FULL-LENGTH PRACTICE TESTS

PRACTICE TEST 14 – 100 QUESTIONS

1. The vascular cambium produces what tissues?

A. Cork and lenticels

B. Pith and cortex

C. Epidermis and cuticle

D. Xylem toward the inside and phloem toward the outside

2. What personal protective equipment is specifically required for workers operating chain saws during felling operations?

A. Hearing protection only

B. Leg protection designed to reduce chain saw injury

C. Steel-toed boots only

D. Safety glasses only

3. What soil texture has the highest cation exchange capacity (CEC)?

A. Sand

B. Loamy sand

C. Clay

D. Gravel

4. A tree that maintains foliage throughout the year, continuously replacing old leaves, is classified as what?

A. Evergreen

B. Deciduous

C. Marcescent

D. Dormant

5. The branch collar contains specialized tissue that functions primarily for what purpose?

A. Water transport

B. Compartmentalization and wound closure

C. Photosynthesis

D. Nutrient storage

6. What pruning operation removes dead, dying, diseased, and broken branches throughout the crown?

A. Crown reduction

B. Crown raising

C. Crown thinning

D. Crown cleaning

7. Soil structure refers to what property?

A. The arrangement of soil particles into aggregates

B. The proportion of sand, silt, and clay

C. The percentage of pore space

D. The nutrient content

8. Which CODIT wall limits lateral decay spread through ray parenchyma cells?

A. Wall 1

B. Wall 4

C. Wall 3

D. Wall 2

9. Round exit holes approximately 3/8 inch in diameter with smooth edges on hardwood trees are characteristic of what pest?

A. Emerald ash borer

B. Bronze birch borer

C. Bark beetles

D. Asian longhorned beetle

10. What must be verified before committing full body weight to a climbing tie-in point?

A. Tree species

B. Load test showing no movement, sounds, or visual changes

C. Branch diameter only

D. Time since last inspection

11. The cohesion-tension theory explains water movement through what mechanism?

A. Transpiration pull creating tension in continuous water columns held together by cohesion

B. Root pressure pushing water upward

C. Osmotic gradient in leaves

D. Active transport by living cells

12. What distance should mulch be kept away from tree trunks?

A. Mulch should contact the trunk

B. 1 inch

C. 3-6 inches

D. 12 inches minimum

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

A. Along a central rachis

B. In opposite pairs

C. Divided into secondary leaflets

D. Radiating from a single point at the petiole tip

14. Armillaria root rot is identified by what characteristic diagnostic sign?

A. D-shaped exit holes

B. White mycelial fans beneath bark and black rhizomorphs

C. Bacterial ooze

D. Powdery white coating

15. When should a climbing rope showing significant sheath wear exposing the core be retired?

A. Immediately

B. After the current job

C. When convenient

D. It can be used for rigging instead

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

A. Cabling

B. Guying

C. Bracing

D. Propping

17. The pericycle layer in roots gives rise to what structures?

A. Root hairs

B. Mycorrhizae

C. Endodermis

D. Lateral roots

18. What plant hormone promotes stem elongation and delays senescence?

A. Gibberellin

B. Ethylene

C. Abscisic acid

D. Cytokinin

19. What diagnostic tool uses sound wave transmission to create cross-sectional images of tree trunks?

A. Resistograph

B. Sonic tomograph

C. Increment borer

D. Penetrometer

20. Aphids damage plants and create secondary problems by doing what?

A. Tunneling through bark

B. Creating galls

C. Piercing tissue to suck phloem sap and excreting honeydew

D. Consuming entire leaves

21. What characteristic makes a tree species a "good compartmentalizer"?

A. Fast growth rate

B. Large leaves

C. Abundant sap production

D. Ability to form strong chemical and physical barriers against decay spread

22. Verticillium wilt is caused by what type of organism?

A. Fungus

B. Bacterium

C. Water mold

D. Virus

23. What are the three components of tree risk assessment?

A. Species, age, and location

B. Likelihood of failure, likelihood of impact, and consequences

C. Height, diameter, and crown spread

D. Soil type, drainage, and exposure

24. Heartwood differs from sapwood in what primary way?

A. Heartwood conducts more water

B. Heartwood is always lighter in color

C. Heartwood no longer conducts water and contains no living cells

D. Heartwood is structurally weaker

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

A. Acute insect attack

B. Seasonal dormancy

C. Normal aging

D. Decline from chronic stress

26. Guard cells regulate what process in leaves?

A. Stomatal opening and closing, controlling gas exchange and water loss

B. Photosynthesis rates

C. Nutrient absorption

D. Chlorophyll production

27. The critical root zone (CRZ) calculation of 1 foot per inch of trunk diameter represents what?

A. Maximum protection zone

B. Exact root extent

C. Minimum protection zone that may need to be larger based on conditions

D. Optional guideline

28. Chlorosis on the youngest leaves with interveinal yellowing while older leaves remain green indicates deficiency of what?

