Royal Horticultural Society

RHS LEVEL 3 ADVANCED CERTIFICATE IN HORTICULTURE
WRITTEN EXAMINATION

2:00pm Tuesday 5th July 2011

MODULE B

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

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 Describe the visual symptoms for **EACH** of the following plant/crop problems:

i) two spotted spider mite;
ii) rust. **2**

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Q2 Identify **ONE** biological control agent for **EACH** of the following pest or disease problems:

i) aphids;
ii) powdery mildew;
iii) mealy bug;
iv) slugs. **2**

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Q3 State **FOUR** features of weeds that make them successful competitors. **2**

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Please see over/…..

MARKS

Q4 a) Identify the type of nozzle in figure 1.

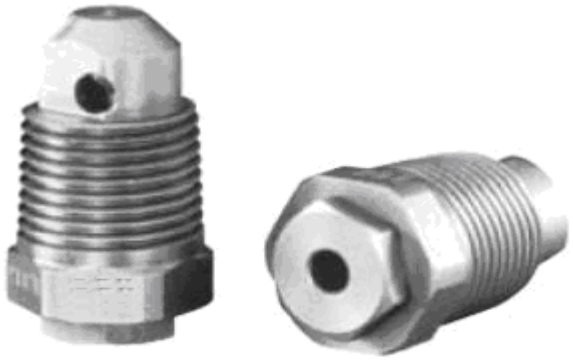

Figure 1

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b) State its use in horticulture. **2**

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Q5 State the functions of the micropyle and the testa in:

i) seed storage;
ii) seed germination. **2**

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ANSWER ALL QUESTIONS

MARKS

Q6 State the function of **EACH** of the following:

i) palisade mesophyll;
ii) spongy mesophyll. **2**

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Q7 State plant species in which the specific epithet is derived from:

i) country of origin;
ii) shape;
iii) colour;
iv) persons name. **2**

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Q8 a) Define the term water potential.

b) State why it is important to plants. **2**

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Please see over/.....

ANSWER ALL QUESTIONS

MARKS

Q9 Explain how the type of respiration changes during the first few hours of seed germination. **2**

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Q10 Define according to COSHH regulations (1988) the terms:

i) hazard;
ii) risk. **2**

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Royal Horticultural Society

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WRITTEN EXAMINATION

2:00pm Tuesday 5th July 2011

MODULE B

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

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) Define the term ‘inflorescence’. **2**

b) Describe **FOUR** different types of inflorescence, using **NAMED** plant examples together with clear line diagrams to illustrate your answer. **12**

c) Describe how the inflorescences of insect and wind pollinated plants may differ from each other. **6**

Q12 a) Draw a fully labelled diagram of a **NAMED** corm. **8**

b) Describe the annual life-cycle of a corm. **6**

c) Describe, using **NAMED** plant examples, **TWO** other stem structures adapted for the storage of food. **6**

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Please see over/…..

Section C – Processes of Plant Physiology

Answer ONE question only from this section

MARKS

Q13 a) Describe, with the aid of a large clearly labelled diagram, the role of a chloroplast. **4**

b) Explain how the horticulturist can manipulate the environment in a modern glasshouse to maximise plant growth. **12**

c) Explain how the law of limiting factors affects the choices made by the horticulturist in b). **4**

Q14 a) Define the term plant tropism. **2**

b) Describe, with the aid of clearly labelled diagrams:

i) chemotropism;
ii) a negative tropism. **8**

c) Describe **FOUR** horticultural operations which directly relate to **NAMED** plant tropisms. **10**

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Please turn over/…..

Section D – Knowledge of Plant Health

Answer ONE question only from this section

MARKS

Q15 a) Discuss the advantages and limitations of using pesticides. **8**

b) Review the use of integrated pest management in modern horticulture. **12**

Q16 a) Describe, using **THREE NAMED** examples, the symptoms of damage caused by viruses. **6**

b) Relate the management of virus diseases in horticulture to their methods of transmission. **14**

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MODULE B

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

Candidates Registered	**48**		**Total Candidates Passed**	**19**	**51.35%**
Candidates Entered	37	77.08%	Passed with Commendation	0	-
Candidates Absent	7	14.58%	Passed	19	51.35%
Candidates Deferred	2	4.17%	Failed	18	48.65%
Candidates Withdrawn	2	4.17%			

Section A – Short Answer Questions

Q1 Describe the visual symptoms for **EACH** of the following plant/crop problems:

i) two spotted spider mite;
ii) rust.

Answers to each part of this question frequently lacked sufficient detail; with the wider range of symptoms frequently omitted. Consequently full marks were not always awarded.

