

FULL-LENGTH PRACTICE TEST

PRACTICE TEST 10 – 100 QUESTIONS

1. Secondary xylem and secondary phloem are produced by what meristematic tissue?
 - A. Apical meristem
 - B. Vascular cambium
 - C. Cork cambium
 - D. Pericycle

2. What is the minimum number of personnel required to be present during tree felling operations according to ANSI Z133?
 - A. One person is sufficient
 - B. Four persons minimum
 - C. Two persons minimum
 - D. Three persons minimum

3. Which soil property refers to the relative proportions of sand, silt, and clay particles?
 - A. Texture
 - B. Structure
 - C. Porosity
 - D. Density

4. A tree that loses all its leaves during a specific season each year is classified as what?

- A. Evergreen
- B. Marcescent
- C. Semi-evergreen
- D. Deciduous

5. The reactive kickback zone on a chain saw bar is located where?

- A. At the base of the bar near the engine
- B. At the upper quadrant of the bar tip
- C. Along the bottom of the bar
- D. In the middle section of the bar

6. What type of pruning cut removes a branch at its point of origin?

- A. Thinning cut
- B. Heading cut
- C. Stub cut
- D. Topping cut

7. Soil with high cation exchange capacity has what characteristic?

- A. Poor water drainage
- B. Low nutrient availability
- C. High nutrient-holding ability
- D. Excessive aeration

8. The barrier zone formed after wounding in the CODIT model is designated as which wall?

- A. Wall 1
- B. Wall 2
- C. Wall 3
- D. Wall 4

9. Rhizomorphs (black shoestring-like structures) in soil near a declining tree are indicative of what pathogen?

- A. Armillaria root rot
- B. Verticillium wilt
- C. Phytophthora root rot
- D. Oak wilt

10. What is the minimum breaking strength required for arborist climbing lines per ANSI Z133?

- A. 4,000 pounds
- B. 5,400 pounds
- C. 6,000 pounds
- D. 7,000 pounds

11. The pressure flow hypothesis explains transport through what plant tissue?

- A. Xylem
- B. Cork
- C. Epidermis
- D. Phloem

12. What is the proper distance to keep mulch away from a tree trunk?

- A. Mulch should contact the trunk
- B. 12 inches minimum
- C. 3 to 6 inches
- D. No gap is necessary

13. A leaf that is not divided into leaflets is classified as what type?

- A. Simple
- B. Compound
- C. Bipinnate
- D. Palmately compound

14. Sudden oak death is caused by what type of organism?

- A. Bacterium
- B. Water mold (*Phytophthora ramorum*)
- C. Virus
- D. Fungus

15. When is the use of heading cuts considered appropriate in tree pruning?

- A. For all routine maintenance pruning
- B. To create strong branch structure
- C. Whenever reducing branch length
- D. Limited applications such as restoration of topped trees or formal hedges

16. What type of support system uses rigid threaded rods installed through weak branch unions?

- A. Cabling
- B. Guying
- C. Bracing
- D. Propping

17. The Casparian strip is found in what root tissue layer?

- A. Endodermis
- B. Epidermis
- C. Cortex
- D. Pericycle

18. What plant hormone is primarily responsible for cell elongation in shoots?

- A. Cytokinin
- B. Auxin
- C. Abscisic acid
- D. Ethylene

19. A clinometer is used to measure what tree characteristic?

- A. Trunk diameter
- B. Wood density
- C. Root depth
- D. Tree height

20. Leaf miners cause damage by feeding in what manner?

- A. Chewing through entire leaf tissue
- B. Sucking plant fluids
- C. Tunneling between leaf epidermal layers
- D. Creating galls

21. What does research indicate about the effectiveness of wound dressings?

- A. They do not prevent decay and may slow wound closure
- B. They accelerate compartmentalization
- C. They are essential for all pruning wounds
- D. They prevent insect infestation effectively

22. Dutch elm disease is transmitted between trees primarily by what mechanism?

- A. Wind-blown spores
- B. Contaminated soil
- C. Rain splash
- D. Bark beetles and root grafts

23. In tree risk assessment, what does "likelihood of impact" evaluate?

- A. The probability of tree failure
- B. The probability that failure will strike the target
- C. The severity of potential damage
- D. The tree species characteristics

24. The phellogen is another name for what tissue?

- A. Vascular cambium
- B. Apical meristem
- C. Cork cambium
- D. Ground meristem

25. Crown dieback that is more severe on one side of the tree often indicates what condition?

- A. Root damage on the corresponding side
- B. Uniform disease infection
- C. Normal growth variation
- D. Genetic defect

26. Chlorophyll molecules are located within what cellular structures?

- A. Mitochondria
- B. Vacuoles
- C. Cell walls
- D. Chloroplasts

27. A tree protection plan should specify what elements?

- A. Only the trees to be removed
- B. Protection zones, fencing, prohibited activities, and monitoring requirements
- C. Landscape planting design only
- D. Construction schedule only

28. General chlorosis affecting the entire tree, especially older leaves, most commonly indicates deficiency of what nutrient?

- A. Nitrogen
- B. Iron
- C. Calcium
- D. Boron

29. Trees that effectively limit decay spread after wounding are described as what?

- A. Poor compartmentalizers
- B. Non-reactive trees
- C. Good compartmentalizers
- D. Decay-resistant species only

30. When planting a balled-and-burlapped tree, what should be done with wire baskets?

- A. Leave completely intact
- B. Push deeper into the hole
- C. Fill with additional soil
- D. Remove or cut away at least the top one-third

31. What effect does organic matter have on soil structure?

- A. Decreases aggregation
- B. Promotes aggregation and improves structure
- C. Has no effect
- D. Increases compaction

32. What anatomical structure should be preserved when making a proper pruning cut?

- A. Branch collar
- B. Branch stub
- C. Central pith
- D. Terminal bud

33. Arbuscular mycorrhizae differ from ectomycorrhizae in what way?

- A. They only colonize diseased roots
- B. They do not benefit the host plant
- C. They penetrate root cell walls
- D. They form a visible external sheath

34. What is a common negative consequence of topping trees?

- A. Improved branch structure
- B. Enhanced wind resistance
- C. Accelerated wound closure
- D. Weakly attached sprouts, decay, and increased long-term hazard

35. What is the maximum percentage of any single genus recommended for urban forest diversity?

- A. 10 percent
- B. 20 percent
- C. 30 percent
- D. 40 percent

36. A sample tree inventory differs from a complete inventory in what way?

- A. It uses statistical sampling to estimate population characteristics
- B. It documents every individual tree
- C. It costs more to conduct
- D. It provides more detailed individual tree data