A. Nitrogen

B. Iron or manganese

C. Phosphorus

D. Potassium

29. Oaks and beeches are generally classified as what type of compartmentalizers?

A. Poor compartmentalizers

B. Non-compartmentalizers

C. Variable compartmentalizers

D. Good compartmentalizers

30. What is the primary cause of transplant failure in trees?

A. Inadequate water management for the reduced root system

B. Excessive fertilization

C. Improper staking

D. Wrong season

31. Soil compaction primarily damages tree roots by reducing what?

A. Soil temperature

B. Nutrient content

C. Oxygen availability and physical space for root growth

D. Soil pH

32. What is the consequence of leaving a stub when pruning?

A. Faster wound closure

B. Prevents proper closure and creates decay entry point

C. Improved branch structure

D. Enhanced compartmentalization

33. Arbuscular mycorrhizae form associations with roots by doing what?

A. Growing only on root surfaces

B. Parasitizing root tissue

C. Having no direct contact

D. Penetrating root cell walls to form structures inside cells

34. Removing more than what percentage of live crown may cause significant stress in mature trees?

A. 25 percent

B. 50 percent

C. 10 percent

D. 75 percent

35. The 10-20-30 rule sets what limit for genus representation in urban forests?

A. 10 percent

B. 20 percent

C. 30 percent

D. 40 percent

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

A. Using statistical sampling

B. Being less expensive

C. Documenting every individual tree

D. Providing population estimates only

37. Phosphorus deficiency often causes what symptom in trees?

A. Interveinal chlorosis on new leaves

B. Marginal leaf scorch

C. General yellowing of older leaves

D. Purplish discoloration and reduced growth

38. What is the minimum approach distance from electrical conductors below 50 kV for qualified line-clearance workers?

A. Varies based on employer's minimum approach distance (MAD) procedures

B. 10 feet

C. 15 feet

D. 5 feet

39. What is the most effective method to prevent stem-girdling roots?

A. Regular fertilization

B. Proper nursery production and correct planting depth

C. Deep watering

D. Frequent pruning

40. A tree risk assessment requires the presence of what two elements to assign a risk rating?

A. Large size and old age

B. Previous failure history

C. Structural defects AND a target in the potential failure zone

D. Visible decay and dead branches

41. What substance is transported downward through phloem tissue?

A. Only water

B. Only minerals

C. Oxygen

D. Sugars produced by photosynthesis

42. The establishment period for a newly transplanted tree is approximately how long?

A. 1 year per inch of trunk caliper

B. 6 months regardless of size

C. 2 weeks

D. 5 years for all trees

43. Construction damage to roots often becomes apparent in the crown after what time period?

A. Immediately

B. 1-5 years or longer

C. 10-15 years

D. Never

44. Dutch elm disease spreads locally through what primary mechanism?

A. Wind-blown spores

B. Rain splash

C. Root grafts between adjacent elms

D. Contaminated soil

45. What does the species rating evaluate in tree appraisal?

A. Relative landscape value, longevity, and desirability of the species

B. Current health condition

C. Location factors

D. Trunk size

46. Level 1 limited visual assessment is appropriate for what purpose?

A. Detailed individual tree evaluation

B. Post-failure investigation

C. Advanced decay mapping

D. Rapid screening of large tree populations to identify those needing further assessment

47. What information is required in pre-work job briefings according to ANSI Z133?

A. Marketing plans

B. Hazards, work procedures, responsibilities, and emergency plans

C. Equipment costs

D. Long-term contracts

48. Callus tissue (woundwood) originates from what source?

A. Heartwood regeneration

B. Pith expansion

C. Vascular cambium at wound margins

D. Cork cambium

49. Vertical mulching is a technique used to remediate what soil problem?

A. Compaction

B. Excessive drainage

C. High pH

D. Nutrient toxicity

50. Why are urban forest diversity standards important?

A. Reduced maintenance costs

B. Simplified inventory

C. Uniform appearance

D. Protection against catastrophic losses from species-specific pests and diseases

51. When should tree stakes and guys be removed after planting?

A. After 5 years

B. After root establishment (1-2 growing seasons)

C. Never

D. After 10 years

52. Crown thinning reduces what while maintaining the tree's natural form and size?

A. Tree height

B. Crown spread

C. Crown density

D. Lower branch clearance

53. Extended drought causes physiological stress primarily because stomatal closure results in what?

A. Reduced photosynthesis and carbohydrate production

B. Increased water uptake

C. Enhanced growth

D. Improved pest resistance

54. Augmentative biological control involves what approach?

A. Protecting existing natural enemies

B. Eliminating all insects

C. Calendar-based pesticide applications

D. Releasing additional natural enemies to supplement existing populations

55. The branch bark ridge indicates what?

A. A site of decay

B. The upper boundary of the branch-trunk junction where cuts should begin

C. Where flush cuts should be made

D. An area of weakness

56. For voltages above 50 kV, the minimum approach distance for unqualified workers increases by what amount per 10 kV?

A. 2 inches

B. 6 inches

C. 4 inches

D. 8 inches

57. What distinguishes a proper reduction cut from a heading cut?

A. Both are identical

B. Heading cuts are always preferred

C. Reduction cuts leave longer stubs

D. Reduction cuts are made to laterals at least 1/3 the diameter of the removed branch

58. Tissue analysis is most valuable when what situation exists?

A. Trees show deficiency symptoms despite adequate soil nutrient levels

B. Soil testing is unavailable

C. Trees are newly planted

D. No problems are present

59. Doubled rope technique (DRT) provides what advantage for climbing?

A. Faster descent only

B. Two points of attachment with rope moving through the tie-in

C. Eliminates need for secondary tie-in

D. Works only on small trees

60. Plant health care differs from traditional pest management by emphasizing what?

A. More frequent pesticide applications

B. Reactive treatments

C. Prevention and maintaining overall plant health

D. Immediate plant removal

61. Why are basal trunk wounds more structurally significant than upper trunk wounds?

A. They are more visible

B. They affect foliage production

C. They heal more slowly

D. They compromise the structural foundation where all loads transfer to roots

62. What determines the visibility of annual growth rings in wood?

A. Contrast between larger earlywood cells and smaller latewood cells

B. Bark thickness

C. Tree species only

D. Tree age

63. Structural pruning of young trees is most effective when started at what stage?

A. After the tree matures

B. Early, when corrections require small cuts

C. Only after structural defects cause problems

D. During the decline phase

64. Fire blight disease is caused by what type of organism?

A. Fungus

B. Virus

C. Water mold

D. Bacterium

65. What is the primary purpose of tree risk assessment?

A. Calculate tree value

B. Determine tree age

C. Plan routine pruning

D. Identify trees with potential to fail and cause harm for management decisions

66. ISA certification requires what for maintenance?

A. Continuing education credits and periodic renewal

B. One-time examination only

C. No ongoing requirements

D. Annual written testing

67. What is the function of the chipper feed control bar?

A. Adjust chip size

B. Stop or reverse the feed mechanism when contacted

C. Direct chip discharge

D. Increase feed speed

68. In tree risk assessment, "target" refers to what?

A. The defect identified

B. The tree being assessed

C. What could be harmed if the tree fails

D. The assessment method

69. Safe rigging requires understanding what factors?

