

ASHS Certified Horticulturist Program Certification Examination Study Outline

This Study Outline is intended to serve as a recommended outline of review and study for people who are preparing to take the American Society for Horticultural Science (ASHS) Certified Horticulturist Examination. This outline is organized in 7 major sections, referred to as Categories, which correspond to the certification examination domains. Each Category has a variable number of Competency Areas, which themselves correspond to the subject matter areas within each of the 7 examination domains, and there is a total of 35 Competency Areas. The numbers in parentheses opposite each Category, and each Competency Area within a Category, correspond to the weight of that Category or Competency Area in the ASHS Certified Horticulturist Examination. (For example, a 3.5% in parentheses opposite a Competency Area indicates that the subject covered constitutes about 3.5% of the entire examination. Since the examination consists of 200 questions, a 3.5% representation would indicate that about 7 questions would be expected to cover that topic on the examination.)

Examination Contents

The American Society for Horticultural Science (ASHS) Certified Horticulturist examination is designed to assess an individual's knowledge and skills in a defined range of horticultural topics. The examination will assess knowledge and skills in the following categories:

	Category	Percentage of Certification Examination
Category 1	Landscape Design and Maintenance	14.5%
Category 2	Production of Fruits, Vegetables, Turf and Ornamental Plants	19.5%
Category 3	Shipping and Handling of Final Product	8.5%
Category 4	Propagation	9%
Category 5	Monitoring and Testing	10%
Category 6	Diagnosing and Managing Plant Problems	25%
Category 7	Business Practices	13.5%

Within each of the 35 Competency Areas of this Study Outline, there are a series of objectives that detail the knowledge and skills assessed on the ASHS Certified Horticulturist Examination. Test questions on the examination will assess your mastery of the knowledge and skills documented in these objectives. This Study Outline is not intended to be the only program of study to obtain the ASHS Certified Horticulturist credential. Recommended references for specific areas in horticulture are given at the end of this outline, for the convenience of people

who wish to review in more detail information that may be contained in the examination. These references are strongly recommended for anyone who desires more detailed reference information on the topics covered in this Study Outline

Also, a complete Study Guide for the ASHS Certified Horticulturist Examination is currently in preparation. When complete, it will follow the same general organization as in this Study Outline, with Sections and Chapters corresponding to the Categories and Competency Areas. Even though it will contain much more detailed information than the information in this Study Outline, it will still not be intended to be a stand-alone document, and people will be strongly advised to study the recommended references that cover the examination material in greater detail.

Competency Areas

Each category is composed of three to seven competency areas. Each competency area corresponds to a task or set of tasks in which a Certified Horticulturist should be proficient. There are a total of 35 competency areas assessed on the ASHS Certified Horticulturist examination.

Objectives

Within each competency area, you will find a number of objectives. Each objective defines knowledge a Certified Horticulturist should possess or skills a Certified Horticulturist should have mastered. Test questions on the Certified Horticulturist examination will be based on these objectives. Pay particular attention to these objectives as you prepare for the examination. If you feel that you have mastered the knowledge and skills documented in the objectives, you should do well on the examination. If you find that there are significant gaps in your knowledge and skills as they relate to the objectives, you should probably increase your study or develop more experience before attempting to take the examination.

Organization of this Study Outline

This study guide is divided into three units:

Unit 1: Examination Outline

The Examination Outline is organized into seven Categories. The proportion of examination test questions assigned to each category is indicated in parentheses after the Category title. Within each Category, you will find three to seven Competency Areas. The proportion of examination test questions assigned to each Competency Area is indicated in parentheses after the title of the competency Area. For example, 3.5% of the examination's test questions will address the first Competency Area, Plant Identification. Since the examination consists of 200 test questions, you can expect to find seven test questions addressing this Competency Area.

Below each Competency Area, you will find a number of objectives detailing the knowledge and skills a Certified Horticulturist should possess. Test questions will assess your mastery of the knowledge and skills documented in these objectives.

Unit 2: Sample Test Items

Following the end of Chapter 35, and immediately before the list of recommended references, there is a short section of sample questions of the type that will be on the ASHS Certified Horticulturist Examination. None of these questions will be on the examination, but they are in

the same form and cover the same general subject matter. These test items are designed to familiarize you with the types and formats of questions you may find on the Certified Horticulturist examination. The correct answers are found immediately after the last question.

Unit 3: Recommended References

This unit contains a list of references that may be consulted by individuals wishing to review, in more detail, the specific areas of horticulture addressed by the American Society of Horticultural Science Certified Horticulturist examination. These references are strongly recommended for anyone who desires more detailed reference information on the contents covered in this Study Outline. Please note, however, that no reference can completely replace practical experience in the field of horticulture. Without practical experience in the field of horticulture, it will be very difficult to pass the examination.

This Study Outline is the only official documentation of the standards assessed on the ASHS Certified Horticulturist examination. Although ASHS and non-ASHS references may be recommended or made available to prepare for the ASHS Certified Horticulturist examination, ASHS makes no assertion or guarantee that the use of any of these other reference materials will help certification candidates attain a higher score on the examination.

Any recommendations contained or inferred in this Study Outline should be practiced only after thorough analysis of the particular situation and should be practiced only by those who are properly trained, educated, and experienced in the field of horticulture. ASHS is responsible only for the educational content of this Study Outline and is not responsible for the use or misuse of these ideas in specific situations or by inexperienced or improperly trained individuals.

Category 1: Landscape Design and Maintenance (14.5% of the Examination)

Competency Area 1, Plant Identification. (3.5%)

- Describe how to determine the difference between a monocot and a dicot plant.
- Describe leaf venation patterns.
- Describe the structure of flower parts.
- List the number of petals on a given flower.
- Describe how to tell the difference between a perfect and imperfect flower.
- For imperfect flowers, describe how to tell the difference between monoecious and dioecious plants.
- Describe how to tell the difference between herbaceous and woody plants.
- Describe a branching pattern (alternate, opposite or whorled).
- Describe simple and compound leaves.
- For compound leaves, describe alternate vs. opposite leaf arrangement.
- List characteristics needed to identify grasses and sedges.
- List characteristics needed to identify conifers.
- List possible leaf margins.
- Describe leaf color as it relates to the time of year.
- List possible leaf shapes.

- Describe different surface characteristics of leaves.
- Given a flower and leaf sample of a plant, show the steps of possible identification.
- List possible resources available for identifying plants.
- Perform a plant identification using a dichotomous key.

Competency Area 2, Landscape Design Issues. (2.5%)

- Communicate and summarize customer wants, needs, likes, and dislikes regarding landscape design style, plant preferences, hardscaping, and cost.
- Describe the impact of fertilizer and pesticide runoff on water quality.
- Explain how air quality is negatively impacted by pesticide drift and dust from earth moving.
- Explain how energy (and concurrent emission of CO₂) is required for production of fertilizer, pesticide and for lawn mowing.
- Explain why pesticides not only kill pest insects, but also beneficial insects and other creatures that eat pest insects.
- Explain how the use of pesticides could promote insect problems.
- Describe the contribution of runoff from urban areas to overall sources of water pollution.
- Predict the impact of traditional versus “environmentally friendly” landscape design and maintenance on water quality, energy usage, air quality, soil erosion and CO₂ emissions.
- Assemble educational materials needed to educate customers on the merits of “environmentally friendly” landscape approaches.
- Show the effect of traditional versus “environmentally friendly” landscape design and maintenance on water quality, energy usage, air quality, soil erosion, and CO₂ emissions.
- List landscape techniques that may be used to ensure that water and air quality is protected in a designed landscape.
- List landscape techniques that reduce cost of water, mowing, chemical use, trash disposal, etc. to the customer.
- Explain options for dealing with previously undeveloped sites such as native habitat conservation, conservation of selected elements of native habitat and supplementation with new landscape materials, or installation of entirely new landscape.
- Identify the final design needs of the customer based on realistic expectations and use of “environmentally friendly” practices.
- Assemble and summarize knowledge of local conditions including rainfall, soil type, sunlight, topography and temperature regime into an integrated description of site environmental conditions.
- Perform an inventory of existing plants.
- List source(s) of information for identifying native and landscape plant species.
- Identify plants to be conserved in new landscape.
- Identify situations where services of a certified arboriculturist would be desirable.
- Describe situations where commissioning a tree survey would be desirable.
- List other site considerations that would impact landscape design, including terrain, drainage, utilities, locations of buildings, zoning regulations, etc.
- Define microclimate.
- Explain why the urban growing season can be different than a surrounding rural area.
- Explain how the presence of buildings, roads or other cement/brick/rock structures can change the microclimate in their immediate vicinity.

- Explain basic concepts of wildlife habitats that would normally/commonly be encountered in urban areas: including flyways, corridors, habitat loss, habitat fragmentation, etc.
- Define the basic soil properties: water holding capacity, aeration, porosity, texture, bulk density.
- Describe the effect of compaction on water retention, soil aeration, porosity, bulk density and texture.
- Describe the effect of soil compaction on root growth.
- Describe the effect of construction equipment on soil compaction.
- Describe the soil location where the majority of tree roots may be found.
- Describe the effect of soil compaction on large trees.
- Explain why large scale earth moving in and around the vicinity of trees may kill them.
- List sources of information on preserving/protecting selected areas of habitat during construction.
- Explain how erecting barriers and setting strict rules with construction companies can be used as methods to protect land/habitat areas to be left undisturbed.
- List resources for obtaining information on assessing the economic value of trees and native habitat.
- Compute value of trees and habitat on site.
- Define an invasive species.
- Explain why invasive species often thrive on disturbed land.
- Assemble appropriate equipment/tools for taking site measurements, including land plat drawings, previous landscape drawings, surveying equipment, etc.
- Take appropriate physical measurements of the site to be landscaped, including, but not limited to, length/width dimensions and grade.
- Construct a preliminary drawing showing dimensions of site, location of buildings, locations of other structures such as roads, location of natural features such as ravines, streams, hills, etc.
- Take appropriate digital photographs documenting site including existing plant material, structures, natural features, roads, etc.
- List sources of information on suitability of landscape plants for a given area.
- Explain the characteristics of a plant that is well adapted to a specific area.
- Define a native plant.
- List sources of information on plants native to specific areas.
- Describe characteristics of drought tolerant plants.
- List sources of information on drought tolerant landscape plants.
- List sources of information for turf and native grass species.
- List common turf grass species that exhibit drought tolerance.
- Describe characteristics of disease and pest resistance in plants.
- List sources of information on disease and insect resistant species of landscape plants.
- Describe a common landscape plant that can be either very high or low maintenance depending on species/variety selected (example: roses).
- Describe characteristics of heat tolerance in plants.
- List sources of information on heat tolerant landscape plants.
- Describe characteristics of landscape plants that would attract/maintain wildlife (provide food or cover).

- Explain why monoculture (or culture of just a few varieties) promotes buildup of insects and disease.
- Explain how beneficial insects can be attracted by flowering plants that provide nectar and pollen.
- Describe characteristics of invasive species.
- Explain how horticultural plants have/can become invasive species.
- Integrate plant characteristics and site information and assemble a list of suitable landscape plants.
- Define basic/common landscape styles including: English garden, oriental, formal, woodland, informal.
- Explain how plant form, color, shape and texture are utilized in landscape design.
- Describe how landscaping with slow-growing, drought tolerant plants will conserve water and reduce yard trimmings.
- Explain how high maintenance/mowed areas could be reduced or replaced with shrubs, wildflowers, etc.
- Explain how use of chemicals (fertilizer and pesticides) can be minimized by an appropriate landscape design.
- Define garden types: xeriscapes, rain gardens, wildlife habitat gardens, hummingbird or butterfly gardens, wetland gardens, etc.
- Explain how any landscape design style could be implemented using “environmentally friendly” concepts.
- Define ecological concepts of habitat and habitat loss and fragmentation.
- Explain why it would be desirable to connect areas that form native/natural habitat on golf courses or large landscaped areas.
- Given a document detailing a landscape plan, identify hardscaped areas of the site.
- Identify appropriate plant materials based on site considerations, environmental friendliness and climate.
- Assemble appropriate equipment and tools for creating a landscape design including computer drawing and/or plant database software, paper, drawing or graphic forms, rulers, etc.
- Synthesize knowledge of local environmental/physical conditions, plant material and customer preferences into a design.
- Describe the irrigation regime that should be used during the establishment phase and maintenance phase of a landscape.
- Describe an irrigation schedule design to minimize water use.
- Describe the mowing schedule and reseeding schedule that should be used during the establishment and maintenance phase of wildflower areas.
- Describe a mowing regime for turfgrass to minimize mowing and reduce water use.
- Explain why use of slow release fertilizer creates less fertilizer runoff pollution than other kinds of fertilizer.
- Explain the characteristics of a fertilization and pest control plan that aims for minimal chemical use.
- Describe the purpose of wood bark or compost mulches.
- State the common/normal frequency for replacement/replenishment of mulches.
- List sources of information on pruning techniques for landscape plants.
- Describe how cultural factors (water, fertilizer) can be manipulated to minimize sources of green “waste” (clippings, pruned wood).

