10 pts.  1.  a) V 12
     b) Node 5
     c) Approximately 70 %
     d) Free moisture no longer visible when mid-ear kernel is opened. "Dough" is visible instead.
     e) Approximately 40 - 45 %

4 pts.  2.  Approximately 2 acre inches of water are plant-available per foot in this field capacity soil.

10 pts.  3.  Soybeans are the more drought tolerant crop.

   a) Soybeans sustain their photosynthetic rate under a more negative leaf water potential (e.g. down to -11 bars vs. down to -4 bars for corn).

   b) Soybeans flower over a much longer period and are therefore able to compensate for stress during one part of flowering by retaining a higher percentage of flowers, pods, and seeds as they are formed later in the season when the stress is likely to be lessened (soybeans produce a much larger number of flowers than will ever be realized as pods).

   c) Soybeans are a self-pollinating crop and are therefore less vulnerable to drought stress than corn which is open-pollinated.

8 pts.  4.  a) Seed within 2 weeks after the Hessian Fly Free date.

In Indiana, the Fly Free date spans September 22 in the northern part of the state through October 9 in the southern part of the state. Seed within 2 weeks after the appropriate date at a given latitude. For Indiana, these dates span the period September 22 - October 6 in the North through October 6 - October 23 in the South.

   b) This timing allows the wheat plants to escape serious economic loss to the Hessian Fly as egg laying in much reduced by the cooler temperatures prevalent as the Fall progresses beyond the Fly Free date.

   If seeded earlier, risk of Hessian Fly injury increases as does the risk of infection by foliar diseases (e.g. Powdery Mildew) as too much vegetative growth in the Fall results in a "matting of the leaves.

   If seeded later, the wheat may not have adequate time to become well-established prior to the advent of the cooler temperatures of late Fall (which slow root and leaf growth) possibly resulting in extensive stand loss to winter kill or heaving of the roots (occurs when roots are poorly developed and successive cycles of freezing and thawing push these shallow roots (and the plant crown) up out of the soil.

12 pts.  5.  a) 25 to 30 plants/square foot

   b) 144 in.² / 9 in. = 16 inches of row length/square foot
c) (25 plants per square foot) (2 potential heads per plant) (1.6) = 80 bushels per acre

9 pts.

6. a) \(40 + [(1.75) (80 \text{ Bu/Acre} - 50)] = 92.5 \text{ Total Lbs. N/Acre}\)

b) \((0.63 \text{ Lbs. P}_2\text{O}_5/\text{Bu}) (80 \text{ Bu/Acre}) = 50.4 \text{ Lbs. P}_2\text{O}_5 / \text{ Acre}\)

c) \([(0.37 \text{ Lbs. K}_2\text{O}/\text{Bu}) (80 \text{ Bu/Acre})] + 20 = 49.6 \text{ Lbs. K}_2\text{O} / \text{ Acre}\)

9 pts.

7. As dormancy is broken while tillering (prior to jointing)

a) N available when needed for growth as it begins in the Spring.

b) Least foliar burn potential as exposure is limited to the first leaves.

c) Avoids stem breakage as only leaf tissue is exposed.

d) Maximum ability to compensate for damage done by wheel traffic or through leaf burn as tillering and leaf development continue until jointing.

4 pts.

8. \((60 \text{ Bu/Acre}) (0.80 \text{ Lbs. P}_2\text{O}_5/\text{Bu}) = 48 \text{ Lbs. P}_2\text{O}_5/\text{Acre}\)

\[\{(60 \text{ Bu/Acre}) (1.40 \text{ Lbs. K}_2\text{O}/\text{Bu})\} + 20 = 104 \text{ Lbs. K}_2\text{O}/\text{Acre}\]

9 pts.

9. a) Approximately 175,000 plants per acre for drill rows. The precise recommendation for 7 inch row width is 168,000 or 2.25 plants per foot of row. Populations at 2 to 3 plants per foot of row equal approximately 150,000 to 225,000 plants per acre.

The recommended population for 30 inch rows is about 105,000 per acre. Populations of 6 to 8 plants per foot of row equal approximately 105,000 to 139,000 per acre.

b) Soybeans compensate readily (branches at low population vs. self-thinning at excessive populations) over a wide range of populations so precision seeding exactly at recommended rates for various row widths is not critical as long as the established stand is uniformly distributed. However, weed pressure increases at low populations and lodging increases at excessive population levels.

c) At recommended populations, seeds in 30 inch rows are spaced at 6 - 8 per foot of row and are in position to work together to form a crack in a surface crust and push through uniformly. In contrast, seeds in drill rows (e.g. 7 inch row width) are at a greater risk of irregular emergence as the seeds are spaced at only 2 to 3 per foot of row at recommended populations and are therefore less able to produce a crack in a surface crust. As a result, drilled soybeans are generally less uniform in emergence through crust than are soybeans planted in 30 inch rows.

9 pts.

10. a) Indeterminate plants are taller as they continue to grow in height for a relatively - longer time after flowering has begun.

Determinate plants cease growing in height (terminate) relatively sooner after flowering has begun and are therefore relatively shorter.

b) Indeterminate plants generally have smaller and fewer pods at the plant top since their growth is as described in part a). Determinate plants have a terminal raceme.

c) Indeterminate plants have smaller leaves at the plant top since their growth is as described in part a).
11. a) V 3 = Leaf at the fourth leaf node on the main stem is the uppermost node with leaf margins no longer touching (three trifoliolate leaf nodes with margins not touching).

b) R 3 = Pod greater than or equal to 3/16 inch (5 mm) long at one of the top four developed leaf nodes on the main stem.

c) R 5 = Seed greater than or equal to 1/8 inch (3 mm) long in a pod at one of the top four developed leaf nodes on the main stem.

d) R 6 = Green seed fills the pod cavity in a pod at one of the top four developed leaf nodes on the main stem.

12. Diameter = 30 inches; Radius = 15 inches.

\[
\frac{43560}{(3.14)(15^2)/144} = 8871.7 \text{ Hoop Areas Per Acre}
\]

( 25 Plants Per Hoop ) (8871.7 Hoop Areas Per Acre) = 221792 Plants Per Acre

5 pts. **BONUS** Leaf canopy closure must be accomplished by the time of early pod fill (potentially even by flowering) in order to optimize light use with respect to yield potential.

When plants are relatively short (usually because they have had a limited time for vegetative growth) going into this reproductive period of the season they are unable to close the leaf canopy so light is wasted in between the rows and yield potential is lost. Examples of such situations may include; a) very late planting as for double crop soybeans after wheat in northern Indiana, b) planting an early variety at a given location [a Maturity Group II variety would be probably respond more positively to drill rows than would a group III variety when both are planted in central Indiana on the same date], c) planting an adapted variety at a northern location vs. an adapted variety at a southern location [more northern location produces a stronger yield advantage for drill rows], planting a determinate variety adapted to a northern latitude [e.g. Maturity Group IV and earlier], d) soybeans grown under non-irrigated dryland conditions.