A. Tree species only

B. Weather forecast only

C. Time of day

D. Load weight, equipment ratings, anchor strength, and dynamic forces

70. What is the effect of lion-tailing on branch structure?

A. Increased end-weight loading, reduced damping, and higher failure risk

B. Improved structure

C. Enhanced compartmentalization

D. Better wind resistance

71. Preserving mature trees during development is valuable primarily because of what?

A. Lower construction costs

B. Immediate environmental benefits not replaceable for decades

C. Simplified permits

D. Reduced insurance

72. What tree condition indicates that climbing should not proceed?

A. Minor lichen growth

B. Previous pruning

C. Evidence of severe structural defects or basal decay

D. Small outer deadwood

73. The feed control bar on a chipper must be tested at what interval?

A. Monthly

B. Annually

C. Only when problems occur

D. Before each use

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

A. Immobility

B. Toxicity

C. Abundance

D. Mobility (can be translocated to new growth)

75. What does the location rating evaluate in tree appraisal?

A. Species characteristics

B. The tree's functional and aesthetic contribution to the site

C. Health condition

D. Age

76. Pollarding is best described as what type of practice?

A. One-time size reduction

B. Emergency response

C. Planned ongoing management with regular pruning to permanent scaffold branches

D. Identical to topping

77. What factor most significantly influences wound closure rate?

A. Time of year

B. Wound dressing application

C. Exact cut angle

D. Tree vigor and growth rate

78. What is the functional difference between sapwood and heartwood?

A. Sapwood contains living cells and conducts water; heartwood does not

B. Heartwood conducts more water

C. They are functionally identical

D. Sapwood provides more structural support

79. A basic tree risk assessment should evaluate what areas of the tree and site?

A. Crown only

B. Crown, trunk, root zone, and target area

C. Only visible defects

D. Trunk only

80. A horizontal crack extending through the trunk indicates what?

A. Normal growth

B. Minor cosmetic issue

C. A serious structural defect with potential for failure

D. Improved strength

81. Air excavation removes soil using what medium?

A. Water pressure

B. Mechanical cutting

C. Chemical dissolution

D. Compressed air that displaces particles without cutting roots

82. Reaction wood forms in response to what stimulus?

A. Non-vertical orientation or mechanical stress

B. Drought

C. Disease infection

D. Nutrient deficiency

83. When is fertilization most appropriate for established landscape trees?

A. Every spring

B. When soil or tissue testing confirms nutrient deficiency

C. During active drought

D. Immediately after severe pruning

84. Conks and mushrooms growing from trees are classified as what type of diagnostic evidence?

A. Environmental factors

B. Normal bark features

C. Symptoms (plant responses)

D. Signs (direct evidence of the pathogen)

85. What rigging device provides friction to control descent rate of lowered pieces?

A. Carabiner

B. Sling

C. Block

D. Friction device (Port-a-wrap or similar)

86. The correct IPM sequence begins with what step?

A. Monitoring to detect pest presence

B. Immediate pesticide application

C. Plant removal

D. Calendar-based treatment

87. Oak wilt is transmitted over long distances primarily by what mechanism?

A. Root grafts

B. Insect vectors (nitidulid beetles) carrying spores to fresh wounds

C. Wind

D. Contaminated tools

88. Container-grown trees held too long typically develop what root defect?

A. Deep taproot

B. Enhanced fibrous roots

C. Circling and potentially girdling roots

D. Improved root architecture

89. Root collar excavation is performed primarily to accomplish what?

A. Apply fertilizer

B. Improve drainage

C. Increase planting depth

D. Expose and assess the trunk-root transition zone for problems

90. Higher wood specific gravity indicates what properties?

A. Greater density and mechanical strength

B. Lower strength

C. Lighter weight

D. More decay susceptibility

91. What must be completed before climbing any tree for work?

A. Financial appraisal

B. Pre-climb safety assessment identifying hazards

C. Inventory count

D. Marketing review

92. Tree protection fencing should be installed at what point during construction?

A. When tree stress becomes visible

B. After grading

C. Before any construction activity begins

D. At project completion

93. Action thresholds in IPM define what?

A. Maximum chemical application rates

B. Calendar dates for treatment

C. Cost limits

D. Pest levels at which treatment becomes justified

94. Lightning protection systems should be inspected at what frequency?

A. Annually and after lightning events

B. Every 10 years

C. Never after installation

D. Monthly

95. Cable and brace support systems require inspection at what minimum interval?

A. Every 5 years

B. Annually and after major storms

C. Monthly

D. Only when problems are visible

96. What does crown raising accomplish?

A. Reduced crown density

B. Removal of dead branches

C. Vertical clearance beneath the crown

D. Reduced tree height

97. Nitrogen-fixing bacteria associate with trees in what plant family?

A. Pinaceae (pine family)

B. Rosaceae (rose family)

C. Fagaceae (oak family)

D. Fabaceae (legume family)

98. In tree risk assessment, consequences evaluate what?

A. Severity of harm if failure strikes the target

B. Probability of failure

C. Likelihood of impact

D. Tree species characteristics

99. What does "likelihood of impact" assess in tree risk evaluation?

A. Failure probability

B. Probability that failure will strike the target

C. Consequence severity

D. Tree condition

100. Proper pruning cut placement preserves what structure for optimal wound response?

A. Branch bark ridge only

B. Stub for regrowth

C. Branch collar

D. Flush surface with trunk

PRACTICE TEST 14: ANSWER KEY WITH EXPLANATIONS

1. **D. Xylem toward the inside and phloem toward the outside** - The vascular cambium is a thin cylindrical layer of meristematic cells located between bark and wood. During each growing season, it divides to produce new xylem (wood) cells toward the tree's center and new phloem (inner bark) cells toward the outside. This continuous production increases trunk diameter annually. The contrast between spring and summer xylem production creates visible annual growth rings in temperate climate trees.

2. **B. Leg protection designed to reduce chain saw injury** - ANSI Z133 requires workers operating chain saws during felling operations to wear leg protection (chaps or cut-resistant pants) specifically designed to reduce chain saw injuries. These garments contain layers of cut-resistant fibers that, when contacted by a moving chain, pull out and jam the saw mechanism, reducing injury severity. Leg injuries from chain saws can be devastating, potentially severing major arteries, making proper protection essential.

3. **C. Clay** - Clay soils have the highest cation exchange capacity (CEC) due to their extremely small particle size and large surface area with negative electrical charges. These charges attract and hold positively charged nutrient ions (cations) like calcium, magnesium, potassium, and ammonium. While high CEC means excellent nutrient retention, clay soils often have drainage and aeration problems. Sand has very low CEC due to its large particle size and limited surface area.

4. **A. Evergreen** - Evergreen trees maintain foliage throughout the year, continuously producing new leaves while gradually shedding older ones. This contrasts with deciduous trees that drop all leaves seasonally. Evergreen species include most conifers (pines, spruces, firs) and broadleaved evergreens (hollies, magnolias, live oaks). The evergreen habit provides year-round photosynthetic capacity but requires adaptations for winter conditions in cold climates.

