PLSC 210 Horticulture Science Name\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Fall Semester, 2010

Homework #3

(Total 25 points, due November 12, show calculations for full credit)

1. You have a 50 lb bag of 20-20-20 commercial analysis (general purpose) fertilizer.

a. Indicate the amounts of each fertilizer (in oxide form) contained in the 50 lb bag. (*2 points*)

Answer: N = \_\_\_\_\_\_\_ lb, P2O5 = \_\_\_\_\_\_\_ lb, K2O =\_\_\_\_\_\_\_ lb

*Calculations*:

b. What is the elemental analysis of this fertilizer? (*2 points*)

Answer: Elemental analysis \_\_\_\_\_\_ - \_\_\_\_\_\_\_ - \_\_\_\_\_\_\_ N - P - K.

*Calculations*:

c. How many lb of each fertilizer element (elemental analysis) is contained in the 50 lb bag? (*2 points*)

Answer: N =\_\_\_\_\_\_\_ lb, P =\_\_\_\_\_\_\_ lb, K =\_\_\_\_\_\_\_ lb

*Calculations*:

2. You would like to fertilize your potted plants with a nutrient solution containing 200 ppm nitrogen (N),100 ppm phosphorus (P2O5) and 250 ppm potassium (K2O) using a 100-gallon stock tank which is installed with a 1:200 proportion injector. Your fertilizers are ammonium nitrate (NH4NO3), potassium mono-phosphate (KH2PO4) and potassium chloride (KCl).

 Commercial analysis (N-P2O5-K2O): NH4NO3 (33.5-0-0), KH2PO4 (0-53-34), KCl (0-0-62) (see Table 1)

 Conversion factors: P/ P2O5 = 0.44, K/K2O = 0.83

a. How many lb of each fertilizer should you use for the 100-gallon stock tank? (*3 points*)

Answer: NH4NO3 =\_\_\_\_\_\_\_\_ lb, KH2PO4=\_\_\_\_\_\_\_\_\_ lb, KCl=\_\_\_\_\_\_\_\_\_ lb

*Calculations*:

b. What are the concentrations of elemental nitrogen (N), phosphorus (P) and potassium (K) of your stock solution and the final fertilizer solution being applied? (*3 points*)

Answer:

1. Final fertilizer solution: N =\_\_\_\_\_\_\_\_\_\_ ppm, P =\_\_\_\_\_\_\_\_\_\_\_ ppm, K =\_\_\_\_\_\_\_\_\_\_\_ ppm
2. Stock solution: N =\_\_\_\_\_\_\_\_\_\_ ppm, P =\_\_\_\_\_\_\_\_\_\_\_ ppm, K= \_\_\_\_\_\_\_\_\_\_\_ ppm

*Calculations*:

c. You have 5,000 pots of chrysanthemums in your greenhouse and each pot requires 0.5 gallon of fertilizer solution per day. How many days would the stock tank (100 gallon) last after it has been filled once with your fertilizer stock? (*2 points*)

Answer: 1) Total volume of final solution: \_\_\_\_\_\_\_\_\_\_\_\_\_ gallon

2) Total number of days: \_\_\_\_\_\_\_\_\_\_\_\_\_ days

*Calculations*:

d. Using Table 1, calculate the cost of fertilizer needed to fill your stock tank and feed your crop. (*3 points*)

Answer: 1) Cost of fertilizers $\_\_\_\_\_\_\_\_\_\_\_\_\_/100-gallon stock tank

2) Cost of fertilizers $\_\_\_\_\_\_\_\_\_\_\_\_\_/5,000 pots per month

3) Cost of fertilizers $\_\_\_\_\_\_\_\_\_\_\_\_\_/pot per month

*Calculations*:

 *Costs of chemical fertilizers:*

 *Commercial Cost per*

*Fertilizer Formula analysis 50- lb bag*

*Ammonium nitrate NH4NO3 33.5-0-0 $20.50*

*Potassium mono-phosphate KH2PO4 0-53-34 $22.30*

*Potassium chloride KCl 0-0-62 $15.50*

3. You would like to prepare 100 liter of 200 ppm nitrogen (N) using magnesium nitrate [Mg(NO3)2 6H2O]. How many grams of this fertilizer should be used in 100 liter? (*4 points*)

Answer: Magnesium nitrate needed: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ g/100 liter.

