

FULL-LENGTH PRACTICE TESTS

PRACTICE TEST 7 - 100 QUESTIONS

1. The layer of actively dividing cells that produces secondary xylem and secondary phloem is called what?
 - A. Cork cambium
 - B. Apical meristem
 - C. Vascular cambium
 - D. Pericycle

2. What is the first step that should be taken when arriving at a job site to perform tree work?
 - A. Conduct a job hazard assessment
 - B. Begin unloading equipment
 - C. Start the chain saw
 - D. Climb the tree to assess from above

3. Sandy soils typically have what characteristic that affects tree growth?
 - A. High water-holding capacity
 - B. Low water-holding capacity and rapid drainage
 - C. High cation exchange capacity
 - D. Poor drainage and waterlogging

4. A leaf with a smooth edge that has no teeth or lobes is described as having what type of margin?

- A. Serrate
- B. Dentate
- C. Lobed
- D. Entire

5. According to ANSI Z133, when must a second person be present during tree work operations?

- A. When using a chain saw or working at heights requiring climbing
- B. Only during commercial operations
- C. Only when working near electrical conductors
- D. Never; solo work is always permitted

6. Which type of pruning involves removing branches to provide clearance below the crown?

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

7. What property of clay soils makes them challenging for tree root growth during wet periods?

- A. Rapid drainage causing drought stress
- B. Poor drainage and reduced oxygen availability
- C. Low nutrient content
- D. High soil temperature fluctuations

8. In the CODIT model, which wall is typically the strongest barrier against decay spread?
- A. Wall 1 (vertical plugging)
 - B. Wall 2 (ring boundary)
 - C. Wall 3 (ray cells)
 - D. Wall 4 (barrier zone)
9. Serpentine galleries beneath ash bark and D-shaped exit holes are diagnostic signs of what pest?
- A. Asian longhorned beetle
 - B. Bronze birch borer
 - C. Emerald ash borer
 - D. Bark beetles
10. What is the appropriate action when a climber observes an unforeseen hazard while in a tree?
- A. Stop work, secure position, and reassess before proceeding
 - B. Continue work to finish quickly
 - C. Ignore minor hazards
 - D. Call out but continue working
11. The cohesion-tension theory explains the movement of water through what tissue?
- A. Phloem
 - B. Xylem
 - C. Cork
 - D. Pith

12. What is the maximum recommended depth for mulch application around trees?

- A. 1 inch
- B. 6 to 8 inches
- C. 10 to 12 inches
- D. 2 to 4 inches

13. A tree with leaves arranged in pairs at each node, directly across from each other, has what arrangement?

- A. Alternate
- B. Whorled
- C. Opposite
- D. Spiral

14. The presence of Armillaria mushrooms (honey fungus) at the base of a tree indicates what?

- A. Beneficial mycorrhizal relationship
- B. Root and butt rot caused by an aggressive pathogen
- C. Improved soil conditions
- D. Normal decomposition of surface mulch

15. What is the minimum diameter generally recommended for a safe tie-in point when climbing?

- A. 4 inches of live, sound wood
- B. 2 inches
- C. 6 inches
- D. Any diameter that initially supports the climber's weight

16. Bracing in tree support systems differs from cabling by providing what type of support?

- A. Flexible support in the upper crown
- B. Ground-level anchoring
- C. Support from adjacent trees
- D. Rigid direct reinforcement at the point of weakness

17. The pericycle is a root tissue responsible for initiating the development of what structures?

- A. Root hairs
- B. The root cap
- C. Lateral (branch) roots
- D. Mycorrhizal associations

18. Which plant hormone promotes cell division and is often found in high concentrations in roots?

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

19. Trunk diameter measured at 4.5 feet above ground level is referred to by what abbreviation?

- A. TD
- B. DBH
- C. TDH
- D. CBD

20. Aphids, scales, and leafhoppers are classified as what type of insect based on their feeding method?

- A. Defoliators
- B. Wood borers
- C. Gall-forming insects
- D. Sucking insects

21. Which statement about wound dressings on pruning cuts is supported by research?

- A. Wound dressings do not prevent decay and may slow wound closure
- B. Wound dressings should always be applied to fresh cuts
- C. Wound dressings accelerate compartmentalization
- D. Only latex-based dressings are effective

22. Verticillium wilt is a vascular disease that primarily affects what tissue?

- A. Root cortex
- B. Leaf mesophyll
- C. Xylem vessels
- D. Phloem

23. In tree risk assessment, which of the following is an example of a target?

- A. A cavity in the trunk
- B. A playground beneath the tree canopy
- C. Included bark at a branch union
- D. A fungal conk on the trunk

24. Cork cells that form the outer bark are produced by what tissue?

- A. Vascular cambium
- B. Apical meristem
- C. Pericycle
- D. Cork cambium (phellogen)

25. A tree exhibiting thinning crown, small leaves, and branch dieback over several years is most likely experiencing what condition?

- A. Decline from chronic stress
- B. Acute bacterial infection
- C. Nutrient toxicity
- D. Normal seasonal changes

26. The palisade and spongy mesophyll layers of a leaf are the primary site of what process?

- A. Water absorption
- B. Sugar storage
- C. Photosynthesis
- D. Transpiration regulation

27. What is the primary purpose of establishing a critical root zone during construction?

- A. To mark trees for removal
- B. To increase construction efficiency
- C. To calculate replacement costs
- D. To protect roots from damage and compaction

28. Chlorosis on the youngest leaves of a tree while older leaves remain green typically indicates deficiency of what nutrient type?

- A. Mobile nutrients
- B. Immobile nutrients such as iron
- C. All macronutrients equally
- D. Only nitrogen

29. The rate at which a tree can close a pruning wound is most directly related to what factor?

- A. The tree's growth rate and vigor
- B. The type of wound dressing used
- C. The exact shape of the cut
- D. The compass direction the wound faces

30. Treated or synthetic burlap on balled-and-burlapped trees should be handled at planting by doing what?

- A. Leaving it intact for root ball stability
- B. Burying it deeper
- C. Removing it completely because it will not decompose
- D. Treating it with decomposition accelerators

31. Soil compaction in the root zone most severely limits root function by reducing what?

- A. Soil nutrient content
- B. Soil temperature
- C. Soil pH
- D. Oxygen availability

32. The branch collar is important in pruning because it contains tissue specialized for what function?

- A. Water storage
- B. Compartmentalization and wound closure
- C. Photosynthesis
- D. Nutrient absorption

33. Which type of mycorrhizal fungi forms a visible sheath around roots without penetrating cell walls?

- A. Ectomycorrhizae
- B. Endomycorrhizae
- C. Arbuscular mycorrhizae
- D. Vesicular-arbuscular mycorrhizae

34. The typical growth response following a heading cut is what?

- A. Single strong replacement branch
- B. Complete healing with no regrowth
- C. Multiple sprouts with weak attachments
- D. Improved branch structure

35. According to urban forest diversity guidelines, what is the maximum percentage of any single family that should be represented?

