



**RHS LEVEL 3 ADVANCED CERTIFICATE IN HORTICULTURE
WRITTEN EXAMINATION**

Tuesday 7 February 2012

2:00pm – 4:00pm

MODULE B

**Principles of Plant Taxonomy, Morphology and 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.
- vii) Please note, sufficient lined space is provided. It is not necessary that all lined space is used in answering the questions.

Please turn over/.....

ANSWER ALL QUESTIONS

MARKS

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

- i) two spotted spider mite;
- ii) capsid bug.

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Q2 Identify the visual symptoms for **EACH** of the following plant/crop problems:

- i) rust;
- ii) oedema.

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Q3 Explain the mode of action for the chemical control of a **NAMED** perennial weed.

2

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Please see over/.....

Q4 State **FOUR** environmental factors external to the plant that increase transpiration.

2

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Q5 State **TWO** methods that move metabolic products from their source to where they are stored in the plant.

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Q6 a) State what is meant by plant tropism.

b) Identify **ONE** other type of plant growth movement.

2

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Q7 Describe the structure and function of:

2

- i) mitochondria;
- ii) chloroplasts.

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Q8 **Name** a stem adaptation and state its function. **2**

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Q9 Identify **TWO** specific epithets derived from **EACH** of the following:

i) person;

ii) shape. **2**

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Q10 State **FOUR** hazards associated with the handling of plants during identification. **2**

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MODULE B

**Principles of Plant Taxonomy, Morphology and Anatomy
Processes of Plant Physiology
Knowledge of Plant Health**

Sections B, C and 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.
- vii) Please note, sufficient lined space is provided in the answer booklets. It is not necessary that all lined space is used in answering the questions.

Please turn over/.....

Section B – Principles of Plant Taxonomy, Morphology and Anatomy

Answer ONE question only from this section

MARKS

- Q11** a) Describe, with the aid of clearly labelled diagrams and named plant examples, **ONE** fruit from **EACH** of the following categories:
- i) dry indehiscent;
 - ii) dry dehiscent;
 - iii) fleshy/succulent.
- 15**
- b) Describe how the types of fruit in a), enable efficient dispersal of the contained seeds.
- 5**
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- Q12** a) Describe, with the aid of clearly labelled diagrams, the structure of the following types of seed:
- i) dicotyledonous;
 - ii) monocotyledonous.
- 10**
- b) State the function of **EACH** of the parts of a seed.
- 6**
- c) Explain how the seedcoat may limit germination.
- 4**

Please see over/.....

Section C – Process of Plant Physiology

Answer ONE question only from this section

MARKS

Q13 a) Explain, with the aid of clearly labelled diagrams, how water is lost from the plant.

6

b) Explain how water loss is reduced from plants in **EACH** of the following situations:

- i) plant propagation;
- ii) shrub planting on a windy site;
- iii) a recently potted up cutting under glass.

9

c) Explain why excessive transpiration is detrimental to plant growth and development.

5

Q14 a) Describe the effects of environmental factors on **EACH** of the following plant processes:

- i) photosynthesis;
- ii) respiration;
- iii) phototropism.

12

b) Describe how the above three processes affect the optimal growth of a plant.

8

Please turn over/.....

Section D – Knowledge of Plant Health

Answer ONE question only from this section

		MARKS
Q15	a) Review a NAMED bacterial disease under EACH of the following headings:	1
	i) host range;	1
	ii) symptoms and damage;	2
	iii) spread;	2
	iv) chemical control method;	2
	v) cultural control methods.	2
	b) Review a NAMED fungal disease under EACH of the following headings:	1
	i) host range;	1
	ii) symptoms and damage;	2
	iii) spread;	2
	iv) chemical control method;	2
	v) cultural control methods.	2
Q16	a) Describe the effects of the current Plant Protection Products Directive on the use of pesticides within the EU.	14
	b) Describe the requirements of a storage facility, used to hold small quantities of pesticides, in accordance with current legislation.	6

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MODULE B

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

Candidates Registered	33		Total Candidates Passed	15	68.18%
Candidates Entered	22	66.67%	Passed with Commendation	3	13.64%
Candidates Absent	9	27.27%	Passed	12	54.54%
Candidates Deferred	-	-	Failed	7	31.82%
Candidates Withdrawn	2	6.06%			

Section A – Short Answer Questions

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

- i) two spotted spider mite;
- ii) capsid bug.

