RHS LEVEL 3 ADVANCED CERTIFICATE IN HORTICULTURE
WRITTEN EXAMINATION

2:00pm Tuesday 6th July 2010

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 Name **FOUR** leaf adaptations giving a **NAMED** plant example for **EACH**. **2**

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Q2 Label the **FOUR** features of the corm arrowed below in figure 1. **2**

Figure 1

Q3 Explain the difference between a petal and a tepal, giving **ONE NAMED** plant example of **EACH**. **2**

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Please see over/…..

MARKS

Q4 Give **FOUR** different examples of how viruses can be transmitted between plants. **2**

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Q5 Allocate **EACH** of the following to the appropriate column below:

i) oedema; ii) scale; iii) big bud; iv) canker. **2**

PEST	DISEASE	DISORDER
……	……	……
……	……	……
……	……	……
……	……	……

Q6 Distinguish between the zone of elongation and the zone of differentiation in the root systems of plants. **2**

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Q7 State what is meant by the term ‘partial soil sterilisation’. **2**

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Please turn over/…..

ANSWER ALL QUESTIONS

MARKS

Q8 a) Define the term ‘nastic movement’.

b) Give a **NAMED** example. **2**

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Q9 Explain the possible effects of road salt on plants growing in adjacent soil. **2**

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Q10 Explain why plants have the potential for growing during darkness. **2**

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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) State the main characteristics of members of the plant kingdom. **2**

b) Describe the following divisions of the plant kingdom:

i) mosses; **3**
ii) ferns; **3**
iii) gymnosperms; **3**
iv) monocotyledons; **3**
v) dicotyledons. **3**

c) Describe, what is meant by the term 'family' in the classification of plants. **3**

Q12 a) Describe the distribution of vascular tissue in the young dicotyledonous stem and root. **8**

b) Describe, using clearly labelled diagrams to illustrate your answer, **FOUR** non-lignified types of cells to be found in the young root and state a function for **EACH**. **12**

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Please see over/…..

Section C – Processes of Plant Physiology

Answer ONE question only from this section

MARKS

Q13 Explain how the horticulturist can maximise the process of photosynthesis by manipulating the following environmental conditions:

i)	light;	**6**
ii)	nutrients;	**5**
iii)	carbon dioxide;	**4**
iv)	water availability.	**5**

Q14 a) Explain the central role of respiration in plant growth. **14**

b) Explain how a grower ensures that respiration proceeds optimally. **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, a **NAMED** spray applicator. **8**

b) Describe how to calibrate the spray applicator named in a). **6**

c) Describe the safe working practices for the spray applicator named in a). **6**

Q16 a) Review the methods by which insects damage plants. **8**

b) Describe how the different life cycles of insects affect possible control methods. **12**

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MODULE B

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

Candidates Registered	**147**		**Total Candidates Passed**	**47**	**44.77%**
Candidates Entered	105	71.43%	Passed with Commendation	8	7.62%
Candidates Absent	25	17.01%	Passed	39	37.14%
Candidates Deferred	16	10.88%	Failed	58	55.24%
Candidates Withdrawn	1	0.68%			

Section A – Short Answer Questions

Q1 Name **FOUR** leaf adaptations giving a **NAMED** plant example for **EACH**.

This question was well answered by most candidates, although some found difficulty in identifying FOUR adaptations together with a named plant example for each. Adaptations which included, for example sunken stomata; in-rolling of leaves; silvery white leaf surface scales; hairy indumentums; leaf reduction to form spines; tendril adaptations and bulbous swollen leaf bases all attracted marks. Other valid examples also gained marks. Marks were not awarded to invalid answers which confused stems with leaf structures, for example, corms; cladodes and the swollen barrel stems of cacti.

Q2 Label the **FOUR** features of the corm arrowed below in figure 1.

This question highlighted a weakness in candidates' knowledge of the basic structure of corms. Candidates were asked to identify FOUR common features associated with corms. Marks awarded were relatively low due to either the inability to identify the part indicated; incorrect identification of the part or incomplete answers which failed to distinguish the part from other associated structures.
The FOUR features which should have been identified included the new (daughter) corm or leaf sheath bases; the old (shrivelled up) corm; the cormlets or cormels; and finally adventitious roots.
Answers incorrectly identifying the cormlets as bulbils or bulblets did not receive marks. Similarly answers identifying "roots" alone failed to gain marks since it insufficiently distinguished the correct answer "adventitious roots" from contractile roots which would have been joined to the "new corm" base.

Q3 Explain the difference between a petal and a tepal, giving **ONE NAMED** plant example of **EACH**.