- Describe common plant maintenance operations such as dead heading, cutting back and seasonal planting of annuals.
- Complete a landscape maintenance plan for the proposed landscape design.
- Identify availability of plant and other landscape material.
- Evaluate the quality of vendors' products.
- Modify landscape design based on availability of selected plant or hardscape materials.
- Obtain competitive bids from plant material suppliers.
- Obtain competitive bids from suppliers of other landscape supplies, as needed.
- Synthesize price information, knowledge of suppliers and quality of material in order to create the desired landscape design at the most competitive price.
- Choose source(s) of landscape components that best meet needs of customer including, but not limited to, best price, quality and timeliness of delivery.
- Configure the cost of the landscaping project based on material costs, design costs and installation costs.
- Identify customer's wants and needs in a design and bid presentation.
- Describe professional sales presentation techniques.
- Clarify how the specified plant material will enrich the site.
- Clarify and respond to customer's feedback on design bid.
- Identify customer concerns significant enough to alter and modify the original landscape design.
- Evaluate and address any customer concerns about price, time to completion, availability of plant materials or other supplies and "environmental friendliness" of the landscape design.
- Adjust the price of landscape design based on alterations on the original design and bid.
- Invoice the customer and collect payment.
- Collect payment from customer for the landscape design within a reasonable time frame.

Competency Area 3, Plant Installation. (2.5%)

- Match a site design with a site.
- Accurately measure proper distances shown for placement (spacing) of potted plants to be installed according to the design.
- Explain how to locate utilities on a plant installation job site.
- Explain the consequences (broken utility lines plus fines) imposed on an individual that hits a utility and had chosen not to call "one call".
- Coordinate people, equipment and tools for a jobsite where plants will be installed.
- Explain how to estimate labor time according to company history on a plant installation jobsite.
- Describe the importance of proper surface drainage of a plant installation site.
- Explain the importance of modifying inadequate soil types with soil types required by a given plant.
- Evaluate soils on a plant installation jobsite.
- Summarize how to install a plant into a chosen location.
- Describe a situation in which plants are left in their containers on a plant installation jobsite.
- List concerns to be addressed when planting a plant in an installation.
- List possible effects that may be expected if plants are installed too deep.
- Dig the planting hole to the correct depth.

- Plant a plant.
- Backfill so that irrigation or precipitation water will not collect around the trunk.
- Water a newly installed plant until field capacity exists.
- List suitable additives for watering-in newly installed plants.

Competency Area 4, Invasive Plant Species. (2%)

- Restate the ideas contained in the following Presidential Executive Order: Invasive species are “alien species whose introduction does or is likely to cause economic or environmental harm or harm to human health.”
- Describe a situation in which a native plant could become an invasive species.
- Explain why knowledge of ecology and horticulture is necessary for prevention of invasive species.
- Describe common growth characteristics of invasive species.
- Explain why invasive species often thrive on disturbed soil.
- Explain the role of human activities in dispersion of plant material.
- Explain why plants can become invasive at a time and place far removed from the site of original introduction.
- List at least three types of ecological damage caused by non-native invasive species.
- Explain how horticultural plants have or can become invasive species.
- Explain how breeding plants for success in the horticulture industry may endow them with traits that make them prone to becoming invasive.
- Explain why a plant species may become invasive in some regions but not others.
- Explain how an invasive species can upset the ecological balance of an ecosystem.
- Explain why invasive species are second only to habitat loss as a threat to plant species loss and biodiversity.
- Explain why preservation of plant biodiversity is essential for the long term health of the horticulture industry.
- List sources of information on identification and detection of invasive species.
- Name five horticultural crops that are considered to be invasive species.
- Name a horticultural crop that is invasive in one region but not another.
- List sources of information on prevention of invasive species.
- List sources of information on a plant’s performance in other climatic or geographic regions.
- Describe risk assessment techniques that can be used to assess a plant’s invasive potential in a given region before it is offered for sale to the public at large.
- Assemble and summarize knowledge of local/regional conditions, including rainfall, soil type, sunlight, topography, and temperature regime, into an integrated description of environmental conditions suitable for evaluating plant materials.
- Identify plant materials which are suited for local/regional conditions.
- Select plant material alternatives to those that are known to be invasive in a given region.
- List sources of information on identification, prevention, detection and control of invasive species.
- Explain the purpose of the Federal Noxious Weed list.
- Explain why prevention and early detection are the two most important control methods against invasive species.

- Once an invasive species has become established in a certain area, discuss the likelihood of its removal.
- Describe the common methods (physical removal, herbicide application, burning) that must be used to attempt to eradicate an invasive plant species from an area.
- Describe options (such as physical or distance barriers) for minimizing aggressive potential of plants in the landscape.
- Assemble a plan for controlling or eradicating an invasive species.
- List sources of information on federal and state regulations regarding invasive species.
- Demonstrate or show horticultural business practices in compliance with state and federal regulations regarding invasive species.
- List situations in which a known invasive species may be sold.
- List sources of information or regulations regarding the permitting of sale of invasive species.
- Define a voluntary code of conduct.
- Define a best management practice.
- Explain the role of voluntary codes of conduct, best management practices and regulation in environmentally sensitive horticultural operations.
- List a federal, state and local commercial horticulture association that has adopted a code of conduct regarding invasive species.
- Write a voluntary code of conduct regarding invasive species prevention for the nursery/landscape industry.
- Write a best management practice regarding invasive species prevention for the nursery industry.
- Write a best management practice regarding invasive species prevention for a landscape.
- Assemble educational materials needed to educate customers about invasive species.
- Explain the effect of invasive species on native habitat and disturbed lands.
- Explain the monetary and social cost of eradication of an established invasive species.
- List alternative plant species that can be used in place of invasive or prone-to-invasiveness species.

Competency Area 5, Irrigation Scheduling. (4%)

- Name the principle potential evapotranspiration calculation procedures.
- State the advantages and disadvantages of the principle potential evapotranspiration procedures in different climatic and growing conditions.
- State how changes in ambient air temperatures could be expected to influence crop water use.
- State how changes in ambient air humidity could be expected to influence crop water use.
- State how changes in wind speed could be expected to influence crop water use.
- State the advantages of using crop coefficients, if known, in determining more precise crop water needs.
- State how soil texture can influence soil water holding capacity.
- State how soil water holding capacity can influence the amount of time between irrigation events.
- Describe where and how a flow accumulator should be placed to correctly measure the amount of water entering an irrigation system.
- Describe how rain gauges should be placed in the area to be irrigated in order to accurately measure the amount of water that reaches the crop's root zone.

- Given simulated data, calculate irrigation efficiency for the stated conditions.
- State common causes of low irrigation efficiency in irrigation systems.
- State the likely consequences of operating an irrigation system that has low irrigation efficiency.
- State how to convert potential evapotranspiration rates, in inches or centimeters, into equivalent volume amounts, in gallons or liters, depending upon the area to be irrigated.
- Given simulated data, calculate conversions from potential evapotranspiration rate to volume of water to be applied to a given land area.
- State how crop water budget levels can change during different weather conditions.
- State how crop water budget levels can change at different times of the year.
- State common symptoms of crops undergoing water stress.
- State how elevated crop canopy temperatures can be used to predict the possibility of water stress.

Category 2: Production of Fruits, Vegetables, Turf and Ornamental Plants

(19.5% of the Examination)

Competency Area 6, Horticultural Crop Production. (3.5%)

- Name all available cultivar choices in a given market.
- Select a plant to grow based on predicted market acceptability.
- Compare and contrast the life cycles of perennials, annuals and biennials.
- Predict production capability using an available physical plant.
- For an annual crop, given information about growing conditions and a specific crop, predict time to plant based on when the crop needs to be harvested.
- For a perennial crop or plant, describe temperature, soil and other conditions needed to optimize survival.
- Given a specific crop, define proper stage of maturity based on market demand.
- Compare the speed of production using seed versus vegetative propagules versus using alternative vegetative propagules.
- Choose the most economic source of acceptable quality germplasm.
- Describe how self-incompatibility of plant would affect the method of production.
- Define “monoecious” and “dioecious” and describe how they affect how a plant is grown.
- Define the specific container needs of a given growing plant in each stage of production.
- Construct a cohesive container system to create the best quality plant.
- Describe how the size and type of a container affects root development, drainage, aeration and moisture holding of the media.
- Describe the size of a specific pot, flat and/or plug tray according to current industry standards.
- Describe how physical characteristics of a site, such as topography and soil type, influence the type of crop that can be grown in the ground.
- Identify appropriate growing media for a specific plant to be grown in a specific location.
- Describe the appropriate use of wetting agents.
- State the origin and define the characteristics of media amendments, including peat, perlite, vermiculite, coir, composted bark and rock wool.
- Describe the importance of pasteurization and/or clean media.

- Describe how to improve the aeration, drainage and/or moisture holding of a soil or growing media.
- Describe the conditions in which soil pasteurization would be important.
- Describe how the choice of media affects watering practices.
- Describe how the choice of media affects fertilization practices or management of a plant's nutritional requirements.
- Explain the differences between hydro-phylic and hydro-phobic soils.
- Assemble all materials needed to assure smooth and timely operation by labor when planting or transplanting a plant.
- Define a schedule of irrigation needs to achieve best quality results.
- Summarize the factors influencing water needs of a plant at each stage of production as determined by weather factors including evapotranspiration.
- Practice the efficient use of an irrigation system to meet the combined needs of media, plant, container and climate.
- Explain how to visually and manually determine when a plant needs to be re-watered.
- Explain how watering practices affect disease management of plants.
- Describe how to determine how much water to apply to a plant.
- Describe the symptoms of an over watered plant.
- Explain how a plant can become over watered.
- Explain the importance of spot watering.
- Explain when leaching is appropriate and describe how to implement it.
- Describe the difference between permanent wilting and incipient wilting.
- Explain how the time of day when a plant is watered affects irrigation efficiency, plant growth and disease control.
- Select an appropriate irrigation technology for a specific growing situation.
- Explain the importance of water quality and its potential effects on irrigation efficiency.
- Describe the issues involved with using grey, effluent or recycled water for irrigation.
- Define the entire range of nutritional needs through all stages of growth of a plant.
- Select the form of fertilizer to best suit a plant and system in process.
- Solve all deficiency problems found in a plant with remedial nutrition applied in its most efficient form.
- Describe when it might be appropriate to change the rate of fertilizer.
- List the nutrients essential for plant growth.
- Describe the effects and symptoms of insufficient light on plants.
- Describe the symptoms and effects of excessive light on plants.
- Choose an artificial light source for a specific crop production situation.
- Determine the light requirements for a given plant.
- Describe the uses of different types of artificial light sources.
- Describe how to implement night interruption lighting to provide long day conditions.
- Describe methods to decrease light conditions in a production environment.
- Describe the interaction of light and temperature in a production setting.
- Describe how to provide short day conditions.
- Describe how companion planting can be used to regulate light.
- Describe the effects of light quality on plant growth.
- Describe the effects of low temperature on plants including chilling injury and freezing injury.
- Describe the temperature requirements for a specific crop.

- Describe the effects of root zone temperature on plant growth and development.
- Describe how abnormal temperatures can alter nutrient uptake by a plant's roots.
- Describe the symptoms of heat stress on plants.
- Identify methods available to mitigate inappropriate temperatures.
- Explain the interaction of temperature and water usage by plants.
- Define growing degree days.
- Predict the plant response to short term versus long term abnormal temperatures.
- Predict the injury to a plant that has not been adequately hardened-off for winter.
- Describe frost-heaving.
- Explain the possible effects of air pollution on normal plant growth.
- Predict the effect of strong winds on growing plants.
- Describe the methods used to increase or decrease humidity levels to enhance plant growth.
- Describe how humidity levels affect water usage by plants.
- Explain why the presence of high ethylene levels could be a problem in production.
- Describe when a grower would add carbon dioxide to a greenhouse production area.
- Explain the importance of providing air movement around plants (interaction with disease control).
- List sources of unwanted ethylene.
- Given a specific plant grown for a specific use, identify the appropriate time and method of pinching and pruning.
- Define deadheading and predict the plants' responses.
- Describe the importance of spacing plants.
- Given the need to keep a plant looking aesthetically pleasing, describe techniques used to groom the plant according to industry standards.
- List plant growth regulators and their potential effects on plants.
- Describe possible concerns related to using plant growth regulators.
- Identify when a media would benefit from the use of a wetting agent.
- Compare and contrast the characteristics of different types of mulches.
- Describe how organic mulches may affect short term and long term nitrogen levels in the soil.
- Describe the appropriate technique and timing for applying organic mulches.
- Describe when and how to provide a mulch for winter protection.
- List mulching materials.
- Describe the effect of mulching on soil moisture, weed control, disease management and potential temperature fluctuations.
- Install landscape fabric.
- Describe sanitation procedures used in propagating and growing greenhouse crops.
- Describe how to develop a customer base.
- Describe plant characteristics that influence perishability.
- List market forces that affect seasonality.
- Given a crop or plant with a specific end use, determine the proper stage of maturity.
- Given a crop or plant with established grade standards, describe how to use these to select individual crops or plants with the highest market value.
- Given a crop or plant with specific temperature and humidity requirements, describe proper postharvest handling techniques.
- List factors that affect seasonality of crops and plants.

