FULL-LENGTH PRACTICE TESTS

PRACTICE TEST 8 – 100 QUESTIONS

1. What tissue is responsible for lateral water movement from xylem to living cells in the wood?

A. Vessel elements

B. Ray parenchyma

C. Tracheids

D. Fibers

2. According to ANSI Z133, what must be worn by all workers within two tree lengths of a tree being felled?

A. Chainsaw chaps

B. Reflective vest only

C. Climbing harness

D. Hard hat and appropriate PPE

3. Which soil texture has the highest cation exchange capacity?

A. Sand

B. Loamy sand

C. Clay

D. Gravel

4. A tree species that retains green foliage year-round and sheds leaves gradually over time is classified as what?

A. Evergreen

B. Deciduous

C. Marcescent

D. Semi-deciduous

5. When cutting with a chain saw, which part of the bar should be avoided to prevent kickback?

A. The bottom of the bar

B. The middle section of the bar

C. The upper quadrant of the bar tip

D. The area closest to the engine

6. According to ANSI A300, crown reduction involves reducing the height or spread of a tree using what type of cut?

A. Reduction cuts to appropriate lateral branches

B. Heading cuts at any convenient point

C. Flush cuts at the trunk

D. Stub cuts for future sprouting

7. What soil condition results when pore spaces are filled with water, excluding air?

A. Compaction

B. Drought stress

C. Nutrient toxicity

D. Waterlogging or saturation

8. Wall 3 in the CODIT model represents what type of barrier to decay?

A. Vessel plugging above and below the wound

B. Ray cells limiting lateral spread

C. The annual ring boundary

D. The barrier zone of new wood

9. Cankers on tree bark characterized by sunken, dead areas with callus tissue at the margins are typically caused by what?

A. Fungal or bacterial pathogens

B. Nutrient deficiency

C. Herbicide exposure

D. Winter cold injury only

10. What is the recommended action if an arborist's climbing rope shows signs of core damage or significant sheath wear?

A. Continue using with extra caution

B. Downgrade to rigging use only

C. Remove from service immediately

D. Repair with tape and continue use

11. Sugars produced in leaves are transported to roots primarily through what tissue?

A. Xylem vessels

B. Cork cells

C. Heartwood

D. Phloem

12. What is the purpose of creating a basin or berm around a newly planted tree?

A. To prevent weed growth

B. To direct water to the root ball

C. To improve aesthetics

D. To prevent root growth beyond the basin

13. A leaf composed of multiple leaflets all originating from a single point at the end of the petiole has what type of structure?

A. Pinnately compound

B. Bipinnately compound

C. Palmately compound

D. Simple with deep lobes

14. Slime flux or wetwood is a bacterial condition that results in what visible symptom?

A. Oozing of foul-smelling liquid from the bark

B. White powdery coating on leaves

C. Gall formation on branches

D. Leaf curling and distortion

15. When is it appropriate to use heading cuts in tree pruning?

A. Generally avoided; limited uses include restoration of topped trees

B. For all routine pruning operations

C. Whenever reducing branch length

D. To create strong branch attachments

16. What type of support system involves installing flexible steel cables in the upper crown to limit branch movement?

A. Bracing

B. Guying

C. Propping

D. Cabling

17. The endodermis with its Casparian strip is found in roots and functions primarily to do what?

A. Absorb water directly

B. Store carbohydrates

C. Control what enters the vascular system

D. Produce lateral roots

18. Gibberellins are plant hormones that primarily promote what process?

A. Stem elongation and seed germination

B. Leaf abscission

C. Root initiation

D. Stomatal closure

19. What instrument is commonly used to measure tree height from the ground?

A. Diameter tape

B. Increment borer

C. Resistograph

D. Clinometer or hypsometer

20. Defoliating insects that consume leaf tissue by chewing are categorized as what type of pest?

A. Sucking insects

B. Leaf-feeding or chewing insects

C. Boring insects

D. Gall-forming insects

21. What is the appropriate response to a tree that has been previously topped and now has multiple weakly attached sprouts?

A. Restoration pruning over several years to select and develop new leaders

B. Top it again to the same height

C. Remove the tree immediately

D. No intervention is possible

22. Fire blight disease spreads most rapidly under what environmental conditions?

A. Cold, dry weather

B. Hot, dry summer conditions

C. Warm, wet weather during bloom

D. Cool fall temperatures

23. In tree risk assessment, what is evaluated when determining "likelihood of failure"?

A. The value of potential targets

B. The severity of harm if failure occurs

C. The tree species and size

D. The probability that the tree or tree part will fail

24. The phelloderm is a tissue produced by the cork cambium located where in relation to the cork?

A. Outside the cork

B. Inside the cork (toward the center of the tree)

C. Mixed within the cork layer

D. Only in roots

25. Symptoms of decline that appear on one side of a tree crown often indicate what?

A. Root damage or loss on the corresponding side

B. Uniform nutrient deficiency

C. Crown disease spreading downward

D. Normal asymmetric growth

26. Chloroplasts, which contain chlorophyll and are the site of photosynthesis, are found in highest concentration in what leaf tissue?

A. Upper epidermis

B. Cuticle

C. Vascular bundles

D. Mesophyll cells

27. What document should specify tree protection requirements, fencing locations, and monitoring protocols during construction?

A. Building permit only

B. Contractor's preference

C. Tree protection plan

D. Landscape design

28. A tree showing marginal leaf scorch, with browning progressing from leaf edges inward, may be experiencing what condition?

A. Nitrogen deficiency

B. Drought stress or salt damage

C. Iron chlorosis

D. Phosphorus deficiency

29. The formation of tyloses in xylem vessels is part of what tree defense process?

A. Photosynthetic response

B. Hormone production

C. Nutrient absorption

D. Compartmentalization (blocking vessel transport)

30. When planting a container-grown tree, what should be done if circling roots are observed?

A. Cut, spread, or remove circling roots before planting

B. Plant without disturbing roots

C. Add extra soil over the root ball

D. Increase fertilizer application

31. What soil property is most directly improved by incorporating organic matter?

A. Soil temperature

B. Bedrock depth

C. Structure, water retention, and microbial activity

D. Mineral content only

32. Leaving a branch stub after pruning is problematic because it does what?

A. Improves wound closure

B. Prevents proper compartmentalization and invites decay

C. Provides wildlife habitat

D. Stimulates healthy regrowth

33. Arbuscular mycorrhizae form what type of relationship with tree roots?

A. Parasitic relationship causing disease

B. No significant interaction

C. Surface attachment only

D. Symbiotic relationship with fungal penetration into root cells

34. What response occurs when excessive live crown is removed from a mature tree in a single pruning?

A. Stress response with epicormic sprouting and depleted energy reserves

B. Improved tree structure

C. Accelerated growth rate

D. Enhanced disease resistance

35. According to urban forest diversity guidelines, no single genus should represent more than what percentage of the tree population?

A. 10 percent

B. 30 percent

C. 20 percent

D. 40 percent

36. What type of inventory involves collecting data from statistically selected plots to estimate population characteristics?

A. Complete inventory

B. Sample inventory

C. Emergency assessment

D. Individual tree evaluation

37. A tree exhibiting yellowing of older leaves while new growth remains green is most likely deficient in what nutrient?

