Royal Horticultural Society

RHS LEVEL 3 ADVANCED CERTIFICATE IN HORTICULTURE
WRITTEN EXAMINATION

10:00am Tuesday 5th July 2011

MODULE A

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

ANSWER ALL QUESTIONS

MARKS

Q1 List **FOUR** materials that could be used in a compost suitable when sowing medium sized seeds. **2**

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Q2 State **FOUR** aftercare requirements of newly germinated seedlings grown in containers. **2**

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Q3 State **TWO** benefits and **TWO** limitations of propagating plants by layering. **2**

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Q4 Name **TWO** bacteria and state the role of **EACH** in the nitrogen cycle. **2**

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ANSWER ALL QUESTIONS

MARKS

Q5 List **FOUR** methods of reducing the pH of a soil for the growing of calcifuge plants eg blueberries. **2**

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Q6 Describe the leaf deficiency symptoms of the following plant nutrients:

i) magnesium;
ii) calcium. **2**

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Q7 State **TWO** benefits and **TWO** limitations of non-cultivation (no dig), soil management of a clay soil. **2**

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ANSWER ALL QUESTIONS

MARKS

Q8 Describe **TWO** ways in which micro-nutrients can be incorporated in growing media. **2**

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Q9 List **FOUR** ways by which pollution can occur in the garden from the use of fertilisers and growing media. **2**

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Q10 List **FOUR** types of drainage systems. **2**

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**The Royal Horticultural Society, Wisley, Woking, Surrey, GU23 6QB.
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MODULE A

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

Sections B & 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.

Please turn over/…..

Section B – Understanding of Plant Propagation

Answer ONE question only from this section

MARKS

Q11 a) Describe **TWO** available techniques for taking stem cuttings from **NAMED** hardy shrubs in July/August. **8**

b) Explain the effect of the following environmental factors on the physiological processes involved in the successful rooting of the cuttings taken in a):

i) light;
ii) temperature. **8**

c) Describe the facilities available to control light and temperature in the propagation process described in b). **4**

Q12 a) Describe the importance of seed dormancy to the plant. **4**

b) Describe **FOUR** ways in which the propagator may overcome seed dormancy, referring to a **NAMED** example in **EACH** case. **16**

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Please see over/…..

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

Answer TWO questions from this section

MARKS

Q13 a) Review the benefit of the information provided by the soil survey of England and Wales to horticulturists. **6**

b) Describe **TWO** types of soil that have developed in the UK. **10**

c) Evaluate the types of soil named in b), for their use in horticulture. **4**

Q14 a) Describe **ONE** method of growing plants in a **NAMED** inert substance. **3**

b) Describe how **EACH** of the following may be monitored and controlled in hydroponic systems:

i) pH;
ii) nutrients;
iii) salinity/conductivity. **9**

c) Review the advantages and limitations of using inert substances to control plant nutrient availability. **8**

Q15 a) Describe the impact of weather on soil structure. **6**

b) Describe how biological activities in the soil affect its structure. **4**

c) Describe the activities of fungi in the soil. **10**

Q16 a) Define soil moisture deficit (SMD). **2**

b) Describe how soil texture and other soil factors affect SMD. **10**

c) Discuss **FOUR** techniques available to measure SMD for use as a tool in irrigation. **8**

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RHS LEVEL 3 ADVANCED CERTIFICATE IN HORTICULTURE
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10:00am Tuesday 5 July 2011

MODULE A

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

Candidates Registered	**82**		**Total Candidates Passed**	**49**	**79.03%**
Candidates Entered	62	75.61%	Passed with Commendation	19	30.65%
Candidates Absent	14	17.07%	Passed	30	48.39%
Candidates Deferred	2	2.44%	Failed	13	20.97%
Candidates Withdrawn	4	4.88%			

Section A – Short Answer Questions

Overview: Greater care is being taken by candidates in relating the answer provided to the verb used, e.g. describe, list and state etc. However, the situation provided within the question, e.g. leaf systems or clay soil, were not adhered to thereby causing marks to be missed. Also the use of supporting named examples was reduced in this examination. Mislead candidates gave general responses.

Q1 List **FOUR** materials that could be used in a compost suitable when sowing medium sized seeds.

Any suitable clearly stated four materials were accepted, with measurements if required, e.g. clay loam, perlite, washed sand and coir. The recommendation of garden compost and other organic materials were very general and did not give what state of preparation they should be in before use. Also preparatory mixtures were given as examples, e.g. John Innes, rather than individual components that could be used.

Q2 State **FOUR** aftercare requirements of newly germinated seedlings grown in containers.