- Describe how geographic and consumer characteristics influence demand for a product and where it can be sold.

Competency Area 7, Plant Scheduling. (2.5%)

- Identify market needs for finish time in terms of flowering or fruit production.
- Explain the flowering requirements for a specific crop.
- List potential methods of controlling flowering.
- Use defined requirements to classify needed structures, supplies and equipment for controlling flowering.
- List factors that might limit the use of specific chemicals in a given location.
- Assemble needed structures, supplies and equipment for controlling flowering.
- List stages of growth for a specific plant or crop.
- Given a list of growth stages, indicate the one(s) at which flowering can be induced.
- Describe how to monitor a plant or crop to determine if it is in the proper stage of growth to induce flowering.
- Describe how the growth phase of a plant or crop can affect the flowering process.
- Describe how fertilization can be altered to induce flowering.
- Describe how photoperiod can be altered to induce flowering, including qualitative and quantitative effects of short or long days.
- Describe how soil or media moisture can be altered to induce flowering.
- List types of crops or plants that have a chilling requirement for flowering.
- List crops or plants that can be induced to flower by using specific chemicals.
- List the type of plant growth regulators that can be used to induce or suppress flowering.
- Adjust factors to control flowering.
- Describe why some external factors need to be applied on a continuous basis to be successful for inducing flowering.
- Describe why some external factors need to be applied several times to be successful for inducing flowering.
- Describe why some external factors can be applied once to be successful for inducing flowering.
- Reapply external factors to meet production goals as required by the customer.
- Continuously apply external factors to meet production goals as required by the customer.
- Given a specific crop or plant, explain the proper stage, in terms of either flowering or crop maturity, needed to meet market demands.
- Perform the task of properly harvesting a plant or crop at the stage required by the customer or market.

Competency Area 8, Pruning. (3%)

- Given a plant or crop intended for a specific use and industry standards, select the appropriate plant size and shape to maximize the plant's or crop's intended use.
- Given a specific plant or crop and a specific intended use, state whether the plant or crop would benefit from pruning.
- Given a specific plant or crop and a specific intended use, state whether the plant or crop would benefit from pinching.

- Given a specific plant or crop and a specific intended use, state whether the plant or crop would benefit from disbudding.
- Given a specific plant or crop and a specific intended use, state whether the plant or crop would benefit from shearing.
- Given a specific plant or crop and a specific intended use, state whether the plant or crop would benefit from tip pruning.
- Given a specific plant or crop and a specific intended use, state whether the plant or crop would benefit from heading.
- Given a crop or plant that needs to be pruned, predict whether timing will affect the desired outcome.
- Given a crop or plant that needs to be pinched, predict whether timing will affect the desired outcome.
- Given a crop or plant that needs to be disbudded, predict whether timing will affect the desired outcome.
- Given a crop or plant that needs to be tip pruned, predict whether timing will affect the desired outcome.
- Given a crop or plant that needs to be headed, predict whether timing will affect the desired outcome.
- Assemble the people and equipment required to control plant size using physical means such as pruning, pinching, disbudding, shearing, tip pruning and/or heading.
- Choose the appropriate tools for a specific size control procedure.
- Describe how to prune a plant to achieve a desired size or shape for an intended use.
- Describe how to pinch a plant to achieve a desired size or shape for an intended use.
- Describe how to disbud a plant to achieve a desired size or shape for an intended use.
- Describe how to tip prune a plant to achieve a desired size or shape for an intended use.
- Describe how to head a plant to achieve a desired size or shape for an intended use.
- Show which cuts to make to achieve a desired plant size and shape.
- Operate tools safely and effectively according to American National Standards Institute (ANSI) approved procedures.
- Evaluate whether the long-term health and quality of the plant will improve enough to justify short-term costs when deciding how to change the size and shape of a plant.
- Using industry standards, decide if pinching, pruning, disbudding, tip pruning or heading techniques have produced a plant with the desired shape and size.
- Complete any final pruning, pinching, disbudding, tip pruning or heading that is necessary on a given plant.

Competency Area 9, Transplanting Perennial Plants. (3%)

- List possible end uses of a transplant which affect the installation process.
- Define the size or location needed for growth of a transplant.
- Measure and determine the existing pot size of a plant to be transplanted.
- Define the appropriate moisture level based on a specific plant's end use and growing medium.
- Use water to obtain the proper moisture level in transplanting media or soil.
- Describe the conditions that affect the final size of the transplant hole.

- Use a measuring instrument to determine the optimal size of a hole based on the size of a root ball and type of plant. (S-6)
- Use appropriate tools to dig/dibble a hole to a predetermined depth for transplanting.
- Describe when roots should be treated and type of treatments that have a positive and cost-effective effect on transplant survival.
- Describe the steps required to prepare a root ball for transplanting into a final site.
- Water, prune, break-up and/or treat root balls of transplants as needed.
- Describe the effect of girdling roots on transplant survival and explain how this can be corrected.
- Describe conditions under which a shoot would be pinched or pruned prior to transplanting.
- Describe the steps required to prepare a shoot for transplanting into a final site.
- Pinch, prune and/or apply anti-transpirant to shoots of transplants as needed.
- Describe the conditions when an anti-transpirant would have a positive and cost-effective effect on transplant survival.
- List plants that tolerate deeper than standard transplant depths.
- Describe the proper planting depth and location for a new transplant in its new site.
- Site a transplant according to predetermined depth and position.
- Describe soil conditions under which amendments should not be added to a planting hole for perennial plants such as trees and shrubs.
- Describe adequate root-media contact as it relates to a transplant.
- Describe the process of determining the correct depth of planting and backfilling to ensure adequate root-media contact.
- Verify that the position of a transplant is correct and backfill to begin to establish root-media contact.
- Apply water to ensure adequate root-media contact and long-term survival of a transplant.

Competency Area 10, Transplanting Annual Plants. (2.5%)

- Define the size or location for the transplant.
- Define the end use of a transplant.
- Describe the conditions under which plants should be hardened and the steps required to harden the plant.
- Define the appropriate moisture level based on a specific plant's end use and where it will be grown.
- Describe the process of determining whether the soil or media is at the correct moisture level.
- Use water to obtain the proper moisture level in transplanting media or soil.
- Describe the relationship between the type of container used to grow a transplant and the size of the root ball.
- Describe the conditions that affect the final size of the transplant hole.
- Describe conditions of transplant root balls when roots should be treated and types of treatments that have a positive and cost-effective effect on transplant survival.
- Describe the steps required to prepare a root ball for transplanting into a final site.
- Water or break-up root balls of transplants as needed.
- Describe conditions under which a shoot would be pinched or pruned prior to transplanting.
- Pinch, prune or disbud shoots as needed.

- Describe the differences between digging, dibbling and punching as ways to create a hole for a transplant and the effect on the plant.
- Use appropriate tools to dig, dibble or punch a hole to a predetermined depth for transplanting.
- List plants that tolerate deeper than standard transplant depths.
- Describe the proper planting depth and location for a new transplant in its new site.
- Site a transplant according to predetermined depth and position.
- Describe adequate root-media contact as it relates to a transplant.
- Describe the process of determining the correct depth of planting to ensure adequate root-media contact.
- Verify that the position of a transplant is correct and establish root-media contact.
- Describe weather conditions which might require the use of an at-transplant fungicide.
- Describe soil-borne or other insect pest problems that might require the use of an at-transplant insecticide.
- Compare the rate of fertilizer that might be used at transplanting as opposed to fertilizer used at other times during the plant's life.
- Mix insecticides, fungicides and/or transplant fertilizer.
- Apply water to ensure adequate root-media contact and long-term survival of a transplant.

Competency Area 11, Cold Protection of Horticultural Crops. (2.5%)

- Install an on-site monitoring system to record and forecast weather.
- List potential resources used to monitor the weather.
- Describe how specific tools can be used to make decisions about protecting a crop.
- List tools that would be useful to have to measure current conditions during a cold weather event.
- List climatic factors that would be associated with a prediction of an advective freeze event.
- List climatic factors that would be associated with a prediction of a radiational freeze event.
- Describe overhead irrigation rates appropriate for radiational freeze protection under different wind speed conditions.
- Contrast the protection procedures used for advective freezes and radiational freezes and select the correct procedure based on defined methods.
- Describe the likely consequences that could be expected if a grower mistakenly implemented freeze protection procedures for a radiational freeze event when, in fact, an advective freeze event actually occurred.
- Describe the likely consequences that could be expected if a grower mistakenly implemented freeze protection procedures for an advective freeze event, when, in fact, a radiational freeze event actually occurred.
- Describe insulating values for different thermal coverings.
- Describe the type and placement of thermal coverings for freeze protection.
- Practice periodic checks of irrigation system during winter months.
- Explain how to inspect irrigation heads for clogging.
- Install replacement irrigation heads when inspection of heads shows malfunction.
- Explain how to use meteorological data to distinguish between radiational freezes and advective freezes.
- Determine at which point one should initiate irrigation for cold protection.

- Explain why it is important to check or monitor ice clarity after irrigation.
- Explain the difference between radiational freeze conditions and advective freeze conditions.
- List equipment required to employ inversion techniques for cold protection.
- Decide when to terminate freeze protection based on available metrological data.

Competency Area 12, Plant Nutrition. (2.5%)

- List the nutrients (macro and micro-elements) essential for plant growth.
- Show how pH affects nutrient availability of plants.
- Describe typical symptoms of nutritional deficiency for a given plant in a specific location.
- Define “chlorosis” and “interveinal chlorosis”.
- Explain where to find references that can be used to identify plant nutritional deficiency and toxicity symptoms.
- Describe the plant parts that should be examined when identifying plant nutritional status.
- Explain the effect of sulfur on soil pH.
- Explain how to perform a media or soil test for a given crop.
- Choose a suitable testing facility, and take soil samples using correct techniques.
- Choose leaves in the correct stage of development for sampling.
- Illustrate how to take and process leaf samples for tissue analysis.
- Identify where to find resource information on tissue analysis and soil analysis standards in determining suboptimal, optimal and supraoptimal ranges of elemental nutritional levels for a given crop.
- Evaluate the results of a soil or media test and determine excesses and deficiencies.
- Evaluate the results of a leaf tissue nutritional analysis test and determine excesses and deficiencies.
- Use known resources for information on nutritional requirements of specific crops to evaluate media/tissue analysis and design a recommended fertilizer program to alleviate any fertility problems.
- Describe how soil and site conditions influence the selection, type and form of fertilizer.
- Solve all deficiency problems found in a plant with remedial nutrition applied in its most efficient form.
- Describe when it might be appropriate to change the rate of fertilizer.
- Select the form of fertilizer to best suit the production system of a given crop.
- Demonstrate the ability to read and interpret the label of a fertilizer container.
- Compare and contrast the rate of nutrient availability from a slow release versus quick release fertilizer.
- Choose and purchase the appropriate fertilizer based on leaf/media analysis and site requirement for the crop.
- Describe where to locate instructions on how to maintain equipment.
- Describe where to locate instructions on how to recalibrate a sprayer or applicator.
- Explain the importance of calibrating sprayers and applicators.
- Describe the importance of periodic recalibration of spray and applicator equipment.
- Describe the effects of applying excess amounts of fertilizer to a crop.
- Describe the differences between a drop fertilizer spreader versus a rotary fertilizer spreader.
- Describe alternative methods of fertilizer application.
- Given a specific crop or plant, choose a method of applying a fertilizer.

- Describe how the type of fertilizer can affect soluble salts and possible salinity.
- Describe how the quality of irrigation water affects intended fertilizer response.
- Demonstrate how to effectively leach the root zone of a given crop.
- Describe the typical symptoms of nutritional deficiency and toxicity for a given crop in question.
- Implement a system to periodically monitor plants for visual symptoms of nutritional stress and for periodic monitoring of media/soil and leaf tissue analysis as cost-effectively appropriate to assure optimum growth of the crop.

