9.2	9.5297	2.14	31.879730	68.120270	0.064586
16.0	9.3	9.5297	1.70	37.073914	62.926086	0.055538
16.0	9.4	9.5297	1.35	42.585342	57.414658	0.048350
16.0	9.5	9.5297	1.07	48.287354	51.712646	0.042841
16.0	9.6	9.5297	0.85	54.034348	45.965652	0.038105
16.0	9.7	9.5297	0.68	59.675995	40.324005	0.034503
16.0	9.8	9.5297	0.54	65.072754	34.927246	0.031641
16.0	9.9	9.5297	0.43	70.109070	29.890930	0.029369
16.0	10.0	9.5297	0.34	74.701492	25.298508	0.027563
16.0	10.1	9.5297	0.27	78.801666	21.198334	0.026129

** CONCENTRATIONS OF AMMONIA(NH4+NH3) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH3-N

TEMP C	PH	PKA	RATIO	% UNIONIZED AMMONIA	% IONIZED AMMONIA	CONCENTRATION NH ₄ +NH ₃ **
16.5	5.0	9.5134	32617.05	0.003066	99.996933	671.605713
16.5	5.1	9.5134	25908.68	0.003860	99.996140	533.480225
16.5	5.2	9.5134	20580.03	0.004859	99.995132	423.763428
16.5	5.3	9.5134	16347.32	0.006117	99.993881	336.611816
16.5	5.4	9.5134	12985.16	0.007701	99.992299	267.385010
16.5	5.5	9.5134	10314.49	0.009694	99.990295	212.395950
16.5	5.6	9.5134	8193.10	0.012204	99.987793	168.716431
16.5	5.7	9.5134	6508.02	0.015363	99.984634	134.020706
16.5	5.8	9.5134	5169.51	0.019340	99.980652	106.460754
16.5	5.9	9.5134	4106.29	0.024347	99.975647	84.569168
16.5	6.0	9.5134	3261.75	0.030649	99.969345	67.180023
16.5	6.1	9.5134	2590.90	0.038582	99.961411	53.367294
16.5	6.2	9.5134	2058.03	0.048567	99.951431	42.395447
16.5	6.3	9.5134	1634.75	0.061134	99.938858	33.680191
16.5	6.4	9.5134	1298.53	0.076951	99.923050	26.757370
16.5	6.5	9.5134	1031.46	0.096855	99.903137	21.259408
16.5	6.6	9.5134	819.32	0.121903	99.878092	16.890396
16.5	6.7	9.5134	650.81	0.153419	99.846573	13.420784
16.5	6.8	9.5134	516.96	0.193066	99.806931	10.664761
16.5	6.9	9.5134	410.64	0.242934	99.757065	8.475559
16.5	7.0	9.5134	326.18	0.305643	99.694351	6.736624
16.5	7.1	9.5134	259.09	0.384476	99.615524	5.355335
16.5	7.2	9.5134	205.81	0.483545	99.516449	4.258135
16.5	7.3	9.5134	163.48	0.607986	99.392014	3.386593
16.5	7.4	9.5134	129.86	0.764204	99.235794	2.694305
16.5	7.5	9.5134	103.15	0.960175	99.039825	2.144401
16.5	7.6	9.5134	81.93	1.205789	98.794205	1.707596
16.5	7.7	9.5134	65.08	1.513271	98.486725	1.360628
16.5	7.8	9.5134	51.70	1.897657	98.102341	1.085021
16.5	7.9	9.5134	41.06	2.377327	97.622665	0.866099
16.5	8.0	9.5134	32.62	2.974561	97.025436	0.692203
16.5	8.1	9.5134	25.91	3.716127	96.283859	0.554071
16.5	8.2	9.5134	20.58	4.633736	95.366257	0.444350
16.5	8.3	9.5134	16.35	5.764360	94.235626	0.357195
16.5	8.4	9.5134	12.99	7.150168	92.849823	0.287465
16.5	8.5	9.5134	10.31	8.837895	91.162094	0.232974
16.5	8.6	9.5134	8.19	10.877323	89.122665	0.189293
16.5	8.7	9.5134	6.51	13.318614	86.681381	0.154596
16.5	8.8	9.5134	5.17	16.208176	83.791824	0.127035
16.5	8.9	9.5134	4.11	19.543008	80.456992	0.105142
16.5	9.0	9.5134	3.25	23.463806	76.536194	0.087752
16.5	9.1	9.5134	2.59	27.847305	72.152695	0.073939
16.5	9.2	9.5134	2.06	32.699860	67.300140	0.062967
16.5	9.3	9.5134	1.63	37.953217	62.046783	0.054251
16.5	9.4	9.5134	1.30	43.504990	56.495010	0.047328
16.5	9.5	9.5134	1.03	49.224564	50.775436	0.041829
16.5	9.6	9.5134	0.82	54.964523	45.035477	0.037461
16.5	9.7	9.5134	0.65	60.575333	39.424667	0.033991
16.5	9.8	9.5134	0.52	65.920471	34.079529	0.031235
16.5	9.9	9.5134	0.41	70.889236	29.110764	0.029045
16.5	10.0	9.5134	0.33	75.403809	24.596191	0.027306
16.5	10.1	9.5134	0.26	79.421509	20.578491	0.025925

** CONCENTRATIONS OF AMMONIA(NH₄+NH₃) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH₃-N

TEMP C	PH	PKA	RATIO	% UNIONIZED AMMONIA	% IONIZED AMMONIA	CONCENTRATION NH4+NH3 **
17.0	5.0	9.4972	31420.18	0.003183	99.996811	646.961914
17.0	5.1	9.4972	24957.97	0.004007	99.995993	513.905518
17.0	5.2	9.4972	19824.83	0.005044	99.994956	408.213867
17.0	5.3	9.4972	15747.45	0.006350	99.993650	324.260498
17.0	5.4	9.4972	12508.66	0.007994	99.992006	257.573730
17.0	5.5	9.4972	9936.00	0.010063	99.989937	204.502707
17.0	5.6	9.4972	7892.45	0.012667	99.987333	162.526123
17.0	5.7	9.4972	6269.21	0.015948	99.984052	129.103561
17.0	5.8	9.4972	4977.82	0.020077	99.979923	102.554977
17.0	5.9	9.4972	3955.61	0.025274	99.974726	81.466690
17.0	6.0	9.4972	3142.06	0.031816	99.968184	64.715561
17.0	6.1	9.4972	2495.83	0.040051	99.959949	51.409698
17.0	6.2	9.4972	1982.51	0.050416	99.949584	40.840469
17.0	6.3	9.4972	1574.77	0.063461	99.936539	32.445023
17.0	6.4	9.4972	1250.88	0.079860	99.920140	25.776276
17.0	6.5	9.4972	993.61	0.100642	99.899358	20.479080
17.0	6.6	9.4972	789.26	0.126541	99.873459	16.271362
17.0	6.7	9.4972	626.93	0.159254	99.840746	12.929064
17.0	6.8	9.4972	497.99	0.200405	99.799595	10.274172
17.0	6.9	9.4972	395.57	0.252164	99.747836	8.165305
17.0	7.0	9.4972	314.21	0.317249	99.682751	6.490176
17.0	7.1	9.4972	249.59	0.399064	99.600936	5.159573
17.0	7.2	9.4972	198.25	0.501872	99.498128	4.102835
17.0	7.3	9.4972	157.48	0.630999	99.369001	3.263078
17.0	7.4	9.4972	125.09	0.793084	99.206916	2.596193
17.0	7.5	9.4972	99.36	0.996386	99.003614	2.066467
17.0	7.6	9.4972	78.93	1.251145	98.748855	1.645691
17.0	7.7	9.4972	62.69	1.570012	98.429988	1.311454
17.0	7.8	9.4972	49.80	1.968523	98.031477	1.045961
17.0	7.9	9.4972	39.56	2.465652	97.534348	0.835073
17.0	8.0	9.4972	31.42	3.084377	96.915623	0.667557
17.0	8.1	9.4972	24.96	3.852230	96.147770	0.534495
17.0	8.2	9.4972	19.83	4.801769	95.198231	0.428800
17.0	8.3	9.4972	15.75	5.970829	94.029171	0.344843
17.0	8.4	9.4972	12.51	7.402375	92.597625	0.278154
17.0	8.5	9.4972	9.94	9.143778	90.856222	0.225180
17.0	8.6	9.4972	7.89	11.245087	88.754913	0.183102
17.0	8.7	9.4972	6.27	13.756176	86.243824	0.149678
17.0	8.8	9.4972	4.98	16.722351	83.277649	0.123129
17.0	8.9	9.4972	3.96	20.178467	79.821533	0.102039
17.0	9.0	9.4972	3.14	24.141815	75.858185	0.085288
17.0	9.1	9.4972	2.50	28.604660	71.395340	0.071981
17.0	9.2	9.4972	1.98	33.527878	66.472122	0.061412
17.0	9.3	9.4972	1.57	38.837479	61.162521	0.053016
17.0	9.4	9.4972	1.25	44.425980	55.574020	0.046347
17.0	9.5	9.4972	0.99	50.159134	49.840866	0.041049
17.0	9.6	9.4972	0.79	55.888123	44.111877	0.036841
17.0	9.7	9.4972	0.63	61.464503	38.535497	0.033499
17.0	9.8	9.4972	0.50	66.755280	33.244720	0.030844
17.0	9.9	9.4972	0.40	71.654678	28.345322	0.028735
17.0	10.0	9.4972	0.31	76.090561	23.909439	0.027060
17.0	10.1	9.4972	0.25	80.025818	19.974182	0.025729

** CONCENTRATIONS OF AMMONIA(NH4+NH3) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH3-N

TEMP C	PH	PKA	RATIO	% UNIONIZED AMMONIA	% IONIZED AMMONIA	CONCENTRATION NH ₄ +NH ₃ **
17.5	5.0	9.4810	30271.12	0.003303	99.996689	623.302734
17.5	5.1	9.4810	24045.24	0.004159	99.995834	495.112061
17.5	5.2	9.4810	19099.84	0.005235	99.994751	393.286133
17.5	5.3	9.4810	15171.56	0.006591	99.993404	312.403076
17.5	5.4	9.4810	12051.22	0.008297	99.991699	248.155106
17.5	5.5	9.4810	9572.63	0.010445	99.989548	197.121048
17.5	5.6	9.4810	7603.82	0.013150	99.986847	156.583206
17.5	5.7	9.4810	6039.94	0.016554	99.983444	124.382874
17.5	5.8	9.4810	4797.70	0.020839	99.979156	98.805206
17.5	5.9	9.4810	3810.95	0.026233	99.973755	78.488159
17.5	6.0	9.4810	3027.15	0.033023	99.966965	62.349670
17.5	6.1	9.4810	2404.56	0.041570	99.958420	49.530411
17.5	6.2	9.4810	1910.01	0.052328	99.947662	39.347702
17.5	6.3	9.4810	1517.18	0.065868	99.934128	31.259247
17.5	6.4	9.4810	1205.14	0.082909	99.917084	24.834366
17.5	6.5	9.4810	957.28	0.104354	99.895645	19.730896
17.5	6.6	9.4810	760.39	0.131338	99.868652	15.677076
17.5	6.7	9.4810	604.00	0.165289	99.834702	12.456995
17.5	6.8	9.4810	479.78	0.207997	99.791992	9.899187
17.5	6.9	9.4810	381.10	0.261711	99.738281	7.867455
17.5	7.0	9.4810	302.72	0.329251	99.670746	6.253582
17.5	7.1	9.4810	240.46	0.414149	99.585846	4.971636
17.5	7.2	9.4810	191.00	0.520824	99.479172	3.953351
17.5	7.3	9.4810	151.72	0.654794	99.345200	3.144498
17.5	7.4	9.4810	120.52	0.822941	99.177048	2.502002
17.5	7.5	9.4810	95.73	1.033816	98.966171	1.991649
17.5	7.6	9.4810	76.04	1.298021	98.701965	1.586260
17.5	7.7	9.4810	60.40	1.628636	98.371353	1.264247
17.5	7.8	9.4810	47.98	2.041718	97.958267	1.008464
17.5	7.9	9.4810	38.11	2.556851	97.443146	0.805287
17.5	8.0	9.4810	30.27	3.197714	96.802277	0.643897
17.5	8.1	9.4810	24.05	3.992620	96.007370	0.515701
17.5	8.2	9.4810	19.10	4.974972	95.025024	0.413872
17.5	8.3	9.4810	15.17	6.183463	93.816528	0.332985
17.5	8.4	9.4810	12.05	7.661833	92.338165	0.248735
17.5	8.5	9.4810	9.57	9.458030	90.541962	0.217699
17.5	8.6	9.4810	7.60	11.622317	88.377670	0.177159
17.5	8.7	9.4810	6.04	14.204165	85.795822	0.144957
17.5	8.8	9.4810	4.80	17.247635	82.752365	0.119379
17.5	8.9	9.4810	3.81	20.785217	79.214783	0.099061
17.5	9.0	9.4810	3.03	24.830673	75.169327	0.082922
17.5	9.1	9.4810	2.40	29.371536	70.628464	0.070102
17.5	9.2	9.4810	1.91	34.363205	65.636795	0.059919
17.5	9.3	9.4810	1.52	39.726044	60.273956	0.051830
17.5	9.4	9.4810	1.21	45.347610	54.652390	0.045405
17.5	9.5	9.4810	0.96	51.090378	48.909622	0.040301
17.5	9.6	9.4810	0.76	56.804504	43.195496	0.036247
17.5	9.7	9.4810	0.60	62.343094	37.656906	0.033027
17.5	9.8	9.4810	0.48	67.576859	32.423141	0.030469
17.5	9.9	9.4810	0.38	72.405212	27.594788	0.028437
17.5	10.0	9.4810	0.30	76.761780	23.238220	0.026823
17.5	10.1	9.4810	0.24	80.614670	19.385330	0.025541

** CONCENTRATIONS OF AMMONIA(NH₄+NH₃) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH₃-N

TEMP C	PH	PKA	RATIO	% UNIONIZED AMMONIA	% IONIZED AMMONIA	CONCENTRATION NH4+NH3 **
18.0	5.0	9.4649	29167.86	1.003425	99.996567	600.586670
18.0	5.1	9.4649	23168.89	0.004316	99.995682	477.068359
18.0	5.2	9.4649	18403.73	0.005433	99.994553	378.953369
18.0	5.3	9.4649	14618.62	0.006849	99.993149	301.018066
18.0	5.4	9.4649	11612.00	0.008611	99.991379	239.111710
18.0	5.5	9.4649	9223.75	0.010840	99.989151	189.937592
18.0	5.6	9.4649	7325.70	0.013647	99.986343	150.877182
18.0	5.7	9.4649	5819.81	0.017180	99.982819	119.850433
18.0	5.8	9.4649	4622.84	0.021627	99.978363	95.204941
18.0	5.9	9.4649	3672.06	0.027225	99.972763	75.628326
18.0	6.0	9.4649	2916.83	0.034272	99.965729	60.078033
18.0	6.1	9.4649	2316.92	0.043142	99.956848	47.725983
18.0	6.2	9.4649	1840.40	0.054307	99.945694	37.914383
18.0	6.3	9.4649	1461.88	0.068358	99.931641	30.120743
18.0	6.4	9.4649	1161.22	0.086042	99.913956	23.930038
18.0	6.5	9.4649	922.39	0.108247	99.891693	19.012543
18.0	6.6	9.4649	732.68	0.136299	99.863693	15.105463
18.0	6.7	9.4649	581.99	0.171530	99.828461	12.003737
18.0	6.8	9.4649	462.29	0.215847	99.784149	9.539157
18.0	6.9	9.4649	367.21	0.271583	99.728409	7.581466
18.0	7.0	9.4649	291.69	0.341662	99.658325	6.026421
18.0	7.1	9.4649	231.70	0.429747	99.570251	4.791196
18.0	7.2	9.4649	184.04	0.540417	99.459579	3.810022
18.0	7.3	9.4649	146.19	0.679393	99.320602	3.030644
18.0	7.4	9.4649	116.12	0.853802	99.146194	2.411565
18.0	7.5	9.4649	92.24	1.072500	98.927490	1.919812
18.0	7.6	9.4649	73.27	1.346457	98.653534	1.529198
18.0	7.7	9.4649	58.20	1.689194	98.310791	1.218422
18.0	7.8	9.4649	46.23	2.117311	97.882675	0.972460
18.0	7.9	9.4649	36.72	2.650998	97.348999	0.776688
18.0	8.0	9.4649	29.17	3.314652	96.685333	0.621181
18.0	8.1	9.4649	23.17	4.137386	95.862610	0.497657
18.0	8.2	9.4649	18.40	5.153449	94.846542	0.399538
18.0	8.3	9.4649	14.62	6.402369	93.597626	0.321600
18.0	8.4	9.4649	11.61	7.928659	92.071335	0.259691
18.0	8.5	9.4649	9.22	9.780784	90.219208	0.210515
18.0	8.6	9.4649	7.33	12.064131	87.930860	0.171453
18.0	8.7	9.4649	5.82	14.662650	85.337341	0.140425
18.0	8.8	9.4649	4.62	17.783981	82.216019	0.115778
18.0	8.9	9.4649	3.67	21.403122	78.596878	0.096201
18.0	9.0	9.4649	2.92	25.530090	74.469910	0.080650
18.0	9.1	9.4649	2.32	30.147569	69.852432	0.068297
18.0	9.2	9.4649	1.84	35.205383	64.794617	0.058485
18.0	9.3	9.4649	1.46	40.618317	59.381683	0.050691
18.0	9.4	9.4649	1.16	46.269220	53.730774	0.044500
18.0	9.5	9.4649	0.92	52.017624	47.982376	0.039583
18.0	9.6	9.4649	0.73	57.713058	42.286942	0.035676
18.0	9.7	9.4649	0.58	63.210632	36.789368	0.032574
18.0	9.8	9.4649	0.46	68.384949	31.615051	0.030109
18.0	9.9	9.4649	0.37	73.140808	26.859192	0.028151
18.0	10.0	9.4649	0.29	77.417435	22.582565	0.026596
18.0	10.1	9.4649	0.23	81.188278	18.811722	0.025361

** CONCENTRATIONS OF AMMONIA(NH4+NH3) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH3-N

A-40

TEMP C	PH	PKA	RATIO	% UNIONIZED AMMONIA	% IONIZED AMMONIA	CONCENTRATION NH4+NH3 **
18.5	5.0	9.4488	28108.36	0.003558	99.996442	578.771484
18.5	5.1	9.4488	22327.29	0.004479	99.995521	459.739502
18.5	5.2	9.4488	17735.21	0.005638	99.994362	365.188477
18.5	5.3	9.4488	14087.60	0.007098	99.992899	290.084229
18.5	5.4	9.4488	11190.19	0.008936	99.991064	230.426590
18.5	5.5	9.4488	8848.70	0.011249	99.988751	183.038895
18.5	5.6	9.4488	7060.55	0.014161	99.985839	145.397369
18.5	5.7	9.4488	5608.41	0.017827	99.982173	115.497589
18.5	5.8	9.4488	4454.92	0.022442	99.977558	91.747437
18.5	5.9	9.4488	3538.68	0.028251	99.971749	72.881912
18.5	6.0	9.4488	2810.87	0.035563	99.964437	57.896423
18.5	6.1	9.4488	2232.76	0.044768	99.955232	45.993057
18.5	6.2	9.4488	1773.55	0.056352	99.943648	36.537872
18.5	6.3	9.4488	1408.78	0.070933	99.929067	29.027359
18.5	6.4	9.4488	1119.03	0.089283	99.910717	23.061508
18.5	6.5	9.4488	884.88	0.112374	99.887626	18.322662
18.5	6.6	9.4488	706.07	0.141430	99.858570	14.558470
18.5	6.7	9.4488	560.85	0.177984	99.822016	11.568457
18.5	6.8	9.4488	445.50	0.223965	99.776035	9.193397
18.5	6.9	9.4488	353.87	0.281792	99.718208	7.306814
18.5	7.0	9.4488	281.09	0.354495	99.645505	5.808255
18.5	7.1	9.4488	223.28	0.445873	99.554127	4.617902
18.5	7.2	9.4488	177.36	0.560673	99.439327	3.672369
18.5	7.3	9.4488	140.84	0.704822	99.295178	2.921306
18.5	7.4	9.4488	111.91	0.885700	99.114299	2.324714
18.5	7.5	9.4488	88.89	1.112477	98.887523	1.850823
18.5	7.6	9.4488	70.61	1.396502	98.603498	1.474398
18.5	7.7	9.4488	56.09	1.751756	98.248244	1.175391
18.5	7.8	9.4488	44.55	2.145369	97.854631	0.937883
18.5	7.9	9.4488	35.39	2.748181	97.251819	0.749223
18.5	8.0	9.4488	28.11	3.435305	96.564695	0.599365
18.5	8.1	9.4488	22.33	4.286650	95.713350	0.480327
18.5	8.2	9.4488	17.74	5.337334	94.662666	0.385773
18.5	8.3	9.4488	14.09	6.627704	93.372296	0.310666
18.5	8.4	9.4488	11.19	8.203004	91.796996	0.251006
18.5	8.5	9.4488	8.89	10.112186	89.887814	0.203616
18.5	8.6	9.4488	7.06	12.405654	87.594346	0.165973
18.5	8.7	9.4488	5.61	15.131721	84.868279	0.136072
18.5	8.8	9.4488	4.46	18.331451	81.668549	0.112321
18.5	8.9	9.4488	3.54	22.032160	77.967840	0.093454
18.5	9.0	9.4488	2.81	26.239914	73.760086	0.078468
18.5	9.1	9.4488	2.23	30.932434	69.067566	0.066564
18.5	9.2	9.4488	1.77	36.053970	63.946030	0.057109
18.5	9.3	9.4488	1.41	41.513794	58.486206	0.049598
18.5	9.4	9.4488	1.12	47.140277	52.859723	0.043632
18.5	9.5	9.4488	0.89	52.940353	47.059647	0.038893
18.5	9.6	9.4488	0.71	58.613419	41.386581	0.035128
18.5	9.7	9.4488	0.56	64.066785	35.933215	0.032138
18.5	9.8	9.4488	0.45	69.179413	30.820587	0.029763
18.5	9.9	9.4488	0.35	73.861420	26.138580	0.027877
18.5	10.0	9.4488	0.28	78.057785	21.942215	0.026378
18.5	10.1	9.4488	0.22	81.746918	18.253082	0.025187