A broad range of any suitable four aftercare requirements were accepted, e.g. increasing light levels, reduction of temperature, reduction of humidity levels and avoiding over irrigation/wetting. Weeding and weed removal were also accepted as this could be the case in tree or alpine seedlings. The vital role of roguing was often overlooked and general, level 2, responses were awarded half marks.

Q3 State **TWO** benefits and **TWO** limitations of propagating plants by layering.

An excellent quality of responses was noted with any two suitable benefits e.g. minimal damage to the mother plant and large size of new plant produced, being accepted.
Also, any two suitable limitations, taken from a range of options, e.g. time taken and room required for numbers produced, were excellent and very comprehensive. However, some confusion was noted with regard to the skill level required, this usually rests with the timing of the operations.

Q4 Name **TWO** bacteria and state the role of **EACH** in the nitrogen cycle.

Any suitable two, related to the nitrogen cycle, e.g. *Nitrosomonas spp.*, where ammonium is oxidized to nitrite and *Nitrobacter sp.,* where nitrite is oxidized to nitrate, were accepted. Also the *Rhizobia* were included as commencing the cycle but *Azotobacter spp., were* taken as outside the cycle, together with any non-bacterial examples, e.g. mycorrhizal activators.

Q5 List **FOUR** methods of reducing the pH of a soil for the growing of calcifuge plants e.g. blueberries.

This question caused some confusion with the word "*calcifuge*" being read as "*calcicole*", resulting in a wide range of actions being recommended than would have increased the pH level. The required responses included any suitable four methods, e.g. rainfall (carbonic acid), and tannic acid from organic matter breakdown, application of herbicides, sulphur in the form of fertilisers, amelioration with pine needles or other named acid material, e.g. Sphagnum peat or the use of a more acidic soil to mix with the existing media, rather than as a direct replacement.

Q6 Describe the leaf deficiency symptoms of the following plant nutrients:

i) magnesium;
ii) calcium.

The term "describe" was sometimes overlooked with a statement or list being given instead. A suitable description for each could have been:
Magnesium: Yellowing (Chlorosis) of **older foliage** with the veins remaining green. The leaf subsequently develops necrotic spots and also the chlorosis can be central in the leaf as shown in Legumes.
Calcium: Reduced leaf area, e.g. leaf rolling, tip burn and slow speed of development.
An overall understanding of the required terms were given but stronger linkage back to the **leaf** was required, rather than just general deficiency symptoms shown across the plant.

Q7 State **TWO** benefits and **TWO** limitations of non-cultivation (no dig), soil management of a clay soil.

A very broad range of suitable (two) examples for each were provided, benefits would include reduced compaction and increased earthworm activity. Limitations would include preventions of application of organic matter at depth and reduced speed of compaction removal. However, some examples overlooked the stated situation, i.e. **a clay soil**, resulting in missing marks.

Q8 Describe **TWO** ways in which micro-nutrients can be incorporated in growing media.

Again the use of the word “describe” was not fully noted by some candidates, with the result of just a list or statement being provided. Also the most comprehensive responses provided named products, together with the group descriptions. Possible answers were added as part of a controlled release fertiliser, e.g. Osmocote Plus or as frits, e.g. fritted trace elements in the media before use, and top dressing or liquid feeding with a seaweed product, e.g. Maxicrop, as the plants/crops are growing.
A wide range of responses were provided by candidates with clay loam soil, organic matter and rock dust being other suitable responses which were rewarded.

Q9 List **FOUR** ways by which pollution can occur in the garden from the use of fertilisers and growing media.

Any suitable four were rewarded e.g. over application by mis-calculation, incorrect time of year or season for the product selected, leaching of soluble nutrients via long term storage and faulty application equipment.
A clear understanding of the situations was usually provided, but further detail was required to link back to the fact that pollution was the result.

Q10 List **FOUR** types of drainage systems.

A broad range of any suitable four examples were rewarded, e.g. French drain, ditches, mole drainage, herring bone, grid system and sand bed.
However, some drainage systems were different arrangements of the same piped system or items within a system, e.g. silt traps. Other systems that were accepted included sand slitting, soakaway; swale and reed bed.

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) Describe **TWO** available techniques for taking stem cuttings from **NAMED** hardy shrubs in July/August.

b) Explain the effect of the following environmental factors on the physiological processes involved in the successful rooting of the cuttings taken in a):

i) light;
ii) temperature.

c) Describe the facilities available to control light and temperature in the propagation process described in b).

