

FULL-LENGTH PRACTICE TESTS

PRACTICE TEST 12 - 100 QUESTIONS

1. The movement of sugars from leaves to roots occurs through what vascular tissue?
 - A. Xylem
 - B. Epidermis
 - C. Phloem
 - D. Cork

2. According to ANSI Z133, what must all workers in the immediate work area wear during chain saw operations?
 - A. Hearing protection, eye protection, and head protection
 - B. Steel-toed boots only
 - C. Reflective vests only
 - D. Leather gloves only

3. What soil amendment most effectively improves both drainage in clay soils and water retention in sandy soils?
 - A. Sand
 - B. Gravel
 - C. Chemical fertilizers
 - D. Organic matter

4. A tree species that drops its leaves seasonally in response to cold or dry periods is classified as what?

- A. Evergreen
- B. Deciduous
- C. Marcescent
- D. Persistent

5. The undercut in the three-cut pruning method serves what primary purpose?

- A. Prevents bark tearing when the branch falls
- B. Speeds the cutting process
- C. Creates a proper pruning angle
- D. Marks the final cut location

6. What type of pruning is specifically defined as reducing the density of branches throughout the crown?

- A. Crown cleaning
- B. Crown raising
- C. Crown reduction
- D. Crown thinning

7. The ability of soil to hold and exchange positively charged nutrient ions is measured by what property?

- A. Soil texture
- B. Soil porosity
- C. Cation exchange capacity (CEC)
- D. Soil structure

8. Which CODIT wall is formed by plugged vessels above and below a wound to limit vertical decay spread?

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

9. D-shaped exit holes approximately 1/8 inch wide on ash trees are diagnostic of what pest?

- A. Emerald ash borer
- B. Asian longhorned beetle
- C. Bronze birch borer
- D. Bark beetles

10. What is the minimum breaking strength requirement for arborist climbing lines?

- A. 4,000 pounds
- B. 6,000 pounds
- C. 5,400 pounds
- D. 7,500 pounds

11. Root pressure can contribute to water movement in plants but is most significant during what conditions?

- A. Hot, dry days
- B. High transpiration periods
- C. When stomata are fully open
- D. Cool conditions with low transpiration and moist soil

12. What is the recommended mulch depth for landscape trees?

- A. 6-8 inches
- B. 2-4 inches
- C. 8-12 inches
- D. 1 inch maximum

13. A bipinnately compound leaf has leaflets arranged in what pattern?

- A. Along a single central rachis
- B. Radiating from one point
- C. Leaflets divided into secondary leaflets along multiple axes
- D. In opposite pairs

14. *Phytophthora ramorum*, which causes sudden oak death, belongs to what type of organism?

- A. Water mold (oomycete)
- B. True fungus
- C. Bacterium
- D. Virus

15. When should a climbing rope be inspected?

- A. Monthly only
- B. Before each use
- C. Annually
- D. Only when damage is suspected

16. What type of support system is most appropriate for a recently transplanted large tree?

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

17. The Casparian strip in root endodermis functions primarily to do what?

- A. Store carbohydrates
- B. Absorb water directly
- C. Regulate what enters the vascular system
- D. Produce lateral roots

18. What plant hormone delays leaf senescence and promotes cell division?

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

19. What instrument measures the angle to a tree's top and base for height calculation?

- A. Diameter tape
- B. Clinometer
- C. Resistograph
- D. Increment borer

20. Scale insects damage plants primarily through what feeding method?

- A. Chewing leaf tissue
- B. Tunneling in wood
- C. Creating galls
- D. Piercing and sucking plant fluids

21. What factor most significantly affects a tree's ability to compartmentalize decay after wounding?

- A. Tree health and vigor at the time of wounding
- B. Size of the wound dressing applied
- C. Season when wounding occurred
- D. Species of decay fungus

22. *Xylella fastidiosa* is the causal agent of what disease?

- A. Oak wilt
- B. Dutch elm disease
- C. Bacterial leaf scorch
- D. Fire blight

23. In risk assessment, what is considered when evaluating "consequences"?

- A. The probability of failure
- B. The severity of harm if failure strikes the target
- C. The cost of tree removal
- D. The age of the tree

24. Cork cells produced by the cork cambium provide what primary function?

- A. Water conduction
- B. Nutrient storage
- C. Photosynthesis
- D. Protection from water loss and physical damage

25. Progressive decline symptoms appearing over several years most likely indicate what?

- A. Chronic stress from multiple factors
- B. Acute bacterial infection
- C. Normal seasonal changes
- D. Genetic defect

26. Stomata are primarily located on what part of most leaves?

- A. Upper epidermis only
- B. Vascular bundles
- C. Lower epidermis
- D. Palisade mesophyll

27. A tree protection zone (TPZ) should extend to what minimum distance from the trunk?

- A. Equal to the canopy spread
- B. 3 feet regardless of tree size
- C. 6 feet for all trees
- D. Calculated as 1 foot per inch of trunk diameter (or greater based on conditions)

28. Manganese deficiency symptoms first appear on what part of the tree?

- A. Oldest leaves
- B. Youngest leaves
- C. Bark
- D. Roots

29. Species with weak compartmentalization ability include which of the following?

- A. Willows and poplars
- B. Oaks
- C. Beeches
- D. Hickories

30. When is the best time to transplant most deciduous trees?

- A. During active summer growth
- B. Mid-winter when frozen
- C. During dormancy (late fall or early spring)
- D. During flowering

31. What condition results when soil pores are filled with water, excluding oxygen?

- A. Drought stress
- B. Compaction
- C. Nutrient toxicity
- D. Waterlogging (saturation)

32. A stub cut is problematic because it does what?

- A. Damages the branch collar
- B. Prevents proper wound closure and invites decay
- C. Removes too much tissue
- D. Causes excessive bleeding

33. Which mycorrhizal type forms structures inside root cells for nutrient exchange?

- A. Ectomycorrhizae
- B. Parasitic fungi
- C. Saprophytic fungi
- D. Arbuscular (endomycorrhizae)

34. What is the typical response when more than 25% of live crown is removed from a mature tree?

- A. Enhanced growth
- B. Improved structure
- C. Accelerated wound closure
- D. Stress, epicormic sprouting, and depleted reserves