A. Iron

B. Manganese

C. Calcium

D. Nitrogen or another mobile nutrient

38. What is the maximum number of consecutive correct answers that should ideally share the same letter to avoid creating patterns?

A. No more than 2-3 consecutive identical answers

B. Up to 5 identical answers is acceptable

C. Pattern does not affect test validity

D. All answers should vary completely

39. Girdling roots are most commonly caused by what condition?

A. Genetic defects

B. Disease infection

C. Improper planting or container root defects

D. Excessive irrigation

40. A tree that could fail and cause harm due to structural defects but has no nearby targets has what risk level?

A. Extreme risk

B. Low or no risk because no target is present

C. Moderate risk

D. Risk cannot be assessed

41. Lateral meristems are responsible for what type of plant growth?

A. Secondary growth (diameter increase)

B. Primary growth (elongation)

C. Flower development

D. Seed production

42. What is the primary water management goal during tree establishment?

A. Keep surrounding soil dry

B. Water infrequently with large volumes

C. Apply foliar misting only

D. Maintain consistent moisture in the original root ball

43. Which construction activity typically causes the most severe immediate damage to trees?

A. Painting tree trunks

B. Light foot traffic

C. Soil excavation that severs major roots

D. Temporary shade structures

44. Bacterial leaf scorch caused by Xylella fastidiosa produces what characteristic symptom pattern?

A. Uniform yellowing of all leaves

B. Marginal leaf scorch with yellow border between dead and green tissue

C. Leaf spots with concentric rings

D. Powdery coating on leaf surface

45. What does the basic value in the trunk formula method of tree appraisal represent?

A. Replacement cost based on trunk cross-sectional area

B. Annual maintenance cost

C. Removal cost

D. Land value contribution

46. Limited visual tree risk assessment is most appropriate for what situation?

A. Detailed evaluation of a single tree with suspected decay

B. Evaluation after tree failure

C. Post-storm damage documentation

D. Initial screening of large numbers of trees to identify those needing further assessment

47. What action should be taken if a tree's root flare is buried beneath soil or mulch?

A. Add more mulch to protect roots

B. Leave undisturbed if tree appears healthy

C. Carefully excavate to expose the flare

D. Increase watering to compensate

48. What must be discussed in a job briefing before tree work begins?

A. Marketing strategies

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

C. Equipment prices

D. Future job scheduling

49. Trees produce woundwood (callus) most rapidly under what conditions?

A. During dormancy

B. When stressed

C. After wound dressing application

D. When growing vigorously

50. What technique involves drilling holes in compacted soil and filling them with organic material to improve root zone conditions?