** CONCENTRATIONS OF AMMONIA(NH4+NH3) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH3-N

A-41

TEMP C	PH	PKA	RATIO	% UNIONIZED AMMONIA	% IONIZED AMMONIA	CONCENTRATION NH4+NH3 **
19.0	5.0	9.4328	27090.77	0.003691	99.996307	557.819336
19.0	5.1	9.4328	21514.99	0.004647	99.995346	443.096436
19.0	5.2	9.4328	17093.15	0.005850	99.994141	351.368750
19.0	5.3	9.4328	13577.59	0.007365	99.992630	279.543252
19.0	5.4	9.4328	10785.08	0.009271	99.990723	222.085464
19.0	5.5	9.4328	8566.51	0.011671	99.988327	176.413147
19.0	5.6	9.4328	6864.95	0.014693	99.985306	140.134430
19.0	5.7	9.4328	5495.37	0.018497	99.981491	111.317154
19.0	5.8	9.4328	4293.64	0.023245	99.976715	88.426727
19.0	5.9	9.4328	3410.57	0.029312	99.970688	70.244171
19.0	6.0	9.4328	2709.11	0.036444	99.963552	55.801193
19.0	6.1	9.4328	2151.93	0.044644	99.955352	44.328766
19.0	6.2	9.4328	1709.34	0.054468	99.945528	35.215866
19.0	6.3	9.4328	1357.78	0.073596	99.926392	27.977234
19.0	6.4	9.4328	1078.52	0.092633	99.907364	22.227371
19.0	6.5	9.4328	856.70	0.116590	99.883408	17.660095
19.0	6.6	9.4328	686.50	0.146734	99.853256	14.037166
19.0	6.7	9.4328	549.54	0.184657	99.815338	11.150395
19.0	6.8	9.4328	429.37	0.232358	99.767639	8.461320
19.0	6.9	9.4328	341.06	0.292345	99.707642	7.043034
19.0	7.0	9.4328	270.91	0.367762	99.632233	5.598725
19.0	7.1	9.4328	215.20	0.452544	99.547445	4.451468
19.0	7.2	9.4328	170.94	0.548161	99.451838	3.540167
19.0	7.3	9.4328	135.79	0.731103	99.268890	2.816294
19.0	7.4	9.4328	107.85	0.918663	99.081329	2.241300
19.0	7.5	9.4328	85.67	1.153782	98.846207	1.744565
19.0	7.6	9.4328	68.05	1.448197	98.551788	1.421767
19.0	7.7	9.4328	54.06	1.816360	98.183640	1.133585
19.0	7.8	9.4328	42.94	2.275956	97.724030	0.904674
19.0	7.9	9.4328	34.11	2.848468	97.151520	0.722844
19.0	8.0	9.4328	27.09	3.559750	96.440247	0.578411
19.0	8.1	9.4328	21.52	4.440523	95.559464	0.463684
19.0	8.2	9.4328	17.09	5.526737	94.473251	0.372553
19.0	8.3	9.4328	13.58	6.859577	93.140411	0.300164
19.0	8.4	9.4328	10.79	8.444942	91.551501	0.242664
19.0	8.5	9.4328	8.57	10.452319	89.547668	0.196990
19.0	8.6	9.4328	6.81	12.811434	87.188065	0.160710
19.0	8.7	9.4328	5.41	15.611368	84.388626	0.131891
19.0	8.8	9.4328	4.29	18.849954	81.150046	0.109000
19.0	8.9	9.4328	3.41	22.672104	77.327896	0.090816
19.0	9.0	9.4328	2.71	26.959808	73.040192	0.076373
19.0	9.1	9.4328	2.15	31.725708	68.274292	0.064900
19.0	9.2	9.4328	1.71	36.908401	63.091599	0.055787
19.0	9.3	9.4328	1.36	42.411789	57.588211	0.048548
19.0	9.4	9.4328	1.08	48.110046	51.889954	0.042798
19.0	9.5	9.4328	0.86	53.857910	46.142090	0.038230
19.0	9.6	9.4328	0.68	59.504974	40.495026	0.034502
19.0	9.7	9.4328	0.54	64.911179	35.088821	0.031720
19.0	9.8	9.4328	0.43	69.960052	30.039948	0.029431
19.0	9.9	9.4328	0.34	74.567047	25.432953	0.027613
19.0	10.0	9.4328	0.27	78.682816	21.317184	0.026168
19.0	10.1	9.4328	0.22	82.290680	17.709320	0.025021

** CONCENTRATIONS OF AMMONIA(NH4+NH3) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH3-N

TEMP C	PH	PKA	RATIO	% UNIONIZED AMMONIA	% IONIZED AMMONIA	CONCENTRATION NH ₄ +NH ₃ **
19.5	5.0	9.4169	26113.29	0.003829	99.996170	537.693115
19.5	5.1	9.4169	20742.55	0.004821	99.995178	427.109619
19.5	5.2	9.4169	16476.42	0.006069	99.993927	339.270020
19.5	5.3	9.4169	13087.70	0.007640	99.992355	269.496338
19.5	5.4	9.4169	10395.94	0.009618	99.990372	214.072891
19.5	5.5	9.4169	8257.80	0.012108	99.987885	170.048615
19.5	5.6	9.4169	6559.41	0.015243	99.984756	135.078812
19.5	5.7	9.4169	5210.33	0.019189	99.980804	107.301224
19.5	5.8	9.4169	4138.72	0.024156	99.975830	85.236893
19.5	5.9	9.4169	3287.51	0.030409	99.969589	67.710373
19.5	6.0	9.4169	2511.36	0.038279	99.961716	53.788574
19.5	6.1	9.4169	2074.28	0.048186	99.951813	42.730072
19.5	6.2	9.4169	1647.66	0.060655	99.939331	33.945953
19.5	6.3	9.4169	1308.79	0.076348	99.923645	26.964521
19.5	6.4	9.4169	1039.61	0.096093	99.903900	21.426117
19.5	6.5	9.4169	825.79	0.120950	99.879044	17.023621
19.5	6.6	9.4169	655.95	0.152219	99.847778	13.526600
19.5	6.7	9.4169	521.04	0.191550	99.808441	10.748816
19.5	6.8	9.4169	413.88	0.241035	99.758457	8.542335
19.5	6.9	9.4169	328.76	0.303255	99.696732	6.789660
19.5	7.0	9.4169	261.14	0.381475	99.618515	5.397465
19.5	7.1	9.4169	207.43	0.479775	99.520218	4.291595
19.5	7.2	9.4169	164.77	0.603251	99.396744	3.413175
19.5	7.3	9.4169	130.88	0.758262	99.241730	2.715419
19.5	7.4	9.4169	103.96	0.952724	99.047272	2.161172
19.5	7.5	9.4169	82.58	1.196454	98.803543	1.720918
19.5	7.6	9.4169	65.60	1.501593	98.498398	1.371210
19.5	7.7	9.4169	52.10	1.883069	98.116929	1.093427
19.5	7.8	9.4169	41.39	2.359133	97.640854	0.872776
19.5	7.9	9.4169	32.88	2.951945	97.048050	0.697506
19.5	8.0	9.4169	26.11	3.689086	96.311905	0.558284
19.5	8.1	9.4169	20.74	4.599098	95.400894	0.447696
19.5	8.2	9.4169	16.48	5.721779	94.278214	0.359853
19.5	8.3	9.4169	13.09	7.098123	92.901871	0.290077
19.5	8.4	9.4169	10.40	8.774720	91.225266	0.234651
19.5	8.5	9.4169	8.26	10.801306	89.198685	0.190625
19.5	8.6	9.4169	6.56	13.228066	86.771927	0.155654
19.5	8.7	9.4169	5.21	16.101639	83.898361	0.127875
19.5	8.8	9.4169	4.14	19.459457	80.540543	0.105810
19.5	8.9	9.4169	3.29	23.322845	76.677155	0.088283
19.5	9.0	9.4169	2.61	27.689545	72.310455	0.074360
19.5	9.1	9.4169	2.07	32.526993	67.473007	0.063301
19.5	9.2	9.4169	1.65	37.768173	62.231827	0.054517
19.5	9.3	9.4169	1.31	43.311752	56.688248	0.047539
19.5	9.4	9.4169	1.04	49.027985	50.972015	0.041996
19.5	9.5	9.4169	0.83	54.769760	45.230240	0.037594
19.5	9.6	9.4169	0.66	60.387299	39.612701	0.034097
19.5	9.7	9.4169	0.52	65.743530	34.256470	0.031319
19.5	9.8	9.4169	0.41	70.726624	29.273376	0.029112
19.5	9.9	9.4169	0.33	75.257629	24.742371	0.027359
19.5	10.0	9.4169	0.26	79.292679	20.707321	0.025967
19.5	10.1	9.4169	0.21	82.819885	17.180115	0.024861

** CONCENTRATIONS OF AMMONIA(NH₄+NH₃) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH₃-N

TEMP C	PH	PKA	RATIO	* UNIONIZED AMMONIA	* IONIZED AMMONIA	CONCENTRATION NH4+NH3 **
20.0	5.0	9.4010	25174.29	0.003972	99.996017	518.359375
20.0	5.1	9.4010	19996.68	0.005001	99.994995	411.752197
20.0	5.2	9.4010	15483.93	0.006273	99.993698	327.070557
20.0	5.3	9.4010	12617.07	0.007923	99.992065	259.806152
20.0	5.4	9.4010	10022.11	0.009977	99.990021	206.375885
20.0	5.5	9.4010	7960.86	0.012560	99.987427	163.934601
20.0	5.6	9.4010	6323.54	0.015811	99.984177	130.222321
20.0	5.7	9.4010	5022.98	0.019903	99.980047	103.443619
20.0	5.8	9.4010	3989.90	0.025057	99.974930	82.172592
20.0	5.9	9.4010	3169.29	0.031543	99.968445	65.276337
20.0	6.0	9.4010	2517.46	0.039707	99.960281	51.855103
20.0	6.1	9.4010	1999.69	0.049983	99.950012	41.194250
20.0	6.2	9.4010	1588.42	0.062916	99.937073	32.726044
20.0	6.3	9.4010	1261.72	0.079194	99.920807	25.999512
20.0	6.4	9.4010	1002.23	0.099679	99.900314	20.656387
20.0	6.5	9.4010	796.10	0.125455	99.874542	16.412216
20.0	6.6	9.4010	632.36	0.157887	99.842102	13.040948
20.0	6.7	9.4010	502.30	0.198687	99.801300	10.363042
20.0	6.8	9.4010	399.00	0.250003	99.749985	8.235901
20.0	6.9	9.4010	316.93	0.314531	99.685455	6.546247
20.0	7.0	9.4010	251.75	0.395649	99.604340	5.204113
20.0	7.1	9.4010	199.97	0.497582	99.502411	4.138015
20.0	7.2	9.4010	158.84	0.625611	99.374390	3.291182
20.0	7.3	9.4010	126.17	0.786323	99.213669	2.618517
20.0	7.4	9.4010	100.22	0.987903	99.012085	2.084199
20.0	7.5	9.4010	79.61	1.240528	98.759460	1.659776
20.0	7.6	9.4010	63.24	1.556730	98.443268	1.322643
20.0	7.7	9.4010	50.23	1.951939	98.048050	1.054849
20.0	7.8	9.4010	39.90	2.444984	97.555008	0.842132
20.0	7.9	9.4010	31.69	3.058684	96.941315	0.673165
20.0	8.0	9.4010	25.18	3.820394	96.179596	0.538950
20.0	8.1	9.4010	20.00	4.762475	95.237518	0.432338
20.0	8.2	9.4010	15.88	5.922563	94.077423	0.347654
20.0	8.3	9.4010	12.62	7.343440	92.656555	0.280386
20.0	8.4	9.4010	10.02	9.072329	90.927658	0.226954
20.0	8.5	9.4010	7.96	11.159234	88.840759	0.184511
20.0	8.6	9.4010	6.32	13.654114	86.345836	0.150797
20.0	8.7	9.4010	5.02	16.602524	83.397476	0.124017
20.0	8.8	9.4010	3.99	20.039825	79.960175	0.102745
20.0	8.9	9.4010	3.17	23.984131	76.015869	0.085848
20.0	9.0	9.4010	2.52	28.428741	71.571259	0.072427
20.0	9.1	9.4010	2.00	33.335800	66.664200	0.061765
20.0	9.2	9.4010	1.59	38.632690	61.367310	0.053297
20.0	9.3	9.4010	1.26	44.213013	55.786987	0.046570
20.0	9.4	9.4010	1.00	49.943390	50.056610	0.041227
20.0	9.5	9.4010	0.80	55.675278	44.324722	0.036982
20.0	9.6	9.4010	0.63	61.259903	38.740097	0.033611
20.0	9.7	9.4010	0.50	66.563477	33.436523	0.030933
20.0	9.8	9.4010	0.40	71.479034	28.520966	0.028806
20.0	9.9	9.4010	0.32	75.933243	24.066757	0.027116
20.0	10.0	9.4010	0.25	79.887543	20.112457	0.025774
20.0	10.1	9.4010	0.20	83.334732	16.665268	0.024708

** CONCENTRATIONS OF AMMONIA(NH4+NH3) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH3-N

A-44

TEMP C	PH	PKA	RATIO	* UNIONIZED AMMONIA	% IONIZED AMMONIA	CONCENTRATION NH ₄ +NH ₃ **
20.5	5.0	9.3851	24272.02	0.004120	99.995880	499.781494
20.5	5.1	9.3851	19279.97	0.005186	99.994812	396.995361
20.5	5.2	9.3851	15314.65	0.006529	99.993469	315.349121
20.5	5.3	9.3851	12164.88	0.008220	99.991776	250.495422
20.5	5.4	9.3851	9662.92	0.010348	99.989639	198.980042
20.5	5.5	9.3851	7675.54	0.013027	99.986969	158.059467
20.5	5.6	9.3851	6096.91	0.016399	99.983597	125.555493
20.5	5.7	9.3851	4842.95	0.020644	99.979355	99.737000
20.5	5.8	9.3851	3846.90	0.025988	99.973999	79.228195
20.5	5.9	9.3851	3055.70	0.032715	99.967285	62.937515
20.5	6.0	9.3851	2427.23	0.041182	99.958817	49.997345
20.5	6.1	9.3851	1928.02	0.051840	99.948151	39.718597
20.5	6.2	9.3851	1531.49	0.065253	99.934738	31.553879
20.5	6.3	9.3851	1216.50	0.082135	99.917862	25.068405
20.5	6.4	9.3851	966.31	0.103380	99.896606	19.916824
20.5	6.5	9.3851	767.56	0.130113	99.869873	15.824747
20.5	6.6	9.3851	609.70	0.163747	99.836243	12.574297
20.5	6.7	9.3851	484.30	0.206057	99.793930	9.992354
20.5	6.8	9.3851	384.70	0.259272	99.740723	7.941461
20.5	6.9	9.3851	305.57	0.326185	99.673813	6.312364
20.5	7.0	9.3851	242.73	0.410295	99.589691	5.018335
20.5	7.1	9.3851	192.81	0.515982	99.484009	3.990446
20.5	7.2	9.3851	153.15	0.648716	99.351273	3.173963
20.5	7.3	9.3851	121.65	0.815314	99.184677	2.525407
20.5	7.4	9.3851	96.63	1.024255	99.975739	2.010242
20.5	7.5	9.3851	76.76	1.2886050	99.713943	1.601027
20.5	7.6	9.3851	60.97	1.613665	99.386322	1.275976
20.5	7.7	9.3851	48.43	2.023028	97.976959	1.017780
20.5	7.8	9.3851	38.47	2.533567	97.466431	0.812688
20.5	7.9	9.3851	30.56	3.168740	96.831207	0.649777
20.5	8.0	9.3851	24.27	3.956787	96.043213	0.520372
20.5	8.1	9.3851	19.28	4.930778	95.069214	0.417581
20.5	8.2	9.3851	15.32	6.129224	93.870773	0.335932
20.5	8.3	9.3851	12.17	7.595678	92.404312	0.271075
20.5	8.4	9.3851	9.66	9.377950	90.622040	0.219558
20.5	8.5	9.3851	7.68	11.526245	88.473755	0.178636
20.5	8.6	9.3851	6.10	14.090154	85.909836	0.146130
20.5	8.7	9.3851	4.84	17.114044	82.885956	0.120310
20.5	8.8	9.3851	3.85	20.631073	79.368927	0.099401
20.5	8.9	9.3851	3.06	24.655853	75.344147	0.083510
20.5	9.0	9.3851	2.43	29.177170	70.822830	0.070569
20.5	9.1	9.3851	1.93	34.151794	65.848206	0.060290
20.5	9.2	9.3851	1.53	39.501495	60.498505	0.052125
20.5	9.3	9.3851	1.22	45.115051	54.884949	0.045639
20.5	9.4	9.3851	0.97	51.855774	49.144226	0.040487
20.5	9.5	9.3851	0.77	56.574005	43.425995	0.036395
20.5	9.6	9.3851	0.61	62.122437	37.877563	0.033144
20.5	9.7	9.3851	0.48	67.370834	32.629166	0.030562
20.5	9.8	9.3851	0.38	72.217270	27.782730	0.028511
20.5	9.9	9.3851	0.31	76.593903	23.406097	0.026882
20.5	10.0	9.3851	0.24	80.467560	19.532440	0.025588
20.5	10.1	9.3851	0.19	83.835434	16.164566	0.024560

