RHS LEVEL 3 ADVANCED CERTIFICATE IN HORTICULTURE
WRITTEN EXAMINATION

2:00pm Tuesday 9th February 2010

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** modifications of the androecium for wind pollination. **2**

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Q2 State **TWO** characteristics of plants belonging to the Spermatophyta. **2**

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Q3 State **FOUR** benefits of ‘damping down’ in glasshouses. **2**

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Q4 State what is meant by ‘mass flow’ movement within the phloem. **2**

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Please see over/…..

ANSWER ALL QUESTIONS

MARKS

Q5 State **FOUR** factors that ensure the effectiveness of translocated herbicides. **2**

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Q6 Describe a horticultural use for **EACH** of the following spray nozzles:

i) flat fan;
ii) hollow cone. **2**

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Q7 Name a biological control agent for **EACH** of the following pests:

i) glasshouse white fly;
ii) mealy bug;
iii) slug;
iv) caterpillar. **2**

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ANSWER ALL QUESTIONS

MARKS

Q8 State **ONE** function of **EACH** of the following:

i) vacuole;
ii) middle lamella;
iii) plasmodesmata;
iv) ribosomes. **2**

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Q9 State **TWO** functions in epigeal germination of **EACH** of the following:

i) cotyledons;
ii) hypocotyl. **2**

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Q10 State the end products of the following processes:

i) aerobic respiration;
ii) anaerobic respiration. **2**

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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)	Draw large, clearly labelled diagrams to illustrate the internal and external structure of a dicotyledonous leaf.	**8**
	b)	Describe how specialised cells from any **TWO** leaf tissues, differ from non-specialised plant cells.	**6**
	c)	Describe, using **NAMED** examples, how the internal or external structure of leaves may be modified to perform functions other than photosynthesis.	**6**
Q12	a)	Distinguish between pollination and fertilisation.	**2**
	b)	Describe the process of pollination in angiosperms.	**5**
	c)	Outline with the aid of a large clearly labelled diagram, the structure of an angiosperm embryo, stating the function of **EACH** part.	**5**
	d)	State, using a **NAMED** plant example for each, **FOUR** fruit structures that enable dispersal by animals.	**8**

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Please see over/…..

Section C – Processes of Plant Physiology

Answer ONE question only from this section

MARKS

Q13 a) Define the term 'water potential'. **4**

b) Explain, with the aid of clearly labelled diagrams, how water and solutes enter and move within the plant. **12**

c) State **FOUR** methods the horticulturist can use to reduce transpiration from plants grown in a glasshouse. **4**

Q14 a) Define the term 'Plant Tropism'. **2**

b) Describe **EACH** of the following terms:

i) geotropism;
ii) phototropism;
iii) thigmotropism.

Explain how **EACH** term affects plant growth. **12**

c) Relate **EACH** of the above tropisms to sound horticultural practices. **6**

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Please turn over/…..

Section D – Knowledge of Plant Health

Answer ONE question only from this section

			MARKS
Q15	a)	Describe, with the aid of a clearly labelled diagram, the life-cycle of powdery mildew on a **NAMED** plant.	**8**
	b)	Evaluate **FOUR** different methods of controlling powdery mildew.	**12**

Q16	a)	Discuss the importance of weeds in **EITHER** an amenity situation **OR** a **NAMED** crop.	**8**
	b)	Evaluate current methods of weed control for their effectiveness and suitability for the chosen situation or crop named in a).	**12**

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MODULE B

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Knowledge of Plant Health
Processes of Plant Physiology

Candidates Registered	**343**		**Total Candidates Passed**	204	69.15%
Candidates Entered	295	86.01%	Passed with Commendation	51	17.29%
Candidates Absent	39	11.37%	Passed	153	51.86%
Candidates Deferred	8	2.33%	Failed	91	30.85%
Candidates Withdrawn	1	0.29%			

Section A – Short Answer Questions

Q1 State **FOUR** modifications of the androecium for wind pollination.

Although candidates generally answered this question very well, too many confused the androecium with the gynaecium or gave answers which addressed the overall features of wind pollinated flowers rather than the specific modifications relating to the androecium.

