Candidate Number: ……

Candidate Name: ……

Centre Number/Name: ……

RHS (LEVEL 3) DIPLOMA IN HORTICULTURE
WRITTEN EXAMINATION

Thursday 9th February 2006

IMPORTANT – Please read carefully before commencing.

i) The duration of the papers in Module **G** 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.

Module G

Genetics, Plant Breeding and Systematic Botany
Physiology of Flowering, Reproduction and Development

Section A - Short Answer Questions

Please turn over/……

ANSWER ALL QUESTIONS

Marks

Q1 Describe the role of ethylene in fruit ripening with reference to a **NAMED** fruit. **2**

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Q2 Define, using **NAMED** plant growth regulators, the terms:

i) synergy;

ii) antagonism. **2**

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Q3 Explain why it is not advantageous for growers to save F_2 seed. **2**

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Q4 Describe **TWO** ways by which weeds may reduce the quality of **NAMED** crops. **2**

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Please see over/…….

ANSWER ALL QUESTIONS

Marks

Q5 a) Define the term apical dominance.
b) Name the growth regulator associated with it. **2**

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Q6 a) Define the term sterility.
b) State **ONE** horticultural advantage of sterility. **2**

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Q7 a) Name **TWO** UK seed banks.
b) Describe the contribution of **ONE** of these to the horticultural industry. **2**

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ANSWER ALL QUESTIONS

Marks

Q8 List **TWO** field scale risk assessments that research scientists are undertaking with genetically modified crops. **2**

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Q9 a) Define the term 'periclinal' chimera.
b) State **ONE NAMED** plant example. **2**

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Q10 Define the term 'Accumulated Cold Units' in the context of the commercial forcing of rhubarb. **2**

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RHS (LEVEL 3) DIPLOMA IN HORTICULTURE
WRITTEN EXAMINATION

Thursday 9th February 2006

IMPORTANT – Please read carefully before commencing.

i) The duration of the papers in Module **G** is **2 hours**.
ii) Answer **ONE** question from section **B** and **TWO** questions from Section **C**.
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.

Module G

Genetics, Plant Breeding and Systematic Botany
Physiology of Flowering, Reproduction and Development

Sections B & C

Structured Questions

Please turn over/……

Section B – Genetics, Plant Breeding and Systematic Botany

Answer ONE question only from this section

			Marks
Q1	a)	Distinguish between the structures of the nucleus, chromosomes and DNA (Deoxyribonucleic acid).	**6**
	b)	Describe the stages of mitosis.	**8**
	c)	Describe how variation in genetic material could occur during mitosis and the effects of this in plants.	**6**
Q2	a)	After crossing **TWO** homozygous pure lines in peas, one grown from round seed, the other with wrinkled seed; all the seeds produced were round. This seed was sown, the plants self pollinated and the resulting seed collected. Explain the genotype of the F_1 generation and predict the genotype and phenotype of the F_2 generation using a Punnett square.	**8**
	b)	Explain how a backcross could be carried out to determine the genotypes of round seeded pea plants.	**8**
	c)	Outline the advantages of F_2 hybrids to the grower and the seed producer.	**4**

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Please see over/……

Section C – Physiology of Flowering, Reproduction & Development

Answer TWO questions from this section

Marks

Q3 a) Describe how the vegetative and reproductive stages of a **NAMED** plant are affected by the manipulation of the photoperiod. **8**

b) Explain the importance of the following:

i) critical day length; **4**
ii) plant response group; **4**
iii) photo inductive cycles. **4**

Q4 a) Describe **FOUR** factors that are influenced by crop canopy and the spatial arrangement of planting. **8**

b) Describe **FOUR** practical methods of increasing yields. **12**

Q5 Explain the use of growth regulators under the following headings:

i) effect on apical dominance; **5**
ii) reduction in plant height; **5**
iii) influence on fruit set; **5**
iv) tissue culture. **5**

Q6 a) Describe the structure and function of phytochrome in plants. **10**

b) Explain how photochemical changes affect the development of a **NAMED** plant/crop. **10**

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RHS (LEVEL 3) DIPLOMA IN HORTICULTURE
WRITTEN EXAMINATION

Thursday 9th February 2006

Module G

Genetics, Plant Breeding and Systematic Botany
Physiology of Flowering, Reproduction and Development

Examiners Comments

Candidates Registered	69		Total Candidates Passed		
Candidates Entered	61	88..40%	Passed with Commendation	4	6.56%
Candidates Absent	4	5.80%	Passed	40	65.57%
Candidates Deferred	2	2.90%	Failed	17	27.87%
Candidates Withdrawn	2	2.90%			

Section A - Short Answer Questions

Q1 Describe the role of ethylene in fruit ripening with reference to a **NAMED** fruit.

