

FULL-LENGTH PRACTICE TESTS

PRACTICE TEST 15 – 100 QUESTIONS

1. The primary function of ray parenchyma cells in wood is to provide what?
 - A. Vertical water transport
 - B. Structural support only
 - C. Lateral transport of water, nutrients, and carbohydrates, and storage
 - D. Protection from pathogens

2. ANSI Z133 requires a minimum of how many workers during tree felling operations?
 - A. One qualified worker
 - B. Two workers
 - C. Three workers
 - D. Four workers

3. What soil characteristic most directly affects a tree's ability to obtain oxygen for root respiration?
 - A. Porosity and aeration
 - B. Color
 - C. Age of formation
 - D. Mineral content only

4. The term "dripline" refers to what location relative to a tree?
- A. Where irrigation should be applied
 - B. The trunk base
 - C. The root collar
 - D. The outer edge of the crown projected to the ground
5. When making a pruning cut, the final cut should be positioned where relative to the branch collar?
- A. Through the collar
 - B. Just outside the branch collar
 - C. Flush with the trunk
 - D. Several inches beyond the collar
6. Vista pruning is performed to accomplish what objective?
- A. Remove dead branches
 - B. Reduce crown density
 - C. Create or enhance a view through selective branch removal
 - D. Provide vertical clearance
7. Soil texture is determined by the relative proportions of what components?
- A. Sand, silt, and clay particles
 - B. Organic matter and minerals
 - C. Water and air
 - D. Bacteria and fungi

8. In CODIT, the strongest wall is typically which one?

- A. Wall 1
- B. Wall 2
- C. Wall 3
- D. Wall 4 (barrier zone)

9. Cankers on tree trunks and branches are typically caused by what type of organism?

- A. Insects only
- B. Fungi or bacteria
- C. Viruses exclusively
- D. Nutrient deficiencies

10. What is the function of the cambium saver (friction saver) in tree climbing?

- A. Increases climbing speed
- B. Replaces the need for a secondary tie-in
- C. Protects bark from rope damage and reduces friction
- D. Eliminates need for load testing

11. What process drives the majority of water movement from roots to leaves in trees?

- A. Transpiration creating tension in xylem water columns
- B. Root pressure
- C. Active pumping by living cells
- D. Osmosis alone

12. The root flare (trunk flare) should be positioned at what level when planting a tree?

- A. 6 inches below grade
- B. 3 inches below grade
- C. Varies by species
- D. At or slightly above finished grade

13. Alternate leaf arrangement means leaves are attached to the stem in what pattern?

- A. Two leaves at each node
- B. Three or more leaves at each node
- C. One leaf at each node, alternating sides
- D. Leaves in clusters

14. Bacterial wetwood (slime flux) is characterized by what symptom?

- A. White powdery coating
- B. Foul-smelling liquid oozing from wounds
- C. Leaf spots
- D. Root decay

15. A climbing rope with a soft spot felt during inspection indicates what condition?

- A. Core damage requiring immediate retirement
- B. Normal wear
- C. Acceptable for continued use
- D. Need for minor repair

16. What is the primary purpose of tree cabling systems?

- A. Support the trunk
- B. Anchor to the ground
- C. Provide rigid connections at unions
- D. Limit movement of branches relative to each other to reduce failure likelihood

17. The function of the root cap is to provide what benefit?

- A. Nutrient absorption
- B. Water storage
- C. Protection for the root apical meristem as it grows through soil
- D. Hormone production

18. Abscisic acid (ABA) is a plant hormone that primarily functions to do what?

- A. Promote cell elongation
- B. Promote stress responses and stomatal closure
- C. Stimulate flowering
- D. Delay senescence

19. An increment borer is used to extract samples for determining what information?

- A. Soil nutrients
- B. Root depth
- C. Leaf chlorophyll content
- D. Tree age and growth rate

20. Defoliating insects cause damage primarily by doing what?

- A. Consuming leaf tissue and reducing photosynthetic capacity
- B. Tunneling in bark
- C. Sucking phloem sap
- D. Creating galls

21. What characteristic distinguishes poor compartmentalizers from good compartmentalizers?

- A. Growth rate
- B. Leaf type
- C. Weak barrier formation allowing extensive decay spread
- D. Bark thickness

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

- A. Cold, dry weather
- B. Warm, wet weather during bloom
- C. Hot, dry summer conditions
- D. Freezing winter temperatures

23. What are the three components evaluated in tree risk assessment?

- A. Species, size, and age
- B. Crown, trunk, and roots only
- C. Height, diameter, and location
- D. Likelihood of failure, likelihood of impact, and consequences

24. Tension wood forms on what side of a leaning hardwood tree?

- A. Upper side (pulling the tree upward)
- B. Lower side
- C. Equally on all sides
- D. Only on the windward side

25. A tree exhibiting chlorotic foliage, reduced growth, and premature leaf drop in late summer is most likely experiencing what?

- A. Normal seasonal change
- B. Excessive vigor
- C. Stress from one or more environmental or biological factors
- D. Improved health

26. Photosynthesis primarily occurs in what cell type within leaves?

- A. Epidermal cells
- B. Mesophyll cells containing chloroplasts
- C. Guard cells
- D. Vascular bundle cells

27. What is the recommended action if tree protection fencing is breached during construction?

- A. Continue work normally
- B. Remove remaining fencing
- C. Wait until project completion
- D. Stop work, assess damage, reinstall fencing, and document the incident

28. Potassium deficiency typically causes what symptom pattern?

- A. Marginal leaf scorch or necrosis, often on older leaves
- B. Interveinal chlorosis on new leaves
- C. Purplish discoloration
- D. White powdery coating

29. Trees planted too deeply are predisposed to develop what problems?

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

30. The establishment period for a transplanted tree is generally considered complete when what occurs?

- A. New leaves appear
- B. One growing season passes
- C. Roots have grown sufficiently into surrounding soil to meet crown water demands
- D. Stakes are removed

31. What soil remediation technique involves drilling holes and filling them with organic matter?

- A. Surface mulching
- B. Radial trenching
- C. Soil replacement
- D. Vertical mulching

32. A heading cut is made at what location?

- A. At a random point along a branch, not to a lateral branch of adequate size
- B. Just outside the branch collar
- C. At the branch point of origin
- D. To a lateral at least 1/3 the diameter of the removed branch

33. What type of mycorrhizae is most common in landscape trees such as maples and ashes?

- A. Ectomycorrhizae only
- B. Arbuscular mycorrhizae (endomycorrhizae)
- C. Parasitic associations
- D. No mycorrhizal associations

34. Epicormic sprouts (water sprouts) typically have what attachment characteristic?

- A. Strong, well-developed attachments
- B. Deep origin within the wood
- C. Weak attachments originating near the bark surface
- D. No attachment concerns