** CONCENTRATIONS OF AMMONIA(NH₄+NH₃) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH₃-N

TEMP C	PH	PKA	RATIO	% UNIONIZED AMMONIA	% IONIZED AMMONIA	CONCENTRATION NH ₄ +NH ₃ **
21.0	5.0	9.3693	23405.03	0.004272	99.995728	481.930176
21.0	5.1	9.3693	18591.30	0.005379	99.994614	382.815430
21.0	5.2	9.3693	14767.62	0.006771	99.993225	304.085693
21.0	5.3	9.3693	11730.35	0.008524	99.991470	241.548538
21.0	5.4	9.3693	9317.77	0.010731	99.989258	191.873352
21.0	5.5	9.3693	7401.37	0.013509	99.986441	152.414886
21.0	5.6	9.3693	5879.13	0.017005	99.982986	121.071808
21.0	5.7	9.3693	4669.96	0.021409	99.978592	96.175156
21.0	5.8	9.3693	3709.49	0.026951	99.973038	76.398926
21.0	5.9	9.3693	2946.55	0.033926	99.966064	60.590140
21.0	6.0	9.3693	2349.54	0.042707	99.957291	48.212704
21.0	6.1	9.3693	1859.16	0.053759	99.946228	38.300598
21.0	6.2	9.3693	1476.78	0.067669	99.932327	30.427551
21.0	6.3	9.3693	1173.05	0.085175	99.914825	24.173721
21.0	6.4	9.3693	931.79	0.107205	99.892792	19.206116
21.0	6.5	9.3693	740.15	0.134926	99.865067	15.250231
21.0	6.6	9.3693	587.92	0.169602	99.830145	12.125885
21.0	6.7	9.3693	467.00	0.213674	99.786316	9.636169
21.0	6.8	9.3693	370.95	0.268851	99.731140	7.658529
21.0	6.9	9.3693	294.66	0.338227	99.661774	6.087627
21.0	7.0	9.3693	234.06	0.425429	99.574570	4.839818
21.0	7.1	9.3693	185.92	0.534993	99.464996	3.848644
21.0	7.2	9.3693	147.68	0.672584	99.327408	3.061326
21.0	7.3	9.3693	117.31	0.845260	99.154739	2.435935
21.0	7.4	9.3693	93.18	1.061793	98.938202	1.939172
21.0	7.5	9.3693	74.02	1.333054	98.666946	1.544574
21.0	7.6	9.3693	58.79	1.672440	98.327560	1.231135
21.0	7.7	9.3693	46.70	2.096396	97.903595	0.982161
21.0	7.8	9.3693	37.10	2.624954	97.375046	0.784395
21.0	7.9	9.3693	29.47	3.282309	96.717692	0.627302
21.0	8.0	9.3693	23.41	4.097354	95.902634	0.502519
21.0	8.1	9.3693	18.59	5.104105	94.895889	0.403400
21.0	8.2	9.3693	14.77	6.341866	93.658127	0.324668
21.0	8.3	9.3693	11.73	7.854949	92.145050	0.262128
21.0	8.4	9.3693	9.32	9.691668	90.308319	0.212451
21.0	8.5	9.3693	7.40	11.972390	88.027595	0.172990
21.0	8.6	9.3693	5.88	14.536221	85.463776	0.141646
21.0	8.7	9.3693	4.67	17.636209	82.363800	0.110748
21.0	8.8	9.3693	3.71	21.233032	78.766968	0.096972
21.0	8.9	9.3693	2.95	25.337769	74.662231	0.081262
21.0	9.0	9.3693	2.34	29.934446	70.065552	0.068784
21.0	9.1	9.3693	1.86	34.974411	65.025589	0.058872
21.0	9.2	9.3693	1.48	40.373978	59.626022	0.050998
21.0	9.3	9.3693	1.17	46.017212	53.982788	0.044744
21.0	9.4	9.3693	0.93	51.764450	48.235550	0.039776
21.0	9.5	9.3693	0.74	57.465408	42.534592	0.035830
21.0	9.6	9.3693	0.59	62.974472	37.025528	0.032696
21.0	9.7	9.3693	0.47	68.165298	31.834702	0.030206
21.0	9.8	9.3693	0.37	72.941116	27.058884	0.028228
21.0	9.9	9.3693	0.29	77.239639	22.760361	0.026657
21.0	10.0	9.3693	0.23	81.032926	18.967072	0.025409
21.0	10.1	9.3693	0.19	84.322327	15.677673	0.024418

** CONCENTRATIONS OF AMMONIA(NH₄+NH₃) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH₃-N

TEMP C	PH	PKA	RATIO	% UNIONIZED AMMONIA	% IONIZED AMMONIA	CONCENTRATION NH4+NH3 **
21.5	5.0	9.3536	22571.79	0.004430	99.995560	464.773682
21.5	5.1	9.3536	17929.43	0.005577	99.994415	369.187500
21.5	5.2	9.3536	14241.87	0.007021	99.992979	293.260742
21.5	5.3	9.3536	11312.74	0.008839	99.991150	232.449921
21.5	5.4	9.3536	8986.04	0.011127	99.988861	185.043137
21.5	5.5	9.3536	7137.88	0.014004	99.985992	146.989532
21.5	5.6	9.3536	5669.83	0.017634	99.982361	116.762253
21.5	5.7	9.3536	4503.71	0.022199	99.977794	92.751984
21.5	5.8	9.3536	3577.43	0.027945	99.972046	73.679779
21.5	5.9	9.3536	2841.65	0.035178	99.964813	58.530243
21.5	6.0	9.3536	2257.21	0.044283	99.955704	46.496521
21.5	6.1	9.3536	1792.97	0.055742	99.944244	36.937790
21.5	6.2	9.3536	1424.21	0.070165	99.929825	29.345016
21.5	6.3	9.3536	1131.29	0.088317	99.911642	23.313843
21.5	6.4	9.3536	898.62	0.111154	99.888840	18.523102
21.5	6.5	9.3536	713.80	0.139900	99.860092	14.717680
21.5	6.6	9.3536	566.99	0.176059	99.823929	11.694914
21.5	6.7	9.3536	450.38	0.221544	99.778442	9.293844
21.5	6.8	9.3536	357.75	0.278747	99.721252	7.386613
21.5	6.9	9.3536	284.17	0.350669	99.649323	5.871639
21.5	7.0	9.3536	225.72	0.441065	99.558929	4.668248
21.5	7.1	9.3536	179.30	0.554633	99.445358	3.712362
21.5	7.2	9.3536	142.42	0.697240	99.302750	2.953073
21.5	7.3	9.3536	113.13	0.876190	99.123810	2.349947
21.5	7.4	9.3536	89.86	1.100559	98.899429	1.870867
21.5	7.5	9.3536	71.38	1.391583	98.608408	1.490318
21.5	7.6	9.3536	56.70	1.733109	98.266891	1.186038
21.5	7.7	9.3536	45.04	2.172104	97.827896	0.947929
21.5	7.8	9.3536	35.78	2.719219	97.280777	0.757203
21.5	7.9	9.3536	28.42	3.394357	96.605632	0.605703
21.5	8.0	9.3536	22.57	4.242190	95.757797	0.485362
21.5	8.1	9.3536	17.93	5.282571	94.717422	0.389772
21.5	8.2	9.3536	14.24	6.560617	93.439377	0.313842
21.5	8.3	9.3536	11.31	8.121366	91.878632	0.253529
21.5	8.4	9.3536	8.99	10.013612	89.986374	0.205620
21.5	8.5	9.3536	7.14	12.287778	87.712219	0.167565
21.5	8.6	9.3536	5.67	14.942370	85.007614	0.137336
21.5	8.7	9.3536	4.50	18.168961	81.831039	0.113325
21.5	8.8	9.3536	3.58	21.845627	78.154373	0.094252
21.5	8.9	9.3536	2.84	26.029643	73.970352	0.079102
21.5	9.0	9.3536	2.26	30.700241	69.299759	0.067068
21.5	9.1	9.3536	1.79	35.803253	64.196747	0.057509
21.5	9.2	9.3536	1.42	41.249588	58.750412	0.049916
21.5	9.3	9.3536	1.13	46.918915	53.081085	0.043884
21.5	9.4	9.3536	0.90	52.668915	47.331085	0.039093
21.5	9.5	9.3536	0.71	59.348969	41.651031	0.035288
21.5	9.6	9.3536	0.57	63.815674	36.184326	0.032265
21.5	9.7	9.3536	0.45	68.946701	31.053299	0.029864
21.5	9.8	9.3536	0.36	73.650589	26.349411	0.027956
21.5	9.9	9.3536	0.28	77.870651	22.129349	0.026441
21.5	10.0	9.3536	0.23	81.583847	18.416153	0.025238
21.5	10.1	9.3536	0.18	84.795624	15.204376	0.024282

** CONCENTRATIONS OF AMMONIA(NH4+NH3) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH3-N

TEMP C	PH	PKA	RATIO	% UNIONIZED AMMONIA	% IONIZED AMMONIA	CONCENTRATION NH ₄ +NH ₃ **
22.0	5.0	9.3379	21770.85	0.004593	99.995407	448.282471
22.0	5.1	9.3379	17293.22	0.005782	99.994217	356.087891
22.0	5.2	9.3379	13736.52	0.007274	99.992722	282.855225
22.0	5.3	9.3379	10911.32	0.009164	99.990829	224.584616
22.0	5.4	9.3379	8667.17	0.011535	99.988464	178.477661
22.0	5.5	9.3379	6884.59	0.014523	99.985474	141.774261
22.0	5.6	9.3379	5468.63	0.018283	99.981705	112.619675
22.0	5.7	9.3379	4343.89	0.023016	99.976974	89.461380
22.0	5.8	9.3379	3450.48	0.028973	99.971024	71.066055
22.0	5.9	9.3379	2740.82	0.036472	99.963516	56.454086
22.0	6.0	9.3379	2177.11	0.045911	99.954086	44.847366
22.0	6.1	9.3379	1729.35	0.057742	99.942200	35.627823
22.0	6.2	9.3379	1373.67	0.072745	99.927246	28.304443
22.0	6.3	9.3379	1091.15	0.091563	99.908432	22.487274
22.0	6.4	9.3379	866.73	0.115243	99.884750	17.866531
22.0	6.5	9.3379	688.47	0.145034	99.854950	14.196157
22.0	6.6	9.3379	546.87	0.182525	99.817474	11.280662
22.0	6.7	9.3379	434.40	0.229676	99.770325	8.964794
22.0	6.8	9.3379	345.05	0.288973	99.711014	7.125235
22.0	6.9	9.3379	274.09	0.363523	99.636475	5.564020
22.0	7.0	9.3379	217.71	0.457217	99.542770	4.503330
22.0	7.1	9.3379	172.94	0.574921	99.425079	3.581359
22.0	7.2	9.3379	137.37	0.727206	99.272783	2.849813
22.0	7.3	9.3379	109.12	0.908132	99.091858	2.267290
22.0	7.4	9.3379	86.67	1.140587	98.859406	1.805210
22.0	7.5	9.3379	68.85	1.431684	98.568314	1.438167
22.0	7.6	9.3379	54.69	1.795724	98.204259	1.146612
22.0	7.7	9.3379	43.44	2.250215	97.749771	0.915023
22.0	7.8	9.3379	34.51	2.816441	97.183548	0.731064
22.0	7.9	9.3379	27.41	3.520019	96.479980	0.584940
22.0	8.0	9.3379	21.77	4.391410	95.608582	0.468870
22.0	8.1	9.3379	17.29	5.456293	94.543707	0.376672
22.0	8.2	9.3379	13.74	6.785608	93.214386	0.303436
22.0	8.3	9.3379	10.91	8.395065	91.604935	0.245263
22.0	8.4	9.3379	8.67	10.343902	89.656097	0.199054
22.0	8.5	9.3379	6.88	12.642503	87.357490	0.162350
22.0	8.6	9.3379	5.47	15.458677	84.541321	0.133194
22.0	8.7	9.3379	4.34	18.712311	81.287689	0.110034
22.0	8.8	9.3379	3.45	22.468750	77.531250	0.091638
22.0	8.9	9.3379	2.74	26.731308	73.268692	0.077026
22.0	9.0	9.3379	2.18	31.474213	68.525787	0.065419
22.0	9.1	9.3379	1.73	36.637843	63.362152	0.056199
22.0	9.2	9.3379	1.37	42.127838	57.872162	0.048875
22.0	9.3	9.3379	1.09	47.819626	52.180374	0.043058
22.0	9.4	9.3379	0.87	53.568604	46.431396	0.038437
22.0	9.5	9.3379	0.69	59.224274	40.775726	0.034766
22.0	9.6	9.3379	0.55	64.645706	35.354294	0.031851
22.0	9.7	9.3379	0.43	69.714920	30.285080	0.029535
22.0	9.8	9.3379	0.35	74.345734	25.654266	0.027695
22.0	9.9	9.3379	0.27	78.486984	21.513016	0.026234
22.0	10.0	9.3379	0.22	82.120483	17.879517	0.025073
22.0	10.1	9.3379	0.17	85.255554	14.744446	0.024151

** CONCENTRATIONS OF AMMONIA(NH₄+NH₃) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH₃-N

A-48

TEMP C	PH	PKA	RATIO	% UNIONIZED AMMONIA	% IONIZED AMMONIA	CONCENTRATION NH ₄ +NH ₃ **
22.5	5.0	9.3222	21000.95	0.004761	99.995239	432.430176
22.5	5.1	9.3222	16681.67	0.005994	99.994003	343.496094
22.5	5.2	9.3222	13259.73	0.007545	99.992447	272.853027
22.5	5.3	9.3222	10525.45	0.009500	99.990494	216.739456
22.5	5.4	9.3222	8360.67	0.011954	99.988037	172.166824
22.5	5.5	9.3222	6641.12	0.015055	99.984940	136.761276
22.5	5.6	9.3222	5275.24	0.018953	99.981033	108.637602
22.5	5.7	9.3222	4190.28	0.023859	99.976135	86.298477
22.5	5.8	9.3222	3328.46	0.030035	99.969955	68.553619
22.5	5.9	9.3222	2643.90	0.037804	99.962189	54.456389
22.5	6.0	9.3222	2100.12	0.047594	99.952393	43.262131
22.5	6.1	9.3222	1668.19	0.059904	99.940079	34.366591
22.5	6.2	9.3222	1325.09	0.075410	99.924591	27.304230
22.5	6.3	9.3222	1052.56	0.094910	99.905075	21.592780
22.5	6.4	9.3222	836.08	0.119463	99.880524	17.235443
22.5	6.5	9.3222	664.12	0.150348	99.849640	13.694859
22.5	6.6	9.3222	527.53	0.189203	99.810791	10.882461
22.5	6.7	9.3222	419.03	0.238070	99.761917	8.648491
22.5	6.8	9.3222	332.85	0.299535	99.700455	6.873989
22.5	6.9	9.3222	264.39	0.376803	99.623199	5.464442
22.5	7.0	9.3222	210.02	0.473903	99.526093	4.344400
22.5	7.1	9.3222	166.82	0.595872	99.404114	3.455438
22.5	7.2	9.3222	132.51	0.749002	99.250992	2.748990
22.5	7.3	9.3222	105.26	0.941111	99.058884	2.187839
22.5	7.4	9.3222	83.61	1.181907	98.818095	1.742100
22.5	7.5	9.3222	66.41	1.483391	98.516602	1.388036
22.5	7.6	9.3222	52.75	1.860331	98.139664	1.106791
22.5	7.7	9.3222	41.90	2.330788	97.669205	0.883392
22.5	7.8	9.3222	33.29	2.916684	97.083313	0.705938
22.5	7.9	9.3222	26.44	3.644354	96.355637	0.564983
22.5	8.0	9.3222	21.00	4.545082	95.454910	0.453017
22.5	8.1	9.3222	16.68	5.655359	94.344635	0.364079
22.5	8.2	9.3222	13.25	7.016913	92.983078	0.293434
22.5	8.3	9.3222	10.53	8.676120	91.323868	0.237318
22.5	8.4	9.3222	8.36	10.682600	89.317398	0.192743
22.5	8.5	9.3222	6.64	13.086604	86.913391	0.157336
22.5	8.6	9.3222	5.28	15.935098	84.064896	0.124212
22.5	8.7	9.3222	4.19	19.260144	80.739856	0.106871
22.5	8.8	9.3222	3.33	23.102173	76.897827	0.089126
22.5	8.9	9.3222	2.64	27.442337	72.557663	0.075030
22.5	9.0	9.3222	2.10	32.255875	67.744125	0.063833
22.5	9.1	9.3222	1.67	37.477615	62.522385	0.054939
22.5	9.2	9.3222	1.33	43.008026	56.991974	0.047875
22.5	9.3	9.3222	1.05	48.718629	51.281372	0.042263
22.5	9.4	9.3222	0.84	54.462875	45.537125	0.037806
22.5	9.5	9.3222	0.66	60.090790	39.909210	0.034265
22.5	9.6	9.3222	0.53	65.464188	34.535812	0.031452
22.5	9.7	9.3222	0.42	70.464666	29.530334	0.029218
22.5	9.8	9.3222	0.33	75.026413	24.973587	0.027444
22.5	9.9	9.3222	0.26	79.088684	20.911316	0.026034
22.5	10.0	9.3222	0.21	82.642991	17.357010	0.024914
22.5	10.1	9.3222	0.17	85.702408	14.297592	0.024025

** CONCENTRATIONS OF AMMONIA (NH₄+NH₃) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH₃-N

TEMP C	PH	PKA	RATIO	% UNIONIZED AMMONIA	% IONIZED AMMONIA	CONCENTRATION NH4+NH3 **
23.0	5.0	9.3067	20260.71	0.004935	99.995065	417.188721
23.0	5.1	9.3067	16043.68	0.006213	99.993787	331.349404
23.0	5.2	9.3067	12781.68	0.007822	99.992178	263.236572
23.0	5.3	9.3067	10154.46	0.009847	99.990153	209.100815
23.0	5.4	9.3067	8065.98	0.012346	99.987654	166.049167
23.0	5.5	9.3067	6407.05	0.015605	99.984395	131.941605
23.0	5.6	9.3067	5089.30	0.019645	99.980355	104.804280
23.0	5.7	9.3067	4042.58	0.024731	99.975269	83.257355
23.0	5.8	9.3067	3211.14	0.031132	99.968868	66.137985
23.0	5.9	9.3067	2550.70	0.039187	99.960813	52.539581
23.0	6.0	9.3067	2026.10	0.049332	99.950668	41.737961
23.0	6.1	9.3067	1609.39	0.062097	99.937903	33.157428
23.0	6.2	9.3067	1278.39	0.078162	99.921838	26.342545
23.0	6.3	9.3067	1015.46	0.098381	99.901619	20.928909
23.0	6.4	9.3067	806.61	0.123522	99.876478	16.628662
23.0	6.5	9.3067	640.71	0.154833	99.845167	13.212872
23.0	6.6	9.3067	508.94	0.194102	99.805898	10.499608
23.0	6.7	9.3067	404.26	0.246753	99.753247	8.344376
23.0	6.8	9.3067	321.12	0.310445	99.689555	6.632417
23.0	6.9	9.3067	255.07	0.390513	99.609487	5.272557
23.0	7.0	9.3067	202.61	0.491128	99.508872	4.192386
23.0	7.1	9.3067	160.94	0.617508	99.382492	3.334370
23.0	7.2	9.3067	127.84	0.776154	99.223846	2.652822
23.0	7.3	9.3067	101.55	0.975160	99.024840	2.111448
23.0	7.4	9.3067	80.66	1.224560	98.775440	1.681419
23.0	7.5	9.3067	64.07	1.536755	98.463245	1.339836
23.0	7.6	9.3067	50.89	1.926989	98.073011	1.068506
23.0	7.7	9.3067	40.43	2.413668	97.586332	0.852980
23.0	7.8	9.3067	32.11	3.020025	96.979975	0.681782
23.0	7.9	9.3067	25.51	3.772481	96.227519	0.545794
23.0	8.0	9.3067	20.26	4.703325	95.296675	0.437775
23.0	8.1	9.3067	16.09	5.849887	94.150113	0.351973
23.0	8.2	9.3067	12.78	7.254682	92.745318	0.283817
23.0	8.3	9.3067	10.15	8.964696	91.035294	0.229679
23.0	8.4	9.3067	8.07	11.029845	88.970155	0.186675
23.0	8.5	9.3067	6.41	13.500183	86.499817	0.152516
23.0	8.6	9.3067	5.09	16.421677	83.578323	0.125383
23.0	8.7	9.3067	4.04	19.830444	80.169556	0.103830
23.0	8.8	9.3067	3.21	23.745773	76.254227	0.086710
23.0	8.9	9.3067	2.55	28.162582	71.837418	0.073111
23.0	9.0	9.3067	2.03	33.044922	66.955078	0.062309
23.0	9.1	9.3067	1.61	38.322144	61.677856	0.053729
23.0	9.2	9.3067	1.28	43.889694	56.110306	0.046913
23.0	9.3	9.3067	1.02	49.615448	50.384552	0.041499
23.0	9.4	9.3067	0.81	55.351318	44.648682	0.037199
23.0	9.5	9.3067	0.64	60.948120	39.051880	0.033783
23.0	9.6	9.3067	0.51	66.270889	33.729111	0.031069
23.0	9.7	9.3067	0.40	71.210876	28.789124	0.028914
23.0	9.8	9.3067	0.32	75.692673	24.307327	0.027202
23.0	9.9	9.3067	0.26	79.675934	20.324066	0.025842
23.0	10.0	9.3067	0.20	83.151749	16.848251	0.024762
23.0	10.1	9.3067	0.16	86.136505	13.863495	0.023904