Candidates were expected to refer to specific modifications of the androecium including long filaments, anthers hinged to facilitate pollen distribution; the production of vast amounts of small grains of pollen, sometimes with wing like projections. Answers referring these to gained marks whilst confused references to styles, stigmas and small petals (flowers) failed to attract marks.

Q2 State **TWO** characteristics of plants belonging to the Spermatophyta.

Too many candidates did not understand the botanical reference to Spermatophyta and consequently failed to make the important link with “seed bearing” plants. Candidates gaining marks made references to plants being insect and wind pollinated; pollen producers; plants with flowers containing male and/or female parts or some being cone bearers; plants with seeds in enclosed ovaries (fruits) or exposed (naked) as in coniferous plants.

Marks were apportioned for partially correct answers or when only one characteristic was identified.

Q3 State **FOUR** benefits of ‘damping down’ in glasshouses.

Answers attracting marks included the cooling effect of “damping down” on glasshouse temperatures, increasing humidity levels helping to reduce plant stress and transpiration rate, stomata staying open and allowing photosynthetic processes to continue, discouraging two spotted spider mite and whitefly, reductions in spread of powdery mildew infections and improvement in working conditions for staff.

Only a few candidates were able to demonstrate a deeper knowledge by referring to beneficial effects such as improved pollination e.g. in tomato crops aiding the sticking of pollen grains to the female stigma and encouragement of the pollen grains to germinate and develop a pollen tube. The question asked for the benefits of damping down and any answers referring to the disadvantages were not rewarded.

Q4 State what is meant by ‘mass flow’ movement within the phloem.

Some answers to this question were rather weak and lacking in content and accuracy. A number of candidates incorrectly related mass flow to the uptake of water from the soil into the root system by osmosis and its subsequent upward movement via the xylem to leaves. Such answers did not attract marks other than where movement was linked to mass flow in the phloem.

Answers attracting marks usually made references to “sources” and “sinks”, sugars being actively pumped into the phloem at sites of photosynthesis (sources) and moved to meristematic or storage sites (sinks); high sugar levels in phloem encouraging the movement of water from the xylem i.e. high to low water potentials; increase in hydrostatic pressure pushing the sucrose solution along the phloem to the sink. A few candidates correctly referred to “sinks” becoming the “sources” of sugars as in the case of tap root storage organs re-growing in springtime.

Other valid references to mass flow attracted marks.

Q5 State **FOUR** factors that ensure the effectiveness of translocated herbicides.

Answers to this question were variable in accuracy and content. It was assumed that the correct translocated herbicide would be chosen for the weed population and also that the “general” label directions would be followed. Answers in this context did not attract marks. However, references using the correct dose/dilution rate and ensuring correct nozzle size and avoiding worn nozzles gained recognition.

Answers awarded marks referred to target weeds having large surface area to absorb maximum amounts of herbicide, target weeds being in active growth to translocate the herbicide, herbicide applied in periods of bright light, dry (no rain) and higher temperature conditions. Good candidate answers also referred to the use of “wetters” to stick the herbicide on leaf surfaces and weeds being turgid and not suffering water stress. Any references to application during periods of active water uptake, transpiration, photosynthesis and respiration were awarded marks.

Q6 Describe a horticultural use for **EACH** of the following spray nozzles:

i) flat fan;
ii) hollow cone.

Too many candidates were confused by the differences between these nozzle types and the specific horticultural uses to which each can be put. Candidates should have drawn clear distinctions between each nozzle type and its use or have qualified why each may be used under defined crop situations. Sometimes candidates failed to gain marks when they did not relate the nozzle to a horticultural use example.

Answers attracting marks may have sufficiently identified some of the following:-

i) <u>Flat fan nozzle</u>
Often used on hydraulic tractor mounted sprayers and sometimes used on knapsack sprayers to apply herbicides to arable cropping situations e.g. residual herbicides after sowing or planting identified crop types, applying pesticides to control pests and diseases in lawn turf situations or total weed killers applied to weedy areas before soil preparation or pathways, drives etc.

ii) <u>Hollow cone nozzle</u>
Normally used to apply insecticides or fungicides to taller growing crops where it is necessary to ensure a thorough wetting of all crop parts e.g. leaves, stems and flowers. Used to treat fruit, vegetables, nursery stock and glasshouse crops. Answers referring to hollow cone nozzles on tractor mounted hydraulic sprayers or knapsack sprayers would have attracted marks.