35. The 10-20-30 diversity rule establishes limits at what taxonomic levels?

- A. Only at the species level
- B. Only at the genus level
- C. Only at the family level
- D. Species (10%), genus (20%), and family (30%)

36. What type of tree inventory provides specific data on every individual tree?

- A. Complete (100%) inventory
- B. Sample inventory
- C. Windshield survey
- D. Statistical estimation

37. Iron chlorosis is often caused by what soil condition rather than actual iron absence?

- A. Low organic matter
- B. High pH making iron chemically unavailable
- C. Excessive drainage
- D. Low soil temperature

38. What is the proper response if unexpected electrical conductors are discovered during tree work?

- A. Continue if they appear to be phone lines
- B. Work carefully around them
- C. Touch them to test if energized
- D. Stop work and contact the utility company

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

- A. Heavy fertilization
- B. Deep watering
- C. Removal by cutting, often requiring root collar excavation
- D. Ignore them

40. A tree with codominant stems and included bark represents what type of condition?

- A. A structural defect with increased failure potential
- B. Normal growth pattern
- C. Improved strength
- D. A minor cosmetic issue

41. Sugars are loaded into phloem at source tissues through what process?

- A. Passive diffusion only
- B. Active transport requiring energy
- C. Root pressure
- D. Transpiration pull

42. What is the recommended irrigation approach during tree establishment?

- A. Deep, infrequent watering of surrounding soil only
- B. No irrigation after planting
- C. Daily light watering of foliage
- D. Frequent watering focused on the root ball until roots establish

43. Symptoms appearing only on one side of the crown often indicate what condition?

- A. Nutrient deficiency
- B. Viral infection
- C. Root damage or vascular disease on the corresponding side
- D. Normal variation

44. Powdery mildew infections are favored by what environmental conditions?

- A. High humidity without leaf wetness and moderate temperatures
- B. Cold, wet weather
- C. Hot, dry conditions
- D. Freezing temperatures

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

- A. Species characteristics
- B. The tree's functional and aesthetic contribution to the site
- C. Current health
- D. Age

46. Level 2 basic assessment in tree risk evaluation involves what approach?

- A. Limited walk-by survey
- B. Use of specialized equipment
- C. Post-failure investigation
- D. Detailed visual inspection at ground level of accessible tree parts

47. What protective equipment must be worn when operating a chain saw?

- A. Hearing protection only
- B. Eye protection only
- C. Eye, hearing, head, and leg protection
- D. No specific requirements

48. The job briefing before tree work must include information about what?

- A. Hazards, work plan, responsibilities, and emergency procedures
- B. Equipment costs only
- C. Marketing strategies
- D. Long-term contracts

49. Proper pruning cuts promote effective wound closure because they preserve what structure?

- A. The stub
- B. The branch collar
- C. The flush surface
- D. The branch bark ridge only

50. What soil amendment most effectively improves overall soil quality for tree growth?

- A. Sand only
- B. Gravel
- C. Chemical fertilizers
- D. Organic matter

51. Why are mature trees valuable during development projects?

- A. Lower construction costs
- B. Simplified permits
- C. Immediate environmental benefits not replaceable for decades
- D. Reduced insurance

52. What is the proper climbing response if a tie-in branch begins to crack during loading?

- A. Immediately select a different anchor point
- B. Continue with caution
- C. Add more rope wraps
- D. Ignore if the crack is small

53. The feed control bar on a chipper must be capable of what function?

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

54. Nutrient deficiency symptoms appearing on the youngest leaves indicate what about the nutrient?

- A. Mobility
- B. Abundance
- C. Toxicity
- D. Immobility (cannot be translocated from older tissue)

55. What does the condition rating evaluate in tree appraisal?

- A. Species characteristics
- B. Location factors
- C. Health and structural integrity
- D. Age only

56. What is the fundamental difference between pollarding and topping?

- A. Pollarding is planned, ongoing management; topping is indiscriminate cutting
- B. They are identical
- C. Topping is always acceptable
- D. Pollarding is more harmful

57. Wound closure rate is most significantly influenced by what factor?

- A. Wound dressing type
- B. Tree vigor and growth rate
- C. Season of pruning
- D. Exact cut angle

58. What is the primary function of sapwood?

- A. Structural support only
- B. Decay resistance
- C. Extractive storage
- D. Water conduction and living cell functions

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

- A. Crown only
- B. Only defects visible from one angle
- C. Crown, trunk, root zone, and target area
- D. Trunk only

60. A vertical crack through a branch union indicates what condition?

- A. A serious structural defect with potential for union failure
- B. Normal bark formation
- C. Minor cosmetic issue
- D. Improved strength

61. Air excavation technology is most useful for what application?

- A. Fertilizer injection
- B. Exposing roots without damage for assessment or treatment
- C. Irrigation installation
- D. Pest control

62. Compression wood forms on what side of leaning conifer trees?

- A. Upper side
- B. Equally on all sides
- C. Only on the leeward side
- D. Lower side (pushing the tree upward)

63. When is fertilization most justified for established landscape trees?

- A. Every spring
- B. During drought
- C. When testing confirms nutrient deficiency
- D. After severe pruning

64. A bracket fungus (conk) growing from a tree trunk indicates what?

- A. Established decay fungus within the tree
- B. Normal bark feature
- C. Improved tree health
- D. Beneficial relationship

65. What rigging principle requires that load never exceed the rating of the weakest component?

- A. Dynamic loading concept
- B. System strength is limited by the weakest component
- C. Anchor capacity rule
- D. Rope stretch principle

66. IPM programs begin with what step?

- A. Chemical application
- B. Plant removal
- C. Calendar-based treatment
- D. Monitoring to detect pest presence

67. Dutch elm disease is transmitted over distance primarily by what mechanism?

- A. Wind-blown spores
- B. Rain splash
- C. Bark beetles carrying fungal spores
- D. Contaminated soil

68. Trees held in containers too long develop what root defect?

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

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

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

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

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

71. Pre-climb inspection should identify what potential hazards?

- A. Tree species only
- B. Financial value
- C. Structural defects, dead branches, electrical hazards, wildlife, and overall condition
- D. Marketing considerations

72. Tree protection fencing should be installed at what point?

- A. Before any construction activity begins
- B. When tree stress appears
- C. After grading
- D. At project completion

73. Action thresholds in IPM define what?

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

74. Lightning protection systems require inspection at what frequency?

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

75. Support system (cable and brace) inspection should occur at what minimum interval?

- A. Every 10 years
- B. Only when problems are visible
- C. Annually and after major storms
- D. Monthly

76. Crown thinning accomplishes what objective?

- A. Reduced crown density while maintaining form and size
- B. Reduced height
- C. Removal of lower branches
- D. Removal of dead branches only

77. Nitrogen-fixing bacteria form symbiotic associations with trees in what plant family?

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

78. What does "consequences" evaluate in tree risk assessment?

- A. Failure probability
- B. Impact likelihood
- C. Tree species
- D. Severity of harm if failure strikes the target

79. "Likelihood of impact" in risk assessment evaluates what factor?