** CONCENTRATIONS OF AMMONIA(NH4+NH3) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH3-N

TEMP C	PH	PKA	RATIO	% UNIONIZED AMMONIA	% IONIZED AMMONIA	CONCENTRATION NH4+NH3 **
23.5	5.0	9.2911	19548.94	0.005115	99.994873	402.533203
23.5	5.1	9.2911	15528.30	0.006439	99.993561	319.748047
23.5	5.2	9.2911	12334.58	0.008107	99.991882	253.989685
23.5	5.3	9.2911	9797.72	0.010205	99.989792	201.755707
23.5	5.4	9.2911	7782.62	0.012647	99.987152	160.264679
23.5	5.5	9.2911	6181.96	0.016173	99.983826	127.307129
23.5	5.6	9.2911	4910.52	0.020360	99.979630	101.128098
23.5	5.7	9.2911	3900.56	0.025631	99.974365	80.333176
23.5	5.8	9.2911	3098.33	0.032265	99.967728	63.815231
23.5	5.9	9.2911	2461.10	0.040610	99.959381	50.694550
23.5	6.0	9.2911	1954.92	0.051127	99.948868	40.272400
23.5	6.1	9.2911	1552.85	0.064355	99.935638	31.943790
23.5	6.2	9.2911	1233.48	0.081006	99.918991	25.417847
23.5	6.3	9.2911	979.79	0.101959	99.898041	20.194366
23.5	6.4	9.2911	778.27	0.128325	99.871674	16.045212
23.5	6.5	9.2911	618.20	0.161497	99.838501	12.749427
23.5	6.6	9.2911	491.06	0.203228	99.796768	10.131466
23.5	6.7	9.2911	390.06	0.255714	99.744278	8.051355
23.5	6.8	9.2911	309.84	0.321712	99.678284	6.400138
23.5	6.9	9.2911	246.11	0.404673	99.595327	5.088057
23.5	7.0	9.2911	195.49	0.508919	99.491074	4.045827
23.5	7.1	9.2911	155.29	0.639847	99.360153	3.217954
23.5	7.2	9.2911	123.35	0.804187	99.195801	2.560350
23.5	7.3	9.2911	97.98	1.010305	98.989685	2.037997
23.5	7.4	9.2911	77.83	1.268580	98.731415	1.623074
23.5	7.5	9.2911	61.82	1.591817	98.408173	1.293490
23.5	7.6	9.2911	49.11	1.995750	98.004242	1.031692
23.5	7.7	9.2911	39.01	2.499581	97.500412	0.823738
23.5	7.8	9.2911	30.98	3.126546	96.873444	0.656554
23.5	7.9	9.2911	24.61	3.904475	96.095520	0.527344
23.5	8.0	9.2911	19.55	4.866241	95.133759	0.423119
23.5	8.1	9.2911	15.53	6.049997	93.949997	0.340331
23.5	8.2	9.2911	12.34	7.499009	92.500977	0.274570
23.5	8.3	9.2911	9.80	9.260873	90.739120	0.222333
23.5	8.4	9.2911	7.78	11.385717	88.614273	0.180841
23.5	8.5	9.2911	6.18	13.923285	86.076706	0.147882
23.5	8.6	9.2911	4.91	16.918427	83.081573	0.121702
23.5	8.7	9.2911	3.90	20.405135	79.594864	0.100906
23.5	8.8	9.2911	3.10	24.349399	75.650601	0.084387
23.5	8.9	9.2911	2.46	28.891724	71.108276	0.071266
23.5	9.0	9.2911	1.96	33.840912	66.159088	0.060844
23.5	9.1	9.2911	1.55	39.170898	60.829102	0.052565
23.5	9.2	9.2911	1.23	44.772247	55.227753	0.045988
23.5	9.3	9.2911	0.98	50.509476	49.490524	0.040765
23.5	9.4	9.2911	0.78	56.233337	43.766663	0.036615
23.5	9.5	9.2911	0.62	61.795914	38.204086	0.033319
23.5	9.6	9.2911	0.49	67.065598	32.934402	0.030701
23.5	9.7	9.2911	0.39	71.938416	28.061584	0.028622
23.5	9.8	9.2911	0.31	76.344620	23.655380	0.026970
23.5	9.9	9.2911	0.25	80.248871	19.751129	0.025658
23.5	10.0	9.2911	0.20	83.646635	16.353165	0.024615
23.5	10.1	9.2911	0.16	86.558090	13.441910	0.023787

** CONCENTRATIONS OF AMMONIA(NH4+NH3) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH3-N

TEMP C	PH	PKA	RATIO	A UNIONIZED AMMONIA	* IONIZED AMMONIA	CONCENTRATION NH4+NH3 **
24.0	5.0	9.2756	18864.42	0.005301	99.994690	388.438965
24.0	5.1	9.2756	14984.56	0.006673	99.993317	308.552734
24.0	5.2	9.2756	11902.68	0.008401	99.991592	245.096680
24.0	5.3	9.2756	9454.04	0.010576	99.989410	194.691559
24.0	5.4	9.2756	7510.10	0.013314	99.986679	154.653442
24.0	5.5	9.2756	5965.49	0.016760	99.983231	122.850037
24.0	5.6	9.2756	4738.57	0.021099	99.978997	97.547662
24.0	5.7	9.2756	3763.98	0.026561	99.973434	77.520966
24.0	5.8	9.2756	2989.44	0.033435	99.966553	61.541406
24.0	5.9	9.2756	2374.92	0.042089	99.957901	48.920151
24.0	6.0	9.2756	1886.47	0.052981	99.947006	38.862961
24.0	6.1	9.2756	1498.48	0.066690	99.933304	30.874191
24.0	6.2	9.2756	1190.28	0.083943	99.916046	24.528519
24.0	6.3	9.2756	945.48	0.105655	99.894333	19.487946
24.0	6.4	9.2756	751.02	0.132975	99.867020	15.484095
24.0	6.5	9.2756	596.56	0.167344	99.832642	12.303703
24.0	6.6	9.2756	473.86	0.210567	99.789413	9.777427
24.0	6.7	9.2756	376.40	0.264967	99.735031	7.770729
24.0	6.8	9.2756	298.99	0.333346	99.666641	6.176759
24.0	6.9	9.2756	237.50	0.419296	99.580704	4.910615
24.0	7.0	9.2756	188.65	0.527289	99.472702	3.904877
24.0	7.1	9.2756	149.85	0.662912	99.337082	3.105992
24.0	7.2	9.2756	119.03	0.833125	99.166870	2.471416
24.0	7.3	9.2756	94.55	1.046583	98.953415	1.967354
24.0	7.4	9.2756	75.10	1.314008	98.685989	1.566961
24.0	7.5	9.2756	59.66	1.648625	98.351364	1.248918
24.0	7.6	9.2756	47.39	2.066672	97.933319	0.996288
24.0	7.7	9.2756	37.64	2.537934	97.412064	0.795615
24.0	7.8	9.2756	29.90	3.236329	96.763657	0.636214
24.0	7.9	9.2756	23.75	4.040434	95.959564	0.509598
24.0	8.0	9.2756	18.87	5.033935	94.966064	0.409024
24.0	8.1	9.2756	14.99	6.255799	93.744186	0.329135
24.0	8.2	9.2756	11.90	7.750040	92.249954	0.265676
24.0	8.3	9.2756	9.46	9.564775	90.435211	0.215269
24.0	8.4	9.2756	7.51	11.750319	87.249680	0.175229
24.0	8.5	9.2756	5.97	14.355982	85.644012	0.143425
24.0	8.6	9.2756	4.74	17.425369	82.574631	0.118161
24.0	8.7	9.2756	3.76	20.990173	79.009827	0.098093
24.0	8.8	9.2756	2.99	25.062897	74.937103	0.082153
24.0	8.9	9.2756	2.38	29.629436	70.370514	0.069492
24.0	9.0	9.2756	1.89	34.643478	65.356522	0.059434
24.0	9.1	9.2756	1.50	40.023392	59.976608	0.051445
24.0	9.2	9.2756	1.19	45.855167	54.344833	0.045099
24.0	9.3	9.2756	0.95	51.400253	49.599747	0.040058
24.0	9.4	9.2756	0.75	57.108551	42.891449	0.036054
24.0	9.5	9.2756	0.60	62.633820	37.366180	0.032874
24.0	9.6	9.2756	0.47	67.848038	32.151962	0.030347
24.0	9.7	9.2756	0.38	72.652328	27.347672	0.028340
24.0	9.8	9.2756	0.30	76.982300	23.017700	0.026746
24.0	9.9	9.2756	0.24	80.807755	19.192245	0.025480
24.0	10.0	9.2756	0.19	84.128571	15.871429	0.024474
24.0	10.1	9.2756	0.15	86.967438	13.032562	0.023676

** CONCENTRATIONS OF AMMONIA(NH4+NH3) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH3-N

TEMP C	PH	PKA	RATIO	% UNIONIZED AMMONIA	% IONIZED AMMONIA	CONCENTRATION NH ₄ +NH ₃ **
24.5	5.0	9.2602	18206.05	0.005492	99.994507	374.883301
24.5	5.1	9.2602	14461.60	0.006914	99.993073	297.784668
24.5	5.2	9.2602	11487.27	0.008705	99.991287	236.543549
24.5	5.3	9.2602	9124.67	0.010958	98.989029	187.897583
24.5	5.4	9.2602	7248.00	0.013795	98.986191	149.256790
24.5	5.5	9.2602	5751.30	0.017365	98.982620	118.563263
24.5	5.6	9.2602	4573.19	0.021862	97.978134	94.182526
24.5	5.7	9.2602	3632.62	0.027521	97.972473	74.416208
24.5	5.8	9.2602	2885.50	0.034644	96.965347	59.432938
24.5	5.9	9.2602	2292.03	0.043610	95.956390	47.213562
24.5	6.0	9.2602	1820.63	0.054896	94.945099	37.507355
24.5	6.1	9.2602	1446.18	0.069100	93.930893	29.797455
24.5	6.2	9.2602	1148.74	0.086970	91.913025	23.673187
24.5	6.3	9.2602	912.48	0.109471	89.890518	18.808533
24.5	6.4	9.2602	724.81	0.137777	86.862213	14.944422
24.5	6.5	9.2602	575.74	0.173387	82.826599	11.875021
24.5	6.6	9.2602	457.33	0.218186	78.181815	9.436911
24.5	6.7	9.2602	363.27	0.274524	72.54644	7.500255
24.5	6.8	9.2602	288.55	0.345357	65.4633	5.961405
24.5	6.9	9.2602	229.21	0.434392	56.5598	4.739453
24.5	7.0	9.2602	182.07	0.546253	45.3735	3.769316
24.5	7.1	9.2602	144.62	0.686719	31.3278	2.998313
24.5	7.2	9.2602	114.88	0.862993	13.6993	2.385882
24.5	7.3	9.2602	91.25	1.044020	9.15970	1.899411
24.5	7.4	9.2602	72.48	1.360874	6.39114	1.512993
24.5	7.5	9.2602	57.57	1.707220	4.292770	1.206050
24.5	7.6	9.2602	45.73	2.139803	3.860184	0.962236
24.5	7.7	9.2602	36.33	2.679011	3.320944	0.766567
24.5	7.8	9.2602	28.86	3.349437	2.650554	0.614730
24.5	7.9	9.2602	22.92	4.183434	2.819565	0.492533
24.5	8.0	9.2602	18.21	5.206492	2.793503	0.395467
24.5	8.1	9.2602	14.46	6.467390	2.532608	0.318366
24.5	8.2	9.2602	11.49	8.007854	2.992142	0.257123
24.5	8.3	9.2602	9.13	9.876494	2.123505	0.208475
24.5	8.4	9.2602	7.25	12.123717	2.876282	0.169832
24.5	8.5	9.2602	5.76	14.798297	2.201691	0.139138
24.5	8.6	9.2602	4.57	17.942424	2.057571	0.114756
24.5	8.7	9.2602	3.63	21.585373	2.414627	0.095389
24.5	8.8	9.2602	2.89	25.735962	2.264038	0.080005
24.5	8.9	9.2602	2.29	30.375473	2.624527	0.067785
24.5	9.0	9.2602	1.82	35.452133	2.547867	0.058078
24.5	9.1	9.2602	1.45	40.879054	2.120941	0.050368
24.5	9.2	9.2602	1.15	46.537790	2.462204	0.044244
24.5	9.3	9.2602	0.91	52.287094	2.712906	0.039379
24.5	9.4	9.2602	0.72	57.976410	2.023590	0.035514
24.5	9.5	9.2602	0.58	63.461395	2.538605	0.032445
24.5	9.6	9.2602	0.46	64.617966	2.382034	0.030007
24.5	9.7	9.2602	0.36	73.352432	2.647568	0.028070
24.5	9.8	9.2602	0.29	77.605713	2.394287	0.026532
24.5	9.9	9.2602	0.23	81.352692	2.647308	0.025310
24.5	10.0	9.2602	0.18	84.597168	2.402832	0.024339
24.5	10.1	9.2602	0.14	87.364792	2.635208	0.023568

** CONCENTRATIONS OF AMMONIA(NH₄+NH₃) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH₃-N

TEMP C	PH	PKA	RATIO	% UNIONIZED AMMONIA	% IONIZED AMMONIA	CONCENTRATION NH4+NH3 **
25.0	5.0	9.2448	17572.79	0.005690	99.994308	361.844238
25.0	5.1	9.2448	13958.57	0.007164	99.992836	287.427490
25.0	5.2	9.2448	11087.70	0.009018	99.990982	228.316391
25.0	5.3	9.2448	8807.29	0.011353	99.988647	181.362625
25.0	5.4	9.2448	6995.89	0.014292	99.985703	144.065857
25.0	5.5	9.2448	5557.04	0.017942	99.981995	114.439957
25.0	5.6	9.2448	4414.12	0.022644	99.977341	90.907333
25.0	5.7	9.2448	3506.27	0.028512	99.971481	72.214584
25.0	5.8	9.2448	2785.13	0.035892	99.964096	57.366409
25.0	5.9	9.2448	2212.31	0.045181	99.954819	45.572052
25.0	6.0	9.2448	1757.30	0.056873	99.943115	36.203415
25.0	6.1	9.2448	1395.88	0.071548	99.928406	28.761688
25.0	6.2	9.2448	1108.79	0.090107	99.909882	22.850494
25.0	6.3	9.2448	880.74	0.113412	99.886581	18.155045
25.0	6.4	9.2448	699.60	0.142735	99.857254	14.425319
25.0	6.5	9.2448	555.71	0.179626	99.820374	11.462694
25.0	6.6	9.2448	441.42	0.226030	99.773956	9.109389
25.0	6.7	9.2448	350.63	0.284389	99.715607	7.240087
25.0	6.8	9.2448	275.52	0.357760	99.642227	5.755246
25.0	6.9	9.2448	221.23	0.449976	99.550018	4.575795
25.0	7.0	9.2448	175.73	0.565827	99.434174	3.638924
25.0	7.1	9.2448	139.59	0.711290	99.288696	2.894738
25.0	7.2	9.2448	110.88	0.893814	99.106186	2.303611
25.0	7.3	9.2448	88.08	1.122645	98.877350	1.834060
25.0	7.4	9.2448	69.96	1.409228	98.590759	1.461082
25.0	7.5	9.2448	55.57	1.767661	98.232330	1.164816
25.0	7.6	9.2448	44.14	2.215213	97.784775	0.929482
25.0	7.7	9.2448	35.06	2.772880	97.227112	0.742549
25.0	7.8	9.2448	27.85	3.465960	96.534027	0.594063
25.0	7.9	9.2448	22.12	4.324570	95.675430	0.476117
25.0	8.0	9.2448	17.57	5.384014	94.615982	0.382428
25.0	8.1	9.2448	13.96	6.644872	93.35125	0.308009
25.0	8.2	9.2448	11.09	8.272555	91.727432	0.248895
25.0	8.3	9.2448	8.81	10.195118	89.803879	0.201940
25.0	8.4	9.2448	7.00	12.565975	87.434019	0.164641
25.0	8.5	9.2448	5.56	15.250261	84.749725	0.135014
25.0	8.6	9.2448	4.41	18.469604	81.530396	0.111480
25.0	8.7	9.2448	3.51	22.190613	77.809387	0.092787
25.0	8.8	9.2448	2.79	26.418381	73.581619	0.077938
25.0	8.9	9.2448	2.21	31.129364	68.870636	0.066143
25.0	9.0	9.2448	1.76	36.266373	63.733627	0.056774
25.0	9.1	9.2448	1.40	41.737366	58.262634	0.049332
25.0	9.2	9.2448	1.11	47.419617	52.580383	0.043421
25.0	9.3	9.2448	0.88	53.169495	46.830505	0.038725
25.0	9.4	9.2448	0.70	58.836441	41.163559	0.034995
25.0	9.5	9.2448	0.56	64.278351	35.721649	0.032033
25.0	9.6	9.2448	0.44	69.375259	30.624741	0.029679
25.0	9.7	9.2448	0.35	74.038696	25.961304	0.027810
25.0	9.8	9.2448	0.28	78.214920	21.785080	0.026325
25.0	9.9	9.2448	0.22	81.883789	18.116211	0.025145
25.0	10.0	9.2448	0.18	85.052856	14.947144	0.024208
25.0	10.1	9.2448	0.14	87.750458	12.249542	0.023464

** CONCENTRATIONS OF AMMONIA(NH4+NH3) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH3-N

TEMP C	PH	PKA	RATIO	% UNIONIZED AMMONIA	% IONIZED AMMONIA	CONCENTRATION NH4+NH3 **
25.5	5.0	9.2295	16963.52	0.005897	99.994095	349.299316
25.5	5.1	9.2295	13474.62	0.007421	99.992569	277.462891
25.5	5.2	9.2295	10703.29	0.009342	99.990646	220.401184
25.5	5.3	9.2295	8501.93	0.011761	99.988235	175.075424
25.5	5.4	9.2295	6753.34	0.014805	99.985184	139.071747
25.5	5.5	9.2295	5364.37	0.018634	99.981354	110.473053
25.5	5.6	9.2295	4261.08	0.023463	99.976532	87.756180
25.5	5.7	9.2295	3384.70	0.029536	99.970459	69.711578
25.5	5.8	9.2295	2688.56	0.037181	99.962814	55.378128
25.5	5.9	9.2295	2135.61	0.046803	99.953186	43.992722
25.5	6.0	9.2295	1696.37	0.058915	99.941084	34.948944
25.5	6.1	9.2295	1347.48	0.074158	99.925842	27.765213
25.5	6.2	9.2295	1070.34	0.093341	99.906647	22.058945
25.5	6.3	9.2295	850.21	0.117480	99.882507	17.526306
25.5	6.4	9.2295	675.34	0.147854	99.852142	13.925903
25.5	6.5	9.2295	536.44	0.186060	99.813934	11.065989
25.5	6.6	9.2295	426.11	0.234139	99.765859	8.794266
25.5	6.7	9.2295	338.47	0.294573	99.705414	6.989777
25.5	6.8	9.2295	268.86	0.370562	99.629425	5.556419
25.5	6.9	9.2295	213.56	0.466062	99.533936	4.417864
25.5	7.0	9.2295	169.64	0.586030	99.413971	3.513474
25.5	7.1	9.2295	134.75	0.736647	99.263351	2.795090
25.5	7.2	9.2295	107.04	0.925619	99.074371	2.224457
25.5	7.3	9.2295	85.02	1.162498	98.837494	1.771186
25.5	7.4	9.2295	67.54	1.459105	98.540894	1.411139
25.5	7.5	9.2295	53.65	1.829488	98.169998	1.125144
25.5	7.6	9.2295	42.61	2.292950	97.707047	0.897970
25.5	7.7	9.2295	33.85	2.869612	97.130386	0.717518
25.5	7.8	9.2295	26.89	3.585978	96.414017	0.574181
25.5	7.9	9.2295	21.36	4.472943	95.527054	0.460323
25.5	8.0	9.2295	16.96	5.566621	94.433365	0.369883
25.5	8.1	9.2295	13.48	6.908379	93.091614	0.298044
25.5	8.2	9.2295	10.70	8.544285	91.455704	0.240480
25.5	8.3	9.2295	8.50	10.523791	89.476196	0.195652
25.5	8.4	9.2295	6.75	12.897219	87.102768	0.159647
25.5	8.5	9.2295	5.36	15.711929	84.288071	0.131047
25.5	8.6	9.2295	4.26	19.006866	80.993134	0.108329
25.5	8.7	9.2295	3.38	22.805847	77.194153	0.090284
25.5	8.8	9.2295	2.69	27.109985	72.890015	0.075950
25.5	8.9	9.2295	2.14	31.890854	68.109146	0.064564
25.5	9.0	9.2295	1.70	37.085846	62.914154	0.055520
25.5	9.1	9.2295	1.35	42.597837	57.402161	0.048336
25.5	9.2	9.2295	1.07	48.300125	51.699875	0.042629
25.5	9.3	9.2295	0.85	54.047043	45.952957	0.038096
25.5	9.4	9.2295	0.68	59.688293	40.311707	0.034436
25.5	9.5	9.2295	0.54	65.084381	34.915619	0.031636
25.5	9.6	9.2295	0.43	70.119766	29.880234	0.029364
25.5	9.7	9.2295	0.34	74.711121	25.288879	0.027559
25.5	9.8	9.2295	0.27	78.810196	21.189804	0.026126
25.5	9.9	9.2295	0.21	82.401337	17.598663	0.024987
25.5	10.0	9.2295	0.17	85.495926	14.504074	0.024083
25.5	10.1	9.2295	0.13	88.124725	11.875275	0.023365