Q7 Name a biological control agent for **EACH** of the following pests:

i) glasshouse white fly;
ii) mealy bug;
iii) slug;
iv) caterpillar.

Too many candidates were incorrectly confusing the term “biological control” with physical and cultural control options and failed to gain marks when wrong examples were given. Biological control implies a living predator or other organism controlling an identified pest problem.

Marks were also not awarded when candidates gave the wrong biological control for the specific pest listed. Some allowance was made for correct answers with slightly incorrect spellings but candidates failed to gain marks when the answers (spellings) were too far off the target.

Answers awarded marks included:-

i) glasshouse white fly - Encarsia formosa
Delphastus pusillus

ii) Mealy bugs - Cryptolaemus montrouzeri

iii) Slugs - Phasmarhabditis hermaphrodita

iv) Caterpillar - Bacillus thuringiensis

Specific “trade names” when correctly identified with the pest e.g. <u>Nemaslug</u> (Phasmarhabditis hermaphradita) gained marks in the absence of the scientific name.

Q8 State **ONE** function of **EACH** of the following:

i) vacuole;
ii) middle lamella;
iii) plasmodesmata;
iv) ribosomes.

Candidates generally demonstrated a good knowledge of this subject area but it was notable that some candidates were unfamiliar with this terminology and in particular structures ii), iii) and iv) above presented some difficulty.

Possible answers were:

i) <u>vacuole</u>
maintenance of cell/plant turgidity; storage of metabolic or waste products; force cytoplasm outwards to cell edges to reduce diffusion paths for oxygen, carbon dioxide to mitochondria and chloroplasts etc.

ii) <u>middle lamella</u>
'cement' between cells; maintains tissue integrity under physical stress.

iii) <u>plasmodesmata</u>
form intercellular connective channels; permit cytosplasmic streaming between cells; facilitate water movement, mineral nutrients and organic solutes.

iv) <u>ribosomes</u>
sites of protein synthesis in cells.

Q9 State **TWO** functions in epigeal germination of **EACH** of the following:

i) cotyledons;
ii) hypocotyl.

Most candidates were sufficiently knowledgeable of this area of study to give answers attracting marks. Some candidates did not gain full marks when they omitted to give <u>TWO</u> functions of cotyledons and <u>TWO</u> functions of the hypocotyl.

Candidates generally were clear on the functions of cotyledons. References to their function as food stores to facilitate early development and after emergence becoming photosynthetic attracted marks. Their role in protecting the emergent growing point was also rewarded.

Candidates readily identified the role of the hypocotypl in its emergent hooked state being protective to the developing plumule and also its function in projecting the cotyledons above the soil to intercept light for photosynthesis. Only a few candidates noted that the hypocotyl is also capable of photosynthesis and able to develop lateral roots from the buried parts and absorb water and mineral nutrients.

Q10 State the end products of the following processes:

i) aerobic respiration;
ii) anaerobic respiration.

The question asks candidates to state the end products of aerobic and anaerobic respiration.

Answers which attracted marks included the following:

i) Aerobic respiration
carbon dioxide, water and high energy release (many ATP molecules).

ii) Anaerobic respiration
carbon dioxide, ethanol (ethyl alcohol) and low energy release (few ATP molecules).

Candidates who incorrectly quoted ethene (ethylene) as one of the products of anaerobic respiration failed to attract marks for this.

Section B – Principles of Plant Taxonomy, Morphology & Anatomy

Q11 a) Draw large, clearly labelled diagrams to illustrate the internal and external structure of a dicotyledonous leaf.

b) Describe how specialised cells from any **TWO** leaf tissues, differ from non-specialised plant cells.

c) Describe, using **NAMED** examples, how the internal or external structure of leaves may be modified to perform functions other than photosynthesis.