- A. Defect severity
- B. Tree age
- C. Probability that failure will strike the target
- D. Consequence severity

80. Proper pruning preserves the branch collar because it contains what?

- A. Specialized tissue for compartmentalization and wound closure
- B. Water storage cells
- C. Photosynthetic tissue
- D. Nutrient reserves only

81. What is the minimum breaking strength required for arborist climbing lines?

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

82. The three-cut method prevents what problem when removing large branches?

- A. Excessive wound size
- B. Improper cut angle
- C. Branch collar damage
- D. Bark tearing on the trunk

83. Urban forest diversity standards protect against what primary threat?

- A. Aesthetic uniformity
- B. High maintenance costs
- C. Catastrophic losses from species-specific pests and diseases
- D. Inventory complexity

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

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

85. Girdling roots are most effectively prevented by what practice?

- A. Deep planting
- B. Proper nursery production and correct planting depth
- C. Heavy fertilization
- D. Frequent irrigation

86. A tree with structural defects but no target in the potential failure zone has what risk rating?

- A. High risk
- B. Moderate risk
- C. Extreme risk
- D. Low or no risk (target required for risk)

87. Crown raising removes branches to provide what benefit?

- A. Reduced density
- B. Reduced size
- C. Vertical clearance beneath the crown
- D. Dead branch removal

88. What distinguishes ectomycorrhizae from arbuscular mycorrhizae?

- A. Ectomycorrhizae form external sheaths without penetrating cell walls
- B. There is no difference
- C. Ectomycorrhizae are parasitic
- D. Ectomycorrhizae penetrate cell walls

89. Stub cuts are problematic because they do what?

- A. Remove the branch collar
- B. Prevent proper wound closure and create decay entry points
- C. Cause excessive bleeding
- D. Damage the branch bark ridge

90. What is the establishment period guideline for transplanted trees?

- A. 2-4 weeks
- B. 6 months for all sizes
- C. 5 years minimum
- D. Approximately 1 year per inch of trunk caliper

91. Compaction damages tree roots primarily by reducing what?

- A. Soil temperature
- B. Nutrient levels
- C. Oxygen availability and space for root growth
- D. Soil pH

92. Shade from mature trees can reduce building cooling costs by what estimated percentage?

- A. Up to 25-30% or more depending on placement and climate
- B. Less than 5%
- C. Has no measurable effect
- D. Increases cooling costs

93. What factor most influences a tree's ability to compartmentalize decay?

- A. Tree age
- B. Tree health and vigor at the time of wounding
- C. Time of year
- D. Wound dressing application

94. Foliar analysis is most useful when what situation exists?

- A. Soil tests are unavailable
- B. Trees are newly planted
- C. No problems exist
- D. Soil shows adequate nutrients but trees show deficiency symptoms

95. What type of cut stimulates multiple weakly attached sprouts?

- A. Thinning cut
- B. Reduction cut
- C. Heading cut
- D. Collar cut

96. The cohesion-tension theory explains movement of water through what tissue?

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

97. What is the recommended response if a climber's equipment becomes entangled?

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

98. Reduction cuts differ from heading cuts by being made to laterals of what minimum size?

- A. Any available size
- B. Equal to the removed branch
- C. One-half the diameter
- D. At least one-third the diameter of the removed branch

99. Trees respond to wounding through what biological process?

- A. Regeneration of lost tissue
- B. Complete healing
- C. Compartmentalization—walling off damaged tissue
- D. Shedding the wounded part

100. What is the primary goal of plant health care programs?

- A. Prevention and maintaining overall plant health rather than reactive treatment
- B. Maximum pesticide application
- C. Calendar-based treatment schedules
- D. Immediate removal of affected plants

PRACTICE TEST 15: ANSWER KEY

WITH EXPLANATIONS

1. **C. Lateral transport of water, nutrients, and carbohydrates, and storage** - Ray parenchyma cells extend radially through the wood like spokes of a wheel, providing pathways for lateral (horizontal) transport of water, nutrients, and carbohydrates between the inner bark and the inner wood. They also serve as storage sites for starch and other reserves. In the CODIT model, ray cells form Wall 3, limiting lateral decay spread. Rays are visible as lines radiating from the center in cross-sections of some species.
2. **B. Two workers** - ANSI Z133 requires a minimum of two qualified workers during tree felling operations. One person operates the saw while the second serves as a lookout, monitors for hazards, can summon emergency assistance if needed, and assists with job coordination. Felling is among the most hazardous tree operations, and the presence of a second qualified person provides critical safety backup. Some complex operations may require additional personnel.
3. **A. Porosity and aeration** - Soil porosity—the percentage of soil volume occupied by pore spaces—directly determines oxygen availability for root respiration. Roots require oxygen to produce energy through cellular respiration; without adequate oxygen, roots cannot function and begin dying. Well-structured soils have approximately 50% pore space, ideally with half air-filled and half water-filled. Compaction destroys pore spaces, severely limiting aeration.
4. **D. The outer edge of the crown projected to the ground** - The dripline is the imaginary line on the ground directly beneath the outermost extent of the tree's crown, where rain would drip from the outer branch tips. While historically used to estimate root extent, research shows roots typically extend 2-3 times beyond the dripline. The term remains useful for describing crown spread and as a reference point, though it underestimates actual root zone extent.
5. **B. Just outside the branch collar** - Proper pruning cuts are positioned just outside the branch collar—the swollen area at the branch base containing specialized tissue for compartmentalization and wound closure. This position preserves the collar's function while removing all branch tissue. Flush cuts remove the collar and damage trunk tissue; stub cuts leave branch tissue that cannot close properly. Correct cut placement is fundamental to good pruning practice.
6. **C. Create or enhance a view through selective branch removal** - Vista pruning (also called view pruning or window pruning) selectively removes branches to create or enhance a specific view while retaining the tree's overall form and health. This specialized technique requires careful planning to identify which branches block the desired view and skill to remove them without

disfiguring the tree. Vista pruning differs from other pruning types in its specific aesthetic objective.