Most candidates were able to provide two techniques for taking stem cuttings and those who selected distinct techniques gained the most marks. Reading the question was key to doing well as the techniques also needed to be appropriate to the stated time of year. No marks were awarded to candidates who gave hardwood cutting as an example as this technique is not used in July and August. Candidates who were able to provide two shrub examples complete with their full botanical latin names gained maximum marks for this part of the answer. No marks were awarded to candidates who went beyond describing the type of cutting, rooting media and environment.

Good answers to part b) described the crucial role of photosynthesis and the control of transpiration along with the need to reduce the impact of stress on a cutting. Both the importance of top and bottom heat also needed exploring to gain maximum marks.

In part c) the importance of selecting the correct examples was again evident as a candidate who selected hardwood cutting as part of the answer in a) was not able to gain maximum marks in c). The time of year was also significant when describing the facilities, as grow lamps would not be necessary. However the candidates who described the importance of shade cloths, screens and whitewashing to reduce light levels within the propagation environment scored well.

Q12 a) Describe the importance of seed dormancy to the plant.

b) Describe **FOUR** ways in which the propagator may overcome seed dormancy, referring to a **NAMED** example in **EACH** case.

This question was generally well answered and candidates who provided information about the importance of seed dormancy to the plant in respect of long term survival, maintenance of viability, dispersal and being available for germination when environmental factors are favourable scored maximum marks for part a).

In part b) the candidate is required to select four distinct techniques available to the propagator to break dormancy. These would not include describing optimum germination requirement for a particular seed. Instead the candidate who provided four techniques which made reference to both scarification and stratification, and techniques used to break multiple dormancies scored well. It is important when answering this type of question that the candidate is clear on the differences between scarification and stratification. For each example the candidate who provided an appropriate plant example in full botanical latin gained maximum marks. Many candidates found this part of the question more difficult to complete in full.

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

Q13 a) Review the benefit of the information provided by the soil survey of England and Wales to horticulturists.

b) Describe **TWO** types of soil that have developed in the UK.

c) Evaluate the types of soil named in b), for their use in horticulture.

The aim of the question was to test candidates' knowledge of soil classification and soil type in the UK in relation to horticulture use.

Most candidates were able to provide a review of the benefits of the national soil survey. The highest marks were gained by candidates who listed specific benefits relating to soil structure, texture, depth, parent rock, fertility, vegetation, rainfall, land use, drainage etc. Some candidates only described how land is graded in the UK. References to land use/grade and agriculture attracted very few marks.

The answers provided for part b) tended to correspond to the answers to part a) with most candidates able to describe two of the four main soil types found in the UK: brown earth, gley, podzol, rendzina. Candidates that described two grades of UK land gained some marks if they also incorporated information regarding soil type.

The evaluation of soil types for horticulture use, part c), was well answered by some candidates with the individual characteristics of soil type being related to the types of horticulture that would make best use of them. The highest marks were gained where a wide range of possible horticulture uses were cited e.g. sports facilities, different types of plant nursery, different types of garden etc.
Marks were gained with clear accurate diagrams (part b) and good use of technical language.

Q14 a) Describe **ONE** method of growing plants in a **NAMED** inert substance.

b) Describe how **EACH** of the following may be monitored and controlled in hydroponic systems:

i) pH;
ii) nutrients;
iii) salinity/conductivity.

c) Review the advantages and limitations of using inert substances to control plant nutrient availability.

The aim of this question was to test candidates' knowledge of growing plants in a soilless environment.

Most candidates cited rock wool as their inert substance and hydroponics as the growing system used to produce plant crops. Some candidates answered the question without naming a specific inert substance. The highest marks were gained where accurate technical details and technical language were used.

Most candidates stated that pH, nutrients and salinity were monitored and controlled by automated systems. Some candidates were able to describe how the systems worked and how the individual types of equipment were used and calibrated. Some displayed a good understanding of the subject by giving examples of the substances used to provide nutrients and ensure the nutrient solution was kept at its optimum quality. Marks were earned accordingly.

Part c) of the question was very well answered by many candidates. Advantages and limitations of using inert substances were accurately identified and succinctly reviewed. Factors such as cost, hygiene, quality, production levels versus size of operation, staffing and their skill levels, running costs, adaptability, potential system failure, etc. were all included. Good marks were achieved by most candidates for this part of the question even if parts a) and b) could only be answered in general terms.

The highest marks were gained by candidates whose answers were well structured, contained technical information and correctly used technical terms.

Q15 a) Describe the impact of weather on soil structure.

b) Describe how biological activities in the soil affect its structure.

c) Describe the activities of fungi in the soil.

The key words in the first part of the question are 'weather' and 'soil structure'. The effects of temperature and precipitation are important for this answer. Aggregates can become more granular after frost and thaw, and drying and wetting. The structure can also be damaged: high temperatures causing cementation of clay; prolonged moisture causing slaking; heavy rain causing capping or physical loss of topsoil.