In the case of the two spotted mite, candidates frequently failed to refer to the visual presence of the mites and their greenish yellow summer colouration compared to the autumnal darker reddish brown colour prior to hibernation. Some answers did refer correctly to the whitish yellow speckling on upper leaf surfaces but failed to describe leaf bronzing and the appearance of webbing etc.

Answers frequently failed to mention pustules as being the main visual symptom of rust infection and spore release, and hardly any reference was made to changes in colour of both pustules and spores depending upon the time of year. Often descriptions were rather vague and inadequate.

In answer to both parts little if any reference was made to visual signs of loss of vigour.

Q2 Identify **ONE** biological control agent for **EACH** of the following pest or disease problems:

i) aphids;
ii) powdery mildew;
iii) mealy bug;
iv) slugs.

In answer to this question candidates were expected to identify (name) biological control agents available from commercial sources for applications in the horticultural industry and by other users. It was expected that candidates would give the scientific name of the agent or the commercial name under which it is marketed. It was insufficient to refer to wild naturally occurring predators such as hover flies, lady birds, frogs and natural bird populations.
Candidates are expected to spell the scientific name of biological control agents correctly. However marks were still awarded when names were misspelt so long as they could be clearly identified with the controlling agent. Too often candidates gave a correct control agent name but linked it to the wrong pest problem, thus failing to gain marks. The following correct answers to the problems listed attracted marks:

i) aphids: Aphidius colemani; Aphidoletes aphidimyza
ii) powdery mildew: Bacillus subtilis (Serenade)
iii) mealy bug: Cryptolaemus montrouzieri
iv) slugs: Phasmarhabditis hermaphrodita (Nemaslug)

Other correct answers attracted marks.

Q3 State **FOUR** features of weeds that make them successful competitors.

Candidates generally had a good grasp of the answers to this question and were fully aware of plant botanical features and adaptations which make weeds successful competitors. Full marks were frequently awarded. Those who failed to gain marks either failed to give four distinct features or answers insufficiently described the feature(s) making certain weeds successful competitors. For example the ability of some weeds to adapt their growth and flowering to survive below the cutting height of lawnmower blades was sometimes inadequately explained and could not be awarded full marks. Good answers attracting marks referred to:

Seed features: high seed numbers produced; ephemeral (repeat) life cycles each year; efficient seed dispersal mechanisms and rapid growth (competitive) characteristics,
vegetative features: the ability of some weeds to easily spread above or below the soil surface by means of stolons, runners, rhizomes and suckering growths; also swollen perennating organs such as tap roots, tubers etc,
morphological adaptations: some weeds capable of spreading horizontally when cut down repeatedly by lawn mower blades; swollen tap roots, tubers, rhizomes etc. capable of surviving severe draught, heat, cold etc; tap roots capable of producing adventitious growth buds (shoots) especially when damaged.

Q4 a) Identify the type of nozzle in figure 1.
b) State its use in horticulture.

In part a) many candidates did not identify the nozzle as a ‘cone nozzle’ type and failed to attract marks. Those able to state hollow or full cone nozzle were awarded marks.
In part b) those who identified this as a ‘hollow cone nozzle’ should have linked its use to the high volume spraying of commercial crops or ornamental garden plants to achieve maximum crop penetration and coverage. It is intended for the application of insecticides, fungicides and foliar feeds.

Any candidates who identified it as a ‘full’ cone nozzle should have related its horticultural use to the ‘spot’ spraying treatment and as such would often be used for the control of individual weeds by spot treating with a herbicide. Marks were apportioned according to the correct uses identified.

Q5 State the functions of the micropyle and the testa in:

i) seed storage;
ii) seed germination.

The question required references to the functions of the micropyle and the testa for

both part (i) and part (ii) of the question. Marks were frequently not awarded when candidates failed to do this in their answers.
Some of the answers attracting marks made reference to the following functions:

Seed storage:

- micropyle; allows some gaseous exchange to maintain cellular metabolism,
- testa; provides protection from pest and disease attack, prevents drying out, in some cases maintains seed dormancy.

Seed germination:

- micropyle; allows inhibition of water to trigger germination,
- testa; in some cases water absorbed to aid germination, seed coat weakens, ruptures and allows ingress of oxygen.

Q6 State the function of **EACH** of the following:

i) palisade mesophyll;
ii) spongy mesophyll.

Overall candidates demonstrated a sound knowledge of the functions relating to these two leaf tissues; and generally gave full answers demonstrating that a good learning process had taken place.

Although most candidates readily identified the function of palisade mesaphyll as the main site of photosynthetic activity, only a few were able to say that the tissue is designed to direct sunlight downwards onto the many chloroplasts which it contains. Likewise there was little reference to the function of this tissue in moving the sugars produced away from the ‘source to the sinks’ e.g. roots and storage organs.