7. **A. Sand, silt, and clay particles** - Soil texture is determined by the relative proportions of sand (largest particles, 0.05-2.0 mm), silt (medium, 0.002-0.05 mm), and clay (smallest, less than 0.002 mm). Texture is classified using the soil textural triangle into categories like sandy loam, clay loam, or silt. Unlike structure (which can be improved), texture is an inherent soil property that cannot be practically changed through management.
8. **D. Wall 4 (barrier zone)** - In the CODIT model, Wall 4 is typically the strongest barrier because it is composed entirely of new tissue produced by the cambium after wounding. This barrier zone contains specialized cells with enhanced chemical and structural properties designed to resist decay spread. Wall 4 strength depends heavily on tree vigor—vigorous trees produce stronger barriers. Walls 1-3 are formed from existing tissue that must be modified after wounding.
9. **B. Fungi or bacteria** - Cankers are localized dead areas on bark and underlying tissue, typically caused by fungal or bacterial pathogens. The tree attempts to wall off the infection, often resulting in sunken areas with raised callus ridges at margins. Cankers can girdle branches or trunks, disrupting vascular flow. Examples include Nectria canker, Cytospora canker, and bacterial canker. Environmental stress often predisposes trees to canker diseases.
10. **C. Protects bark from rope damage and reduces friction** - A cambium saver (friction saver) is a device installed at the tie-in point that protects bark from abrasion damage caused by rope movement and reduces friction for easier rope retrieval. It consists of rings or sleeves connected by a strap that wraps around the branch. By protecting the cambium layer beneath bark, these devices minimize harm to the tree while improving climbing efficiency.
11. **A. Transpiration creating tension in xylem water columns** - The cohesion-tension theory explains that water evaporating from leaves (transpiration) creates negative pressure (tension) in leaf cells that pulls water upward through continuous columns in xylem vessels. Water molecules' cohesion (hydrogen bonding) maintains these unbroken columns from roots to leaves. This passive mechanism can lift water over 300 feet in tall trees without the tree expending direct metabolic energy.
12. **D. At or slightly above finished grade** - The root flare (trunk flare) should be visible at or slightly above the finished soil grade after planting. This transition zone where trunk becomes roots should never be buried. Deep planting leads to trunk decay from constant moisture contact and development of stem-girdling roots. Before planting, excess soil should be removed from the root ball to locate the true root flare.
13. **C. One leaf at each node, alternating sides** - Alternate leaf arrangement means one leaf attaches at each node (stem junction point), with successive leaves on alternating sides of the stem. This is one of three main leaf arrangements used in tree identification: alternate (one leaf per node),

opposite (two leaves per node, directly across from each other), and whorled (three or more leaves per node). Examples of alternate-leaved trees include oaks, elms, and birches.

14. **B. Foul-smelling liquid oozing from wounds** - Bacterial wetwood (slime flux) results from bacterial fermentation inside the tree, producing gases that force foul-smelling, often dark-colored liquid to ooze from wounds, cracks, or branch stubs. The liquid may kill grass beneath the tree and stain bark. While unsightly and concerning to tree owners, wetwood rarely causes serious harm to otherwise healthy trees. No effective treatment exists; maintaining overall tree health is the best approach.
15. **A. Core damage requiring immediate retirement** - A soft spot felt during rope inspection indicates core damage—the load-bearing center of the rope is compromised. Core damage may result from shock loading, internal abrasion, or localized crushing. Because the core provides the majority of rope strength, any core damage makes strength unpredictable and rope failure possible without warning. Such ropes must be immediately retired from life-safety use.
16. **D. Limit movement of branches relative to each other to reduce failure likelihood** - Tree cabling systems install flexible steel cables between branches or codominant stems in the upper crown to limit their movement relative to each other. By reducing excessive movement during wind or ice loading, cables decrease stress on weak attachments and reduce failure likelihood. Cables do not prevent failure but reduce its probability. They are often combined with bracing for comprehensive support.
17. **C. Protection for the root apical meristem as it grows through soil** - The root cap is a thimble-shaped mass of cells covering the root apical meristem (growing tip). As roots grow through soil, the root cap protects delicate meristematic cells from physical damage. Root cap cells are continuously sloughed off and replaced from behind. The cap also secretes mucilage that lubricates root passage through soil and may influence root direction in response to gravity.
18. **B. Promote stress responses and stomatal closure** - Abscisic acid (ABA) is often called the "stress hormone" because it accumulates in response to drought, cold, and other stresses. Its primary functions include promoting stomatal closure to conserve water during drought, inducing seed and bud dormancy, and inhibiting growth during unfavorable conditions. ABA works antagonistically with growth-promoting hormones, helping plants survive stress periods.
19. **D. Tree age and growth rate** - An increment borer extracts a thin cylindrical core of wood from the trunk, allowing examination of annual growth rings without seriously damaging the tree. Counting rings provides tree age (at core height); measuring ring widths reveals growth rate patterns over time. Narrow rings indicate stress years (drought, defoliation, competition); wide rings indicate favorable conditions. Cores can also reveal injury history and decay presence.
20. **A. Consuming leaf tissue and reducing photosynthetic capacity** - Defoliating insects (caterpillars, sawflies, beetles, and others) consume leaf tissue, directly reducing the tree's photosynthetic capacity. Severe or repeated defoliation depletes carbohydrate reserves, reduces

growth, weakens defenses against secondary pests and diseases, and can ultimately cause mortality. Most healthy trees can survive one complete defoliation, but consecutive years of severe defoliation cause progressive decline.

21. **C. Weak barrier formation allowing extensive decay spread** - Poor compartmentalizers form weak chemical and physical barriers after wounding, allowing decay to spread extensively through the wood. Species like willows, poplars, and birches typically compartmentalize poorly, meaning wounds on these trees often result in significant internal decay. Good compartmentalizers (oaks, beeches) form strong barriers that effectively limit decay spread. This genetic capability varies significantly among species.
22. **B. Warm, wet weather during bloom** - Fire blight, caused by the bacterium *Erwinia amylovora*, spreads most rapidly during warm (65-85°F), wet weather, particularly during bloom when flowers provide entry points for the pathogen. Rain, insects, and contaminated pruning tools spread the bacteria. The combination of susceptible tissue (open flowers), favorable temperatures, and moisture creates epidemic conditions. Dry weather slows disease development significantly.
23. **D. 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 conditions), 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 components must be evaluated for complete risk assessment.
24. **A. Upper side (pulling the tree upward)** - In leaning hardwood trees, tension wood forms on the upper (tension) side of the lean. Tension wood contains specialized fibers (gelatinous fibers) that generate pulling forces, helping straighten the tree or maintain its position. This contrasts with conifers, where compression wood forms on the lower side and pushes upward. Understanding reaction wood location helps predict tree response to lean and potential hazards.
25. **C. Stress from one or more environmental or biological factors** - Chlorotic foliage, reduced growth, and premature leaf drop are classic symptoms of tree stress. Causes may include drought, root damage, soil compaction, nutrient deficiency, root disease, or multiple interacting factors. These symptoms indicate the tree is not functioning optimally and requires diagnosis to identify causes. Early intervention offers better prognosis than waiting until decline becomes advanced.
26. **B. Mesophyll cells containing chloroplasts** - Mesophyll cells, located between the upper and lower epidermis of leaves, contain abundant chloroplasts and are the primary site of photosynthesis. The palisade mesophyll (columnar cells near the upper surface) is optimized for light capture, while spongy mesophyll (irregularly shaped cells with air spaces) facilitates gas exchange. Together, these cells convert light energy into chemical energy stored in sugars.
27. **D. Stop work, assess damage, reinstall fencing, and document the incident** - If tree protection fencing is breached during construction, work in that area should stop immediately. Damage

assessment determines what harm occurred and what remediation is possible. Fencing must be reinstalled properly, and the incident should be documented for accountability and potential future reference if tree decline occurs. Prevention is preferable, but prompt response limits damage.