A. Vertical mulching

B. Trenching

C. Air spading

D. Hydraulic injection

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

A. Simplified maintenance

B. Uniform appearance

C. Protection against catastrophic pest or disease losses

D. Cost reduction

52. When should guy wires supporting a newly planted tree be removed?

A. After 5 years

B. After root establishment, typically 1-2 growing seasons

C. Never

D. After 10 years

53. Crown thinning reduces what while maintaining the tree's natural shape?

A. Tree height

B. Trunk diameter

C. Root mass

D. Crown density

54. What physiological process is directly reduced when trees close stomata during drought?

A. Photosynthesis (CO_2 uptake is limited)

B. Root respiration

C. Bark development

D. Wood decay resistance

55. Biological control of pests involves using what to manage pest populations?

A. Synthetic chemical pesticides

B. Mechanical removal only

C. Natural enemies such as predators, parasites, or pathogens

D. Cultural practices exclusively

56. The branch bark ridge is located at what position on a branch attachment?

A. Bottom of the attachment

B. Top of the attachment where branch and trunk bark meet

C. Middle of the branch

D. At the branch tip

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

A. Varies based on specific training and authorization

B. 10 feet always

C. 5 feet always

D. 15 feet always

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

A. Reduction cuts are made to branches too small to assume terminal function

B. There is no difference

C. Heading cuts preserve branch collar

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

59. Soil testing provides information about nutrient levels but not what?

A. Soil pH

B. Organic matter content

C. Nutrients actually absorbed by the tree

D. Soil texture

60. What is the appropriate response if a climbing system becomes entangled during ascent?

A. Cut the rope to free yourself

B. Stop, secure position, carefully untangle before proceeding

C. Continue climbing to reach a better position

D. Call for help and wait without taking action

61. What approach does plant health care emphasize for managing plant problems?

A. Reactive pesticide applications

B. Calendar-based treatments

C. Removing affected plants

D. Prevention and maintaining overall plant health

62. A wound at the base of a tree is more concerning than one higher in the crown because it affects what?

A. The structural foundation where all loads are transferred

B. Only aesthetic value

C. Branch development patterns

D. Leaf production

63. What tissue layer produces annual growth rings visible in a cross-section of the trunk?

A. Cork cambium

B. Phloem

C. Vascular cambium (producing xylem)

D. Pith

64. The best time to identify and correct structural defects in trees is when?

A. After defects cause failure

B. Early in the tree's development when branches are small

C. After the tree reaches mature size

D. Only during dormant season

65. Powdery mildew diseases are caused by what type of organism?

A. Fungi

B. Bacteria

C. Viruses

D. Nematodes

66. What is the function of root hairs on young roots?

A. Structural support

B. Food storage

C. Protection from pathogens

D. Dramatically increasing surface area for water and nutrient absorption

67. In risk assessment, a parking lot regularly used by many people beneath a tree with dead branches represents what?

A. Low occupancy target

B. Defect only

C. High occupancy target

D. Assessment location

68. What mulch depth can lead to problems including oxygen reduction and stem-girdling root development?

A. 2 inches

B. Excessive depth greater than 4-6 inches

C. 3 inches

D. 1 inch

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

A. Excessive vigor

B. Improved stability

C. Enhanced disease resistance

D. Trunk decay and girdling roots

70. What specialized tool uses sound waves to create an image of internal wood condition?

A. Sonic tomograph

B. Increment borer

C. Mallet

D. Resistograph

71. Reduction cuts should be made to lateral branches that are at least what size relative to the branch being removed?

A. One-quarter the diameter

B. Equal diameter

C. One-third the diameter

D. One-half the diameter

72. Progressive leaf drop starting at the interior of the crown and moving outward often indicates what?

A. Normal seasonal change

B. Insufficient light reaching interior (shade-induced shedding)

C. Root disease

D. Insect infestation

73. The primary benefit of preserving mature trees during development is what?

A. Immediate environmental and aesthetic benefits that new plantings cannot provide for decades

B. Reduced initial costs only

C. Simplified site design

D. Lower insurance rates

74. What condition would require a tree to be evaluated using alternative methods rather than climbing?

A. Minor deadwood in outer crown

B. Previous pruning wounds

C. Light lichen growth

D. Evidence of severe structural defects or advanced decay

75. The chipper feed control bar must be able to do what when activated?

A. Increase feed rate

B. Adjust chip size

C. Stop or reverse the feed mechanism

D. Discharge chips in a different direction

76. Nutrient deficiency symptoms appearing on youngest leaves first indicate what about the deficient nutrient?

A. It is mobile within the plant

B. It is immobile and cannot be translocated from older tissue

C. It is a macronutrient

D. It is always nitrogen

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

A. Tree age only

B. Location on property

C. Owner preference

D. The relative value and desirability of the species for landscape use

78. What is the term for removing all branches to leave only a trunk or main scaffold stubs?

A. Topping or pollarding (depending on intent and maintenance)

B. Crown thinning

C. Crown reduction

D. Crown cleaning

79. What factor has the greatest influence on wound closure rate?

A. Wound dressing type

B. Time of year wound was made

C. Tree vigor and growth rate

D. Compass direction wound faces

80. Sapwood differs from heartwood in that sapwood does what?

A. Provides structural support only

B. Contains living cells and conducts water

C. Resists decay better

D. Is always darker in color

81. What areas should be evaluated during a basic tree risk assessment?

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

B. Trunk only

C. Crown structure only

D. Root zone only

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

A. Normal growth pattern

B. Minor cosmetic defect

C. Improved structural strength

D. A serious structural defect indicating the union may be failing

83. Air excavation removes soil from root zones by using what?

A. Water pressure

B. Mechanical auger

C. Chemical treatment

D. Compressed air that displaces soil without cutting roots

84. What is the term for a tree's response to non-vertical orientation, producing specialized wood to maintain position?

A. Normal wood formation

B. Reaction wood

C. Sapwood development

D. Heartwood conversion

85. Under what circumstances should fertilization be applied to landscape trees?

A. Every spring regardless of tree condition

B. Immediately after transplanting

C. During drought stress

D. When testing confirms nutrient deficiency

86. A fungal fruiting body (mushroom or conk) on a tree is classified as what?

A. A sign of disease (direct evidence of the causal organism)

B. A symptom of disease

C. Beneficial to the tree

D. Unrelated to tree health

87. Which rigging component directly controls the descent rate of lowered pieces?

A. Sling

B. Block

C. Friction device or lowering line

D. Choker configuration

88. Integrated pest management prioritizes what approach to pest problems?

A. Immediate chemical application

B. Monitoring, accurate identification, and using thresholds before intervention

C. Calendar-based treatments

D. Single-tactic approach

89. What is the primary method of transmission for oak wilt disease between trees that are not connected by root grafts?

A. Insect vectors (nitidulid beetles) attracted to fresh wounds

B. Wind-blown spores

C. Contaminated soil

D. Rainfall splash

90. The condition of limited root development that occurs when trees are grown in containers too long is most accurately described as what?

A. Root-bound with circling roots

B. Healthy root development

C. Natural adaptation

D. Enhanced root architecture

91. Root flare excavation is performed to accomplish what?

A. Improve drainage

B. Add fertilizer

C. Expose and assess the root-trunk transition zone

D. Increase mulch depth

92. Wood with higher specific gravity generally has what properties?

A. Lower strength

B. Greater density and strength

C. Lighter weight

D. Less decay resistance

93. What type of assessment should occur before any climbing work begins?

A. Financial appraisal

B. Inventory counting

C. Marketing evaluation

D. Pre-climb safety inspection of the tree

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

A. At the critical root zone boundary before construction begins

B. After construction is complete

C. Only around the trunk

D. When problems are observed

95. Action thresholds in IPM programs define what?

A. Maximum pesticide application rates

B. Calendar dates for treatment

C. Pest levels at which intervention is justified

D. Cost limits for treatment

96. A lightning protection system for trees must be inspected how often?

A. Every 10 years

B. Annually and after lightning events

C. Only after visible damage

D. Never after initial installation

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

A. Annually and after major weather events

B. Every 5 years

C. Monthly

D. Only when problems are visible

98. Crown raising is performed to accomplish what objective?

A. Reduce crown density

B. Remove dead branches throughout the crown

C. Decrease overall tree height

D. Provide vertical clearance beneath the crown

99. Legume trees like black locust and honeylocust have symbiotic relationships with bacteria that do what?

A. Cause root disease

B. Decompose organic matter

C. Fix atmospheric nitrogen

D. Produce antibiotics

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

A. The probability of tree failure

B. The severity of harm that would result if failure occurs and strikes the target

C. The tree's species characteristics

D. The cost of tree removal

PRACTICE TEST 8: ANSWER KEY WITH EXPLANATIONS

1. **B. Ray parenchyma** - Ray parenchyma cells form horizontal channels (rays) that extend radially from the center of the tree outward through the wood. These living cells transport water and nutrients laterally from the xylem to living cells in the wood and bark, and they also store carbohydrates and other compounds. Rays are visible as lines radiating from the center in cross-sections of wood. Vessel elements and tracheids conduct water vertically, while fibers provide structural support.

2. **D. Hard hat and appropriate PPE** - ANSI Z133 requires all workers within two tree lengths of a tree being felled to wear hard hats and other appropriate personal protective equipment. This distance accounts for the possibility of the tree falling in unexpected directions, broken branches being thrown, or the tree bouncing or rolling after impact. The two tree-length zone is a safety buffer that recognizes felling operations are inherently unpredictable.

3. **C. Clay** - Clay particles are extremely small (less than 0.002 mm) with enormous surface area relative to their volume. This large surface area carries negative electrical charges that attract and hold positively charged nutrient ions (cations) like potassium, calcium, and magnesium. Sandy soils have very low CEC because large particles have minimal surface area. While clay's high CEC is beneficial for nutrient retention, clay's poor drainage and low oxygen availability can limit tree root health.

4. **A. Evergreen** - Evergreen trees retain functional green foliage year-round, shedding old leaves gradually while maintaining overall canopy coverage. This contrasts with deciduous trees that lose all leaves seasonally. Evergreen species include most conifers (pines, spruces, firs) and some broadleaf trees (live oaks, magnolias, hollies). The evergreen habit provides continuous photosynthetic capacity and is advantageous in climates where growing conditions persist year-round.

5. **C. The upper quadrant of the bar tip** - The upper quadrant of the chain saw bar tip is the kickback zone. When this area contacts wood or other objects, the chain's movement can cause the bar to rotate rapidly upward and backward toward the operator. Kickback is a leading cause of chain saw injuries. To avoid kickback, operators should use the bottom portion of the bar for cutting, maintain awareness of bar tip position, use reduced-kickback chains and bars, and keep the chain sharp and properly tensioned.

6. **A. Reduction cuts to appropriate lateral branches** - ANSI A300 specifies that crown reduction should be accomplished using reduction cuts—cuts made to lateral branches large enough (at least

one-third the diameter of the removed branch) to assume the terminal role. This maintains the tree's natural form while reducing size. Heading cuts (cutting to random points) stimulate weakly attached sprouts and are not appropriate for crown reduction, though they are commonly misused in improper "topping."

7. **D. Waterlogging or saturation** - When soil pore spaces fill completely with water, air is excluded and the soil becomes saturated or waterlogged. Tree roots require oxygen for cellular respiration; without it, roots cannot function and begin to die within days during the growing season. While some species tolerate temporary flooding, prolonged saturation kills most landscape trees. Drainage improvement and proper site selection for flood-tolerant species address this issue.