Some clear accurate answers were given to this question indicative of sound teaching and revisionary processes having taken place. Candidates were expected to identify that petals formed a separate whorl within the distinct whorl of sepals which forms the protective calyx whilst tepals form two whorls of similar perianth segments e.g. tulips. Answers along these lines gained marks.
Many good named plant examples were identified including roses and aster representative of flowers with separate whorls of petals and sepals whilst tulips and crocus examples were given to represent tepals. Other valid examples gained marks as did those answers using correct botanical genus and species names.

Q4 Give **FOUR** different examples of how viruses can be transmitted between plants.

Many answers gave FOUR different and correctly identified examples of virus transmission. These included references to virus transmission by sap sucking insects; cross infection on propagation or pruning tools from infected to healthy plants; random feeding by soil borne free living nematodes on plant root systems and planting healthy plants into virus infected soil situations etc. Other valid answers also gained marks.
Answers should have been indicative of the possibility of sap transfer between plants to gain marks.
Answers quoting wind (air) or water transmission did not attract marks. Similarly answers referring to growing plants close together without reference to the transmission mechanism, e.g. plant rubbing/wind rub etc for sap transfer, did not gain marks.
References to seed coat/tissue transmission and tomato (tobacco) mosaic transmission on the hands of (smoker) workers were rewarded.

Q5 Allocate **EACH** of the following to the appropriate column below:

i) oedema; ii) scale; iii) big bud; iv) canker.

PEST	**DISEASE**	**DISORDER**

Most candidates failed to get the FOUR examples of pests, diseases or disorders in the correct box. Only a relatively low number of candidates gained full marks.
Answers generally and quite correctly placed oedema as a disorder; scale as a pest and canker as a disease. Most candidates were unsure of where to place ‘big bud’! Some placing it as a disorder (swollen bud) and some as a disease possibly because of its links with ‘reversion virus’ disease. The causal organism is the ‘big bud mite’ and as such should have been grouped under the pest column.

Q6 Distinguish between the zone of elongation and the zone of differentiation in the root systems of plants.

There was confusion with many candidates when attempting to distinguish between the zone of elongation and the zone of differentiation in the root systems of plants. Some candidates wrongly indicated their relative position behind the root cap and apical root meristem. Although some reduced mitotic cell division can still occur in the zone of elongation, candidates tended to over emphasise this and failed to refer to the importance of the increase in individual cell size (vacuolation) in pushing the growing points forward into the soil. Although the early stages of vascular development can appear here and cellulose starts to be laid down on cell walls, candidates should have referred more to the rapid increase in size of individual cells. In the zone of differentiation candidates should have made more positive reference to this being the site where mature vascular tissues develop. Also more precise references to the development of other tissues such as cortical tissue; pericycle, endodermis and the piliferous layer could have been made to distinguish clearly from the elongation zone.
Marks were appointed to reflect the standard of answers given.

Q7 State what is meant by the term ‘partial soil sterilisation’.

Candidates produced a very variable response to what is meant by the term ‘partial soil sterilisation’. Marks were not awarded for references to the growing of certain crops leaving behind claimed sterilisation benefits. This is not what is generally accepted as partial soil sterilisation.
Answers attracting marks would have referred to partial soil sterilisation as being the use of heat (various sources) a range of chemical treatments to control a wide range of harmful organisms including soil borne pests, diseases and weed seeds whilst at the same time leaving many (not all) beneficial organisms unaffected.
Candidates frequently failed to identify weed seed control as one of the main objectives of partial soil sterilisation. Those candidates, who in support of their answers used references to heat sources e.g. steam and temperatures required to have an effect and named a chemical alternative, e.g. Dazomet (Basamid), gained marks.

Q8 a) Define the term ‘nastic movement’.

b) Give a **NAMED** example.

Many candidates gained full marks with clear definitions and accurately named examples to this question.
Unfortunately some candidates failed to give accurate answers by confusing nastic movements with tropic responses. Answers attracting marks made references to a nastic movement as being a plants non-directional movement (response) to an external stimulus, for example, the opening or closing of flower in response to diurnal (light/dark) variations as in crocus, tulips etc or a similar response to temperature variations, as in witch hazel flowers etc. the latter being a thermo-nastic movement.
Other valid answers gained marks.

Q9 Explain the possible effects of road salt on plants growing in adjacent soil.

Too many candidates failed to give a range of examples of 'possible effects of road salt on plants' and this failed to gain full marks. Some answers in this context only referred to the effect of plasmolysis and its associated reversal of high to low water potentials. Full marks were awarded when answers included other potential effects, including salt deposition on foliage and reduced photosynthesis; foliar scorch; wilting (flaccidity) of plant tissues and in some cases eventual plant death.

