RHS LEVEL 3 ADVANCED CERTIFICATE IN HORTICULTURE
WRITTEN EXAMINATION

Tuesday 8th February 2011
2:00pm – 4:00pm

MODULE B

Principles of Plant Taxonomy, Morphology & Anatomy, Knowledge of Plant Health, Processes of Plant Physiology

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 **B** 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.

Please turn over/…..

ANSWER ALL QUESTIONS

MARKS

Q1 State **FOUR** differences between monocotyledonous and dicotyledonous plants. **2**

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Q2 Give an example of a specific epithet that identifies:

i) colour;
ii) country of origin;
iii) growth of habit;
iv) leaf shape. **2**

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Q3 a) Name **ONE** example of **EACH** of the following:

i) bulb;
ii) corm.

b) State **TWO** differences between bulbs and corms. **2**

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Please see over/.....

MARKS

Q4 Identify **TWO** requirements for accurate knapsack sprayer calibration and explain why each is important. **2**

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Q5 State **TWO** environmental factors external to the plant that:

i) promote transpiration;
ii) reduce transpiration. **2**

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Q6 Identify **ONE** mechanism of virus spread for **EACH** of the following:

i) workers tools;
ii) soil. **2**

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Q7 Identify **TWO** processes that contribute to the movement of metabolic products within the plant. **2**

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MARKS

Q8 State how **EACH** of the following contributes to safe working practices when using crop pesticides:

i) observing harvest internal (HI) recommendation;
ii) early morning and late evening spray applications;
iii) reading product label;
iv) UK pesticide guide ('The Green Book'). **2**

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Q9 a) State **TWO** anatomical differences between the palisade and spongy mesophyll tissues in leaves.

b) Relate these differences to their role in photosynthesis. **2**

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Q10 a) State what is meant by an ephemeral weed.

b) Name **TWO** ephemeral weeds. **2**

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Royal Horticultural Society

RHS LEVEL 3 ADVANCED CERTIFICATE IN HORTICULTURE
WRITTEN EXAMINATION

Tuesday 8th February 2011
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MODULE B

Principles of Plant Taxonomy, Morphology & Anatomy, Knowledge of Plant Health, Processes of Plant Physiology

Sections B, C & D - Structured Questions

IMPORTANT – Please read carefully before commencing.

i) The duration of the papers in Module **B** is **2 hours**.
ii) Answer **ONE** question from **EACH** of the sections **B**, **C** and **D**.
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 – Principles of Plant Taxonomy, Morphology & Anatomy

Answer ONE question only from this section

MARKS

Q11 a) State **THREE** ways in which the botanical system of classification is of use to the horticulturist. **3**

b) i) State, using a **NAMED** plant example, what is meant by 'species'. **3**

ii) Describe **FIVE** other categories of the taxonomic hierarchy, using **NAMED** plant examples to illustrate the answer. **10**

c) Identify, using **NAMED** plant examples, **TWO** circumstances in which the name of a plant may be changed. **4**

Q12 a) Describe, with the aid of a clearly labelled diagram, **EACH** of the following types of cell:

i) parenchyma;
ii) sclerenchyma;
iii) xylem vessel;
iv) xylem tracheid. **8**

b) Describe, with the aid of fully labelled cross-sectional diagrams, the process of secondary thickening in a plant stem. **12**

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Please see over/.....

Section C – Knowledge of Plant Health

Answer ONE question only from this section

MARKS

Q13 a) i) Describe the types of weed that are characteristically found in **THREE** different horticultural situations. **3**

ii) Explain the features of a **NAMED** weed in **EACH** of the three situations described in a), that contribute to their success. **6**

b) **NAME** an appropriate herbicide (active ingredient) to control weeds in **EACH** situation described in a). **3**

c) Describe a programme of cultural operations which could be adopted in order to prevent weed establishment and persistence in **ONE** of the situations described in a). **8**

Q14 a) Describe the current phytosanitary controls and legislation which are intended to prevent distribution of diseases and pests. **12**

b) Assess the effectiveness of the controls described in a). **8**

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Please turn over/.....

