Indicate the most correct answer in the left hand column (38 pts @ 2 pts/question).

1. For successful acclimatization of tissue culture-produced plantlets the following must occur:
   a. the leaf needs to form a better developed cuticle
   b. better stomatal control needs to occur to control water loss
   c. plantlets need to become more heterotrophic by increasing photosynthesis
   d. a, b & c
   e. a & b

2. The following rooting preparation is a powder formulation of auxin containing IBA
   a. Hormodin
   b. Dip ‘N Grow
   c. Hormo-Root
   d. a & c
   e. b & c

3. In stage III of tissue culture systems the following occurs:
   a. rooting ex vitro
   b. shoot proliferation & subculturing
   c. rooting in vitro
   d. a low auxin to high cytokinin level is used
   e. a high cytokinin to ABA level is used

4. In easy-to-root plant species, roots of stem cuttings form most frequently from:
   a. pith
   b. phloem ray parenchyma cells
   c. callus
   d. xylem ray parenchyma cells
   e. sclereids

5. In stem chimeras:
   a. sectorial chimeras become either mericlinal or normal
   b. sectorial chimeras become either periclinal or sectorial
   c. periclinal chimeras become either mericlinal or normal
   d. periclinal chimeras become either sectorial or mericlinal
   e. mericlinal chimeras become either periclinal or normal

6. The following chimera is both unstable and typically found in roots:
   a. periclinal
   b. mericlinal
   c. sectorial
   d. a & b
   e. a & c
7. The use of mist systems for propagation:
   a. can cause nutrient leaching of cuttings
   b. minimizes heat stress and speeds up rooting
   c. can sometimes adversely cool down the propagation media which can reduce rooting
   d. a, b & c
   e. b & c

8. Van Overbeek demonstrated with Hibiscus cuttings that:
   a. buds produce auxins
   b. flowers produce carbohydrates and GA
   c. roots produce cytokinins
   d. leaves produce carbohydrates and ABA
   e. shoots produce GA

9. The two most important stages in *de novo* adventitious root formation are:
   a. elongation of primordia and dedifferentiation of parenchyma cells
   b. dedifferentiation of parenchyma cells and root initial formation
   c. primordia development and elongation of primordia
   d. root initial formation and primordia development
   e. dedifferentiation of parenchyma cells and primordia development

10. Wounding of cuttings has the following effect:
    a. creates a sink area that stimulates cell division
    b. stimulates auxin accumulation and ethylene evolution
    c. removes any potential mechanical barrier to rooting
    d. a, b & c
    e. a & c

11. Exposing stock plants to short days and cooler temperatures has the following effect:
    a. increases auxin levels
    b. increases cytokinin levels
    c. increases adventitious bud formation
    d. a & c
    e. b & c

12. The following CHO/N ratio of stock plants most likely favors rooting of hardwood cuttings:
    a. low CHO/high N
    b. high CHO/high N
    c. high CHO/low to moderate N
    d. low CHO/low to moderate N
    e. a & b

13. What is NOT an advantage of using cutting propagation:
    a. clonal regeneration of plants
    b. production of uniform, high value cash crops
    c. accumulation of viruses and mycoplasmas
    d. genetic uniformity
    e. propagation of plants which are sexually sterile
14. What plant growth regulator is most likely to be used for propagating root and leaf cuttings
   a. NAA
   b. Kinetin
   c. GA
   d. IAA
   e. Ethylene

15. A contact layer system of polyethylene placed over watered-in cuttings:
   a. works best with softwood cuttings
   b. requires strict temperature control via light manipulation and other methods
   c. avoids the problems of nutrient leaching in cutting propagation
   d. a, b & c
   e. b & c

16. During mist propagation, the nutrition of cuttings
   a. is commonly enhanced by fertigating (applying liquid fertilizer in the mist)
   b. depends initially on residual nutrients in the cutting tissue when collected (harvested) from the stock plant
   c. any significant uptake of fertilizer occurs only after cuttings have formed roots
   d. a & b
   e. b & c