Category 3: Shipping and Handling of Final Product (8.5% of the Examination)

Competency Area 13, Selecting and Growing High Quality Plants. (3.5%)

- Identify end usage and sale requirements of plants (characteristics and time).
- Identify customer expectations for plants.
- List factors that determine whether a plant meets customer expectations.
- Define quality characteristics of plants.
- Identify both published and unpublished grades and standards for plants.
- Use identified criteria to identify plants that deviate from grades and standards.
- Identify the implications of how faults affect the long term use of a healthy plant.
- Choose plants meeting company standards based on defined implications.
- Choose plants that can receive corrective measures to bring them up to grade.
- Determine which corrective measures can be taken to bring a plant up to specific standards.
- Describe circumstances when it would be cost effective to undertake corrective measures and when it would not.
- Dispose of plants not meeting predefined company standards.
- Identify characteristics most desirable for a plant.
- Choose plants with the best quality based on defined characteristics.

Competency Area 14, Harvesting and Marketing High Quality Plants. (2.5%)

- Identify the market requirements of a crop to determine necessary postharvest handling measures.
- Summarize the best management practices (BMP) for postharvest handling of a given crop, including crop maturation date, customer locations and requests and shipping period.
- Show how factors, such as the production environment, fertility and the stages of plant growth, affect shelf life of a crop or plant.
- Choose production and postharvest preparation steps that take into account the specific postharvest handling requirements of a given crop.
- Explain how hardening-off affects the shelf life of crops.
- Describe ways that postharvest techniques and systems vary by the postharvest handling required.
- Assess how harvesting (including labor, machinery and timing of the crop or plant harvest) influences postharvest handling concerns.
- Summarize the system requirements for grading and processing a crop or plant (i.e. labor, equipment, supplies for packaging and processing).

- Grade and/or process a crop according to postharvest handling requirements for market grades and standards.
- Remove any portion of the crop or discard plants that will not be saleable.
- Place crop in storage appropriate to postharvest concerns.
- Summarize acceptable market grades and standards.
- List the systems requirements of people, machines and mechanization to achieve acceptable grading and processing of a crop or plants.
- Use the appropriate systems approach (i.e. people, machinery, mechanization) for grading and processing.
- Employ packing methods that reduce the buildup of ethylene and reduce transpiration of a crop.
- Choose appropriate shipping materials to maintain postharvest crop quality.
- Describe the effect of temperature, respiration rates and ethylene levels on crops in shipping.
- List some measures that can be taken to maintain the proper environment when shipping a given crop.
- Maintain environment during shipping.
- Summarize the financial and budgetary costs, including impacts of alternative actions for the shipping environment, for enhancing plant health and the postharvest quality of harvested plants or crops.
- Judge the success of a shipping method by evaluating plant health and quality.
- Evaluate postharvest handling techniques by inspecting plant health and quality after shipping.
- Identify the post production and postharvest needs for harvesting a crop or plants at the correct stage of development while utilizing proper handling techniques, incorporating people (and mechanization, where appropriate).
- Summarize the appropriate best management practices (BMP) to maintain company and industry standards for postharvest.
- Compile problems with postharvest, and develop solutions and systems to streamline postharvest systems for future crops and plants.
- Alter postharvest handling techniques to correct problems or improve the quality of shipped products.

Competency Area 15, Plant Loading and Shipping Procedures. (2.5%)

- Calculate the volume and weight of the items ordered to determine the size of the order to be loaded on the truck.
- Predict how long a given perishable plant can survive under various environmental transit conditions.
- Explain how moisture conditions of the product prior to and during transit can affect plant viability and health.
- Explain how different temperatures during transit can affect plant viability and health.
- Describe the situations in which ethylene could become a problem during shipping.
- List the symptoms of ethylene damage on plants.
- Describe the symptoms of cold damage and freeze damage on shipped plants.
- Describe the conditions that promote diseases during transit.

- Describe the consequences of different lengths of darkness during shipping on plant health and viability.
- Contract truck based on defined volume, weight and perishability of the order and length of transit time.
- Allocate staff required to pull, park and load delivery based on size of order.
- Describe how and when to properly water a plant prior to shipping.
- Describe what legally needs to be on a label of a plant that is being shipped to a retail location (requirements of national labeling standards including what, who and size).
- Accurately identify a specific plant of a specific size (of pot, root ball, stem diameter, stage of plant development, stage of flower opening, etc.) and quality characteristics to fill a given order.
- Identify industry and company quality standards for plants to be pulled for order.
- Perform the task of pulling an accurate order based on company standards and order specifications.
- Given a specific plant, describe the appropriate stage of plant development, including root development, for a given shipping order.
- Check to determine if company quality standards are met throughout the shipping process.
- Count plants pulled in an order to determine if the customer's requests are met.
- Complete appropriate inventory and order processing paperwork.
- Identify processes required to correctly package a customer order as defined by industry and company standards to ensure continued product quality during shipping.
- Assemble product and package, using identified procedures.
- Explain how the difference in plant temperature at the time of shipping can affect plant health and viability.
- Compare and contrast the advantages and disadvantages of different types of packaging for a specific plant product.
- Explain the correct procedures needed to correctly load customer orders on trucks based on delivery destinations and company standards.
- Explain the correct procedures needed to secure product into truck or transportation method, based on company standards.

Category 4: Propagation (9% of the Examination)

Competency Area 16, Propagating Plants by Seed. (2.5%)

- Given a plant species, determine the variety or cultivar that is best adapted to market requirements and growing conditions.
- Given the percent germination and cost of seed for different varieties, state whether percent germination is a critical factor in the choice of which variety to plant.
- Describe the procedures used to calculate the correct amount of seed to order.
- List the steps involved in filling a pot with a planting medium for a direct seeded crop.
- List the steps involved in preparing soil for planting a direct seeded crop.
- Describe the effect of depth of planting on seed germination.
- Describe how to calculate the number of seed to plant based on a given germination rate and sowing density.

- Determine if top-dressing is required after sowing seed, and if so, select the appropriate material for covering seed.
- Describe how top-dressing may benefit some crops and be detrimental to others.
- Describe how to plant seeds to achieve maximum germination rates.
- Explain the best method for planting a specific crop or plant.
- Describe common ways to mechanize the process of planting seed.
- Operate planting equipment.
- Given specific environmental conditions, predict pest predation of young sprouts in soil.
- Describe the symptoms of damping-off.
- Given a specific crop and likely soil-borne problems, compare timing and application methods for fungicidal or insecticidal drenches versus granular applications, and state which is more likely to be successful.
- Describe weather and other conditions that encourage disease problems during germination.
- Describe how much and how often water should be applied to maximize germination.
- Based on the number of seeds that were planted per unit area, use the number of seeds that have germinated in a given area in a field to calculate the percent germination.
- Based on the average number of seeds planted per pot, use the number of seeds that have germinated in a given number of pots to calculate the percent germination.

Competency Area 17, Media Issues in Seedling Management. (2.5%)

- Given a plant species, identify the appropriate container size to accommodate the seedlings.
- Compare various sources of appropriate containers.
- Choose the best aggregate mix for a given plant type.
- Describe desired media attributes of a germination media.
- Compare the costs of different media and select the one to use given the need to also satisfy specific cultural requirements.
- Determine media properties to be considered based on target seedling crop cultural requirements.
- Describe the processes used to determine the number of pots or trays to order.
- Describe the processes used to determine the amount of seed to order.
- Given a specific container size and quantity to be used for seed germination, determine the amount of media or media components to order.
- Describe the process of filling a pot or flat, including when to water the media.
- Demonstrate proper filling technique for pots or flats.
- List reasons for scarifying or stratifying seed.
- Describe how to scarify a seed.
- Describe how to stratify a seed.
- Demonstrate how to properly scarify seeds.
- Determine the appropriate seed scarification method for a given crop.
- Create a list of the most common methods of seed scarification.
- Determine the appropriate seed stratification method for a given crop.
- Define the types of seed dormancy overcome by the different types of seed stratification.
- Demonstrate how to stratify seeds.
- Describe the effect of depth of planting on seed germination rate.
- Describe how to calculate the number of seed to plant based on a given germination rate.

- Determine if top-dressing is required after sowing seed, and if so, select the appropriate material for covering seed.
- Describe how top-dressing may benefit some crops and be detrimental to others.
- Describe how to sow seeds to achieve maximum germination rates.
- Determine the best method for sowing a specific seed crop.
- Describe common automation or mechanization utilized when sowing seed.
- Describe how to properly label a plant to meet current standards.
- List the items that must appear on a plant label.
- Compare seed sources and select the source which provides seed with the greatest viability.
- Describe how seed viability can affect growing space requirements, sowing rates and profitability.
- Explain how past germination records can be used to improve future crops.
- Identify light, temperature and moisture requirements for best rate of germination.
- Describe how to treat seeds to overcome various types of seed dormancy.
- Describe an appropriate environment for germinating a specific species.
- Operate seeding equipment.
- Describe the different types of seeding equipment used within the green industry.
- Given specific environmental conditions, predict pest predation of young sprouts in soil.
- Describe the symptoms of damping-off.
- Describe how to apply a fungicide or insecticidal drench to a seed flat.
- Explain how to alter the growing environment to reduce the risk of disease problems.
- Describe the conditions that encourage disease problems during germination.
- Monitor and adjust temperature, light and humidity for best germination.
- Define the growth stage when a plant needs an altered environment.
- Describe common environmental conditions that should be adjusted after germination.

Competency Area 18, Propagation by Division. (2%)

- Select plants to be divided based on criteria for particular genus.
- List a crop in which division is the primary means of propagation.
- Describe the benefits of propagation by division.
- Choose stock plants to be dug for division.
- Remove stock plants from the plant bed for division.
- Given a specific plant that needs to be divided, describe characteristics that can be used to distinguish the crop from weeds.
- Describe how to track weeds that might be present in the plant bed prior to digging.
- Separate target plant from non-desired plants and other foreign material in the planting bed.
- List common tools and supplies for dividing perennials.
- List the steps required for preparing a new bed before planting new stock plants.
- Assemble equipment and labor to till planting bed.
- Till planting bed.
- Describe the process of testing soil.
- Describe information that might be included in a soil test and explain how the information can be used to amend soil for a planting bed.
- Select appropriate soil amendments for perennial beds based on the results of a soil test.

- Given a specific plant or crop, describe the proper spacing and depth that should be used when planting divided perennial sections.
- Install divided perennials into a prepared seed bed.
- Explain why watering-in new divisions is crucial to success.
- Describe the process of watering-in new divisions.
- Water in new divisions.

Competency Area 19, Propagation by Cuttings. (2%)

- Determine the types of cuttings and the quantities needed to fill an order based on type of plant and customer specifications.
- Construct a production schedule based on customer needs and cropping system needs.
- Calculate the number of cuttings that can be harvested from a given stock plant.
- Predict how long it will take to develop roots on a specified plant species.
- Identify the sanitation protocol and crop specifications of a company.
- List sanitation supplies needed to have clean, pathogen and pest-free cuttings.
- Configure people, equipment and materials needed to obtain proper sanitation.
- Describe how temperature of the air and media influence disease development during propagation.
- Describe how air movement and humidity influence disease development during propagation.
- Describe how water and oxygen in the root zone affect disease development during propagation.
- List cultural practices that would prevent diseases during propagation.
- Describe how diseases spread in a propagation area.
- Describe the temperature and timing requirements for steam pasteurization of a sand propagation bed.
- Explain why it is important to sanitize a propagation area between crops.
- Explain how to take (harvest) cuttings from stock plants according to standards outlined by a company.
- Identify the appropriate size and quality of stock plants and the appropriate plant pieces on a stock plant to use for harvesting cuttings for a specific species.
- Identify the appropriate type of cutting to take for a species and intended purpose.
- Maintain sanitation practices while taking the cuttings to prevent diseases.
- List the sanitation practices that must be performed when taking cuttings to prevent diseases.
- Describe the physical characteristics of a quality cutting for a given plant species to be rooted for a specific market.
- List the equipment or supplies needed to take a quality cutting.
- Identify the node and internode of a cutting.
- Describe proper handling procedures that should be used with a cutting to ensure its viability and health.
- Calculate the bench space requirement for a given number of cuttings to be propagated in a given container.
- Describe how root zone temperature, water and oxygen availability influence the callus formation and rooting response in cuttings for a given plant species.
- Describe how air temperature, humidity, day length and light intensity influence the successful rooting of cuttings from a given plant species.