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

36. A complete tree inventory differs from a sample inventory in that it does what?

- A. Uses statistical sampling techniques
- B. Documents every individual tree
- C. Is less accurate
- D. Costs less to conduct

37. Interveinal chlorosis on the newest leaves is most characteristic of deficiency in which nutrient?

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

38. What is the proper response when unexpected electrical lines are discovered during tree operations?

- A. Stop work immediately and contact the utility company
- B. Continue if the lines appear to be telephone cables
- C. Work carefully around them
- D. Use wooden tools only and proceed

39. What root defect commonly develops in container-grown trees that are held in pots too long?

- A. Excessive taproot growth
- B. Improved root architecture
- C. Increased fine root density
- D. Circling and potentially girdling roots

40. A tree that has structural defects with potential to fail AND is located where failure could harm people or property is called what?

- A. A declining tree
- B. A hazard tree
- C. A stressed tree
- D. A defective tree only

41. The elongation of shoots and roots through cell division at growing tips is called what type of growth?

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

42. What is the recommended approach for watering a newly planted tree?

- A. Apply water directly to the original root ball, adjusting frequency to conditions
- B. Water only the surrounding soil
- C. Apply light misting to leaves daily
- D. No watering is needed if mulch is applied

43. Which root damage scenario typically causes the most severe impact on tree health?

- A. Loss of fine roots only
- B. Exposure of surface roots
- C. Damage to roots beyond the dripline
- D. Severing large roots close to the trunk

44. Fire blight disease affects trees in which plant family?

- A. Pinaceae
- B. Rosaceae
- C. Fagaceae
- D. Betulaceae

45. In the trunk formula method of tree appraisal, the condition rating reflects what?

- A. Tree health and structural integrity
- B. Species suitability for the site
- C. Location relative to buildings
- D. Tree age

46. Advanced tree risk assessment using specialized equipment is most appropriate when?

- A. Assessing healthy trees with no defects
- B. Evaluating recently planted trees
- C. Internal decay is suspected but not visible externally
- D. Minor deadwood is present in the outer crown

47. What minimum characteristics must a branch have to serve as a safe climbing tie-in point?

- A. Any diameter that holds the climber initially
- B. Dead wood at least 6 inches diameter
- C. 2 inches diameter
- D. Live, sound wood at least 4 inches diameter with good attachment

48. What is the purpose of conducting a job briefing before tree work?

- A. To calculate job cost
- B. To communicate hazards, responsibilities, and emergency procedures
- C. To market services to clients
- D. To document tree species

49. Callus tissue that grows to close wounds is produced by what structure?

- A. Heartwood
- B. Pith
- C. Cambium at wound margins
- D. Root tips

50. What is the most effective approach for treating established soil compaction in tree root zones?

- A. Prevention combined with vertical mulching and organic matter incorporation
- B. Heavy fertilization
- C. Foliar spraying
- D. Increased irrigation only

51. The 10-20-30 rule for urban forest diversity establishes limits on what?

- A. Tree heights
- B. Planting densities
- C. Maintenance budgets
- D. Percentages of species (10%), genus (20%), and family (30%)

52. What type of support system uses cables from the tree to ground anchors?

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

53. When reducing tree height, what type of cut should be used?

- A. Reduction cuts to laterals capable of assuming terminal role
- B. Heading cuts at random points
- C. Topping at uniform height
- D. Flush cuts at the trunk

54. Trees conserve water during drought conditions through what physiological mechanism?

- A. Increasing transpiration
- B. Expanding stomatal openings
- C. Closing stomata to reduce water loss
- D. Immediate leaf shedding

55. Which pest management approach modifies growing conditions to reduce pest problems?

- A. Chemical control
- B. Augmentative biological control
- C. Classical biological control
- D. Cultural control

56. The branch bark ridge indicates what in relation to proper pruning?

- A. Where wound dressing should be applied
- B. The upper boundary of the branch attachment for guiding cut placement
- C. Areas of decay
- D. Where flush cuts should be made

57. At what voltage does the minimum approach distance from electrical conductors begin to increase beyond the base 10 feet?

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

58. Crown thinning is performed to achieve what objective?

- A. Stimulate dense regrowth
- B. Create wildlife habitat stubs
- C. Reduce crown density while maintaining natural form
- D. Lower tree height

59. What information does tissue (foliar) analysis provide that soil testing cannot?

- A. Soil pH
- B. Soil texture
- C. Organic matter content
- D. Nutrients actually absorbed by the tree

60. If a tie-in point fails a pull test before climbing, what action should be taken?

- A. Proceed with extra caution
- B. Select a different anchor point and retest
- C. Add extra wraps to the friction hitch
- D. Continue if the failure seemed minor

61. Plant health care emphasizes what approach over reactive pest treatment?

- A. Calendar-based chemical applications
- B. Immediate pesticide spraying
- C. Prevention and maintaining overall plant health
- D. Removing all affected plants

62. Which wound location presents the greatest concern for tree structural stability?

- A. Large basal wounds on the lower trunk
- B. Small wounds on outer branches
- C. Wounds in the upper crown
- D. Minor bark scrapes

63. The annual increase in trunk diameter produced by the vascular cambium is called what?

- A. Primary growth
- B. Apical growth
- C. Terminal extension
- D. Secondary growth

64. When should structural pruning of young trees begin?

- A. Only after defects become serious problems
- B. Early, when corrections require small cuts
- C. After the tree reaches mature size
- D. Never; trees should grow without pruning

65. What type of organism causes anthracnose diseases?

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

66. What structure at the root tip protects the meristem during growth through soil?

- A. Root cap
- B. Root hairs
- C. Pericycle
- D. Endodermis

67. In tree risk assessment, a sidewalk beneath a tree with dead branches represents what?

- A. A structural defect
- B. A sign of disease
- C. An assessment location
- D. A target

68. What is the proper placement of mulch in relation to the tree trunk?

- A. Piled against the trunk
- B. Several inches away from trunk with no contact
- C. Covering the root flare
- D. In direct contact with bark

69. The development of adventitious roots above the original root flare typically indicates what?

- A. The tree was planted too deeply
- B. Excellent soil aeration
- C. Optimal moisture
- D. Superior tree vigor

70. What diagnostic tool measures wood density as a probe penetrates the trunk?

- A. Increment borer
- B. Mallet sounding
- C. Resistance drill (resistograph)
- D. Visual inspection

71. According to ANSI A300, a reduction cut should be made to a lateral branch that is at least what proportion of the removed branch diameter?

- A. One-quarter
- B. One-half
- C. Two-thirds
- D. One-third

72. What symptom typically appears first in trees experiencing drought stress?

- A. Excessive flowering
- B. Wilting and/or leaf scorch
- C. Bark splitting
- D. Root rot

73. What is the primary benefit of species diversity in urban forests?

- A. Uniform appearance
- B. Simplified maintenance
- C. Resilience against species-specific pests and diseases
- D. Reduced costs

74. What tree condition indicates climbing should not proceed until further assessment?

- A. Significant basal decay or evidence of structural failure
- B. Minor lichen growth
- C. Small outer crown deadwood
- D. Previous proper pruning

75. What safety device on a wood chipper stops the feed mechanism when activated?

- A. Discharge deflector
- B. Engine governor
- C. Fuel shutoff
- D. Feed control bar

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

- A. Immobility in the plant
- B. Mobility allowing translocation to newer growth
- C. Toxicity at any level
- D. No relationship to symptom location

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

- A. The tree's functional and aesthetic contribution based on its site
- B. Only distance from buildings
- C. Soil quality
- D. Climate suitability