5. **B. Compartmentalization and wound closure** - The branch collar is a swollen ring of overlapping trunk and branch tissue at the base of branches. It contains specialized cells that enable effective compartmentalization of decay and production of callus tissue for wound closure. Pruning cuts made just outside the collar preserve this critical tissue, optimizing the tree's wound response. Flush cuts remove the collar, severely compromising compartmentalization and closure ability.

6. **D. Crown cleaning** - Crown cleaning is the selective removal of dead, dying, diseased, broken, crossing, and weakly attached branches throughout the crown. This pruning type improves tree health by removing potential infection sources, enhances safety by eliminating branches most

likely to fail, and improves appearance. Crown cleaning is appropriate for most mature trees requiring maintenance and is often combined with other pruning operations.

7. **A. The arrangement of soil particles into aggregates** - Soil structure describes how individual soil particles (sand, silt, clay) are arranged and bound together into larger aggregates or clumps. Good structure creates pore spaces between aggregates that allow water infiltration, drainage, air exchange, and root penetration. Structure can be improved through organic matter addition, while compaction and poor management destroy structure. This differs from texture, which describes particle size proportions.

8. **C. Wall 3** - In the CODIT (Compartmentalization of Decay in Trees) model, Wall 3 consists of ray parenchyma cells that limit lateral (tangential) spread of decay around the trunk's circumference. Ray cells extend radially like spokes, creating compartments that limit decay spread from one sector to another. Wall 3 is generally more effective than Walls 1 and 2, though its strength varies among species and depends on tree health at the time of wounding.

9. **D. Asian longhorned beetle** - The Asian longhorned beetle (Anoplophora glabripennis) creates characteristic round exit holes approximately 3/8 inch (10 mm) or larger in diameter with smooth edges when adults emerge from infested hardwood trees. This invasive pest attacks many hardwood species including maples, birches, elms, and willows. The large round holes distinguish ALB from emerald ash borer (D-shaped, 1/8 inch) and other borers. ALB infestations require aggressive eradication efforts.

10. **B. Load test showing no movement, sounds, or visual changes** - Before trusting a tie-in point with full weight and dynamic climbing loads, load testing helps verify anchor integrity. Apply body weight gradually while carefully observing and listening for any movement, cracking sounds, or visual changes indicating weakness. If any concern arises, immediately select a different anchor. Visual inspection alone may miss internal defects; loading helps reveal problems before they cause failure during climbing.

11. **A. Transpiration pull creating tension in continuous water columns held together by cohesion** - The cohesion-tension theory explains that water evaporating from leaves (transpiration) creates negative pressure (tension) that pulls water upward through continuous columns in xylem vessels. Water molecules' cohesion (attraction to each other via hydrogen bonds) maintains these continuous columns from roots to leaves. This passive mechanism can lift water over 300 feet without the tree expending direct energy.

12. **C. 3-6 inches** - Mulch should be kept 3-6 inches away from tree trunks to prevent bark decay, rodent damage, and stem-girdling root development. Direct contact between mulch and bark creates constantly moist conditions promoting decay and provides habitat for bark-gnawing rodents. Proper mulch application creates a donut shape around the tree, not a volcano piled against the trunk. This gap allows bark to dry and function normally.

13. **D. Radiating from a single point at the petiole tip** - Palmately compound leaves have multiple leaflets radiating from a single point at the tip of the petiole, resembling fingers extending from a palm. Examples include buckeye, horsechestnut, and Ohio buckeye. This arrangement differs from pinnately compound leaves (leaflets along a central rachis) and bipinnately compound leaves (leaflets further divided into secondary leaflets).

14. **B. White mycelial fans beneath bark and black rhizomorphs** - Armillaria species (honey fungus) produce distinctive diagnostic signs: white mycelial fans growing between bark and wood with a characteristic mushroom odor, and black rhizomorphs ("shoestrings") in soil that spread the fungus between trees. Honey-colored mushroom clusters at tree bases in autumn are another diagnostic feature. Armillaria is an aggressive root rot pathogen capable of killing otherwise healthy trees.

15. **A. Immediately** - Any climbing rope showing significant sheath wear that exposes the core must be immediately retired from life-safety use. The sheath protects the load-bearing core from abrasion, UV damage, and contamination; once compromised, rope strength is unpredictable and failure can occur without warning. Damaged ropes cannot be repaired, downgraded to rigging use (which also involves life safety), or used with extra caution. When in doubt, retire the rope.

16. **C. Bracing** - Bracing involves installing rigid threaded steel rods through weak branch unions, typically codominant stems with included bark. The rod provides direct mechanical connection between the two stems, preventing them from splitting apart. Bracing is often combined with cabling (flexible cables installed higher in the crown) for comprehensive support of structurally compromised unions. Unlike cables that limit movement, braces provide rigid reinforcement.

17. **D. Lateral roots** - The pericycle is a layer of cells between the endodermis and vascular tissue in roots that retains meristematic (cell division) capability. When lateral root formation is initiated, pericycle cells divide to form a new root primordium that grows outward through the cortex and epidermis. This internal origin explains why lateral roots emerge from within the parent root rather than from surface tissues.

18. **A. Gibberellin** - Gibberellins are plant hormones that promote stem elongation, seed germination, flowering, and can delay senescence in some tissues. They stimulate cell elongation and division, particularly in stems, leading to increased height growth. Gibberellins are produced in young leaves, root tips, and developing seeds. Commercial applications include promoting fruit development and breaking seed dormancy.

19. **B. Sonic tomograph** - Sonic tomography uses the transmission of sound waves between multiple sensors placed around the trunk to create cross-sectional images of internal wood condition. Sound travels faster through solid wood and slower through decayed or hollow areas. By analyzing transmission times between all sensor pairs, software generates images showing decay location and extent. This non-destructive technique helps quantify internal conditions for management decisions.

20. **C. Piercing tissue to suck phloem sap and excreting honeydew** - Aphids have piercing-sucking mouthparts (stylets) that penetrate plant tissue to withdraw phloem sap. Their diet of sugar-rich sap results in excretion of excess sugars as honeydew, which coats surfaces below and supports growth of black sooty mold fungi. Honeydew also attracts ants that may protect aphid colonies. Heavy infestations can stress plants through continuous sap removal and honeydew-related problems.