8. **B. Ray cells limiting lateral spread** - In the CODIT model, Wall 3 consists of ray parenchyma cells that limit the lateral (tangential) spread of decay around the trunk's circumference. Rays create compartments like slices of a pie; decay tends to remain within individual ray segments. Wall 1 consists of plugged vessels above and below the wound, Wall 2 is the annual ring boundary, and Wall 4 is the barrier zone formed by new growth after wounding.

9. **A. Fungal or bacterial pathogens** - Cankers are localized areas of dead bark and cambium typically caused by fungal or bacterial pathogens. They appear sunken compared to surrounding healthy tissue, and the tree produces callus tissue at the margins in an attempt to wall off the infection. Common canker diseases include Nectria canker, Cytospora canker, and bacterial cankers. Cankers can girdle branches or trunks, causing dieback or death of portions above the canker.

10. **C. Remove from service immediately** - Climbing ropes showing core damage (felt as lumps, soft spots, or inconsistent stiffness) or significant sheath wear must be immediately retired from climbing use. Core damage indicates compromised strength that could lead to catastrophic failure. Rope inspection before each use is mandatory; any rope with suspected damage should be removed from service. Some organizations cut retired ropes to prevent accidental reuse for life safety applications.

11. **D. Phloem** - Phloem tissue transports sugars (primarily sucrose) produced by photosynthesis in leaves to other parts of the tree including roots, developing fruits, and growing points. This movement occurs through sieve tube elements via the pressure flow mechanism. Phloem is located just inside the bark; damage to bark that affects phloem can starve roots and eventually kill the tree. Xylem transports water upward; it does not transport sugars.

12. **B. To direct water to the root ball** - A soil basin or berm around a newly planted tree creates a reservoir that holds water over the root ball, allowing it to soak in slowly rather than running off. This is particularly important during establishment when roots are confined to the original root ball and cannot access water from surrounding soil. The basin should be wide enough to encompass the root ball and should be maintained until roots establish into surrounding soil.

13. **C. Palmately compound** - Palmately compound leaves have multiple leaflets radiating from a single point at the end of the petiole (leaf stalk), like fingers spreading from a palm. Common examples include buckeye, horsechestnut, and some maples (which actually have simple palmate leaves, not compound). Pinnately compound leaves have leaflets arranged along a central rachis (axis). Identifying compound leaf types is an important skill for tree identification.

14. **A. Oozing of foul-smelling liquid from the bark** - Slime flux (wetwood) is a bacterial condition affecting the inner wood that creates internal pressure, forcing foul-smelling liquid to ooze from wounds, cracks, or branch stubs. The liquid often stains bark and may kill grass beneath the tree. While unsightly, slime flux rarely causes serious harm to otherwise healthy trees. There is no effective treatment; maintaining tree health and avoiding unnecessary wounds is the best management approach.

15. **A. Generally avoided; limited uses include restoration of topped trees** - Heading cuts (cutting to random points rather than to lateral branches) generally produce poor results—multiple weakly attached sprouts and increased maintenance needs. However, they have limited appropriate uses, including restoration pruning of previously topped trees where selecting among existing sprouts is necessary, formal hedge maintenance, and some fruit tree training systems. Understanding when heading cuts are appropriate (and when they're not) is essential knowledge.

16. **D. Cabling** - Cabling involves installing flexible steel cables high in the crown to limit the movement of branches or stems relative to each other. Cables don't prevent failure but reduce the likelihood and extent of movement that could cause weak attachments to fail. Standard cabling uses rigid end connections; dynamic (shock-absorbing) cables allow some movement before engaging. Bracing uses rigid rods at the attachment point; guying connects the tree to ground anchors.

17. **C. Control what enters the vascular system** - The endodermis is a single layer of cells surrounding the vascular tissue in roots. The Casparian strip—a band of waxy suberin in endodermal cell walls—forces water and dissolved minerals to pass through endodermal cell membranes rather than between cells. This selectivity allows the root to control what enters the vascular system, blocking some potentially harmful substances while allowing beneficial nutrients to pass.

18. **A. Stem elongation and seed germination** - Gibberellins are plant hormones that promote stem elongation (internode extension), seed germination, flowering in some species, and fruit development. They work partly by stimulating cell division and elongation. Commercially, gibberellins are used to increase grape size and promote uniform fruit development. In trees, gibberellins influence height growth and development patterns.

19. **D. Clinometer or hypsometer** - Clinometers measure angles, allowing calculation of tree height using trigonometry (measuring the angle to the top, angle to the base, and distance from the tree). Hypsometers combine angle measurement with distance measurement to calculate height directly.

Both instruments allow height measurement from the ground without climbing. Diameter tape measures trunk diameter; increment borers extract wood cores for age determination; resistographs measure wood density.

20. **B. Leaf-feeding or chewing insects** - Defoliating insects (caterpillars, sawfly larvae, beetles) have chewing mouthparts that consume leaf tissue, creating holes, notches, or complete leaf loss. Unlike sucking insects that remove plant fluids through piercing mouthparts, chewing insects physically destroy leaf tissue. Heavy defoliation reduces photosynthesis, stresses trees, and can predispose them to other problems. Most healthy trees can survive one or two years of defoliation but decline with repeated attacks.

21. **A. Restoration pruning over several years to select and develop new leaders** - Previously topped trees can often be improved through restoration pruning—selectively reducing competing sprouts, selecting well-positioned sprouts to develop as future leaders and scaffold branches, and gradually restoring more natural structure over multiple pruning cycles (typically 3-5 years). This approach is preferable to re-topping (which perpetuates problems) or immediate removal (which may be unnecessary for restorable trees).

22. **C. Warm, wet weather during bloom** - Fire blight, caused by the bacterium Erwinia amylovora, spreads most rapidly during warm (75-85°F), wet conditions, particularly during bloom when flowers provide infection sites and insects spread bacteria between flowers. Rain splashes bacteria to new infection sites. The disease can devastate susceptible trees in the rose family within a single season under favorable conditions. Avoiding overhead irrigation during bloom reduces infection risk.

23. **D. The probability that the tree or tree part will fail** - Likelihood of failure is one of three components of tree risk assessment (along with likelihood of impacting target and consequences of impact). This evaluation considers the presence and severity of structural defects, species-specific failure characteristics, loading potential (wind, ice, wet soil), and tree size. A tree with severe defects has high likelihood of failure; a sound tree has low likelihood regardless of other factors.

24. **B. Inside the cork (toward the center of the tree)** - The cork cambium (phellogen) produces cork cells (phellem) toward the outside and phelloderm toward the inside. The phelloderm consists of living parenchyma cells that function in storage and metabolic activities. Together, these three tissues—phelloderm, cork cambium, and cork—constitute the periderm, which replaces the epidermis as the protective outer covering of woody stems and roots.

25. **A. Root damage or loss on the corresponding side** - Crown symptoms often mirror root zone conditions because specific roots supply specific portions of the crown. When roots are damaged or lost on one side of the tree (from construction, grade changes, or disease), the corresponding crown section loses its water and nutrient supply, showing decline symptoms while other portions remain healthy. This pattern helps diagnose root problems that may not be visible above ground.