- Judge harvested cuttings to ensure that all critical specifications (quantity, sanitation, quality, size, etc.) have been met.
- Describe how the size of a cutting can influence its ability to withstand environmental stress.
- Describe how the air temperature and humidity between the time the cutting is taken and when it is stuck can influence the viability of the cutting.
- Explain what handling procedures would decrease the viability of a cutting between harvest and sticking.
- Identify the most efficient transportation method to move cuttings from the propagation area to the packing shed.
- Explain how the moisture level and temperature of a cutting just before shipping can affect its survival during shipping.
- Coordinate the most efficient movement of harvested cutting material.
- Define critical environmental requirements during processing, holding and shipping of cuttings.
- Describe the environmental and sanitation handling procedures required to prevent diseases and ensure cutting health during handling.
- Predict what will happen to a cutting during shipping if the cutting is too wet when shipped.
- Predict what will happen to a cutting during shipping if the cutting is too warm when packed into the shipping box.
- Describe how to cool (remove field heat) cuttings prior to shipping.
- Explain the function of holes in the sides of shipping boxes.
- Identify a shipping container that will ensure the maintenance of plant quality during shipping, including accommodations for physical and environmental conditions.
- Describe a common method to keep cuttings cool during shipping in the heat of summer.
- List needed supplies, equipment and labor for shipping and handling of cuttings, including environmental controls.
- Identify the correct media to be used for a given propagation system.
- Identify optimal propagation flats or liner containers based on crop and production needs.
- Fill flats or liner containers with cutting media.
- Apply rooting hormone to cuttings.
- Select the appropriate rooting hormone concentration and application method for a specific crop.
- Utilize personal protection equipment (PPE) using best management practices to ensure applicator and environmental safety.
- Identify depth and spacing of cuttings.
- Stick cuttings into flats at the proper depth and spacing.
- Program a misting system appropriately for selected cuttings based on the crop and cutting type requirement.
- Monitor a mist system for accurate operation.

Category 5: Monitoring and Testing (10% of the Examination)

Competency Area 20, Irrigation Water Quality Testing. (2.5%)

- Select an appropriate test kit for a specific set of requirements.
- Given a set of requirements, list the appropriate pH ranges for water.
- Describe conditions of when a total coliform test would be appropriate.

- List the variety of water tests that may be commonly performed on water in horticultural settings.
- State the impact of testing water pH when mixing and applying sprays and liquid fertilizer.
- Explain why it is important to know the alkalinity level of a given water source.
- Describe conditions under which a soluble salt test on water would be appropriate.
- Choose the appropriate testing equipment for desired water tests.
- Explain the correct techniques for collecting a water sample from specific sources.
- Given a water test device, conduct a water test.
- Determine the significance of water test results.
- Given readings from a test device, explain what the readings mean.

Competency Area 21, Irrigation of Horticultural Crops. (3%)

- Describe how to correctly install and use a tensiometer to monitor soil water status.
- Describe how to correctly install and use an infrared thermometer to monitor leaf canopy temperatures.
- Operate irrigation system when soil water status is drier than a predetermined critical threshold level.
- Describe how to read a tensiometer at different soil water status levels.
- Complete irrigation of plants when tensiometer reading indicates a predetermined critical threshold level.

Competency Area 22, Measuring pH and Soluble Salts. (2.5%)

- Explain how to collect a representative soil sample.
- List materials (tools) required to collect a soil sample for a pH or soluble soil test.
- Perform the procedure of collecting a soil sample for a pH or soluble salts test.
- Demonstrate how to prepare a soil slurry with the proper ratio of water to soil used when testing the pH or soluble salts content of the soil sample.
- Explain why a slurry must be prepared in order to measure pH or soluble salts.
- Demonstrate a two-point pH meter calibration.
- Demonstrate the correct calibration procedure for a soluble salts meter.
- List the materials needed to properly calibrate a pH and/or soluble salts probe.
- Demonstrate the correct procedure for immersing a pH meter and a soluble salts meter.
- Define acceptable pH and EC/SS levels in soil-less media mixtures.
- Decide the optimal time period for the pH and soluble salts values to stabilize.
- Practice professional lab techniques when using, cleaning and maintaining fragile and expensive equipment.

Competency Area 23, Using Electronic Monitoring Devices. (2%)

- Describe the removal of an electronic monitoring device from a testing site to prepare for downloading data onto a computer.
- List the types of environmental data that can be collected on an electronic monitoring device.
- Explain the steps used to download data from a logger or monitor.
- Describe the process of downloading data from an electronic monitoring device.

- Explain how data collected by an electronic monitoring device can be used to compute degree days.
- Explain how data collected by an electronic monitoring device can be used to predict the likelihood of scab infestation.
- Diagram a chart of typical or simulated data from an electronic monitoring device to assist in production decision making.
- Explain how degree day data can be used to support insect-control decisions made in plant cultivation.
- Decide to make cultural changes in production based on watchdog monitor data.
- Record and maintain historical data for long-term or future decision in production practices.
- Explain how the relationship between leaf wetness and temperature can be used to support decisions about an apple scab infection so that appropriate integrated pest management recommendations can be developed.
- Explain the steps used to reboot electronic monitoring devices.
- Describe redeployment of an electronic monitoring device to a plant production area.

Category 6: Diagnosing and Managing Plant Problems (25% of the Examination)

Competency Area 24, Prevention of Plant Disorders. (3.5%)

- Explain the stages of plant growth and development.
- Describe some tools that are used to monitor plant growth.
- Monitor the environmental conditions within a growing area so that the crop is ready on time.
- Describe why soil and water tests are important for an effective plant health monitoring system.
- Explain the role of yellow and/or blue sticky cards in a plant health monitoring program.
- Predict the effect given environmental and/or cultural conditions will have on continued plant growth and development.
- Describe the differences in physical appearance between a healthy and an unhealthy root system.
- Explain the importance of early detection of plant disorders.
- List environmental and/or cultural conditions that favor fungal infestations.
- Categorize problems that affect plants.
- Explain how fungal diseases are spread.
- Explain how virus diseases are spread.
- Explain how bacterial diseases are spread.
- List potential preventative strategies to protect plants from disorders.
- Describe why screening incoming plant material is important in protecting plants from disorders.
- Choose a preventative strategy that supports or complies with best management practices.
- Describe how proper sanitation can prevent or reduce disease and insect infestations of plants.
- State the components of an appropriate sanitation program when growing plants.
- Given a specific set of cultural conditions for a plant or crop, select preventative strategies to protect plants from disorders.
- Implement preventative strategies for a given plant disorder.
- Contrast plant growth and development after the implementation of preventative strategies with plant growth and development prior to the implementation of preventative strategies.

- Given the development of a specific plant problem, evaluate if previously implemented preventative strategies were adequate.
- Explain the compatibility of a chosen preventative strategy with the overall production system.

Competency Area 25, Diagnosing Plant Disorders. (4%)

- Name resources that could be used to assist with the identification of plant abnormalities.
- List typical signs and symptoms of plant abnormalities.
- Describe how frequently a crop or plant should be checked for signs and symptoms of abnormalities.
- List the plant parts that should be examined when monitoring a plant for condition of health.
- Describe the normal growth of a crop or plant.
- Compare a problem's extent and significance to defined normal growth characteristics of a crop.
- Describe the types of information found in crop production records.
- Assemble crop and plant records from internal and external sources.
- List the five environmental factors that affect the growth of plants.
- List factors that contribute to leaf health of a plant.
- Describe how a leaf changes its physical outward appearance as it matures.
- Explain how to examine leaves for abnormalities.
- Examine leaves for defined health and list any discrepancies.
- Explain why the lower leaves on a plant might look different than the upper leaves.
- List factors that contribute to the stem health of a plant.
- List symptoms of graft incompatibilities.
- Examine stems for defined health and list any discrepancies.
- Describe what a graft incompatibility would look like.
- List factors that contribute to the root health of a plant.
- Describe the physical appearance of a healthy root system.
- Examine roots for defined health and list any discrepancies.
- Define root-bound condition and explain its impact on plant health.
- Compare and contrast the physical appearance of healthy and unhealthy roots and root hairs.
- Describe the physical appearance of stem girdling roots.
- Explain how stem girdling roots affect plant health.
- List factors that contribute to flower health of a plant.
- Examine flowers for defined health and list any discrepancies.
- List possible causes of malformed flowers.
- Compare and contrast the physical appearance of healthy and abnormal flowers and fruits.
- List factors that contribute to the plant vigor of a plant.
- Examine plant vigor for defined health and list any discrepancies.
- Describe common symptoms and signs of a decline in plant vigor.
- List common symptoms of virus diseases.
- List common symptoms of bacterial diseases.
- List the common symptoms caused by fungal plant diseases.

- Describe the physical appearance of common, typical plant disease symptoms, including leaf spots, wilts, root rots, stem rot, crown rot, leaf blight, mottling, fruit rot, stunting, malformed growth, leaf abscission and leaf discoloration.
- Compare and contrast the physical appearance of wilt from lack of adequate water to wilt from diseases.
- List common signs and symptoms of insect damage.
- Given a specific set of symptoms, identify the problem as a disease, insect or abiotic problem.
- Commit to regular scouting.
- Use a local Extension Office to obtain a list possible testing labs.
- Describe how to take a soil test of a plant or crop.
- Describe how to take, prepare and send in a tissue sample from a plant or crop to a lab for testing.
- Describe how to take, prepare and send in a specified plant part for further professional diagnosis.
- Identify test results that are different from the norm.
- Choose among causes based on health test results.
- List possible causes of health discrepancies.
- Read a lab test report and summarize the findings and recommendations for control.

Competency Area 26, Weed Control. (3%)

- List the supplies needed to scout a production area.
- Identify and rate the level of weed infestation.
- Describe the proper procedure of scouting a field or seed bed for rating weed populations.
- List the supplies needed to collect samples during weed scouting.
- Describe the proper procedure of collecting weed samples, including what parts of the plant would be needed to help with plant identification.
- Demonstrate the use of a weed identification manual to accurately identify a given weed.
- Explain the criteria needed to determine action thresholds for weed infestations.
- Given weed scouting data and information resources indicating action threshold levels, calculate if the existing weed density exceeds the action threshold.
- Describe where to look to find information to match an herbicide for a specific crop to a specific weed.
- Explain why certain herbicides are not appropriate for use on certain crop species.
- Given a specific weed to control, read an herbicide label and describe an appropriate control procedure.
- Explain how to tell the difference between a monocot and a dicot plant.
- Compare and contrast the ease of controlling annual versus perennial weeds.
- State the type of license needed in order to apply herbicides.
- Explain how different types of weeds can spread.
- Explain why some weeds may reoccur after control procedures have been implemented.
- Predict the environmental impact of using different weed control methods.
- Explain how soil and/or air temperature can affect the efficacy of an herbicide or other weed control procedure.
- Explain how wind conditions can affect the efficacy and environmental impact of an herbicide application.

- Explain how soil moisture and timing of water applications to the soil can affect the efficacy of an herbicide.
- Support best environmental practices to result in minimal environmental impact when selecting an herbicide for weed control.
- Describe the differences between pre-emergent and post-emergent herbicides.
- List three methods of mechanical weed control for a given production system.
- Explain the benefits of a weed-free growing area on the over-all plant's or crop's growth and development.
- Explain the benefits of a weed-free growing area as it relates to the disease and insect control program.
- Practice good sanitation methods to reduce weed populations in a growing area.
- Apply herbicide to a desired area according to product label directions.
- Given an herbicide label, describe the optimum environmental and climatological application conditions for that herbicide.
- Always first implement the method with the least environmental impact and then use other methods of control if problems persist.
- List the required information that must be recorded following an herbicide application.
- Complete a chemical record log for an herbicide application.
- Describe the signage that must be posted after an herbicide application in order to be in compliance with national worker protection standards.
- Describe the steps one would take to determine if a weed control method was effective.
- Demonstrate a commitment to continual pest scouting.

Competency Area 27, Insect Pests. (3.5%)

- Describe how to examine a plant or crop for signs, symptoms or the presence of an insect or insect-like pest.
- Describe how to sweep a field with an insect net to collect pest population data.
- Explain how yellow and/or blue sticky cards are used in insect monitoring and scouting.
- Describe how pheromone traps are used in a scouting program.
- Describe how mechanical traps are used in a scouting program.
- Locate the position of insect damage on a plant.
- Describe signs and symptoms of damage on plants or crops and identify the plant part(s) on which they are located.
- Define the terms mottling, stippling and chlorosis as they relate to insect damage on plants.
- Given a damaged plant, determine if the damage is consistent with the damage caused by an insect and/or an insect-like pest.
- Choose an appropriate subject matter expert or laboratory to identify an insect or insect-like pest.
- Describe the physical appearance and typical injury symptoms caused by thrips.
- Describe the physical appearance and typical injury symptoms caused by whitefly.
- Describe the physical appearance and typical injury symptoms caused by scale.
- Describe the physical appearance and typical injury symptoms caused by mealybugs.
- Describe the physical appearance and typical injury symptoms caused by spider mites.
- Describe the physical appearance and typical injury symptoms caused by aphids.