37. Interveinal chlorosis on the youngest leaves with veins remaining green is characteristic of what deficiency?

- A. Nitrogen
- B. Phosphorus
- C. Potassium
- D. Iron or manganese

38. What is the required response if minimum approach distances from electrical conductors cannot be maintained?

- A. Use rubber gloves and continue
- B. Work during dry conditions only
- C. Stop work and contact the utility company
- D. Use wooden ladders only

39. What root defect is most commonly associated with container-grown trees?

- A. Excessive taproot development
- B. Circling and potentially girdling roots
- C. Lack of fine roots
- D. Root disease infection

40. A hazard tree is defined by the presence of what two factors?

- A. Structural defects AND a target that could be struck
- B. Disease symptoms only
- C. Old age only
- D. Location in a park

41. What type of growth increases the length of stems and roots?

- A. Secondary growth
- B. Lateral growth
- C. Radial growth
- D. Primary growth

42. Proper establishment irrigation for newly planted trees focuses water where?

- A. On the leaves only
- B. At the dripline only
- C. Directly on the original root ball
- D. On surrounding soil only

43. What factor most increases the severity of root damage?

- A. Proximity to the trunk (closer = more severe)
- B. Distance from the tree
- C. Root color
- D. Season of damage

44. *Erwinia amylovora* is the causal agent of what disease?

- A. Oak wilt
- B. Fire blight
- C. Dutch elm disease
- D. Anthracnose

45. What does the species rating in the trunk formula method of tree appraisal evaluate?

- A. Tree location on property
- B. Current health condition
- C. Tree age
- D. Relative landscape value and desirability of the species

46. When is an advanced tree risk assessment most appropriate?

- A. For routine evaluation of healthy trees
- B. For newly planted trees
- C. When internal defects are suspected but not visible
- D. For annual inventory updates

47. What should be done before committing full weight to a climbing tie-in point?

- A. Load test by applying weight gradually and observing for any response
- B. Visual inspection only is sufficient
- C. No testing is required for live branches
- D. Test only if branch diameter is questionable

48. What must be communicated during a job briefing before tree work?

- A. Marketing strategies
- B. Hazards, work plan, responsibilities, and emergency procedures
- C. Equipment prices
- D. Long-term scheduling

49. What tissue produces the callus that closes over tree wounds?

- A. Heartwood
- B. Pith
- C. Bark surface
- D. Cambium at wound margins

50. What approach is most effective for addressing soil compaction in tree root zones?

- A. Fertilization only
- B. Increased irrigation only
- C. Prevention and remediation through vertical mulching and organic matter
- D. Foliar applications

51. What is the primary purpose of urban forest species diversity requirements?

- A. Resilience against species-specific pest and disease losses
- B. Aesthetic uniformity
- C. Reduced maintenance costs
- D. Simplified inventory management

52. How long should tree staking and guying typically remain in place?

- A. Permanently
- B. Until roots establish (usually 1-2 growing seasons)
- C. For 5 years minimum
- D. For 10 years

53. Crown thinning reduces what while maintaining natural tree form?

- A. Tree height
- B. Root mass
- C. Trunk diameter
- D. Crown density

54. When stomata close during drought, what physiological process is directly reduced?

- A. Root respiration
- B. Bark development
- C. Photosynthesis
- D. Nutrient storage

55. Biological control in IPM uses what to manage pest populations?

- A. Living natural enemies (predators, parasitoids, pathogens)
- B. Synthetic pesticides only
- C. Cultural practices only
- D. Mechanical removal only

56. The branch bark ridge indicates what about a branch attachment?

- A. The location for flush cuts
- B. The upper boundary where branch and trunk tissues meet
- C. Areas requiring wound dressing
- D. Internal decay presence

57. The minimum approach distance from electrical conductors increases at what voltage threshold?

- A. 25 kV
- B. 75 kV
- C. 100 kV
- D. 50 kV

58. What characteristic distinguishes a reduction cut from a heading cut?

- A. Reduction cuts leave stubs
- B. They are identical
- C. Reduction cuts are made to laterals at least 1/3 the diameter of the removed branch
- D. Heading cuts produce better structure

59. Foliar analysis provides what information that soil testing cannot?

- A. What nutrients the tree has actually absorbed
- B. Soil pH
- C. Soil texture
- D. Organic matter content

60. What is the proper response if a climbing system becomes entangled?

- A. Continue climbing to reach a better position
- B. Stop, secure position, and carefully untangle before proceeding
- C. Cut the rope to free yourself
- D. Call for help without taking any action

61. Plant health care emphasizes what approach to managing plant problems?

- A. Calendar-based pesticide applications
- B. Reactive chemical treatment
- C. Immediate removal of affected plants
- D. Prevention and overall plant health maintenance

62. Basal trunk wounds are more structurally concerning than upper trunk wounds because they affect what?

- A. Only aesthetic appearance
- B. Branch development patterns
- C. The structural foundation where all loads transfer to the root system
- D. Leaf production

63. Annual growth rings in tree trunks are produced by what tissue?

- A. Vascular cambium producing xylem
- B. Cork cambium
- C. Phloem
- D. Epidermis

64. When is structural pruning most effective for correcting tree form?

- A. After severe defects develop
- B. Early in the tree's life when branches are small
- C. After the tree reaches maturity
- D. Only during dormancy

65. Anthracnose diseases affecting trees are caused by what type of organism?

- A. Bacteria
- B. Viruses
- C. Nematodes
- D. Fungi

66. What is the primary function of root hairs?

- A. Structural anchorage
- B. Food storage
- C. Increasing surface area for water and nutrient absorption
- D. Hormone production

67. In risk assessment, what does a busy parking lot beneath a tree with dead branches represent?

- A. A high-occupancy target
- B. A structural defect
- C. A disease sign
- D. An assessment method

68. Mulch applied deeper than 4-6 inches can cause what problems?

- A. Improved root growth
- B. Oxygen deprivation and stem-girdling root development
- C. Better weed control only
- D. Enhanced nutrient availability

69. Trees planted too deeply commonly develop what condition over time?

- A. Improved vigor
- B. Better anchorage
- C. Enhanced disease resistance
- D. Trunk decay and girdling roots

70. What diagnostic tool measures wood density by recording resistance as a needle penetrates the trunk?

- A. Sonic tomograph
- B. Increment borer
- C. Resistograph
- D. Mallet

71. ANSI A300 specifies that reduction cuts should be made to lateral branches of what minimum size?

- A. At least 1/3 the diameter of the removed branch
- B. At least 1/4 the diameter
- C. At least 1/2 the diameter
- D. Any size lateral is acceptable

72. What is "lion-tailing" and why is it harmful?

- A. A beneficial pruning technique
- B. Excessive removal of inner branches, causing end-weight loading and increased failure risk
- C. Proper crown cleaning
- D. A method for improving structure