26. **D. Mesophyll cells** - Mesophyll tissue (palisade and spongy parenchyma) contains abundant chloroplasts, the organelles where photosynthesis occurs. Chloroplasts contain chlorophyll, the green pigment that captures light energy. The concentration of chloroplasts in mesophyll cells makes this tissue the primary photosynthetic layer in leaves. Epidermal cells typically lack chloroplasts (except guard cells), and vascular bundles function in transport rather than photosynthesis.

27. **C. Tree protection plan** - A tree protection plan is a comprehensive document specifying measures to prevent tree damage during construction. It should include tree inventory data, protection zone boundaries, fencing specifications, prohibited activities, monitoring requirements, remediation procedures if damage occurs, and responsible parties. The plan should be referenced in construction contracts and enforced throughout the project. Generic specifications or verbal instructions are insufficient for effective tree protection.

28. **B. Drought stress or salt damage** - Marginal leaf scorch—browning that begins at leaf edges and progresses inward—commonly indicates inadequate water supply to leaf margins (the last point water reaches through veins). This can result from drought, limited root systems, root damage, or salt accumulation (which causes physiological drought by impeding water uptake). Similar symptoms occur with bacterial leaf scorch, which can be distinguished by its progressive nature over years and laboratory testing.

29. **D. Compartmentalization (blocking vessel transport)** - Tyloses are balloon-like growths of parenchyma cells that protrude through pits into adjacent xylem vessels, blocking water transport. While this reduces water flow, it is a defense mechanism that helps compartmentalize wounded or infected tissue, preventing the spread of decay organisms and air through the vascular system. Tyloses formation is part of Wall 1 in the CODIT model and varies in effectiveness among tree species.

30. **A. Cut, spread, or remove circling roots before planting** - Circling roots that are not corrected at planting often continue their circular growth pattern, eventually girdling (strangling) the trunk or major roots. At planting, circling roots should be cut, straightened and spread outward, or removed entirely if severe. Techniques include vertical slicing of the root ball, butterfly cuts, or bare-rooting with complete root straightening. Failure to address root defects leads to problems years or decades later.

31. **C. Structure, water retention, and microbial activity** - Organic matter improves virtually all soil properties. It promotes aggregation (improving structure), increases water-holding capacity in sandy soils, improves drainage in clay soils, provides slow-release nutrients, increases cation exchange capacity, and supports beneficial soil organisms. Incorporating organic matter is one of the most effective ways to improve soil conditions for tree growth, particularly in disturbed urban soils.

32. **B. Prevents proper compartmentalization and invites decay** - Branch stubs cannot close properly because callus tissue develops from the cambium at the cut surface—which on a stub is at the end of the branch, unable to roll over and close the wound. Stubs also lack the branch collar's specialized compartmentalization tissue. As stubs die, they become entry points for decay organisms that can spread into the trunk. Proper cuts outside the branch collar allow effective wound closure.

33. **D. Symbiotic relationship with fungal penetration into root cells** - Arbuscular mycorrhizae (AM, also called endomycorrhizae or VAM) form symbiotic relationships where fungal hyphae penetrate root cell walls and form specialized structures (arbuscules and vesicles) inside cells for nutrient exchange. The tree provides carbohydrates to the fungus; the fungus dramatically increases water and phosphorus absorption. AM associations occur in most landscape trees and are essential for optimal tree health.

34. **A. Stress response with epicormic sprouting and depleted energy reserves** - Removing excessive live crown (more than 25% from mature trees) causes severe stress. The tree loses stored energy in removed branches, reduces photosynthetic capacity, and often responds with vigorous epicormic sprouting (water sprouts from latent buds on the trunk and remaining branches). These sprouts are weakly attached and require ongoing management. Over-pruning predisposes trees to decline, pest problems, and sun scald.

35. **C. 20 percent** - The 10-20-30 diversity guideline recommends that no single genus comprise more than 20% of an urban forest. This limit protects against genus-level threats like emerald ash borer (which affects all ash species in the Fraxinus genus). Combined with the 10% species limit and 30% family limit, this approach ensures diversity at multiple taxonomic levels for comprehensive protection against various pest and disease threats.

36. **B. Sample inventory** - Sample inventories collect data from statistically selected plots (random or stratified random) and use statistical methods to estimate population characteristics (species composition, size distribution, condition) for the entire area without documenting every tree. This approach is cost-effective for large areas where complete inventories would be prohibitively expensive. Sample inventories provide population estimates but cannot generate individual tree work orders.

37. **D. Nitrogen or another mobile nutrient** - Mobile nutrients (nitrogen, phosphorus, potassium, magnesium) can be remobilized from older tissue to support new growth. When these nutrients are deficient, the plant moves existing supplies from older leaves to developing leaves, causing symptoms to appear on older leaves first. Nitrogen deficiency causes general chlorosis (yellowing) of older leaves, often starting at the bottom of the tree and progressing upward.

38. **A. No more than 2-3 consecutive identical answers** - In well-constructed tests, answer patterns should be randomized to avoid creating predictable patterns that test-wise candidates might exploit. Having more than 2-3 consecutive identical answers can create a perceivable pattern.

Answer distribution should be roughly equal across all options (A, B, C, D) with no option significantly over- or under-represented. This question tests awareness of exam construction principles.

39. **C. Improper planting or container root defects** - Girdling roots most commonly develop from circling roots in containers that continue circling after planting, or from trees planted too deeply (which encourages adventitious roots that may grow tangentially). Poor root architecture from container production and failure to correct defects at planting are primary causes. Once established, girdling roots are difficult to correct and may eventually strangle the trunk, causing decline or death.

40. **B. Low or no risk because no target is present** - Tree risk requires both a potential for failure AND a target that could be harmed. Without a target, there is no risk regardless of tree condition. A tree with severe structural defects in a remote forest with no people, property, or activities has no risk rating. Risk management focuses resources on trees where failure would actually cause harm, not simply on trees with defects.

41. **A. Secondary growth (diameter increase)** - Lateral meristems (vascular cambium and cork cambium) produce secondary growth, which increases stem and root diameter. The vascular cambium produces secondary xylem (wood) and secondary phloem, while the cork cambium produces bark tissues. This differs from primary growth (elongation), which occurs at apical meristems at shoot and root tips. Secondary growth allows trees to become massive structures by continuously adding girth.

42. **D. Maintain consistent moisture in the original root ball** - Newly planted trees have all their roots confined to the original root ball. This limited root system can dry out even when surrounding soil is moist because water doesn't move well between dissimilar soil types. Irrigation must target the root ball directly and be frequent enough to prevent drying while avoiding saturation. As roots grow into surrounding soil over 1-3 years, irrigation can become less frequent and cover a wider area.

43. **C. Soil excavation that severs major roots** - Root severance causes immediate damage by removing water and nutrient-absorbing capacity and by creating wounds that allow decay entry. The severity depends on root size (larger roots serve larger crown portions), proximity to trunk (closer equals more severe), and percentage of root system affected. Excavation within the critical root zone can remove enough roots to cause rapid decline or death. Compaction is serious but more gradual in effect.

