



RHS LEVEL 3 ADVANCED CERTIFICATE IN HORTICULTURE WRITTEN EXAMINATION

2:00pm Tuesday 10th February 2009

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 State the functions of the following seed and flower parts:

- i) micropyle;
- ii) pollen tube.

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Q2 Explain the difference between a cultivar and a variety in plant nomenclature.

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Q3 State the environmental conditions most favourable for the spread of **EACH** of the following pest and disease:

- i) powdery mildew;
- ii) two spotted spider mite.

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Please see over/.....

ANSWER ALL QUESTIONS

MARKS

Q4 **NAME TWO** currently available methods used for partial soil sterilisation.

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Q5 a) Define the term osmosis.

b) State **ONE** soil condition, which may affect osmosis.

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Q6 State the benefit of aerobic respiration compared to anaerobic respiration in plants.

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Q7 State the function of the cork cambium.

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Please turn over/.....

ANSWER ALL QUESTIONS

MARKS

Q8 Explain the function of **EACH** of the following in relation to plant structure:

- i) cytoplasm;
- ii) plasmodesmata.

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Q9 Name the characteristic features of a composite inflorescence giving **ONE NAMED** plant example.

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Q10 Describe the use for **EACH** of the following, with reference to a **NAMED** pest:

- i) yellow sticky traps;
- ii) pheromone traps.

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The Royal Horticultural Society, Wisley, Woking, Surrey. GU23 6QB



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2:00pm Tuesday 10th February 2009

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
Q1	a) Describe FOUR distinct ways in which plant parts may be modified for different functions and state a NAMED example of each.	8
	b) Explain the role and function of the adaptations described in a).	12
Q2	a) Describe with the aid of clearly labelled diagrams, the structure and function of the following cells and tissues within the stem of a dicotyledonous plant:	
	i) collenchyma OR sclerenchyma;	4
	ii) phloem;	4
	iii) xylem.	4
	b) Describe the structural changes that take place as a result of secondary thickening in woody stems.	8

Please see over/.....

Section C – Processes of Plant Physiology

Answer ONE question only from this section

MARKS

- Q3** a) Review **EACH** of the following in relation to photosynthesis:
- i) the role of chloroplasts; 5
 - ii) the law of limiting factors. 5
- b) Describe how the manipulation of environmental conditions influences the growth of plants in protected structures. 10
-
- Q4** a) Define **EACH** of the following terms:
- i) tropisms; 2
 - ii) nastic response. 2
- b) Describe **EACH** of the following types of responses that may occur in plants:
- i) positive geotropism; 2
 - ii) positive phototropism; 2
 - iii) thigmotropism; 2
 - iv) thermonasty; 2
 - v) epinasty. 2
- c) Explain the possible physiological basis for **ONE** of the types described in b), using a diagram to illustrate the answer. 6

Please turn over/.....

Section D – Knowledge of Plant Health

Answer ONE question only from this section

MARKS

- Q5** a) Name **TWO** distinct weed species to be found in **EACH** of the following situations:
- | | | |
|------|-----------------------------------|---|
| i) | established amenity turf; | 2 |
| ii) | a vegetable garden; | 2 |
| iii) | container grown trees and shrubs; | 2 |
| iv) | an herbaceous border. | 2 |
- b) Name an appropriate chemical herbicide (active ingredient) to control **ONE** of the weeds named in **EACH** situation. 4
- c) Describe a programme of cultural operations, which could be adopted in order to prevent weed establishment in **EACH** of the situations named in a). 8
-
- Q6** a) Describe the damage associated with attack by a typical aphid. 4
- b) Describe the life-cycle for a **NAMED** species of aphid, indicating timings and typical host plants. 8
- c) Review the methods available for aphid control in horticulture. 8

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Tuesday 10th February 2009

MODULE B

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

Candidates Registered	301		Total Candidates Passed	190	77.87%
Candidates Entered	244	81.06%	Passed with Commendation	56	22.95%
Candidates Absent	31	10.30%	Passed	134	54.92%
Candidates Deferred	20	6.65%	Failed	54	22.13%
Candidates Withdrawn	6	1.99%			

Section A – Short Answer Questions

Q1 State the functions of the following seed and flower parts:

- iii) micropyle;
- iv) pollen tube.