In general, the quality of the drawing of both external and sectional views of the leaf was good and a distinct improvement on earlier years. Most candidates drawings were large and well-labelled. Sometimes, however, label lines failed to reach the part labelled. The use of colour and shadings does not always add to the clarity of the drawing. Drawings, also, should either consistently include cell walls or omit them. Many drawings seemed to imply the presence of chloroplasts in the cell wall. Organelles should not be included in drawings at this level of magnification.

Common choices for the specialised cells were guard cells and palisade mesophyll cells. Complex tissues caused some problems e.g. candidates who chose xylem often named the specialised cell as a xylem cell rather than tracheid or vessel element and then confused the two or confused them with a sclerenchyma fibre. The emphasis of the question was on specialised types of cell rather than tissues. Chloroplast was sometimes stated to be a specialised type of cell. Diagrams were seldom used to illustrate the cell chosen.

It was expected that a large range of leaf modifications could have been put forward, both external (e.g. tendrils or hairs on the epidermis) and internal (e.g. water storage in the mesophyll of leaf succulents). It was essential, though, that the function of the modification was given and this candidates did not always do. Spines were often stated to be protective without it being clear what they were protecting the plant against i.e. herbivory. The thick cuticle and reduced size of Pinus leaves were usually stated to reduce water loss in dry habitats instead of being adaptations of evergreen plants to the relative unavailability of water in cold conditions. It must be noted that cactus is not a plant name but Ferocactus or Opuntia (or similar) should have been given instead.

Q12 a) Distinguish between pollination and fertilisation.

b) Describe the process of pollination in angiosperms.

c) Outline with the aid of a large clearly labelled diagram, the structure of an angiosperm embryo, stating the function of **EACH** part.

d) State, using a **NAMED** plant example for each, **FOUR** fruit structures that enable dispersal by animals.

Pollination was usually understood to be the transfer of pollen from anther to stigma while fertilisation as the fusion of male and female gametes to produce a zygote was not usually stated clearly. In particular, male gametes and pollen and female gametes and ovules were often confused.

The description of pollination and the agents involved (insect or wind) was usually done well. Marks were also awarded for descriptions of flower modifications for insect or wind pollination and for the distinction between self- and cross-pollination. Many candidates went on to describe fertilisation although this was irrelevant in this part of the question.

The diagram of the embryo was almost always drawn in situ in the seed but the distinction

between parts belonging to the embryo and those belonging to the enveloping seed was hardly ever made specific. However, marks were awarded whenever the candidate did not obviously confuse the two.

The botanical name for the type of fruit was required together with a named plant example. Berries, pomes and drupes were common acceptable answers although the examples were sometimes wrong, usually due to candidates being misled by the common name (Ilex has a berry but Cotoneaster and Crataegus both have promes). It should be mentioned in answers that the pome has receptacle as well as ovary material involved in its structure. Rubus was accepted either as an aggregate fruit, drupelet or even drupe if it was clear one unit was meant. Dry fruits were less well-known; the commonest answer was usually a nut but the use of hooked pericarps, styles etc could have been mentioned. Common names are not acceptable as named plant examples.

Section C – Processes of Plant Physiology

Q13 a) Define the term 'water potential'.

b) Explain, with the aid of clearly labelled diagrams, how water and solutes enter and move within the plant.

c) State **FOUR** methods the horticulturist can use to reduce transpiration from plants grown in a glasshouse.

The aims of the question were to explore how water and solutes move within the plant. It is important to understand the concept of water potential as this is of major importance in respect to this question.

The examiner was looking for a scientific definition of water potential which will be further explained in section b) of the question. The movement of water to include all the different processes and pathways within the plant was required. The movement of solutes by active transport with phosphorus bonding was required to fully answer the question.

Candidates' answers provided good information on the movement of water into and within the plant. Diagrams in many cases were small and not labelled correctly. A major observation was the lack of information by the majority of candidates on the movement of solutes within the plant. Many candidates recorded in one or two lines that solutes move in the phloem. The examiner was looking for the processes involved in moving solutes within the plant which are of major importance in the growth and development of plants.