35. According to the 10-20-30 rule, no single species should represent more than what percentage of the urban forest?

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

36. A sample inventory differs from a complete inventory by doing what?

- A. Documenting every tree
- B. Using statistical sampling to estimate population characteristics
- C. Providing more individual tree detail
- D. Costing more to conduct

37. Nitrogen deficiency symptoms typically appear first on what leaves?

- A. Older leaves
- B. Youngest leaves
- C. Middle canopy leaves
- D. Leaves nearest the trunk

38. What is the minimum approach distance from electrical conductors below 50 kV for unqualified workers?

- A. 5 feet
- B. 15 feet
- C. 10 feet
- D. 20 feet

39. Girdling roots are most commonly caused by what?

- A. Excessive pruning
- B. Overwatering
- C. Disease infection
- D. Container production defects or planting too deeply

40. A tree with visible defects that has no targets within its failure zone has what risk rating?

- A. High risk
- B. Low or no risk because risk requires a target
- C. Extreme risk
- D. Moderate risk

41. Xylem tissue transports primarily what substances?

- A. Sugars and hormones
- B. Only hormones
- C. Water and dissolved minerals
- D. Carbohydrates only

42. How long does establishment typically take for a 2-inch caliper transplanted tree?

- A. Approximately 2 years
- B. 2-4 weeks
- C. 6 months
- D. 5 years minimum

43. Root loss from excavation on one side of a tree will cause symptoms to appear where?

- A. Throughout the entire crown uniformly
- B. At the top of the tree first
- C. On the opposite side
- D. On the corresponding side of the crown

44. Dutch elm disease is caused by what type of organism?

- A. Bacterium
- B. Fungus
- C. Water mold
- D. Virus

45. What does the condition rating in tree appraisal assess?

- A. Species characteristics
- B. Location value
- C. Tree health and structural integrity
- D. Age only

46. Level 3 advanced assessment is appropriate when what situation exists?

- A. Internal defects are suspected but cannot be evaluated visually
- B. Trees are newly planted
- C. Annual inventory updates are needed
- D. Trees appear healthy with no visible defects

47. Load testing a tie-in point involves what action?

- A. Visual inspection only
- B. Assuming adequate strength if diameter is sufficient
- C. No testing is necessary for live branches
- D. Gradually applying body weight while observing for any response

48. What information must be included in a pre-work job briefing?

- A. Long-term business plans
- B. Hazards, work plan, responsibilities, and emergency procedures
- C. Equipment purchase schedules
- D. Marketing strategies

49. The cambium produces callus tissue that does what?

- A. Grows from wound margins to close the wound
- B. Regenerates lost wood
- C. Heals the wound completely
- D. Replaces heartwood

50. Air excavation tools are used in tree care primarily for what purpose?

- A. Fertilizer injection
- B. Watering deep roots
- C. Removing soil without damaging roots
- D. Pest control applications

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

- A. Simplified maintenance
- B. Uniform aesthetics
- C. Lower initial costs
- D. Resilience against pest and disease outbreaks

52. When should tree stakes and guy wires be removed?

- A. After 5 years
- B. After root establishment (typically 1-2 growing seasons)
- C. Never
- D. After 10 years

53. Crown cleaning primarily removes what types of branches?

- A. Lower branches for clearance
- B. Branches throughout to reduce density
- C. Dead, dying, diseased, broken, and weakly attached branches
- D. Branches to reduce overall size

54. Extended drought stress causes trees to close stomata, which results in what?

- A. Reduced photosynthesis and depleted energy reserves
- B. Increased water absorption
- C. Enhanced growth
- D. Improved disease resistance

55. What approach does biological control use to manage pests?

- A. Synthetic chemical applications
- B. Calendar-based treatments
- C. Mechanical removal only
- D. Natural enemies (predators, parasitoids, pathogens)

56. Where is the branch collar located?

- A. At the tip of the branch
- B. At the base of the branch where it meets the trunk
- C. In the middle of the branch
- D. Only on dead branches

57. For each 10 kV above 50 kV, the minimum approach distance increases by how much?

- A. 2 inches
- B. 6 inches
- C. 4 inches
- D. 8 inches

58. What is the key difference between a heading cut and a reduction cut?

- A. Reduction cuts are made to laterals at least 1/3 the diameter of the removed branch
- B. Heading cuts are always preferred
- C. There is no difference
- D. Reduction cuts leave stubs for regrowth

59. When soil tests show adequate nutrients but the tree shows deficiency symptoms, what diagnostic test is most helpful?

- A. Additional soil testing
- B. Root excavation
- C. Bark sampling
- D. Foliar (tissue) analysis

60. If the climbing system becomes entangled during work, what should be done?

- A. Continue to a better position
- B. Stop, secure position, and carefully untangle before proceeding
- C. Cut the rope
- D. Descend immediately regardless of entanglement status

61. Plant health care programs prioritize what approach?

- A. Calendar-based pesticide applications
- B. Reactive treatment after problems develop
- C. Prevention and maintaining overall plant health
- D. Immediate removal of stressed plants

62. Wounds at the base of the trunk are structurally more significant because they affect what?

- A. The load-bearing foundation where all forces transfer to roots
- B. Aesthetic appearance only
- C. Leaf production
- D. Upper branch development

63. Latewood cells differ from earlywood cells by having what characteristics?

- A. Larger diameter
- B. Thinner walls
- C. More conductive capacity
- D. Smaller diameter with thicker walls

64. Structural pruning should begin at what stage of tree development?

- A. After the tree reaches mature size
- B. Early, when branches are small and corrections require minor cuts
- C. Only after defects become serious
- D. During the decline phase

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

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

66. Root hairs dramatically increase root surface area for what purpose?

- A. Structural support
- B. Hormone production
- C. Water and nutrient absorption
- D. Carbohydrate storage

67. In risk assessment, what does a children's playground beneath a tree with dead branches represent?

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

68. Mulch piled against the trunk of a tree can cause what problems?

- A. Only aesthetic issues
- B. Bark decay, rodent damage, and girdling root development
- C. Improved moisture retention
- D. Enhanced root growth

69. Deep planting commonly leads to what long-term problems?

- A. Excessive vigor
- B. Improved stability
- C. Trunk decay and girdling roots
- D. Enhanced drought tolerance

70. What diagnostic instrument records resistance as a needle penetrates through wood?

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

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

- A. One-half the diameter
- B. One-quarter the diameter
- C. Any size available
- D. One-third the diameter