44. **B. Marginal leaf scorch with yellow border between dead and green tissue** - Bacterial leaf scorch caused by Xylella fastidiosa produces characteristic marginal scorch with a yellow or reddish border (halo) between dead tissue at the margin and green tissue toward the midvein. Symptoms progress over years, typically appearing first on oldest leaves and spreading through

the tree. Unlike drought scorch, bacterial leaf scorch appears even with adequate moisture and recurs and intensifies annually.

45. **A. Replacement cost based on trunk cross-sectional area** - In the trunk formula method, basic value is calculated by multiplying trunk cross-sectional area (derived from DBH measurement) by a unit cost determined from regional nursery stock prices. This basic value represents what it would theoretically cost to replace the tree's trunk at nursery prices. This value is then adjusted by species rating, condition rating, and location rating to determine the final appraised value.

46. **D. Initial screening of large numbers of trees to identify those needing further assessment** - Limited visual assessment is a "walk-by" evaluation appropriate for efficiently screening many trees to identify those with obvious defects requiring more detailed inspection. It cannot provide detailed risk ratings for individual trees but can categorize trees as "apparently low risk" or "needs further assessment." This approach allows efficient allocation of resources by focusing detailed assessment on trees where it's most needed.

47. **C. Carefully excavate to expose the flare** - Root flare excavation (root collar excavation) removes soil and debris from around the trunk base to expose the structural root flare. This allows assessment of the trunk-root transition, identification of girdling roots, and evaluation of buried trunk condition. Many trees, especially those planted too deeply, have buried flares that can be exposed to improve long-term health. Air excavation tools minimize root damage during this process.

48. **B. Hazards, work procedures, emergency plans, and responsibilities** - ANSI Z133 requires job briefings before tree work begins. These meetings ensure all crew members understand specific hazards present, how hazards will be controlled, individual responsibilities, communication protocols, emergency procedures, and the work plan. Briefings should be repeated when conditions change significantly. Effective communication before work begins prevents incidents that result from misunderstanding or lack of awareness.

49. **D. When growing vigorously** - Wound closure rate is directly proportional to tree vigor because callus tissue is produced by cambial growth at wound margins. Trees producing abundant annual growth can close wounds quickly, while stressed or slow-growing trees close wounds slowly or not at all. This relationship underscores the importance of maintaining tree health when wounding is unavoidable and explains why wounds on declining trees often become permanent decay entry points.

50. **A. Vertical mulching** - Vertical mulching involves drilling or boring holes into compacted soil throughout the root zone and filling them with organic matter, sand, or other porous materials. The holes provide channels for air and water infiltration and create spaces for root growth. Combined with surface organic matter application, vertical mulching can gradually improve compacted soils, though prevention of compaction is always preferable to remediation.

51. **C. Protection against catastrophic pest or disease losses** - Species diversity requirements (such as the 10-20-30 rule) exist to prevent the devastating losses that occur when species-specific threats arrive in communities with monocultures or low diversity. The loss of American chestnut, American elm, and ash species demonstrates how entire canopy populations can be lost. Diversity ensures that no single pest or disease can eliminate more than a portion of the urban forest.

52. **B. After root establishment, typically 1-2 growing seasons** - Guy wires should remain only until roots have established sufficiently to anchor the tree independently—typically 1-2 growing seasons for most transplants. Leaving guys longer prevents proper trunk development (trunk strengthening in response to wind), creates potential for trunk girdling as the tree grows against support materials, and may cause attachment points to become embedded in bark.

53. **D. Crown density** - Crown thinning selectively removes branches throughout the crown to reduce density (number of branches and amount of foliage) while maintaining the tree's natural shape and overall size. Benefits include improved light penetration, reduced wind resistance, and decreased weight. Unlike crown reduction (which reduces size) or crown raising (which removes lower branches), thinning addresses density throughout the crown without changing overall dimensions.

54. **A. Photosynthesis (CO_2 uptake is limited)** - When stomata close to conserve water, carbon dioxide cannot enter the leaf for photosynthesis. This creates a tradeoff: the tree conserves water but cannot produce carbohydrates. Prolonged drought and stomatal closure deplete energy reserves, reduce growth, and weaken the tree's ability to defend against pests and pathogens. Extended drought stress predisposes trees to secondary problems even after moisture becomes available again.

55. **C. Natural enemies such as predators, parasites, or pathogens** - Biological control uses living organisms to suppress pest populations. Predators (lady beetles, lacewings) consume pests directly; parasitoids (parasitic wasps) develop inside pest bodies, killing them; and pathogens (Bt, insect fungi) cause pest diseases. Biological control can be conservation (protecting existing natural enemies), augmentation (releasing additional natural enemies), or classical (introducing natural enemies to control invasive pests).

56. **B. Top of the attachment where branch and trunk bark meet** - 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 forms as the branch and trunk grow together, pushing bark tissue upward. The ridge indicates where branch tissue ends and trunk tissue begins, helping identify the proper starting point and angle for pruning cuts. The branch collar is at the bottom of the attachment.

57. **A. Varies based on specific training and authorization** - Qualified line-clearance arborists receive specialized training that allows them to work closer to energized conductors than unqualified workers. Their specific minimum approach distances vary based on their training level, employer authorization, voltage levels, and applicable regulations. This is why the question cannot

have a single fixed answer—it truly varies. Unqualified workers must maintain 10 feet minimum from conductors below 50 kV.

58. **D. Reduction cuts are made to laterals at least 1/3 the diameter of the removed branch** - Reduction cuts remove back to lateral branches large enough (minimum one-third diameter) to assume the terminal role and continue growing in the same general direction. Heading cuts remove to random points or to laterals too small to assume terminal function, stimulating multiple weakly attached sprouts. This distinction between proper reduction and improper heading is fundamental to quality pruning practice.

59. **C. Nutrients actually absorbed by the tree** - Soil testing reveals nutrient concentrations in the soil but cannot indicate what the tree has actually absorbed. Nutrients may be present in soil but chemically unavailable (like iron in alkaline soils), or the tree may have root damage limiting uptake. Foliar (tissue) analysis reveals nutrient concentrations within the tree itself, showing what has actually been taken up regardless of soil conditions.

60. **B. Stop, secure position, carefully untangle before proceeding** - If the climbing system becomes entangled, stop immediately and secure your position before attempting to untangle. Never continue climbing with an entangled system—entanglement can cause unexpected tension, limit movement, or trap the climber. Take time to carefully identify the problem and resolve it before proceeding. Rushing increases the risk of making the situation worse or creating additional hazards.

61. **D. Prevention and maintaining overall plant health** - Plant health care (PHC) emphasizes proactive maintenance of plant health rather than reactive response to pest outbreaks. Healthy, vigorous plants better resist and tolerate pest pressure. PHC integrates proper cultural practices (watering, mulching, soil management), regular monitoring, accurate problem diagnosis, and intervention only when thresholds are exceeded. This approach typically reduces pesticide use while improving long-term plant health.

62. **A. The structural foundation where all loads are transferred** - The tree base is where all above-ground weight and wind loads transfer to the root system. Decay or damage at this location compromises the structural foundation and can lead to complete tree failure. A basal wound of a given size represents a greater structural concern than the same-sized wound higher on the trunk because the percentage of load-bearing wood affected is greater at the base where the trunk is narrower relative to overall tree mass.