 This solution will contain: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ ppm Mg.

*Calculations*:

4. How many ounce (oz) of a 20-20-20 commercial fertilizer or potassium nitrate (KNO3) should be dissolved in 100 gallon of water to make a 200 ppm nitrogen (N) solution? (*4 points*)

 (Note: 1 oz/100 gallon = 75 ppm)

 *Answer:* 20-20-20 fertilizer: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ oz/100 gallon.

KNO3: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ oz/100 gallon.

*Calculations*:

*Note* 1 gallon=3.8 liter, 1 kg=2.2 lb, 1 oz=29 g

1 kg=1,000 g=1,000,000 mg

 Atomic weights: N=14.01, P=30.98, K=39.1, Mg=24.32, S=32.07, Ca=40.08

 H=1.01, C=12.01, O=16.0

 Molecular weights: KNO3=101.11

 Mg(NO3)2 6H2O=256.4

 Commercial analysis: Mg(NO3)2 6H2O=11-0-0

 KNO3=13-0-44

Table 1. Common fertilizers supplying macronutrients required by plants.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ **Effect**

 **Molec. Equiv. on Solubilityc Other**

**Compound Formulaa Analysisb weight weight acidity g/100 ml lbs/100 gal materials**

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Ammonium chloride NH4Cl 25-0-0 53.5 53.5 acid 39.7 248 ---

Amdmonium nitrate NH4NO3 33.5-0-0 80.05 80.05 acid 118.3 991 ---

Monoammonium NH4H2PO4 11-48-0 115.04 115.04 acid 22.7 190 1.4% Ca

 phosphate 2.6% S

Diammonium phosphate (NH4)2HPO4 21-53-0 132.07 66.0 acid 42.9 359 ---

Ammonium sulfate (NH4)2SO4 20-0-0 132.15 66.1 very acid 70.6 591 24% S

Aluminum sulfate Al2(SO4)3.18H2O 0-0-0 666.45 222.15 very acid soluble soluble 14% S

Calcium sulfate CaSO4.2H2O 0-0-0 172.18 86.09 neutral 0.2 1.7 23% Ca. 19% S

 (gypsum)

Calcium nitrate Ca(NO3)2.4H2O 15-0-0 236.16 118.1 basic 102.0 854 17% Ca

Sodium nitrate NaNO3 16-0-0 85.01 85.01 basic 73.0 611 27% Na

Urea CO(NH2)2 45-0-0 60.06 30.03 acid 78.0 653 ---

Superphosphate CaH4(PO4)2 0-20-0 --- --- neutral 1.8 15 18% Ca, 12% S

Treble superphosphate CaH4(PO4)2 0-46-0 --- --- neutral 1.8 15 12% Ca

Phosphoric acid H3PO4 0-52-0 98.0 98.0 very acid 548 4,600 ---

Potassium chloride

 (muriate of potash) KCl 0-0-62 74.55 74.55 neutral 34.7 291 ---

Potassium nitrate

 (saltpeter) KNO3 13-0-44 101.1 101.1 basic 13.3 111 ---

Potassium sulfate K2SO4 0-0-53 174.26 87.13 neutral 6.9 58 18% S

Magnesium sulfate MgSO4.7H2O 0-0-0 246.5 123.25 neutral 71 595 10% Mg, 13% S

 (epsom salts)

