RHS LEVEL 3 ADVANCED CERTIFICATE IN HORTICULTURE
WRITTEN EXAMINATION

Tuesday 7 February 2012

10:00am – 12:00noon

MODULE A

Understanding of Plant Propagation Processes and Application of Soils, Growing Media and Plant Nutrition

Section A – Short Answer Questions

Candidate Number:……

Candidate Name:……..

Centre Number/Name:……

IMPORTANT – Please read carefully before commencing.

i) The duration of the papers in Module **A** is **2 hours**.
ii) Answer **ALL** questions in Section **A**.
iii) **ALL** questions in Section **A** carry equal marks.
iv) Write your answers legibly in the spaces provided.
v) Use **METRIC** measurements **ONLY**.
vi) Where plant names are required, they should include genus, species and where appropriate cultivar.
vii) Please note, sufficient lined space is provided. It is not necessary that all lined space is used in answering the questions.

Please turn over/…..

ANSWER ALL QUESTIONS

MARKS

Q1 State **THREE** storage requirements for **ONE NAMED** recalcitrant seed. **2**

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Q2 Explain, with reference to **ONE NAMED** example, why plants need light to germinate. **2**

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Q3 Explain **TWO** requirements of the aftercare of newly germinated seedlings grown in the open ground. **2**

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Q4 Describe, with reference to **ONE NAMED** plant, the division of an herbaceous perennial with a fleshy root system. **2**

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Please see over/.....

MARKS

Q5 State **TWO** characteristics of **EACH** of the following materials as a basis for alternative growing media:

i) expanded clay (LECA);
ii) perlite. **2**

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Q6 State **FOUR** indicators of soil compaction. **2**

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Q7 State **TWO** advantages and **TWO** limitations of the use of controlled release fertilizers for the delivery of nutrients in containers. **2**

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Q8 State **FOUR** management techniques for maintaining soil moisture at optimum levels for open ground plants. **2**

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MARKS

Q9 Describe the toxicity symptoms of **ONE NAMED** nutrient in **ONE NAMED** plant. **2**

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Q10 Evaluate the use of leaf and tissue analysis in the management of plant nutrition. **2**

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Royal Horticultural Society

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MODULE A

Understanding of Plant Propagation Processes and Application of Soils Growing Media and Plant Nutrition

Sections B and C - Structured Questions

IMPORTANT – Please read carefully before commencing.

i) The duration of the papers in Module **A** is **2 hours**.
ii) Answer **ONE** question from Section **B** and **TWO** questions from Section **C**.
iii) **ALL** questions carry equal marks.
iv) Write your answers legibly in the answer booklets provided.
v) Use **METRIC** measurements **ONLY**.
vi) Where plant names are required, they should include genus, species and where appropriate cultivar.
vii) Please note, sufficient lined space is provided in the answer booklets. It is not necessary that all lined space is used in answering the questions.

Please turn over/…..

Section B – Understanding of Plant Propagation

Answer ONE question only from this section

MARKS

Q11 a) Identify **FIVE** hazards associated with a mist unit propagation facility. **5**

b) Complete a risk assessment for the mist unit propagation facility using **EACH** of the following headings:

i) severity of risk;
ii) likelihood;
iii) measures taken to reduce risk. **15**

Q12 a) Explain why **EACH** of the following facilities is most suitable for the given type of cutting below:

i) fog unit for a grey foliage shrub; **2**
ii) mist unit for a deciduous shrub; **2**
iii) cold frame for an evergreen shrub. **2**

b) Describe the propagation of a **NAMED** plant in a fogging unit from cutting selection to weaning. **14**

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Please see over/.....

Section C – Processes and Application of Soils, Growing Media and Plant Nutrition

Answer TWO questions only from this section

MARKS

Q13 a) Describe the natural processes that result in soil formation and development in the UK. **15**

b) Explain how horticultural practices may change the natural development of soil. **5**

Q14 a) Draw a fully labelled diagram of the nitrogen cycle to show the main stages and processes from leaf protein to nitrate taken up by roots, under aerobic neutral conditions. **10**

b) Summarise the ways in which nitrogen is:

i) lost;
ii) gained;
iii) by the soil.