63. **C. Vascular cambium (producing xylem)** - Annual growth rings visible in tree cross-sections are formed by xylem (wood) produced by the vascular cambium. In temperate climates, the cambium produces large, light-colored cells in spring (earlywood or springwood) and smaller, darker cells in summer (latewood or summerwood). This alternating pattern creates visible rings. Each ring typically represents one year's growth, allowing age determination and growth history analysis.

64. **B. Early in the tree's development when branches are small** - Structural pruning is most effective when started early because corrections require only small cuts that close quickly with minimal stress to the tree. Removing a 1-inch diameter competing leader causes minimal harm; removing a 6-inch diameter codominant stem creates a large wound with significant decay potential. Early intervention also shapes growth before defects become structural problems. Regular pruning during the first 10-15 years establishes lifelong structure.

65. **A. Fungi** - Powdery mildew diseases are caused by various fungal species that produce characteristic white, powdery growth on leaf surfaces. Unlike most fungi, powdery mildew thrives in dry conditions (though high humidity without leaf wetness). The fungi draw nutrients from leaf epidermal cells without killing them initially. While unsightly, powdery mildew rarely causes serious harm to established trees, though it may stress young or already weakened plants.

66. **D. Dramatically increasing surface area for water and nutrient absorption** - Root hairs are tubular extensions of epidermal cells on young roots that dramatically increase root surface area for water and mineral absorption. A single root may have millions of root hairs, increasing absorptive surface area by 5-20 times. Root hairs are short-lived (days to weeks) and continuously replaced as the root grows. They are extremely fragile and easily damaged by transplanting or soil disturbance.

67. **C. High occupancy target** - A parking lot regularly used by many people represents a high occupancy target—a location where people are frequently present and could be harmed by tree failure. Target occupancy (frequency and duration of use) significantly affects risk assessment because it determines how likely someone would be present if failure occurred. High-use areas like parking lots, playgrounds, and sidewalks require more careful risk management than rarely occupied areas.

68. **B. Excessive depth greater than 4-6 inches** - Mulch deeper than 4 inches can create problems including oxygen reduction at root surfaces, excessive moisture retention against the trunk (promoting bark decay), habitat for bark-damaging rodents, and encouragement of stem-girdling root development. The proper depth of 2-4 inches provides benefits without these risks. "Volcano mulching" (mulch piled against trunks) is particularly harmful and unfortunately common.

69. **D. Trunk decay and girdling roots** - Trees planted too deeply have their trunk bark in contact with soil moisture, promoting bark decay that progresses into the wood. Additionally, buried trunks develop adventitious roots that often grow tangentially, eventually girdling the trunk or major roots. These problems may not become apparent for years or decades, making deep planting a hidden cause of later decline. The root flare should be visible at or slightly above finished grade.

70. **A. Sonic tomograph** - Sonic tomography uses sound wave transmission between sensors placed around the trunk to create images showing internal wood condition. Sound travels faster through solid wood and slower through decayed or hollow areas. By measuring transmission times between multiple sensor pairs, software generates a cross-sectional image showing the location and extent

of decay. This non-destructive technique complements resistance drilling, which samples only along the drill path.

71. **C. One-third the diameter** - ANSI A300 specifies that reduction cuts should be made to lateral branches at least one-third the diameter of the branch being removed. Laterals of this size can assume the terminal role and continue growth without stimulating excessive sprouting. Smaller laterals cannot assume this function effectively; cuts to them function more like heading cuts, stimulating multiple weakly attached sprouts.

72. **B. Insufficient light reaching interior (shade-induced shedding)** - Interior shading causes lower and inner branches to receive insufficient light for photosynthesis. These shaded branches become energy drains rather than energy producers, and the tree sheds them as a normal adaptation. This progressive interior shedding is common in dense-crowned trees and is generally not concerning unless accompanied by other decline symptoms. It differs from decline, which shows additional symptoms like dieback of branch tips.

73. **A. Immediate environmental and aesthetic benefits that new plantings cannot provide for decades** - Mature trees provide immediate, substantial benefits including shade, energy savings, stormwater management, air quality improvement, wildlife habitat, and aesthetic value that newly planted trees cannot match for decades. A single mature tree may provide hundreds of dollars in annual environmental benefits. Preservation planning should recognize that some values cannot be replaced on any practical timeline.

74. **D. Evidence of severe structural defects or advanced decay** - Trees showing evidence of severe structural problems (horizontal cracks, significant lean with root plate movement, extensive basal decay) may not safely support a climber's dynamic loads. Climbing such trees risks triggering failure. Alternative access (aerial lift) or ground-based assessment may be necessary. The pre-climb inspection specifically evaluates whether the tree can safely support climbing operations before ascent.

75. **C. Stop or reverse the feed mechanism** - The chipper feed control bar is a safety device that stops or reverses the feed mechanism when pushed. If entanglement begins, pushing the bar may halt feed before the operator is pulled further into the machine. This device must be tested before operation and never disabled. Even with this safety feature, proper operating procedures (no loose clothing, feed butt-end first, stand to side, release material before hands approach opening) remain essential.

76. **B. It is immobile and cannot be translocated from older tissue** - Immobile nutrients (iron, manganese, boron, calcium) cannot be moved from older tissue to support new growth. When these nutrients are deficient, the tree cannot supply developing leaves from existing reserves, so symptoms appear on youngest leaves first. Understanding nutrient mobility explains deficiency symptom patterns and helps diagnose specific deficiencies based on where symptoms appear in the crown.

77. **D. The relative value and desirability of the species for landscape use** - Species rating in tree appraisal reflects the species' characteristics that affect its landscape value—longevity, maintenance requirements, pest and disease susceptibility, growth rate, ornamental features, structural strength, and suitability for various uses. High-value species like oaks and maples typically receive higher ratings than short-lived or problem-prone species. Ratings are often developed regionally to reflect local conditions.

78. **A. Topping or pollarding (depending on intent and maintenance)** - Removing all branches to leave only a trunk or main scaffold stubs is called topping when done without intent for ongoing management, or pollarding when it's part of a planned system with regular maintenance. Topping is harmful—it creates weak sprouts, large wounds, and structural hazards. Pollarding, when properly initiated on young trees and maintained on regular cycles, is an established practice in some contexts, though rarely appropriate in modern arboriculture.

79. **C. Tree vigor and growth rate** - Wound closure rate correlates directly with the tree's annual radial growth rate because callus tissue is produced by cambial activity at wound margins. A vigorous tree producing 1/2 inch of radial growth annually closes wounds twice as fast as one producing 1/4 inch. This relationship explains why maintaining tree health is critical when wounding is unavoidable and why wounds on stressed or declining trees may never close.

80. **B. Contains living cells and conducts water** - Sapwood is the outer portion of the wood containing living parenchyma cells (in rays and axial parenchyma) and functional xylem vessels and tracheids that conduct water. As the tree grows, older sapwood gradually converts to heartwood through cell death and accumulation of extractives. Heartwood no longer conducts water or contains living cells but provides structural support and may resist decay better than sapwood due to its extractive content.