73. Why is preserving mature trees during construction valuable?

- A. Only for reduced costs
- B. Simplified permits
- C. Lower insurance rates
- D. Immediate benefits that new plantings cannot provide for decades

74. What condition indicates a tree should not be climbed until alternative assessment is conducted?

- A. Previous pruning wounds
- B. Minor lichen growth
- C. Evidence of severe basal decay or structural failure
- D. Small deadwood in outer crown

75. What must the feed control bar on a wood chipper be capable of doing?

- A. Stopping or reversing the feed mechanism
- B. Increasing chip size
- C. Directing discharge
- D. Adjusting feed speed

76. Deficiency symptoms appearing on newest leaves indicate the nutrient has what characteristic?

- A. High mobility within the plant
- B. Immobility (cannot translocate from older tissue)
- C. Toxicity at low levels
- D. Abundance in soil

77. In tree appraisal, what does the location rating evaluate?

- A. Species characteristics
- B. Tree age
- C. Health condition
- D. The tree's functional and aesthetic contribution based on site

78. What is pollarding?

- A. Crown thinning
- B. A type of crown cleaning
- C. Repeated pruning back to permanent scaffold branches on a regular cycle
- D. Crown reduction

79. What factor most strongly influences the rate at which trees close wounds?

- A. Tree vigor and growth rate
- B. Wound dressing type
- C. Time of year
- D. Wound shape

80. What distinguishes sapwood from heartwood functionally?

- A. Heartwood conducts water more efficiently
- B. Sapwood contains living cells and conducts water
- C. Sapwood provides more structural support
- D. There is no functional difference

81. A thorough basic tree risk assessment should evaluate what areas?

- A. Only the trunk
- B. Only the crown
- C. Only the root zone
- D. Crown, trunk, root zone, and target area

82. A vertical crack extending from a branch union downward indicates what?

- A. Normal growth
- B. Improved strength
- C. A serious structural defect suggesting union failure
- D. A minor cosmetic issue

83. Air excavation tools use what medium to remove soil without damaging roots?

- A. Compressed air
- B. High-pressure water
- C. Chemical solvents
- D. Mechanical cutting

84. Reaction wood forms in trees in response to what condition?

- A. Normal vertical growth
- B. Non-vertical orientation (lean or bending)
- C. Drought stress
- D. Disease infection

85. When is fertilization most beneficial for established landscape trees?

- A. Every spring regardless of condition
- B. During drought stress
- C. Immediately after transplanting
- D. When testing confirms nutrient deficiency

86. A fungal fruiting body on a tree trunk is classified as what in disease diagnosis?

- A. A symptom
- B. Normal bark feature
- C. A sign (direct evidence of the causal organism)
- D. An environmental factor

87. What rigging component provides friction to control the descent rate of lowered pieces?

- A. Friction device or lowering line wrap
- B. Sling
- C. Choker
- D. Block alone

88. What is the correct sequence in integrated pest management?

- A. Apply pesticides first, then monitor
- B. Monitor, identify, determine if threshold is reached, select appropriate tactics
- C. Treat on a calendar schedule
- D. Remove all affected plants immediately

89. Oak wilt spreads between non-root-grafted trees primarily through what mechanism?

- A. Wind-dispersed spores
- B. Rain splash
- C. Contaminated tools
- D. Insect vectors (beetles) carrying spores to fresh wounds

90. What condition results when container-grown trees remain in pots too long?

- A. Enhanced root architecture
- B. Better transplant success
- C. Root-bound with circling roots
- D. Improved stability

91. Root collar (flare) excavation is performed to accomplish what?

- A. Expose and assess the root-trunk transition zone
- B. Improve drainage only
- C. Apply fertilizer
- D. Increase planting depth

92. Higher specific gravity of wood indicates what characteristic?

- A. Lower strength
- B. Greater density and mechanical strength
- C. Lighter weight
- D. More decay susceptibility

93. What type of inspection must occur before climbing any tree for work?

- A. Financial appraisal
- B. Marketing analysis
- C. Inventory count
- D. Pre-climb safety assessment for hazards

94. Tree protection fencing should be installed at what location and time?

- A. Only around the trunk
- B. After construction completion
- C. At the critical root zone boundary before construction begins
- D. When damage is observed

95. In IPM, action thresholds define what?

- A. Pest population levels at which intervention is justified
- B. Maximum pesticide rates
- C. Calendar dates for treatment
- D. Cost limits for pest control

96. Lightning protection systems for trees should be inspected at what interval?

- A. Never after installation
- B. Annually and after lightning events
- C. Every 10 years
- D. Monthly

97. What is the minimum recommended inspection frequency for cable and brace support systems?

- A. Every 10 years
- B. Monthly
- C. Only when failure occurs
- D. Annually and after major storms

98. Crown raising accomplishes what pruning objective?

- A. Reduces crown density
- B. Decreases overall tree height
- C. Provides vertical clearance beneath the crown
- D. Removes dead branches throughout

99. Nitrogen-fixing bacteria in legume root nodules convert what substance to plant-available form?

- A. Atmospheric nitrogen (N_2)
- B. Carbon dioxide
- C. Soil phosphorus
- D. Organic matter

100. In tree risk assessment, "consequences" refers to what?

- A. Probability of failure
- B. Severity of harm if failure occurs and strikes the target
- C. Tree species risk factors
- D. Assessment methodology

PRACTICE TEST 10: ANSWER KEY

WITH EXPLANATIONS

1. **B. Vascular cambium** - The vascular cambium is a cylindrical layer of meristematic cells located between the wood (xylem) and inner bark (phloem). It produces secondary xylem toward the inside of the tree and secondary phloem toward the outside. This lateral meristem is responsible for secondary growth—the increase in trunk and branch diameter that occurs each growing season. The cork cambium produces bark tissues, while the apical meristem produces primary growth.
2. **C. Two persons minimum** - ANSI Z133 requires at least two qualified persons during tree felling operations. One person operates the saw while the second serves as a lookout, can summon emergency assistance if needed, and assists with job coordination. Felling is among the most hazardous tree operations, and the presence of a second person provides critical safety backup. Some operations may require additional personnel based on specific hazards.
3. **A. Texture** - Soil texture refers to the relative proportions of sand, silt, and clay particles in the soil. It is a fundamental soil property that influences drainage, water-holding capacity, aeration, and nutrient retention. Texture is determined by particle size analysis and is classified using the soil textural triangle (sandy loam, clay loam, silt, etc.). Unlike structure, texture cannot be changed through management practices.
4. **D. Deciduous** - Deciduous trees lose all their leaves during a specific season each year, typically autumn in temperate climates. This adaptation conserves water and energy during unfavorable periods. The term comes from Latin "decidere" meaning "to fall off." Deciduous habit contrasts with evergreen (retaining foliage year-round) and marcescent (retaining dead leaves until pushed off by new growth).
5. **B. At the upper quadrant of the bar tip** - The kickback zone is located at the upper quadrant of the chain saw bar tip. When this area contacts wood or other objects, the chain's movement can cause the bar to rotate rapidly upward and backward toward the operator. Kickback is a leading cause of chain saw injuries. Safe operation requires awareness of bar tip position, using reduced-kickback chains, maintaining proper chain tension, and avoiding contact with the kickback zone.
6. **A. Thinning cut** - A thinning cut removes a branch at its point of origin—either at the trunk or at a parent branch. This type of cut reduces the number of branches without stimulating excessive regrowth. Thinning cuts are the primary cuts used in crown cleaning and crown thinning operations. They contrast with heading cuts, which remove branches at random points between nodes, stimulating multiple weakly attached sprouts.