72. Lion-tailing (removing inner branches while leaving only end foliage) causes what problem?

- A. Improved wind resistance
- B. Increased end-weight loading and higher failure risk
- C. Better branch structure
- D. Enhanced compartmentalization

73. Why is preserving existing mature trees valuable during development?

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

74. What tree condition indicates climbing should not proceed without further evaluation?

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

75. The feed control bar on a wood chipper must be capable of doing what when contacted?

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

76. Symptoms appearing on young leaves first indicate the deficient nutrient has what characteristic?

- A. High mobility
- B. Immobility (cannot translocate from older leaves)
- C. Abundance in soil
- D. Toxicity at any level

77. In tree appraisal, the species rating evaluates what?

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

78. Pollarding differs from topping in what fundamental way?

- A. They are identical practices
- B. Topping is always acceptable
- C. Pollarding is a planned, ongoing management system initiated on young trees
- D. Pollarding is done only once

79. What factor most significantly influences wound closure rate?

- A. Wound dressing application
- B. Exact shape of the cut
- C. Time of year
- D. Tree vigor and growth rate

80. What distinguishes sapwood from heartwood?

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

81. A complete basic risk assessment should evaluate what areas?

- A. Crown, trunk, root zone, and target area
- B. Crown only
- C. Trunk only
- D. Above-ground portions only

82. A horizontal crack through the trunk indicates what?

- A. Minor cosmetic defect
- B. Normal growth
- C. A serious structural defect indicating potential imminent failure
- D. Improved strength

83. Compressed air excavation removes soil by doing what?

- A. Dissolving it chemically
- B. Cutting through roots
- C. Washing it away with water
- D. Displacing particles without cutting roots

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

- A. Drought stress
- B. Non-vertical orientation or mechanical stress
- C. Disease infection
- D. Normal growth

85. Fertilization is most beneficial for landscape trees under what circumstances?

- A. When soil or tissue testing confirms nutrient deficiency
- B. Every spring regardless of condition
- C. During active drought
- D. Immediately after severe pruning

86. A fungal conk growing from a tree trunk is classified as what type of diagnostic evidence?

- A. An environmental factor
- B. A normal bark feature
- C. A sign (direct evidence of the pathogen)
- D. A symptom (plant response)

87. What rigging equipment component controls the descent rate of lowered pieces?

- A. Sling
- B. Choker
- C. Block alone
- D. Friction device

88. The correct sequence in integrated pest management is what?

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

89. Oak wilt is primarily transmitted between non-grafted trees by what mechanism?

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

90. Container-grown trees held too long typically develop what root condition?

- A. Circling/girdling roots
- B. Enhanced root architecture
- C. Deep taproot development
- D. Improved fibrous root mass

91. Root collar excavation is performed to accomplish what?

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

92. Wood with higher specific gravity has what characteristics?

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

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

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

94. Tree protection fencing should be installed when during a construction project?

- A. Before any construction activity begins
- B. After grading is complete
- C. When tree stress becomes visible
- D. At project completion for appearance

95. In IPM, action thresholds define what?

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

96. Lightning protection systems require inspection at what interval?

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

97. Cable and brace systems should be inspected at what minimum frequency?

- A. At least annually and after major storms
- B. Every 5 years
- C. Monthly
- D. Only when obvious problems develop

98. Crown raising provides what benefit?

- A. Reduced crown density
- B. Removal of dead branches
- C. Vertical clearance beneath the crown
- D. Reduced overall height

99. Nitrogen-fixing bacteria form symbiotic relationships with trees in what family?

- A. Fagaceae
- B. Pinaceae
- C. Rosaceae
- D. Fabaceae (legumes)

100. In tree risk assessment, likelihood of impact considers what factor?

- A. The severity of potential harm
- B. The probability that failure will strike the target
- C. The tree's species characteristics
- D. The cost of removal

PRACTICE TEST 12: ANSWER KEY

WITH EXPLANATIONS

1. **C. Phloem** - Phloem tissue is responsible for transporting sugars (primarily sucrose) produced during photosynthesis from source tissues (mature leaves) to sink tissues (roots, developing fruits, growing points, storage organs). This process, explained by the pressure flow hypothesis, involves active loading of sugars into sieve tube elements at sources, which draws water in osmotically, creating pressure that pushes the solution toward sinks where sugars are unloaded. Phloem is located just inside the bark, making it vulnerable to girdling damage.
2. **A. Hearing protection, eye protection, and head protection** - ANSI Z133 requires workers in the immediate area of chain saw operations to wear appropriate personal protective equipment including hearing protection (chain saws generate damaging noise levels), eye protection (from flying debris), and head protection (hard hats for protection from falling branches and debris). Additional PPE requirements may apply depending on specific operations, including leg protection for operators during certain cutting activities.
3. **D. Organic matter** - Organic matter is unique in its ability to improve both extremes of soil texture. In clay soils, it promotes aggregation, creating larger pore spaces that improve drainage and aeration. In sandy soils, organic matter increases water-holding capacity and nutrient retention by providing surfaces for water adhesion and cation exchange. It also supports beneficial soil organisms, provides slow-release nutrients, and improves overall soil structure regardless of original texture.
4. **B. Deciduous** - Deciduous trees shed all their leaves seasonally in response to environmental cues, typically cold temperatures in temperate climates or dry seasons in tropical regions. This adaptation conserves water and energy during unfavorable periods when photosynthesis would be inefficient or impossible. Leaf drop is preceded by nutrient resorption (the tree reclaims valuable nutrients) and formation of an abscission layer that separates the leaf from the stem.
5. **A. Prevents bark tearing when the branch falls** - The undercut (first cut in the three-cut method) is made on the bottom of the branch, cutting upward approximately one-third through the branch diameter. When the second cut is made from the top farther out on the branch, the branch falls when the cuts meet, but the undercut prevents the bark from tearing back along the trunk. Without this undercut, the weight of a falling branch can strip bark from the trunk, damaging valuable trunk tissue.
6. **D. Crown thinning** - Crown thinning is the selective removal of branches throughout the crown to reduce density while maintaining the tree's natural shape and size. This improves light

penetration to interior branches and the ground below, reduces wind resistance, and decreases weight on individual branches. Thinning cuts (removing branches at their point of origin) are used, and removal should be distributed throughout the crown rather than concentrated in any area.