21. **D. Ability to form strong chemical and physical barriers against decay spread** - Good compartmentalizers effectively wall off wounded and decaying tissue through strong chemical barriers (phenolics, tannins, antimicrobial compounds) and physical barriers (modified cell walls, tyloses). This genetic capability limits decay spread from wounds, protecting the tree's structural integrity. Species like oaks, beeches, and hickories typically compartmentalize well, while willows and poplars compartmentalize poorly.

22. **A. Fungus** - Verticillium wilt is caused by soil-borne fungi (Verticillium dahliae and V. albo-atrum). These pathogens enter through roots and colonize xylem vessels, blocking water transport and producing toxins. Characteristic symptoms include wilting and dieback often affecting one side of the tree first, and olive or brown vascular streaking visible when branches are cut. Many tree species are susceptible, including maples, ash, and catalpa.

23. **B. Likelihood of failure, likelihood of impact, and consequences** - Tree risk assessment integrates three components: likelihood of failure (probability the tree or part will fail based on defects and loading), likelihood of impact (probability that failure will strike the target based on location and occupancy), and consequences (severity of harm if impact occurs based on target type and vulnerability). All three must be evaluated to determine overall risk rating and appropriate response.

24. **C. Heartwood no longer conducts water and contains no living cells** - Heartwood is older wood in the trunk center where living parenchyma cells have died and xylem vessels no longer conduct water. It forms as sapwood ages and undergoes chemical changes, often accumulating extractives that darken the wood and may increase decay resistance. Heartwood provides structural support but not active physiological function. Sapwood, in contrast, contains living cells and actively conducts water.

25. **D. Decline from chronic stress** - Progressive symptoms developing over years—crown dieback, small leaves, reduced growth, early fall color—characterize tree decline from chronic stress. Decline typically results from accumulated stresses: soil compaction, restricted rooting space, grade changes, repeated drought, root damage, or multiple interacting factors. Unlike acute problems with rapid onset, decline develops gradually. Early intervention offers better prognosis than waiting until advanced.

26. **A. Stomatal opening and closing, controlling gas exchange and water loss** - Guard cells are specialized epidermal cells flanking stomatal pores. Changes in guard cell turgor pressure (water

content) cause stomata to open or close. Open stomata allow carbon dioxide entry for photosynthesis but also permit water loss through transpiration. Guard cells respond to light, carbon dioxide levels, humidity, and plant water status, enabling trees to balance photosynthetic needs against water conservation.

27. **C. Minimum protection zone that may need to be larger based on conditions** - The standard critical root zone calculation (1 foot radius per inch DBH) represents a minimum protection area encompassing most roots critical for survival. However, larger zones may be appropriate based on species sensitivity (some species are more intolerant of root disturbance), existing root distribution, tree value, or site conditions. The calculation provides a starting point, not an absolute requirement.

28. **B. Iron or manganese** - Interveinal chlorosis (yellowing between veins while veins remain green) on the youngest leaves while older leaves remain green is characteristic of iron or manganese deficiency. These nutrients are immobile—they cannot be translocated from older tissue to support new growth. Deficiency often results from high soil pH making these nutrients chemically unavailable rather than their actual absence. Soil pH modification may be necessary for correction.

29. **D. Good compartmentalizers** - Oaks and beeches are examples of good compartmentalizers—species that form strong chemical and physical barriers after wounding, effectively limiting decay spread. This genetic capability means wounds on these species typically result in limited, contained decay. Understanding species-specific compartmentalization ability helps predict wound response and guides management decisions, including acceptable wound sizes and pruning approaches.

30. **A. Inadequate water management for the reduced root system** - Transplanting removes 90-95% of a tree's root system while the crown remains largely intact, creating severe imbalance between water demand (transpiration from existing foliage) and supply (greatly reduced root capacity). The most common cause of transplant failure is inadequate water management during the establishment period. Consistent moisture in the root ball is essential until new roots grow into surrounding soil.

31. **C. Oxygen availability and physical space for root growth** - Soil compaction collapses pore spaces, severely reducing oxygen availability for root respiration. Tree roots require oxygen to function; without it, cells cannot maintain essential processes and begin dying. Compaction also physically impedes root penetration, limiting soil volume roots can explore. Additionally, compacted soil reduces water infiltration, creating both drought stress and potential waterlogging. Prevention is far easier than remediation.

32. **B. Prevents proper closure and creates decay entry point** - Stub cuts leave branch tissue extending beyond the branch collar. Because callus develops from the cambium at the cut surface, stubs cannot close properly—the collar's wound-closure mechanism is bypassed. The exposed stub dies, decays, and serves as entry point for pathogens that can spread into the trunk. Proper cuts just outside the branch collar allow effective closure.

33. **D. Penetrating root cell walls to form structures inside cells** - Arbuscular mycorrhizae (AM), also called endomycorrhizae, form structures inside root cells—arbuscules (highly branched structures for nutrient exchange) and vesicles (storage structures). They penetrate cell walls but not cell membranes. AM associations are extremely common, occurring in most plant families. This contrasts with ectomycorrhizae, which form external sheaths without penetrating cell walls.

34. **A. 25 percent** - Removing more than 25% of live crown from a mature tree may cause significant stress, including depleted energy reserves, reduced photosynthetic capacity, and stimulation of epicormic sprouting (water sprouts with weak attachments). Young, vigorously growing trees may tolerate somewhat more removal, but mature trees have limited recovery capacity. Excessive crown removal is a common cause of tree decline and increased future hazard.

35. **B. 20 percent** - The 10-20-30 diversity guideline recommends no single genus comprise more than 20% of the urban forest. This protects against genus-level threats like emerald ash borer, which affects all ash species (Fraxinus genus). Combined with species limits (10%) and family limits (30%), this multi-level approach provides comprehensive protection against pests and diseases operating at various taxonomic levels.

36. **C. Documenting every individual tree** - Complete inventories document every tree in the population, recording location, species, size, condition, maintenance needs, and other relevant data. This enables individual tree management, specific work order generation, and detailed tracking over time. Sample inventories use statistical methods to estimate population characteristics without documenting every tree—cost-effective for large areas but unable to support individual tree management.