7. **C. High nutrient-holding ability** - Cation exchange capacity (CEC) measures soil's ability to attract, hold, and exchange positively charged nutrient ions (cations) such as potassium, calcium, magnesium, and ammonium. High CEC indicates the soil can retain nutrients for plant uptake rather than losing them to leaching. Clay particles and organic matter contribute most to CEC due to their large surface area and negative electrical charges.
8. **D. Wall 4** - In the CODIT (Compartmentalization of Decay in Trees) model, Wall 4 is the barrier zone formed by new wood produced by the cambium after wounding. This wall is typically the strongest barrier because it consists entirely of new tissue with specialized chemical and physical properties designed to resist decay spread. Walls 1-3 are formed from existing tissue that must be chemically modified after wounding.
9. **A. Armillaria root rot** - Rhizomorphs are black, shoestring-like fungal structures characteristic of *Armillaria* species (honey fungus). These structures allow the fungus to spread through soil from infected trees or stumps to healthy roots. *Armillaria* is an aggressive root rot pathogen that can kill otherwise healthy trees. Other diagnostic signs include white mycelial fans beneath bark and honey-colored mushrooms at the tree base in autumn.
10. **B. 5,400 pounds** - ANSI Z133 specifies that arborist climbing lines must have a minimum breaking strength of 5,400 pounds (24 kN). This requirement provides an adequate safety margin for dynamic loading that occurs during climbing operations. Ropes meeting this standard are typically 11-13 mm (7/16 to 1/2 inch) diameter. Regular inspection is essential because rope strength can be compromised by wear, contamination, or damage.
11. **D. Phloem** - The pressure flow (mass flow) hypothesis explains sugar transport through phloem tissue. Sugars loaded into sieve tube elements at sources (mature leaves) increase osmotic pressure, drawing in water. This creates positive pressure that pushes sap toward sinks (roots, fruits, growing points) where sugars are unloaded, reducing pressure. This passive mechanism enables bidirectional transport depending on source-sink relationships.
12. **C. 3 to 6 inches** - Mulch should be kept 3-6 inches away from tree trunks. Contact between mulch and bark creates conditions favoring bark decay, provides habitat for bark-damaging rodents, and can encourage stem-girdling root development. Proper mulch application creates a donut shape around the tree, not a volcano shape piled against the trunk. This gap allows bark to dry and function normally.
13. **A. Simple** - A simple leaf has a single, undivided blade, though it may be lobed or have various margin types. The key distinction is that the blade is one piece, not divided into separate leaflets. Examples include maple, oak, and elm leaves. Compound leaves have blades divided into distinct leaflets—pinnately compound (leaflets along a rachis) or palmately compound (leaflets radiating from a single point).
14. **B. Water mold (*Phytophthora ramorum*)** - Sudden oak death is caused by *Phytophthora ramorum*, a water mold (oomycete) that kills tanoak and several oak species while also infecting

many other hosts. It spread from nursery stock and causes bleeding cankers on trunks of susceptible species. The pathogen thrives in wet conditions and has caused extensive mortality in California and Oregon coastal forests. Strict quarantines attempt to limit its spread.

15. **D. Limited applications such as restoration of topped trees or formal hedges** - Heading cuts are generally inappropriate because they stimulate multiple weakly attached sprouts and create ongoing maintenance needs. However, they have limited legitimate uses: restoration pruning of previously topped trees (selecting among existing sprouts), formal hedge maintenance, some fruit tree training systems, and pollarding when properly initiated and maintained. Understanding appropriate applications prevents misuse.
16. **C. Bracing** - Bracing involves installing rigid threaded steel rods through weak attachments, typically codominant stem unions with included bark. The rod provides direct mechanical connection between the two stems, preventing them from separating. Bracing is often combined with cabling (flexible cables installed higher in the crown) for comprehensive support. Unlike cables that limit movement, braces provide rigid reinforcement at the point of weakness.
17. **A. Endodermis** - The Casparian strip is a band of waxy material (suberin) in the cell walls of endodermal cells that surrounds the vascular tissue in roots. This strip forces water and dissolved minerals to pass through endodermal cell membranes rather than flowing between cells, allowing selective control over what enters the vascular system. This regulation is critical for nutrient uptake and exclusion of potentially harmful substances.
18. **B. Auxin** - Auxin is the primary hormone promoting cell elongation in shoots. Produced mainly in apical meristems and young leaves, it moves basipetally (downward) through the plant. Auxin maintains apical dominance by suppressing lateral bud growth and influences tropisms (growth responses to light and gravity). It was the first plant hormone discovered and remains central to understanding plant growth regulation.
19. **D. Tree height** - A clinometer measures angles, allowing calculation of tree height using trigonometry. By measuring the angle to the tree's top, the angle to its base (if different from eye level), and the distance from the tree, height can be calculated. Hypsometers combine angle and distance measurement to calculate height directly. These ground-based methods allow height measurement without climbing.
20. **C. Tunneling between leaf epidermal layers** - Leaf miners are larvae (of flies, moths, sawflies, or beetles) that feed by tunneling between the upper and lower epidermal layers of leaves, consuming mesophyll tissue while protected inside the leaf. Their feeding creates characteristic serpentine mines or blotches visible as light-colored trails or patches. Damage is usually more aesthetic than harmful to tree health, though severe infestations can stress trees.
21. **A. They do not prevent decay and may slow wound closure** - Decades of research have conclusively shown that wound dressings (pruning paints, sealers) do not prevent decay entry, do not accelerate healing, and may actually impede wound closure by trapping moisture or creating

conditions favorable for decay organisms. Trees compartmentalize wounds most effectively when left untreated. This scientific consensus contradicts traditional practices still sometimes seen.