28. **A. Marginal leaf scorch or necrosis, often on older leaves** - Potassium deficiency typically causes marginal leaf scorch (browning at leaf edges) or necrosis, often beginning on older leaves because potassium is mobile and translocated to new growth. Symptoms may resemble drought stress or salt damage. Potassium is important for water regulation, disease resistance, and overall plant vigor. Deficiency is relatively uncommon in most landscape soils.
29. **B. Trunk decay and stem-girdling roots** - Trees planted too deeply have trunk bark in prolonged contact with moist soil, promoting bark decay that can progress into wood. Additionally, buried trunks often produce adventitious roots that grow tangentially, eventually girdling the trunk or major roots. These problems develop gradually over years or decades, making deep planting a hidden cause of later decline and structural compromise.
30. **C. Roots have grown sufficiently into surrounding soil to meet crown water demands** - Tree establishment is complete when roots have grown adequately into surrounding soil to supply the crown's water needs without supplemental irrigation. This typically takes 1-3 years depending on tree size (roughly one year per inch of caliper). During establishment, the limited root ball cannot meet transpiration demands, requiring regular irrigation focused on the original root ball.
31. **D. Vertical mulching** - Vertical mulching involves drilling holes (typically 2-4 inches diameter, 12-18 inches deep) throughout the root zone and filling them with organic matter, compost, or porous material. This creates channels for air and water infiltration and pathways for root growth through compacted soil. Combined with surface organic matter application, vertical mulching gradually improves conditions in compacted root zones.
32. **A. At a random point along a branch, not to a lateral branch of adequate size** - A heading cut removes a branch at a random point between nodes or to a lateral too small to assume the terminal role (less than one-third the diameter of the removed branch). Heading cuts stimulate multiple dormant buds below the cut to grow, producing numerous weakly attached sprouts. This differs fundamentally from reduction cuts and thinning cuts, which do not stimulate excessive sprouting.
33. **B. Arbuscular mycorrhizae (endomycorrhizae)** - Arbuscular mycorrhizae (AM) are the most common mycorrhizal type, associating with the majority of plant species including most landscape trees like maples and ashes. AM fungi penetrate root cell walls (but not membranes) to form arbuscules for nutrient exchange. Ectomycorrhizae, which form external sheaths, are most common in forest trees like oaks, pines, and birches.
34. **C. Weak attachments originating near the bark surface** - Epicormic sprouts (water sprouts) originate from dormant or adventitious buds located near the bark surface, resulting in shallow, weak attachments to the parent branch. Unlike branches that develop from buds within branch

tissue during normal growth, epicormic sprouts lack deep structural connection. As they grow larger, their weak attachments become increasingly prone to failure, creating ongoing hazards.

35. **D. Species (10%), genus (20%), and family (30%)** - The 10-20-30 diversity guideline establishes limits at three taxonomic levels: no single species should exceed 10% of the urban forest, no single genus should exceed 20%, and no single family should exceed 30%. This multi-level approach provides comprehensive protection against pests and diseases operating at various taxonomic levels—species-specific, genus-wide, or potentially family-affecting threats.
36. **A. Complete (100%) inventory** - A complete inventory documents every individual tree in the population, recording location, species, size, condition, maintenance needs, and other relevant data for each tree. This enables individual tree management, specific work order generation, and detailed tracking over time. Complete inventories are more expensive than sample inventories but provide data necessary for managing trees as individuals rather than populations.
37. **B. High pH making iron chemically unavailable** - Iron chlorosis commonly results from high soil pH (alkaline conditions) that makes iron chemically unavailable rather than actual iron absence. At pH above 7, iron forms insoluble compounds that roots cannot absorb. This "lime-induced chlorosis" is common in areas with calcareous soils or where concrete leaches lime into soil. Treatment may require soil acidification or iron application in plant-available forms.
38. **D. Stop work and contact the utility company** - If unexpected electrical conductors are encountered during tree work, operations must stop immediately. Never assume any line is safe—what appears to be a phone or cable line may be attached to poles with energized components, or may actually be an electrical conductor. Contact the utility company for identification and appropriate action. Working near unidentified conductors violates safety standards and risks electrocution.
39. **C. Removal by cutting, often requiring root collar excavation** - Once stem-girdling roots have developed, the most effective treatment is removal by cutting. This typically requires root collar excavation (using air excavation tools) to expose the root system and identify girdling roots. Roots are then cut and removed. Success depends on girdling severity—early-stage girdling may be correctable, while severe girdling causing significant vascular restriction may be irreversible.
40. **A. A structural defect with increased failure potential** - Codominant stems (stems of roughly equal size arising from the same point) with included bark represent a significant structural defect. Included bark—bark trapped within the union rather than turned outward—prevents strong wood-to-wood connection. These unions are prone to failure, especially under loading from wind, ice, or additional weight. Support systems (cabling and bracing) may reduce failure likelihood.
41. **B. Active transport requiring energy** - Sugar loading into phloem sieve tube elements at source tissues (mature leaves) requires active transport—energy expenditure by companion cells to move sugars against concentration gradients. This loading increases solute concentration in sieve tubes,

drawing water in osmotically and creating the positive pressure that drives mass flow toward sink tissues. The energy investment enables efficient long-distance sugar transport.