Section D – Process of Plant Physiology

Answer ONE question only from this section

			MARKS
Q15	a)	Explain the role of respiration in the metabolic pathway.	**8**
	b)	Explain the differences between anaerobic and aerobic plant respiration.	**4**
	c)	Explain how anaerobic respiration is avoided in **TWO NAMED** horticultural situations.	**4**
	d)	Describe the links between photosynthesis and respiration.	**4**

Q16	a)	Describe, with the aid of clearly labelled diagrams, how water moves from the soil to all parts of a plant.	**12**
	b)	Explain the role of water in the plant.	**4**
	c)	Explain how plasmolysis occurs in horticultural situations.	**4**

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RHS LEVEL 3 ADVANCED CERTIFICATE IN HORTICULTURE
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MODULE B

Principles of Plant Taxonomy, Morphology & Anatomy
Knowledge of Plant Health
Processes of Plant Physiology

Candidates Registered	**169**		**Total Candidates Passed**	**113**	**84.97%**
Candidates Entered	133	78.70%	Passed with Commendation	42	31.58%
Candidates Absent	25	14.79%	Passed	71	53.38%
Candidates Deferred	8	4.73%	Failed	20	15.04%
Candidates Withdrawn	3	1.78%			

Section A – Short Answer Questions

Q1 State **FOUR** differences between monocotyledonous and dicotyledonous plants.

Answers to this question generally indicated that candidates have a good grasp of the basic differences between monocotyledonous and dicotyledonous plants.

Most candidates were able to identify common differences relative to the floral parts; internal arrangement of vascular bundles; the presence or absence of cambium tissue and other similar features all of which attracted marks. Some candidates identified other differences such as fibrous rooted or tap rooted and depending on clarity and accuracy of answers also gained marks.

Q2 Give an example of a specific epithet that identifies:

i) colour;
ii) country of origin;
iii) growth of habit;
iv) leaf shape.

Candidates in the main were able to identify a specific epithet relative to each of the four parts of the question, demonstrating a good knowledge of the meaning of plant

names. Some candidates gave full genus and species names but only the specific epithet was counted. Generic names without a specific name were not awarded marks. A number of candidates failed to make a satisfactory distinction between specific names relating to growth habit such as pendula and horizontalis with those names which identify leaf shape such as palmatum, quercifolia or dentata etc. In these cases marks were not awarded.

Q3 a) Name **ONE** example of **EACH** of the following:

i) bulb;
ii) corm.

b) State **TWO** differences between bulbs and corms.

Some candidates found it difficult to answer part a) of this question accurately and with full generic and specific names. Marks were apportioned where answers only included a generic name. Some candidates gave accurate names but linked them to the wrong (bulb/corm) grouping and failed to gain marks for this. The examiner was looking for examples such as: -

Bulbs: - Narcissus pseudonarcissus

Narcissus “King Alfred”

Allium cepa

Corms:- Crocosmia “Lucifer”

Crocus tommasinianus

Other valid answers gained marks.

Part b) of the question was answered too vaguely by many candidates who gave imprecise or inaccurate differences between bulbs and corms. Some candidates were very unsure and confused the features of corms with those of bulbs. A common mistake was for candidates not to make sufficiently clear the difference that in the bulb the swollen leaf bases are the main food storage parts whilst in the corm it is the whole of the solid swollen stem making up the corm which stores food.

Differences referring to daughter (offset) bulbs being produced by mother bulbs compared to corms producing cormels or (cormlets) around the periphery of the newly formed corm attracted marks as did references to new corms being formed annually on top of the older corm.

Other correctly identified differences also gained marks. Overall candidates were too vague or imprecise in their answer to this question.

Q4 Identify **TWO** requirements for accurate knapsack sprayer calibration and explain why each is important.