37. **D. Purplish discoloration and reduced growth** - Phosphorus deficiency often causes purplish or reddish discoloration of leaves (due to anthocyanin accumulation), particularly on older leaves, along with reduced growth, delayed maturity, and poor root development. Phosphorus is mobile in plants, so symptoms appear on older leaves first. Deficiency is relatively uncommon in established trees but can occur in very acidic or alkaline soils where phosphorus availability is limited.

38. **A. Varies based on employer's minimum approach distance (MAD) procedures** - Qualified line-clearance arborists may work within reduced distances from energized conductors, but specific distances depend on employer procedures, voltage levels, and applicable regulations. Employers must establish minimum approach distances (MAD) based on voltage and other factors. Qualified workers receive specific training on these procedures. Unqualified workers must maintain standard distances (10 feet below 50 kV).

39. **B. Proper nursery production and correct planting depth** - Prevention is the most effective approach to stem-girdling roots. This requires proper nursery practices (appropriate container sizes, production times, and root management) to prevent circling roots from developing, and correct planting depth with the root flare at or slightly above grade. Once established, girdling

roots are difficult to treat effectively. Root inspection and correction at planting addresses existing problems.

40. **C. Structural defects AND a target in the potential failure zone** - Tree risk requires both elements: structural defects creating likelihood of failure AND targets within the potential failure zone that could be harmed. Without both components, there is no risk regardless of individual element severity. A severely defective tree in a remote location with no targets has no risk; a sound tree over a playground has no hazard. Both elements must be present.

41. **D. Sugars produced by photosynthesis** - Phloem tissue transports sugars (primarily sucrose) produced during photosynthesis from source tissues (mature leaves) to sink tissues (roots, developing fruits, growing points, storage organs). This movement occurs through the pressure flow mechanism. Phloem also transports amino acids, hormones, and other organic compounds throughout the tree. Located just inside the bark, phloem is vulnerable to girdling damage.

42. **A. 1 year per inch of trunk caliper** - A general guideline for tree establishment is approximately one year per inch of trunk diameter (caliper). A 2-inch caliper tree requires about 2 years; a 4-inch tree requires about 4 years. During establishment, roots grow into surrounding soil to restore the ability to meet crown water demands without supplemental irrigation. Larger trees require proportionally longer establishment periods with more careful water management.

43. **B. 1-5 years or longer** - Construction damage to tree roots often does not become visible in the crown for 1-5 years or more. Trees have stored resources that temporarily mask root loss effects; the crown may appear healthy initially. As reserves deplete and remaining roots cannot meet crown needs, decline symptoms gradually appear. This delayed response means construction damage often isn't connected to tree problems occurring years later.

44. **C. Root grafts between adjacent elms** - Dutch elm disease spreads locally through root grafts—natural connections that form between root systems of adjacent trees. The fungus moves through these connections from infected to healthy trees without involvement of insect vectors. This explains why the disease often kills groups of adjacent elms rather than random individuals. Root graft disruption through trenching or chemical treatment can help protect valuable trees near infected ones.

45. **A. Relative landscape value, longevity, and desirability of the species** - The species rating in tree appraisal evaluates characteristics affecting landscape value: longevity, maintenance requirements, pest susceptibility, growth rate, ornamental features, structural strength, and overall desirability. High-value species like oaks typically receive higher ratings than short-lived or problem-prone species. Ratings are often developed regionally to reflect local climate, pest pressures, and preferences.

46. **D. Rapid screening of large tree populations to identify those needing further assessment** - Level 1 limited visual assessment is a "walk-by" or "drive-by" survey appropriate for efficiently screening many trees to identify those with obvious problems requiring detailed inspection. It

cannot provide detailed risk ratings for individual trees but quickly categorizes trees as "apparently low risk" or "needs further assessment." This efficiently allocates assessment resources where most needed.

47. **B. Hazards, work procedures, responsibilities, and emergency plans** - ANSI Z133 requires job briefings before tree work to communicate specific hazards identified at the site, work procedures 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 resulting from misunderstanding.

48. **C. Vascular cambium at wound margins** - Callus tissue (woundwood) is produced by the vascular cambium at wound margins. Cambial cells around wound edges divide and produce new tissue that gradually rolls over the wound surface from edges toward the center. Trees do not regenerate lost tissue—they compartmentalize damage and grow new tissue over wounds. Callus production rate depends on tree vigor; vigorous trees close wounds faster.

49. **A. Compaction** - Vertical mulching involves drilling holes (typically 2-4 inches diameter, 12-18 inches deep) in a pattern throughout the root zone and filling them with organic material, comite, or other amendments. This creates channels for air and water infiltration and pathways for root growth through otherwise compacted, impenetrable soil. Combined with surface organic matter, vertical mulching gradually improves compacted root zones.

50. **D. Protection against catastrophic losses from species-specific pests and diseases** - Urban forest diversity standards protect against devastating losses when species-specific threats arrive. The loss of American elm to Dutch elm disease and ash to emerald ash borer demonstrates how low-diversity populations are vulnerable. Diversity ensures no single pest or disease can eliminate more than a limited portion of the urban forest, maintaining overall canopy cover and benefits.

51. **B. After root establishment (1-2 growing seasons)** - Tree stakes and guys 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 strength develops in response to wind movement), creates potential for girdling, and may cause hardware to become embedded. Support systems should be removed on schedule.

52. **C. Crown density** - Crown thinning selectively removes branches throughout the crown to reduce density while maintaining the tree's natural form and size. Benefits include improved light penetration to interior branches and ground below, reduced wind resistance, and decreased weight on branch unions. Thinning should be distributed throughout the crown rather than concentrated in any area, using thinning cuts (removal at point of origin).

53. **A. Reduced photosynthesis and carbohydrate production** - When stomata close during drought to conserve water, carbon dioxide cannot enter leaves for photosynthesis. With photosynthesis stopped, the tree cannot produce carbohydrates and must draw on stored reserves. Prolonged

stomatal closure depletes reserves, reducing growth, weakening defenses against pests and pathogens, and potentially causing decline that persists after drought ends.

54. **D. Releasing additional natural enemies to supplement existing populations** - Augmentative biological control involves releasing natural enemies (predators, parasitoids, pathogens) to supplement populations already present. This may be done periodically (inoculative release) or in large numbers for immediate control (inundative release). This approach differs from conservation biological control (protecting existing natural enemies) and classical biological control (introducing natural enemies for invasive pests).