17. Which type of bud has the greatest potential to act as a competing sink and inhibit rooting of a cutting:
   a. vegetative terminal bud
   b. flower bud
   c. mixed bud
   d. vegetative axillary bud
   e. adventitious bud

18. The use of auxin in the rooting of stem cuttings:
   a. speeds up the rate of rooting and root development
   b. is normally applied at 1000 to 3000 ppm for most semi-hardwood cuttings
   c. is applied at high concentrations (up to 70,000 ppm in difficult-to-root species)
   d. a & b
   e. a & c

19. The following mutation is commonly advantageous to certain horticultural plants:
   a. polyploidy
   b. deletions
   c. point mutations
   d. inversions
   e. aneuploidy

Circle the most correct answer in the following true-false statements. **If the answer is false EXPLAIN WHY** (29pts @ 1 pt/question).
T  F  20. Water droplets of intermittent mist are typically greater than 50 µm, whereas fog droplets average around 15 µm or less.

T  F  21. While mutations are the ultimate source of biological variation and important in the natural selection of plants, most mutations are deleterious and not retained by plants.

T  F  22. While there is no perfect or universal propagation media, it is important that the mineral and organic components of media lead to good drainage, aeration, water holding capacity, are commercially available and equally important — are cost effective, i.e. pine bark media is routinely being substituted for peat.

T  F  23. Parallel propagation of cuttings can refer to selecting cuttings for maximum rooting potential from: 1) each new generation of containerized plants that were previously propagated by rooted cuttings and/or 2) by using environmental and nutritional manipulation of containerized stock plants that were initially propagated from cuttings to enhance the rooting of each new generation of cuttings.

T  F  24. Many commercial tissue culture operations tend to bypass Stage III (rooting in vitro) and go from Stage II directly to Stage IV, where rooting and acclimation take place at the same time.

T  F  25. Accelerated senescence refers to speeding up (reducing) the production time of rooted cuttings or seedlings through programmed growth control such as the manipulation of light, temperature, mycorrhizal fungi, CO2 levels, etc.

T  F  26. Shading and banding are used to manipulate stock plants from which hardwood cuttings are later collected.

T  F  27. Apical meristem cells in layer III divide anticlinally and periclinally, and later form the inner cortex and pith.

T  F  28. Some common methods that a grower can use to increase stock plant carbohydrates relative to nitrogen levels for rooting — are to select wood (shoots) from the basal rather than apical portions of stock plants, reduce light levels and increase fertility.

T  F  29. Genetic engineering is composed of whole plant breeding and selection, cellular-protoplast manipulation, and molecular biology — which entails gene manipulation.

T  F  30. Hare’s rooting compound contains auxin, ethylene, gibberellic acid, carbohydrates and cytokinins.

T  F  31. The principal reason for poor rooting in difficult to root plants are greater numbers of sclereids and fibers which form mechanical barriers that prevent the penetration of roots through the xylem.

T  F  32. Conditional registration for IBA means that technical grade IBA can no longer be utilized for propagation, but formulated products containing IBA such as Wood’s Rooting Compound and Dip N Grow are permissible for commercial propagation.

T  F  33. One of the best ways to propagate a thornless rose or variegated plant is by root cuttings.

T  F  34. An embryoid is often a heart-shaped structure produced in a tissue culture system from somatic or vegetative tissue.
35. Direct sticking of cuttings (as opposed to inserting cuttings in a conventional propagation flat) more efficiently utilizes propagation space, and saves money by reducing a production step.

36. Genetic mosaics occur when different genotypes exist in the same organism, hence, chimeras are genetic mosaics, but not all genetic mosaics are chimeras.

37. Rooting cofactors are phenolic compounds that can enhance the rooting process.

38. A high cytokinin: low auxin ratio favors formation of adventitious roots.

39. A somatic embryo produced through tissue culture can be developed into a plantlet or be used in producing synthetic seed for fluid drilling systems.

40. Injection of supplementary CO₂ is used in autotrophic tissue culture systems and in propagation houses which are closed up. Ambient CO₂ is around 360 ppm, so any injection of CO₂ would have to exceed this level.