Candidates generally understood the role of the micropyle as being the point where imbibition of water occurs into the seed. However, too many failed to identify the micropyle's role in receiving the pollen tube.

Confusing and incorrect terminology was often used by candidates when stating the functions of the pollen tube, resulting in some marks not being awarded. Marks were gained by those who referred to the pollen tube developing from the pollen grain and growing down the style to enter the ovary and finally the ovule via the micropyle to deliver the male gamete prior to fertilisation. Imprecise references to the pollen grain moving down the style, or in some instances the filament, and the pollen grain entering the ovule or the micropyle did not attract marks.

Q2 Explain the difference between a cultivar and a variety in plant nomenclature.

Only a relatively low number of candidates were able to give clear differences between cultivars and varieties and attract full marks. It is incorrect and confusing when candidates refer to cultivars as being “varieties” of plants propagated in gardens or varieties as being “sub-species” of plants in the wild!

Although many candidates were aware that cultivars are frequently selections of hybridised species and other similar garden-type crosses, most failed to identify that they could also be selections from species that occur in the wild. Many answers also indicated that varieties, quite correctly, are found in wild populations but then failed to explain that they are natural variants from the true species which are inter breeding successfully amongst themselves.

Q3 State the environmental conditions most favourable for the spread of **EACH** of the following pest and disease:

- iii) powdery mildew;
- iv) two spotted spider mite.

Many candidates successfully identified that each of these problems is encouraged by very hot, dry atmospheric conditions, which is made worse if plants are suffering drought (water stress) conditions at the roots. Only a few candidates identified the importance of occasional leaf moisture to trigger the spores of powdery mildew to germinate and the significance of air currents (wind) to distribute air-borne spores. Rain or irrigation splash was incorrectly cited as being significant in the spread of spores. Also, incorrect references were made by numerous candidates indicating that humidity within protected cropping aided the build up and spread of two spotted spider mites. Some candidates correctly indicated that this particular pest was encouraged by bright light (sunny conditions) and long days and gained marks for this.

Q4 **NAME TWO** currently available methods used for partial soil sterilisation.

Many candidates were able to identify two methods of partially sterilising soils. However candidates were required to name a specific type for each such as “steam grids”, Hoddesdon pipes or sheet steaming and with chemical options candidates should have given active ingredient names such as Dazomet (Basamid), chloropicrin and dichloropropene (Telone II) etc. Candidates should understand that steam grids, steam ploughs and Hoddesdon pipes, although unlikely to be used for sterilising glasshouse soils today, may still be used to sterilise loam on trailers for specific uses. Similarly candidates should note that methyl bromide is now withdrawn from use. References to Jeyes fluid as a soil sterilant or the use of certain plant crops to sterilise land did not attract marks as they are unlikely to achieve even and consistent partial soil sterilisation.

Q5

- b) Define the term osmosis.
- c) State **ONE** soil condition, which may affect osmosis.
- a) Candidates who referred to the diffusion of water along a water potential gradient from an area of high water potential through a semi-permeable membrane to an area of lower water potential were awarded full marks. Candidates who omitted to refer to a semi-permeable membrane received apportioned marks.
- b) Answers indicated very clearly that most candidates understood that “over use” of artificial fertiliser nutrient sources interfered with the normal process of osmosis between soil, water and root hair uptake. In this context references to reverse osmosis, plasmolysis and similar were awarded full marks. Similarly, references to dry (drought) soil conditions causing a rise in the electrical conductivity (E.C.) of soils and its affect on osmosis also attracted marks. The examiner also allowed references to frozen soil conditions effectively stopping water (osmotic) uptake completely.

Q6

State the benefit of aerobic respiration compared to anaerobic respiration in plants.

Candidates very frequently failed to address the requirements of the question set and because of this were not awarded full marks. The question asked for the benefits of aerobic respiration compared with the benefits or otherwise of anaerobic respiration. Candidates gaining marks were those who referred to:-

Aerobic respiration as being:-

1. very efficient (processes work actively)
2. high energy output (thorough breakdown of sugars)
3. stimulates healthy vigorous growth of roots, shoots and flower parts etc.