81. **A. Crown, trunk, root zone, and target area** - A thorough basic risk assessment systematically evaluates all parts of the tree that could fail (crown for dead branches, trunk for structural defects, root zone for stability indicators) plus the area around the tree where failure could cause harm. Limiting assessment to any single zone potentially misses critical information. The target area evaluation identifies what could be harmed and assesses the consequences of potential failure.

82. **D. A serious structural defect indicating the union may be failing** - A vertical crack extending from a branch union downward (sometimes called a ram's horn crack) indicates stress concentration and possible failure of an included bark union. Such cracks may extend when the tree is loaded by wind, eventually causing complete separation. This is a serious structural defect that often warrants immediate mitigation. The crack represents active structural failure in progress, not just a passive defect.

83. **D. Compressed air that displaces soil without cutting roots** - Air excavation tools use 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 treatment of girdling roots

while minimizing root damage. The technique has expanded options for tree preservation during construction and improved diagnostic capabilities for root-related problems.

84. **B. Reaction wood** - Reaction wood is specialized wood that forms in response to non-vertical orientation, helping the tree maintain or regain upright position. In hardwoods, reaction wood (tension wood) forms on the upper side of leaning stems and pulls upward. In conifers, reaction wood (compression wood) forms on the lower side and pushes upward. Reaction wood has different properties than normal wood and may affect wood utilization.

85. **D. When testing confirms nutrient deficiency** - Fertilization is most beneficial when actual nutrient deficiencies limit tree health or growth. Soil or tissue testing identifies whether deficiencies exist and which nutrients are lacking. Fertilizing without confirmed need wastes resources, may harm trees (excess nitrogen encourages succulent growth susceptible to pests), and can pollute water resources. Most established trees in reasonably healthy landscapes do not require regular fertilization.

86. **A. A sign of disease (direct evidence of the causal organism)** - Fungal fruiting bodies (mushrooms, conks, brackets) are the reproductive structures of fungi and represent direct evidence of the organism itself—a "sign" rather than a "symptom." Symptoms are plant responses (wilting, chlorosis, dieback); signs are the pathogen or pest itself. Finding a conk on a tree trunk is a sign of wood decay fungus, though the extent and significance of decay requires further assessment.

87. **C. Friction device or lowering line** - Friction devices (Port-a-wrap, rigging wrench, or rope wrapped around a friction post) control the descent rate of lowered pieces by allowing the ground crew to apply friction to the lowering line. Proper friction control allows smooth, controlled lowering; insufficient friction allows uncontrolled descent with potential for shock loading. The ground worker controlling the friction device has critical responsibility for safe rigging operations.

88. **B. Monitoring, accurate identification, and using thresholds before intervention** - IPM follows a systematic decision process: regular monitoring detects pest presence, accurate identification ensures appropriate response, and action thresholds determine whether intervention is justified. This approach prevents unnecessary treatment of minor problems while ensuring effective response when treatment is warranted. IPM uses all available tactics (cultural, biological, chemical) but only when monitoring indicates need.

89. **A. Insect vectors (nitidulid beetles) attracted to fresh wounds** - Oak wilt spreads between non-connected trees primarily via nitidulid (sap-feeding) beetles that carry fungal spores from infected trees to fresh wounds on healthy trees. These beetles are most active in spring and early summer, which is why oak pruning is discouraged during April-July in oak wilt areas. Root grafts spread the disease between connected trees, but long-distance spread requires insect vectors.

90. **A. Root-bound with circling roots** - Trees grown too long in containers develop circling roots that conform to the container shape. This root-bound condition persists after planting—circling

roots often 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. Container production time and root management practices affect this outcome.

91. **C. Expose and assess the root-trunk transition zone** - Root flare excavation removes soil, mulch, or debris that has buried 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 from deep planting, grade changes, or mulch accumulation. Excavation is both diagnostic and sometimes therapeutic (removing girdling roots, allowing trunk to dry).

92. **B. Greater density and strength** - Specific gravity (the ratio of wood density to water density) directly correlates with wood strength. Higher specific gravity indicates denser wood with more cell wall material per unit volume, resulting in greater mechanical strength and stiffness. Species with high specific gravity (oak, hickory) produce stronger wood than those with low specific gravity (cottonwood, willow). This property affects both living trees' structural capacity and wood products' suitability for various uses.

93. **D. Pre-climb safety inspection of the tree** - Before climbing any tree, a thorough safety assessment must identify potential hazards including structural defects, decay, dead branches, electrical conductors, wildlife (especially stinging insects), and overall tree condition. This inspection determines whether the tree can safely support climbing operations and identifies conditions requiring precautions or alternative access methods. The pre-climb inspection is a mandatory safety practice under ANSI Z133.

94. **A. At the critical root zone boundary before construction begins** - Effective tree protection requires physical barriers installed at the critical root zone boundary (minimum) before any construction activity begins. The fence must be in place before any equipment arrives on site, remain throughout construction, and be clearly marked to identify the protected area. Protection measures implemented after construction begins cannot prevent damage that has already occurred; prevention is the only effective protection strategy.

95. **C. Pest levels at which intervention is justified** - Action thresholds define the pest population, damage level, or environmental conditions at which treatment becomes justified based on potential harm exceeding treatment costs and risks. Below threshold, pest presence is tolerated because damage is minor or natural enemies may provide control. Above threshold, intervention is warranted. Thresholds vary with plant value, pest species, time of year, and management objectives.

96. **B. Annually and after lightning events** - Lightning protection systems require annual inspection to verify component condition (corrosion, loose connections, damage) and proper function. Additional inspection is warranted after lightning strikes to detect 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.

97. **A. Annually and after major weather events** - Tree support systems (cables and braces) require regular inspection to ensure continued proper function. Annual inspection at minimum, plus inspection after significant storms (wind, ice, heavy snow), verifies hardware condition, cable tension, tree growth around components, and whether the system remains appropriate for current conditions. Cable systems typically require re-inspection and potential adjustment every 2-3 years as trees grow.

98. **D. Provide vertical clearance beneath the crown** - Crown raising removes lower branches to increase clearance beneath the crown for pedestrians, vehicles, buildings, or sight lines. It is commonly performed along streets, over parking areas, near buildings, and where ground-level activities require overhead clearance. On young trees, crown raising can be accomplished with minor cuts; on mature trees, removing large lower limbs creates significant wounds and removes substantial photosynthetic capacity.

99. **C. Fix atmospheric nitrogen** - Legume trees (black locust, honeylocust, redbud, Kentucky coffeetree) host nitrogen-fixing bacteria (Rhizobium and related species) in specialized root nodules. These bacteria convert atmospheric nitrogen gas (N2) to ammonia (NH3), which the plant uses for growth. This symbiosis allows legumes to thrive in nitrogen-poor soils and enriches soil nitrogen for subsequent plants. Not all legumes fix nitrogen equally; some like honeylocust fix less than others.

100. **B. The severity of harm that would result if failure occurs and strikes the target** - Consequences in tree risk assessment evaluate what harm would result if the tree fails and strikes the target. Consequences range from negligible (minor property damage) to severe (serious injury or death). Factors include target type (people vs. property), target vulnerability, and the size of the potential failure (small branch vs. entire tree). Higher consequences justify more aggressive risk mitigation even when failure likelihood is moderate.