42. **D. Frequent watering focused on the root ball until roots establish** - During establishment, tree roots are confined to the original root ball, which can dry out even when surrounding soil is moist because water moves poorly between dissimilar soil types. Irrigation must target the root ball directly, keeping it consistently moist without waterlogging. As roots grow into surrounding soil (1-3 years), irrigation can gradually expand to a wider area and decrease in frequency.
43. **C. Root damage or vascular disease on the corresponding side** - Symptoms appearing only on one side of the crown often indicate localized problems affecting that specific portion. Root damage on one side affects the crown sector those roots supply; vascular diseases may initially colonize vessels on one side before spreading. This asymmetric pattern is diagnostically useful—it suggests investigating root zone conditions or vascular tissue on the affected side.
44. **A. High humidity without leaf wetness and moderate temperatures** - Unlike most fungal diseases that require leaf wetness for infection, powdery mildews thrive in conditions of high humidity without free water on leaf surfaces, combined with moderate temperatures (60-80°F). This unusual preference explains why powdery mildews often appear during dry periods when other diseases decline. Shaded, crowded conditions with poor air circulation favor development.
45. **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—the functional benefits it provides (shade, energy savings, windbreak, screening, privacy) and its aesthetic contribution to the property and landscape design. A well-placed tree providing significant functional and aesthetic benefits receives a higher rating than an identical tree in a less valuable position.
46. **D. Detailed visual inspection at ground level of accessible tree parts** - Level 2 basic assessment involves systematic visual inspection of individual trees, typically walking around the tree and examining all accessible parts from ground level. The assessor evaluates crown, trunk, and root zone for defects and identifies targets. This level provides sufficient information for risk rating most trees and determining whether advanced assessment is needed.
47. **C. Eye, hearing, head, and leg protection** - ANSI Z133 requires comprehensive personal protective equipment for chain saw operation: eye protection (from debris), hearing protection (chain saws exceed safe noise levels), head protection (hard hat for falling debris), and leg protection (cut-resistant chaps or pants during felling and certain other operations). Additional PPE may be required based on specific hazards present.
48. **A. Hazards, work plan, responsibilities, and emergency procedures** - ANSI Z133 requires job briefings before tree work to communicate: specific hazards identified at the work site, the work plan and sequence of operations, individual crew member responsibilities, communication protocols, and emergency procedures including rescue plans. Briefings ensure all workers

understand conditions and their roles. Briefings should be repeated when conditions change significantly.

49. **B. The branch collar** - Proper pruning cuts preserve the branch collar—the swollen area at the branch base containing specialized tissue for compartmentalization and wound closure. The collar's unique tissue composition enables it to produce callus efficiently and form effective barriers against decay spread. Cuts made just outside the collar optimize wound response; flush cuts that remove the collar severely compromise the tree's ability to respond effectively.
50. **D. Organic matter** - Organic matter is the most beneficial soil amendment for overall soil quality improvement. It improves soil structure and aggregation, increases water-holding capacity in sandy soils while improving drainage in clay soils, enhances nutrient retention through increased cation exchange capacity, provides slow-release nutrients as it decomposes, and supports beneficial soil organisms. No other single amendment provides such comprehensive benefits.
51. **C. Immediate environmental benefits not replaceable for decades** - Mature trees provide substantial immediate benefits—shade, cooling, stormwater management, air quality improvement, wildlife habitat, aesthetic value, property value enhancement—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 during development essential.
52. **A. Immediately select a different anchor point** - If a tie-in point shows any sign of failure during loading—cracking sounds, visible movement, or any other indication of weakness—immediately transfer to a different anchor point. Never continue with a compromised tie-in regardless of how secure it appeared during initial inspection or testing. The consequences of anchor failure during climbing are severe. Select and test a new anchor before proceeding.
53. **B. Stopping or reversing the feed mechanism** - The feed control bar is a critical safety device spanning the chipper infeed opening that, when pushed, stops or reverses the feed mechanism. 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 to verify function and must never be disabled or bypassed. It represents the last line of defense against feed-related injuries.
54. **D. Immobility (cannot be translocated from older tissue)** - Immobile nutrients (iron, manganese, zinc, copper, boron, calcium) cannot be moved from older tissue to support new growth. When these nutrients are deficient, developing leaves cannot obtain them from existing plant reserves, so symptoms appear on youngest leaves first. This pattern contrasts with mobile nutrient deficiencies (nitrogen, phosphorus, potassium, magnesium), where symptoms appear on older leaves.
55. **C. Health and structural integrity** - The condition rating in tree appraisal evaluates overall health (crown density, leaf size and color, growth vigor, decline symptoms) and structural integrity (absence of decay, cracks, weak attachments, codominant stems with included bark). Trees in

excellent condition receive 100%; significant problems reduce the rating proportionally. A tree rated at 50% condition is worth only half what an identical healthy tree would be worth.

56. **A. Pollarding is planned, ongoing management; topping is indiscriminate cutting** - Pollarding is a traditional practice of repeatedly removing all new growth back to permanent scaffold branches on a regular cycle, initiated on young trees and maintained throughout the tree's life. It's a planned management system. Topping is typically indiscriminate cutting of mature trees at arbitrary points without ongoing management plans, causing serious structural problems, decay, and weakly attached regrowth.
57. **B. Tree vigor and growth rate** - Wound closure rate correlates directly with annual radial growth because callus tissue is produced by cambial activity at wound margins. A vigorous tree producing substantial annual growth closes wounds faster than a stressed or slow-growing tree. This relationship explains why maintaining tree health is critical when wounding is unavoidable and why wounds on declining trees may remain permanently open.
58. **D. Water conduction and living cell functions** - Sapwood is the outer portion of wood containing functional xylem vessels that conduct water and living parenchyma cells that store starch and other compounds. These living cells also participate in compartmentalization responses to wounding. As trees age, inner sapwood converts to heartwood through cell death and chemical changes. Sapwood width varies by species and growing conditions.
59. **C. Crown, trunk, root zone, and target area** - A thorough basic risk assessment systematically evaluates all tree components that could fail: the crown (for dead branches, weak attachments, decay), the trunk (for cracks, decay, lean, cankers), and the root zone (for stability indicators, root damage, soil conditions). Assessment also identifies targets in the potential failure zone and evaluates potential consequences. Limiting assessment to any single area may miss critical defects.
60. **A. A serious structural defect with potential for union failure** - Vertical cracks extending through branch unions indicate the union is actively separating under stress—a serious structural defect. Such cracks often occur at codominant stem unions with included bark, where weak attachment cannot resist loading forces. The crack may extend further during each loading event, eventually causing complete separation. This defect typically requires prompt mitigation.
61. **B. Exposing roots without damage for assessment or treatment** - Air excavation uses compressed air to displace soil particles without cutting roots, allowing root examination, root collar investigation, girdling root treatment, and careful work in root zones while minimizing root damage. This technology has transformed arboricultural diagnostics and tree preservation capabilities, enabling interventions that previously would have caused unacceptable root damage.
62. **D. Lower side (pushing the tree upward)** - In leaning conifers, compression wood forms on the lower (compression) side of the lean. Compression wood has different cell structure—shorter tracheids with thicker walls and rounder cross-sections—that generates pushing forces to maintain

or restore upright position. This contrasts with hardwoods, where tension wood on the upper side pulls the tree up. Compression wood properties differ from normal wood.