55. **B. The upper boundary of the branch-trunk junction where cuts should begin** - The branch bark ridge is a raised line of bark at the top of a branch attachment where branch and trunk bark meet and turn inward. It indicates where the pruning cut should begin—just above the ridge, angling down and away from the trunk. Cutting through the ridge damages trunk tissue; cutting too far away leaves a stub. The ridge helps identify proper cut placement.

56. **C. 4 inches** - For voltages above 50 kV, the minimum approach distance for unqualified workers increases by 4 inches for each additional 10 kV increment. This ensures adequate separation from higher-voltage conductors that can arc over greater distances. Precise calculations are necessary: at 70 kV (20 kV above threshold), distance increases by 8 inches (4 inches × 2), making total distance 10 feet 8 inches.

57. **D. Reduction cuts are made to laterals at least 1/3 the diameter of the removed branch** - ANSI A300 specifies that reduction cuts must be made to lateral branches at least one-third the diameter of the branch being removed. These laterals can assume the terminal role and continue growth without excessive sprouting. Heading cuts remove to smaller laterals or random points, stimulating multiple weakly attached sprouts—a fundamentally different and usually undesirable outcome.

58. **A. Trees show deficiency symptoms despite adequate soil nutrient levels** - Tissue (foliar) analysis is particularly valuable when soil tests show adequate nutrients but trees display deficiency symptoms. This situation suggests nutrients are present but unavailable (often due to pH problems) or that root dysfunction prevents uptake. Tissue analysis reveals what nutrients the tree has actually absorbed, identifying whether the problem is soil chemistry, root health, or other factors.

59. **B. Two points of attachment with rope moving through the tie-in** - Doubled rope technique (DRT), also called moving rope system (MRS), uses a single rope passed over a branch with both ends attached to the climber, creating two points of attachment. As the climber moves, the rope moves through the tie-in point above. This differs from single rope technique (SRT) where the rope is fixed at one point. Both systems require appropriate backup.

60. **C. Prevention and maintaining overall plant health** - Plant health care (PHC) 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 thresholds are exceeded, typically reducing pesticide use while improving outcomes.

61. **D. They compromise the structural foundation where all loads 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 cause complete tree failure. A wound of given size at the base affects a greater percentage of load-bearing capacity than the same wound higher on the trunk where diameter may be larger and loads are distributed differently.

62. **A. Contrast between larger earlywood cells and smaller latewood cells** - Annual growth rings are visible because of contrast between earlywood (springwood) and latewood (summerwood). Earlywood produced early in the growing season has larger, thinner-walled cells; latewood produced later has smaller, thicker-walled cells. This alternating pattern creates visible rings. Ring width indicates growing conditions—narrow rings suggest stress years (drought, defoliation); wide rings indicate favorable conditions.

63. **B. Early, when corrections require small 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 problems. Regular evaluation and training during the first 10-15 years establishes lifelong structure.

64. **C. Bacterium** - Fire blight is caused by the bacterium Erwinia amylovora. This disease affects trees and shrubs in the rose family (Rosaceae) including apple, pear, crabapple, and hawthorn. It causes rapid wilting and blackening of shoots, blossoms, and fruits, creating a scorched appearance. Characteristic symptoms include shepherd's crook bending of shoot tips. The disease spreads rapidly during warm, wet weather, especially during bloom.

65. **D. Identify trees with potential to fail and cause harm for management decisions** - Tree risk assessment is a systematic process to identify trees with structural defects or health conditions creating potential for failure, and to evaluate whether failure would cause harm to targets. Assessment informs management decisions—whether to accept, mitigate, or remove the risk. The goal is informed decision-making that balances safety, tree value, and management resources.

66. **A. Continuing education credits and periodic renewal** - ISA (International Society of Arboriculture) certification requires ongoing continuing education to maintain credentials. Certified Arborists must earn a specified number of continuing education units (CEUs) during each three-year certification period and pay renewal fees. This ensures certified professionals stay current with evolving knowledge, techniques, and standards. Failure to meet requirements results in certification lapse.

67. **B. Stop or reverse the feed mechanism when contacted** - 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.

68. **C. What could be harmed if the tree fails** - In tree risk assessment, the target is anything of value that could be harmed if the tree or portion fails—people, vehicles, structures, utilities, or other property. Target assessment considers type (people vs. property), occupancy rate (how often the target is present), and vulnerability. Without a target in the failure zone, there is no risk regardless of tree condition.

69. **D. Load weight, equipment ratings, anchor strength, and dynamic forces** - Safe rigging requires understanding multiple factors: the weight of pieces being removed, strength ratings of all equipment components (ropes, blocks, slings), anchor point capacity, and the dynamic forces generated when loads move or stop. Dynamic forces can multiply static weights by 2-10 times. The system is only as strong as its weakest component—all elements must be rated for anticipated loads.

70. **A. Increased end-weight loading, reduced damping, 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 unions. It also removes damping foliage that normally slows branch movement in wind, leading to greater motion and stress during storms. Sun exposure on previously shaded bark can cause sunscald. Lion-tailing is improper practice that increases failure risk.

71. **B. Immediate environmental benefits not replaceable 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 environmental services. These values cannot be replaced on any practical timeline, making preservation essential during development planning.

72. **C. Evidence of severe structural defects or basal decay** - Trees showing evidence of severe structural problems (extensive basal decay, horizontal cracks, recent lean with root plate movement) should not be climbed until alternative assessment determines whether they can safely support climbing loads. The dynamic forces of climbing could trigger failure in compromised trees. Alternative access (aerial lift) or ground-based assessment may be necessary.

73. **D. Before each use** - The feed control bar must be tested before each chipper use to verify it functions properly—that pushing the bar actually stops or reverses the feed mechanism. Equipment damage or malfunction could disable this critical safety device. Testing takes only moments and verifies the last line of defense against entanglement injuries. Never operate a chipper with a non-functional feed control bar.

74. **D. Mobility (can be translocated to new growth)** - Mobile nutrients (nitrogen, phosphorus, potassium, magnesium) can be moved from older tissue to support new growth. When deficient, the plant translocates existing supplies from older leaves to developing leaves, causing symptoms to appear on older leaves first. This pattern helps diagnose specific deficiencies—older leaf symptoms indicate mobile nutrient deficiency; young leaf symptoms indicate immobile nutrients.