As there is a connection between organic matter and soil structure, the weather is also involved in secondary effects. Examples could include high temperatures increasing the rate of turnover of organic matter (negative effect on structure) and warm moist conditions increasing plant growth, and therefore root mass (positive effect on structure).

Several answers alluded to excess rain or irrigation causing water-logging, anaerobic conditions and root death, but did not go on to make a link with soil structure – water logged soil lacks some of the agents beneficial to structure such as living roots and earthworms, as well as being susceptible to mechanical damage such as smearing.

Some candidates interpreted the question as relating to the formation of soil from parent rock. Although this was not the aim of the question (which sought the impact of weather, not weathering), credit was given for relevant statements.

As with the first part of the question, several candidates clearly had an understanding of soil processes but did not apply this to address the effect on *soil structure* specified in the second part of the question. Several candidates lost time by discussing the effect on soil nutrients. Headings could have included mechanical and biological effects:

- deep burrowing (e.g. *Lumbricus)* earthworms and root ramification leading to the creation of air channels and separation of massive structures,
- plant exudates, animal exudates, processed organic matter, dead biota and factors helping to aggregate soil particles.

Marks would also have been awarded for the mention of deleterious activities such as stock poaching, rabbits mining banks or flatworms reducing (beneficial) earthworm populations.

Candidates are reminded to be aware of the number of marks available: in this case an equal number of marks for part c) were available as a) and b) put together.

As long as the activities were soil based, this question offered a wide range of possible answers which could be grouped into:

- detritivore fungi or saprophytes,
- mycorrhizal and other beneficial associations,
- parasites.

Some fungi could be placed in more than one group. Detailed answers on mycorrhizae were frequent and most candidates offered at least one example of a fungal parasite, typically honey fungus. Although detritivores were not generally named or differentiated, most candidates mentioned the importance of (basidiomycetes) in the breakdown of lignin: fewer cited groups like sugar fungi, brown rots (cellulose) or coprophilous fungi. The importance of fungi in acid environments was rarely mentioned. One could also mention nematophagous fungi in relation to biological control and fungi are themselves a food source, although perhaps being eaten cannot be said to be an activity.

Root nodules in legumes and alders, and *Rhizobium* were commonly mentioned: important as their roles are, they are not fungi. Some candidates mentioned *actino*mycetes which are also bacteria although once classified with the fungi.

Q16 a) Define soil moisture deficit (SMD).

b) Describe how soil texture and other soil factors affect SMD.

c) Discuss **FOUR** techniques available to measure SMD for use as a tool in irrigation.

The difference between the existing soil moisture content and field capacity was correctly stated in the majority of papers.

Several candidates demonstrated a good knowledge of how water was held in the soil and the significance of the pore size but were then unable to apply this to the second part of the question which is specifically about soil moisture deficit (SMD).

A common answer was that sandy soils are likely to have a higher SMD than clay soils. Many candidates stated that sandy soils, with a higher percentage of larger pores had relatively little available water, but they didn't follow up by saying that a SMD develops *faster* on a sandy soil than a clay soil or conversely that the SMD could be satisfied by irrigation more quickly. The SMD of a sandy soil would need rectifying more frequently because of the inherently smaller available water capacity.

Other relevant factors include the soil structure, levels of organic matter and factors which affected the rate of water use, such as the evapotranspiration rate (itself controlled by crop cover, temperature and wind speed).

The soil texture, structure and slope also affect the rate of infiltration and hence the speed at which water can be applied to correct the deficit.
Several candidates misinterpreted the third part of the question and explained how to assess the texture of a soil and its drainage characteristics. Knowing how quickly a soil drains could affect the rate at which irrigation was applied but it is not a measurement of SMD.

Answers could encompass the various permutations of a water balance sheet (calculated losses and measured gains) and instruments such as tensiometers, evaporimeters, solarimeters or neutron probes.

Laboratory assessment (gravimetric methods) were mentioned in varying degrees of detail.

Visual methods were commonly put forward. Visual assessment combined with crop knowledge and horticultural experience can be a useful *guide*. The assessment of a squeezed sample of topsoil – noting, for instance that at field capacity there is no free water but a wet outline is left on the hand – depends on the experience of the tester. Judging SMD by the degree of crop wilting would also be affected by the maturity of the crop, the temperature and strength of the sun or wind. It requires an experienced observer to match the precision of scientific methods.

'Discuss' was the verb used in the question. Few comparisons were made. Points could have included: accuracy versus time and expense, required levels of skill, complexity of the equipment, reliability, operator experience and the value of the crop.