78. The practice of repeated removal of growth back to permanent scaffold branches on a regular cycle is called what?

- A. Crown thinning
- B. Vista pruning
- C. Pollarding
- D. Crown cleaning

79. What factor most strongly influences the rate of wound closure on trees?

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

80. What is the physiological function of heartwood in a living tree?

- A. Water conduction
- B. Structural support only (no longer physiologically active)
- C. Nutrient storage
- D. Sugar transport

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

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

82. A horizontal crack through a tree trunk indicates what level of concern?

- A. High concern indicating potential imminent structural failure
- B. No significant concern
- C. Minor concern only
- D. Moderate concern requiring routine monitoring

83. What is the purpose of air excavation in tree care?

- A. Fertilizer injection
- B. Efficient watering
- C. Vegetation removal
- D. Removing soil without damaging roots

84. The retention of dead leaves through winter is called what?

- A. Abscission
- B. Marcescence
- C. Senescence
- D. Dormancy

85. When is fertilization most likely to benefit an established landscape tree?

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

86. What distinguishes a disease sign from a symptom?

- A. Signs are direct evidence of the causal agent; symptoms are plant responses
- B. Signs always appear first
- C. Symptoms are always more visible
- D. There is no difference

87. Which rigging component changes rope direction and can provide mechanical advantage?

- A. Sling
- B. Choker
- C. Port-a-wrap
- D. Block or pulley

88. What is the correct sequence for implementing integrated pest management?

- A. Apply pesticides, then monitor
- B. Monitor, identify, determine if threshold reached, select tactics
- C. Preventive calendar treatment
- D. Eliminate monitoring to save costs

89. When are beetle vectors most likely to transmit oak wilt disease?

- A. During spring and early summer when attracted to fresh wounds
- B. During winter dormancy
- C. Only in fall
- D. Equally year-round

90. What is the primary cause of transplant shock in newly planted trees?

- A. Excessive root mass
- B. Genetic weakness
- C. Loss of root mass creating water supply deficit
- D. Too much shade

91. What does visible root flare at the trunk base indicate?

- A. Root disease
- B. That the flare should be buried
- C. Poor species selection
- D. Proper planting depth

92. Specific gravity of wood is most directly related to what property?

- A. Color
- B. Density and strength
- C. Bark characteristics
- D. Leaf size

93. What assessment should be performed before climbing a tree for work?

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

94. What is the most effective method for protecting tree roots during construction?

- A. Installing protective fencing at CRZ boundary before construction
- B. Verbal notification to contractor
- C. Marking trees with paint
- D. Watering after construction

95. What is the purpose of action thresholds in integrated pest management?

- A. Maximize pesticide applications
- B. Schedule treatments by calendar
- C. Eliminate monitoring
- D. Determine when pest levels justify intervention

96. A complete lightning protection system includes air terminals, conductors, and what?

- A. Solar panels
- B. Ground rods
- C. Insulation only
- D. Irrigation connections

97. How often should tree support systems (cables and braces) be inspected?

- A. At least annually and after major storms
- B. Only when problems appear
- C. Every 10 years
- D. Monthly

98. Which pruning type removes dead, dying, diseased, and broken branches?

- A. Crown reduction
- B. Vista pruning
- C. Crown cleaning
- D. Crown thinning

99. Nitrogen-fixing bacteria in legumes form what structures?

- A. Leaf galls
- B. Bark lesions
- C. Stem nodules
- D. Root nodules

100. In tree risk assessment, "likelihood of impact" evaluates what?

- A. Probability of tree failure
- B. Probability that failure will strike the target
- C. Severity of damage
- D. Tree species risk

PRACTICE TEST 7: ANSWER KEY

WITH EXPLANATIONS

1. **C. Vascular cambium** - The vascular cambium is a thin cylindrical layer of meristematic (actively dividing) cells located between the bark and wood. It is responsible for secondary growth, producing secondary xylem (wood) toward the inside of the tree and secondary phloem toward the outside. This continuous cell division is what allows trees to increase in diameter throughout their lives. The cork cambium produces bark tissues, while the apical meristem is responsible for primary (lengthwise) growth.
2. **A. Conduct a job hazard assessment** - Before beginning any tree work, the first priority is safety assessment. This includes evaluating the tree's condition, identifying potential hazards (electrical lines, dead branches, decay, traffic, bystanders), determining escape routes, and planning the work sequence. ANSI Z133 requires this assessment before work begins. Starting equipment or climbing before assessment creates unnecessary risk and violates industry safety standards.
3. **B. Low water-holding capacity and rapid drainage** - Sandy soils have large particle sizes (0.05-2.0 mm) that create large pore spaces. Water drains rapidly through these pores, leaving little moisture available for plant uptake. This characteristic means trees in sandy soils are prone to drought stress and may require more frequent irrigation. Sandy soils also have low cation exchange capacity, meaning they hold fewer nutrients. However, their excellent drainage prevents waterlogging and provides good soil aeration for root respiration.
4. **D. Entire** - A leaf with an entire margin has smooth, continuous edges without any teeth, serrations, or lobes. Examples include magnolia, dogwood, and live oak. This contrasts with serrate margins (teeth like a saw), dentate margins (pointed teeth), and lobed margins (deep indentations creating distinct lobes). Leaf margin characteristics are important identification features used year-round, even on fallen leaves.
5. **A. When using a chain saw or working at heights requiring climbing** - ANSI Z133 requires a second qualified person be present during high-risk operations including chain saw use and climbing work. This person can summon help, perform rescue if needed, and assist with job coordination. The requirement recognizes that the most dangerous tree work operations—cutting and climbing—create situations where a single worker who becomes injured or trapped cannot self-rescue. This is not merely a recommendation but a safety standard requirement.
6. **C. Crown raising** - Crown raising (also called crown lifting or raising) involves removing lower branches to increase vertical clearance beneath the tree canopy. This is commonly performed to allow pedestrian or vehicle passage, improve sight lines, or provide clearance for structures. Crown

raising should be performed gradually on young trees rather than removing large lower limbs from mature trees, which creates large wounds and removes significant photosynthetic capacity.

7. **B. Poor drainage and reduced oxygen availability** - Clay soils have very small particle sizes (less than 0.002 mm) that create tiny pore spaces. Water moves slowly through clay, and during wet periods, these pores remain filled with water rather than air. Tree roots require oxygen for cellular respiration, and waterlogged clay soils can cause oxygen deprivation (anoxia) leading to root death. While clay soils have excellent nutrient-holding capacity, their drainage limitations can be problematic for many tree species.
8. **D. Wall 4 (barrier zone)** - In the CODIT (Compartmentalization of Decay in Trees) model, Wall 4 is the barrier zone formed by new wood laid down by the cambium after wounding occurs. This wall is typically the strongest because it is composed of entirely new tissue with specialized chemical and physical properties that resist decay spread. Walls 1-3 are formed from existing tissue that must be chemically modified to resist decay, making them generally weaker. Understanding CODIT helps arborists appreciate why wound location and tree vigor at the time of injury affect decay development.
9. **C. Emerald ash borer** - The emerald ash borer (*Agrilus planipennis*) produces distinctive serpentine (S-shaped) larval galleries beneath ash bark and D-shaped adult exit holes approximately 1/8 inch wide. These signs are diagnostic for this devastating invasive pest, which has killed hundreds of millions of ash trees since its discovery in Michigan in 2002. The D-shaped exit hole distinguishes EAB from other borers like Asian longhorned beetle (round holes) or native bark beetles (smaller holes). Early detection is critical for management decisions.
10. **A. Stop work, secure position, and reassess before proceeding** - When unexpected hazards are discovered during climbing, the safest response is to immediately stop work, secure your position, and carefully evaluate the new information before deciding how to proceed. Continuing to work while assessing increases risk. Hazards discovered during climbing might include previously hidden decay, wildlife (especially stinging insects), unstable branches, or structural defects not visible from the ground. Sometimes the appropriate response is to descend and develop a new work plan.
11. **B. Xylem** - The cohesion-tension theory explains water movement through xylem tissue from roots to leaves. Transpiration from leaves creates negative pressure (tension) that pulls water upward. Water molecules' cohesive properties (attraction to each other) and adhesion to xylem walls maintain continuous water columns throughout the tree. This passive mechanism can move water to heights exceeding 300 feet in the tallest trees without requiring energy expenditure by the plant. Root pressure contributes only slightly to this movement.
12. **D. 2 to 4 inches** - Mulch should be applied 2-4 inches deep for optimal benefits. This depth conserves soil moisture, moderates soil temperature, suppresses weeds, and improves soil structure as it decomposes. Shallower applications provide inadequate benefits, while deeper mulch (6+

