INDICATE THE ONE BEST RESPONSE. Please cover your answers when not writing.

1. Mitscherlich’s equation accounts for:
   a) nutrient interactions with the environment.
   b) less output per unit input at higher input levels.
   c) the mobility of nutrients in the soil and reduction in plant uptake.
   d) the capacity of the plant to produce seed and therefore influence yield.
   e) the most limiting component needed by the plant for growth.

2. Soil structural units (peds) in Iowa subsoils result mostly from:
   a) overhead traffic on the soil surface.
   b) root penetration and other biological processes.
   c) shrinking and swelling of 2:1 lattice clays.
   d) slippage along well defined wetting fronts.

3. It is a nonessential nutrient often found in plants that strengthens stems and reduces lodging.
   a) N   b) Na   c) Br   d) Ni   e) Si

4. Certain elements have specialized functions in plant growth but others, such as ______, seem to be involved in all of the vital processes of plants.
   a) calcium   b) chlorine   c) iron   d) nitrogen   e) potassium

5. A soil layer containing _____ fertilizers is likely to have more roots than a layer without the fertilizers.
   a) any if needed   b) K and N   c) P and K   d) N and P

6. Which of these nutrients is most apt to readily move through soil after application?
   a) N and P   b) Ca and Mg   c) P and K   d) S and N   e) Mg and K

7. Which of the following elements are expected to be most abundant in plant tissue?
   a) N, P, K   b) H, O, C   c) Si, C, O   d) Ca, Mg, N

8. In which of these responses do yields decrease as more and more fertilizer is applied?
   a) quadratic   b) linear   c) exponential   d) linear and exponential   e) quadratic and exponential

9. According to your reading, what yield response is expected if a) seeding rate is a limiting factor vs. b) both seeding rate and phosphorus are limiting factors.
   a) yields are the same for a and b but less than no limitations.
   b) yields are the same as for no limitations.
   c) yields are less for b than for a.
   d) yields are less for a than for b.

10. For carrot production in Sudan, a study was conducted where N as a limiting nutrient was added in 10 lb/acre units. One would expect the greatest increase in yield per unit N at the ____ lb/acre rate.
    a) 50   b) 40   c) 30   d) 20   e) 10
11. The deficiency of a nutrient first shows on the younger tissue, which indicates the nutrient:
   a) is likely N or P.
   b) is being stored by the roots.
   c) is immobile within the plant.
   d) readily moves within the above-ground portions of the plant.
   e) is in short supply in the soil and doesn’t readily move within the soil.

12. A large difference in growth between plants with and without mycorrhizae is most likely to occur:
   a) where plants are grown in soil with low fertility.
   b) where plants are grown in soil with medium fertility.
   c) where plants are grown in soil with high fertility.
   d) where plants are grown in solution culture (hydroponics).

13. A soil with poor tilth is likely to have:
   a) low fertility.
   b) low water-holding capacity.
   c) poor aeration.
   d) sandy texture.

14. Cells sloughed off from plant roots:
   a) are an indication of certain plant diseases.
   b) ferment into growth inhibitors as they decompose.
   c) persist for decades as indicators of plants that once grew there.
   d) provide an energy source for soil microbes.

15. The main source of this nutrient for all plants is the air.
   a) C   b) N   c) K   d) P   e) Mg

16. Which of these elements occurs in the highest proportion in plant seeds compared with vegetative tissue?
   a) Ca   b) N   c) P   d) S   e) Si

17. Soil structure is:
   a) the proportion of sand, silt, and clay in a soil.
   b) the percentage of soil filled with water.
   c) the percentage of the soil filled with air.
   d) the percentage of the soil filled with pores.
   e) the arrangement of sand, silt, and clay particles.

18. Your reading discusses the rooting systems of plants and concludes that approximately ____ of the soil-root volume in occupied by roots.
   a) 0.05%   b) 2%   c) 5%   d) 10%   e) 20%

19. Soil crusts form when an unprotected soil with weak soil structure is subjected to:
   a) heavy traffic by tractors or other vehicles.
   b) large applications of chemical fertilizers.
   c) pounding by raindrops.
   d) repeated intense temperature changes.

20. The saturated sponge demonstration flat vs. vertical in lecture showed:
   a) the change of gravity in the two directions.
   b) the change of pore size in the two directions.
   c) the change of pore length in the two directions.
   d) the change of pore constrictions in the two directions.
21. Which two nutrients listed show deficiency symptoms first at the bottom of the plant?
   a) Mn and K   b) Cu and P   c) Zn and N   d) Mo and Ca   e) K and N

22. After a saturating rain and the soil has drained for approximately three days (soil at field capacity), which of the following statements is most likely true?
   a) the small pores are free of water
   b) the soil is still too wet to be tilled
   c) about 1/3 of the pores contain air
   d) the soil contains about 75% porosity
   e) the water in the soil is held at 15 bars tension

23. High levels of N in growing tomatoes will:
   a) likely be most profitable.
   b) produce high yields of fruit but little vegetation.
   c) produce large amounts of vegetation but little fruit.
   d) retard root growth in the zone of application.
   e) require less K because N can somewhat substitute for K.

24. The Baule unit concept can be used as a means of interpreting:
   a) Bray's nutrient mobility concept.
   b) de Saussure's explanation of how plants grow.
   c) Liebig's Law of the Minimum.

25. Earthworms proliferate best when:
   a) the pH of a neutral soil is lowered.
   b) manure is added to soil.
   c) the soil becomes compacted.
   d) the soil becomes waterlogged.
   e) the soil is tilled.
26. Indicate the two (2) main functions (or purposes) of micronutrients in plant growth. Why are they required in only small quantities? (6)

27. When serving as a consultant, Grower A has superior management and Grower B has average management, should the same fertilizer rate be recommended for both? Why or why not? (4)

28. By looking at a field, how do you tell **visually** the soil is compacted? Why is it bad? Explain. (5)

29. Explain to a University of Iowa graduate ‘hidden hunger’ in plant growth. Good or bad? Why. (5)