This was very poorly answered. Candidates lost marks for describing the commercial use of ethylene and **not** describing the **role** of ethylene in fruit ripening. High marks were awarded for a description of the fact that ethylene initiates a number of qualitative metabolic changes e.g. hydrolysis of starch to sugar, softening of tissues and the synthesis of pigments and flavor changes.

Q2 Define, using **NAMED** plant growth regulators, the terms:

i) synergy;
ii) antagonism.

This was very poorly answered. Candidates could not be rewarded when poor and imprecise definitions of the terms were given. High marks were awarded for synergy as defined as "when the combined effect of two growth regulators is greater that expected" and antagonism "when two growth regulators work against each other". Candidates were not rewarded for citing the effects of cytokinin and auxin in tissue culture as an example of synergy as this is the role of these growth regulators in development and **not** an example of synergy.

Q3 Explain why it is not advantageous for growers to save F_2 seed.

This was adequately answered. High marks were awarded for an explanation of why F2 does not come true to type and a description of why the resultant progeny would not be uniform.

Q4 Describe **TWO** ways by which weeds may reduce the quality of **NAMED** crops.

This was poorly answered due to misinterpretation of the question. Many candidates failed to describe the effect of weeds on the **quality** of crops and instead described the effect on yield.

Q5 a) Define the term apical dominance.
b) Name the growth regulator associated with it.

This was adequately answered. High marks were awarded for a precise definition of apical dominance i.e. the phenomenon of coordinated bud development wherein the apical bud suppresses the growth and development of lateral buds and the naming of Auxin.

Q6 a) Define the term sterility.
b) State **ONE** horticultural advantage of sterility.

This was adequately answered. High marks were awarded for a precise definition of sterility i.e. any flower incapable of producing seeds and appropriate horticultural advantages, such as no siblings are produced in crosses with cytoplasmic male sterile material.

Q7 a) Name **TWO** UK seed banks.
b) Describe the contribution of **ONE** of these to the horticultural industry.

This was very poorly answered. A common mistake was to quote the Millennium Genebank at Wakehurst Place and the Kew seed bank as two separate seed banks. They are the same with the seed bank being housed at Wakehurst Place. High marks were awarded for a factual description of the contribution the chosen genebank makes.

Q8 List **TWO** field scale risk assessments that research scientists are undertaking with genetically modified crops.

This was adequately answered. High marks were awarded for citing any of the following: Pollen drift assessment, development of the new hybrid strains in endemic weed populations, biodiversity assessments.

Q9 a) Define the term ‘periclinal’ chimera.
b) State **ONE NAMED** plant example.

This was very poorly answered. Marks were not gained as many candidates confused GRAFT hybrids and periclinal chimeras. High marks were awarded when periclinal chimeras were described as a mutation where an outer layer of mutated cells overlays an inner core of the original genotype and an appropriate example given.

Q10 Define the term ‘Accumulated Cold Units’ in the context of the commercial forcing of rhubarb.

This was very poorly answered. Candidates described rather than **defined** ACU. High marks were awarded when ACU were defined as follows: ‘The amount of cold required before forcing or dormancy breaking can be started is referred to as “Cold Units”. Cold Units are the accumulated number of degrees below 9.45C/49F (and above –2.2C/28F) as recorded at mid-morning.’

Section B – Genetics, Plant Breeding and Systematic Botany

Q1 a) Distinguish between the structures of the nucleus, chromosomes and DNA (Deoxyribonucleic acid).
b) Describe the stages of mitosis.
c) Describe how variation in genetic material could occur during mitosis and the effects of this in plants.

a) Most candidates correctly interpreted this part of the question describing and distinguishing between the structures of the nucleus, chromosomes and DNA. Several candidates included diagrams that clarified their descriptions. An explanation of the function and the role of DNA were not asked for, some candidates gave descriptions of DNA, RNA and protein synthesis that was not required.

b) The stages of mitosis, including interphase when DNA replication occurred, was adequately described by the majority of candidates. Most answers included large clearly labelled diagrams that enhanced the written description.

c) There were some very good answers to this section of the question which asked for descriptions of different types of mutation. Candidates were rewarded for examples such as gene mutation by addition, substitution or deletion of bases during DNA replication, chromosome mutation with inversion, deletion or addition of segments during replication of DNA or in the later stages of mitosis, chromosome number alterations due to chromatids not fully separating during the anaphase or polyploidy where chromosomes numbers doubled due to the spindle not forming.
Maximum marks were given where these and other valid forms of mutations were linked to examples of their possible effects on plants.

Q2 a) After crossing **TWO** homozygous pure lines in peas, one grown from round seed, the other with wrinkled seed; all the seeds produced were round. This seed was sown, the plants self pollinated and the resulting seed collected.