10

Q15 a) Identify **SIX** factors that can cause environmental pollution for nutrients in horticultural soils and composts. **6**

b) State **FOUR** causes of soil erosion. **4**

c) Describe how a soil can be managed to reduce the adverse effects on the environment of horticultural practices. **10**

Q16 a) Describe the role of soil organic matter in plant nutrition. **10**

b) Describe the role of organic matter in growing media. **10**

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**The Royal Horticultural Society, Wisley, Woking, Surrey. GU23 6QB
Charity Registration Number: 222879/SC038262**

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10:00am Tuesday 7 February 2012

MODULE A

Understanding of Plant Propagation Processes & Application of Soils, Growing Media & Plant Nutrition

Candidates Registered	**20**		**Total Candidates Passed**	**6**	**37.5%**
Candidates Entered	16	80.0%	Passed with Commendation	1	6.25%
Candidates Absent	3	15.0%	Passed	5	31.25%
Candidates Deferred	-	-	Failed	10	62.5%
Candidates Withdrawn	1	5.0%			

Section A – Short Answer Questions

Q1 State **THREE** storage requirements for **ONE NAMED** recalcitrant seed.

The botanical name of any suitable example, e.g. *Quercus robur*, was sometimes missing and three clear suitable storage requirements, e.g. suitable temperature: (4°C); suitable moisture level (above 40% RH) and rodent free area were required to obtain the full marks.

Q2 Explain, with reference to **ONE NAMED** example, why plants need light to germinate.

Again the botanical name of any suitable plant example, e.g. *Lactuca sativa* and three clear reasons, e.g. survival characteristic (after ripening); suitable germination conditions and correct season of the year (time measurement), were expected. However, references to photosynthesis and tropic movements were also included, which relate to the seedling development **after** germination has occurred.

Q3 Explain **TWO** requirements of the aftercare of newly germinated seedlings grown in the open ground.

Any two clear explanations were required, e.g. provide irrigation, as required, to maintain the speed of initial growth, keeping the growing media at field capacity, resulting in quick establishment and ground coverage, or provide rodent protection to prevent loss of photosynthetic material and / or uprooting of the whole seedling. For methods stated without the reasons included half marks were awarded.

Q4 Describe, with reference to **ONE NAMED** plant, the division of an herbaceous perennial with a fleshy root system.

Once more the botanical name of any suitable example, e.g. *Kniphofia rooperi,* was sometimes overlooked and a clear description was given in an abbreviated form. The latter should have included time of year (spring); tools required, (e.g. fork and old knife), and method used (crown cut back, if required, dug up and knife used to cut the fleshy stock, old central section discarded and the outer ring divided into sections with three buds, which are then reused).

Q5 State **TWO** characteristics of **EACH** of the following materials as a basis for alternative growing media:

i) expanded clay (LECA);
ii) perlite.

Clear characteristics were needed, such as:

LECA is sterile, contains trace elements, available in different grades and has a long lasting structure; white perlite is sterile, expanded volcanic rock, high carbon footprint, inert and dusty when dry.

Q6 State **FOUR** indicators of soil compaction.

Marks were awarded for any clear four indicators, e.g. lack of cracks; lack of earthworms; presence of pans; surface capping and presence of a perched water table.

Q7 State **TWO** advantages and **TWO** limitations of the use of controlled release fertilizers for the delivery of nutrients in containers.

A good range of two clear advantages, e.g. gradual availability of nutrients, over a set time period, when the plant is actively growing and a suitable moisture level is achieved, was needed.
Also two clear limitations were expected, e.g. a higher financial cost compared to standard fertilisers and unsuitable quick release with increased temperatures resulting in rapid use of the available nutrients resulting in the need for another nutrient supply.

Q8 State **FOUR** management techniques for maintaining soil moisture at optimum levels for open ground plants.

An excellent selection was given by some candidates, e.g. surface mulching with a 10cm layer of organic matter, maintaining total crop cover, ground level irrigation methods, e.g. leaky pipe, rolling of the soil after drilling, fleece or polythene film coverage. However, sometimes a range of different irrigation types were given rather than techniques, these were taken as one technique.