inches) restricts oxygen exchange, creates habitat for rodents that may girdle bark, retains excessive moisture against the trunk, and encourages stem-girdling root development. Proper mulch depth is one of the most important yet frequently violated tree care practices.

13. **C. Opposite** - Opposite leaf arrangement has leaves emerging in pairs at each node, positioned directly across from each other on the stem. Common trees with opposite arrangement include maples, ashes, dogwoods, and buckeyes—remembered by the acronym MADCap Horse (Maple, Ash, Dogwood, Caprifoliaceae, Horse chestnut). This arrangement is less common than alternate arrangement and is a useful identification characteristic, especially in winter when examining twig structure.
14. **B. Root and butt rot caused by an aggressive pathogen** - Armillaria species (honey fungus) are aggressive root rot pathogens that can kill healthy trees. The honey-colored mushrooms appearing in clusters at the tree base in autumn are fruiting bodies indicating established infection. Other diagnostic signs include white mycelial fans beneath bark and black rhizomorphs ("shoestrings") in soil. Armillaria spreads through root contact and can persist in dead stumps for years, infecting nearby susceptible trees. This is a significant structural concern requiring careful assessment.
15. **A. 4 inches of live, sound wood** - Safe tie-in points require live, healthy branches at least 4 inches in diameter at the point where the climbing system attaches. The branch must have sound attachment to the parent stem without included bark, cracks, or decay. Load testing by pulling firmly on the installed climbing line before committing full weight helps verify the tie-in point will hold. Dead branches, regardless of size, should never be used as primary tie-in points because they may fail without warning.
16. **D. Rigid direct reinforcement at the point of weakness** - Braces are threaded steel rods installed through weak attachments (typically codominant stem unions) to provide rigid, direct structural support at the exact point of weakness. They prevent the two stems from moving apart. Cables, in contrast, are flexible and are installed higher in the crown to limit movement rather than provide rigid support. Bracing is often combined with cabling for comprehensive support of codominant stems with included bark.
17. **C. Lateral (branch) roots** - The pericycle is a layer of cells inside the root, between the endodermis and vascular tissue, that retains meristematic capability. When lateral root formation is initiated, pericycle cells begin dividing to form a new root primordium that grows outward through the cortex and epidermis. This process allows the root system to branch and expand. The pericycle's location inside the root means lateral roots originate from within the parent root rather than from surface tissues.
18. **A. Cytokinin** - Cytokinins are plant hormones that promote cell division (cytokinesis) and are produced primarily in root tips and transported upward through the xylem. They work antagonistically with auxins in many developmental processes: while auxin promotes apical dominance, cytokinins promote lateral bud growth. Cytokinins also delay leaf senescence by

maintaining chloroplast function. This hormone's production in roots explains why root damage often leads to crown decline—reduced cytokinin supply affects crown health.

19. **B. DBH** - DBH stands for Diameter at Breast Height, the standard measurement taken at 4.5 feet (54 inches or 1.37 meters) above ground level on the uphill side of the tree. This standardized measurement point allows consistent comparison between trees and over time. When trees have abnormalities at 4.5 feet (swelling, branches, wounds), the measurement is taken at the nearest representative point above or below the abnormality. DBH is fundamental to tree inventory, appraisal, and management planning.
20. **D. Sucking insects** - Aphids, scales, leafhoppers, and similar insects have piercing-sucking mouthparts that penetrate plant tissue to feed on phloem sap or cell contents. Many sucking insects excrete honeydew—excess sugar solution from their diet—which accumulates on surfaces below and supports sooty mold growth. This honeydew and associated sooty mold is often the first indication of infestation. Sucking insects can vector plant pathogens, cause leaf distortion, and weaken plants through continuous sap removal.
21. **A. Wound dressings do not prevent decay and may slow wound closure** - Decades of research have demonstrated that wound dressings (pruning paints, sealers) do not prevent decay entry, do not accelerate wound closure, and may actually impede the tree's natural wound response by trapping moisture or creating conditions favorable for decay organisms. Healthy trees compartmentalize wounds most effectively when left untreated. The practice of applying wound dressings persists despite scientific evidence against it, making this an important concept for arborists to understand and communicate.
22. **C. Xylem vessels** - Verticillium wilt is caused by soil-borne fungi (*Verticillium dahliae* and *V. albo-atrum*) that infect roots and colonize xylem vessels, blocking water transport. Symptoms include wilting (often on one side of the tree first), vascular discoloration (brown streaking visible in cut branches), and progressive decline. The disease is particularly problematic in maples, elms, and many other susceptible species. Because the pathogen persists in soil, replanting susceptible species in the same location often results in reinfection.
23. **B. A playground beneath the tree canopy** - A target in tree risk assessment is anything of value that could be harmed if the tree or a portion of it fails. A playground is an important target because children—the most vulnerable population—gather there. Target assessment considers occupancy rate (how often and how long targets are present), mobility (can targets move away from danger), and value. Without a target, there is no risk regardless of tree condition, which is why target assessment is a critical component of risk evaluation.
24. **D. Cork cambium (phellogen)** - The cork cambium (also called phellogen) is a lateral meristem that produces cork cells (phellem) to the outside and phelloderm to the inside, collectively forming the periderm. Cork cells are dead at maturity, have cell walls impregnated with suberin (a waxy substance), and provide protection against water loss, mechanical damage, and pathogens. The

cork cambium replaces the epidermis as the tree grows and develops bark, with new cork cambium layers forming as the tree expands in diameter.

