Practice calculation questions for CA CCA exam

Testing and Continuing Ed committee, CA CCA program
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1. Urea (46% N) sells for $450/ton. What is the cost of a pound of N as urea at this price?
2. ETo in a field is 0.25 inches/day, and (Kc) crop coefficient is 0.85. How long will it take to use 3" of plant available water? If the irrigation system is 75% efficient, how much water must be applied to refill the soil profile with 3" of water?
3. Saturated paste extracts from two different soils were analyzed and reported by two different labs. Lab 1 one reported Mg as 3 meq/l, while Lab 2 reported Mg as 26 mg/l (ppm). Which sample contains more Mg^{+2} by weight? The equivalent weight of magnesium (Mg) is 12 – that is 12 mg/l Mg = 1 meq/l Mg.
4. 50 pounds of KNO_3 (15-0-34) and 50 pounds of 20-20-20 are blended. What is the analysis of the new fertilizer mixture?
5. An irrigation water contains 7 ppm nitrate-N. How much N is applied in three acre feet of water? (1 acre foot = 326,000 gallons = 2.7 million pounds)
6. Soil samples come back from the lab showing that the top foot of a soil contains 5 ppm N as nitrate. The next two feet of soil contains 2 ppm N as nitrate. 6 acre inches of soil weigh 2 million pounds. How much N as nitrate per acre is in the top 3 feet of this soil?
7. Tomatoes require 75 pounds N/A, 150 pounds P_2O_5/A and 150 pounds K_2O /A. How much 10-20-20 is needed for a five-acre field?
8. Calculate an N fertilizer rate for a walnut orchard (in-shell yield is 3 tons/acre) growing on sandy loam soil with no cover crop in the Sacramento Valley. The irrigation water contains 5 ppm nitrate-N and 3.0 acre feet of water will be applied. Three tons of composted cow manure will be applied per acre (1.3 % N).

Assumptions:

1. 15% of the composted cow manure N is available this season.
2. 1,000 pounds of crop = 20 pounds N exported from the field in the harvested crop.
3. N supplied by irrigation water (pounds/acre) = acre-ft x N concentration in ppm x 2.7.
4. Fertilizer efficiency = 70 %

- How many pounds of N will be removed in the harvested crop?
- Calculate the annual N fertilizer requirement (N removed – N supplied by composted cow manure and irrigation). Assume no additional N is needed to support vegetative growth.
- How much fertilizer N should be applied per year?
- If UN32 (32% N, 3.54 pounds N/gallon) is N fertilizer used, how many gallons per acre of UN32 will be needed per year?

9. A farmer has two rice fields, both rectangular in shape. Field 1 is a quarter of a mile long by half a mile wide, Field 2 is three quarters of a mile long by half a mile wide. The nutrient requirements for the field are 150 pounds N/acre, 70 pounds P_2O_5/acre, and 180 pounds K_2O/acre. How many total pounds of N, P_2O_5, and K_2O are needed to meet the nutrient requirements of both these fields? A mile = 5280 feet.

10. In June, an almond orchard with no significant ground cover has a daily ETo of 0.28" and a Kc of 0.9. There are 124 trees per acre and each tree receives 4 gallons of water/hour through 4x1 gallon per hour drip emitters. Given that 1 acre inch of water = 27,154 gallons and the irrigation system is 95% efficient…

    - What is the daily water use (ETc) in this orchard in acre inches?
    - How many gallons of water does the irrigation system apply per hour?
    - How many hours must the irrigation system be run to replace the water used in a day?
    - If the maximum ETo is 0.35 acre inches and the Kc = 0.9 in this orchard, what is the maximum daily run time for this irrigation system to replace daily ETc?

Detailed answer key:

1. $450 per ton of urea ÷ 2000 pounds per ton = $0.225/pounds urea

   ($0.225/pounds urea) ÷ 0.46 pounds N per 1pounds urea) = $0.49/pounds N.

2. ETo*Kc = ETc = 0.2125”/day. 3” ÷ 0.2125”per day = 14.11 days (14 days) to use 3” of water. To correct for irrigation efficiency (75%): 3” ÷ 0.75 = 4” of water applied.

3. 12 mg Mg ÷ 1 meq Mg * 3 meq/l Mg, so a sample that is 3 meq/l Mg = 36 mg/l Mg (ppm). The sample from Lab 1 has more Mg than the sample from Lab 2 – 36 mg/l vs 26 mg/l.

