RHS Qualifications

Examination: RHS Level 2
Unit: Unit 1
Examination date: February 2023

523 candidates sat this examination.
74 candidates sat the examination online.

General introductory comments

This is the first examination series for the new RHS Level 2 Certificate in the Principles of Plant Growth and Development. It is therefore difficult to make meaningful comparisons between the range of candidate responses seen in this examination with previous Level 2 examination series, as both the syllabus and the format of examination has changed.

This report is authored by senior examiners within RHS Qualifications. Its aim is to summarise the performance of candidates and provide guidance and support to both potential candidates and the teaching staff at RHS approved centres.

Overview of Examination

This was the first examination series for the new RHS Level 2 Certificate in the Principles of Plant Growth and Development, and it is likely that some centres have delayed entering candidates for this first examination, preferring to enter candidates for the June examination series thus allowing centres the opportunity to review the February 2023 paper.

RHS qualifications have reviewed all candidate papers and communication from centres and will be implementing a number of developmental changes to the examinations for June 2023.

- It is noted that some candidates annotated scripts with indicative timings to assist with their time management.

  The June paper will include guidance with regard to indicative timings.

- Some candidates did not wish to detach pages from the examination booklet (Section A answer sheet), which caused them inconvenience during the examination.

RHS qualifications will be providing centres with a script for invigilators to read out prior to the commencement of the examination to ensure effective communication with candidates. The paper is also being redesigned.

- Candidates may wish to consider the order in which they undertake sections within the examination.

  The invigilator script will advise candidates that they may answer questions in any order, and may return to sections during the examination.

- It is noted that some candidates in Section C, wrote the question out in full before answering the question.

  The layout of the examination paper is being improved to eliminate this.

- Some online candidates did not access the italics tool, writing [in italics] before suggesting a scientific name for a plant.

  RHS qualifications would like to assure all candidates and centres that marks were not deducted as a result of the failure to apply italics in candidate responses.

Analysis of candidate performance has shown that while it was the intention that the long-form questions in Section C would enable differentiation, it is noted that some candidates focused their efforts on Section A and Section B. These candidates were able to score high marks within the examination.

Section A
Questions 1 – 20

The mean mark for Section A was 15

The highest mark awarded to a candidate in Section A was 20 and the lowest mark was 8.

Section B

The mean mark for Section B was 31

The highest mark awarded to a candidate in Section B was 49

Each question is considered separately.

Question 1

This question required candidates to put the stages of Integrated Pest Management in the correct order. The correct order was outlined in the Qualification Guidance Document.

The question was generally well answered by candidates.

Question 2

In part (a) of this question candidates were required to describe two symptoms of nitrogen deficiency. This question was answered well. Strong candidate responses included yellowing/chlorosis of older leaves, and poor stunted growth.

Incorrect responses included, curling of leaves, marginal necrosis, purple hues to the leaf. Other incorrect responses included the plant looking sick or growing slowly. These candidate responses did not demonstrate the level of technical knowledge required at Level 2.

Part (b) required candidates to discuss the impact of the deficiency symptoms on poor growth. Strong candidate responses related to leaves that are yellow in colour having reduced levels of chlorophyll and so reduced rates of photosynthesis, leading to lower carbohydrate production, which in turn leads to reduced growth.

Part (c) required candidates to suggest reasons why this deficiency might have occurred. Strong candidate responses included:

- an imbalance in the C:N ratio within the soil
- waterlogging/leaching of nitrogen
- low levels of organic matter
- reduced soil bacteria activity due to abiotic factors
- competition from other plants
- where nitrogen was depleted in growing media (container grown plants)

Some candidate responses included clubroot, roots eaten by vine weevil, roots suffering mechanical damage. As nitrogen deficiency was not a primary result of these scenarios, full marks were not awarded. These responses gained a reduced mark.

Question 3

Candidates in part (a) either scored full marks, as they correctly defined the terms, or they scored low marks as they confused soil texture and soil structure.