25. **A. Decline from chronic stress** - Progressive symptoms developing over multiple years—crown thinning, reduced leaf size, branch dieback, and overall reduction in vigor—characterize tree decline. Decline typically results from accumulated chronic stresses (soil compaction, restricted rooting space, grade changes, root damage, repeated drought) that gradually deplete tree resources. This differs from acute problems that cause rapid symptom development. Decline is often irreversible once advanced, making early recognition and stress reduction important for tree preservation.
26. **C. Photosynthesis** - The mesophyll tissue, comprising palisade and spongy parenchyma layers, contains chloroplast-rich cells where photosynthesis primarily occurs. Palisade mesophyll (usually beneath the upper epidermis) has columnar, tightly packed cells optimized for light capture. Spongy mesophyll has irregularly shaped cells with air spaces that facilitate gas exchange for CO₂ uptake and O₂ release. The arrangement maximizes both light absorption and gas exchange efficiency in the limited space within the leaf.
27. **D. To protect roots from damage and compaction** - The critical root zone (CRZ) establishes a protection boundary to prevent the two most damaging construction impacts: physical root severance and soil compaction. The standard calculation (1 foot radius per inch trunk diameter) encompasses most of the tree's structural and absorbing roots. Effective protection requires physical barriers (fencing) installed before construction begins, maintained throughout the project, and accompanied by specifications prohibiting equipment entry, material storage, and grade changes within the zone.
28. **B. Immobile nutrients such as iron** - Immobile nutrients cannot be translocated from older tissue to support new growth. When these nutrients are deficient, the plant cannot move existing supplies to developing leaves, so symptoms appear on the youngest tissue first. Iron and manganese deficiency characteristically cause interveinal chlorosis (yellowing between veins while veins remain green) on new leaves. This contrasts with mobile nutrient deficiency (nitrogen, potassium, magnesium) where symptoms appear on older leaves as the plant remobilizes nutrients to new growth.
29. **A. The tree's growth rate and vigor** - Wound closure rate is directly proportional to the tree's annual growth rate because callus tissue is produced by cambial activity at wound margins. Vigorous trees produce more new wood annually and close wounds faster than stressed or slow-growing trees. A 2-inch wound on a fast-growing tree might close in 5 years, while the same wound on a stressed tree might take 15 years or never close completely. This relationship underscores the importance of maintaining tree health when wounding is unavoidable.
30. **C. Removing it completely because it will not decompose** - Synthetic burlap, treated burlap, nylon strapping, and plastic twine do not decompose and will eventually girdle the trunk and

surface roots as they expand against these materials. Complete removal of all synthetic materials is essential at planting. Natural, untreated burlap will decompose (though slowly) and may be left on the bottom of the root ball, but the top portion should still be removed or folded away from the trunk. Wire baskets should have at least the top one-third removed.

31. **D. Oxygen availability** - Soil compaction compresses pore spaces, reducing the soil's ability to hold air. Tree roots require oxygen for cellular respiration—the process that converts sugars to energy. When oxygen is unavailable, roots cannot function and begin to die. Compaction also reduces water infiltration, creating both drought conditions (water runs off rather than infiltrating) and potential waterlogging in low spots. Root growth through compacted soil is physically impeded even when oxygen is present.
32. **B. Compartmentalization and wound closure** - The branch collar contains specialized tissue that enables efficient compartmentalization of decay after branch removal and production of callus tissue that closes wounds. When pruning cuts properly preserve the collar (cutting just outside it), this tissue can function effectively. Flush cuts that remove the collar damage trunk tissue and impair wound response. Understanding collar anatomy and function is fundamental to proper pruning technique.
33. **A. Ectomycorrhizae** - Ectomycorrhizal fungi form a visible mantle (sheath) around root tips and grow between root cortex cells (forming the Hartig net) but do not penetrate root cell walls. This type is common in temperate forest trees including oaks, pines, birches, and beeches. Endomycorrhizae (including arbuscular mycorrhizae) penetrate root cell walls and form structures inside cells. Both types dramatically enhance water and nutrient absorption, but their structural relationships with roots differ significantly.
34. **C. Multiple sprouts with weak attachments** - Heading cuts remove the terminal bud and its apical dominance, releasing multiple dormant buds below the cut to grow. These sprouts originate from surface tissues (beneath bark) rather than from deep within the branch, creating inherently weak attachments. Multiple sprouts compete for dominance, often developing included bark between them. This poor structural response is why heading cuts (and topping) create future hazard and require ongoing maintenance—the opposite of the desired pruning outcome.
35. **D. 30 percent** - The 10-20-30 diversity rule recommends limiting any single family to no more than 30% of the urban forest, any genus to 20%, and any species to 10%. This protects against catastrophic losses from pests or diseases that typically affect related trees. The devastation caused by Dutch elm disease (affecting the elm genus) and emerald ash borer (affecting the ash genus) demonstrates why diversity at all taxonomic levels matters.
36. **B. Documents every individual tree** - Complete inventories collect data on every tree in the defined area, enabling individual tree management, specific work orders, detailed condition tracking, and precise location mapping. Sample inventories collect data from statistically selected plots or transects and project findings to estimate population characteristics—useful for planning

but not for managing specific trees. Complete inventories require more resources but provide data essential for comprehensive urban forest management.

37. **C. Iron or manganese** - Interveinal chlorosis (yellowing between veins while veins remain green) on the newest leaves is the classic symptom pattern for iron or manganese deficiency. These micronutrients are immobile in the plant, so they cannot be translocated from older leaves to support new growth. The deficiency often results from high soil pH (alkaline conditions) making these nutrients chemically unavailable rather than their actual absence from soil. Foliar applications or trunk injections bypass soil chemistry problems.
38. **A. Stop work immediately and contact the utility company** - Discovering unexpected electrical lines requires immediate work stoppage. Never assume wires are safe based on appearance—communication cables and power lines can look similar, and even communication infrastructure may be attached to power poles with energized components nearby. Only the utility company can confirm line types and voltages. Proceeding with work near unidentified lines violates safety standards and creates life-threatening hazard.
39. **D. Circling and potentially girdling roots** - When trees remain in containers too long, roots reach the container walls and begin growing in circles. After planting, these roots often continue their circular pattern rather than growing outward into surrounding soil. Circling roots may eventually girdle (strangle) the trunk or major roots, causing decline or death years or decades after planting. Root inspection and correction (cutting, spreading, or removing circling roots) at planting is essential but cannot completely correct severe defects.
40. **B. A hazard tree** - The definition of a hazard tree requires both components: structural defects creating likelihood of failure AND targets that could be harmed if failure occurs. A tree with severe defects in a remote forest with no targets has no risk rating regardless of condition. Conversely, a structurally sound tree over a playground has no hazard tree designation. Understanding this two-part definition is fundamental to tree risk assessment and management decision-making.
41. **C. Primary growth** - Primary growth is the elongation of shoots and roots through cell division at apical meristems (growing tips). This growth increases plant length, producing new leaves, stems, and root length. Secondary growth, produced by lateral meristems (vascular cambium and cork cambium), increases diameter. Both types of growth occur simultaneously in woody plants, with primary growth at the extremities and secondary growth in previously formed stems and roots.
42. **A. Apply water directly to the original root ball, adjusting frequency to conditions** - Newly planted trees have all their roots in the original root ball, which can dry out even when surrounding soil is moist because water doesn't move well between different soil types. Water must be applied directly to the root ball. Frequency depends on weather, soil type, root ball size, and tree response—typically starting with every 2-3 days and adjusting based on soil moisture monitoring. Establishment watering continues for one to three years depending on tree size.