** CONCENTRATIONS OF AMMONIA(NH4+NH3) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH3-N

A-55

TEMP C	PH	PKA	RATIO	% UNIONIZED AMMONIA	% IONIZED AMMONIA	CONCENTRATION NH ₄ +NH ₃ **
26.0	5.0	9.2142	16377.31	0.006106	99.993881	337.229492
26.0	5.1	9.2142	13009.98	0.007686	99.992310	267.475488
26.0	5.2	9.2142	10333.42	0.009676	99.990311	212.745721
26.0	5.3	9.2142	8208.14	0.012152	99.987808	169.026077
26.0	5.4	9.2142	6519.96	0.015335	99.984665	134.266663
26.0	5.5	9.2142	5179.00	0.019305	99.980682	106.656158
26.0	5.6	9.2142	4113.83	0.024302	99.975693	84.724396
26.0	5.7	9.2142	3267.74	0.030593	99.969406	67.303299
26.0	5.8	9.2142	2595.66	0.038511	99.961487	53.465164
26.0	5.9	9.2142	2061.81	0.048478	99.951523	42.473190
26.0	6.0	9.2142	1637.75	0.061022	99.938965	33.741943
26.0	6.1	9.2142	1300.92	0.076810	99.923187	26.406458
26.0	6.2	9.2142	1033.36	0.096678	99.903320	21.297379
26.0	6.3	9.2142	820.82	0.121681	99.878311	16.921371
26.0	6.4	9.2142	652.01	0.153134	99.846863	13.445383
26.0	6.5	9.2142	517.91	0.192713	99.807281	10.684299
26.0	6.6	9.2142	411.39	0.242490	99.757507	8.491087
26.0	6.7	9.2142	326.78	0.305084	99.694916	6.748950
26.0	6.8	9.2142	259.57	0.383775	99.616211	5.365122
26.0	6.9	9.2142	206.18	0.482664	99.517334	4.265909
26.0	7.0	9.2142	163.78	0.606878	99.393112	3.392772
26.0	7.1	9.2142	130.09	0.762815	99.237183	2.699213
26.0	7.2	9.2142	103.34	0.958433	99.041565	2.148299
26.0	7.3	9.2142	82.08	1.203606	98.796387	1.710692
26.0	7.4	9.2142	65.20	1.510541	98.489456	1.363088
26.0	7.5	9.2142	51.79	1.894248	98.105743	1.086974
26.0	7.6	9.2142	41.14	2.373075	97.626923	0.867651
26.0	7.7	9.2142	32.68	2.969275	97.030716	0.693435
26.0	7.8	9.2142	25.96	3.709571	96.290421	0.555050
26.0	7.9	9.2142	20.62	4.625638	95.374359	0.445127
26.0	8.0	9.2142	16.38	5.754405	94.245590	0.357813
26.0	8.1	9.2142	13.01	7.138002	92.861984	0.288456
26.0	8.2	9.2142	10.33	8.823131	91.176865	0.233364
26.0	8.3	9.2142	8.21	10.859558	89.140442	0.189602
26.0	8.4	9.2142	6.52	13.247468	86.702530	0.154841
26.0	8.5	9.2142	5.18	16.183289	83.816711	0.127230
26.0	8.6	9.2142	4.11	19.554169	80.445831	0.105297
26.0	8.7	9.2142	3.27	23.430878	76.569122	0.087875
26.0	8.8	9.2142	2.60	27.810471	72.189529	0.074037
26.0	8.9	9.2142	2.06	32.659515	67.340485	0.063044
26.0	9.0	9.2142	1.64	37.910049	62.089951	0.054313
26.0	9.1	9.2142	1.30	43.459933	56.540070	0.047377
26.0	9.2	9.2142	1.03	49.178741	50.821259	0.041868
26.0	9.3	9.2142	0.82	54.919159	45.080841	0.037491
26.0	9.4	9.2142	0.65	60.531509	39.468491	0.034015
26.0	9.5	9.2142	0.52	65.879257	34.120743	0.031254
26.0	9.6	9.2142	0.41	70.851349	29.148651	0.029061
26.0	9.7	9.2142	0.33	75.369760	24.630234	0.027319
26.0	9.8	9.2142	0.26	79.391556	20.608444	0.025935
26.0	9.9	9.2142	0.21	82.905533	17.094467	0.024835
26.0	10.0	9.2142	0.16	85.926590	14.073410	0.023962
26.0	10.1	9.2142	0.13	88.487869	11.512131	0.023269

** CONCENTRATIONS OF AMMONIA(NH₄+NH₃) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH₃-N

TEMP C	PH	PKA	RATIO	% UNIONIZED AMMONIA	% IONIZED AMMONIA	CONCENTRATION NH4+NH3 **
26.5	5.0	9.1990	15813.26	0.006323	99.993664	325.615479
26.5	5.1	9.1990	12560.93	0.007961	99.992035	258.650146
26.5	5.2	9.1990	9977.52	0.010022	99.989975	205.457687
26.5	5.3	9.1990	7925.44	0.012610	99.987381	163.705338
26.5	5.4	9.1990	6295.40	0.015882	99.984116	129.642868
26.5	5.5	9.1990	5000.62	0.019994	99.979996	102.983276
26.5	5.6	9.1990	3972.14	0.025169	99.974823	81.406992
26.5	5.7	9.1990	3155.19	0.031684	99.968307	64.485931
26.5	5.8	9.1990	2506.26	0.039844	99.960114	51.624466
26.5	5.9	9.1990	1990.80	0.050200	99.949783	41.011063
26.5	6.0	9.1990	1581.35	0.063197	99.936798	32.540551
26.5	6.1	9.1990	1256.11	0.079547	99.920441	25.843911
26.5	6.2	9.1990	997.76	0.100124	99.899872	20.564560
26.5	6.3	9.1990	792.55	0.126015	99.873478	16.339264
26.5	6.4	9.1990	629.55	0.158592	99.841400	12.983000
26.5	6.5	9.1990	500.07	0.199573	99.800415	10.317009
26.5	6.6	9.1990	397.22	0.251114	99.748871	8.199340
26.5	6.7	9.1990	315.52	0.315433	99.684057	6.517207
26.5	6.8	9.1990	250.63	0.397410	99.602585	5.181049
26.5	6.9	9.1990	199.08	0.499794	99.500198	4.119694
26.5	7.0	9.1990	158.14	0.628390	99.371597	3.276628
26.5	7.1	9.1990	125.61	0.789810	99.210190	2.606956
26.5	7.2	9.1990	99.78	0.992281	99.007706	2.075016
26.5	7.3	9.1990	79.26	1.246007	98.753983	1.652480
26.5	7.4	9.1990	62.96	1.563581	98.436417	1.316849
26.5	7.5	9.1990	50.01	1.960491	98.039505	1.050246
26.5	7.6	9.1990	39.72	2.455644	97.544342	0.838476
26.5	7.7	9.1990	31.55	3.071935	96.928055	0.670261
26.5	7.8	9.1990	25.06	3.836813	96.163177	0.536643
26.5	7.9	9.1990	19.91	4.782745	95.217255	0.430506
26.5	8.0	9.1990	15.81	5.947464	94.052536	0.346198
26.5	8.1	9.1990	12.56	7.373846	92.626144	0.279230
26.5	8.2	9.1990	9.98	9.109190	90.890808	0.226035
26.5	8.3	9.1990	7.93	11.203529	88.796463	0.183781
26.5	8.4	9.1990	6.30	13.706773	86.293213	0.150218
26.5	8.5	9.1990	5.00	16.664352	83.335648	0.123557
26.5	8.6	9.1990	3.97	20.111389	79.888611	0.102380
26.5	8.7	9.1990	3.16	24.065536	75.934464	0.085558
26.5	8.8	9.1990	2.51	28.519577	71.480423	0.072196
26.5	8.9	9.1990	1.99	33.434999	66.565002	0.061582
26.5	9.0	9.1990	1.58	38.738480	61.261520	0.053151
26.5	9.1	9.1990	1.26	44.323044	55.676956	0.046454
26.5	9.2	9.1990	1.00	50.054910	49.945084	0.041135
26.5	9.3	9.1990	0.79	55.785309	44.214691	0.036909
26.5	9.4	9.1990	0.63	61.365692	38.634308	0.033553
26.5	9.5	9.1990	0.50	66.662674	33.337326	0.030887
26.5	9.6	9.1990	0.40	71.569870	28.430130	0.028769
26.5	9.7	9.1990	0.32	76.014664	23.985336	0.027087
26.5	9.8	9.1990	0.25	79.959122	20.040878	0.025751
26.5	9.9	9.1990	0.20	83.396561	16.603439	0.024689
26.5	10.0	9.1990	0.16	86.345108	13.654892	0.023846
26.5	10.1	9.1990	0.13	88.840073	11.159927	0.023176

** CONCENTRATIONS OF AMMONIA(NH4+NH3) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH3-N

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TEMP C	PH	PKA	RATIO	% UNIONIZED AMMONIA	% IONIZED AMMONIA	CONCENTRATION NH4+NH3 **
27.0	5.0	9.1839	15270.39	0.006548	99.993439	314.437744
27.0	5.1	9.1839	12129.72	0.008244	99.991745	249.771591
27.0	5.2	9.1839	9634.99	0.010375	99.989609	198.405075
27.0	5.3	9.1839	7653.36	0.013054	99.986923	157.603165
27.0	5.4	9.1839	6079.29	0.016447	99.983551	125.193024
27.0	5.5	9.1839	4828.96	0.020704	99.979294	99.444807
27.0	5.6	9.1839	3835.78	0.026064	99.973923	78.999344
27.0	5.7	9.1839	3046.87	0.032810	99.967178	62.755722
27.0	5.8	9.1839	2420.22	0.041301	99.958694	49.452905
27.0	5.9	9.1839	1922.45	0.051990	99.947998	39.603451
27.0	6.0	9.1839	1527.06	0.065442	99.934555	31.462753
27.0	6.1	9.1839	1212.99	0.082373	99.917618	24.996017
27.0	6.2	9.1839	963.51	0.103679	99.896317	19.859314
27.0	6.3	9.1839	765.35	0.130489	99.869507	15.779072
27.0	6.4	9.1839	607.94	0.164221	99.835770	12.538010
27.0	6.5	9.1839	482.90	0.206653	99.793335	9.963548
27.0	6.6	9.1839	383.58	0.260022	99.739975	7.918560
27.0	6.7	9.1839	304.69	0.327127	99.672867	6.294185
27.0	6.8	9.1839	242.03	0.411480	99.588516	5.003891
27.0	6.9	9.1839	192.25	0.517470	99.482529	3.978972
27.0	7.0	9.1839	152.71	0.650584	99.349411	3.164849
27.0	7.1	9.1839	121.30	0.817658	99.182343	2.518167
27.0	7.2	9.1839	96.35	1.027194	98.972794	2.004489
27.0	7.3	9.1839	76.54	1.289723	98.710266	1.596459
27.0	7.4	9.1839	60.79	1.618265	98.381729	1.272349
27.0	7.5	9.1839	48.29	2.028773	97.971222	1.014898
27.0	7.6	9.1839	38.36	2.540725	97.459274	0.810399
27.0	7.7	9.1839	30.47	3.177673	96.822327	0.647958
27.0	7.8	9.1839	24.20	3.967802	96.032196	0.518927
27.0	7.9	9.1839	19.23	4.944363	95.055634	0.416434
27.0	8.0	9.1839	15.27	6.145899	93.854095	0.335020
27.0	8.1	9.1839	12.13	7.616018	92.383972	0.270351
27.0	8.2	9.1839	9.64	9.402570	90.597427	0.218983
27.0	8.3	9.1839	7.65	11.555795	88.444199	0.178179
27.0	8.4	9.1839	6.08	14.125226	85.874771	0.145768
27.0	8.5	9.1839	4.83	17.155151	82.844849	0.120022
27.0	8.6	9.1839	3.84	20.678513	79.321487	0.099572
27.0	8.7	9.1839	3.05	24.709671	75.290329	0.083328
27.0	8.8	9.1839	2.42	29.237015	70.762985	0.070424
27.0	8.9	9.1839	1.92	34.216904	65.783096	0.060175
27.0	9.0	9.1839	1.53	39.570679	60.429321	0.052933
27.0	9.1	9.1839	1.21	45.146737	54.813263	0.045566
27.0	9.2	9.1839	0.96	50.928110	49.071884	0.040430
27.0	9.3	9.1839	0.77	56.645111	43.354889	0.036349
27.0	9.4	9.1839	0.61	62.190536	37.809464	0.033108
27.0	9.5	9.1839	0.48	67.434443	32.565552	0.030533
27.0	9.6	9.1839	0.38	72.275299	27.724701	0.028488
27.0	9.7	9.1839	0.30	76.645752	23.354248	0.026864
27.0	9.8	9.1839	0.24	80.513031	19.486969	0.025573
27.0	9.9	9.1839	0.19	83.874603	16.125397	0.024549
27.0	10.0	9.1839	0.15	86.751801	13.248199	0.023734
27.0	10.1	9.1839	0.12	89.181763	10.818237	0.023088

** CONCENTRATIONS OF AMMONIA(NH4+NH3) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH3-N

TEMP C	PH	PKA	RATIO	% UNIONIZED AMMONIA	% IONIZED AMMONIA	CONCENTRATION NH4+NH3 **
27.5	5.0	9.1687	14747.86	0.006780	99.993210	303.678955
27.5	5.1	9.1687	11714.64	0.008535	99.991465	241.225143
27.5	5.2	9.1687	9305.29	0.010745	99.989243	191.616440
27.5	5.3	9.1687	7391.46	0.013527	99.986465	152.210400
27.5	5.4	9.1687	5871.26	0.017029	99.982971	120.409775
27.5	5.5	9.1687	4661.71	0.021438	99.978561	96.046387
27.5	5.6	9.1687	3704.52	0.026987	99.973007	76.296722
27.5	5.7	9.1687	2942.61	0.033972	99.966019	60.608963
27.5	5.8	9.1687	2337.40	0.042764	99.957230	48.147720
27.5	5.9	9.1687	1856.67	0.053831	99.946167	38.249374
27.5	6.0	9.1687	1474.80	0.067760	99.932236	30.366810
27.5	6.1	9.1687	1171.48	0.085289	99.914703	24.141373
27.5	6.2	9.1687	930.54	0.107349	99.892639	19.180435
27.5	6.3	9.1687	739.16	0.135107	99.864883	15.239822
27.5	6.4	9.1687	587.13	0.170029	99.829971	12.109673
27.5	6.5	9.1687	466.38	0.213950	99.786026	9.623306
27.5	6.6	9.1687	370.46	0.269210	99.730789	7.648307
27.5	6.7	9.1687	294.27	0.338678	99.661316	6.079514
27.5	6.8	9.1687	233.74	0.425997	99.573990	4.833365
27.5	6.9	9.1687	185.67	0.535707	99.464279	3.843518
27.5	7.0	9.1687	147.48	0.673480	99.326508	3.057255
27.5	7.1	9.1687	117.15	0.846384	99.153610	2.432702
27.5	7.2	9.1687	93.06	1.063202	98.936798	1.936603
27.5	7.3	9.1687	73.92	1.334815	98.665176	1.542534
27.5	7.4	9.1687	58.71	1.674644	98.325348	1.229515
27.5	7.5	9.1687	46.64	2.094146	97.900844	0.980875
27.5	7.6	9.1687	37.05	2.628379	97.371613	0.783372
27.5	7.7	9.1687	29.43	3.286564	96.713425	0.626490
27.5	7.8	9.1687	23.37	4.102623	95.897369	0.501874
27.5	7.9	9.1687	18.57	5.110600	94.889389	0.402888
27.5	8.0	9.1687	14.75	6.349829	93.650162	0.324261
27.5	8.1	9.1687	11.72	7.864645	92.135345	0.261805
27.5	8.2	9.1687	9.31	9.703393	90.296600	0.212194
27.5	8.3	9.1687	7.39	11.916437	88.083557	0.172786
27.5	8.4	9.1687	5.87	14.552863	85.447128	0.141484
27.5	8.5	9.1687	4.66	17.655670	82.344330	0.116620
27.5	8.6	9.1687	3.70	21.255447	78.744553	0.096869
27.5	8.7	9.1687	2.94	25.363129	74.636871	0.081181
27.5	8.8	9.1687	2.34	29.962555	70.037445	0.068719
27.5	8.9	9.1687	1.86	35.004883	64.995117	0.058820
27.5	9.0	9.1687	1.47	40.406219	59.593781	0.050958
27.5	9.1	9.1687	1.17	46.050476	53.949524	0.044712
27.5	9.2	9.1687	0.93	51.797897	48.202103	0.039751
27.5	9.3	9.1687	0.74	57.498138	42.501862	0.035810
27.5	9.4	9.1687	0.59	63.005722	36.994278	0.032680
27.5	9.5	9.1687	0.47	68.194382	31.805618	0.030193
27.5	9.6	9.1687	0.37	72.967560	27.032440	0.028218
27.5	9.7	9.1687	0.29	77.263199	22.736801	0.026649
27.5	9.8	9.1687	0.23	81.053482	18.946518	0.025403
27.5	9.9	9.1687	0.19	84.340027	15.659973	0.024413
27.5	10.0	9.1687	0.15	87.146835	12.853165	0.023627
27.5	10.1	9.1687	0.12	89.513153	10.486847	0.023002

** CONCENTRATIONS OF AMMONIA(NH4+NH3) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH3-N

TEMP C	PH	PKA	RATIO	% UNIONIZED AMMONIA	% IONIZED AMMONIA	CONCENTRATION NH4+NH3 **
28.0	5.0	9.1537	14244.64	0.007020	99.992981	293.322510
28.0	5.1	9.1537	11315.12	0.008837	99.991150	232.999039
28.0	5.2	9.1537	8947.94	0.011125	99.988875	185.082245
28.0	5.3	9.1537	7139.38	0.014005	99.985992	147.070432
28.0	5.4	9.1537	5671.02	0.017630	99.982361	116.786357
28.0	5.5	9.1537	4504.66	0.022194	99.977798	92.771545
28.0	5.6	9.1537	3578.18	0.027934	99.972061	73.695313
28.0	5.7	9.1537	2842.25	0.035171	99.964828	58.542587
28.0	5.8	9.1537	2257.69	0.044274	99.955719	46.506332
28.0	5.9	9.1537	1793.35	0.055731	99.944260	36.945572
28.0	6.0	9.1537	1424.51	0.070150	99.929840	29.351196
28.0	6.1	9.1537	1131.53	0.088298	99.911697	23.318741
28.0	6.2	9.1537	898.81	0.111135	99.888855	18.527008
28.0	6.3	9.1537	713.95	0.139870	99.860123	14.726785
28.0	6.4	9.1537	567.11	0.176022	99.823975	11.697370
28.0	6.5	9.1537	450.47	0.221494	99.778488	9.245797
28.0	6.6	9.1537	357.82	0.278684	99.721298	7.388163
28.0	6.7	9.1537	284.23	0.350595	99.649399	5.872859
28.0	6.8	9.1537	225.77	0.440972	99.559021	4.669229
28.0	6.9	9.1537	179.34	0.554517	99.445480	3.713140
28.0	7.0	9.1537	142.45	0.697094	99.302902	2.953691
28.0	7.1	9.1537	113.15	0.876007	99.123993	2.350438
28.0	7.2	9.1537	89.88	1.100324	98.899658	1.871257
28.0	7.3	9.1537	71.40	1.381295	98.618694	1.490628
28.0	7.4	9.1537	56.71	1.732750	98.267242	1.188284
28.0	7.5	9.1537	45.05	2.171657	97.828339	0.948124
28.0	7.6	9.1537	35.78	2.718662	97.281326	0.757357
28.0	7.7	9.1537	28.42	3.398664	96.601334	0.605826
28.0	7.8	9.1537	22.58	4.241334	95.758652	0.485460
28.0	7.9	9.1537	17.93	5.281515	94.718475	0.389850
28.0	8.0	9.1537	14.25	6.559325	93.440674	0.313904
28.0	8.1	9.1537	11.32	8.119794	91.880203	0.253578
28.0	8.2	9.1537	8.99	10.011713	89.988281	0.205659
28.0	8.3	9.1537	7.14	12.285509	87.714478	0.167596
28.0	8.4	9.1537	5.67	14.984691	85.010300	0.137361
28.0	8.5	9.1537	4.50	18.165817	81.834183	0.113345
28.0	8.6	9.1537	3.58	21.842026	78.157974	0.094268
28.0	8.7	9.1537	2.84	26.025587	73.974411	0.079114
28.0	8.8	9.1537	2.26	30.695755	69.304245	0.067078
28.0	8.9	9.1537	1.79	35.798401	64.201599	0.057517
28.0	9.0	9.1537	1.42	41.244476	58.755524	0.049922
28.0	9.1	9.1537	1.13	46.913665	53.086334	0.043889
28.0	9.2	9.1537	0.90	52.663651	47.336349	0.039097
28.0	9.3	9.1537	0.71	58.343842	41.656158	0.035291
28.0	9.4	9.1537	0.57	63.810791	36.189209	0.032267
28.0	9.5	9.1537	0.45	68.942215	31.057785	0.029866
28.0	9.6	9.1537	0.36	73.646500	26.353500	0.027958
28.0	9.7	9.1537	0.28	77.867020	22.132980	0.026443
28.0	9.8	9.1537	0.23	81.580673	18.419327	0.025239
28.0	9.9	9.1537	0.18	84.792877	15.207123	0.024283
28.0	10.0	9.1537	0.14	87.530563	12.469437	0.023523
28.0	10.1	9.1537	0.11	89.834488	10.165512	0.022920