22. **D. Bark beetles and root grafts** - Dutch elm disease, caused by fungi in the genus *Ophiostoma*, spreads primarily through two mechanisms: bark beetles (*Scolytus* and *Hylurgopinus* species) that carry fungal spores from infected trees to fresh wounds on healthy trees, and root grafts that form between adjacent elms, allowing direct fungal movement. Management strategies target both transmission routes through sanitation, vector control, and root graft disruption.
23. **B. The probability that failure will strike the target** - Likelihood of impact evaluates the probability that if the tree or part fails, it will actually strike the identified target. Factors include the target's location relative to potential failure direction, target occupancy rate (how often the target is present), and target mobility (whether it can move away). Even a tree certain to fail may have low impact likelihood if the target is rarely present.
24. **C. Cork cambium** - The phellogen (cork cambium) is the lateral meristem that produces the outer bark. It generates cork cells (phellem) toward the outside and phelloderm toward the inside. Cork cells are dead at maturity with walls impregnated with suberin, making them waterproof and protective. The cork cambium, cork, and phelloderm together constitute the periderm, which replaces the epidermis in woody plants.
25. **A. Root damage on the corresponding side** - Crown symptoms often mirror root zone conditions because specific root sectors supply corresponding crown portions. When roots on one side are damaged or lost (from construction, disease, or severing), the crown section they supplied loses its water and nutrient source, showing dieback while other portions remain healthy. This diagnostic pattern helps identify root problems not visible above ground.
26. **D. Chloroplasts** - Chloroplasts are organelles containing chlorophyll, the green pigment that captures light energy for photosynthesis. They are most abundant in mesophyll cells of leaves. Chloroplasts contain stacked membrane systems (grana) where light reactions occur and fluid stroma where carbon fixation takes place. They evolved from photosynthetic bacteria through endosymbiosis and contain their own DNA.
27. **B. Protection zones, fencing, prohibited activities, and monitoring requirements** - A comprehensive tree protection plan specifies which trees to preserve, protection zone boundaries (based on critical root zone calculations), fencing specifications, activities prohibited within protection zones, monitoring schedules and responsible parties, and procedures if damage occurs. The plan should be developed during project design and incorporated into construction contracts for enforcement.
28. **A. Nitrogen** - General chlorosis (yellowing) affecting the entire tree, particularly older leaves, most commonly indicates nitrogen deficiency. Nitrogen is mobile in plants, so when deficient, the plant remobilizes existing nitrogen from older leaves to support new growth, causing older leaves

to yellow first. Nitrogen is required in larger quantities than any other mineral nutrient and is frequently deficient in urban soils.

29. **C. Good compartmentalizers** - Trees vary significantly in their ability to form effective barriers against decay spread after wounding. Species with strong compartmentalization ability ("good compartmentalizers") produce robust chemical and physical barriers that effectively wall off infected tissue. Oaks, for example, are generally good compartmentalizers. Understanding species-specific compartmentalization ability helps predict wound response and guides pruning decisions.
30. **D. Remove or cut away at least the top one-third** - Wire baskets help maintain root ball integrity during handling but can restrict root growth and girdle expanding roots and trunk if left completely intact. At planting, at least the top one-third of the wire basket should be removed or cut away after the tree is positioned. Some practitioners remove more, but complete removal risks root ball collapse. All synthetic materials must be completely removed.
31. **B. Promotes aggregation and improves structure** - Organic matter improves soil structure by promoting aggregation—the binding of individual soil particles into larger clumps with pore spaces between them. Good structure improves aeration, water infiltration, drainage, and root penetration. Organic matter also provides food for soil organisms whose activities further enhance structure. Adding organic matter is one of the most effective soil improvement practices.
32. **A. Branch collar** - Proper pruning cuts preserve the branch collar, the swollen area at the base of a branch where it attaches to the parent stem. The collar contains specialized tissue that enables effective compartmentalization and wound closure. Cutting just outside the collar allows these tissues to function optimally. Flush cuts remove the collar and damage trunk tissue; stub cuts prevent proper closure.
33. **C. They penetrate root cell walls** - Arbuscular mycorrhizae (endomycorrhizae) penetrate root cell walls and form specialized structures (arbuscules and vesicles) inside cells for nutrient exchange. Ectomycorrhizae form an external sheath (mantle) and grow between root cells (Hartig net) without penetrating cell walls. Both types enhance nutrient and water uptake, but their structural relationships with roots differ significantly.
34. **D. Weakly attached sprouts, decay, and increased long-term hazard** - Topping causes multiple negative consequences: large wounds that cannot close properly become decay entry points; dormant buds stimulated to grow produce multiple sprouts with weak attachments prone to failure; reduced photosynthetic capacity stresses the tree; sun scald damages newly exposed bark. Topped trees become increasingly hazardous over time and require costly ongoing maintenance.
35. **B. 20 percent** - The 10-20-30 diversity guideline recommends that no single genus comprise more than 20% of an urban forest. This protects against genus-level threats like emerald ash borer, which affects all ash species (*Fraxinus* genus). Combined with species limits (10%) and family limits (30%), this approach provides comprehensive protection against threats at various taxonomic levels.

36. **A. It uses statistical sampling to estimate population characteristics** - Sample inventories collect data from statistically selected plots or transects and use statistical methods to estimate population characteristics (species composition, size distribution, condition) without documenting every tree. This approach is cost-effective for large areas but cannot generate specific work orders for individual trees. Complete inventories document every tree, enabling detailed individual management.
37. **D. Iron or manganese** - Interveinal chlorosis (yellowing between veins while veins remain green) on newest leaves is characteristic of iron or manganese deficiency. These micronutrients are immobile in plants—they cannot be translocated from older leaves to support new growth. Deficiency often results from high soil pH making these nutrients chemically unavailable rather than their absence from soil.
38. **C. Stop work and contact the utility company** - When minimum approach distances from electrical conductors cannot be maintained with planned work, operations must stop until the utility company de-energizes lines, installs protective covering, or provides appropriate supervision. There are no acceptable shortcuts. Only qualified line-clearance arborists with specific training may work within reduced distances from energized conductors.
39. **B. Circling and potentially girdling roots** - When trees remain in containers too long, roots reach container walls and begin growing in circles. After planting, these roots often continue circling rather than growing outward. They may eventually girdle (strangle) the trunk or major roots, causing decline or death years or decades later. Root inspection and correction at planting is essential but cannot fully correct severe defects.
40. **A. Structural defects AND a target that could be struck** - A hazard tree requires both elements: structural defects creating likelihood of failure AND targets within the potential failure zone that could be harmed. Without both components, there is no hazard regardless of tree condition. A severely defective tree in a remote location with no targets has no risk rating; a sound tree over a playground has no hazard designation.
41. **D. Primary growth** - Primary growth is the elongation of stems and roots produced by apical meristems at growing tips through cell division and elongation. This contrasts with secondary growth (diameter increase), produced by lateral meristems (vascular cambium and cork cambium). Both occur simultaneously in woody plants—primary growth extends the extremities while secondary growth increases girth of previously formed structures.
42. **C. Directly on the original root ball** - Newly planted trees have all their absorbing roots confined to the original root ball. This limited volume can dry out even when surrounding soil is moist because water moves poorly between dissimilar soil types. Irrigation must target the root ball directly, keeping it consistently moist until roots grow into surrounding soil over 1-3 years. As establishment progresses, irrigation can expand to a wider area.