Explain the genotype of the F_1 generation and predict the genotype and phenotype of the F_2 generation using a Punnett square.
b) Explain how a backcross could be carried out to determine the genotypes of round seeded pea plants.
c) Outline the advantages of F_2 hybrids to the grower and the seed producer.

The candidates who answered this question gained a wide range of marks.
a) Candidates gaining higher marks laid out their answer in a detailed and logical manner explaining the genotypes of the original parents, the gametes formed by meiosis, the F_1 generation and the genotype and phenotype of the F_2 generation using a Punnet square.
Most candidates used accepted notation for a monohybrid cross and correctly predicted a 1:2:1 ratio of genotypes and 3:1 ratio of dominant (round) and recessive (wrinkled) phenotypes in the F_2 generation. However some candidates incorrectly described dihybrid inheritance and gave incorrect ratios of genotype for the F_2.
b) Tthe required description of the backcross should include crossing the round seeded plant with unconfirmed genotype with recessive pure line parent, harvesting the resulting seed and identifying its phenotype as round or wrinkled.
Crossing a homozygous (RR) round seeded F_1 or F_2 plant with the recessive parent would give all round seeded offspring, whereas crossing a heterozygous (Rr) round seeded F_1 or F_2 with the recessive parent produces equal numbers of round seeded and wrinkled seeded offspring.

c) Most candidates were able to describe the benefits of F_2 seed to the grower as a wider range of colours, flowering period and harvest period with associated hybrid vigour and the possibility of selecting for new combinations of characteristics. The ascribed benefits of F_2 seed to the seed producer were more varied but included the points that large volumes of seed could be produced by allowing F_1 plants to self and cross pollinate without the need for emasculation, a high value product that was easy to produce and provided opportunities for selection and development of new hybrids.

Section C – Physiology of Flowering, Reproduction & Development

Q3 a) Describe how the vegetative and reproductive stages of a **NAMED** plant are affected by the manipulation of the photoperiod.

b) Explain the importance of the following:

i) critical day length;
ii) plant response group;
iii) photo inductive cycles.

a) The actual stages of vegetative reproductive development were requested and where provided with gained high marks.
The relationship between a **named** plant and the specific stages of development was requested. Candidates who identified a **named** plant gained higher marks.

b) i) Critical day length – this was answered well with good clear definitions

ii) Plant response group – candidates were rewarded when they could relate the time required to produce a flower bud (or vegetative growth) from the start of the photoperiod period.
Much confusion occurred between critical day length and response periods with the majority of candidates relating to critical day length when describing plant response groups.

iii) Photo inductive cycles – higher marks were awarded to candidates who were able to relate to the production of Pr and Pfr in the photo inductive cycles and the effect of this relationship within the plant.

Q4 a) Describe **FOUR** factors that are influenced by crop canopy and the spatial arrangement of planting.

b) Describe **FOUR** practical methods of increasing yields.

a) A well answered question which contained good technical and practical factors affecting crop canopy. Candidates who could provide specific detailed evidence of the influence of crop canopy i.e. leaf area index, gained higher marks.

b) Answers should be specific i.e. methods affecting a plant's growth rates. Irrigation should relate to plant response periods and soil moisture deficit in order to make maximum use of water. Answers should be illustrated with examples of suitable crop/plant situations.
Fertilizers when quoted should state which nutrients are supplied and when should they be applied in the crop production cycle.

Q5 Explain the use of growth regulators under the following headings:

i) effect on apical dominance;
ii) reduction in plant height;
iii) influence on fruit set;
iv) tissue culture.

i) This was a well answered question with good clear information relating to auxin production and its influence within the plant.
ii) Better candidates were able to provide information on:
- ∞ Internode growth
- ∞ The masking of auxin and other natural plant hormones
- ∞ The reduction in the influence of gibberellins

iii) Poor answers provided too much reference to ripening rather than **fruit set.** Candidates who made reference to improving fruit numbers or reduction of some fruit to allow greater fruit set amongst the remaining fruit gained high marks.
iv) There were some good answers for this section of the question. Better candidates were able to explain the relationship of auxin and cytokinins in the production of plants by tissue culture.

Q6 a) Describe the structure and function of phytochrome in plants.

b) Explain how photochemical changes affect the development of a **NAMED** plant/crop.

a) Candidates who clearly described how phytochrome is structured and how it affects plant development gained higher marks. Many candidates spent too much time drawing leaf sections to show where the phytochrome was positioned in the plant – this was not required.

b) Better candidates provided good answers, which explained the relationship of long or short nights and how cyclic lighting could be used in the production of a **NAMED** crop. The use of “blackouts” was very well explained and understood.