Some candidates failed to understand and answer what the specific question asked for. The question was about "accurate" knapsack sprayer calibration and why each of the two requirements is important. The question was not about health and safety issues. Answers not addressing the question(s) asked did not receive marks for these parts.

Correct answers attracting marks would have, for example, made reference to: maintaining even constant pressure; checking for leaks (loss of pressure); nozzles not worn out which would result in inaccurate application; forward(walking) speed calculated to ensure correct output over given area; correct chemical spray dilution rate to avoid over/under dosing etc.

Q5 State **TWO** environmental factors external to the plant that:

i) promote transpiration;
ii) reduce transpiration.

Again candidates failed to apply and relate the opening question to both part I and part ii of the question set. The examiner was looking for TWO factors which promoted transpiration and TWO factors which reduced transpiration. Those who failed to do this failed to be awarded more than half marks.

Answers attracting marks for factors to promote transpiration included increasing temperatures and light levels; dry air; air movement (wind) etc. and factors reducing transpiration include declining or poor light levels; reducing temperatures; reduction in air movement (lower wind speed) and high air humidity levels etc.

Some candidates referred to soil environmental factors reducing transpiration such as very dry soil conditions triggering stomatal closure or frozen soil conditions preventing water uptake and loss; these examples also gained marks.

Q6 Identify **ONE** mechanism of virus spread for **EACH** of the following:

i) workers tools;
ii) soil.

Too many candidates failed to explain the mechanism of virus spread in part (i) clearly enough. It is inadequate to simply state knives and secateurs alone. The connection must be made between virus infected sap being spread on cutting blades between infected and healthy plant material. The mechanism of spreading the sap transfer facilitated by the cutting tools used. Similarly it is insufficient to state the use of virus infected soil as the mechanism of transfer itself. Again as in part i above a sap transfer mechanism is involved within the soil.

A common agent of spread is microscopic free living nematodes present in the soil e.g. Longidorus and Xiphinema species which feed on plant root hairs and as a result facilitate infected sap transfer to healthy plant roots e.g. Arabis Mosaic virus frequently spreads this way.

Candidates could have referred to foraging new plant roots rubbing against older (previous crop) plant roots facilitating a sap transfer of virus particles.

Candidates who identified these mechanisms of transfer gained marks. Marks were also apportioned to credit candidates who gave answers pointing towards these mechanisms.

Q7 Identify **TWO** processes that contribute to the movement of metabolic products within the plant.

Very few candidates were able to give satisfactory answers to this question. The question was primarily related to the movement of metabolic products (sugars) from sites or "sources" of production to their destination or "sinks" such as apical meristems or storage tissues in roots, bulbs or corms etc.

Many candidates simply stated for example respiration, osmosis or root pressure etc. without explanation of how each is involved in the movement process. Good answers attracting marks made reference to "active transport"; energy aided transport, loading the phloem with sugars via metabolically active transfer cells etc. Also answers referring to the "mass flow" hypothesis including loading of sugar at sites of production and of unloading at sinks or storage sites; osmosis creating hydrostatic pressure moving sugars along or down the phloem tubes and water potential or pressure gradients would have attracted marks.

Q8 State how **EACH** of the following contributes to safe working practices when using crop pesticides:

i) observing harvest internal (HI) recommendation;
ii) early morning and late evening spray applications;
iii) reading product label;
iv) UK pesticide guide ('The Green Book').

Overall this question was well answered by most candidates who gave full and accurate answers which attracted maximum marks.

However, a number of candidates failed to give adequate explanations particularly relating to question 8(i) and 8(ii).

In part i) some candidates failed to understand that the harvest interval is the obligatory period of time which must elapse between application of pesticides and the time at which it is safe to harvest edible products for consumption. This ensures that any pesticide residues remaining are below the maximum residue levels (MRLs) permitted for the pesticide/crop involved.