63. **C. When testing confirms nutrient deficiency** - Fertilization is justified when soil or tissue testing confirms that nutrient deficiency is limiting tree health or growth. Testing identifies whether deficiencies exist and which specific nutrients are needed. Fertilizing without confirmed need wastes resources, may harm trees (excess nitrogen promotes succulent growth susceptible to pests and diseases), and can contribute to water pollution. Most healthy established trees do not require regular fertilization.
64. **A. Established decay fungus within the tree** - A bracket fungus (conk) is the reproductive structure of a wood decay fungus, indicating established fungal colonization within the tree. By the time fruiting bodies appear externally, decay has typically been developing internally for years. The significance depends on decay extent, location, and tree use. Finding a conk warrants further assessment to determine structural implications and appropriate management response.
65. **B. System strength is limited by the weakest component** - A fundamental rigging principle states that system strength equals the strength of its weakest component. Every element—ropes, slings, carabiners, blocks, anchors—must be rated for anticipated loads. If one component is underrated, the entire system may fail at that point regardless of other components' strength. Load calculations must account for dynamic forces, which can multiply static weights significantly.
66. **D. Monitoring to detect pest presence** - Integrated pest management begins with regular monitoring to detect pest presence before populations build to damaging levels. This is followed by accurate pest identification, threshold determination (deciding whether action is needed), and appropriate tactic selection if thresholds are exceeded. Monitoring-based decision-making prevents unnecessary treatment while enabling timely response when intervention is warranted.
67. **C. Bark beetles carrying fungal spores** - Dutch elm disease spreads over distances via bark beetles (primarily *Scolytus multistriatus* and *Hylurgopinus rufipes* in North America) that carry fungal spores from infected trees to healthy trees. Beetles breed in dying elm wood; emerging adults carry spores on their bodies. When they feed on healthy elms (typically in twig crotches), they introduce the fungus. Local spread also occurs through root grafts between adjacent trees.
68. **A. Circling and potentially girdling roots** - Trees held in containers too long develop circling roots that conform to container walls. This root-bound condition often persists after planting—roots 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. Root inspection and correction at planting is essential.
69. **B. Expose and assess the trunk-root transition zone** - Root collar excavation removes soil, mulch, or debris burying the trunk base, exposing the root-trunk transition (root flare) for visual assessment. This reveals problems like girdling roots, trunk decay, improper planting depth, or

root defects not visible when buried. Many tree health and structural problems trace to conditions at the root collar. Excavation is both diagnostic and often therapeutic.

70. **D. Greater density and mechanical strength** - Specific gravity (ratio of wood density to water density) correlates directly with mechanical strength. Higher specific gravity means more cell wall material per unit volume, resulting in greater strength and stiffness. Species with high specific gravity (white oak, hickory, black locust) produce stronger wood than low specific gravity species (cottonwood, willow, basswood). This affects both living tree structure and wood products.
71. **C. Structural defects, dead branches, electrical hazards, wildlife, and overall condition** - Pre-climb inspection systematically identifies hazards that could endanger the climber: structural defects (cracks, decay, weak attachments) that might not support climbing loads, dead branches that could fall during climbing, electrical conductors, wildlife (especially stinging insects like wasps or bees), and overall tree condition. This assessment determines whether climbing is safe and identifies necessary precautions.
72. **A. Before any construction activity begins** - Effective tree protection requires barriers installed before any construction activity—before equipment arrives, before material staging, before any ground disturbance. Once damage occurs, it cannot be undone. Fencing must be at the protection zone boundary (minimum 1 foot radius per inch DBH), clearly marked, and maintained throughout construction. Protection implemented after work begins cannot prevent already-inflicted damage.
73. **B. Pest levels at which treatment is justified** - Action thresholds define pest populations or damage levels at which treatment becomes justified because potential harm exceeds treatment costs, risks, and environmental impacts. Below threshold, pest presence is tolerated—damage is acceptable, or natural enemies may provide adequate control. Above threshold, intervention is warranted. Thresholds vary with plant value, pest species, season, and management objectives.
74. **D. Annually and after lightning events** - Lightning protection systems require annual inspection to verify component condition (checking for corrosion, physical damage, loose connections) and proper function. Additional inspection following lightning strikes detects damage not immediately visible. As trees grow, conductors may need repositioning or extension. Proper maintenance ensures continued protection throughout the system's service life.
75. **C. Annually and after major storms** - Tree support systems (cables and braces) require regular inspection to ensure continued function. Annual inspection at minimum, plus inspection after major storms (wind, ice, heavy snow), verifies hardware condition, cable tension (for standard cables), attachment integrity, tree growth around components, and whether the system remains appropriate for current tree conditions. Neglected systems may fail or damage trees.
76. **A. Reduced crown density while maintaining form and size** - Crown thinning selectively removes branches throughout the crown to reduce density (number of branches and foliage) while maintaining the tree's natural shape and overall size. This improves light penetration, reduces wind

resistance, and decreases weight on branch unions. Thinning should be distributed throughout the crown using thinning cuts (removal at point of origin) rather than concentrated in any area.

77. **B. Fabaceae (legumes)** - Nitrogen-fixing bacteria (*Rhizobium* and related species) form symbiotic relationships with trees in the legume family (Fabaceae). Bacteria colonize root nodules where they convert atmospheric nitrogen (N_2) to ammonia (NH_3), which plants use for growth. In return, plants provide carbohydrates to the bacteria. Leguminous trees include black locust, honeylocust, Kentucky coffeetree, redbud, and mimosa.
78. **D. Severity of harm if failure strikes the target** - Consequences in tree risk assessment evaluate the severity of harm that would result if tree failure occurs and strikes the target. Consequences range from negligible (minor property damage easily repaired) to severe (serious injury or death, major structural damage). Factors include target type (people vs. property), vulnerability (a child is more vulnerable than an adult), and failure size (twig vs. whole tree).
79. **C. 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 probable failure direction, target occupancy (how often the target is present—a busy sidewalk vs. rarely used path), and target mobility (can the target move to avoid falling debris). High likelihood of failure doesn't equal high risk if impact likelihood is low.
80. **A. Specialized tissue for compartmentalization and wound closure** - The branch collar contains specialized tissue where trunk and branch wood overlap, providing unique capability for compartmentalization (forming barriers against decay spread) and callus production (wound closure). Preserving this tissue through proper cut placement optimizes the tree's wound response. Flush cuts that remove the collar eliminate this specialized tissue, severely compromising wound response.
81. **B. 5,400 pounds** - ANSI Z133 requires arborist climbing lines to have a minimum breaking strength of 5,400 pounds (24 kN). This provides adequate safety margin for dynamic loads that occur during climbing—falls, sudden movements, and shock loading. Ropes meeting this standard are typically 11-13 mm diameter kernmantle construction. Regular inspection is essential because rope strength degrades with use, UV exposure, contamination, and damage.
82. **D. Bark tearing on the trunk** - The three-cut method prevents bark tearing (stripping) that occurs when heavy branches fall before the cut is complete. The undercut prevents bark from peeling back as the branch falls; the second cut removes branch weight; the final cut creates proper pruning placement outside the collar. Without this technique, falling branches can strip bark along the trunk, creating large wounds that damage valuable trunk tissue.
83. **C. Catastrophic losses from species-specific pests and diseases** - Urban forest diversity standards exist primarily to prevent catastrophic losses when species-specific threats arrive. The devastating loss of American chestnuts, American elms, and ash trees to introduced pests and diseases demonstrates vulnerability of low-diversity forests. Diversity ensures no single pest or

disease can eliminate more than a limited portion of the urban forest, maintaining canopy cover and ecosystem services.