Magnesium nitrate Mg(NO3)2.6H2O 11-0-0 256.4 128.2 neutral 42.3 354 10% Mg

Calcium carbonate

 (limestone) CaCO3 0-0-0 100.1 50.1 basic 0.002 0.01 40% Ca

Calcium hydroxide

 (hydrated lime) Ca(OH)2 0-0-0 74.1 37.1 basic 0.19 1.6 60-80% Ca

Potassium mono-

 phosphate KH2PO4 0-53-34 120.1 120.1 basic 33 276 ---

Potassium diphosphate K2HPO4 0-41-54 174.2 87.1 basic 167 1,400 ---

Calcium cyanamide CaCN2 20-0-0 80.11 --- basic decomposes ---

Sulfur S 0-0-0 32.1 --- acid insoluble ---

Dolomite MgCO3.CaCO3 0-0-0 --- --- basic --- --- 22% Ca, 13% Mg

 (dolomitic limestone)

Basic slag CaO.P2O5.SiO2 0-17-0 --- --- basic --- --- 33% Ca, 10% Fe

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aFormula may differ due to addition of water molecules; or source of material as the case of limestone, superphosphates, etc.

bPercentage N, P2O5, and K2O will differ between sources, depending upon manufacturing process. Molecular and equivalent weights are for the formulas as given.

cSolubility of materials in water, usually 0oC.

Table 2. Parts per million (ppm) and milliequivalents per liter (meq/) supplied when one pound or kg of material is dissolved in 1000 gal or 10 m3 (10,000 ) of water.

Analysisa ppm meq/b

Compound (N-P2O5-K2O) lb/1000 gal kg/10 m3 lb/1000 gal kg/10 m3

NH4NO3 33.5‑0‑0 40 N 34 1.5 NH4+ 1.3

 1.5 NO3‑ 1.3

NH4Cl 25‑0‑0 30 N 25 2.2 NH4+ 1.9

 79 Cl 66 2.2 Cl‑ 1.9

(NH4)2SO4 20‑0‑0 24 N 20 1.8 NH4+ 1.5

 29 S 24 1.8 SO4‑ 1.5

Ca(NO3)24H2O 15‑0‑0 18 N 15 1.0 NO3‑ 0.8

 44 Ca 37 1.0 Ca2+ 0.8

NaNO3 16‑0‑0 19 N 16 1.4 NO3‑ 1.2

 32 Na 27 1.4 Na+ 1.2

H3PO4 0‑80‑0c 80 P 64 1.2 H2PO4‑ 1.0

KNO3 13‑0‑44 16 N 13 1.2 K+ 1.0

 53 K2O 53 1.2 NO3‑ 1.0

KCl 0‑0‑62 74 K2O 62 1.6 K+ 1.3

 57 Cl 48 1.6 Cl‑ 1.3

(NH4)2HPO4 21‑53‑0 25 N 21 1.8 NH4+ 1.5

 63 P2O5 53 1.8 HPO42‑ 1.5

K2SO4 0‑0‑53 63 K2O 53 1.4 K+ 1.1

 21 S 18 1.4 SO42‑ 1.1

NH4H2PO4 11‑18‑0 13 N 11 1.0 NH4+ 0.9

 57 P2O5 48 1.0 H2PO4‑ 0.9

MgSO4 ‑ 24 Mg 20 2.0 Mg2+ 1.7

 32 S 27 2.0 SO42‑ 1.7

Mg(NO3)26H2O 11‑0‑0 13 N 11 0.9 Mg2+ 0.8

 11 Mg 10 0.9 NO3‑ 0.8

HNO3 (pure) 18‑0‑0 21 N 18 1.9 NO3‑ 1.6

K2HPO4 0‑11‑54 49 P2O5 41 1.4 K+ 1.1

 64 K2O 54 1.4 HPO42‑ 1.1

KH2PO4 0‑53‑34 61 P2O5 53 1.0 K+ 0.8

 41 K2O 34 1.0 H2PO4‑ 0.8

a Analyses in percentage N, P2O5, and K2O.

b Milliequivalents are calculated on the basis of equivalent weight.

c Percentage of H2PO4 in liquid.