Candidate answers indicated a good knowledge of the two spotted spider mite but weak and often inaccurate answers were given for capsid bug visual symptoms.

For the first part of the question they should have referred to the visual presence of mites and symptoms of whitish yellow leaf speckles coincident with feeding sites, later developing symptoms of leaf bronzing and webbing with heavy mite infestations.

Few candidates indicated a visual loss of plant vigour with severe attacks.

For the second part, answers lacked detail and accuracy. Most candidates failed to link attacks with soft new growth on shrubby and herbaceous plant material. Those gaining marks indicated either leaf, bud or shoot distortion associated with the insects toxic saliva; also whitish yellow leaf spotting which later tears into small holes with brown edges.

Q2 Identify the visual symptoms for **EACH** of the following plant/crop problems:

- i) rust;
- ii) oedema.

In the first part of the question candidates should have referred to rust primarily attacking leaves but may also develop along plant stems, petioles etc. Marks were awarded for descriptions of rust pustules (spores) being orange in colour but reference to these changing colour at different stages of the year/fungal stage development indicated a good knowledge of the problem. Complete answers referred to leaf fall, plant skeletonisation and loss of plant vigour.

For oedema the answers were more variable and less accurate descriptions were given. Answers attracting marks referred to “greenish” leaf surface eruptions mainly on the underside of leaf tissue as often seen in e.g. ivy leaved pelargonium (*Pelargonium peltatum*). Good answers referred to these eruptions becoming “corky” in appearance and turning brownish in colour. References to affected areas possibly cracking or splitting also gained marks.

Q3 Explain the mode of action for the chemical control of a **NAMED** perennial weed.

Overall candidates gave satisfactory answers to this question and sometimes indicated that perennial weeds could not be controlled by most contact or residual herbicides. Good answers indicated that perennial weeds had some means of perennation making them more difficult to control and requiring treatment with chemical herbicide which either have translocated or selective/growth regulator modes of action. Answers gaining marks referred to these modes of action and indicated that they are applied to leaf surfaces into which they are absorbed and translocated to all parts of the plant body especially the root system. With herbicides candidates should preferably refer to “translocated” rather than systemic herbicides. However the use of the term systemic is not strictly inaccurate in this context and the examiner did not penalise answers which used this term. Most candidates were able to name one example of a perennial weed.

Q4 State **FOUR** environmental factors external to the plant that increase transpiration.

A good knowledge of this subject area was demonstrated in the answers given to this question with most candidates gaining full marks.

Candidates were able to identify the following:-

- Increase in transpiration could be related to daylight or increasing level of light intensity compared with darkness;
- temperature increasing above 6°C;
- dry atmospheric conditions; increasing air movement (wind) across leaf surfaces.

- Q5** State **TWO** methods that move metabolic products from their source to where they are stored in the plant.

This question represented a weak area of knowledge for many candidates who failed to gain full marks.

Answers attracting marks were methods which could be grouped under the headings of “active transport” or the “mass flow hypothesis”.

Answers including active transport could have referred to energy aided transport; the movement of sugar from production sites into the phloem; loading the phloem via metabolically active transfer cells etc.

Reference to the mass flow hypothesis attracting marks could have included references to water potential gradients; osmosis creating hydrostatic pressure to move sugar along/down phloem tubes; loading sugars at source and off loading at sinks; high sugar levels in phloem drawing water into sieve tubes and pushing sugars towards sinks etc.

- Q6** a) State what is meant by plant tropism.
- b) Identify **ONE** other type of plant growth movement.