Q9 Describe the toxicity symptoms of **ONE NAMED** nutrient in **ONE NAMED** plant.

Marks were awarded for any suitable nutrient, e.g. potassium and for any suitable botanical name of plant e.g. *lycopersicon esculentum*, and also for a suitable description, e.g. increased incidence of magnesium deficiency, shown as inter-venial chlorosis on the older leaves of the plant.

Q10 Evaluate the use of leaf and tissue analysis in the management of plant nutrition.

Any clear suitable responses were accepted e.g. detailed results provided for the amount of each nutrient taken up by each part of the plant, used for conformation of the nutrient supply, speed of uptake and sites of deposit, noting any imbalances or antagonistic levels found, together with use as a programming tool to confirm the correct nutrient supply and uptake for the current stage of crop development. However, sometimes the term “leaf and tissue analysis” was not fully understood; confusion was shown with DNA testing for plant identification or pest & disease conformation.

Understanding of Plant Propagation, Processes & Application of Soils, Growing Media & Plant Nutrition.

Sections B & C – Structured Questions

Section B – Understanding of Plant Propagation

Q11 a) Identify **FIVE** hazards associated with a mist unit propagation facility.

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b) Complete a risk assessment for the mist unit propagation facility using **EACH** of the following headings:

i) severity of risk;
ii) likelihood;
iii) measures taken to reduce risk.

This question is designed to test the candidate's understanding of the significance of health and safety within a propagation environment and their knowledge of how to undertake an appropriate risk assessment.
Candidates who shaped their answers around this understanding scored well, and while not wrong, those candidates who identified hazards to mean the risk for example of scorching to soft foliage or water logging within the propagation media were less able to demonstrate an understanding of health and safety in the context imagined by the examiner.
Good answers included five distinct hazards and a sensible and logical hierarchy of risk identified based on likelihood of outcome, complete with practical solutions to minimize the risk.

Q12 a) Explain why **EACH** of the following facilities is most suitable for the given type of cutting below:

i) fog unit for a grey foliage shrub;
ii) mist unit for a deciduous shrub;
iii) cold frame for an evergreen shrub.

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b) Describe the propagation of a **NAMED** plant in a fogging unit from cutting selection to weaning.

This question is designed to test the candidate's understanding of vegetative propagation within a number of propagation facilities and to describe in detail the successful propagation of an appropriate plant example within a fogging unit.
In the first part of the question marks were awarded to the candidate who could identify the different types of environments created by each facility and explain why they may require the various different shrub types to be propagated.
In the second part of the question full marks can be gained only if the plant example selected is correctly named, using full botanical latin.

It is important to stick within the parameters of the question and those candidates who did just that were more likely to score well. Information relating beyond the weaning stage did not receive any marks. Those candidates who were able to accurately describe the size and shape of the cutting, the rooting media, propagation environment including temperature at the rooting zone, length of time taken to root and how best to wean a rooted cutting all scored well.

Section C – Processes & Application of Soils, Growing Media & Plant Nutrition

Q13 a) Describe the natural processes that result in soil formation and development in the UK.

b) Explain how horticultural practices may change the natural development of soil.

The aim of the first part of the question was to test the candidates' knowledge of soil weathering processes: mechanical (physical), chemical and biological as they contribute to soil formation. Highest marks were gained where descriptions were detailed and covered:

- freezing and thawing,
- heating and cooling,
- the action of wind, water and ice,
- wetting and drying,
- the formation and action of carbonic acid,
- soil water and dissolved compounds,
- the contribution of plants to soil formation.

Some candidates concentrated mainly on biological weathering, giving a very detailed description of how the action of plants and weathering processes eventually form identifiable soil types and profiles. These answers were valid with the best also mentioning the importance of environmental factors, e.g. temperature and humidity, to the speed and success of soil formation.

The second part of the question asked candidates to explain how soil is changed by processes that fall into four main categories: losses, additions, transformations and translocations.