Q10 Explain why plants have the potential for growing during darkness.

Candidates who were able to make the link between the interdependency of photosynthetic and respirational processes to a plants potential for growth during darkness were awarded marks.
Answers were expected to refer to daytime 'sugar' production and the storage of surplus amounts, which are essential for night time respirational processes to release chemical energy to fuel the growth of plant tissues. Candidate references to night time completion of the photo-synthetic processes to produce sugars for growth in some specialised plants was noted and rewarded accordingly. Candidates' too frequently failed to stress the day time build up and night time burn up of sugars being closely linked to the potential for growth during darkness. In these cases full marks were not awarded.

Section B – Principles of Plant Taxonomy, Morphology & Anatomy

Q11 a) State the main characteristics of members of the plant kingdom.

b) Describe the following divisions of the plant kingdom:

i) mosses;
ii) ferns;
iii) gymnosperms;
iv) monocotyledons;
v) dicotyledons

c) Describe, what is meant by the term 'family' in the classification of plants.

The first part of this question was concerned with the characteristics that all plants have in common while the second part was concerned with the characteristics defining some sub-groups of the plant kingdom. The third part was concerned with one particular level of the taxonomic hierarchy.

The general consensus is that the plant kingdom excludes fungi and most algae. Photosynthesis is characteristic of all algae as well as plants so is not acceptable as an answer. A cell wall is also found in fungi so its composition is important. Acceptable answers included the presence of chlorophyll (strictly speaking chlorophylls a and b, only found in plants and some algae) and a cellulose cell wall.
Descriptions of mosses and ferns were not well done. Answers could have included a reference for mosses to a dominant gametophyte, no true roots, no true vascular tissue, Sphagnum as an example and a reference for ferns to a thalloid gametophyte, true roots and spores produced on leaves. Gymnosperms were widely known to have seeds not produced in an ovary (naked). Other characteristics were usually forthcoming and good examples were named. Monocotyledons and dicotyledons were known very well in comparison although there was still a widespread belief that monocotyledons were wind-pollinated with insignificant flowers while dicotyledons were insect-pollinated with showy flowers.

Many candidates knew that a family is composed of a number of genera with major botanical characteristics in common, e.g. flowers in umbels for the Apiaceae, and were able to give an example.

Q12 a) Describe the distribution of vascular tissue in the young dicotyledonous stem and root.

b) Describe, using clearly labelled diagrams to illustrate your answer, **FOUR** non-lignified types of cells to be found in the young root and state a function for **EACH**.

The aim of the question was to test candidates' knowledge of the primary anatomy of the stem and root of dicotyledonous plants.

It is important always to carefully read the question and to frame an answer according to the instructions. In the first part of this question, candidates usually failed to follow the instruction to describe the layout of vascular tissue in the young stem and root. Many provided diagrams alone and this limited the marks they could gain.
A similar mis-reading occurred in the answers to the second part of the question. Candidates were asked to describe four types of cell. However, many confused cell and tissue e.g. type of cell given as phloem and the description including sieve-tube cells and companion cells. Despite the question stating 'non-lignified', many candidates included xylem in their answer. Descriptions were requested with diagrams to illustrate the answer but most gave a description only..

Section C – Processes of Plant Physiology

Q13 a) Explain how the horticulturist can maximise the process of photosynthesis by manipulating the following environmental conditions:

i) light;
ii) nutrients;
iii) carbon dioxide;
iv) water availability.

This question relates the needs of photosynthesis to the methods by which the horticulturist can improve the efficiency of photosynthesis. It is important to note that this is not a question on the biochemical processes of photosynthesis. The question tests the candidates knowledge of environmental factors which can be manipulated in order to improve the photosynthetic rate for plants.

Two main problems existed with the majority of candidates scripts;

- candidates did not read the question carefully and the majority of candidates spent much time recording the biochemical processes of photosynthesis which was not requested in the question,
- the environmental factors were recorded in a very general way. The key points are listed below;

- Light: Quality, duration, intensity. Orientation of protective structures. Cleanliness of cladding material. Use of reflective material inside protective structures. Supplementary and replacement lighting.
- Nutrients: nitrogen and magnesium to be used for chlorophyll production. The availability of nutrients to include quick release, controlled release, liquid and foliar feeding. The strength of fertilisers to be included.
- Carbon dioxide: The methods of increasing carbon dioxide to include ventilation, burning propane gas and direct injection of carbon dioxide into protective structures. The timing and the levels of carbon dioxide to be recorded.
- Water availability: The importance of supplying water to meet the needs of the plant. Examples of mechanised water systems to include hydroponics. An understanding of the plant response periods which are used to make maximum use of the water supply. Methods of measuring the plant water requirements to include soil tensiometers, hydrometers and Jones Rothwell evaporators.