Answers to this question indicated a sound understanding of plant tropisms with most answers attracting full marks for this section. However some candidates either failed to give an answer for part (b) or confused it with part (a) by giving references which were in fact plant tropisms.

Answers to part (a) attracting full marks referred to a bending or movement in plants towards or away from an external stimulus coming from a particular direction.

For part (b) candidates had to identify one other type of plant growth movement.

References to “nastic movements” gained full marks. It was unnecessary to identify examples of nastic movement but those who did were rewarded if the example given was in fact a nastic movement.

- Q7** Describe the structure and function of:
- i) mitochondria;
 - ii) chloroplasts.

This question revealed a weakness amongst many candidates in this area of the syllabus. The question was rarely answered in full and as a result only a few candidates were awarded full marks. A recurring feature was candidates giving answers to the function of mitochondria and chloroplasts but failing to describe the structure of each.

Answers attracting marks would have made some reference to the following: -

Mitochondria

Structural references could have included mitochondria being sausage shaped with an ability to change shape frequently; mitochondria being surrounded by two membranes i.e. outer and inner membrane with the inner membrane being deeply folded with finger like folds called “crista”; references to two internal compartments and the presence of the matrix within the inner compartment etc. Function references should include mitochondria releasing stored energy for growth; sites of respiration where sugars combine with oxygen for energy release etc.

Chloroplasts

Answers to the structure of chloroplasts may have included references to inner and outer membranes; with thylakoid membranes in stacks called grana etc. Functional references may have included sites of photosynthesis; light absorbing pigment (chlorophyll); sites where carbon dioxide is converted into sugars etc.

Q8 Name a stem adaptation and state its function.

Many candidates were able to accurately name a stem adaptation and to state its function. A frequent and accurate answer given was a potato tuber (a swollen stem) whose function is to store carbohydrate and reproduce/develop new growth. Other types of stem adaptation accurately quoted included cornus of *Crocus*, *Gladiolus*, and *Crocasmia* etc. which are swollen stems acting as a food store to fuel future growth development. A number of candidates referred accurately to stem thorns for protection; creeping surface stolons for reproduction and stem tendrils etc. for support.

Q9 Identify **TWO** specific epithets derived from **EACH** of the following:

- i) person;
- ii) shape.

Too many candidates failed to gain full marks because they did not give TWO specific epithets for EACH of (i) person and (ii) shape as the question required. As a result for many only up to half marks were possible.

Accurate answers for the first part of the question would include examples such as *Primula bulleyana*; *Berberis darwinii*, *Euonymus fortunei*. Marks were still given even when the generic name was left out viz *bulleyana*; *darwinii*; *fortunei* etc. A similar approach was adopted for the second part where accurate answers included *Betula pendula*; *Hydrangea quercifolia*; *Acer palmatum* etc.

Q10 State **FOUR** hazards associated with the handling of plants during identification.

Some candidates failed to gain full marks for this question because they wrongly linked the question to the damage that could be caused to plant material by mis-handling rather than the hazards (to humans) when handling plants.

Examples of such hazards include e.g. skin dermatitis (*Primula obconica*); skin sever blisters (*Ruta graveolens*); skin rashes from sap contact, (*Euphorbia* spp.), cuts from sharp leaf edges (*Cortaderia selloana*); sharp nodal remains (*Bambusa* sp); skin irritation from very fine plant surface hairs (*Fremontodendron californicum*). Other valid answers gained marks.

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Section B – Principles of Plant Taxonomy, Morphology & Anatomy

- Q11** a) Describe, with the aid of clearly labelled diagrams and named plant examples, **ONE** fruit from **EACH** of the following categories:
- i) dry indehiscent;
 - ii) dry dehiscent;
 - iii) fleshy/succulent.
- b) Describe how the types of fruit in a), enable efficient dispersal of the contained seeds.

Part a) of the question asked for three items of information; a diagram, a description and an example of each type of fruit. The description was often lacking and only rarely did candidates name the type of fruit, referring to pod rather than legume and acorn instead of nut.