Anaerobic respiration as being:-

1. low efficiency
2. low energy output (low sugar breakdown)
3. harmful bi-products produced such as ethanol (ethyl alcohol) that is harmful to plant tissue development
4. the low energy release is not beneficial to plants resulting in poor weak growth, stunting and eventual plant death.

Q7 State the function of the cork cambium.

Answers to this question revealed much misunderstanding amongst candidates as to the functions of the cork cambium. Very few candidates, as a result, gained full marks. Too many answers indicated that candidates thought the cork cambium was the protective cork layer itself or that the cork cambium only produced cork cells. Answers gaining marks were those that referred to the functions of the cork cambium as:

1. being a meristematic tissue concerned with the production of new cells inwards and new cells outwards
2. producing new cell tissues outwards which later become suberised cork cells and therefore protective in woody perennials
3. produces new cells inwards which differentiate to become secondary cortical tissue
4. producing new cell tissues peripherally to ensure that the expanding girth of wood perennials remains protected and avoid inner tissues becoming exposed and open to pest or disease invasion

Q8 Explain the function of **EACH** of the following in relation to plant structure:

- iii) cytoplasm;
- iv) plasmodesmata.

Candidates answered this question extremely well and this is indicative of sound learning and revisionary processes having taken place. Answers in the main attracted full marks. Answers attracting marks referred to a selection of the following: -

1. cytoplasm acts as a differentially permeable membrane assisting the process of osmosis and is the site of photosynthetic and respirational activity. Also it functions as the site of biochemical reactions and also provides a site where ribosomes and other organelles operate. Few candidates recognised that the cytoplasm, because of its high sugar and mineral nutrient content, resists the effects of freezing in many plant species.
2. plasmodesmata – candidates fully understood that these are the inter-cellular pits involved in cytoplasmic streaming and the cell to cell movement of mineral and organic substances.

Q9 Name the characteristic features of a composite inflorescence giving **ONE NAMED** plant example.

Very few candidates were familiar with the main diagnostic features of a composite flower structure and as a result only a few candidates gained full marks. The accurate naming of the various structural parts of the flower revealed a weakness in the knowledge of many candidates.

Those who were awarded marks were able to refer to one or more of the following: -

- many individual florets mounted on a pin cushion (often domed) receptacle
- a swollen receptacle forming a capitulum
- an outer ring of mainly sterile “ray” florets and an inner ring (or dome) of mainly fertile “disc” florets
- a whorl or several whorls of bracts attached to the capitulum below the open flower head

Answers worded differently but referring to the above received marks accordingly. Generally most candidates were able to name accurately a plant with a composite inflorescence. Marks could not be awarded fully when only a generic name was given but those giving genus plus species or genus plus a named cultivar were rewarded.

Q10 Describe the use for **EACH** of the following, with reference to a **NAMED** pest:

- iii) yellow sticky traps;
- iv) pheromone traps.

Answers to this question were interesting in that most candidates were fully aware that each kind of trap was designed to trap in the case of (i) above aphids, whitefly, sciarid flies etc. and (ii) above codling or plum moths (male), but few understood accurately why this is done. Too many candidates wrongly indicated that each of the traps were a means of control in itself rather than being an ancillary benefit to the traps primary function of monitoring the presence of insects, and serving to indicate when threshold levels were reached, so that control timings could be more accurately judged for either biological or chemical control options.

Most candidates were able to name a pest for (i) above accurately but many gave incorrect examples for (ii).

Section B – Principles of Plant Taxonomy, Morphology & Anatomy

- Q1** a) Describe **FOUR** distinct ways in which plant parts may be modified for different functions and state a **NAMED** example of each.
- b) Explain the role and function of the adaptations described in a).

The aims of the question are to elicit details of plant modifications and for these to be explained in terms of advantage to the plant in its habitat.