Most candidates gave good answers to the second part by making reference to these loosely packed, thin walled cells being used to facilitate the movement or diffusion of oxygen, carbon dioxide and water molecules within and between the cellular tissue structures. Unfortunately too many candidates failed to record that the tissue does have, albeit, a reduced level of photosynthetic activity.
Marks were awarded to reward the functions of each tissue stated.

Q7 State the species in which the specific epithet is derived from:

i) country of origin;
ii) shape;
iii) colour;
iv) persons name.

To answer this question adequately candidates were required to name a plant species which includes both generic and specific names for each of the groups listed; the species name being derived from each of these.
Marks were not awarded where answers only gave a species example without a genus name being included. Likewise marks were withheld when candidates either quoted a genus and a cultivar name or quoted a genus, species and a cultivar or variety name where the species was wrong but the cultivar or variety allowed to the groups listed.
Generally many candidates gained full marks. Examples of answers attracting marks included:

For country of origin: Wisteria sinensis, Cryptomeria japonica,

For shape: Acer palmatum, Betula pendula,
For colour: ribes sanguineum, Passiflora caerulea,
For persons name: Primula bulleyana, Berberis wilsoniae.

Q8 a) Define the term water potential.

b) State why it is important to plants.

Overall this question was not answered very well. Candidates' answers often failed to define water potential adequately and failed to identify reasons why it is important to plants. This resulted in fewer than expected candidates achieving full marks and apportioned marks were also quite low. Teaching, learning and revisionary processes need to improve in the area of the syllabus.

In part a) answers were expected to have referred to the diffusion of water from regions of high water potential to areas of low (lower) water potential and in so doing set up a water potential gradient. Candidates should have identified normal soil/compost conditions as having a high water potential compared with the internal root cells having a low water potential with water moving along a water potential gradient from the soil into the plant and upwards by cell to cell transfer following a similar gradient.

In part b) again candidates were unable in many cases able to explain adequately why water potential is important in plants. Candidates should have referred to water potential as a means of ensuring water flows into the plant from the rooting medium to create hydrostatic pressure and maintain turgor to keep cells and tissues turgid forcing water towards the upper shoots and leaves. Little reference was made to the effects of hydrostatic pressure helping to load or push sugars from the production sites in leaves into the phloem sieve tubes and move them from 'sources to sinks'.

Q9 Explain how the type of respiration changes during the first few hours of seed germination.

Some candidates failed to understand that this question was primarily about the type of respiration which occurs and changes in the initial stages of germination. It is not so much about the stages of seed development or how the radicle and plumule develop. Failing to understand this resulted in lower or nil marks being awarded. Good answers referred to imbibitioned water flooding the embryonic tissue but impervious testa preventing entry of much oxygen, thus creating anaerobic respirational conditions with low energy release for a short period of time. Rehydrating of cellular tissues causing expansion and bursting of the testa allowing oxygen to rush in, reverses the anaerobic conditions to aerobic respiration and high energy releases to fuel growth.
Answers along these lines attracted marks.

Q10 Define according to COSHH regulations (1988) the terms:

i) hazard;
ii) risk.

Too many candidates failed to understand that COSHH relates to 'Control of Substances Hazardous to Health' regulations and incorrectly linked it to other health and safety regulations. Answers sometimes reflected this error resulting in lower marks being awarded. Similarly some candidates appeared to have little knowledge of 'hazard' and 'risk' in this context and answers were too often guesses.

For 'hazard' answers, which referred to substances having the potential to cause harm to people attracted marks. Sometimes candidates made good references to

potential hazards from pesticides used in horticulture. Securely stored pesticides have the potential to cause harm but present a low risk because they are not being handled or used.

For ‘risk’, candidates were expected to refer to the likelihood of a person or persons being harmed as a result of exposure to a hazardous substance. Answers referring to the handling or use of pesticides increasing the risk to persons from hazardous substances also attracted marks.

Section B – Principles of Plant Taxonomy, Morphology & Anatomy

Q11 a) Define the term ‘inflorescence’.

b) Describe **FOUR** different types of inflorescence, using **NAMED** plant examples together with clear line diagrams to illustrate your answer.

c) Describe how the inflorescences of insect and wind pollinated plants may differ from each other.

Candidates had difficulty defining an inflorescence as the way flowers are arranged on the flowering shoot. Some stated it was the arrangement of floral parts in the flower.

The most frequent inflorescences quoted by candidates in the second part of the question were raceme, spike, umbel, corymb, and capitulum (composite). Diagrams were often good although full plant names were not always quoted as examples.