The reduction of transpiration within a glasshouse required an exact answer as general answers very often did not provide sufficient details. The examiner was looking for examples to include:

- shading on the outside of the glass (shading on the inside of a glasshouse will reduce light intensity but will not reduce heat in the glasshouse).
- increasing the relative humidity by 10% can dramatically reduce transpiration without having an adverse effect on plant growth and development. Many candidate answers simply recorded that the relative humidity should be changed without providing any further information.
- reducing the air temperature by careful ventilation which avoids direct air currents in the glasshouse is recommended.
- the use of anti-transparent sprays may be used on mature plants, however care must be practised with this technique as the growth and development of plants can be adversely affected by this application.

Candidates are advised to carefully read the question, it is clear from the candidates responses that the word **solute** was not given due consideration in formulating answers to this question. Excellent answers however were provided for water movement. It was however disappointing **not** to observe many answers on how solutes are transported within the plant.

Q14 a) Define the term 'Plant Tropism'.

b) Describe **EACH** of the following terms:

i) geotropism;
ii) phototropism;
iii) thigmotropism.

Explain how **EACH** term affects plant growth.

c) Relate **EACH** of the above tropisms to sound horticultural practices.

The definition of a Plant tropism was clearly explained by the majority of candidates. Poor examination technique, resulting in a general incomplete answer was a common fault of some candidates, who perhaps rushed this section of the question.

The examiner was looking for a clear relationship between the plant tropisms and plant growth and development. Many candidates provided a detailed definition of the plant tropism but did not relate this to the growth and development of plants.

It was expected that candidates would relate internal plant processes to the concept of plant tropisms. This was achieved by many candidates who were awarded higher marks. There was some confusion on other plant movements i.e. nastic movements by a small number of candidates.

Answers to section c) of the question were very general and not in the majority of cases providing information at a level 3 qualification level. The examiner was looking for technical as well as practical horticultural practices. An example is geotropism, plant pots are dark in colour in order to prevent light penetration to the roots.

This was a question which required good examination technique. A long script was not required as the topic is technical and exact. Many candidates however provided very general answers and often repeated themselves making the same point several times. In addition, the sound horticultural practices were in the majority of cases very limited and did not relate to current horticultural practice.

Section D – Knowledge of Plant Health

Q15 a) Describe, with the aid of a clearly labelled diagram, the life-cycle of powdery mildew on a **NAMED** plant.

b) Evaluate **FOUR** different methods of controlling powdery mildew.

Few diagrams illustrated the complete life-cycle, including seasonal timings. The majority described the typical symptoms and spore movement during the summer. Full marks were awarded for mentioning the asexual and sexual spores and their role in the life-cycle. Additionally the Latin name was required for the named host plant.

Many candidates were able to name four control measures suitable for controlling powdery mildew. Full marks were awarded for discussing both negative and positive aspects of each method rather than producing a list of control methods.

Examples of suitable answers would be:

Sulphur can be used as a control for American gooseberry mildew. This should be used before or at first sign of the disease and will give good control for the whole season, but should not be used on sulphur-shy varieties such as ‘Leveller’ or ‘Bedford Yellow’.

Purchasing powdery mildew resistant plants. This will reduce the infection of plants by powdery mildew and reduce chemical controls required, although there may be an increased initial cost and in years of severe disease outbreaks may still become infected.

Removal and disposal of leaf litter and infected plant material will reduce the overwintering stage and limit infection next season, although with large areas this can be time consuming and laborious.

Q16 a) Discuss the importance of weeds in **EITHER** an amenity situation **OR** a **NAMED** crop.

b) Evaluate current methods of weed control for their effectiveness and suitability for the chosen situation or crop named in a).

In general the majority of the candidates were able to give a good account of the negative aspect of weeds, being aware of how weeds compete for water, light and nutrients as well as harbouring pests and diseases. Higher marks were awarded for highlighting the benefits of weeds (harbouring beneficial insects such as bees and ladybirds) and discussing this in relation to an amenity or crop situation (affecting the appearance, public safety and yield loss depending on the situation).

The second section was answered well with many candidates giving a well rounded answer highlighting both chemical and cultural controls as well as preventative and curative methods. It was sometimes overlooked that the evaluation of control methods had to be in relation to the situation named in section a). The majority of answers used an amenity area consisting of lawn and beds and were able to name appropriate, effective and suitable control measures.