7. **C. Cation exchange capacity (CEC)** - Cation exchange capacity measures the soil's ability to attract, hold, and exchange positively charged nutrient ions (cations) such as calcium, magnesium, potassium, and ammonium. Soil particles (especially clay) and organic matter carry negative charges that attract and hold these positively charged nutrients, preventing leaching and making them available for plant uptake. Higher CEC generally indicates greater nutrient-holding ability and soil fertility potential.
8. **B. Wall 1** - In the CODIT (Compartmentalization of Decay in Trees) model, Wall 1 is formed by plugging of xylem vessels above and below the wound, limiting vertical decay spread. This plugging occurs through tyloses (balloon-like outgrowths from adjacent parenchyma cells) and deposition of gums and resins. Wall 1 is typically the weakest of the four walls because vessels are designed for transport, not barrier function. Its effectiveness varies significantly among tree species.
9. **A. Emerald ash borer** - The emerald ash borer (*Agilus planipennis*) is an invasive beetle that has killed hundreds of millions of ash trees since its discovery in Michigan in 2002. Adult beetles create distinctive D-shaped exit holes approximately 1/8 inch (3-4 mm) wide when emerging from beneath the bark. Larvae feed on phloem and outer sapwood, creating serpentine galleries that disrupt vascular function. The D-shaped exit hole distinguishes EAB from other borers with round exit holes.
10. **C. 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 during climbing operations, including unexpected shock loads. Climbing lines meeting this standard are typically 11-13 mm diameter kernmantle construction. Regular inspection is essential because rope strength degrades with use, UV exposure, contamination, and damage.
11. **D. Cool conditions with low transpiration and moist soil** - Root pressure develops when mineral ions are actively pumped into root xylem, creating osmotic potential that draws water in. This pressure is most evident when transpiration is minimal (cool temperatures, high humidity, closed stomata) and soil moisture is abundant. Root pressure can cause guttation (water droplets on leaf edges) and contributes to refilling embolized vessels. However, it plays a minor role compared to transpiration-driven cohesion-tension in moving water to tree crowns.
12. **B. 2-4 inches** - Proper mulch depth is 2-4 inches for optimal benefits: moisture conservation, temperature moderation, weed suppression, and soil improvement. Shallower applications provide inadequate benefits; deeper mulch can cause oxygen deprivation at the root surface, excessive

moisture retention against the trunk, rodent habitat, and stem-girdling root development. Mulch should be kept 3-6 inches away from the trunk and spread in a wide area, not just a narrow ring.

13. **C. Leaflets divided into secondary leaflets along multiple axes** - Bipinnately (twice-pinnately) compound leaves have leaflets that are themselves divided into smaller leaflets (pinnules) along secondary axes. Examples include honeylocust, mimosa, and Kentucky coffeetree. This represents the most complex leaf division pattern. Understanding compound leaf types is essential for accurate tree identification and distinguishing individual leaflets from simple leaves.
14. **A. Water mold (oomycete)** - *Phytophthora ramorum*, which causes sudden oak death, is an oomycete (water mold), not a true fungus despite superficial similarities. Oomycetes are more closely related to brown algae than fungi and have distinct cell wall composition and reproductive structures. *P. ramorum* thrives in wet conditions and has caused extensive mortality in California and Oregon coastal forests, particularly affecting tanoak and several oak species while also infecting many other host plants.
15. **B. Before each use** - Climbing ropes must be inspected before each use to identify damage that could lead to failure. Inspection involves visual examination for cuts, abrasion, discoloration, and contamination, plus tactile examination (running the rope through hands) to detect core damage felt as soft spots, lumps, or inconsistencies. Any rope showing signs of significant damage must be immediately retired from climbing use. Pre-use inspection is a fundamental safety practice.
16. **D. Guying** - Guying systems use cables, straps, or rope running from the tree trunk to ground anchors (stakes or deadmen) to provide support during root establishment. This is the appropriate support system for recently transplanted large trees that lack sufficient root anchorage. Guy attachments should use broad straps to prevent bark damage. Systems should be removed after root establishment (typically 1-2 years) to allow proper trunk development and prevent girdling.
17. **C. Regulate what enters the vascular system** - The Casparian strip is a band of waxy suberin in endodermal cell walls that forms a barrier forcing water and dissolved minerals to pass through endodermal cell membranes rather than flowing passively between cells. This allows selective regulation of what enters the vascular system—the plant can control nutrient uptake and potentially exclude harmful substances. This checkpoint function is critical for maintaining appropriate internal chemistry.
18. **A. Cytokinin** - Cytokinins are plant hormones that promote cell division (cytokinesis), delay leaf senescence by maintaining chloroplast function and protein synthesis, and stimulate lateral bud growth. They are produced primarily in root tips and transported upward through the xylem. Cytokinins work antagonistically with auxins in many developmental processes. Reduced cytokinin production (from root damage or stress) often manifests as accelerated crown decline.
19. **B. Clinometer** - A clinometer measures angles, allowing calculation of tree height using trigonometry. The user measures the angle to the tree's top and the angle to its base (if different from eye level), along with the horizontal distance from the tree. Using these measurements, height

can be calculated. Some instruments (hypsonometers) combine angle measurement with distance measurement to calculate height directly. These tools allow height measurement from the ground without climbing.