The dispersal of the seeds was, in general, well done with candidates mentioning scatter hoarding of nuts, explosive dispersal of seeds from pods and succulent fruits being ingested by birds etc.

- Q12** a) Describe, with the aid of clearly labelled diagrams, the structure of the following types of seed:
- i) dicotyledonous;
 - ii) monocotyledonous.
- b) State the function of **EACH** of the parts of a seed.
- c) Explain how the seedcoat may limit germination.

Diagrams were not of a good standard and the dicotyledonous seed was much better known than the monocotyledonous. However, despite the wording of the question, almost invariably there was no description in part a) of the question and answers to part b) combined description with function. Candidates should answer the question as it stands. Descriptions even then were not well done. To take one example, in part a) it was expected that the micropyle would be described as an interruption in the testa and in part b) that candidates would refer to the uptake of water in imbibition. The latter was well known but the former was seldom given.

In part c) the role of the hardness or impermeability of the testa in limiting germination was generally known but then candidates usually continued with descriptions of scarification etc. which were not required. The question did ask for an explanation which could have included reference to the need for water for metabolism and oxygen for respiration. No candidate mentioned these.

Section C – Knowledge of Plant Health

- Q13**
- a) Explain, with the aid of clearly labelled diagrams, how water is lost from the plant.
- b) Explain how water loss is reduced from plants in **EACH** of the following situations:
- i) plant propagation;
 - ii) shrub planting on a windy site;
 - iii) a recently potted up cutting under glass.
- c) Explain why excessive transpiration is detrimental to plant growth and development.

The first part of the question requested clearly labelled diagrams. It is important to show detail in the diagrams which support the candidate's answer. The three main problems identified with the majority of candidate diagrams were:

- very small diagrams which made deciphering of information very difficult;
- inadequate labelling of the diagrams. E.g. a label pointing to the centre of a poorly presented diagram with the words 'water moving up' or 'water moving down';
- inaccurate diagrams, which very often showed the wrong position of the xylem and phloem within the stem of the plant.

Very few candidates recorded information on how water can be lost through the Cuticle of the leaf. The influence of relative humidity on water loss was not explained by the majority of candidates.

A very surprising omission by the majority of candidates was a lack of information on lenticels, especially with deciduous woody plants over the winter period.

In part b) i) the concept of the mist unit in propagation was efficiently explained by the majority of candidates. Very few candidates however mentioned the fogging unit which can be used on a wider variety of plants, especially hairy plants.

The use of shading (which is very important in the propagation of plants) was not mentioned by many candidates. It is important to remember that in a glasshouse the reduction in temperature by shading can only be achieved by shading on the outside of the glass. Shading on the inside of the glass will reduce light intensity, but will not reduce temperature.

In part b) ii) the use of anti-transpirant agents at the planting stage of shrubs was only mentioned by a few candidates. The process of hardening of plants before actual planting to ensure that the cuticle has fully developed was not mentioned by any candidate.

The use of mulches was adequately explained, however very few candidates explained the benefits of a geotextile liner to be used as a mulch.

The method of watering is particularly important in order to ensure the plant has adequate water without wastage. The examiner was looking for irrigation methods which applied water to the roots without wasting water on the surface. There are a number of sub irrigation systems which will apply water to the roots very efficiently.

In part b) iii) water should be maintained in the compost at field capacity in order to avoid water stress to the plant.

The use of shading material (which in this case can be inside the glasshouse, as it is the reduction of light intensity which is required) was mentioned very briefly by few candidates.

It is important to avoid over feeding a young plant with a developing root system. It is very easy for exosmosis to occur.

In the final part of the question, the examiner was looking for information about:

- permanent wilting point could be reached, which is particularly important with young plants,
- abscisic acid may be produced in a plant water stress situation, which will often lead to the defoliation of the plant,
- the development of flowers and fruit are dependent on a good hormonal balance of the plant, it is known that water stress can cause disruption to hormone production,
- the underdeveloped tips (meristems) of plants especially monocotyledons, often suffer drainage under water stress.
- Water stress will reduce photosynthesis.