Most candidates grasped the importance of the question but failed to provide sufficient detail. This comment applies particularly to the second part of the question where the role and function of the adaptations was asked for. Thus the importance of the climbing habit was often baldly put as 'near the light' without any reference to competitive advantage or the increase in photosynthesis due to the higher light levels. Similarly the bulb was often described as a 'storage organ for starch' without reference as to why such an organ was needed in such a plant's life-cycle or that it allows rapid production of leaves and flowers in the spring to gain a competitive advantage or to avoid inclement conditions of shade or drought. There was some confusion between thorns, spines and prickles and candidates generally were also unsure as to which plant organ was being modified in each case. Plant examples often used common or general names e.g. sweet pea, cacti.

Recommendations.

1. Diagrams should be included in an answer where they add to that answer. They should be large, clear and preferably executed in pencil.
2. Plant names used as examples should be given in as full a form as possible i.e. genus, species and, where appropriate, cultivar.
3. This examination is a level 3 examination and in a question where there is overlap with the level 2 certificate in content, candidates should be able to show an increased, or more detailed, grasp of the subject matter.

Q2 a) Describe with the aid of clearly labelled diagrams, the structure and function of the following cells and tissues within the stem of a dicotyledonous plant:

- iv) collenchyma **OR** sclerenchyma;
- v) phloem;
- vi) xylem.

b) Describe the structural changes that take place as a result of secondary thickening in woody stems.

The aims of the question were to test candidates' knowledge of plant tissues and the changes that occur in the layout of tissues as a result of secondary thickening.

The structure of the four types of tissue was imperfectly understood by the majority of candidates. There was much confusion between collenchyma and sclerenchyma and between sclerenchyma and xylem vessels. Diagrams in general were not very good as depictions of the type of cell concerned. The question asked for description of tissues with the aid of diagrams so the use of diagrams alone is not enough unless they are well annotated. Descriptions of the mechanism of xylem and phloem transport was not asked for but often provided. The transportation of sugar in the phloem was often stated to be glucose, starch or food instead of sucrose.

The descriptions of secondary thickening were usually not comprehensive enough. There was much misunderstanding (e.g. the cambium grows out to form a ring instead of the ray cells differentiating into cambial cells) and vagueness (e.g. xylem cells found in the spring are larger instead of larger in diameter forming the annual rings). The general standard of diagrams was not good although there were some excellent exceptions. There was some confusion here as well with some candidates drawing diagrams of the root or rings of xylem and phloem inside or outside an intact ring of vascular bundles.

Recommendations. As for question 1.

Section C – Processes of Plant Physiology

- Q3** a) Review **EACH** of the following in relation to photosynthesis:
- iii) the role of chloroplasts;
 - iv) the law of limiting factors.
- b) Describe how the manipulation of environmental conditions influences the growth of plants in protected structures.

The aims of the question are to:

- relate theory knowledge to practical application in respect to protected cropping.
- test candidates understanding of key components of the photosynthesis equation.
- test candidates understanding of how photosynthesis can be manipulated to maximum benefit.

The role of chloroplasts was recorded efficiently by the majority of candidates. Candidates who presented clearly labelled and large diagrams were awarded more marks compared to candidates producing small poorly labelled and in many cases inaccurate diagrams.

For an examination at level 3 it is expected that candidates can provide detail of the requirements for efficient photosynthesis and to be able to explain how this can be manipulated by a grower/horticulturist.

Candidates who provided technical detail i.e. the amount of carbon dioxide within the glasshouse to be increased and the light levels to be maintained for maximum growth, gained higher marks.

Light levels are very important for photosynthesis, the majority of candidates identified the need to increase light levels, however little was mentioned of light quality and the duration of light within a 24 hour period.

Recommendations

1. Candidates are advised to relate practical cultural methods of production to the principles of key plant processes i.e. photosynthesis.
2. Candidates need to include technical detail in their answers. Low marks are given to candidates who provide very general statements without supporting evidence. An example of this is carbon dioxide enrichment.

Examiners are looking for:

- At what time during the day is carbon dioxide applied?
- What is the level of carbon dioxide under protective structures considered to be efficient for growth enhancement?
- How is carbon dioxide physically released under protective structures?