- Describe the factors that should be considered when determining an action or economic threshold for an insect or insect-like pest problem.
- Use information from valid research to determine the action threshold for a specific insect or insect-like pest.
- Use scouting information, market acceptability information and/or reference resources to identify if the current pest conditions exceed the action and economic thresholds.
- Define “action threshold” and “economic threshold.”
- Describe the interrelationship between thrips and virus diseases.
- Describe the life cycle of thrips, whitefly, scale, mealybugs, spider mites and aphids.
- Explain how temperature can alter the rate of insect reproduction.
- Describe the advantages and challenges of using biological control methods for insect or insect-like pest problems.
- Compare and contrast the difference between a systemic and contact insecticide.
- Compare and contrast the use of general broad-spectrum vs. specific target pesticides in an insect control program.
- Explain how the different chemical formulations of pesticides – emulsified concentrates, wettable powder, soluble liquid, microencapsulated aerosols and fumigants – affect how the chemical would be used.
- List sources of where to locate additional information on disease treatment options.
- Describe how predatory insects are used for biological control of insects or insect-like pests and the advantages and challenges of their use.
- Describe how parasitic insects are used for biological control of insects or insect-like pests and the advantages and challenges of their use.
- Describe how bacteria and/or fungi are used for biological control of insects or insect-like pests and the advantages and challenges of their use.
- Explain how *Bacillus thuringiensis* is used in insect control.
- List options for biological insect control (predators, parasites, pheromones, insect growth regulators, plant extracts).
- Explain how temperature in general affects the rate of insect reproduction.
- Explain how moisture can affect the incidence of spider mites.
- Explain how horticultural oils are used in insect control.
- Describe the plant health conditions that promote insect infestations.
- Compare insect and insect-like pest control options for efficacy and cost.
- Explain how to design a spray program to avoid the development of insect resistance to a pesticide.
- Explain how wind can affect the efficacy of an insect treatment application.
- Explain how temperature can affect the efficacy of an insect treatment application.
- Explain how the stage of plant development could affect the choice of an appropriate insect control procedure.
- Explain how the health of a plant could affect the choice of an appropriate insect control procedure.
- Choose the best option for control of insects or insect-like pests based on a predetermined action threshold.
- Support the use of sanitation in preventing plant insect problems.
- Support the use of biological treatments for insect control.
- Commit to best management practices to reduce potential insect problems.

- Predict how a specific insect-control method would impact the environment.
- Compare and contrast the potential environmental impact of two different insect control treatments.
- Explain how the method of irrigation and time of irrigation can affect the efficacy of an insect control treatment.
- Perform the steps necessary to reduce an insect or insect-like pest level below a defined population threshold or action threshold using a selected treatment method.
- Compare and contrast a plant or crop before and after treatment for insects to identify if the insect or insect-like pest population has been reduced below the population threshold or action threshold level.
- Given a specific crop or plant that has had insect or insect-like problems, predict if it is marketable.

Competency Area 28, Plant Diseases. (4%)

- Describe the steps that should be taken to adequately scout a crop or plant for diseases.
- Describe the environmental conditions in which diseases are likely to be present.
- List typical symptoms of a fungal disease.
- List the typical symptoms of a viral disease.
- List the typical symptoms of a bacterial disease.
- Explain the difference between a symptom and a sign of a disease.
- Explain the difference between an active and a latent plant disease.
- Explain the differences between symptoms and signs.
- Contrast the symptoms of bacterial and fungal leaf diseases.
- Assemble the tools and resources needed to properly identify a disease.
- Describe the general symptoms of *Phytophthora* and the conditions which promote its development.
- Describe the general symptoms of *Botrytis* and the conditions which promote its development.
- Describe the general symptoms of *Rhizoctonia* and the conditions which promote its development.
- Describe the general symptoms of *Pythium* and the conditions which promote its development.
- Describe the general symptoms of powdery mildew and the conditions which promote its development.
- Describe the general symptoms of downy mildew and the conditions which promote its development.
- Describe the general symptoms of root rot and the conditions which promote its development.
- Describe the general symptoms of viral diseases.
- Describe the general symptoms of bacterial diseases.
- Describe the general symptoms of fungal diseases.
- Explain how diseases cause wilt in plants.
- Describe the physical appearance of a gall.
- Recognize the typical symptoms of plant diseases (blight, leaf spots, leaf abscission, distorted growth, wilt, lesions, mottling, galls, discoloration, soft rot, dry rot, malformed plant parts).
- Define chlorosis.

- Use scouting information, market acceptability and/or reference resources to determine if the current disease conditions exceed the action and economic thresholds.
- Describe the factors that should be considered when determining an action threshold.
- Define “action threshold” and “economic threshold”.
- List general treatment options for bacterial, fungal and viral diseases.
- Describe the advantages and challenges of using biological disease control.
- Describe the process of drenching.
- List sources of where to locate additional information on disease treatment options.
- Judge the effectiveness of biological disease control.
- Judge the effectiveness of host plant resistance in plant disease control.
- Explain how viral, bacterial and fungal diseases are generally spread.
- Define “rouging” of plants.
- Explain when it might be appropriate to eliminate a plant.
- Support the use of sanitation in preventing plant diseases.
- Support the use of biological controls for diseases.
- Commit to best management practices to reduce plant disease.
- Choose a treatment to control a disease problem based on best management practices.
- Describe the type of equipment needed for fungicide application.
- Describe the type of equipment needed to apply bacteria or phytoplasma control materials.
- Perform a selected treatment for disease control.
- Explain how humidity conditions can affect the efficacy of a disease treatment.
- Explain how temperature can affect the efficacy of a disease treatment.
- Explain the interaction between insect control and disease control.
- Explain how air circulation can affect the efficacy of a disease treatment.
- Explain how the method of irrigation and time of irrigation can affect the efficacy of a disease treatment.
- Compare and contrast the potential environmental impact of two different disease treatments.
- Contrast plant health before treatment with after treatment.
- Given a specific crop or plant with a disease, predict if it is marketable.

Competency Area 29, Abiotic Plant Disorders. (3.5%)

- Describe how to physically examine a plant or crop to take an inventory of abnormal plant growth symptoms.
- List the parts of a plant that should be examined when diagnosing an abiotic problem.
- Accurately identify the pattern of abnormality in a plant or crop.
- Assemble tentative causes of observed symptoms of a plant disorder.
- Select appropriate laboratory tests needed to confirm or deny tentative causes of observed symptoms of a plant disorder.
- Describe typical symptoms of air pollution injury.
- Describe typical symptoms of ethylene damage.
- Describe the typical symptoms of the deficiencies and toxicities of the 13 essential mineral elements.
- Describe the effects and symptoms of excessive wind on a plant or crop.
- Explain the cause of leaf scorch.
- Describe the symptoms and causes of sunscald winter injury on trees.

- Describe the symptoms and causes of frost heaving on an herbaceous perennial plant species.
- Describe the symptoms and causes of winter burn on evergreens.
- Describe the symptoms and causes of winter die back of the outer branches of a deciduous shrub.
- Describe the effect of light interruptions occurring during the dark period on a short day plant which is being held in a short day photoperiod to initiate flowers.
- Predict the symptoms of an undesirable pH on a plant.
- Predict the plant injury caused by hail.
- Predict how cultivating too close to the root zone will impact subsequent plant growth.
- Predict how planting a plant or crop too deep will impact subsequent plant growth.
- List the potential causes of high soluble salts in the growing media.
- Explain how to correct high soluble salt levels in growing media.
- Describe the symptoms, causes and corrective measures for edema.
- Describe the causes and symptoms of transplant shock.
- Describe the effects of compacted soil or growing media on plant growth.
- Explain why compacted soils have a negative affect on plant growth and describe the appropriate corrective measures.
- Explain how over-watering causes plant injury.
- Describe the injury symptoms resulting from over-watering a plant.
- Describe the symptoms of plant water stress over time due to insufficient watering.
- Define incipient and permanent wilt.
- Describe the symptoms of incipient and permanent wilt.
- Explain how excessive concentration or improper timing of a pesticide or PGR (plant growth regulator) application can cause injury.
- Describe the symptoms of high temperature stress or injury on a crop or plant.
- Describe the symptoms of low temperature stress or injury on a crop or plant.
- Describe frost and freeze damage on a crop.
- Describe the symptoms of excessive light exposure on a crop or plant.
- Describe the symptoms of low light exposure on a crop or plant.
- Explain how flooding can injure a plant or crop.
- Describe the visual appearance and causes of “witch’s broom”.
- Explain how improper chilling during vernalization can affect subsequent plant growth and development.
- Explain alternate bearing on a fruit tree.
- Explain how a late frost might affect potential crop yield.
- Explain the causes of a lack of flowering or abnormal flowering for a plant or crop.
- Assemble a list of possible management options that are available to reduce the incidence of previous observed symptoms of plants.
- Predict the effect of pH adjustment in growing media on the reduction of previously observed plant disorder symptoms.
- Predict the effect of fertilizer adjustment on the reduction of previously observed plant disorder symptoms.
- Predict the effect of leaching of growing media on the reduction of previously observed plant disorder symptoms.
- Predict the effect of pruning on the reduction of previously observed plant disorder symptoms.

- Predict the effect of humidity alterations on the reduction of previously observed plant disorder symptoms.
- Predict the effect of changes in watering practices on the reduction of previously observed plant disorder symptoms.
- Predict the effect of changes in temperature conditions on the reduction of previously observed plant disorder symptoms.
- Predict the effect of altering light intensity and/or photoperiod on the reduction of previously observed plant disorder symptoms.
- Predict the effect of altering air movement patterns on the reduction of previously observed plant disorder symptoms.
- Predict the environmental impact resulting from the implementation of specific cultural practices to correct an abiotic plant condition.
- Commit to using low impact or eco-friendly management options to manage cultural or physiological plant disorders.
- Utilize laboratory results to determine best management strategy to reduce cultural or physiological disorders.
- Perform a selected cultural adjustment option to reduce previously observed plant disorder symptoms.
- Collect and maintain accurate records to help reduce the occurrence of future plant disorders.
- Evaluate current cultural conditions and plant health to determine when to make cultural adjustments to overcome plant abiotic disorders.

Competency Area 30, Mixing Agricultural Chemicals. (3.5%)

- Describe where to find information to determine the appropriate active ingredient needed to achieve a desired outcome.
- List information that can be found on a published label of a pesticide, fertilizer and/or plant growth regulator (PGR).
- Define “MSDS”.
- List the information that is found on a MSDS sheet.
- List the required certifications one must have, if any, to mix fertilizer, pesticides and/or plant growth regulators (PGR).
- Describe the difference between different chemical formulations, including wettable powder, emulsified concrete, soluble powder, micro-encapsulated timed release, granular, liquid water soluble and dry water soluble.
- Define LD-50 of a chemical.
- Describe the relationship between the LD-50 and toxicity of a chemical.
- Compute total amount of mix based on area to be covered, application method and recommended label rate of product to be used.
- Describe when parts per million would be used as an application rate instead of pounds per unit area of land.
- Define spreader-sticker and wetting agent.
- Explain the benefits of using a spreader-sticker or a wetting agent with certain plants and chemicals.
- Describe how to accurately measure a chemical.
- Describe how to add an active ingredient to a spray tank safely and efficiently.

- Describe how to contain a chemical spill to minimize negative environmental impact.
- Describe how to clean-up a chemical spill to minimize negative environmental impact.
- Name the pesticide formulations that require agitation during application.
- Explain the benefits of spray tank agitation.
- Describe how to add diluents to a tank mix safely and efficiently without spillage.
- Explain how to dispose of empty chemical containers in an environmentally safe manner.

Category 7: Business Practices (13.5% of the Examination)

Competency Area 31, Horticultural Record Keeping. (3.5%)

- Describe methods for keeping records.
- Identify potential regulatory agencies for different businesses.
- Assemble a logical record keeping system for specific types of records.
- Choose a record-keeping system so that different records can be logically filed and readily accessed.
- Identify and contrast OSHA required records and describe which businesses are affected.
- Select reliable sources for obtaining OSHA regulations.
- Identify and contrast EPA related required records and describe which businesses are affected.
- Name reliable sources for obtaining EPA records.
- Identify pertinent business inventory records and documentation needed for tracking and control of inventory.
- Select which company-specific business records are going to be maintained for monitoring inventory control.
- Identify USDA related required and recommended records and describe which businesses are affected.
- Select reliable sources for obtaining USDA regulations.
- Identify company and regulatory agencies' training requirements and needs.
- Assemble and construct training records and evaluate based on standard operating procedures (SOP) of industry and/or agency requirements.
- Identify company standards and goals for successful performance.
- Assemble records and pertinent data, and evaluate based on standard operating procedures (SOP) of company's requirements and annual goals.
- Identify company SOP and regulatory agencies' requirements and needs for successful waste disposal.
- Assemble and construct records and evaluate based on standard operating procedures (SOP) of company and agencies' requirements.
- Identify company SOP and regulatory agencies' requirements and needs for compliance with pesticide usage following the worker protection standards (WPS).
- Assemble and construct records and evaluate based on standard operating procedures (SOP) of company and agencies' requirements for compliance with pesticide usage following the worker protection standards (WPS).
- Identify company SOP and regulatory agencies' requirements and needs for compliance with RUP pesticide usage following the worker protection standards (WPS).
- Assemble and construct records and evaluate based on standard operating procedures (SOP) of company and agencies' requirements for compliance with RUP pesticide usage following the worker protection standards. (WPS).