43. **D. Severing large roots close to the trunk** - Root damage severity increases with root size (larger roots serve larger crown portions), proximity to trunk (roots closer in serve greater percentages of the root system), and total percentage of system affected. Roots within 3× trunk diameter distance are critical; damage within this zone often causes decline or death. Damage beyond the dripline affects smaller roots serving smaller crown portions and usually has minimal impact on overall tree health.
44. **B. Rosaceae** - Fire blight, caused by the bacterium *Erwinia amylovora*, affects trees and shrubs in the rose family (Rosaceae) including apple, pear, crabapple, hawthorn, mountain ash, serviceberry, and ornamental *Prunus* species. The disease causes rapid wilting and blackening of shoots, which curl into characteristic "shepherd's crook" shapes. Bacterial ooze may be visible on infected tissue. Fire blight spreads during warm, wet weather and enters through flowers or wounds.
45. **A. Tree health and structural integrity** - The condition rating in the trunk formula method evaluates the tree's overall health (crown density, leaf size and color, growth rate, absence of decline symptoms) and structural integrity (absence of decay, cracks, included bark, codominant stems, and other defects). Trees in perfect condition receive 100%; significant health or structural problems reduce the rating proportionally. This factor can dramatically affect appraised value—a tree with 50% condition rating is worth only half its potential value.
46. **C. Internal decay is suspected but not visible externally** - Advanced assessment using specialized equipment (resistance drills, sonic tomographs, aerial inspection) is appropriate when conditions that cannot be determined visually may significantly affect management decisions. When external indicators suggest internal decay (fungal fruiting bodies, old wounds, hollow sounds when sounding), but the extent cannot be determined visually, specialized tools can provide quantitative data about wood density, decay location, and residual wall thickness for informed decision-making.
47. **D. Live, sound wood at least 4 inches diameter with good attachment** - Safe tie-in points require multiple characteristics: live wood (dead wood fails unpredictably), sound condition (no decay, cracks, or defects), adequate diameter (at least 4 inches at the attachment point), and proper attachment to the parent stem (no included bark or previous failure). Load testing before committing weight helps verify the system will hold. The "4-inch rule" is a minimum; larger diameter and better position are always preferable.
48. **B. To communicate hazards, responsibilities, and emergency procedures** - Job briefings (tailgate meetings, pre-job planning) ensure all crew members understand the work plan, specific hazards present, how hazards will be controlled, individual responsibilities, communication protocols, and emergency procedures. This communication is required by ANSI Z133 before tree work begins and again when conditions change significantly. Effective briefings prevent miscommunication that contributes to many serious incidents.

49. **C. Cambium at wound margins** - Callus tissue (woundwood) is produced by the vascular cambium at wound margins. Cambial cells around the wound edges begin dividing, producing new tissue that gradually rolls over the wound surface, eventually closing it if the tree is sufficiently vigorous and the wound isn't too large relative to the tree's growth rate. Callus is new tissue growing over the wound, not regeneration of lost tissue—the original wound remains beneath the callus.
50. **A. Prevention combined with vertical mulching and organic matter incorporation** - Soil compaction is much easier to prevent than correct. Where compaction exists, vertical mulching (drilling holes filled with organic material), radial trenching, air injection, and surface organic matter application can gradually improve conditions. However, severe compaction may not respond adequately to any treatment. Prevention through effective protection during construction is always the preferred approach.
51. **D. Percentages of species (10%), genus (20%), and family (30%)** - The 10-20-30 diversity guideline recommends no single species exceed 10%, no genus exceed 20%, and no family exceed 30% of the urban forest. This multi-level approach provides protection against threats at different taxonomic levels—species-specific problems (like Dutch elm disease), genus-level threats (like emerald ash borer affecting all ash species), and family-level issues (less common but possible).
52. **B. Guying** - Guying systems use cables, straps, or rope running from the tree trunk to ground anchors (typically stakes or deadmen) to provide external support. Common applications include newly transplanted large trees, trees with compromised root systems, and trees with significant lean. Guy wires should be attached with wide straps to prevent bark damage and positioned to provide balanced support. They are typically temporary systems removed after root establishment.
53. **A. Reduction cuts to laterals capable of assuming terminal role** - Proper crown reduction uses reduction cuts to lateral branches at least one-third the diameter of the removed branch. These laterals can assume the terminal role and continue growing in the same general direction, maintaining the tree's natural form while reducing overall size. Heading cuts and topping stimulate vigorous, weakly attached sprouting that creates future hazard and requires ongoing maintenance.
54. **C. Closing stomata to reduce water loss** - When water is limiting, trees close stomata to reduce transpirational water loss. This is regulated by abscisic acid (ABA) produced in response to water stress. However, stomatal closure also prevents CO₂ entry, reducing photosynthesis. This tradeoff between water conservation and carbon gain is a fundamental plant stress response. Prolonged drought and stomatal closure deplete energy reserves, weakening trees for subsequent seasons.
55. **D. Cultural control** - Cultural control modifies the growing environment or cultural practices to make conditions less favorable for pests and more favorable for plant health. Examples include proper watering (avoiding both drought stress and overwatering), appropriate plant selection, adequate spacing, sanitation (removing fallen leaves and debris harboring pathogens), and

maintaining overall plant vigor through proper nutrition. Cultural practices form the foundation of integrated pest management.

56. **B. The upper boundary of the branch attachment for guiding cut placement** - The branch bark ridge is a raised area of bark at the top of the branch attachment where branch and trunk tissues meet. It indicates where the cut should begin—starting just above the ridge and angling down and away from the trunk. Cutting through the ridge damages trunk tissue; cutting too far from it leaves a stub. Recognizing this anatomical feature is essential for making proper pruning cuts.
57. **A. 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 100 kV (50 kV over the threshold), the minimum distance would be 10 feet plus 20 inches (4 inches $\times$ 5), or approximately 11 feet 8 inches. These distances are specified in ANSI Z133 and apply to all body parts, tools, and materials.
58. **C. Reduce crown density while maintaining natural form** - Crown thinning selectively removes branches throughout the crown to reduce density, improve light penetration, decrease wind resistance, and reduce weight—all while maintaining the tree's natural form and structure. Branches are removed at their point of origin (thinning cuts), not shortened (heading cuts). Proper thinning is distributed throughout the crown rather than concentrated in any one area ("lion-tailing" is improper thinning).
59. **D. Nutrients actually absorbed by the tree** - Foliar (tissue) analysis reveals nutrient concentrations within plant tissue, showing what the tree has actually taken up regardless of what soil tests indicate is present. This is valuable when symptoms suggest deficiency but soil tests show adequate nutrients—common with iron and manganese in alkaline soils where nutrients are present but chemically unavailable. Tissue analysis confirms whether nutrients are reaching the plant.
60. **B. Select a different anchor point and retest** - If a tie-in point fails load testing, it is not safe to use regardless of how the failure appeared. Select a different anchor and test it before committing weight. Never proceed with caution on a questionable anchor—the consequences of tie-in point failure during climbing are severe. Having multiple tie-in options is one reason thorough tree assessment and proper climbing system configuration matter.
61. **C. Prevention and maintaining overall plant health** - Plant health care (PHC) shifts focus from reactive pest treatment to proactive maintenance of plant health. Healthy, vigorous plants better resist and tolerate pest pressure. PHC emphasizes proper cultural practices (watering, mulching, soil management), regular monitoring to detect problems early, and treatment only when monitoring indicates action thresholds are exceeded. This approach often reduces pesticide use while improving long-term plant health.
62. **A. Large basal wounds on the lower trunk** - Basal (lower trunk) wounds are structurally critical because this is where the tree transfers its entire weight and wind loads to the root system. Decay at the base compromises the tree's structural foundation and can lead to complete failure. Wounds

higher in the crown affect only the portions above them; basal wounds potentially affect the entire tree. This is why basal decay is given special attention in tree risk assessment.