20. **D. Piercing and sucking plant fluids** - Scale insects have piercing-sucking mouthparts (stylets) that penetrate plant tissue to withdraw fluids, typically phloem sap. Many scales are sessile (immobile) as adults, protected beneath waxy or hard coverings. Heavy infestations can weaken plants through continuous sap removal. Many scale species excrete honeydew (excess sugars from their diet), which supports sooty mold growth and attracts ants. Scales can also vector plant pathogens.
21. **A. Tree health and vigor at the time of wounding** - Compartmentalization effectiveness depends heavily on tree health and vigor when wounding occurs. Vigorous trees have energy reserves to invest in chemical barriers (phenolics, tannins) and can produce callus tissue rapidly. Wall 4 (barrier zone) strength particularly depends on growth rate—faster-growing trees produce more robust barriers. Stressed trees lack resources for effective compartmentalization, which is why wounds on declining trees often lead to extensive decay.
22. **C. Bacterial leaf scorch** - Bacterial leaf scorch is caused by the bacterium *Xylella fastidiosa*, which colonizes xylem vessels and blocks water transport. It is spread by xylem-feeding insects (leafhoppers, spittlebugs). Characteristic symptoms include marginal leaf scorch with a yellow or reddish halo between dead and green tissue, progressing and worsening over years. Many tree species are susceptible, including oaks, sycamores, elms, and maples. There is no cure; management focuses on stress reduction.
23. **B. The severity of harm if failure strikes the target** - Consequences in tree risk assessment evaluate the severity of harm that would result if failure occurs and strikes the target. Consequences range from negligible (minor property damage) to severe (serious injury or death, major property damage). Factors include target type (people are more vulnerable than structures), target value, and the size of the potential failure (twig versus whole tree). Higher consequences justify more aggressive risk mitigation.
24. **D. Protection from water loss and physical damage** - Cork cells are dead at maturity with cell walls impregnated with suberin, a waxy waterproof substance. This creates a protective barrier against water loss, physical damage, pathogens, and temperature extremes. Cork is the main component of outer bark. Its waterproof properties also make cork valuable commercially (wine corks, insulation). New cork layers must form as the tree expands because existing cork cannot stretch.
25. **A. Chronic stress from multiple factors** - Progressive decline symptoms developing over multiple years—crown thinning, reduced leaf size, early fall color, twig dieback, declining growth rate—characterize chronic stress syndrome or tree decline. This typically results from accumulated stresses: soil compaction, restricted rooting space, grade changes, repeated drought, root damage,

air pollution, or multiple factors interacting. Unlike acute problems with rapid onset, decline is gradual and often irreversible once advanced.

26. **C. Lower epidermis** - In most broadleaf trees, stomata are concentrated on the lower (abaxial) leaf surface, which is typically shaded and experiences lower temperatures than the upper surface. This placement reduces water loss by protecting stomata from direct sunlight and wind. Some species have stomata on both surfaces (amphistomatic leaves), particularly those with vertically oriented leaves. Stomatal density and distribution vary among species and can adapt to environmental conditions.
27. **D. Calculated as 1 foot per inch of trunk diameter (or greater based on conditions)** - The tree protection zone (TPZ) establishes the minimum area requiring protection during construction. Standard calculation is 1 foot radius per inch of trunk diameter (DBH), which encompasses most critical roots. However, this is a minimum—larger zones may be needed based on species sensitivity, root distribution, tree value, or site conditions. Protection zones should be fenced before construction begins and maintained throughout the project.
28. **B. Youngest leaves** - Manganese is an immobile nutrient that cannot be translocated from older tissue to support new growth. When manganese is deficient, developing leaves cannot obtain it from existing plant reserves, so deficiency symptoms appear on youngest leaves first. Typical manganese deficiency symptoms include interveinal chlorosis on new leaves. Deficiency often results from high soil pH making manganese chemically unavailable rather than its actual absence from soil.
29. **A. Willows and poplars** - Willows and poplars are examples of poor compartmentalizers—species that form weak chemical and physical barriers after wounding, allowing decay to spread extensively. Other poor compartmentalizers include birches and many fruit trees. Good compartmentalizers (oaks, beeches, hickories) form strong barriers that effectively limit decay spread. Understanding species-specific compartmentalization ability helps predict wound response and guides pruning decisions.
30. **C. During dormancy (late fall or early spring)** - Most deciduous trees transplant best during dormancy when water demand is minimal and energy is stored in roots. Late fall (after leaf drop) or early spring (before bud break) are ideal periods. Transplanting during active growth increases stress because the limited root system cannot meet the transpiring crown's water demands. Dormant transplanting allows root growth before the next growing season's demands begin.
31. **D. Waterlogging (saturation)** - When soil pores completely fill with water, air is excluded and the soil becomes waterlogged or saturated. Tree roots require oxygen for cellular respiration; without it, roots cannot function and begin dying within days during the growing season. While some species tolerate brief flooding, prolonged saturation kills most landscape trees. Proper site selection, drainage improvement, and avoiding overwatering help prevent waterlogging.

32. **B. Prevents proper wound closure and invites decay** - Stub cuts leave a portion of the branch extending beyond the branch collar. Because callus tissue develops from the cambium at the cut surface, stubs cannot close properly—the collar's wound-closure mechanism is bypassed. Stubs die, decay, and serve as entry points for pathogens that can spread into the trunk. Proper cuts just outside the branch collar allow effective closure by the collar's specialized tissues.
33. **D. Arbuscular (endomycorrhizae)** - Arbuscular mycorrhizae (AM), also called endomycorrhizae, form structures inside root cells—arbuscules (highly branched structures for nutrient exchange) and vesicles (storage structures). They penetrate root cell walls but not cell membranes. AM associations are extremely common, occurring in most plant families including many landscape trees. They dramatically enhance phosphorus uptake and provide other benefits. This contrasts with ectomycorrhizae, which form external sheaths without penetrating cell walls.
34. **D. Stress, epicormic sprouting, and depleted reserves** - Removing excessive live crown (more than 25% from mature trees) causes severe stress. The tree loses stored energy in removed branches and photosynthetic capacity. It often responds with vigorous epicormic sprouting—water sprouts from dormant buds with weak attachments. Depleted reserves reduce ability to compartmentalize wounds, defend against pests, and maintain normal functions. Over-pruning is a common cause of tree decline and increased hazard.
35. **C. 10 percent** - The 10-20-30 diversity guideline recommends that no single species comprise more than 10% of an urban forest population. This limit protects against species-specific threats like Dutch elm disease or sudden oak death. Combined with genus limits (20%) and family limits (30%), this multi-level approach provides comprehensive protection against pests and diseases at various taxonomic levels.
36. **B. Using 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 where complete inventories would be prohibitively expensive. Sample inventories provide population-level data for planning but cannot generate specific work orders for individual trees.
37. **A. Older leaves** - Nitrogen is a mobile nutrient that can be translocated from older tissue to support new growth. When nitrogen is deficient, the plant moves existing nitrogen from older leaves to developing leaves, causing older leaves to show symptoms first—typically general yellowing (chlorosis) beginning at leaf tips and margins and progressing inward. Severe deficiency causes older leaves to become completely yellow or even necrotic while newer leaves remain greener.
38. **C. 10 feet** - ANSI Z133 specifies that unqualified workers must maintain a minimum approach distance of 10 feet from electrical conductors at voltages below 50 kV. This distance applies to all body parts, tools, equipment, and materials being handled. Even conductors that appear to be

phone or cable lines may be attached to poles with energized components. Only qualified line-clearance arborists with specific training may work within reduced distances.