Q14 a) Explain the central role of respiration in plant growth.

b) Explain how a grower ensures that respiration proceeds optimally

This question tests the candidates knowledge of the concepts of glycolysis and the Krebs cycle. The relationship of temperature, source-sink concept and photosynthetic rates must be recorded with reference to respiration. A review of the requirements for respiration should be included in the candidates answer.
An explanation was expected of methods of maintaining respiration by a grower, to include manipulating the requirements for respiration. The stage of plant growth used to maximise respiration rates to be explained. The relationship between photosynthesis and respiration to be included in the answer.

13% of candidates opted to answer this question, 87% of candidates answered question 13 - candidates had to answer question 13 or 14.
Part (a) of the question was answered efficiently by the majority of candidates. Higher marks were awarded to candidates who provided detail of the role of respiration and related it to plant growth.
Part (b) proved to be more difficult to the majority of candidates. It is important (especially with this horticultural examination) to be able to relate botanical processes to horticultural operations. The examiner was looking for a good relationship between the botanical process and the listed horticultural operation.
Candidates who made very general statements without providing any detail were not awarded any marks.

Section D – Knowledge of Plant Health

Q15 a) Describe, with the aid of a clearly labelled diagram, a **NAMED** spray applicator.

b) Describe how to calibrate the spray applicator named in a).

c) Describe the safe working practices for the spray applicator named in a).

In part a, a clear understanding of how a single named sprayer functions is needed. With points awarded for name (as this affects the answers for all 3 sections of this question), and major parts such as tank/reservoir, pressure mechanism, safety pressure valves, nozzles, filters and carrying harness.

In part b a description of how to measure flow rate, spray width and operator speed and a worked example illustrating their relationship was required.

Part c of the question was to show understanding of safe working. Marks were awarded for each separate identified point, such as regular sprayer maintenance, correct calibration, use of PPE, sprayer cleaning, COSHH, risk assessments, weather conditions and protecting members of the public.

Few candidates chose this question to answer. Many candidates were able to identify the external parts of a sprayer, but those who presented clear labelled diagrams with associated details of internal workings gained higher marks.

Section b appeared a problem area for some candidates as described calibration methods did not centre on the three criteria required and often had laborious calibration protocols. Those who demonstrated a clear understanding providing a worked example were awarded higher marks.

Section c provided an area for many to gain marks, with candidates showing consideration of the environment, members of the public and the safety of the operator. Better candidates highlighted the maintenance of spray equipment and checking for damage.

Q16 a) Review the methods by which insects damage plants.

b) Describe how the different life cycles of insects affect possible control methods.

In part a the examiner was looking for four different types of damages caused by insects and the subsequent effect on the host plant. Acceptable answers would be sapsuckers, such as aphids, resulting in leaf distortion; leaf and stem eaters, such as slugs, resulting in reduced leaf area and subsequently photosynthesis; leaf miners, such as horse chestnut leaf miner, reducing green leaf area and subsequently photosynthesis; and root eaters, such as vine weevil larvae, reducing root system resulting in wilting of plants. Additional marks could be gained for viral transmission between plants.

In part b demonstration of four different insect lifecycles was required, naming the vulnerable stage and how the control measure is suitable. Examples of suitable answer would be for cabbage white butterfly, which has eggs, caterpillar, chrysalis and butterfly. The vulnerable stage would be the caterpillar for which a biological control of a nematode (Steinernema carpcapse) could be used that attacks the caterpillar. Alternative control could be achieved by using fleece over the crop preventing the butterflies from reaching and laying eggs, subsequently reducing caterpillar presence and damage.

Many candidates attempted this question. The understanding of damage caused by insects was clearly demonstrated by all candidates but full points were not always achieved due to selecting insects causing the same damage, e.g. slugs, sawfly and vine weevil adults all eating leaves and reducing photosynthesis. Higher points were awarded for giving examples of a wider range of damage seen and the subsequent affect on the plants.

Section b had many good descriptions of lifecycles. There were also some good details regarding the control measures suitable for insects. Few were able to bring these two elements together, as required by the question, to relate why certain stages were targeted by control measures. Good clear examples benefited candidates by showing their understanding and resulted in higher marks awarded.