Q4 a) Define **EACH** of the following terms:

- iii) tropisms;
- iv) nastic response.

b) Describe **EACH** of the following types of responses that may occur in plants:

- vi) positive geotropism;
- vii) positive phototropism;
- viii) thigmotropism;
- ix) thermonasty;
- x) epinasty.

c) Explain the possible physiological basis for **ONE** of the types described in b), using a diagram to illustrate the answer.

The aims of the question are:

- to relate physiological processes with the physical movement of plants to known stimuli.
- to be able to identify and describe a range of natural plant movements.
- to identify the exact stimulus and to understand how this affects plants physically.
- it is also useful to know why plants respond to plant tropisms.

It is very pleasing to observe good descriptions of plant tropisms. Candidates who were able to provide technical detail gained higher marks compared to candidates who provided very general information.

Epinasty was not understood by the majority of candidates who often confused it with photosynthetic response. The question requested a diagram to assist the answer. The majority of diagrams were very poor and did not contribute many marks to the answer.

Recommendations

1. Candidates are advised to ensure they have good knowledge of tropisms and nastic responses by plants.
2. Thermonasty (a natural plant movement influenced by temperature) and epinasty (a downward curvature on leaves and young stems due to differential in growth pattern).

It is recommended that candidates have a good study of natural hormones and their function in plant growth and development.

Section D – Knowledge of Plant Health

Q5 a) Name **TWO** distinct weed species to be found in **EACH** of the following situations:

- v) established amenity turf;
- vi) a vegetable garden;
- vii) container grown trees and shrubs;
- viii) an herbaceous border.

b) Name an appropriate chemical herbicide (active ingredient) to control **ONE** of the weeds named in **EACH** situation.

c) Describe a programme of cultural operations, which could be adopted in order to prevent weed establishment in **EACH** of the situations named in a).

The aims of the first part of question are for candidates to provide the full Latin name (genus and species) correctly spelt, for weed species commonly found in each situation. Examples of acceptable answer are;

- i) *Bellis perennis*, *Plantago major*, *Ranunculus repens*
- ii) *Capsella bursa-pastoris*, *Poa annua*, *Senecio vulgaris*
- iii) *Cardamine hirsuta*, *Stellaria media*, *Taraxacum officinale*,
- iv) *Convolvulus arvensis*, *Aegopodium podagraria*, *Urtica dioica*

The aims of the second part of question are for candidates to provide an active ingredient of a suitable herbicide for each given situation. Examples of acceptable answers are;

- i) 24-D, mecoprop
- ii) diquat, simazine,
- iii) paraquat, dichlorbenil,
- iv) glyphosate, paraquat.

The aims of the third part of question are for candidates to demonstrate knowledge of cultural methods for weed control in each named situation. Examples of acceptable answers are;

- i) regular mowing, raking, spiking
- ii) stale seed bed, green compost, hoeing
- iii) top dressing, hand weeding, gravel
- iv) hoeing, mulching, close planting

- Q6** a) Describe the damage associated with attack by a typical aphid.
- b) Describe the life-cycle for a **NAMED** species of aphid, indicating timings and typical host plants.
- c) Review the methods available for aphid control in horticulture.

The aims of the first part of the question are candidates to identify typical visible damage to the plant not including the observation of actual aphids. Points were awarded for answers such as;

- stunted growth
- distorted leaves/buds
- discolouration/chlorosis
- honeydew and sooty mold

The aims of the second part of the question are for candidates to name a specific aphid species and then describe a season/year life-cycle for that species. Points were awarded for naming a species (eg peach-potato aphid) and the typical summer and winter hosts. Additional points were awarded for describing the reproduction and the stages found in spring, summer, autumn and winter. Diagrams were particularly useful in illustrating clearly the stages.

The aims of the third part of the question are for candidates to show knowledge of all the available control measures. Points were awarded for identifying cultural, biological and chemical methods and a brief discussion of the merits and drawbacks for each. Answers should include:

- biological controls for both external and protected areas
- pesticides including contact and systemic
- winter washes, soap sprays
- use of sticky traps and physical removal
- integrated pest management

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