** CONCENTRATIONS OF AMMONIA(NH4+NH3) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH3-N

TEMP C	PH	PKA	RATIO	% UNIONIZED AMMONIA	% IONIZED AMMONIA	CONCENTRATION NH ₄ +NH ₃ **
28.5	5.0	9.1386	13760.60	0.007267	99.992722	283.351318
28.5	5.1	9.1386	10930.45	0.009144	99.990845	225.074583
28.5	5.2	9.1386	8682.34	0.011516	99.988480	178.790756
28.5	5.3	9.1386	6896.67	0.014494	99.985489	142.022468
28.5	5.4	9.1386	5478.23	0.018251	99.981735	112.417276
28.5	5.5	9.1386	4351.52	0.022975	99.977020	89.618301
28.5	5.6	9.1386	3456.53	0.028922	99.971069	71.190613
28.5	5.7	9.1386	2745.63	0.036404	99.963593	56.553040
28.5	5.8	9.1386	2180.93	0.045831	99.954163	44.925980
28.5	5.9	9.1386	1732.38	0.057691	99.942307	35.690247
28.5	6.0	9.1386	1376.08	0.072617	99.927383	28.354065
28.5	6.1	9.1386	1093.06	0.091403	99.908585	22.526688
28.5	6.2	9.1386	868.25	0.115042	99.884949	17.497842
28.5	6.3	9.1386	689.64	0.144786	99.855209	14.221025
28.5	6.4	9.1386	547.83	0.182206	99.817795	11.300397
28.5	6.5	9.1386	435.16	0.229275	99.770721	8.986476
28.5	6.6	9.1386	345.66	0.289469	99.711517	7.137691
28.5	6.7	9.1386	274.57	0.362889	99.637100	5.673912
28.5	6.8	9.1386	218.10	0.456420	99.543579	4.511190
28.5	6.9	9.1386	173.24	0.573920	99.426071	3.587605
28.5	7.0	9.1386	137.61	0.721450	99.278549	2.853975
28.5	7.1	9.1386	109.31	0.906556	99.093430	2.271232
28.5	7.2	9.1386	86.83	1.138612	98.861374	1.804342
28.5	7.3	9.1386	68.97	1.429214	98.570786	1.440652
28.5	7.4	9.1386	54.78	1.792637	98.207352	1.148586
28.5	7.5	9.1386	43.52	2.246367	97.753632	0.916591
28.5	7.6	9.1386	34.57	2.811650	97.188339	0.732310
28.5	7.7	9.1386	27.46	3.514070	96.485916	0.585930
28.5	7.8	9.1386	21.81	4.384057	95.615936	0.469656
28.5	7.9	9.1386	17.32	5.457245	94.542755	0.377297
28.5	8.0	9.1386	13.76	6.774529	93.225464	0.303932
28.5	8.1	9.1386	10.93	8.381602	91.618393	0.245657
28.5	8.2	9.1386	8.68	10.327665	89.672333	0.199367
28.5	8.3	9.1386	6.90	12.663119	87.336888	0.162598
28.5	8.4	9.1386	5.48	15.435796	84.564194	0.133391
28.5	8.5	9.1386	4.35	18.685669	81.314331	0.110191
28.5	8.6	9.1386	3.46	22.438232	77.561768	0.091763
28.5	8.7	9.1386	2.75	26.696976	73.303024	0.077125
28.5	8.8	9.1386	2.19	31.436417	68.563583	0.065497
28.5	8.9	9.1386	1.73	36.597183	63.402817	0.056261
28.5	9.0	9.1386	1.38	42.045129	57.914871	0.048925
28.5	9.1	9.1386	1.09	47.775894	52.224106	0.043097
28.5	9.2	9.1386	0.87	53.525009	46.474991	0.038468
28.5	9.3	9.1386	0.69	59.181961	40.818039	0.034791
28.5	9.4	9.1386	0.55	64.605637	35.394363	0.031870
28.5	9.5	9.1386	0.44	69.677902	30.322098	0.029550
28.5	9.6	9.1386	0.35	74.312271	25.687729	0.027707
28.5	9.7	9.1386	0.27	78.457321	21.542679	0.026244
28.5	9.8	9.1386	0.22	82.044757	17.955243	0.025081
28.5	9.9	9.1386	0.17	85.233505	14.766495	0.024157
28.5	10.0	9.1386	0.14	87.903183	12.096817	0.023423
28.5	10.1	9.1386	0.11	90.145950	9.854050	0.022841

** CONCENTRATIONS OF AMMONIA(NH₄+NH₃) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH₃-N

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TEMP C	PH	PKA	RATIO	% UNIONIZED AMMONIA	% IONIZED AMMONIA	CONCENTRATION NH4+NH3 **
29.0	5.0	9.1237	13294.34	0.007521	99.992477	273.750732
29.0	5.1	9.1237	10560.04	0.009469	99.990524	217.452713
29.0	5.2	9.1237	8388.18	0.011920	99.988068	172.733307
29.0	5.3	9.1237	6662.93	0.015005	99.984935	137.211319
29.0	5.4	9.1237	5292.60	0.018891	99.981110	108.445239
29.0	5.5	9.1237	4204.07	0.023781	99.976212	86.442397
29.0	5.6	9.1237	3339.41	0.029930	99.970062	68.779099
29.0	5.7	9.1237	2652.59	0.037687	99.962311	54.537482
29.0	5.8	9.1237	2107.03	0.047438	99.952560	43.464388
29.0	5.9	9.1237	1673.68	0.059713	99.940277	34.481613
29.0	6.0	9.1237	1329.45	0.075162	99.924835	27.393997
29.0	6.1	9.1237	1056.02	0.094605	99.905396	21.744099
29.0	6.2	9.1237	838.83	0.119072	99.880920	17.292084
29.0	6.3	9.1237	666.31	0.149855	99.850143	13.739854
29.0	6.4	9.1237	529.27	0.188584	99.811417	10.918205
29.0	6.5	9.1237	420.41	0.237297	99.762695	8.676980
29.0	6.6	9.1237	333.95	0.293550	99.701431	6.896531
29.0	6.7	9.1237	265.26	0.375567	99.624420	5.442353
29.0	6.8	9.1237	210.71	0.472353	99.527634	4.359031
29.0	6.9	9.1237	167.37	0.593929	99.406067	3.466741
29.0	7.0	9.1237	132.95	0.746564	99.253433	2.757969
29.0	7.1	9.1237	105.60	0.938053	99.061935	2.194970
29.0	7.2	9.1237	83.88	1.178076	98.821915	1.747765
29.0	7.3	9.1237	66.63	1.478599	98.521393	1.392534
29.0	7.4	9.1237	52.93	1.854343	98.145645	1.110366
29.0	7.5	9.1237	42.04	2.323322	97.676666	0.886231
29.0	7.6	9.1237	33.40	2.907334	97.092606	0.708194
29.0	7.7	9.1237	26.53	3.632839	96.367157	0.566774
29.0	7.8	9.1237	21.07	4.530850	95.469147	0.454440
29.0	7.9	9.1237	16.74	5.537854	94.462137	0.365210
29.0	8.0	9.1237	13.29	6.945503	93.054486	0.294332
29.0	8.1	9.1237	10.56	8.650134	91.349854	0.238031
29.0	8.2	9.1237	8.39	10.651302	89.348694	0.193310
29.0	8.3	9.1237	6.66	13.049294	86.950699	0.157786
29.0	8.4	9.1237	5.29	15.891130	84.108856	0.129569
29.0	8.5	9.1237	4.20	19.215103	80.784897	0.107155
29.0	8.6	9.1237	3.34	23.043854	76.956146	0.084351
29.0	8.7	9.1237	2.65	27.376968	72.623032	0.075209
29.0	8.8	9.1237	2.11	32.174124	67.815872	0.063976
29.0	8.9	9.1237	1.67	37.400681	62.599319	0.055052
29.0	9.0	9.1237	1.33	42.927536	57.072464	0.047965
29.0	9.1	9.1237	1.06	48.636551	51.363449	0.042334
29.0	9.2	9.1237	0.84	54.381378	45.618622	0.037862
29.0	9.3	9.1237	0.67	60.011963	39.988037	0.034310
29.0	9.4	9.1237	0.53	65.389893	34.610107	0.031488
29.0	9.5	9.1237	0.42	70.401245	29.598755	0.029247
29.0	9.6	9.1237	0.33	74.964783	25.035217	0.027466
29.0	9.7	9.1237	0.27	79.034256	20.965744	0.026052
29.0	9.8	9.1237	0.21	82.595856	17.404144	0.024929
29.0	9.9	9.1237	0.17	85.662155	14.337845	0.024036
29.0	10.0	9.1237	0.13	88.264999	11.735001	0.023327
29.0	10.1	9.1237	0.11	90.447968	9.552032	0.022764

** CONCENTRATIONS OF AMMONIA(NH4+NH3) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH3-N

TEMP C	PH	PKA	RATIO	% UNIONIZED AMMONIA	% IONIZED AMMONIA	CONCENTRATION NH4+NH3 **
29.5	5.0	9.1087	12845.34	0.007784	99.992203	264.505859
29.5	5.1	9.1087	10203.43	0.009800	99.990189	210.104222
29.5	5.2	9.1087	8104.88	0.012337	99.987656	166.900146
29.5	5.3	9.1087	6437.95	0.015530	99.984467	132.577596
29.5	5.4	9.1087	5113.85	0.019551	99.980438	105.314636
29.5	5.5	9.1087	4062.08	0.024612	99.975388	83.658783
29.5	5.6	9.1087	3225.63	0.030982	99.969009	66.456463
29.5	5.7	9.1087	2563.01	0.039001	99.960999	52.792877
29.5	5.8	9.1087	2035.87	0.049095	99.950897	41.939163
29.5	5.9	9.1087	1617.15	0.061799	99.938202	33.317749
29.5	6.0	9.1087	1284.55	0.077788	99.922211	26.469513
29.5	6.1	9.1087	1020.36	0.097909	99.902084	21.029739
29.5	6.2	9.1087	810.50	0.123229	99.876770	16.704771
29.5	6.3	9.1087	643.80	0.155085	99.844910	13.276493
29.5	6.4	9.1087	511.39	0.195163	99.804825	10.550147
29.5	6.5	9.1087	406.21	0.246571	99.754425	8.384520
29.5	6.6	9.1087	322.67	0.308959	99.691040	6.664306
29.5	6.7	9.1087	256.30	0.388645	99.611343	5.297894
29.5	6.8	9.1087	203.59	0.488783	99.511215	4.212506
29.5	6.9	9.1087	161.72	0.614562	99.385437	3.350351
29.5	7.0	9.1087	128.46	0.772454	99.227539	2.665518
29.5	7.1	9.1087	102.04	0.970525	99.029465	2.121531
29.5	7.2	9.1087	81.05	1.218754	98.781235	1.689430
29.5	7.3	9.1087	64.38	1.529491	98.470505	1.346198
29.5	7.4	9.1087	51.14	1.917917	98.082077	1.073560
29.5	7.5	9.1087	40.62	2.402580	97.597412	0.856995
29.5	7.6	9.1087	32.27	3.005965	96.994034	0.684971
29.5	7.7	9.1087	25.63	3.755054	96.244934	0.548727
29.5	7.8	9.1087	20.36	4.681803	95.318192	0.439787
29.5	7.9	9.1087	16.17	5.823449	94.176544	0.353570
29.5	8.0	9.1087	12.85	7.222376	92.777618	0.285086
29.5	8.1	9.1087	10.20	8.925503	91.074478	0.230487
29.5	8.2	9.1087	8.11	10.982720	89.017273	0.187476
29.5	8.3	9.1087	6.44	13.444097	86.555893	0.153153
29.5	8.4	9.1087	5.11	16.355743	83.644257	0.125888
29.5	8.5	9.1087	4.06	19.754059	80.245941	0.104232
29.5	8.6	9.1087	3.23	23.658768	76.341232	0.087029
29.5	8.7	9.1087	2.56	28.065338	71.934662	0.073364
29.5	8.8	9.1087	2.04	32.938553	67.061447	0.062510
29.5	8.9	9.1087	1.62	38.208481	61.791519	0.053889
29.5	9.0	9.1087	1.28	43.771255	56.228745	0.047040
29.5	9.1	9.1087	1.02	49.445163	50.554837	0.041600
29.5	9.2	9.1087	0.81	55.232361	44.767639	0.037279
29.5	9.3	9.1087	0.64	60.833557	39.166443	0.033846
29.5	9.4	9.1087	0.51	66.163269	33.836731	0.031120
29.5	9.5	9.1087	0.41	71.112122	28.887878	0.028954
29.5	9.6	9.1087	0.32	75.604034	24.395966	0.027234
29.5	9.7	9.1087	0.26	79.597916	20.402084	0.025868
29.5	9.8	9.1087	0.20	83.084213	16.915787	0.024782
29.5	9.9	9.1087	0.16	86.078949	13.921051	0.023920
29.5	10.0	9.1087	0.13	88.616196	11.383804	0.023235
29.5	10.1	9.1087	0.10	90.740692	9.259308	0.022691

** CONCENTRATIONS OF AMMONIA(NH4+NH3) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH3-N

TEMP C	PH	PKA	RATIO	% UNIONIZED AMMONIA	% IONIZED AMMONIA	CONCENTRATION NH ₄ ⁺ ·NH ₃ **
30.0	5.0	9.0939	12412.89	0.008055	99.991943	255.602066
30.0	5.1	9.0939	9859.93	0.010141	99.989859	203.036499
30.0	5.2	9.0939	7832.03	0.012766	99.987234	161.281967
30.0	5.3	9.0939	6221.21	0.016071	99.983929	128.115265
30.0	5.4	9.0939	4941.69	0.020232	99.979767	101.770020
30.0	5.5	9.0939	3925.33	0.025469	99.974531	80.843124
30.0	5.6	9.0939	3118.00	0.032062	99.967938	64.220230
30.0	5.7	9.0939	2476.72	0.040360	99.959640	51.016251
30.0	5.8	9.0939	1967.33	0.050804	99.949196	40.527939
30.0	5.9	9.0939	1562.71	0.063950	99.936050	32.196777
30.0	6.0	9.0939	1241.31	0.080495	99.919495	25.579086
30.0	6.1	9.0939	986.01	0.101315	99.898685	20.322449
30.0	6.2	9.0939	783.21	0.127516	99.872484	16.146957
30.0	6.3	9.0939	622.13	0.160480	99.839520	12.830239
30.0	6.4	9.0939	494.18	0.201949	99.798051	10.195661
30.0	6.5	9.0939	392.54	0.254105	99.745895	8.102947
30.0	6.6	9.0939	311.80	0.319688	99.680312	6.440639
30.0	6.7	9.0939	247.68	0.402130	99.597870	5.120228
30.0	6.8	9.0939	196.74	0.505725	99.494275	4.071383
30.0	6.9	9.0939	156.27	0.635877	99.364123	3.238253
30.0	7.0	9.0939	124.13	0.799154	99.200846	2.576474
30.0	7.1	9.0939	98.60	1.003996	98.996004	2.050805
30.0	7.2	9.0939	78.32	1.260677	98.739323	1.633248
30.0	7.3	9.0939	62.21	1.581934	98.418066	1.301571
30.0	7.4	9.0939	49.42	1.983410	98.016590	1.038111
30.0	7.5	9.0939	39.25	2.484203	97.515797	0.828837
30.0	7.6	9.0939	31.18	3.107433	96.892567	0.662604
30.0	7.7	9.0939	24.77	3.850797	96.149203	0.530561
30.0	7.8	9.0939	19.67	4.837026	95.162974	0.425675
30.0	7.9	9.0939	15.63	6.014127	93.985873	0.342361
30.0	8.0	9.0939	12.41	7.455229	92.544771	0.276182
30.0	8.1	9.0939	9.86	9.207829	90.792171	0.223614
30.0	8.2	9.0939	7.83	11.322022	88.677978	0.181858
30.0	8.3	9.0939	6.22	13.847612	86.152388	0.148690
30.0	8.4	9.0939	4.94	16.829651	83.170349	0.122344
30.0	8.5	9.0939	3.93	20.302551	79.697449	0.101416
30.0	8.6	9.0939	3.12	24.282852	75.717148	0.084792
30.0	8.7	9.0939	2.48	28.741871	71.258129	0.071588
30.0	8.8	9.0939	1.97	33.699371	66.300629	0.061099
30.0	8.9	9.0939	1.56	39.020203	60.979797	0.052768
30.0	9.0	9.0939	1.24	44.615799	55.384201	0.046150
30.0	9.1	9.0939	0.99	50.351303	49.648697	0.040893
30.0	9.2	9.0939	0.78	56.077530	43.922470	0.036717
30.0	9.3	9.0939	0.62	61.646408	38.353592	0.033400
30.0	9.4	9.0939	0.49	66.925613	33.074387	0.030765
30.0	9.5	9.0939	0.39	71.810480	28.189520	0.028673
30.0	9.6	9.0939	0.31	76.230133	23.769867	0.027010
30.0	9.7	9.0939	0.25	80.148407	19.851593	0.025690
30.0	9.8	9.0939	0.20	83.560059	16.439941	0.024641
30.0	9.9	9.0939	0.16	86.484268	13.515732	0.023808
30.0	10.0	9.0939	0.12	88.957123	11.042877	0.023146
30.0	10.1	9.0939	0.10	91.024506	8.975494	0.022620

** CONCENTRATIONS OF AMMONIA(NH₄⁺·NH₃) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH₃-N

A-64

TEMP C	PH	PKA	RATIO	% UNIONIZED AMMONIA	% IONIZED AMMONIA	CONCENTRATION NH ₄ +NH ₃ **
30.5	5.0	9.0791	11396.37	0.008335	99.991653	247.025955
30.5	5.1	9.0791	9529.07	0.010493	99.989502	196.224213
30.5	5.2	9.0791	7569.22	0.013210	99.986786	155.870911
30.5	5.3	9.0791	6012.46	0.016629	99.983368	123.817062
30.5	5.4	9.0791	4775.87	0.020934	99.979065	98.355774
30.5	5.5	9.0791	3793.61	0.026353	99.973633	78.131027
30.5	5.6	9.0791	3013.38	0.033174	99.966812	62.066010
30.5	5.7	9.0791	2393.61	0.041760	99.958237	49.305084
30.5	5.8	9.0791	1901.32	0.052567	99.947433	39.168716
30.5	5.9	9.0791	1510.27	0.066169	99.933823	31.117096
30.5	6.0	9.0791	1199.65	0.083288	99.916702	24.721466
30.5	6.1	9.0791	952.92	0.104831	99.895157	19.641220
30.5	6.2	9.0791	756.93	0.131938	99.868057	15.605837
30.5	6.3	9.0791	601.25	0.166043	99.833954	12.400406
30.5	6.4	9.0791	477.59	0.208946	99.791046	9.854233
30.5	6.5	9.0791	379.37	0.262905	99.737091	7.831740
30.5	6.6	9.0791	301.34	0.330751	99.669235	6.225217
30.5	6.7	9.0791	239.36	0.416034	99.583954	4.949108
30.5	6.8	9.0791	190.13	0.523192	99.476807	3.935456
30.5	6.9	9.0791	151.03	0.657768	99.342224	3.130284
30.5	7.0	9.0791	119.97	0.826671	99.173325	2.440711
30.5	7.1	9.0791	95.29	1.038492	98.961502	1.982681
30.5	7.2	9.0791	75.69	1.303879	98.696121	1.579134
30.5	7.3	9.0791	60.13	1.635961	98.364029	1.258587
30.5	7.4	9.0791	47.76	2.050861	97.949127	1.003968
30.5	7.5	9.0791	37.94	2.568241	97.431747	0.801716
30.5	7.6	9.0791	30.13	3.211861	96.788132	0.641061
30.5	7.7	9.0791	23.94	4.010138	95.989853	0.513449
30.5	7.8	9.0791	19.01	4.996576	95.003418	0.412082
30.5	7.9	9.0791	15.10	6.209970	93.790024	0.331564
30.5	8.0	9.0791	12.00	7.694166	92.305832	0.267605
30.5	8.1	9.0791	9.53	9.497165	90.502823	0.216802
30.5	8.2	9.0791	7.57	11.669252	88.330734	0.176447
30.5	8.3	9.0791	6.01	14.259844	85.740143	0.144331
30.5	8.4	9.0791	4.78	17.312820	82.687180	0.118929
30.5	8.5	9.0791	3.79	20.860413	79.139587	0.098704
30.5	8.6	9.0791	3.01	24.915894	75.084106	0.082638
30.5	8.7	9.0791	2.39	29.466248	70.533752	0.069876
30.5	8.8	9.0791	1.90	34.466156	65.533844	0.059740
30.5	8.9	9.0791	1.51	39.835312	60.164688	0.051688
30.5	9.0	9.0791	1.20	45.460678	54.539322	0.045292
30.5	9.1	9.0791	0.95	51.204345	48.795654	0.040211
30.5	9.2	9.0791	0.76	56.916367	43.083633	0.036176
30.5	9.3	9.0791	0.60	62.450104	37.549896	0.032970
30.5	9.4	9.0791	0.48	67.676727	32.323273	0.030424
30.5	9.5	9.0791	0.38	72.496216	27.503784	0.028401
30.5	9.6	9.0791	0.30	76.843018	23.156982	0.026795
30.5	9.7	9.0791	0.24	80.685883	19.314117	0.025519
30.5	9.8	9.0791	0.19	84.023605	15.976395	0.024505
30.5	9.9	9.0791	0.15	86.878296	13.121704	0.023700
30.5	10.0	9.0791	0.12	89.287994	10.712006	0.023060
30.5	10.1	9.0791	0.10	91.299438	8.700562	0.022552