43. **A. Proximity to the trunk (closer = more severe)** - Root damage severity increases with proximity to trunk because larger, more critical roots are located closer in, and a greater percentage of the root system is affected. Roots within 3× trunk diameter distance are critical; severing major roots in this zone often causes severe decline or death. Damage farther from the trunk affects smaller, more numerous roots with proportionally less impact.
44. **B. Fire blight** - Fire blight, caused by the bacterium *Erwinia amylovora*, is a devastating disease of trees in the rose family (Rosaceae). It causes rapid wilting and blackening of shoots, blossoms, and fruits, creating a scorched appearance. The disease spreads rapidly during warm, wet weather. Characteristic symptoms include shepherd's crook bending of shoot tips and bacterial ooze on infected tissue.
45. **D. Relative landscape value and desirability of the species** - The species rating in tree appraisal reflects characteristics affecting landscape value: longevity, maintenance requirements, pest susceptibility, growth rate, ornamental features, structural strength, and overall desirability. High-quality, long-lived species like oaks typically receive higher ratings than short-lived or problem-prone species. Ratings are often developed regionally to reflect local conditions.
46. **C. When internal defects are suspected but not visible** - Advanced assessment using specialized equipment (resistance drills, sonic tomographs, aerial inspection) is appropriate when conditions affecting management decisions cannot be determined through visual examination alone. When external indicators suggest internal problems (old wounds, fungal fruiting bodies, hollow sounds), specialized tools can quantify internal conditions for informed decision-making.
47. **A. Load test by applying weight gradually and observing for any response** - Before trusting a tie-in point with full weight and dynamic climbing loads, load testing helps verify its integrity. Apply body weight gradually while observing and listening for any movement, sounds, or visual changes indicating weakness. If any concern exists, select a different tie-in point. Visual inspection alone may miss internal defects that testing can reveal.
48. **B. Hazards, work plan, responsibilities, and emergency procedures** - ANSI Z133 requires job briefings before tree work begins. These meetings must communicate specific hazards identified at the site, the work plan and sequence, individual responsibilities, communication protocols, and emergency procedures. Briefings should be repeated when conditions change significantly. Effective communication prevents incidents resulting from misunderstanding.
49. **D. Cambium at wound margins** - Callus tissue (woundwood) is produced by the vascular cambium at wound margins. Cambial cells around wound edges divide and produce new tissue that gradually rolls over the wound surface from edges inward. The rate of callus production depends on tree vigor—actively growing trees close wounds faster. Proper pruning preserves the branch collar, optimizing callus production.
50. **C. Prevention and remediation through vertical mulching and organic matter** - Soil compaction is much easier to prevent than correct. Where compaction exists, remediation options

include vertical mulching (drilling holes filled with organic material), radial trenching, air injection, and surface organic matter application. These techniques gradually improve conditions but may not fully restore severely compacted soils. Prevention through effective protection remains the best strategy.

51. **A. Resilience against species-specific pest and disease losses** - Species diversity requirements exist primarily to prevent catastrophic losses when species-specific threats arrive. Communities dominated by single species or low diversity can lose entire canopy populations, as demonstrated by Dutch elm disease and emerald ash borer. Diversity ensures no single pest or disease can eliminate more than a portion of the urban forest.
52. **B. Until roots establish (usually 1-2 growing seasons)** - Staking and guying should remain only until roots establish sufficiently to anchor the tree independently—typically 1-2 growing seasons for most transplants. Leaving support longer prevents proper trunk development (trunk strengthening requires wind movement), creates potential for trunk girdling, and may cause hardware to become embedded as the tree grows.
53. **D. Crown density** - Crown thinning selectively removes branches throughout the crown to reduce density (number of branches and foliage) while maintaining natural shape and size. Benefits include improved light penetration, reduced wind resistance, and decreased weight on branch unions. This differs from crown reduction (reduces size) and crown raising (removes lower branches). Proper thinning is distributed throughout the crown.
54. **C. Photosynthesis** - When stomata close to conserve water during drought, carbon dioxide cannot enter leaves for photosynthesis. This creates a fundamental physiological tradeoff: water conservation versus carbon gain. Prolonged stomatal closure depletes energy reserves, reduces growth, and weakens defenses against pests and pathogens. Trees surviving severe drought may remain compromised for subsequent years.
55. **A. Living natural enemies (predators, parasitoids, pathogens)** - Biological control uses living organisms to suppress pest populations. Predators (lady beetles, lacewings) consume pests directly; parasitoids (parasitic wasps) develop inside pest bodies; and pathogens (Bt, entomopathogenic fungi) cause disease. Approaches include conservation (protecting existing natural enemies), augmentation (releasing additional ones), and classical (introducing natural enemies for invasive pests).
56. **B. The upper boundary where branch and trunk tissues meet** - The branch bark ridge is a raised line of bark at the top of a branch attachment where branch and trunk tissues meet and turn inward. It indicates where the pruning cut should begin—starting just above the ridge and angling down and away from the trunk. The ridge helps identify proper cut placement for optimal wound closure.
57. **D. 50 kV** - The minimum approach distance for unqualified workers is 10 feet for voltages below 50 kV. Above 50 kV, the distance increases by 4 inches for each additional 10 kV. For example, at

70 kV (20 kV above threshold), the minimum distance would be 10 feet plus 8 inches (4 inches × 2). These distances apply to all body parts, tools, and materials being handled.