In part ii), too many candidates failed to indicate that early morning and late evening pesticide applications are safe working practice because they take place when pollinating insects e.g. bees are in their hives and therefore safe and that wind speeds on average can be lower at these times thus reducing the risk of pesticide drift onto none target sites. Other valid answers were awarded marks.

Parts iii) and iv) were answered very well by most candidates who readily related product label recommendation such as crops treatable; stage of crop development; number of treatments; and PPE requirements as contributory to safe working practice. Also most candidates correctly identified the value of the UK Pesticide Guide in identifying approved produces for use and also those which have been recently withdrawn and should not be used.

Q9 a) State **TWO** anatomical differences between the palisade and spongy mesophyll tissues in leaves.

b) Relate these differences to their role in photosynthesis.

Encouragingly most candidates were familiar with the leaf anatomical structure and were able to clearly state differences between the palisade and spongy mesophyll. Most answers referred to the palisade tissue has being tightly packed with long narrow cell structures and containing many chloroplasts; whereas sound and correct references were made to the spongy mesophyll as being large rounded, loosely packed cells and containing fewer chloroplasts.

Full marks were generally awarded for this part. Marks were only lost when two distinct differences were not clearly identified.

Most candidates gave clear and accurate answers to the second part of the question and gained full marks. These candidates were able to link the palisade mesophyll as being the more efficient photosynthetically with its longer narrow cells directing sunlight downwards onto the chloroplasts which are present in much greater numbers. Likewise they were able to link the loosely packed and rounded cells of the spongy mesophyll with efficient gaseous and water diffusion gradients to assist the palisade tissues in the process of photosynthesis. Good answers identified the photosynthetic capacity of the spongy mesophyll but indicated it was less efficient due to its lower number of chloroplasts compared with palisade tissue.

Q10 a) State what is meant by an ephemeral weed.

b) Name **TWO** ephemeral weeds.

Only a few candidates were unable to describe an ephemeral weed as a weed which is capable of producing several (sometimes numerous) generations of plants which complete their life cycle in the one growing year.

The second part of the question was answered well by many candidates giving two examples with accurate generic and specific name e.g. Stellaria media; Cardamine hirsuta; Senecio vulgaris etc.

Some candidates failed to gain marks when they inaccurately gave examples of perennial weed plants. Marks were also apportioned when candidates could only quote a generic name and not a species name.

Section B – Principles of Plant Taxonomy, Morphology & Anatomy

Q11 a) State **THREE** ways in which the botanical system of classification is of use to the horticulturist.

b) i) State, using a **NAMED** plant example, what is meant by 'species'.

ii) Describe **FIVE** other categories of the taxonomic hierarchy, using **NAMED** plant examples to illustrate the answer.

c) Identify, using **NAMED** plant examples, **TWO** circumstances in which the name of a plant may be changed.

Most candidates understood the international aspect of the Linnaean system and also that it gives each type of plant a unique name that it can be referred to by. Strangely, the accuracy with which plants can be specified for planting schemes was hardly ever mentioned. Candidates did, however, usually mention the systems predictive value in relation to disease susceptibility etc. of close relatives.

The species is a group of morphologically similar plants that can interbreed to give fertile offspring. It is the basic unit of classification and is referred to by two names, the genus and specific epithet. A significant proportion of candidates equated the species with the specific epithet and not the binomial. Many candidates could go on to name five other categories of the taxonomic hierarchy and to give correct examples but descriptions were seldom good. A family, for instance, should be described as a collection of related genera with similarities in flower structure etc. while a division includes groups of plants that differ from others in major, fundamental ways e.g. the presence of seeds in the Spermatophyta.

Most students understood that new research and the application of the priority rule would lead to name changes but experienced difficulty in giving named examples.

Q12 a) Describe, with the aid of a clearly labelled diagram, **EACH** of the following types of cell:

i) parenchyma;
ii) sclerenchyma;
iii) xylem vessel;
iv) xylem tracheid.

b) Describe, with the aid of fully labelled cross-sectional diagrams, the process of secondary thickening in a plant stem.