** CONCENTRATIONS OF AMMONIA(NH₄+NH₃) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH₃-N

A-65

TEMP C	PH	PKA	RATIO	% UNIONIZED AMMONIA	% IONIZED AMMONIA	CONCENTRATION NH ₄ +NH ₃ **
31.0	5.0	9.0643	11545.11	0.008624	99.991364	238.763901
31.0	5.1	9.0643	9210.33	0.010855	99.989136	189.661301
31.0	5.2	9.0643	7316.04	0.013667	99.986328	150.657837
31.0	5.3	9.0643	5811.34	0.017205	99.982788	119.676102
31.0	5.4	9.0643	4616.12	0.021659	99.978333	95.066513
31.0	5.5	9.0643	3666.72	0.027265	99.972733	75.518387
31.0	5.6	9.0643	2912.58	0.034322	99.965668	59.900646
31.0	5.7	9.0643	2313.55	0.043205	99.956787	47.656570
31.0	5.8	9.0643	1837.72	0.054386	99.945602	37.854238
31.0	5.9	9.0643	1459.76	0.068454	99.931534	30.076450
31.0	6.0	9.0643	1159.53	0.086168	99.913818	23.895233
31.0	6.1	9.0643	921.05	0.108454	99.891541	18.944924
31.0	6.2	9.0643	731.61	0.136497	99.863495	15.044522
31.0	6.3	9.0643	581.14	0.171779	99.828217	11.946315
31.0	6.4	9.0643	461.62	0.216161	99.783829	9.525305
31.0	6.5	9.0643	366.68	0.271973	99.728012	7.570463
31.0	6.6	9.0643	291.26	0.342158	99.657837	6.017678
31.0	6.7	9.0643	231.36	0.430370	99.569626	4.784253
31.0	6.8	9.0643	183.77	0.541200	99.458786	3.804508
31.0	6.9	9.0643	145.98	0.680376	99.319611	3.026267
31.0	7.0	9.0643	115.95	0.855035	99.144958	2.408088
31.0	7.1	9.0643	92.11	1.074045	98.925949	1.917051
31.0	7.2	9.0643	73.16	1.348392	98.651596	1.527002
31.0	7.3	9.0643	58.11	1.691618	98.308380	1.217177
31.0	7.4	9.0643	46.16	2.120331	97.879669	0.971075
31.0	7.5	9.0643	36.67	2.654758	97.345230	0.775588
31.0	7.6	9.0643	29.13	3.319324	96.680664	0.620307
31.0	7.7	9.0643	23.14	4.143165	95.856827	0.496963
31.0	7.8	9.0643	18.38	5.160566	94.839432	0.398987
31.0	7.9	9.0643	14.60	6.411096	93.588898	0.321162
31.0	8.0	9.0643	11.60	7.939283	92.060699	0.259343
31.0	8.1	9.0643	9.21	9.793642	90.206345	0.210238
31.0	8.2	9.0643	7.32	12.024528	87.975464	0.171233
31.0	8.3	9.0643	5.81	14.680882	85.319107	0.140250
31.0	8.4	9.0643	4.62	17.805283	82.194717	0.115640
31.0	8.5	9.0643	3.67	21.427628	78.572372	0.096091
31.0	8.6	9.0643	2.91	25.557770	74.442230	0.080563
31.0	8.7	9.0643	2.31	30.178238	69.821762	0.066228
31.0	8.8	9.0643	1.84	35.238602	64.761398	0.054430
31.0	8.9	9.0643	1.46	40.653442	59.346558	0.050648
31.0	9.0	9.0643	1.16	46.305405	53.694595	0.044466
31.0	9.1	9.0643	0.92	52.053955	47.946045	0.039555
31.0	9.2	9.0643	0.73	57.748596	42.251404	0.035655
31.0	9.3	9.0643	0.58	63.244446	36.755554	0.032556
31.0	9.4	9.0643	0.46	68.416458	31.583542	0.030095
31.0	9.5	9.0643	0.37	73.169388	26.830612	0.028140
31.0	9.6	9.0643	0.29	77.442886	22.557114	0.026587
31.0	9.7	9.0643	0.23	81.210541	18.789459	0.025354
31.0	9.8	9.0643	0.18	84.475037	15.524963	0.024374
31.0	9.9	9.0643	0.15	87.261337	12.738663	0.023596
31.0	10.0	9.0643	0.12	89.609085	10.390915	0.022978
31.0	10.1	9.0643	0.09	91.565887	8.434113	0.022487

** CONCENTRATIONS OF AMMONIA(NH₄+NH₃) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH₃-N

A-66

TEMP C	PH	PKA	RATIO	% UNIONIZED AMMONIA	% IONIZED AMMONIA	CONCENTRATION NH ₄ +NH ₃ **
31.5	5.0	9.0496	11208.54	0.008921	99.991074	230.404535
31.5	5.1	9.0496	8903.27	0.011231	99.988770	183.338428
31.5	5.2	9.0496	7072.13	0.014138	99.985855	145.635788
31.5	5.3	9.0496	5617.60	0.017794	99.982193	115.644981
31.5	5.4	9.0496	4462.22	0.022405	99.977595	91.897751
31.5	5.5	9.0496	3544.47	0.028205	99.971786	73.001312
31.5	5.6	9.0496	2815.48	0.035505	99.964493	57.941333
31.5	5.7	9.0496	2235.42	0.044694	99.955292	46.064451
31.5	5.8	9.0496	1776.45	0.056260	99.943726	36.597763
31.5	5.9	9.0496	1411.09	0.070817	99.929169	29.074905
31.5	6.0	9.0496	1120.87	0.089137	99.910858	23.099289
31.5	6.1	9.0496	890.34	0.112191	99.887802	18.352676
31.5	6.2	9.0496	707.22	0.141199	99.858795	14.582294
31.5	6.3	9.0496	561.77	0.177693	99.822296	11.587381
31.5	6.4	9.0496	446.23	0.223599	99.776398	9.208434
31.5	6.5	9.0496	354.45	0.281332	99.718658	7.318765
31.5	6.6	9.0496	281.55	0.353917	99.646072	5.817745
31.5	6.7	9.0496	223.64	0.445147	99.554840	4.625440
31.5	6.8	9.0496	177.65	0.559761	99.440231	3.678358
31.5	6.9	9.0496	141.11	0.703676	99.296310	2.926063
31.5	7.0	9.0496	112.09	0.884263	99.115723	2.328492
31.5	7.1	9.0496	89.04	1.110678	99.889313	1.853823
31.5	7.2	9.0496	70.72	1.394248	98.605743	1.476781
31.5	7.3	9.0496	56.18	1.748933	98.251053	1.177285
31.5	7.4	9.0496	44.62	2.191854	97.808136	0.939387
31.5	7.5	9.0496	35.45	2.743800	97.256180	0.750417
31.5	7.6	9.0496	28.16	3.429874	96.570114	0.600313
31.5	7.7	9.0496	22.36	4.279941	95.720047	0.481081
31.5	7.8	9.0496	17.77	5.329062	94.670929	0.386372
31.5	7.9	9.0496	14.11	6.617578	93.382416	0.311141
31.5	8.0	9.0496	11.21	8.190682	91.809311	0.251383
31.5	8.1	9.0496	8.90	10.097303	89.902695	0.203916
31.5	8.2	9.0496	7.07	12.387861	87.612137	0.166211
31.5	8.3	9.0496	5.62	15.110692	84.889297	0.135261
31.5	8.4	9.0496	4.46	18.306946	81.693054	0.112471
31.5	8.5	9.0496	3.54	22.004024	77.995972	0.093574
31.5	8.6	9.0496	2.82	26.208206	73.791794	0.078563
31.5	8.7	9.0496	2.24	30.897461	69.102539	0.066640
31.5	8.8	9.0496	1.78	36.016220	63.983780	0.057169
31.5	8.9	9.0496	1.41	41.474030	58.525970	0.049646
31.5	9.0	9.0496	1.12	47.149445	52.850555	0.043670
31.5	9.1	9.0496	0.89	52.899521	47.100479	0.038923
31.5	9.2	9.0496	0.71	58.573669	41.426331	0.035152
31.5	9.3	9.0496	0.56	64.029068	35.970932	0.032157
31.5	9.4	9.0496	0.45	69.144516	30.855484	0.029778
31.5	9.5	9.0496	0.35	73.829758	26.170242	0.027888
31.5	9.6	9.0496	0.28	78.029724	21.970276	0.026387
31.5	9.7	9.0496	0.22	81.722458	18.277542	0.025195
31.5	9.8	9.0496	0.18	84.914551	15.085449	0.024248
31.5	9.9	9.0496	0.14	87.633484	12.366516	0.023496
31.5	10.0	9.0496	0.11	89.920532	10.079468	0.022898
31.5	10.1	9.0496	0.09	91.824081	8.175919	0.022423

** CONCENTRATIONS OF AMMONIA(NH₄+NH₃) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH₃-N

TEMP C	PH	PKA	RATIO	% UNIONIZED AMMONIA	% IONIZED AMMONIA	CONCENTRATION NH ₄ +NH ₃ **
32.0	5.0	9.0349	10836.05	0.004225	99.995775	223.134995
32.0	5.1	9.0349	8607.39	0.011617	99.988383	177.246857
32.0	5.2	9.0349	6837.11	0.014624	99.985376	140.796661
32.0	5.3	9.0349	5430.91	0.018410	99.981590	111.843002
32.0	5.4	9.0349	4311.93	0.023175	99.976825	88.844482
32.0	5.5	9.0349	3426.68	0.029174	99.970826	70.575989
32.0	5.6	9.0349	2721.92	0.036725	99.963275	56.064819
32.0	5.7	9.0349	2162.10	0.046230	99.953766	44.538162
32.0	5.8	9.0349	1717.42	0.058193	99.941807	35.382202
32.0	5.9	9.0349	1364.20	0.073250	99.926750	28.109369
32.0	6.0	9.0349	1083.62	0.092198	99.907802	22.332321
32.0	6.1	9.0349	860.75	0.116043	99.883957	17.743454
32.0	6.2	9.0349	683.72	0.146045	99.853955	14.098370
32.0	6.3	9.0349	543.10	0.183790	99.816210	11.202991
32.0	6.4	9.0349	431.40	0.231268	99.768732	8.903098
32.0	6.5	9.0349	342.67	0.290974	99.709026	7.076227
32.0	6.6	9.0349	272.20	0.366038	99.633962	5.625092
32.0	6.7	9.0349	216.21	0.460378	99.539622	4.472409
32.0	6.8	9.0349	171.74	0.578891	99.421109	3.556801
32.0	6.9	9.0349	136.42	0.727689	99.272311	2.829506
32.0	7.0	9.0349	108.36	0.914383	99.085617	2.251792
32.0	7.1	9.0349	86.08	1.148418	98.851582	1.792900
32.0	7.2	9.0349	68.37	1.441484	98.558516	1.428388
32.0	7.3	9.0349	54.31	1.807971	98.192029	1.138845
32.0	7.4	9.0349	43.14	2.265492	97.734508	0.908853
32.0	7.5	9.0349	34.27	2.835447	97.164553	0.726163
32.0	7.6	9.0349	27.22	3.543597	96.456403	0.581048
32.0	7.7	9.0349	21.62	4.420560	95.579440	0.465778
32.0	7.8	9.0349	17.17	5.502172	94.497828	0.374216
32.0	7.9	9.0349	13.64	6.829521	93.170479	0.301485
32.0	8.0	9.0349	10.84	8.448449	91.551551	0.243713
32.0	8.1	9.0349	8.61	10.408270	89.591730	0.197823
32.0	8.2	9.0349	6.84	12.759358	87.240642	0.161372
32.0	8.3	9.0349	5.43	15.549354	84.450646	0.132417
32.0	8.4	9.0349	4.31	18.817810	81.182190	0.109418
32.0	8.5	9.0349	3.43	22.589554	77.410446	0.091148
32.0	8.6	9.0349	2.72	26.867065	73.132935	0.076637
32.0	8.7	9.0349	2.16	31.623672	68.376328	0.065109
32.0	8.8	9.0349	1.72	36.798676	63.201324	0.055953
32.0	8.9	9.0349	1.36	42.296677	57.703323	0.048680
32.0	9.0	9.0349	1.08	47.992355	52.007645	0.042903
32.0	9.1	9.0349	0.86	53.740707	46.259293	0.038314
32.0	9.2	9.0349	0.68	59.391327	40.608673	0.034668
32.0	9.3	9.0349	0.54	64.803757	35.196243	0.031773
32.0	9.4	9.0349	0.43	69.860855	30.139145	0.029473
32.0	9.5	9.0349	0.34	74.477533	25.522467	0.027646
32.0	9.6	9.0349	0.27	78.603592	21.396408	0.026195
32.0	9.7	9.0349	0.22	82.221909	17.778091	0.025042
32.0	9.8	9.0349	0.17	85.342361	14.657639	0.024126
32.0	9.9	9.0349	0.14	87.995087	12.004913	0.023399
32.0	10.0	9.0349	0.11	90.222748	9.777252	0.022821
32.0	10.1	9.0349	0.09	92.074280	7.925720	0.022362

** CONCENTRATIONS OF AMMONIA(NH₄+NH₃) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH₃-N

TEMP C	PH	PKA	RATIO	% UNIONIZED AMMONIA	% IONIZED AMMONIA	CONCENTRATION NH4+NH3 **
32.5	5.0	9.0202	10477.11	0.009544	99.990448	215.744293
32.5	5.1	9.0202	8322.28	0.012014	99.987975	171.376221
32.5	5.2	9.0202	6610.63	0.015125	99.984863	136.133469
32.5	5.3	9.0202	5251.02	0.019040	99.980957	108.139038
32.5	5.4	9.0202	4171.04	0.023969	99.976028	85.902283
32.5	5.5	9.0202	3313.18	0.030173	99.969818	68.238937
32.5	5.6	9.0202	2631.75	0.037983	99.962006	54.208374
32.5	5.7	9.0202	2090.48	0.047813	99.952179	43.063538
32.5	5.8	9.0202	1660.53	0.060186	99.939804	34.210861
32.5	5.9	9.0202	1319.01	0.075757	99.924240	27.178940
32.5	6.0	9.0202	1047.73	0.095354	99.904633	21.593262
32.5	6.1	9.0202	832.24	0.120013	99.879974	17.156403
32.5	6.2	9.0202	661.07	0.151041	99.848953	13.632065
32.5	6.3	9.0202	525.11	0.190075	99.809921	10.832583
32.5	6.4	9.0202	417.11	0.239172	99.760818	8.604877
32.5	6.5	9.0202	331.32	0.300913	99.699081	6.842505
32.5	6.6	9.0202	263.18	0.374531	99.621460	5.439445
32.5	6.7	9.0202	209.05	0.474075	99.523911	4.324944
32.5	6.8	9.0202	166.06	0.598605	99.401382	3.439665
32.5	6.9	9.0202	131.90	0.752431	99.247559	2.736462
32.5	7.0	9.0202	104.77	0.945412	99.054581	2.177887
32.5	7.1	9.0202	83.23	1.187294	98.812698	1.734195
32.5	7.2	9.0202	66.11	1.490131	98.509857	1.381757
32.5	7.3	9.0202	52.51	1.868753	98.131241	1.101804
32.5	7.4	9.0202	41.71	2.341290	97.658707	0.879430
32.5	7.5	9.0202	33.13	2.929744	97.070251	0.702792
32.5	7.6	9.0202	26.32	3.660556	96.339432	0.562483
32.5	7.7	9.0202	20.91	4.565091	95.434906	0.451031
32.5	7.8	9.0202	16.61	5.679964	94.320023	0.362502
32.5	7.9	9.0202	13.19	7.047002	92.952988	0.292181
32.5	8.0	9.0202	10.48	8.712663	91.287323	0.236323
32.5	8.1	9.0202	8.32	10.726603	89.273392	0.191953
32.5	8.2	9.0202	6.61	13.139053	86.860947	0.156708
32.5	8.3	9.0202	5.25	15.996848	84.003143	0.128713
32.5	8.4	9.0202	4.17	19.337830	80.662170	0.106475
32.5	8.5	9.0202	3.31	23.184036	76.815964	0.088811
32.5	8.6	9.0202	2.63	27.534073	72.465927	0.074780
32.5	8.7	9.0202	2.09	32.356522	67.643478	0.063635
32.5	8.8	9.0202	1.66	37.545526	62.414474	0.054782
32.5	8.9	9.0202	1.32	43.120895	56.879105	0.047749
32.5	9.0	9.0202	1.05	48.833618	51.166382	0.042164
32.5	9.1	9.0202	0.83	54.576996	45.423004	0.037727
32.5	9.2	9.0202	0.66	60.201126	39.798874	0.034202
32.5	9.3	9.0202	0.53	65.568161	34.431839	0.031402
32.5	9.4	9.0202	0.42	70.565308	29.434692	0.029179
32.5	9.5	9.0202	0.33	75.112503	24.887497	0.027412
32.5	9.6	9.0202	0.26	79.164688	20.835312	0.026009
32.5	9.7	9.0202	0.21	82.708954	17.291046	0.024895
32.5	9.8	9.0202	0.17	85.758774	14.241226	0.024009
32.5	9.9	9.0202	0.13	88.346436	11.653564	0.023306
32.5	10.0	9.0202	0.10	90.515884	9.484116	0.022747
32.5	10.1	9.0202	0.08	92.316650	7.683350	0.022304