41. The most widely used tissue culture media for herbaceous plants is White’s Media.

42. The correct order of tissues found in a woody stem is pith, vascular cambium, xylem, phloem, cortex and periderm.

43. It is possible to take a softwood cuttings several times during the growing season on woody plant species that undergo more than one episodic growth cycle.

44. Molecular engineering has potentially greater control over genetic change and is less random than traditional whole-organism engineering.

45. Regardless of the explant source, tissue culture is considered to be a form of asexual reproduction.

46. Some cells in a plant such as phloem and xylem ray parenchyma lack a nucleus and are incapable of cell division and forming meristematic areas.

47. Edaphic factors in propagation refer to the effects of the environment and pathogens on rooting of cuttings.

48. With poinsettia, low light during the early stages of cutting propagation is beneficial since it helps reduce transpirational and heat stress — furthermore cuttings can not effectively photosynthesize until roots begin to form.
49. There are numerous advantages and financial benefits in clonally propagating plants, but there are also associated problems. List and DISCUSS four problems in clonally regenerating plants. What approaches are being utilized in forestry to overcome potential clonal regeneration problems of trees? Use appropriate terminology in your discussion.

50. As a commercial propagation manager, you are asked by your boss to put together a proposal considering the advantages of buying-in tissue culture produced liners. What are four possible advantages in utilizing tissue culture produced liners, which you feel would be of merit to the greenhouse business that employs you? (List and DISCUSS).

51. DISCUSS the four most important techniques you could use to manipulate stock plants to enhance the rooting of a difficult-to-root species.
52. Match the correct term with the following twenty definitions. There should be only one term per definition and not all terms have definitions. (20 pts @ 1 pt/definition)

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
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<tbody>
<tr>
<td>acclimatization</td>
<td>ancillary rooting compounds</td>
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<tr>
<td>auxin</td>
<td>autotrophic</td>
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<tr>
<td>chronological age</td>
<td>cell culture</td>
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<td>dedifferentiation</td>
<td>de novo adventitious root formation</td>
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<td>embryo culture</td>
<td>ELISA</td>
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<td>fingerprint</td>
<td>epigenetic</td>
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<td>HEPA filter</td>
<td>ex vitro</td>
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<td>intermittent mist</td>
<td>in vitro</td>
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<td>light spectral quality</td>
<td>leaching of nutrients</td>
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<td>mycoplasma</td>
<td>physiological age</td>
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<td>root inducing (RI) plasmid</td>
<td>rejuvenation</td>
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<td>somatic embryogenesis</td>
<td>shading</td>
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<td>suspension culture</td>
<td>subculture</td>
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<td>thermotherapy</td>
<td>vapor pressure deficit</td>
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<td>vitrification</td>
<td>zeatin</td>
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Used in screening propagation material to be free of viruses & other pathogens.

Growth retardants and inhibitors that can act synergistically with auxin to enhance the rooting of cuttings.

A serological test that can be used in the detection of plant viruses.

Enhances rooting and occurs with stock plants produced from tissue culture or stock plants that are severely pruned or hedged back.

A high temperature treatment used to eliminate viruses within plants.

The storage of vegetative organs at ultra low temperatures.

Used in commercial tissue culture systems to remove microbes (bacteria/fungi) and create sterile air to minimize contamination.

Caused by differences in temperature and relative humidity between the air surrounding a leaf; intermittent mist and evaporative cooling reduces this.

Initially isolated from bacteria and when successfully “transformed” in higher plants can enhance rooting.

Cuttings from these easy-to-root species, root without undergoing de novo rooting.

A cytokinin found in the liquid endosperm of corn, coconuts---and your Friday night pina colada.

This tissue culture system is used for protoplast or callus culture.

A condition that occurs in tissue culture that causes abnormally formed shoots and leaves of the plantlets.

Also known as the cork cambium; it is a meristematic area of a woody shoot.

The culture of plant cells or organs in culture vessels, such as test tubes.

Small cuttings induced to regenerate roots and finally a plantlet.

Nonpermanent changes that occur due to gene expression, i.e. turning genes on & off

Used in DNA marker technology, randomly amplified polymorphic DNA.

A multiplication procedure used in tissue culture to increase shoot numbers