58. **C. Reduction cuts are made to laterals at least 1/3 the diameter of the removed branch** - Reduction cuts remove back to lateral branches large enough (minimum one-third the diameter of the removed portion) to assume the terminal role and continue growing. This maintains natural form while reducing size. Heading cuts remove to random points or to laterals too small to assume terminal function, stimulating multiple weakly attached sprouts.
59. **A. What nutrients the tree has actually absorbed** - Foliar (tissue) analysis reveals nutrient concentrations within the plant itself, showing what has actually been taken up regardless of soil conditions. Nutrients may be present in soil but chemically unavailable, or roots may be damaged. Tissue analysis confirms whether nutrients are reaching the plant, complementing soil test information.
60. **B. Stop, secure position, and carefully untangle before proceeding** - If climbing equipment becomes entangled, stop immediately and secure your position before attempting to resolve the problem. Continuing to climb with entangled equipment creates unpredictable tensions and movement limitations that could trap or injure the climber. Take time to identify the entanglement and resolve it systematically.
61. **D. Prevention and overall plant health maintenance** - Plant health care shifts focus from reactive pest treatment to proactive health maintenance. Healthy, vigorous plants better resist and tolerate pest pressure. PHC integrates proper cultural practices, regular monitoring, accurate diagnosis, and intervention only when thresholds are exceeded. This approach typically reduces pesticide use while improving long-term plant health.
62. **C. The structural foundation where all loads transfer to the root system** - The trunk base is where all above-ground weight and wind loads transfer to the root system. Decay or damage at this location compromises the structural foundation and can cause complete tree failure. A wound of a given size at the base affects a greater percentage of load-bearing capacity than the same wound higher up where the trunk is larger relative to overall mass.
63. **A. Vascular cambium producing xylem** - Annual growth rings visible in tree cross-sections are formed by xylem (wood) produced by the vascular cambium. In temperate climates, early season growth produces larger, thinner-walled cells (earlywood); later growth produces smaller, thicker-walled cells (latewood). This alternating pattern creates visible rings. Each ring typically represents one year's growth.
64. **B. Early in the tree's life when branches are small** - Structural pruning is most effective when started early because corrections require only small cuts that close quickly with minimal stress. Removing a 1-inch competing leader causes far less harm than removing a 6-inch codominant stem later. Early intervention shapes growth before defects become serious problems. Regular pruning during the first 10-15 years establishes lifelong structure.

65. **D. Fungi** - Anthracnose diseases are caused by various fungal pathogens that produce characteristic irregular brown lesions, typically following leaf veins. Cool, wet spring weather favors infection. Common hosts include sycamore, oak, maple, ash, and dogwood. While anthracnose can cause significant defoliation, most healthy trees tolerate moderate infection and re-foliate.
66. **C. Increasing surface area for water and nutrient absorption** - Root hairs are tubular extensions of epidermal cells on young roots that dramatically increase surface area for absorption—by 5-20 times. A single root system may have billions of root hairs. They are short-lived (days to weeks), extremely fragile, and continuously replaced as roots grow. Their loss during transplanting explains why careful water management is critical for establishment.
67. **A. A high-occupancy target** - A busy parking lot represents a high-occupancy target—a location where people are frequently present and could be harmed by tree failure. Target occupancy significantly affects risk assessment because it determines how likely people would be present if failure occurred. High-occupancy targets require more careful risk management than rarely occupied areas.
68. **B. Oxygen deprivation and stem-girdling root development** - Excessive mulch depth (greater than 4-6 inches) creates multiple problems: reduced oxygen at root surfaces; excessive moisture retention against bark promoting decay; habitat for rodents that damage bark; and encouragement of adventitious and girdling root development in the mulch layer. Proper depth is 2-4 inches with a gap at the trunk.
69. **D. Trunk decay and girdling roots** - Trees planted too deeply have trunk bark in contact with soil moisture, promoting bark decay that may progress into wood. Additionally, buried trunks often develop adventitious roots that grow tangentially, eventually girdling the trunk or major roots. These problems may take years or decades to manifest, making deep planting a hidden cause of later decline.
70. **C. Resistograph** - A resistograph (resistance drill) measures the force required to advance a thin needle through wood, recording a profile of wood density. Sound wood offers consistent resistance; decay appears as zones of reduced resistance. This tool provides objective data about internal conditions along the drilling path, including decay location, extent, and residual wall thickness.
71. **A. At least 1/3 the diameter of the removed branch** - ANSI A300 specifies that reduction cuts should be made to lateral branches at least one-third the diameter of the branch being removed. Laterals of this size can assume the terminal role and continue growth without excessive sprouting. Cuts to smaller laterals function like heading cuts, stimulating multiple weakly attached sprouts.
72. **B. Excessive removal of inner branches, causing end-weight loading and increased failure risk** - Lion-tailing removes interior branches while leaving foliage only at branch ends. This concentrates weight at tips, creating lever-arm forces that stress branch unions. It also removes

damping foliage that slows branch movement in wind and exposes bark to sunscald. Lion-tailing increases failure risk and is an improper pruning practice.

73. **D. Immediate benefits that new plantings cannot provide for decades** - Mature trees provide substantial immediate benefits—shade, energy savings, stormwater management, air quality improvement, wildlife habitat, aesthetic value—that newly planted trees cannot match for 20-50+ years. A mature tree may provide hundreds of dollars in annual environmental benefits. These values cannot be replaced on any practical timeline, making preservation essential.
74. **C. Evidence of severe basal decay or structural failure** - Trees showing severe structural problems (extensive basal decay, horizontal cracks, recent lean with root plate movement) may not safely support climbing loads. The dynamic forces of climbing could trigger failure. Alternative access methods (aerial lifts) or ground-based assessment may be necessary. Pre-climb inspection specifically evaluates whether climbing is safe.
75. **A. Stopping or reversing the feed mechanism** - The chipper feed control bar is a critical safety device that stops or reverses the feed mechanism when pushed. If entanglement begins, pushing this bar may halt feed before the operator is pulled further into the machine. This device must be tested before operation and never disabled. Even with this safety feature, proper operating procedures remain essential.
76. **B. Immobility (cannot translocate from older tissue)** - Immobile nutrients (iron, manganese, boron, calcium, copper, zinc) cannot be moved from older tissue to support new growth. When deficient, developing leaves cannot receive these nutrients from existing reserves, so symptoms appear on newest leaves first. Understanding nutrient mobility explains deficiency symptom patterns and aids diagnosis.
77. **D. The tree's functional and aesthetic contribution based on site** - The location rating evaluates how the tree's position affects its value—functional benefits (shade, energy savings, screening) and aesthetic contribution to the property. A well-placed tree providing significant benefits receives a higher rating than an identical tree in a less functional location. Site factors and functional contributions influence the rating.
78. **C. Repeated pruning back to permanent scaffold branches on a regular cycle** - Pollarding is a traditional practice of repeatedly removing all growth back to permanent scaffold branches (pollard heads) on a regular cycle. When properly initiated on young trees and maintained consistently, pollarding creates distinctive forms. It differs from topping in being a planned system requiring ongoing management, not a one-time destructive cut.
79. **A. Tree vigor and growth rate** - Wound closure rate correlates directly with annual radial growth rate because callus is produced by cambial activity at wound margins. A vigorous tree producing substantial annual growth closes wounds faster than a stressed or slow-growing tree. This relationship emphasizes maintaining tree health when wounding is unavoidable and explains why wounds on declining trees may never close.