The answers received from candidates mainly concentrated on the problems caused by wilting and did not provide sufficient detail to explain why the problem occurred.

- Q14** a) Describe the effects of environmental factors on **EACH** of the following plant processes:
- i) photosynthesis;
 - ii) respiration;
 - iii) phototropism.

- b) Describe how the above three processes affect the optimal growth of a plant.

There were some good candidate answers to part a) i), which showed understanding of the subject matter. It is important to state that it is the intensity of light, the duration of light and the quality of light which are most important for the horticulturalist.

A surprising omission by the majority of candidates was information on temperature. This is a major factor in photosynthesis as it directly affects enzyme activity which is vital for the process of photosynthesis to occur.

In part a) ii) the interrelationship of photosynthesis and respiration to include information on the light compensation point, was only briefly mentioned by some candidates and omitted by many candidates.

There were some good answers by candidates on phototropism, which demonstrated a good understanding of the subject matter. It is important however, to ensure that the direction of light is clearly explained in order to confirm that the plant response is not a nastic movement.

In part b) some very general answers were given which did not fully answer the question. The examiner was looking for good clear examples of how the three processes affect optimum growth of the plant, which could have included:

- uniform and optimal plant growth,
- the development of vegetative features e.g. food storage in tubers,
- the manipulation of a named plant tropism in order to ensure efficient growth and development of the plant,
- the importance of light compensation point in the production of plants,
- the development of stock plants with good juvenile growth for vegetative reproduction.

Section D – Process of Plant Physiology

Q15 a) Review a **NAMED** bacterial disease under **EACH** of the following headings:

- i) host range;
- ii) symptoms and damage;
- iii) spread;
- iv) chemical control method;
- v) cultural control methods.

b) Review a **NAMED** fungal disease under **EACH** of the following headings:

- i) host range;
- ii) symptoms and damage;
- iii) spread;
- iv) chemical control method;
- v) cultural control methods.

In part a) candidates named a range of bacterial diseases including significantly important pathogens, such as fireblight and bacterial canker of plum and cherry; higher marks were awarded where susceptible plant species were accurately identified. When reviewing symptoms and damage a fuller answer would include how a disease may present itself on the host, state of growth, climatic conditions & seasonality. Candidates who correctly identified the limitations of chemical controls and emphasised a management strategy that took into account cultural practices, and wider horticultural control measures, gained higher marks.

Fungal diseases often manifest themselves in a number of ways dependent on the stage of their development, condition of the plant and environmental conditions. In part b), candidates who described a range of symptoms and how they affected the host plant gained higher marks.

It is important to have an understanding of the disease's life cycle in order to describe fully how the disease is spread.

Higher marks were awarded to candidates who correctly identified an appropriate chemical control, including its mode of action e.g. as curative and or protective against the disease.

When putting forward a strategy for cultural control, an assessment must be made as to how practical it would be! Cultural controls are part of good husbandry, and should include how the environmental conditions around the plant are managed, and where possible using diseases resistant varieties.

- Q16** a) Describe the effects of the current Plant Protection Products Directive on the use of pesticides within the EU.
- b) Describe the requirements of a storage facility, used to hold small quantities of pesticides, in accordance with current legislation.

In part a) marks were awarded for identifying the main objectives of the PPPD which include:

- rules on the evaluation, authorisation, marketing and control of plant protection products within the EU;
- reducing the impact of pesticide use on human health;
- encouraging integrated pest management and alternative techniques;
- review and approval of pesticides.

Candidates correctly identified the majority of requirements required to legally and safely store pesticides in part b) of the question.

Candidates who were able to make reference to the Code of Practice for the use of Plant Protection Products, and the roll of the Local Environmental Agency in the use and storage of plant protection products gained higher marks.

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