Each of the types of cell should have a reasonable description and be accompanied by a large, labelled diagram. The question emphasised description, not position or function, so that for parenchyma a description could include a thin cell wall, a more or less isodiametric shape, the presence of a large vacuole and perhaps chloroplasts. Diagrams should always show the cell wall by means of two lines not one.

Expected diagrams for the second part of the question were a young stem, a young stem with interfascicular cambium and a stem showing a later stage in secondary thickening. Again, cambium tissue should be shown by means of two lines. Sometimes candidates were careless in their expression e.g. ‘the cambium grew out to form a ring of cambium’ and ‘the primary xylem was pushed into the centre of the stem’. Candidates should be clear that the cambium cells divide to form new cells which differentiate into secondary phloem, secondary xylem or medullary ray parenchyma. Division of the cambium to increase the diameter of the cambial ring was usually missed in accounts.

Section C – Knowledge of Plant Health

Q13 a) i) Describe the types of weed that are characteristically found in **THREE** different horticultural situations.

ii) Explain the features of a **NAMED** weed in **EACH** of the three situations described in a), that contribute to their success.

Points were awarded for having the characteristics and situation. Examples of acceptable horticultural situations would be amenity turf, container grown plants and herbaceous borders. Depending on the named situation acceptable characteristics would be fast growing, low growing/rosette, perennial/annual and spreading habit.

Full points awarded for the Latin name of a suitable weed and attributes that allow their success for each named situation. Examples of acceptable answers would be *Taraxacum officinale*, a low growing, rosette-forming, perennial found in turf or *Stellaria media*, an ephemeral / annual found in container grown plants.

b) **NAME** an appropriate herbicide (active ingredient) to control weeds in **EACH** situation described in a).

Points were awarded for naming a herbicide (active ingredient) suitable for each named situation. Acceptable answer would be 2,4-D for broadleaved plant in turf or Glyphosate for weed control of hard standing areas.

c) Describe a programme of cultural operations which could be adopted in order to prevent weed establishment and persistence in **ONE** of the situations described in a).

Full points were awarded for naming and describing four cultural methods for preventing establishment and persistence of weeds for one of the named situations. Examples of suitable measures would be hand weeding, hoeing, mulching and stale seed bed.

This proved a popular question with most attempting it. Great understanding of the subject was shown although full marks were not always achieved due to not providing the specified information required in the question. For example, many confused describing types of weeds with naming specific weeds. Overall candidates knew their weeds, herbicides and control measures well.

Q14 a) Describe the current phytosanitary controls and legislation which are intended to prevent distribution of diseases and pests.

Points were awarded for demonstrating knowledge of plant passports and Phytosanitary certificates, such as the following:

- Movement of plants across borders requires phytosanitary control, which must be registered through DEFRA.
- In general, all plants and some plant products are permitted to enter into England and Wales from non-EU countries when accompanied by a Phytosanitary Certificate and/or a Plant Health Movement Document. This includes all major fruits (other than bananas and grapes), cut flowers, leafy vegetables and potatoes from a limited number of countries.
- Phytosanitary certificates confirm that the goods have been inspected in their country of origin and meet EU standards on pests and diseases.
- Imports direct into the UK from third countries require pre-notification to the Plant Health and Seed Inspectorate (PHSI) on the rural payments agency's Procedure for Electronic Application for Certificates (PEACH).
- PHSI carry out a document, identity and physical check of all consignments.
- Plant Passports are required on movement of selected plants within the EU and each nursery is registered.

b) Assess the effectiveness of the controls described in a).

Full points were awarded for discussing both the positive and negative effectiveness of the current phytosanitary control measures. Acceptable answers are:

- Positive aspects include, being able to trace plant origins, producers are accountable, monitors and controls the known pests/pathogens, can easily add new pests/disease to list,
- Negative aspects include, only controls known pests/pathogens, will help reduce but not eliminate risk, reduced border controls within the EU, hard to detect latent infections, checked by country of origin and so out of UK control.