Candidates that gained the highest marks explained how horticulturists add materials such as organic matter, fertilisers and water. They explained how harvesting crops, drainage, irrigation, and promoting erosion can result in losses from soil. Translocations were explained as removing soil and cultivation processes. Transformations were explained as the addition of chemicals such as lime, and the changes to organic materials, that alter the fundamental properties of soil.

Q14 a) Draw a fully labelled diagram of the nitrogen cycle to show the main stages and processes from leaf protein to nitrate taken up by roots, under aerobic neutral conditions.

b) Summarise the ways in which nitrogen is:

i) lost;
ii) gained;
iii) by the soil.

This question requested that candidates draw a diagram of the nitrogen cycle. The most accurate diagrams that met the requirements of the question included the processes of mineralization and nitrification. Also, the change in the state of nitrogen from ammonium to nitrate was given in the right order with correct chemical symbols. The action of microorganisms was also included along with the source of nitrogen as required by the question.

In part b) good answers to the first part of the question included summaries of the following ways in which nitrogen is lost from soil:

- cropping and grazing,
- volatilization,
- denitrification,
- poor soil structure or damage to soil structure,
- leaching.

In the second part of the question gains were summarized as:

- the adding of organic matter,
- nitrogen fixation by microorganisms,
- nitrogen fixation by lightening,
- the addition of fertilisers.

Both natural and human processes and activities were correctly covered by many candidates.

Q15 a) Identify **SIX** factors that can cause environmental pollution for nutrients in horticultural soils and composts.

b) State **FOUR** causes of soil erosion.

c) Describe how a soil can be managed to reduce the adverse effects on the environment of horticultural practices.

Horticulture is an intensive form of agriculture that has traditionally used high levels of fertiliser. *Environmental pollution* is key to this question. Concern for the environment and in particular the nutrient enrichment of water courses and ground water means that horticultural inputs come under more scrutiny than was once the case.
The first part of the question concerned the form, amount and evenness of distribution of fertilisers and manures; the timing of applications; the likelihood of excess nutrients being leached through the soil profile; the effects of temperature on nitrogen cycling; and the buffering capacity of soils.

Most candidates identified several causes of erosion in the second part of the question. Wind and water are agents of erosion but complete answers also briefly described the action of wind and water, and under which conditions they were likely to be most damaging. Several candidates pointed to exacerbating factors such as the absence of shelter, crop cover or root spread, poor soil structure and topography and the type of cultivation. Extreme weather events are a cause of water erosion which may become more familiar to growers in the future.

Common adverse effects on the environment already encountered in parts a) and b) of this question are water pollution and erosion. To avoid those adverse effects, answers could have referred to:

- the avoidance of excessive, uneven or untimely application of fertilisers,
- maintenance of crop cover and satisfactory soil organic status,
- field margin buffer strips,
- direction of plough furrows relative to topography,
- timing of cultivations,
- wind breaks,
- closed systems for protected cropping and container nursery stock.

Q16 a) Describe the role of soil organic matter in plant nutrition.

b) Describe the role of organic matter in growing media.

The two parts of this question both referred to organic matter: firstly the role in plant nutrition in the soil and secondly the overall role in growing media. Several candidates discussed the 'soil' in both sections: the term ‘growing media’ in part b indicated that answers should be about substrates formulated for use in containers rather than the natural soil which forms the upper layer of the earth.

For the role of organic matter in *plant nutrition*, relevant points include:

- organic matter as a source of nutrients, description of types, amounts and availability,
- the high cation exchange capacity of humified material, examples of cations, brief description of processes,
- indirect effects: improved structure, greater root ramification to exploit distant nutrients,
- long term effects of organic matter application: increased acidity, effects on individual nutrient availability,
- effects of anaerobic conditions, denitrification.

The role of organic matter in *growing media* could have included:

- physical support,
- absorbing and making available to plant roots both moisture and oxygen,
- allowing good drainage by virtue of its structure,
- either a source of nutrients (e.g. PAS 100) composts, *or*
- nutrient free and therefore nutritionally predictable,
- a chemical buffer (some materials only),
- biologically inactive (therefore pathogen and weed free) *or*
- biologically active (green waste media, some barks able to suppress some pathogens.)