84. **A. 10 feet** - ANSI Z133 specifies that unqualified workers must maintain a minimum approach distance of 10 feet from electrical conductors at voltages below 50 kV. This distance applies to all body parts, tools, equipment, and materials being handled. For voltages above 50 kV, the distance increases by 4 inches per additional 10 kV. Only qualified line-clearance arborists may work within reduced distances from energized conductors.
85. **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 duration, root management to prevent circling) and correct planting with the root flare at or above grade. Once circling or girdling roots develop, correction becomes increasingly difficult and less successful. Prevention through proper practices is far more effective than treatment.
86. **D. Low or no risk (target required for risk)** - Tree risk requires both components: structural defects creating potential for failure AND targets within the potential failure zone that could be harmed. Without a target, there is no risk regardless of defect severity. A severely compromised tree in a remote area with no people, property, or activities present has no risk rating. Risk assessment resources should focus where failure would actually cause harm.
87. **C. Vertical clearance beneath the crown** - Crown raising (also called lifting) removes lower branches to increase vertical clearance beneath the crown for pedestrians, vehicles, sight lines, building clearance, or mowing access. This 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.
88. **A. Ectomycorrhizae form external sheaths without penetrating cell walls** - Ectomycorrhizal fungi form a visible sheath (mantle) around root tips and grow between root cortex cells (forming the Hartig net) but do not penetrate cell walls. This contrasts with arbuscular mycorrhizae (endomycorrhizae), which penetrate root cell walls to form structures (arbuscules, vesicles) inside cells. Both types benefit trees through enhanced nutrient and water uptake.
89. **B. Prevent proper wound closure and create decay entry points** - 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 tissue dies, decays, and provides entry points for decay organisms that can spread into the trunk. Proper cuts just outside the branch collar enable effective closure.
90. **D. Approximately 1 year per inch of trunk caliper** - A widely used guideline for tree establishment is approximately one year per inch of trunk diameter. A 2-inch caliper tree needs about 2 years; a 4-inch tree needs about 4 years. During establishment, roots grow into surrounding

soil to restore balance between root water supply and crown transpiration demand. Consistent irrigation focused on the root ball is essential during this period.

91. **C. Oxygen availability and space for root growth** - Soil compaction collapses pore spaces, severely reducing oxygen availability for root respiration. Roots require oxygen to function; without adequate oxygen, roots cannot absorb water and nutrients, and cells begin dying. Compaction also physically prevents root penetration, limiting the soil volume roots can explore. Additionally, compacted soil reduces water infiltration, potentially causing both drought stress and waterlogging.
92. **A. Up to 25-30% or more depending on placement and climate** - Research consistently shows that shade from properly placed trees can reduce building cooling costs by 25-30% or more. The actual savings depend on tree size, placement relative to windows and walls, climate zone, and building characteristics. Trees shade walls, windows, and roofs from direct solar radiation, and their transpiration provides additional evaporative cooling. This energy benefit represents significant economic value.
93. **B. Tree health and vigor at the time of wounding** - Compartmentalization effectiveness depends heavily on tree health and vigor when wounding occurs. Vigorous trees have energy reserves to produce chemical barriers (phenolics, tannins, other antimicrobial compounds) and callus tissue rapidly. Wall 4 strength particularly depends on growth rate. Stressed trees lacking energy resources cannot mount effective compartmentalization responses, explaining why wounds on declining trees often result in extensive decay.
94. **D. Soil shows adequate nutrients but trees show deficiency symptoms** - Tissue (foliar) analysis is particularly valuable when a disconnect exists between soil test results (showing adequate nutrients) and tree appearance (showing deficiency symptoms). This situation suggests nutrients are present in soil but unavailable (often due to pH effects) or that root dysfunction prevents uptake. Tissue analysis reveals what the tree has actually absorbed, helping identify the limiting factor.
95. **C. Heading cut** - Heading cuts—made at random points along branches rather than to lateral branches of adequate size—stimulate multiple dormant buds below the cut to grow, producing numerous epicormic sprouts. These sprouts originate near the bark surface and have inherently weak attachments. As they grow larger, their weak attachments become increasingly failure-prone. This sprouting response is a primary reason heading cuts are inappropriate for most pruning.
96. **A. Xylem** - The cohesion-tension theory explains water movement through xylem tissue. Transpiration from leaves creates tension (negative pressure) that pulls water upward through continuous columns in xylem vessels and tracheids. Water molecules' cohesion (attraction via hydrogen bonds) maintains these unbroken columns from roots to leaves. This passive mechanism is the primary driver of water transport, moving water over 300 feet in tall trees.
97. **B. Stop, secure position, and carefully untangle before proceeding** - If climbing equipment becomes entangled, stop immediately and secure your position before attempting to resolve the

problem. Continuing to climb with entangled equipment creates unpredictable tensions, restricted movement, and potential for accidents. Take time to carefully identify the entanglement source and systematically resolve it before proceeding. Rushing increases risk and may worsen the situation.

98. **D. At least one-third 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. Laterals of this minimum size can assume the terminal role and continue growth without stimulating excessive sprouting. Cuts to smaller laterals function like heading cuts, triggering multiple weakly attached sprouts that create structural problems and ongoing maintenance needs.
99. **C. Compartmentalization—walling off damaged tissue** - Trees do not heal wounds by regenerating lost tissue. Instead, they respond through compartmentalization—chemically and structurally walling off damaged and potentially infected tissue to limit decay spread while producing new tissue (callus) that grows over the wound surface. Understanding this fundamental process—that trees wall off rather than heal—is essential for proper tree care decisions, particularly regarding wounding and pruning.
100. **A. Prevention and maintaining overall plant health rather than reactive treatment** - Plant health care (PHC) programs emphasize proactive health maintenance rather than reactive pest treatment. The foundation is that healthy, vigorous plants naturally resist and tolerate pest pressure better than stressed plants. PHC integrates proper cultural practices (appropriate watering, mulching, soil management), regular monitoring, accurate diagnosis, and intervention only when monitoring indicates action thresholds are exceeded.