The final part proved difficult for most candidates. The question expected candidates to apply their knowledge of pollination strategies to the whole inflorescence. Thus answers could have included any of the following points for insect pollination: if single, flower large, or, if small, massed e.g. capitulum or attractive bracts e.g. Hydrangea, colours attractive to insect concerned and corymbs, capitula as landing stages. Similarly for wind-pollinated flowers the points expected were: inflorescences long and mobile e.g. catkins, often produced before leafing and colours muted since there is no need to attract vectors.

Q12 a) Draw a fully labelled diagram of a **NAMED** corm.

b) Describe the annual life-cycle of a corm.

c) Describe, using **NAMED** plant examples, **TWO** other stem structures adapted for the storage of food.

The diagram of the corm was usually done quite well but suffered from not being fully labelled. The expected labels were: apical bud, internode, node, scale leaves, new corm, old corm, cormels (cormlets) and adventitious roots.

The life-cycle , however, was not done well. The most common points made by candidates were that the leaves photosynthesise and that the products are used to build up the new corm. Surprisingly, the use of the old corm to produce new leaves and flowers at the start of the season was rarely mentioned. Nor was the use of the products of photosynthesis to produce seeds, the production of cormels on stolons or the production of contractile roots to pull the new corm down into position.

Most candidates correctly chose a rhizomatous Iris for one of the stem adaptations in part c. However, many candidates put forward Dahlia root tubers or Narcissus bulbs as their second example. Either of Potato and Begonia tubers would have been suitable.

Section C – Knowledge of Plant Health

Q13 a) Describe, with the aid of a large clearly labelled diagram, the role of a chloroplast.

b) Explain how the horticulturist can manipulate the environment in a modern glasshouse to maximise plant growth.

c) Explain how the law of limiting factors affects the choices made by the horticulturist in b).

The majority of labelled diagrams were of poor quality. Many were not labelled and a common error was the very small size of the diagram. The average size of most diagrams was only four centimetres in height.
It is important that the diagram clearly showed the grana and thylakoids; this was not the case with the majority of candidates' diagrams.
Manipulating the environment to maximise plant growth was efficiently answered by the majority of candidates. The concept of light compensation point however was not mentioned by candidates.
The difference between replacement lighting and supplementary lighting was often ignored by candidates and often treated as the same. It is very important to review the quality of replacement lighting in respect to wavelength availability.
The law of limiting factors was very generally answered by candidates. The concept of a balanced equation for photosynthesis was not recorded by the majority of candidates, which was disappointing. The quality of the ingredients of photosynthesis and the timing of their delivery is very important, this was not referenced in the majority of candidate answers.

Q14 a) Define the term plant tropism.

b) Describe, with the aid of clearly labelled diagrams:

i) chemotropism;
ii) a negative tropism.

c) Describe **FOUR** horticultural operations which directly relate to **NAMED** plant tropisms.

The majority of candidates clearly described the term plant tropism. Many candidates however, recorded long and detailed answers on plant tropisms. It is important to look at the mark allocation, which in this case was only two marks.
Chemotropism was explained in general terms. Many candidate answers however, did not provide sufficient detail to convince the examiner of the full understanding of chemotropism. A widely referenced form of chemotropism is the development of the pollen tube in the fertilisation of flowers; this was not recorded in any candidate answers.
Negative tropism was very well explained, with good examples mainly of phototropism. This concept is clearly understood by candidates.
The four horticultural operations which relate to named plant tropisms was answered very generally by candidates. Many candidates failed to record the tropism referenced with the horticultural operation.
Two examples of horticultural operations could include: ensuring there is the correct type of support for climbing plants and providing sufficient water to encourage root hair growth in container plants.

Section D – Process of Plant Physiology

Q15 a) Discuss the advantages and limitations of using pesticides.

b) Review the use of integrated pest management in modern horticulture.

Many candidates limited their answers to giving examples of pesticides preventing damage to plants and their impact on the environment. Higher marks were awarded to answers that discussed, for example, the roll of herbicides in reducing time and labour costs, fungicides increasing plant yield and quality, & the build up of resistance to pesticides.

Many candidates gave variable definitions of integrated pest management, examples were mostly of biological controls in protected cropping situations. Candidates who gave examples of the advantages and limitations of the various techniques used in integrated pest management such as cultural controls, plant breeding, biological and chemical controls were awarded high marks.

Q16 a) Describe, using **THREE NAMED** examples, the symptoms of damage caused by viruses.

b) Relate the management of virus diseases in horticulture to their methods of transmission.

Some candidates were able to name three plant viruses. An accurate description of how the virus was expressed in the plant gained high marks.

The second part of the question was generally well understood. Good examples of managing the spread of viruses in plants were given including plant selection, sanitization and hygiene measures and controlling virus vectors.