63. **D. Secondary growth** - Secondary growth is the annual increase in diameter of stems and roots, produced by lateral meristems—primarily the vascular cambium (producing wood and phloem) and cork cambium (producing bark). Each year's growth adds a new layer of wood (visible as an annual ring) and phloem. Primary growth (elongation) occurs at apical meristems. Both types occur simultaneously, with primary growth at tips and secondary growth in previously formed structures.
64. **B. Early, when corrections require small cuts** - Structural pruning is most effective when started early in a tree's development. Young trees can be guided toward proper structure (single leader, well-spaced scaffolds, removal of included bark unions) with small cuts that close quickly and create minimal stress. Waiting until defects become serious problems requires larger cuts that create greater wounds, stress, and decay potential. Regular evaluation and pruning during the first 10-15 years establishes lifelong structure.
65. **C. Fungi** - Anthracnose diseases are caused by various fungal pathogens (including *Apiognomonia*, *Colletotrichum*, and *Discula* species) that produce characteristic irregular brown lesions, typically following leaf veins. Cool, wet spring weather favors infection. Common hosts include sycamore, oak, maple, and dogwood. While anthracnose can cause significant defoliation, most healthy trees tolerate moderate infection. Severe repeated defoliation, however, can weaken trees and predispose them to other problems.
66. **A. Root cap** - The root cap is a thimble-shaped structure covering the root apical meristem that provides mechanical protection as the root grows through soil. Root cap cells are continuously produced and sloughed off as the root advances. These cells also produce mucilage (a slippery substance) that lubricates root passage through soil and may influence microbial communities in the rhizosphere. The root cap also plays a role in gravitropism (the root's response to gravity).
67. **D. A target** - A target in tree risk assessment is anything of value that could be harmed if the tree or part of it fails. The sidewalk represents a location where people regularly pass—making it an occupied target. The dead branches represent defects (potential failure points), not targets. Assessing both defects (likelihood of failure) and targets (likelihood of impact and consequences) is necessary to determine overall risk rating.
68. **B. Several inches away from trunk with no contact** - Mulch should never contact the tree trunk. A gap of 3-6 inches prevents moisture retention against bark (promoting decay), eliminates habitat for bark-damaging rodents, and discourages stem-girdling root development in the mulch layer. "Volcano mulching" (mulch piled against trunks) is one of the most common and damaging tree care malpractices. Proper mulch forms a donut shape around the tree, not a volcano.
69. **A. The tree was planted too deeply** - Adventitious roots forming above the original root flare indicate the trunk is buried—from either deep planting, fill soil addition, or excessive mulch

accumulation. These roots develop because the buried trunk tissue is in conditions favoring root growth (moist, dark). However, adventitious roots often grow at problematic angles and may girdle the trunk. Root flare excavation to expose the original root zone is often recommended for deeply planted trees.

70. **C. Resistance drill (resistograph)** - Resistance drilling measures the force required to advance a thin needle through wood. Sound wood offers consistent resistance; decay appears as zones of reduced resistance on the resulting profile. This tool provides objective, quantitative data about wood density along the drilling path, including decay location, extent, and residual wall thickness. Limitations include that it samples only along the drill path and creates small wounds that should be considered in the assessment decision.
71. **D. One-third** - ANSI A300 Part 1 defines reduction cuts as cuts made to lateral branches at least one-third the diameter of the removed branch. Laterals of this size can assume the terminal role and continue growth in the same general direction, maintaining tree form without stimulating excessive sprouting. Smaller laterals cannot assume this function; cuts to them function more like heading cuts, stimulating multiple sprouts with weak attachments.
72. **B. Wilting and/or leaf scorch** - Drought stress symptoms typically begin with midday wilting as the tree cannot supply water fast enough to meet transpirational demand. As stress continues, leaf scorch (browning of leaf margins and interveinal areas) develops as cells die from desiccation. Premature fall color and leaf drop may follow. These symptoms reflect the direct relationship between water supply (limited by drought) and transpirational demand (continuing based on temperature and humidity).
73. **C. Resilience against species-specific pests and diseases** - Species diversity protects urban forests from catastrophic losses when species-specific threats arrive. The loss of American chestnut to chestnut blight, American elm to Dutch elm disease, and ash to emerald ash borer demonstrates how monocultures are vulnerable to complete destruction. Diversity ensures that no single pest or disease can eliminate more than a portion of the urban forest, maintaining overall canopy cover and benefits.
74. **A. Significant basal decay or evidence of structural failure** - Trees showing significant basal decay (structural foundation compromise) or evidence of structural failure in progress (cracks with movement, recent lean with root plate lifting) should not be climbed until further assessment determines if they can safely support a climber. The added dynamic loads of climbing could trigger failure. Alternative access (aerial lift) or alternative assessment methods may be necessary.
75. **D. Feed control bar** - The feed control bar is a safety device positioned across the chipper feed opening. When pushed (either intentionally or by contact), it stops or reverses the feed mechanism. This provides protection if entanglement begins—pushing the bar may stop feed before the operator is pulled further into the machine. This safety feature must be tested before operation and

never disabled. Proper chipper operation also requires appropriate positioning and prohibition of loose clothing.

76. **B. Mobility allowing translocation to newer growth** - Mobile nutrients (nitrogen, phosphorus, potassium, magnesium) can be translocated from older tissue to support new growth. When these nutrients are deficient, the plant moves existing supplies from older leaves to developing leaves, so deficiency symptoms appear on older leaves first. Understanding mobility explains symptom patterns and helps diagnose specific deficiencies based on where symptoms appear.
77. **A. The tree's functional and aesthetic contribution based on its site** - The location rating in tree appraisal evaluates how the tree's position affects its value. A well-placed tree providing shade, energy savings, screening, or aesthetic enhancement receives a higher rating than an identical tree in a less functional location. Site factors (residential vs. commercial, front yard vs. back, proximity to buildings) and functional factors (shade orientation, view enhancement) influence the rating.
78. **C. Pollarding** - Pollarding is a traditional European practice of repeatedly removing all growth back to permanent scaffold branches (the "pollard head") on a regular cycle (typically annually to every few years). When properly maintained from a young age, pollarding creates distinctive forms seen in European street trees. It differs from topping in that it's a planned system requiring regular maintenance, not a one-time indiscriminate cutting. Topping a previously unpollarded tree does not create a pollard—it creates a hazard.
79. **D. Tree growth rate and vigor** - Wound closure rate directly correlates with the tree's annual radial growth because callus tissue is produced by cambial activity at wound margins. A tree producing 1/2 inch of radial growth annually can close wounds twice as fast as a tree producing 1/4 inch. This relationship explains why maintaining tree vigor is important when wounding is unavoidable and why wounds on stressed trees may never close, remaining as permanent decay entry points.
80. **B. Structural support only (no longer physiologically active)** - Heartwood is dead tissue that no longer conducts water, stores nutrients, or performs active physiological functions. It consists of xylem cells that have aged, died, and often become filled with extractives (resins, tannins, phenolics) that provide decay resistance and darker coloration. Despite being non-living, heartwood provides essential structural support—a tree can survive without heartwood (hollow trees), but structural capacity is reduced.
81. **C. Crown, trunk, root zone, and target area** - Basic tree risk assessment requires systematic evaluation of the entire tree (crown for dead branches and attachment defects, trunk for cracks and decay, root zone for stability indicators and root defects) plus the surrounding area to identify targets and assess consequences of potential failure. Limiting assessment to any single zone misses potentially critical information needed for accurate risk rating.
82. **A. High concern indicating potential imminent structural failure** - Horizontal cracks through the trunk indicate the trunk is actively separating—structural failure in progress. Unlike decay

(which may progress slowly), cracks show the tree has already begun failing. Movement visible when the tree sways confirms the severity. Such trees are typically rated as high or extreme risk requiring immediate mitigation. This is among the most serious defects encountered in tree assessment.