** CONCENTRATIONS OF AMMONIA(NH4+NH3) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH3-N

A-69

TEMP C	PH	PKA	RATIO	% UNIONIZED AMMONIA	% IONIZED AMMONIA	CONCENTRATION NH4+NH3 **
33.0	5.0	9.0057	10131.16	0.009870	99.990128	208.621109
33.0	5.1	9.0057	8047.47	0.012425	99.987564	165.714079
33.0	5.2	9.0057	6392.34	0.015641	99.984344	131.638901
33.0	5.3	9.0057	5077.63	0.019690	99.980301	104.568954
33.0	5.4	9.0057	4033.31	0.024787	99.975204	83.066422
33.0	5.5	9.0057	3203.78	0.031203	99.968796	65.986328
33.0	5.6	9.0057	2544.85	0.039280	99.960709	52.419113
33.0	5.7	9.0057	2021.45	0.049445	99.950546	41.642273
33.0	5.8	9.0057	1605.70	0.062239	99.937759	33.081494
33.0	5.9	9.0057	1275.45	0.078342	99.921646	26.282166
33.0	6.0	9.0057	1013.13	0.098607	99.901382	20.440420
33.0	6.1	9.0057	804.76	0.124107	99.875885	16.590561
33.0	6.2	9.0057	639.24	0.156191	99.843796	13.182410
33.0	6.3	9.0057	507.77	0.196553	99.803436	10.475570
33.0	6.4	9.0057	403.34	0.247319	99.752670	8.325284
33.0	6.5	9.0057	320.38	0.311156	99.688843	6.617253
33.0	6.6	9.0057	254.49	0.391407	99.608582	5.260510
33.0	6.7	9.0057	202.15	0.492252	99.507736	4.182813
33.0	6.8	9.0057	160.57	0.618919	99.381073	3.326765
33.0	6.9	9.0057	127.55	0.777925	99.222061	2.646783
33.0	7.0	9.0057	101.31	0.977380	99.022614	2.106651
33.0	7.1	9.0057	80.48	1.227341	98.772659	1.677610
33.0	7.2	9.0057	63.93	1.540233	98.459763	1.336810
33.0	7.3	9.0057	50.78	1.931334	98.068665	1.066102
33.0	7.4	9.0057	40.33	2.419306	97.580688	0.851070
33.0	7.5	9.0057	32.04	3.026760	96.973236	0.680265
33.0	7.6	9.0057	25.45	3.780829	96.219162	0.544589
33.0	7.7	9.0057	20.22	4.713633	95.286362	0.436818
33.0	7.8	9.0057	16.06	5.862552	94.137436	0.351212
33.0	7.9	9.0057	12.75	7.270148	92.729443	0.283213
33.0	8.0	9.0057	10.13	8.948345	91.051641	0.229199
33.0	8.1	9.0057	8.05	11.052402	88.947586	0.186294
33.0	8.2	9.0057	6.39	13.527022	86.472977	0.152214
33.0	8.3	9.0057	5.08	16.453232	83.546768	0.125143
33.0	8.4	9.0057	4.03	19.866949	80.133011	0.103639
33.0	8.5	9.0057	3.20	23.787397	76.212601	0.086558
33.0	8.6	9.0057	2.54	28.209076	71.790924	0.072991
33.0	8.7	9.0057	2.02	33.095749	66.904251	0.062213
33.0	8.8	9.0057	1.61	38.376450	61.623550	0.053653
33.0	8.9	9.0057	1.28	43.946274	56.053726	0.046853
33.0	9.0	9.0057	1.01	49.672867	50.327133	0.041451
33.0	9.1	9.0057	0.80	55.408051	44.591949	0.037161
33.0	9.2	9.0057	0.64	61.002792	38.997208	0.033753
33.0	9.3	9.0057	0.51	66.322205	33.677795	0.031045
33.0	9.4	9.0057	0.40	71.257919	28.742081	0.028895
33.0	9.5	9.0057	0.32	75.734940	24.265060	0.027187
33.0	9.6	9.0057	0.25	79.713120	20.286880	0.025830
33.0	9.7	9.0057	0.20	83.183868	16.816132	0.024752
33.0	9.8	9.0057	0.16	86.163895	13.836105	0.023896
33.0	9.9	9.0057	0.13	88.687698	11.312302	0.023216
33.0	10.0	9.0057	0.10	90.800262	9.199738	0.022676
33.0	10.1	9.0057	0.08	92.551483	7.448517	0.022247

** CONCENTRATIONS OF AMMONIA(NH4+NH3) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH3-N

A-70

TEMP C	PH	PKA	RATIO	% UNIONIZED AMMONIA	% IONIZED AMMONIA	CONCENTRATION NH4+NH3 **
33.5	5.0	8.9911	9797.72	0.010205	99.989792	201.755707
33.5	5.1	8.9911	7782.62	0.012847	99.987152	160.264679
33.5	5.2	8.9911	6181.96	0.016173	99.983826	127.307129
33.5	5.3	8.9911	4910.52	0.020360	99.979630	101.128098
33.5	5.4	8.9911	3900.56	0.025631	99.974369	80.333176
33.5	5.5	8.9911	3098.33	0.032265	99.967728	63.815231
33.5	5.6	8.9911	2461.10	0.040616	99.959381	50.694550
33.5	5.7	8.9911	1954.92	0.051127	99.948868	40.272400
33.5	5.8	8.9911	1552.45	0.064356	99.935638	31.993790
33.5	5.9	8.9911	1233.48	0.081006	99.918991	25.417847
33.5	6.0	8.9911	979.79	0.101959	99.898041	20.194366
33.5	6.1	8.9911	778.27	0.128325	99.871674	16.045212
33.5	6.2	8.9911	618.20	0.161497	99.838501	12.749427
33.5	6.3	8.9911	491.06	0.203229	99.796768	10.131466
33.5	6.4	8.9911	390.06	0.255714	99.744278	8.051955
33.5	6.5	8.9911	309.84	0.321712	99.678284	6.400138
33.5	6.6	8.9911	246.11	0.404673	99.595322	5.088057
33.5	6.7	8.9911	195.49	0.508919	99.491074	4.045827
33.5	6.8	8.9911	155.29	0.639847	99.360153	3.217954
33.5	6.9	8.9911	123.35	0.804187	99.195801	2.560350
33.5	7.0	8.9911	97.99	1.010305	98.989685	2.037997
33.5	7.1	8.9911	77.83	1.268580	97.731415	1.623074
33.5	7.2	8.9911	61.82	1.591817	98.408173	1.293490
33.5	7.3	8.9911	49.11	1.995750	98.004242	1.031692
33.5	7.4	8.9911	39.01	2.499581	97.500412	0.823738
33.5	7.5	8.9911	30.98	3.126546	96.873444	0.658554
33.5	7.6	8.9911	24.61	3.904475	96.095520	0.527344
33.5	7.7	8.9911	19.55	4.866241	95.133759	0.423119
33.5	7.8	8.9911	15.53	6.049997	93.949997	0.340331
33.5	7.9	8.9911	12.34	7.499009	92.500977	0.274570
33.5	8.0	8.9911	9.80	9.260873	90.739120	0.222333
33.5	8.1	8.9911	7.78	11.385717	88.614273	0.180841
33.5	8.2	8.9911	6.18	13.923285	86.076706	0.147882
33.5	8.3	8.9911	4.91	16.918427	83.081573	0.121702
33.5	8.4	8.9911	3.90	20.405136	79.594864	0.100906
33.5	8.5	8.9911	3.10	24.349399	75.650601	0.084387
33.5	8.6	8.9911	2.46	28.891724	71.108276	0.071266
33.5	8.7	8.9911	1.96	33.840912	66.159088	0.060844
33.5	8.8	8.9911	1.55	39.170894	60.829102	0.052565
33.5	8.9	8.9911	1.23	44.772247	55.227753	0.045988
33.5	9.0	8.9911	0.98	50.509476	49.490524	0.040765
33.5	9.1	8.9911	0.78	56.233337	43.766663	0.036615
33.5	9.2	8.9911	0.62	61.795914	38.204086	0.033319
33.5	9.3	8.9911	0.49	67.065594	32.934402	0.030701
33.5	9.4	8.9911	0.39	71.938416	28.061584	0.028622
33.5	9.5	8.9911	0.31	76.344620	23.655380	0.026970
33.5	9.6	8.9911	0.25	80.248871	19.751129	0.025658
33.5	9.7	8.9911	0.20	83.646835	16.353165	0.024615
33.5	9.8	8.9911	0.16	86.558090	13.441910	0.023787
33.5	9.9	8.9911	0.12	89.019135	10.980865	0.023130
33.5	10.0	8.9911	0.10	91.076050	8.923950	0.022607
33.5	10.1	8.9911	0.08	92.778900	7.221100	0.022193

** CONCENTRATIONS OF AMMONIA(NH4+NH3) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH3-N

A-71

TEMP C	PH	PKA	RATIO	* UNIONIZED AMMONIA	* IONIZED AMMONIA	CONCENTRATION NH4+NH3 **
34.0	5.0	8.9766	9476.27	0.010552	99.989441	195.137024
34.0	5.1	8.9766	7527.29	0.013283	99.986710	155.007355
34.0	5.2	8.9766	5979.14	0.016722	99.983276	123.131180
34.0	5.3	8.9766	4749.41	0.021051	99.978943	97.810944
34.0	5.4	8.9766	3772.60	0.026500	99.973495	77.698318
34.0	5.5	8.9766	2996.64	0.033359	99.966629	61.722290
34.0	5.6	8.9766	2380.35	0.041993	99.958008	49.032074
34.0	5.7	8.9766	1890.78	0.052860	99.947128	38.951843
34.0	5.8	8.9766	1501.90	0.066538	99.933456	30.944809
34.0	5.9	8.9766	1193.01	0.083752	99.916245	24.584610
34.0	6.0	8.9766	947.64	0.105414	99.894577	19.532501
34.0	6.1	8.9766	752.74	0.132672	99.867325	15.519482
34.0	6.2	8.9766	597.92	0.164966	99.833023	12.331820
34.0	6.3	8.9766	474.95	0.210107	99.789886	9.799760
34.0	6.4	8.9766	377.26	0.264365	99.735626	7.788467
34.0	6.5	8.9766	299.67	0.332588	99.667404	6.190844
34.0	6.6	8.9766	238.04	0.418343	99.581650	4.921802
34.0	6.7	8.9766	189.09	0.526092	99.473407	3.913766
34.0	6.8	8.9766	150.19	0.661408	99.338593	3.113053
34.0	6.9	8.9766	119.30	0.831239	99.168747	2.477025
34.0	7.0	8.9766	94.77	1.044218	98.955780	1.971809
34.0	7.1	8.9766	75.27	1.311047	98.688950	1.570500
34.0	7.2	8.9766	59.79	1.644924	98.355072	1.251729
34.0	7.3	8.9766	47.50	2.062051	97.937943	0.998520
34.0	7.4	8.9766	37.73	2.582179	97.417816	0.797389
34.0	7.5	8.9766	29.97	3.224177	96.770813	0.637624
34.0	7.6	8.9766	23.80	4.031580	95.968414	0.510718
34.0	7.7	8.9766	18.91	5.023016	94.976974	0.409913
34.0	7.8	8.9766	15.02	6.242409	93.757584	0.329841
34.0	7.9	8.9766	11.93	7.733712	92.266281	0.266237
34.0	8.0	8.9766	9.48	9.545019	90.454971	0.215715
34.0	8.1	8.9766	7.53	11.726635	88.273361	0.175583
34.0	8.2	8.9766	5.98	14.327899	85.672089	0.143706
34.0	8.3	8.9766	4.75	17.392502	82.607498	0.118384
34.0	8.4	8.9766	3.77	20.952286	79.047714	0.098271
34.0	8.5	8.9766	3.00	25.019983	74.980011	0.082294
34.0	8.6	8.9766	2.38	29.581848	70.418152	0.069603
34.0	8.7	8.9766	1.89	34.591751	65.408249	0.059523
34.0	8.8	8.9766	1.50	39.968536	60.031464	0.051516
34.0	8.9	8.9766	1.19	45.598434	54.401566	0.045155
34.0	9.0	8.9766	0.95	51.343140	48.656860	0.040103
34.0	9.1	8.9766	0.75	57.052567	42.947433	0.036090
34.0	9.2	8.9766	0.60	62.580292	37.419708	0.032902
34.0	9.3	8.9766	0.47	67.798125	32.201874	0.030370
34.0	9.4	8.9766	0.38	72.606857	27.393143	0.028358
34.0	9.5	8.9766	0.30	76.941742	23.058258	0.026761
34.0	9.6	8.9766	0.24	80.772324	19.227676	0.025491
34.0	9.7	8.9766	0.19	84.097992	15.902008	0.024483
34.0	9.8	8.9766	0.15	86.941544	13.058456	0.023683
34.0	9.9	8.9766	0.12	89.341019	10.658981	0.023047
34.0	10.0	8.9766	0.09	91.343566	8.656494	0.022541
34.0	10.1	8.9766	0.08	92.999252	7.000748	0.022140

** CONCENTRATIONS OF AMMONIA(NH4+NH3) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH3-N

A-72

TEMP C	PH	PKA	RATIO	% UNIONIZED AMMONIA	% IONIZED AMMONIA	CONCENTRATION NH4+NH3 **
34.5	5.0	8.9622	9166.37	0.010909	99.989090	188.756180
34.5	5.1	8.9622	7281.12	0.013732	99.986267	149.938766
34.5	5.2	8.9622	5783.60	0.017287	99.982712	119.104950
34.5	5.3	8.9622	4544.99	0.021762	99.978237	94.612408
34.5	5.4	8.9622	3649.22	0.027396	99.972595	75.157944
34.5	5.5	8.9622	2896.68	0.034487	99.965512	59.704391
34.5	5.6	8.9622	2302.51	0.043412	99.956588	47.429184
34.5	5.7	8.9622	1828.95	0.054646	99.945353	37.678635
34.5	5.8	8.9622	1452.79	0.068786	99.931213	29.933502
34.5	5.9	8.9622	1153.99	0.086581	99.913418	23.781281
34.5	6.0	8.9622	916.65	0.108974	99.891025	18.894379
34.5	6.1	8.9622	728.12	0.137151	99.862848	15.012404
34.5	6.2	8.9622	578.37	0.172602	99.827397	11.924190
34.5	6.3	8.9622	454.41	0.217195	99.782799	9.479939
34.5	6.4	8.9622	364.93	0.273279	99.726720	7.534426
34.5	6.5	8.9622	289.87	0.343794	99.656205	5.949056
34.5	6.6	8.9622	230.25	0.432425	99.567574	4.741516
34.5	6.7	8.9622	182.90	0.543782	99.456217	3.786447
34.5	6.8	8.9622	145.28	0.683617	99.316382	3.011921
34.5	6.9	8.9622	115.40	0.859101	99.140898	2.396689
34.5	7.0	8.9622	91.67	1.079143	98.920856	1.907995
34.5	7.1	8.9622	72.81	1.354773	98.645226	1.519812
34.5	7.2	8.9622	57.84	1.699593	98.300406	1.211466
34.5	7.3	8.9622	45.94	2.130293	97.869706	0.966538
34.5	7.4	8.9622	36.49	2.667152	97.332847	0.771984
34.5	7.5	8.9622	28.99	3.334712	96.665287	0.617445
34.5	7.6	8.9622	23.03	4.162210	95.837789	0.494689
34.5	7.7	8.9622	18.29	5.184038	94.815961	0.397180
34.5	7.8	8.9622	14.53	6.439870	93.560129	0.319727
34.5	7.9	8.9622	11.54	7.974337	92.025662	0.258203
34.5	8.0	8.9622	9.17	9.835993	90.164006	0.209333
34.5	8.1	8.9622	7.28	12.075234	87.924765	0.170514
34.5	8.2	8.9622	5.78	14.740912	85.259087	0.139679
34.5	8.3	8.9622	4.59	17.875412	82.124587	0.115186
34.5	8.4	8.9622	3.65	21.508301	78.491698	0.095730
34.5	8.5	8.9622	2.90	25.648911	74.351088	0.080276
34.5	8.6	8.9622	2.30	30.279144	69.720855	0.068001
34.5	8.7	8.9622	1.83	35.347870	64.652129	0.058250
34.5	8.8	8.9622	1.45	40.768936	59.231063	0.050504
34.5	8.9	8.9622	1.15	46.424393	53.575606	0.044352
34.5	9.0	8.9622	0.92	52.173355	47.826644	0.039465
34.5	9.1	8.9622	0.73	57.865295	42.134704	0.035583
34.5	9.2	8.9622	0.58	63.355600	36.644399	0.032499
34.5	9.3	8.9622	0.46	68.519730	31.480269	0.030050
34.5	9.4	8.9622	0.36	73.263194	26.736805	0.028104
34.5	9.5	8.9622	0.29	77.526367	22.473632	0.026559
34.5	9.6	8.9622	0.23	81.283447	18.716552	0.025331
34.5	9.7	8.9622	0.18	84.537689	15.462310	0.024356
34.5	9.8	8.9622	0.15	87.314392	12.685607	0.023581
34.5	9.9	8.9622	0.12	89.653519	10.346480	0.022966
34.5	10.0	8.9622	0.09	91.602768	8.397231	0.022477
34.5	10.1	8.9622	0.07	93.212631	6.787368	0.022089

** CONCENTRATIONS OF AMMONIA(NH4+NH3) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH3-N

TEMP C	PH	PKA	RATIO	% UNIONIZED AMMONIA	% IONIZED AMMONIA	CONCENTRATION NH4+NH3 **
35.0	5.0	8.9478	8867.57	0.011275	99.988724	182.603729
35.0	5.1	8.9478	7043.77	0.014195	99.985794	145.051758
35.0	5.2	8.9478	5545.07	0.017870	99.982117	115.223022
35.0	5.3	8.9478	4444.33	0.022495	99.977493	91.529388
35.0	5.4	8.9478	3530.26	0.028318	99.971680	72.708679
35.0	5.5	8.9478	2804.19	0.035648	99.964340	57.758820
35.0	5.6	8.9478	2227.45	0.044874	99.955124	45.883774
35.0	5.7	8.9478	1769.33	0.056487	99.943512	36.451065
35.0	5.8	8.9478	1405.43	0.071102	99.928894	28.958374
35.0	5.9	8.9478	1116.37	0.089495	99.910492	23.066729
35.0	6.0	8.9478	886.77	0.112642	99.887344	18.279144
35.0	6.1	8.9478	704.39	0.141766	99.858231	14.523905
35.0	6.2	8.9478	559.51	0.178407	99.821579	11.540997
35.0	6.3	8.9478	444.44	0.224497	99.775497	9.171593
35.0	6.4	8.9478	353.03	0.282461	99.717529	7.289493
35.0	6.5	8.9478	280.42	0.355337	99.644653	5.794492
35.0	6.6	8.9478	222.75	0.446931	99.553055	4.606972
35.0	6.7	8.9478	176.94	0.562002	99.437988	3.663688
35.0	6.8	8.9478	140.54	0.706490	99.293503	2.914409
35.0	6.9	8.9478	111.64	0.887792	99.112198	2.319236
35.0	7.0	8.9478	88.68	1.115099	98.884888	1.846472
35.0	7.1	8.9478	70.44	1.399783	98.600204	1.470942
35.0	7.2	8.9478	55.95	1.755857	98.244141	1.172646
35.0	7.3	8.9478	44.44	2.200486	97.799500	0.935702
35.0	7.4	8.9478	35.30	2.754550	97.245438	0.747490
35.0	7.5	8.9478	28.04	3.443210	96.556778	0.597988
35.0	7.6	8.9478	22.28	4.296433	95.703552	0.479234
35.0	7.7	8.9478	17.69	5.349375	94.650620	0.384905
35.0	7.8	8.9478	14.05	6.642450	93.357544	0.309976
35.0	7.9	8.9478	11.16	8.220946	91.779053	0.250458
35.0	8.0	8.9478	8.87	10.133842	89.866150	0.203181
35.0	8.1	8.9478	7.04	12.431543	87.568451	0.165627
35.0	8.2	8.9478	5.60	15.162315	84.837677	0.135797
35.0	8.3	8.9478	4.44	18.367111	81.632889	0.112103
35.0	8.4	8.9478	3.53	22.073074	77.926926	0.093281
35.0	8.5	8.9478	2.80	26.246011	73.753989	0.078331
35.0	8.6	8.9478	2.23	30.983322	69.016678	0.066455
35.0	8.7	8.9478	1.77	36.108871	63.891129	0.057022
35.0	8.8	8.9478	1.41	41.571594	58.428406	0.049529
35.0	8.9	8.9478	1.12	47.249603	52.750397	0.043577
35.0	9.0	8.9478	0.89	52.599649	47.400351	0.038449
35.0	9.1	8.9478	0.70	58.671143	41.328857	0.035094
35.0	9.2	8.9478	0.56	64.121552	35.878448	0.032111
35.0	9.3	8.9478	0.44	69.236164	30.769836	0.029741
35.0	9.4	8.9478	0.35	73.907333	26.092667	0.027859
35.0	9.5	8.9478	0.28	78.098480	21.901520	0.026364
35.0	9.6	8.9478	0.22	81.782364	18.217636	0.025177
35.0	9.7	8.9478	0.18	84.965958	15.034042	0.024233
35.0	9.8	8.9478	0.14	87.676941	12.323059	0.023484
35.0	9.9	8.9478	0.11	89.956940	10.043060	0.022889
35.0	10.0	8.9478	0.09	91.854248	8.145752	0.022416
35.0	10.1	8.9478	0.07	93.419327	6.580673	0.022040

** CONCENTRATIONS OF AMMONIA(NH4+NH3) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH3-N

APPENDIX B

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16. ABSTRACT Several authors have reported that the harmful effects of ammonia are primarily related to the pH and temperature of the water because only the un-ionized ammonia is toxic. The un-ionized fraction increases with rising pH values and with rising temperature. Other factors such as dissolved oxygen, alkalinity, free carbon dioxide, sodium ions, total dissolved solids, prior exposure to ammonia, physical stress, general physiological status, and the presence of other additive toxins or other mitigating parameters will have a great affect on the overall toxicity of ammonia to aquatic organisms. The actual reported toxic concentrations of ammonia vary from 0.16 mg/l to 16.5 mg/l NH₃-N. This apparent variability often resulted from the investigator's failure to report pH and temperature values as well as other factors which may have biased their results. It appears that the highest concentration of un-ionized ammonia which apparently will not cause any adverse effects is 0.02 mg/l NH₃-N.		
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