75. **B. The tree's functional and aesthetic contribution to the site** - The location rating in tree appraisal evaluates how the tree's position affects its value—functional benefits (shade, energy savings, windbreak, screening) and aesthetic contribution to the property. A well-placed tree providing significant benefits receives higher rating than an identical tree in a less functional location. Site factors like visibility, landscape design, and property use influence this rating.

76. **C. Planned ongoing management with regular pruning to permanent scaffold branches** - Pollarding is a traditional practice of repeatedly removing all new growth back to permanent scaffold branches (pollard heads) on a regular cycle, initiated on young trees and maintained consistently throughout the tree's life. It's a planned management system creating distinctive forms and managing tree size. This differs fundamentally from topping—indiscriminate cutting of mature trees without ongoing management plans.

77. **D. Tree vigor and growth rate** - Wound closure rate correlates directly with annual radial growth rate because callus is produced by cambial activity at wound margins. A vigorous tree producing substantial annual growth closes wounds faster than a stressed or slow-growing tree. This relationship explains why maintaining tree health is critical when wounding is unavoidable, and why wounds on declining trees may remain permanently open.

78. **A. Sapwood contains living cells and conducts water; heartwood does not** - Sapwood is the outer portion of wood containing living parenchyma cells and functional xylem vessels that actively conduct water. As trees grow, older sapwood converts to heartwood through cell death and chemical changes (extractive accumulation). Heartwood no longer conducts water or contains living cells but provides structural support and often resists decay due to accumulated extractives.

79. **B. 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 weak attachments, 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.

80. **C. A serious structural defect with potential for failure** - Horizontal cracks extending through the trunk indicate the trunk is actively separating—structural failure in progress. Unlike vertical cracks that may remain stable, horizontal cracks indicate shear failure with potential for complete separation. Movement visible when the tree sways confirms severity. Such trees typically require immediate mitigation—this is among the most serious defects encountered.

81. **D. Compressed air that displaces 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 the damage that mechanical excavation would cause. This technology has expanded options for tree preservation and diagnostic capabilities.

82. **A. 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 through specialized fibers. In conifers, compression wood forms on the lower side, pushing upward through denser cells. Reaction wood has different properties than normal wood.

83. **B. When soil or tissue testing confirms nutrient deficiency** - Fertilization benefits trees when actual deficiencies limit health or growth. 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 through runoff. Most established trees in reasonably healthy landscapes do not require regular fertilization.

84. **C. Signs (direct evidence of the pathogen)** - Fungal fruiting bodies (conks, mushrooms, brackets) are reproductive structures of fungi—direct evidence of the organism itself. This makes them "signs" of disease rather than "symptoms," which are plant responses to disease (wilting, chlorosis, dieback). Finding a conk indicates established decay fungus; determining significance requires assessing decay extent and structural implications.

85. **D. Friction device (Port-a-wrap or similar)** - Friction devices (Port-a-wrap, rigging wrench, rope wrapped around posts) allow ground personnel to control descent rate by applying friction to the lowering line. Proper friction management enables smooth, controlled lowering; insufficient friction allows dangerous uncontrolled descent with shock loading. The person controlling the friction device has critical responsibility for safe rigging operations.

86. **A. Monitoring to detect pest presence** - Integrated pest management begins with regular monitoring to detect pest presence before problems become severe. Monitoring is followed by accurate pest identification, threshold determination (deciding if action is needed), and appropriate tactic selection if thresholds are exceeded. This systematic approach prevents unnecessary treatment while ensuring effective response when warranted.

87. **B. Insect vectors (nitidulid beetles) carrying spores to fresh wounds** - Oak wilt spreads over long distances (between trees not connected by root grafts) primarily via nitidulid (sap-feeding) beetles that carry fungal spores from mats on infected trees to fresh wounds on healthy trees. These beetles are most active in spring and early summer—oak pruning is discouraged April-July in oak wilt areas. Local spread between adjacent trees occurs through root grafts.

88. **C. Circling and potentially girdling roots** - Trees grown too long in containers develop circling roots conforming to container walls. This root-bound condition often persists after planting—roots

may continue circling rather than growing outward into surrounding soil. Without correction at planting, circling roots may eventually girdle the trunk or major roots, causing decline or death years or decades later.

89. **D. Expose and assess the trunk-root transition zone for problems** - 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 (enabling girdling root treatment, allowing bark to dry).

90. **A. Greater density and mechanical strength** - Specific gravity (ratio of wood density to water density) correlates directly with wood strength. Higher specific gravity indicates denser wood with more cell wall material per unit volume, resulting in greater mechanical strength and stiffness. Species with high specific gravity (oak, hickory, locust) produce stronger wood than those with low specific gravity (cottonwood, willow, basswood).

91. **B. Pre-climb safety assessment identifying 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. Pre-climb assessment is mandatory under ANSI Z133.

92. **C. 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.

93. **D. Pest levels at which treatment becomes 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 acceptable or natural enemies may provide control. Above threshold, intervention is warranted. Thresholds vary with plant value, pest species, and management objectives.

94. **A. 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 or extension over time. Proper maintenance ensures the system provides intended protection throughout its service life.

95. **B. Annually and after major storms** - Cable and brace support systems require regular inspection to ensure continued function. Annual inspection at minimum, plus inspection after significant

storms (wind, ice, heavy snow), verifies hardware condition, cable tension (for standard cables), tree growth around components, and whether the system remains appropriate. Neglected systems may fail to provide support or damage trees.

96. **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.

97. **D. Fabaceae (legume family)** - Nitrogen-fixing bacteria (Rhizobium and related species) form symbiotic relationships with trees in the legume family (Fabaceae), including black locust, honeylocust, Kentucky coffeetree, redbud, and mimosa. Bacteria in root nodules convert atmospheric nitrogen (N_2) to ammonia, which plants use for growth. This symbiosis allows legumes to thrive in nitrogen-poor soils and enriches soil nitrogen.

98. **A. 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 potential failure size. Higher consequences justify more aggressive mitigation.

99. **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 (how often present), and target mobility (ability to move away). Even a tree certain to fail may have low impact likelihood if the target is rarely present.

100. **C. Branch collar** - Proper pruning cuts preserve the branch collar—the swollen area at the branch base containing specialized tissue for compartmentalization and wound closure. Cuts made just outside the collar allow these tissues to function optimally, enabling effective decay containment and rapid callus production. Flush cuts remove the collar, damaging trunk tissue; stub cuts cannot close properly. Collar preservation is fundamental to proper pruning.