- Identify U.S. Department of Labor and state required records and describe which businesses are affected.
- Describe reliable sources for obtaining U.S. Department of Labor and state regulations.
- Identify U.S. Immigration and Customs Enforcement required records, and describe which businesses are affected.
- Select reliable sources for obtaining U.S. Immigration and Customs Enforcement regulations.
- Identify U.S. Internal Revenue Service related required records and describe which affect specific businesses.
- Select reliable sources for obtaining U.S. Internal Revenue Service regulations.
- Identify company, state and U.S. Internal Revenue Service related required records needed for determining fringe benefits.
- Summarize and process pertinent data for fringe benefits to comply with company SOP and state and U.S. IRS requirements.
- Identify and use company SOP, industry, state and federal regulatory agencies' requirements and need for compliance with best management practices (BMO).
- Assemble and construct records and evaluate based on company standard operating procedures (SOP), state and federal regulatory agencies requirements and needs for compliance with best management practices.
- Identify and use company SOP, U.S. Food and Drug Administration requirements and needs for compliance with good agricultural practices (GAP) and food safety.
- Identify and use reliable sources for obtaining U.S. Food and Drug Administration regulations.
- Summarize company sales and bookings data.
- Assemble and construct company sales and bookings data and evaluate based on standard operating procedures (SOP) of annual company goals and projections.

Competency Area 32, Marketing Horticultural Products. (2%)

- List existing successes in a given business.
- For a business with specific characteristics, name available plant or seed products to market.
- Identify existing niche markets.
- Identify products available in a specific target area.
- Assess the value of plants or seeds to be marketed to end-users.
- Given a product to sell, identify the characteristics of the target audience.
- Given a product to sell, identify optimal marketing strategies.
- Identify the defensible comparative advantage of a given product for sale.
- Describe the comparative advantage of the business structure to compete, utilizing the proposed marketing plan.
- List available media opportunities and describe their cost effectiveness to achieve desired marketing results.
- Develop a budget to market a plant.
- Configure a defined marketing message and format to create a marketing piece.
- Choose available vehicles and items to deliver a marketing message.
- Describe how to create an effective product display.
- Influence customers' tastes and preferences to buy now.
- Support marketing message repeatedly through the media and other vehicles.

- Construct a process to ensure attractive, effective product displays.
- Summarize relevant industry standards and criteria for interpreting sales data to determine the success or failure of a marketing campaign.
- Collect and use sales data to show success or failure of a marketing campaign, based on company and industry standards.
- Summarize the most important criteria in using displays for marketing products and services.
- Predict active interest of potential buyers by monitoring sales and turn-over of product.

Competency Area 33, Horticultural Worker Training. (3%)

- Classify employee knowledge and skill requirements.
- Determine government required training for employees.
- Assemble the training needs for a specific task.
- List specific skills a given set of employees need to have.
- List and configure the requirements to serve as a trainer to train workers and handlers under the Worker Protection Standard (WPS).
- Describe product and service specifications based upon company and industry requirements so that workers can be trained to meet expected standards.
- Predict the relative priority of specific training skill requirements.
- Decide to focus on safety when developing and performing training.
- Identify available training methods.
- Choose and assemble the most innovative and appropriate training methods.
- Identify appropriate training materials.
- Choose and assemble training materials to be used.
- Identify the criteria for a successful training location.
- Choose the appropriate training time period.
- Identify skills needed by workers in training sessions.
- Demonstrate skills needed by workers in training sessions.
- Identify knowledge needed by workers in training sessions.
- Explain knowledge needed by workers in training sessions.
- Determine when retraining is needed or required.
- Summarize newly-acquired knowledge and skills achieved by trainees.

Competency Area 34, Complaints from Customers and Clients. (3%)

- Practice and commit to patience in complaint resolution, including identifying good listening techniques, body language, etc., where appropriate.
- Given a complaint from a customer, identify all pertinent information from the customer, including the resolution of the complaint sought by the customer.
- Given a complaint from a customer, identify the type of a complaint (objective, subjective, ease of resolution with or without further company procedural input, etc.).
- Describe to the customer the quick resolution of the problem your company seeks and the how, where, what and when the problem will be resolved.
- Assemble data on background causes of claim.
- Given a customer complaint, identify whether a similar complaint occurred in the past.
- If previous complaints occurred in the past, describe how they were resolved in the past.

- Develop procedures to anticipate, identify and avoid potential problems before they occur.
- List potential resolutions to a given problem.
- Predict the economic impact of a potential resolution.
- Describe successful communication skills needed in the workplace.
- Support the development of successful communication skills at the workplace.
- Diagram procedures for handling complaints so that designated employees have a thorough understanding of company policy.
- Present the customer with the resolution of the complaint, based on the nature of the claim, specific conditions of the job/contract and company policies.
- Summarize immediate feedback from customer as to whether your company's resolution is acceptable.
- Identify customer's input on what constitutes an equitable solution if the initial resolution was not acceptable to the customer.
- Describe a situation in which giving credit for plants and/or services rendered would be acceptable.
- Determine the economic impact of crediting an order to the bottom line.
- Determine the economic and political impact of refusing to credit a given order.
- Describe and identify appropriate plant handling techniques to maintain high quality plant products and customer service.
- Perform periodic evaluations of plant handling techniques.
- Describe and identify appropriate business communication practices.
- Practice periodic evaluations of business communication practices.
- Perform periodic evaluations of how to enhance customer relations.

Competency Area 35, Environmental Impact of Horticultural Practices. (2%)

- Define environmental sustainability.
- Explain how environmental quality and sustainability can have economic value even though they are not owned by someone.
- Explain who pays for soil erosion, water pollution, loss of biodiversity, removal of invasive species and other negative environmental impacts.
- Explain how environmentally sustainable horticultural operations can also be cost effective.
- List the three components of an environmental impact assessment.
- Explain who should conduct an environmental impact assessment.
- Explain why an environmental impact assessment may not provide sufficient information for design standards or regulatory purposes.
- Explain why an environmental impact assessment should be conducted.
- Explain how the degree of environmental impact may be related to the size of the horticultural operation.
- Explain how the location of the horticultural business could affect its environmental impact.
- Explain how the ability of a horticultural site to support certain uses varies with its geophysical features (soil type, vegetation, drainage, physical geography etc.).
- Describe how environmental impacts can have far reaching effects that extend beyond the immediate vicinity of the business site.
- Explain why environmental impacts that extend beyond the immediate business site may involve persons other than business employees in the environmental impact assessment.

- List factors that can be used to measure water quality, including turbidity, temperature, oxygen concentration, nutrient levels, salinization, changes in flow rate, etc.
- Explain how water quality factors may be impacted by soil erosion.
- Explain how water quality factors may be impacted by fertilizer runoff.
- Explain how water quality may be impacted by pesticide/herbicide runoff.
- Define non-point source water pollution.
- Describe how water resources for horticulture are/will be impacted by urban development and other demands for water in the future.
- Explain how horticultural runoff may negatively affect riparian zones and water flora and fauna.
- Explain how horticultural use of groundwater may affect flow rate and recharge.
- Describe methods of containing runoff water for recycling in a horticultural process, operation or landscape.
- Explain how energy is used directly (e.g., power mechanized equipment) and indirectly (e.g., energy used to make fertilizer) in a horticultural process, operation or landscape.
- Explain how energy usage impacts greenhouse gas emissions.
- List horticultural operations that have a negative impact on air quality including, but not limited to, pesticide/herbicide spray drift, tillage dust, nitrous oxide emissions from nitrogen fertilizer and noise.
- List horticultural operations that contribute to soil erosion.
- List horticultural operations that contribute to loss of soil fertility.
- List horticultural operations which could become a noise hazard.
- Describe characteristics of invasive species.
- Explain how horticultural plants have, or can, become invasive species.
- Explain how wildlife habitat and/or wetlands can be altered or destroyed by a horticultural operation.
- Explain major plant features used to identify the plant (leaves, flowers).
- Describe characteristics of an endangered plant species.
- Describe how parts of an endangered plant may be physically altered to avoid detection during illegal trafficking.
- Define DNA and germplasm.
- Describe why an organism can be identified by its DNA.
- Describe how germplasm of a native plant species can be altered, changed or polluted by a non-native plant of the same species located nearby for horticultural purposes.
- Explain how wildlife species can be affected by a horticultural operation.
- Describe characteristics of a genetically engineered plant.
- Describe how a genetically engineered plant reduces use of herbicides or pesticides.
- Describe how planting a genetically engineered plant may contribute to increased pesticide or herbicide resistance in insect or plant pests, respectively.
- Describe the likelihood that pollen from a transgenic crop will spread beyond the field where it is being grown.
- Describe situations where residue from genetically engineered crops may be an environmental hazard.
- List environmental factors that may be impacted by the basic horticultural operations – field crop, nursery, greenhouse, landscape and golf course.
- List possible local sources of information for conducting an environmental assessment.

- Explain why utilizing local sources of information would benefit an environmental impact assessment.
- Define a geographic information system (GIS).
- Explain how a geographic information system can be used in an environmental impact assessment.
- Explain how a geographic information system can be utilized in what-if scenarios.
- Explain how aerial photographs can be utilized in environmental impact assessment.
- Explain how spreadsheets or worksheets can be used in environmental assessment.
- Explain how network diagrams, matrices or models could be used in environmental assessment.
- Explain why geophysical conditions, cultural/social/aesthetic factors, human and environmental hazards, waste reduction, surface and ground water resources, plant and wildlife communities and wildlife habitat should be included in an environmental assessment checklist or spreadsheet.
- Create of spreadsheet checklist of factors that should be evaluated in environmental assessment of a horticultural process, operation or landscape.
- List sources of information on invasive species.
- List sources of information on transgenic crops.
- List sources of information on biodiversity and native habitat preservation.
- List local, state and federal agencies that are sources of information on environmental regulations and guidelines.
- Assemble a list of local, state and federal environmental regulations that the horticultural process, operation or landscape must comply with.
- Assemble a list of geophysical data that should be considered in an environmental assessment, including soil type, surface waters, ground water, environmentally sensitive areas, pipelines, fences, ditches or other infrastructure.
- Create or obtain a site map, including boundaries, drainage patterns, water bodies and buffers.
- For each factor listed on a spreadsheet checklist, determine the duration of the environmental impact.
- For each factor listed on a spreadsheet checklist, determine if the environmental impact is none, beneficial, moderate or severe.
- Synthesize relevant environmental regulations and geophysical data with the duration and degree of environmental impact to identify impacts that are not in compliance with existing regulations or commonly accepted guidelines.
- Identify cumulative positive or negative impact of individual environmental impacts on the broad categories of subsurface conditions, hydrology, landforms, wildlife and vegetation, air, and noise.
- Identify any processes, operations or landscapes that are not in compliance with existing regulations or zoning.
- Construct rankings of the environmental impacts in terms of relevance, significance or hazard to the environment and to the profitability of the horticultural process, operation or landscape.
- Define Best Management Practice (BPM).
- Explain why the effectiveness of a Best Management Practice may be effective in one location but not another.
- List the 3-R's of pollution prevention – reduce, reuse and recycle.

- List sources of information on Best Management Practices for a given geographic area and horticultural task.
- Explain how the water management practices of irrigation system selection and optimization of watering schedule to deliver water to crop only when needed can reduce runoff or percolation to ground water.
- Explain the positive and negative environmental impact(s) from using plastic mulch.
- List the interrelationships between the four goals of Integrated Pest Management (IPM) practices – prevention, avoidance, monitoring and suppression.
- Assemble a list of plant physiological characteristics that would be appropriate for sustainable horticulture.
- Construct a plan for reducing, reusing or recycling chemicals in a horticultural process, landscape or operation.
- Explain how contour farming, deep tillage, inter-row or winter cover crops, inter-row mulching and row direction will minimize soil erosion and runoff.
- Describe how constructed wetlands, vegetated buffer strips or riparian zones can be used to treat runoff.
- List environmental factors that should be considered when using genetically engineered crops.
- Identify methods of containing, treating and recycling waste water from a horticultural process, operation or landscape.
- Construct a list of options for reducing air pollution resulting from horticultural operation.
- Explain why conservation of native habitat areas along edges of fields or landscaped areas may be important for conserving wildlife.
- Describe ways of reducing and conserving water use in a horticultural process, operation or landscape.
- Describe how and why “DNA blueprinting” could be used in the future to minimize trafficking of endangered plant species.
- Show ways of reducing greenhouse gas emissions in a horticultural process, operation or landscape.
- Describe how the use of carbon trading and caps on greenhouse gas emissions could impact horticultural business operations.
- Show a cost effective alternative that mitigates a negative environmental impact from a horticultural process, operation or landscape.
- Describe the role of record keeping and audits in environmental compliance and marketing of crops.
- Assemble a plan for reducing, reusing and recycling pollutants and conserving scarce resources and natural habitat for a field crop.
- Assemble a plan for reducing, reusing and recycling pollutants and conserving scarce resources and natural habitat for a nursery and/or greenhouse.
- Assemble a plan for reducing, reusing and recycling pollutants and conserving scarce resources and natural habitat for a landscape or golf course.
- Assemble supplies and equipment for implementing alternative operations to mitigate identified environmental impacts.
- Predict changes in current job descriptions or new job descriptions aimed at implementing alternative operations to mitigate identified environmental impacts.
- Predict any changes in production or marketability of crops or usage of landscapes or golf courses resulting from alternative operations to mitigate identified environmental impacts.