39. **D. Container production defects or planting too deeply** - Stem-girdling roots most commonly develop from circling roots in containers that continue circling after planting, or from trees planted too deeply (which encourages adventitious roots that may grow tangentially). These roots gradually enlarge and compress the trunk, restricting vascular flow. The problem may take years or decades to cause visible decline. Root collar examination can identify girdling roots, and early correction improves outcomes.
40. **B. Low or no risk because risk requires a target** - Tree risk requires both a potential for failure AND a target that could be harmed. Without a target in the potential failure zone, there is no risk regardless of the tree's structural condition. A severely defective tree in a remote location with no people, property, or activities has no risk rating. Risk assessment resources should focus on trees where failure would actually cause harm.
41. **C. Water and dissolved minerals** - Xylem tissue transports water and dissolved minerals (nutrients) from roots to leaves through the transpiration stream. This movement is primarily driven by transpiration (evaporation from leaves), which creates tension pulling water upward through continuous water columns in xylem vessels and tracheids. Xylem transport is passive—the tree expends no direct energy on water movement. Phloem, not xylem, transports sugars and other organic compounds.
42. **A. Approximately 2 years** - A general guideline for tree establishment is approximately one year per inch of trunk diameter (caliper). A 2-inch caliper tree would require approximately 2 years for roots to grow into surrounding soil and restore the ability to meet the crown's water demands without supplemental irrigation. Larger trees require proportionally longer establishment periods. During establishment, trees need consistent moisture in the root ball.
43. **D. On the corresponding side of the crown** - Root damage affects the crown portion supplied by those specific roots due to vascular connections between root sectors and crown sections. When roots on one side are lost, the corresponding crown section loses its water and nutrient supply, showing decline symptoms (wilting, scorch, dieback) while other portions remain healthier. This diagnostic pattern helps identify root problems not visible above ground.
44. **B. Fungus** - Dutch elm disease is caused by fungi in the genus *Ophiostoma* (*O. ulmi* and *O. novo-ulmi*). These vascular pathogens are transmitted by bark beetles and through root grafts between adjacent elms. The fungi colonize xylem vessels, triggering the tree's defensive response (tyloses) that, combined with fungal activity, blocks water transport. Dutch elm disease has killed millions of American elms since its introduction to North America in the 1930s.
45. **C. Tree health and structural integrity** - The condition rating in tree appraisal evaluates the tree's overall health (crown density, leaf size and color, growth rate, presence of decline symptoms) and structural integrity (absence of decay, cracks, weak attachments, codominant stems). Trees in

excellent condition receive 100%; significant health or structural problems reduce the rating proportionally. This factor substantially impacts final appraised value.

46. **A. Internal defects are suspected but cannot be evaluated visually** - Level 3 advanced assessment using specialized equipment (resistance drills, sonic tomographs, aerial inspection) is appropriate when conditions affecting management decisions cannot be determined through visual examination. When external indicators suggest internal problems (old wounds, fungal fruiting bodies, hollow sounds) but the extent cannot be determined visually, specialized tools provide quantitative data for informed decisions.
47. **D. Gradually applying body weight while observing for any response** - Load testing involves gradually applying body weight to the climbing system while carefully observing and listening for any movement, sounds (cracking, creaking), or visual changes in the tie-in point. This helps identify compromised anchors that might fail under dynamic climbing loads. If any concern arises during testing, immediately select a different anchor point. Visual inspection alone may miss internal defects.
48. **B. Hazards, work plan, responsibilities, and emergency procedures** - ANSI Z133 requires job briefings before tree work begins. These briefings must communicate specific hazards identified at the site, the work plan and sequence, individual crew member responsibilities, communication protocols, and emergency procedures (including rescue plans). Briefings should be repeated when conditions change significantly. Effective communication prevents incidents from misunderstanding.
49. **A. Grows from wound margins to close the wound** - Callus tissue (woundwood) is produced by the vascular cambium at wound margins. Cambial cells around the wound edges divide, producing new tissue that gradually rolls over the wound surface from edges inward. Trees do not regenerate lost tissue or truly "heal"—they compartmentalize damage and grow over it. Callus production rate depends on tree vigor; vigorous trees close wounds faster than stressed trees.
50. **C. Removing soil without damaging roots** - Air excavation uses compressed air to displace soil particles without cutting roots. This technology enables root examination, root collar investigation, careful work in root zones, and treatment of girdling roots while minimizing root damage that would occur with mechanical excavation. The ability to expose and work around roots without severing them has expanded options for tree preservation during construction and diagnostic capabilities.
51. **D. Resilience against pest and disease outbreaks** - Urban forest species diversity protects against catastrophic losses when species-specific threats arrive. The loss of American chestnut, American elm, and ash to pests and diseases demonstrates how monocultures or low-diversity forests are vulnerable to devastating losses. Diversity ensures no single pest or disease can eliminate more than a portion of the urban forest, maintaining overall canopy cover and community benefits.

52. **B. After root establishment (typically 1-2 growing seasons)** - Stakes and guy wires 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 as the tree grows against support materials, and may cause hardware to become embedded. Remove support systems on schedule.
53. **C. Dead, dying, diseased, broken, and weakly attached branches** - Crown cleaning specifically targets removal of problematic branches: dead, dying, diseased, broken, crossing, weakly attached, and low-vigor branches. This pruning type improves tree health by removing potential infection sources, enhances safety by removing branches most likely to fail, and improves appearance. Crown cleaning is often the most appropriate pruning type for mature trees and can be combined with other pruning objectives.
54. **A. Reduced photosynthesis and depleted energy reserves** - When stomata close during drought to conserve water, carbon dioxide cannot enter leaves for photosynthesis. With photosynthesis reduced or stopped, the tree cannot produce carbohydrates and must draw on stored reserves. Prolonged stomatal closure depletes these reserves, reducing growth, weakening defenses, and potentially causing decline that persists even after drought ends. This explains why drought effects often extend beyond the actual drought period.
55. **D. Natural enemies (predators, parasitoids, pathogens)** - Biological control uses living organisms to suppress pest populations. Predators (lady beetles, lacewings) consume pests directly; parasitoids (parasitic wasps, flies) develop inside pest bodies, killing them; and pathogens (*Bacillus thuringiensis*, entomopathogenic fungi) cause pest diseases. Approaches include conservation (protecting existing natural enemies), augmentation (releasing additional natural enemies), and classical (introducing natural enemies for invasive pests).
56. **B. At the base of the branch where it meets the trunk** - The branch collar is a swollen ring of tissue at the base of a branch where it attaches to the parent stem. It contains overlapping trunk and branch tissue with specialized cells for compartmentalization and wound closure. Pruning cuts should be made just outside the collar, preserving its function. The collar is often more visible on the underside of branches and may be subtle or pronounced depending on species and branch angle.
57. **C. 4 inches** - For voltages above 50 kV, the minimum approach distance increases by 4 inches for each additional 10 kV increment. For example, at 100 kV (50 kV above the threshold), the distance increases by 20 inches (4 inches \times 5 increments of 10 kV), making the total minimum distance 10 feet plus 20 inches, or approximately 11 feet 8 inches. Higher voltages can arc over greater distances, necessitating increased separation.
58. **A. 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 in the same general direction. 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—a fundamentally different and usually undesirable outcome.