4. Here’s how I would break this down, determine the amount of N, P, and K in each amount of each fertilizer and then put it all together in the final weight to determine N-P-K in new fertilizer…

	Pounds N	Pounds P_2O_5	Pounds K_2O
50 pounds of KNO_3 (15-0-34)	50 * 0.15 = **7.5**	0	50*0.34 = **17**
50 pounds of 20-20-20	50 * 0.20 = **10**	50 * 0.20 = **10**	50 * 0.20 = **10**
100 pounds of new fert	**7.5+10=17.5**	**0+10=10**	**17+10=27**

The new fertilizer analysis is 17.5-10-17.

5. 3 acre feet * 2.7 million pounds/acre foot = 8.1 million pounds. Three acre feet of water with 7 ppm nitrate-N concentration -- or 7 pounds nitrate-N per million pounds -- contains 56.7 pounds N. (8.1 * 7 = 56.7)

6. The top foot of soil contains 10 pounds nitrate per acre (2 million pounds soil per half an acre foot * 2 = 4 million pound per acre foot. 5 ppm nitate-N * 4 million pounds = 20 pounds N as nitrate in the top foot of soil. The next two feet of soil contain 16 pounds N as nitrate (2 million pounds soil per half an acre foot * 4 = 8 million pounds per 2 acre foot. 2 ppm nitrate-N * 8 million pounds = 16 pounds N as nitrate in soil in the two feet of soil below the first foot. 20 pounds N as nitrate + 16 pounds N as nitrate = 36 pounds N as nitrate in the top 3’ of soil.

7. Five acres of tomatoes requires:

   375 pounds of N (75 pounds N/acre * 5 acres)

   750 pounds of P2O5 (150 pounds P2O5/acre * 5 acres)

   750 pounds of K2O (150 pounds K2O/acre * 5 acres)

   Fertilizer needed = 3750 pounds of 10-20-20 to deliver all the N, P, and K needed. (375 pounds N ÷ 0.1 pounds N per one pounds 10-20-20 = 3750 pounds 10-20-20. The N requirement is half of P and K and the fertilizer formulation matches that need.

8.

- 3 tons yield/acre * 2000 pounds/ton = 6000 pounds/acre yield. 20 pounds N/1000 pounds crop * 6000 pounds/acre crop = <u>120 pounds N/acre</u> removed with the crop.
- 3 tons manure * 2000 pounds /ton manure = 6000 pounds manure/acre. N content/acre = 6000 pounds manure/acre * 0.013 = 78 pounds N/acre total N in manure. 15% of all manure N is crop available this year = 78 pounds N/acre * 0.15 = <u>11.7 pounds N/acre</u>.

  3 acre feet of irrigation water * 5 ppm nitrate N * 2.7 = <u>40.5 pounds N/acre</u>

  Per acre N requirement = (120 pounds N/acre – (11.7 pounds N/acre + 40.5 pounds N/acre) = <u>68 pounds N/acre</u>.

- Annual fertilizer requirement with correction for 70% efficiency= 68 pounds N/acre ÷ 0.7 = <u>97 pounds N/acre</u>
- UN32 needed = 97 pounds N/acre ÷ 3.54 pounds N/gallon UN32 = <u>27.4 gallons UN32/acre/year.</u>

9.

- Total Field 1 area = [(5280 ft/mile* 0.25 mile) + (5280 ft/mile * 0.5 mile)] ÷ 43560 ft^2/acre = 80 acres. Total Field 2 area = (5280 ft/mile* 0.75 mile) + (5280 ft/mile * 0.5 mile)] ÷ 43560 ft^2/acre = 240 acres. Total area of both fields = 320 acres.
- Total N requirement = 320 acres * 150 pounds N/acre = 48,000 pounds N
- Total P_2O_5 requirement = 320 * 70 pounds P_2O_5/acre = 22,400 pounds P_2O_5
- Total K_2O requirement = 320 * 180 pounds K_2O /acre = 57,600 pounds K_2O

10.

- Daily water use (ETc) = (0.28*0.9) = <u>0.25” per acre (acre-inch)</u>
- Hourly water delivery = (124 trees per acre * 4 gallons/tree/hour) = <u>496 gallons/hour.</u>
- Irrigation system run time/day = (0.25”/acre/day *27154 gallons/acre inch) ÷ 496 gallons per hour = 13.7 hours per day to replace used water. Correct for 90% efficiency by dividing by 0.90 gives <u>15.2 hours per day run time</u>.
- Maximum irrigation system run time/day = (0.35”/acre *27154 gallons/acre inch) ÷ 496 gallons per hour = 17.25 hours per day to replace used water. Correct for 90% efficiency by dividing by 0.90 gives <u>19.2 hours per day run time</u>.