- Predict short and long-term cost or profit resulting from implementation of alternative operations to mitigate identified environmental impacts.
- Implement alternative operations that mitigate identified negative environmental impacts.

Sample Test Items

The following sample test items provide examples of the types and formats of questions that will be on the ASHS Certified Horticulturist examination. The correct responses are listed immediately after Question 35.

1. Which group of terms describes the shape of leaves?
 - A. serrate, entire, lobed
 - B. parallel, pinnate, palmate
 - C. alternate, opposite, whorled
 - D. simple, pinnately compound, palmate

2. What is a reason to apply mulch around trees and plants?
 - A. to absorb solar radiation
 - B. to kill plant pests that inhabit the soil
 - C. to provide stabilization to the root ball
 - D. to protect the tree or plant from mechanical damage

3. Your landscape company has an accepted bid on a jobsite. Besides organic matter testing, what soil tests would you routinely order from a certified soil testing laboratory?
 - A. pH, soil-water ratio, sodium level
 - B. pH, nitrate-nitrogen levels, salt levels
 - C. presence of mold, soil-water ratio, pH
 - D. lead levels, presence of residual herbicides, argon levels

4. You are considering whether to ship plants to a state your company has never dealt with. Which of the following groups of horticultural crops are commonly considered invasive species in more than one region of the United States of America?
 - A. dandelions, tamarisk, Russian olive, Gayfeather, tree-of-heaven
 - B. purple loosestrife, tree-of-heaven, Russian olive, poison ivy, Gayfeather
 - C. purple loosestrife, tree-of-heaven, leafy spurge, kudzu, Japanese honeysuckle
 - D. dandelions, Japanese honeysuckle, Miscanthus grass, purple loosestrife, tree-of-heaven

5. Which of the following affects the application efficiency of irrigation systems?
- A. head spacing
 - B. water source location
 - C. class or schedule of pipe
 - D. increased lateral pipe size
6. You have 3 ft³ of media that contains predominantly peat. You add 1 ft³ of coarse perlite to it. Which of the properties below will increase in the new peat – perlite mixture?
- A. porosity
 - B. bulk density
 - C. organic content
 - D. water-holding ability
7. A flowering potted plant crop currently in the greenhouse has a production schedule with a target market date of November 1. If the current production conditions are continued, the crop will not be ready for the retail market until November 7. Assuming light intensity is not limiting, what changes could be implemented to help ensure quality plant are ready for the November 1 market date?
- A. Increase the pH and raise the night temperatures.
 - B. Increase the nitrogen and potassium fertility levels.
 - C. Increase the humidity and start night interruption lighting.
 - D. Increase the daytime temperature and inject carbon dioxide into the growing area.
8. Which is the appropriate pruning tool if a limb to be pruned is less than 0.5 inches in diameter?
- A. lopper
 - B. chain saw
 - C. hand pruning saw
 - D. bypass hand pruner
9. What determines the size of the transplant hole for a balled and burlapped tree?
- A. size of the root ball
 - B. proximity to a building
 - C. caliper of the tree trunk
 - D. radius of the tree canopy

10. Which weather conditions might require the use of an at-transplant fungicide?

- A. low humidity
- B. high humidity
- C. low barometric pressure
- D. high barometric pressure

11. After a long period of consistently warm weather, a cold front causes high winds, sub-freezing temperatures and low humidity at a plant nursery. The nursery manager turns on the overhead irrigation system and runs it continuously during the period of sub-freezing temperatures, low humidity and high wind. What is likely to happen to the cold-sensitive, tropical plant species grown in the nursery as a result of these action?

- A. A coating of ice will form on the plants, protecting them from cold damage.
- B. Evaporative cooling will occur and the low temperatures will damage or destroy the crop.
- C. The high level of irrigation will promote fungal disease, which will damage or destroy the crop.
- D. As ice forms on the plant leaf surfaces, heat energy released by the water molecules will warm the plants.

12. A landscaper needs a fertilizer high in nitrogen. What product should be selected?

- A. 4 – 4 – 4
- B. 4 – 4 – 12
- C. 4 – 12 – 4
- D. 12 – 4 – 4

13. You are a wholesale buyer of plants and are evaluating the quality of 5-inch flowering, potted herbaceous plants for sale in the retail market. The market demands well-rooted, appropriately proportioned, healthy flowering potted plants that will have a long postharvest life. Which set of descriptions identifies the quality characteristics you would look for in your selection of plants?

- A. The plant has lateral shoots of variable lengths, the roots are dark brown, 30% of the flowers are showing pollen and the flowers are all equal in size.
- B. The branching roots are visible on the outer root ball, lateral shoots are of equal length, compact internodes and 30% of the flowers are still in bud stage.
- C. The area of leaves equals the area of flowers, roots are encircling the root ball, the internodes at the top of the plant are longer than the internodes at the base and the plant shape is round.

- D. The flowers are distributed uniformly above and below the foliage, the volume of roots equals the volume of shoots, the plant is taller than it is wide and the lower leaves are larger than the upper leaves.

14. How would a hibiscus grower prevent leaf drop during shipping?

- A. cool temperature in truck
- B. light the inside of the truck
- C. water plants before loading truck
- D. apply a quick release fertilizer before shipping

15. Which of the following should be included on a consumer's invoice that will accompany a delivery?

- A. your company's unit cost and the species ordered
- B. the consumer's quantity ordered and species ordered
- C. your company's unit cost and your company's profit margin
- D. the consumer's quantity ordered and your company's profit margin

16. Which of the following encourages disease during germination?

- A. aerobic soil and cool conditions
- B. anaerobic soil and dry conditions
- C. unpasteurized soil and warm conditions
- D. pasteurization of media and moist conditions

17. Why would you use scarification or stratification for seeds?

- A. to break dormancy
- B. to assure a clone of the parent plant
- C. to release the carbohydrate reserves in the seed
- D. to allow greater uptake of rooting hormones by the seed

18. An extension agent has recommended raising the pH of your planting beds after reviewing your most recent soil test. Which amendment will help increase the pH of your soil?

- A. lime
- B. sulfur
- C. copper
- D. iron sulfate

19. How should you first try propagating a new plant species by taking cuttings?
- A. apply warm, humid conditions for the cuttings and a 24-hour day length under low light intensity
 - B. apply cool, damp conditions for the cuttings and experiment with differing levels of day length and light intensity
 - C. apply similar environmental conditions (temperature and humidity) as the plant's native range and a 24-hour day length under low light intensity
 - D. apply similar environmental conditions (temperature and humidity) as the plant's native range, then experiment with different levels of day length and light intensity
20. What decision should be influenced by the results of an alkalinity test of a given water source?
- A. whether or not a wetting agent is necessary in your media
 - B. which chemicals may or may not be compatible with your water
 - C. choosing which form of nitrogen to select in your fertilization program
 - D. determining if you should grow varieties of plants that are sensitive to heavy metals
21. You have a tensiometer with a reading of - 3 centibars. What should you do next?
- A. stop all planting
 - B. stop all irrigation
 - C. begin an irrigation cycle
 - D. begin a fertilization cycle
22. You are using a soilless media mixture to transplant seedlings that require a neutral pH. Which of the following would be an acceptable pH range?
- A. 4.8 – 5.2
 - B. 5.8 – 6.2
 - C. 6.8 – 7.2
 - D. 7.8 – 8.2
23. An electronic weather station has recorded temperature and calculated degree-days. Why are degree-days frequently more useful than just specific temperature readings?
- A. Degree-days will provide the data to determine whether pesticide control is warranted.
 - B. Degree-day calculations include the accumulated response of light intensity and temperature.
 - C. Degree-day calculations also account for the fluctuating humidity levels to predict irrigation needs.

- D. Degree-days measure accumulated heat over time which more accurately predicts plant and insect growth.
24. Cool season turfgrasses are susceptible to many leaf blade, crown and root diseases. What cultural conditions encourage fungal infestations?
- A. excess K fertilizer and dull mower blades
 - B. excess N fertilizer and over-irrigated sites
 - C. excess thatch accumulation and under-irrigated sites
 - D. excess thatch accumulation and higher than desired height of cut
25. How should you examine a leaf for abnormalities?
- A. Inspect both tops and undersides of leaves for pubescence.
 - B. Inspect the adaxial surface for damping-off using a hand lens.
 - C. Smell the leaf for odor and use a hand lens to view dead or irregular flecks.
 - D. Check the upper and lower sides of leaf for signs and symptoms using a hand lens.
26. The herbicide, Millennium Ultra 2, is labeled “for selective broadleaf control.” Which of the following would be an effective application for this product?
- A. crabgrass in lawn and turf
 - B. dandelion and clover in lawn and turf
 - C. crabgrass in an ornamental plant bed
 - D. dandelion and clover in an ornamental plant bed
27. Where on a plant should you look for fungus gnat larvae?
- A. stem
 - B. roots
 - C. foliage
 - D. flowers
28. A client of yours is describing several different types of plants in his landscape, all exhibiting leaf yellowing, leaf distortion and a white covering on leaf surfaces. What is the likely diagnosis?
- A. botrytis
 - B. fire blight
 - C. powdery mildew
 - D. Dutch elm disease

29. Which of the following is a symptom of over-watering a plant?

- A. wilting
- B. etiolation
- C. blanching
- D. stratification

30. What can be expected as the LD₅₀ of a chemical increases?

- A. the toxicity of the chemical increases
- B. the toxicity of the chemical decreases
- C. the water solubility of the chemical increases
- D. the solubility of the chemical in organic solvents decreases

31. Who needs to keep records required by the Environmental Protection Agency (EPA)?

- A. OSHA
- B. produce retailers
- C. turf pesticide applicators
- D. growers' rights advocate

32.

Plant	Number of Plants Sold	Production Cost per Plant (\$)	Total Money Spent on Advertising (\$)	Plants Sold per Customer	Sales Income (\$)
A	1,550	.05	4,000	2	4,650
B	7,462	.09	1,200	4	22,386
C	380	1.12	9,500	1	14,820
D	4,500	.72	60,000	6	63,000

Table 1

Based on the marketing data in Table 1, which plant was most successful based on advertising dollars spent per customer?

- A. Plant A
- B. Plant B
- C. Plant C
- D. Plant D

33. How should you resolve a situation in which an employee is not operating a piece of equipment correctly or safely?

- A. show the employee the correct operating procedure
- B. dock the employee's pay until performance improves
- C. tell the employee to operate a different piece of equipment
- D. ask the employee to perform the task more slowly until it is done correctly

34. You run a retail garden center. A customer returns a potted lily, complaining the plant won't rebloom. You tell him that lilies bloom only once a year. The customer still is not satisfied. What is your next step to ensure the customer is satisfied?

- A. give him a bloom-inducing fertilizer
- B. exchange the lily for a plant that reblooms
- C. exchange the lily for one currently in bloom
- D. ask how he would like you to handle the situation

35. Which characteristic is associated with invasive plant species?

- A. whorled leaf arrangement
- B. production of high amounts of wind-dispersed seed
- C. extensive lateral root system that extends beyond the drip line
- D. flowers that must be insect pollinated rather than wind pollinated

Sample Test Item Answers

1. D	13. B	25. D
2. D	14. A	26. B
3. B	15. B	27. B
4. C	16. C	28. C
5. A	17. A	29. A
6. A	18. A	30. B
7. D	19. D	31. C
8. D	20. C	32. B
9. A	21. B	33. A
10. B	22. C	34. D
11. B	23. D	35. B
12. D	24. B	

Recommended References

The following is a short list of references that cover the subjects described in the Study Outline. No reference should be considered as a substitute for practical experience and knowledge in the field. Also, the following references should not be considered to be either superior or inferior to other references that, for reasons of space, are not listed here.

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