59. **D. Foliar (tissue) analysis** - When soil tests show adequate nutrients but trees display deficiency symptoms, foliar analysis reveals what nutrients the tree has actually absorbed. This situation suggests nutrients are present in soil but unavailable (often due to pH problems making nutrients chemically inaccessible) or that root dysfunction prevents uptake. Tissue analysis identifies whether the problem is soil chemistry, root health, or other factors limiting nutrient acquisition.
60. **B. Stop, secure position, and carefully untangle before proceeding** - If the climbing system 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. Take time to carefully identify the entanglement source and resolve it systematically before proceeding. Rushing increases risk of making the situation worse or creating additional hazards.
61. **C. Prevention and maintaining overall plant health** - Plant health care programs emphasize proactive health maintenance over reactive pest treatment. Healthy, vigorous plants naturally resist and tolerate pest pressure better than stressed plants. PHC integrates proper cultural practices (appropriate watering, mulching, soil management), regular monitoring, accurate diagnosis, and intervention only when monitoring indicates thresholds are exceeded. This typically reduces pesticide use while improving outcomes.
62. **A. The load-bearing foundation where all forces transfer to roots** - 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 lead to complete tree failure. A wound of a given size at the base affects a greater percentage of the tree's load-bearing capacity than the same-sized wound higher on the trunk where diameter may be larger relative to wound size.
63. **D. Smaller diameter with thicker walls** - Latewood (summerwood) is produced later in the growing season when conditions are less favorable for rapid growth. These cells are smaller in diameter with thicker cell walls, providing greater mechanical strength. The contrast between large, thin-walled earlywood and small, thick-walled latewood creates the visible annual rings. Understanding wood anatomy helps interpret growth patterns and evaluate wood strength properties.
64. **B. Early, when branches are small and corrections require minor cuts** - Structural pruning is most effective when started early in tree development 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 structural problems. Regular evaluation and training during the first 10-15 years establishes lifelong structure.

65. **A. Fungi** - Anthracnose diseases are caused by various fungal pathogens (including *Apiognomonia*, *Colletotrichum*, and *Discula* species) that produce characteristic irregular brown lesions, often following leaf veins. Cool, wet spring weather favors infection and disease development. Common hosts include sycamore, oak, maple, ash, and dogwood. While anthracnose can cause significant defoliation in favorable years, most healthy trees survive and re-leaf.
66. **C. 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 compared to roots without hairs. A single root system may have billions of root hairs. They are extremely fragile, short-lived (days to weeks), and continuously replaced as roots grow. Their loss during transplanting explains why careful water management is critical during establishment.
67. **D. A high-occupancy target** - A children's playground represents a high-occupancy target—a location where vulnerable people (children) are frequently present. Target assessment in tree risk evaluation considers type (people vs. property), occupancy rate (frequency and duration of use), and vulnerability (children are more vulnerable than adults). High-occupancy targets with vulnerable occupants require more careful risk management than low-occupancy areas with lower-value targets.
68. **B. Bark decay, rodent damage, and girdling root development** - Mulch piled against tree trunks ("volcano mulching") causes multiple serious problems: constant moisture promotes bark decay that can progress into wood; the warm, moist environment attracts rodents (voles, mice) that gnaw bark; and roots growing into the mulch layer may develop as stem-girdling roots. Proper mulching maintains a 3-6 inch gap between mulch and trunk.
69. **C. Trunk decay and girdling roots** - Trees planted too deeply have trunk bark in contact with soil moisture, promoting bark decay that may progress into the 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. The root flare should always be visible at or slightly above grade.
70. **A. Resistograph** - A resistograph (resistance drill) measures the force required to advance a thin needle through wood, recording a profile of wood density along the drilling path. Sound wood offers consistent high resistance; decayed wood shows reduced resistance appearing as valleys on the recorded profile. This tool provides quantitative data about decay location, extent, and residual wall thickness for informed management decisions.
71. **D. One-third the diameter** - 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 minimum size can assume the terminal role and continue growth without stimulating excessive sprouting.

Cuts to smaller laterals function more like heading cuts, stimulating multiple weakly attached sprouts that create future maintenance needs and potential hazards.

72. **B. Increased end-weight loading and higher 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 attachments. It also removes damping foliage that normally slows branch movement in wind, leading to greater motion and stress during storms. Lion-tailing increases failure risk and is improper pruning technique.
73. **C. Immediate environmental 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 single mature tree may provide hundreds of dollars in annual benefits. These values cannot be replaced on any practical timeline, making preservation planning essential during development.
74. **A. Evidence of severe basal decay or structural failure** - Trees showing evidence of severe structural problems (extensive basal decay, horizontal trunk cracks, recent lean with root plate movement, active structural failure) should not be climbed until alternative assessment determines safety. Climbing adds dynamic forces that could trigger failure in compromised trees. Alternative access (aerial lift) or ground-based assessment may be necessary.
75. **D. Stopping or reversing the feed mechanism** - The feed control bar is a critical safety device positioned across the chipper feed opening 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 each use and never disabled. Despite this safety feature, proper operating procedures remain essential.
76. **B. Immobility (cannot translocate from older leaves)** - 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 is essential for diagnosing deficiencies based on symptom location in the canopy.
77. **A. 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-value, 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 and preferences.
78. **C. Pollarding is a planned, ongoing management system initiated on young trees** - Pollarding is a traditional practice of repeatedly removing all new growth back to permanent scaffold branches on a regular cycle. When properly initiated on young trees and maintained consistently, it creates distinctive forms and manages tree size. Topping, in contrast, is typically a one-time indiscriminate

cutting of mature trees without plans for ongoing management, creating serious structural and health problems.