80. **B. Sapwood contains living cells and conducts water** - Sapwood is the outer portion of wood containing living parenchyma cells and functional xylem vessels that conduct water. As the tree grows, older sapwood converts to heartwood through cell death and extractive accumulation. Heartwood no longer conducts water or contains living cells but provides structural support and may resist decay due to extractives.
81. **D. Crown, trunk, root zone, and target area** - A thorough basic risk assessment systematically evaluates all tree parts that could fail (crown, trunk, root zone) plus the surrounding area to identify targets and assess consequences. Limiting assessment to any single zone potentially misses critical information needed for accurate risk rating and appropriate management response.
82. **C. A serious structural defect suggesting union failure** - Vertical cracks extending from branch unions downward indicate stress concentration and potential failure of included bark unions. These cracks may extend during loading, eventually causing complete separation. This is a serious structural defect often requiring immediate mitigation—the crack represents active structural failure in progress.
83. **A. Compressed air** - Air excavation tools use high-pressure compressed air to displace soil particles without cutting roots. This technology enables root examination, root collar investigation, and careful work in root zones while minimizing root damage. The ability to expose roots without severing them has expanded options for tree preservation and improved diagnostic capabilities.
84. **B. Non-vertical orientation (lean or bending)** - Reaction wood is specialized wood formed in response to non-vertical orientation, helping trees maintain position. In hardwoods, tension wood forms on the upper side of leaning stems, pulling upward. In conifers, compression wood forms on the lower side, pushing upward. Reaction wood has different properties than normal wood.
85. **D. When testing confirms nutrient deficiency** - Fertilization benefits trees when actual deficiencies limit health or growth. Soil or tissue testing identifies whether deficiencies exist and which nutrients are needed. Fertilizing without confirmed need wastes resources, may harm trees, and can pollute water. Most established trees in reasonably healthy landscapes do not require regular fertilization.
86. **C. A sign (direct evidence of the causal organism)** - Fungal fruiting bodies (mushrooms, conks, brackets) are reproductive structures of fungi—direct evidence of the organism itself. This makes them "signs" of disease, as opposed to "symptoms," which are plant responses. Finding a conk indicates established decay; determining significance requires assessing extent and structural impact.
87. **A. Friction device or lowering line wrap** - Friction devices (Port-a-wrap, rope wrapped around posts) allow ground personnel to control descent rate by applying friction to the lowering line. Proper friction control enables smooth, controlled lowering; insufficient friction allows dangerous uncontrolled descent. The person controlling friction has critical responsibility for safe rigging operations.

88. **B. Monitor, identify, determine if threshold is reached, select appropriate tactics** - Integrated pest management follows a systematic decision process: regular monitoring detects pests; accurate identification ensures appropriate response; action thresholds determine whether intervention is justified; and appropriate tactics are selected. This prevents unnecessary treatment while ensuring effective response when warranted.
89. **D. Insect vectors (beetles) carrying spores to fresh wounds** - Oak wilt spreads between non-root-grafted trees primarily via nitidulid (sap-feeding) beetles that carry fungal spores from infected trees to fresh wounds. These beetles are most active in spring and early summer—oak pruning is discouraged April-July in oak wilt areas. Root grafts spread the disease between connected trees.
90. **C. Root-bound with circling roots** - Trees grown too long in containers develop circling roots conforming to container walls. This root-bound condition persists after planting—roots often continue circling rather than growing outward. Without correction at planting, circling roots may eventually girdle the trunk, causing decline or death years later.
91. **A. Expose and assess the root-trunk transition zone** - Root collar excavation removes soil or debris burying the trunk base, allowing assessment of the root-trunk transition zone and identification of problems like girdling roots, trunk decay, or improper planting depth. Many tree problems trace to buried root flares. Excavation is both diagnostic and often therapeutic.
92. **B. Greater density and mechanical strength** - Specific gravity (ratio of wood density to water density) correlates directly with wood strength. Higher specific gravity indicates denser wood with more cell wall material per unit volume, resulting in greater mechanical strength. Species with high specific gravity (oak, hickory) produce stronger wood than those with low specific gravity.
93. **D. Pre-climb safety assessment for hazards** - Before climbing any tree, a thorough safety assessment must identify potential hazards: structural defects, decay, dead branches, electrical conductors, wildlife, and overall condition. This inspection determines whether the tree can safely support climbing and identifies conditions requiring precautions. Pre-climb assessment is mandatory under ANSI Z133.
94. **C. At the critical root zone boundary before construction begins** - Effective tree protection requires physical barriers installed at the critical root zone boundary before any construction activity begins—before equipment arrives. The fence must remain throughout construction and be clearly marked. Protection implemented after construction begins cannot prevent damage already done.
95. **A. Pest population levels at which intervention is justified** - Action thresholds define pest populations or damage levels at which treatment becomes justified because potential harm exceeds treatment costs and risks. Below threshold, pest presence is tolerated; above threshold, intervention is warranted. Thresholds vary with plant value, pest species, and management objectives.

96. **B. Annually and after lightning events** - Lightning protection systems require annual inspection to verify component condition and function. Additional inspection after lightning strikes detects damage not immediately visible. Tree growth may require conductor repositioning over time. Proper maintenance ensures continued protection throughout system service life.
97. **D. Annually and after major storms** - Tree support systems require regular inspection to ensure continued proper function. Annual inspection at minimum, plus inspection after significant storms, verifies hardware condition, cable tension, and tree growth around components. Neglected systems may fail to provide support or may damage trees as they grow.
98. **C. Provides vertical clearance beneath the crown** - Crown raising removes lower branches to increase clearance beneath the crown for pedestrians, vehicles, buildings, or sight lines. It should be accomplished gradually on young trees rather than removing large lower limbs from mature trees, which creates significant wounds and removes substantial photosynthetic capacity.
99. **A. Atmospheric nitrogen (N₂)** - Nitrogen-fixing bacteria (Rhizobium and relatives) in legume root nodules convert atmospheric nitrogen gas (N₂) to ammonia (NH₃), which plants use for growth. This symbiosis allows legumes to thrive in nitrogen-poor soils and enriches soil nitrogen. Legume trees include black locust, honeylocust, and redbud.
100. **B. Severity of harm if failure occurs and strikes the target** - Consequences in risk assessment evaluate what harm would result if the tree fails and strikes the target. Consequences range from negligible (minor property damage) to severe (serious injury or death). Factors include target type, vulnerability, and potential failure size. Higher consequences justify more aggressive mitigation.