83. **D. Removing soil without damaging roots** - Air excavation uses compressed air to blow soil away from roots without cutting them—unlike mechanical excavation that cuts through everything. This technology enables root examination, root collar investigation, careful trenching in root zones, and treatment of girdling roots while minimizing root damage. The ability to work in root zones without significant root loss has expanded options for tree preservation during construction and diagnosis.
84. **B. Marcescence** - Marcescence is the retention of dead leaves through winter, commonly seen in American beech, some oaks (particularly young trees and lower branches), and hornbeam. The leaves eventually fall in spring when pushed off by new growth. The phenomenon's function is debated—theories include deterring browsing animals, capturing snow for spring moisture, and protecting buds. Marcescence differs from failed abscission, which would indicate physiological problems.
85. **C. When testing confirms nutrient deficiency** - Fertilization benefits trees when actual nutrient deficiencies limit growth or health. Soil or tissue testing identifies whether deficiencies exist and which nutrients are lacking, enabling targeted application. Fertilizing without evidence of deficiency wastes resources, may harm trees (excessive nitrogen encourages succulent growth susceptible to pests), and can pollute water resources. Most established landscape trees do not require regular fertilization if they are otherwise healthy.
86. **A. Signs are direct evidence of the causal agent; symptoms are plant responses** - Understanding this distinction is fundamental to plant problem diagnosis. Signs are the pathogen or pest itself—fungal fruiting bodies, bacterial ooze, insects, insect frass. Symptoms are changes in the plant in response to problems—wilting, chlorosis, necrosis, defoliation, dieback. Finding signs identifies the cause; finding symptoms indicates a problem exists but may not reveal the cause. Diagnosis requires connecting symptoms to causes, often confirmed by finding signs.
87. **D. Block or pulley** - Blocks (pulleys) redirect rope direction in rigging systems. Single blocks change direction; multiple blocks configured together can provide mechanical advantage that multiplies the force applied. For example, a 2:1 mechanical advantage allows 100 pounds of pull to control 200 pounds of load. Blocks must be appropriately rated for loads including dynamic forces that occur during rigging operations.
88. **B. Monitor, identify, determine if threshold reached, select tactics** - Integrated pest management follows a systematic decision process: (1) monitor regularly for pest presence, (2) accurately identify the pest, (3) determine if pest levels exceed action thresholds justifying treatment, and (4) select the most appropriate and least disruptive tactics. This approach prevents

unnecessary treatment of minor problems while ensuring effective response when treatment is warranted.

89. **A. During spring and early summer when attracted to fresh wounds** - Nitidulid (sap-feeding) beetles that vector oak wilt fungus are most active in spring and early summer. They are attracted to fresh wounds (including pruning cuts) where they feed on sap and deposit fungal spores. This is why oak pruning is discouraged during April-July in oak wilt areas. If pruning is necessary during this period, wound sealant may be applied (one of few legitimate uses for wound dressing) to reduce beetle attraction.
90. **C. Loss of root mass creating water supply deficit** - Transplanting removes 90-95% of a tree's root system while the crown remains unchanged. This creates severe imbalance between water demand (transpiration from existing foliage) and water supply (greatly reduced root system). The tree cannot supply adequate water to support its crown, causing transplant shock symptoms. Establishment requires time for root regeneration to restore balance, which is why post-transplant care focuses on watering and reducing water demand.
91. **D. Proper planting depth** - Visible root flare at the trunk base indicates the tree is planted at correct depth with proper trunk-root transition. The flare represents the structural connection between trunk and major lateral roots. Trees planted too deeply lack visible flare—the trunk appears to go straight into the ground like a pole. Deep planting leads to trunk decay, girdling roots, and overall poor establishment.
92. **B. Density and strength** - Specific gravity measures wood density relative to water (ratio of wood weight to weight of equal volume of water). Higher specific gravity indicates denser wood with more cell wall material per unit volume, correlating directly with mechanical strength. Species with high specific gravity (like oak) are generally stronger than species with low specific gravity (like cottonwood). This property influences wood's suitability for various uses and its structural contribution to living trees.
93. **C. Pre-climb safety assessment for hazards** - Before climbing, trees must be thoroughly assessed for hazards including structural defects (cracks, decay, weak attachments), dead branches in the climbing path, wildlife (stinging insects, animals), electrical conductors, and overall condition. This assessment identifies conditions that might endanger the climber or require alternative access methods. The assessment should be documented, and conditions noted should influence work planning.
94. **A. Installing protective fencing at CRZ boundary before construction** - Effective tree protection requires physical barriers installed before any construction activity begins. Fencing should be at the critical root zone boundary (or greater), sturdy enough to resist incidental contact, and clearly marked to identify the protected area. The fence must remain throughout construction with no exceptions for temporary access. Verbal instructions or paint markings alone are ineffective—equipment operators need physical barriers that cannot be ignored.

95. **D. Determine when pest levels justify intervention** - Action thresholds define the pest population or damage level at which treatment becomes justified. Below the threshold, pest presence is tolerated because damage is minor or natural enemies may provide control. Above the threshold, intervention is warranted because damage would exceed acceptable levels. Thresholds vary with plant value, pest species, environmental conditions, and management objectives.
96. **B. Ground rods** - A complete lightning protection system includes three essential components: air terminals (copper points at the tree's highest points), conductors (copper cables running down the trunk), and ground rods (copper rods driven deep into earth). The system provides a path of least resistance for lightning current to reach ground, protecting the tree from explosive damage. Installation should follow ANSI A300 Part 4 specifications.
97. **A. At least annually and after major storms** - Tree support systems (cables and braces) require regular inspection to verify continued function and detect developing problems. Annual inspection is minimum; additional inspection after major storms (wind, ice, heavy rain) checks for damage or changed conditions. Inspection evaluates hardware condition, cable tension, tree growth around components, and whether the system remains appropriate for current tree condition.
98. **C. Crown cleaning** - Crown cleaning specifically targets removal of dead, dying, diseased, crowded, weakly attached, low-vigor, and broken branches. This pruning type directly addresses hazard reduction by removing branches most likely to fail. Crown cleaning improves tree health by removing diseased tissue and improving air circulation. It is often the most appropriate pruning type for mature trees requiring maintenance.
99. **D. Root nodules** - Nitrogen-fixing bacteria (*Rhizobium* and related species) form symbiotic relationships with leguminous plants (peas, beans, clover, black locust, honeylocust) in specialized root structures called nodules. Within nodules, bacteria convert atmospheric nitrogen (N_2) to ammonia (NH_3), which the plant can use for growth. In return, the plant provides carbohydrates to the bacteria. This relationship allows legumes to thrive in nitrogen-poor soils and enriches soil nitrogen for subsequent plants.
100. **B. 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 (percentage of time the target is present), and target mobility (whether the target can move away from danger). Even a tree that will definitely fail may have low likelihood of impact if the target is rarely present or positioned away from the failure direction.