79. **D. Tree vigor and growth rate** - Wound closure rate correlates directly with the tree's annual radial growth rate because callus tissue 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 explains why maintaining tree health is critical when wounding is unavoidable and why wounds on declining trees may remain open permanently.
80. **B. Sapwood contains living cells and conducts water** - Sapwood is the outer portion of wood containing living parenchyma cells (in rays and axial parenchyma) and functional xylem vessels that conduct water. As the tree grows, older sapwood gradually converts to heartwood through cell death and extractive accumulation. Heartwood no longer conducts water or contains living cells but provides structural support and often resists decay due to accumulated extractives.
81. **A. Crown, trunk, root zone, and target area** - A thorough basic risk assessment systematically evaluates all tree parts that could fail (crown for dead branches and attachment defects, trunk for cracks and decay, root zone for stability indicators and defects) 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.
82. **C. A serious structural defect indicating potential imminent failure** - Horizontal cracks through the trunk indicate the trunk is actively separating—structural failure in progress. Unlike vertical cracks that may be stable, horizontal cracks show shear failure. Movement visible when the tree sways confirms severity. Such trees typically require immediate mitigation. This is among the most serious defects encountered in tree risk assessment.
83. **D. Displacing particles without cutting roots** - Air excavation tools use high-pressure compressed air to blow soil particles apart and away from roots without cutting them. This allows root examination, root collar investigation, trenching in root zones, and girdling root treatment while minimizing damage that would occur with mechanical excavation. This technology has expanded options for tree preservation during construction.
84. **B. Non-vertical orientation or mechanical stress** - Reaction wood is specialized wood formed in response to non-vertical orientation (lean) or mechanical stress, helping trees maintain or regain upright 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 and affects both living trees and wood products.
85. **A. When soil or tissue 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 (excess nitrogen promotes succulent growth susceptible to pests), and can pollute water. Most established trees in reasonably healthy landscapes do not require regular fertilization.

86. **C. A sign (direct evidence of the pathogen)** - Fungal fruiting bodies (mushrooms, conks, brackets) are reproductive structures of the fungus—direct evidence of the organism itself. This makes them "signs" of disease, as opposed to "symptoms," which are plant responses (wilting, chlorosis, dieback). Finding a conk indicates established decay fungus; determining significance requires assessing decay extent and structural implications.
87. **D. Friction device** - Friction devices (Port-a-wrap, rigging wrench, rope wrapped around friction 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 with potential for shock loading. The person controlling the friction device has critical responsibility for safe rigging operations.
88. **B. Monitor, identify pest, determine if threshold is reached, select tactics** - Integrated pest management follows a systematic decision process: (1) regular monitoring detects pest presence, (2) accurate identification ensures appropriate response, (3) action thresholds determine whether intervention is justified, and (4) appropriate tactics are selected based on effectiveness, cost, and environmental impact. This approach prevents unnecessary treatment while ensuring effective response when warranted.
89. **C. Insect vectors (nitidulid 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 fungal mats on infected trees to fresh wounds on healthy trees. These beetles are most active in spring and early summer, which is why oak pruning is discouraged April-July in oak wilt areas. Root grafts spread the disease between connected trees.
90. **A. Circling/girdling roots** - Trees grown too long in containers develop circling roots that conform to container walls. This root-bound condition persists after planting—roots often continue circling rather than growing outward. Without correction at planting (cutting, spreading, or removing circling roots), they may eventually girdle the trunk, causing decline or death years or decades later.
91. **D. Expose and assess the trunk-root transition zone** - Root collar excavation removes soil, mulch, or debris burying the trunk base, allowing visual assessment of the root-trunk transition (root flare) 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 (identifying problems) and often therapeutic (allowing correction).
92. **B. Greater density and 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 and stiffness. Species with high specific gravity (oak, hickory) produce stronger wood than those with low specific gravity (cottonwood, willow).

93. **C. Pre-climb safety assessment for hazards** - Before climbing any tree, a thorough safety assessment must identify potential hazards: structural defects (cracks, decay, weak attachments), dead branches in the climbing path, electrical conductors, wildlife (especially stinging insects), and overall tree condition. This inspection determines whether climbing is safe and identifies conditions requiring precautions or alternative access methods. Pre-climb assessment is mandatory under ANSI Z133.
94. **A. Before any construction activity begins** - Effective tree protection requires physical barriers installed before any construction activity—before equipment arrives on site. The fence must be at the protection zone boundary, remain throughout construction, and be clearly marked. Protection implemented after construction begins cannot prevent damage already done; prevention is the only effective strategy.
95. **D. Pest levels at which treatment 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 because damage is minor or natural enemies may provide control. 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 (corrosion, damage, loose connections) and proper function. Additional inspection after lightning strikes detects damage not immediately visible. Tree growth may require conductor repositioning over time. Proper maintenance ensures the system provides intended protection throughout its service life.
97. **A. At least annually and after major storms** - Cable and brace support systems require regular inspection to ensure continued proper function. Annual inspection at minimum, plus inspection after significant storms (wind, ice, heavy snow), verifies hardware condition, cable tension, tree growth around components, and whether the system remains appropriate for current conditions. Neglected systems may fail or damage trees.
98. **C. Vertical clearance beneath the crown** - Crown raising removes lower branches to increase vertical clearance beneath the tree canopy for pedestrians, vehicles, sight lines, buildings, or other uses. It should be accomplished gradually through training young trees rather than removing large lower limbs from mature trees, which creates significant wounds and removes substantial photosynthetic capacity.
99. **D. Fabaceae (legumes)** - Nitrogen-fixing bacteria (*Rhizobium* and related species) form symbiotic relationships with trees in the legume family (Fabaceae), including black locust, honeylocust, Kentucky coffeetree, and redbud. Bacteria in root nodules convert atmospheric nitrogen (N_2) to ammonia (NH_3), which plants use for growth. This symbiosis allows legumes to thrive in nitrogen-poor soils and enriches soil for subsequent plants.

100. **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 target 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 or positioned away from likely failure direction.