The importance of phytosanitary controls with regards to the spread of pests and diseases was demonstrated by all those who attempted this question. Full marks were achieved for knowledge of plant movement within and into the EU. Having a well rounded assessment of the effectiveness of the controls was not always present with focus mainly on the negative aspects. Overall the candidates did show understanding of the importance of control measures, although sometime specific details were lacking.

Section D – Process of Plant Physiology

Q15 a) Explain the role of respiration in the metabolic pathway.

b) Explain the differences between anaerobic and aerobic plant respiration.

c) Explain how anaerobic respiration is avoided in **TWO NAMED** horticultural situations.

d) Describe the links between photosynthesis and respiration.

This question was designed to test candidates' knowledge of the process of respiration and how respiration is vital for plant growth and development. The limitations of anaerobic respiration compared to aerobic respiration are important for all candidates to understand.

The relationship between photosynthesis and plant respiration is important in the culture of plants. The question was designed to provide candidates the opportunity to discuss light compensation point and leaf area index information, both of which directly relate to photosynthesis and respiration rates.

Examiners comment on the overall quality of candidates responses

Candidates in many cases provided very poor labelled diagrams which had the following problems:

- very small and difficult to decipher.
- basic in the information provided, (An example is the root hair where the majority of candidates did not even show the semipermeable membrane, which is vital in the function of the root hair).
- very quickly drawn with no information on size of organs or direction of water movement in the plant.

It is important for candidates to relate horticultural practice to scientific principle but this was mostly lacking in candidates answers.

It is important for candidates to fully relate photosynthesis and respiration. Very few candidates mentioned leaf area index and light compensation point which are vital to an understanding in the interrelationship of photosynthesis and respiration.

Candidates should research examples of horticultural practice which relate to the scientific principles of plant production. Anaerobic respiration was clearly explained by the majority of candidates, however providing good examples of anaerobic respiration in plant production proved much more of a challenge for candidates.

The relationship between photosynthesis and respiration was not fully understood by many candidates. Very few candidates mentioned leaf area index and light compensation point which are most important to review when relating photosynthesis with respiration.

Q16 a) Describe, with the aid of clearly labelled diagrams, how water moves from the soil to all parts of a plant.

b) Explain the role of water in the plant.

c) Explain how plasmolysis occurs in horticultural situations.

This question was designed to test candidates' knowledge on the importance of water and transportation of water within the plant. The interrelationship of osmosis, transpiration pull and transpiration should have been clearly recorded in candidates' answers.

The concept of plasmolysis and how it could occur in plants is important for candidates to understand. The question clearly asked the candidates to explain how plasmolysis occurs in different horticultural situations. This point was sadly not answered by many candidates who simply explained the concept of plasmolysis.

The majority of candidates provided good clear answers on the role of water within the plant. It was interesting to note that many candidates however did not mention the cooling properties of water within the plant.

Labelled diagrams by many candidates were very poor and not of level 3 standard. It is important that if a question requests a labelled diagram the candidate response should be with a large clearly labelled diagram. It is easy to criticise, but the examiner found great difficulty in deciphering some of the quickly drawn diagrams which in many cases were not labelled correctly.

Many candidates spent a lot of time explaining how water loss could be avoided in the plant. Whilst the information was mainly correct it was not however requested in the question.

The concept of plasmolysis was very vague for many candidates. The main area of weakness was how plasmolysis can occur in a horticultural situation. This point was often not answered by candidates.

Candidates are strongly advised to research different methods of providing water to the plant and to reduce water stress in plant production.

Questions in this examination will always try and relate the scientific principle to the modern methods of plant production. Candidates who can provide information on modern cultural methods and relate them to the scientific principle will always gain higher marks.