In part (b) candidates who gave technically correct and relevant responses gained full marks.

Responses that included both the way that the soil was degraded with an explanation of how the degradation occurred along with the impact of the factor on soil structure/pore space gained full marks. For example, candidates stating that poor cultivation practices could damage soil structure would score 1 mark, while candidates who went on to explain that this is because soil aggregates can be damaged reducing macropore space in the soil, which can impact on drainage gained an additional mark.

Candidates who gave non-technical answers containing terms such as ‘clods’ or ‘lumps of soil’ instead of using the term aggregate scored low marks. Other candidates gave very general answers, for example the disturbance of micro-organisms. Other incorrect candidate responses related to soil texture.

Question 4

In part (a) candidates were asked to name one plant that is in the taxonomic group Gymnosperm, and one that is in the taxonomic group Eudicotyledon.

Strong candidate responses included appropriately named plants (using their full scientific name), these candidates gained the full two marks available.

Some candidate responses confused Gymnosperms with Monocotyledons, and so did not get credited with marks for that part of their response. Other candidates used common names which were credited with a half, rather than a full mark. Some candidates stated Magnolia as an example of a Eudicotyledon, and so did not get awarded a mark, as Magnolia belongs to the Magnoliids rather than the Eudicotyledons.

In part (b) candidates were required to compare the external characteristics of Gymnosperms and Eudicotyledons.

Candidates who successfully made a direct comparison between Gymnosperms and Eudicotyledons received full marks. Examples of correct comparisons included that:

- Gymnosperms have naked seeds, while the seeds of Eudicotyledons are enclosed
- Gymnosperms having reduced, needle like leaves, while the seeds of Eudicotyledons are broad
- Gymnosperms are wind pollinated, while the flowers of Eudicotyledons are wind or insect pollinated
- Gymnosperms have no flowers (or have strobili), while Eudicotyledons have flowers
- Gymnosperms have cones, while Eudicotyledons bear fruits.

Some candidates failed to gain the full mark allocation as they compared lifecycles, or the internal structures, rather than the requested external characteristics.

Other candidates used imprecise language such as simple leaves when referring to the needle like leaves of Gymnosperms.

A common error amongst candidates was to make statements about Gymnosperms and Eudicotyledons, rather than to directly compare external characteristics. These candidate responses included statements relating to the lack of flowers on a Gymnosperm, and the broad leaves on a Eudicot. These responses did not directly compare features, i.e. leaf characteristics and so were not credited with marks.

In part (c) candidates were asked to explain why one of the taxonomic groups named in (a) might be preferred when selecting plants for environmental sustainability. Candidates were awarded one mark for each correct point, with an additional mark for developed points up to the total of three marks.

Correct candidate responses included the selection of Gymnosperms for exposed sites, or for areas where inspect populations are very low arguing that being wind pollinated Gymnosperms would still be able to produce seeds.

Eudicotyledonous plants were a popular choice with many candidates discussing their positive impacts on biodiversity, through having broad leaves to support feeding caterpillars and flowers with nectar and pollen (as essential food sources for insects). Other correct responses included Eudicotyledons offering a wider range of plant types, which could be suitable for specific sites, and that there are greater numbers of native plants in the Eudicotyledon group.

Some candidates did not state whether their answers related to Gymnosperms, or Eudicotyledonous plants. If this could be clearly determined from the answer, then there was no deduction of marks. However, if it was not clear which group was being discussed then no marks could be awarded.

A common error was that candidates discussed the advantage of Eudicotyledons producing seed. Candidates are reminded that Gymnosperms also produce seeds.

Question 5

In part (a) candidates were provided with a diagram of a young plant stem.

Candidates were asked to name the tissues labelled A and B.

The correct candidate response was:

A – Phloem
B – Xylem

Incorrect responses included candidates stating that A was Xylem and B was Phloem.

Other incorrect responses included stomata, mitochondria, chloroplasts and vascular tubes.

In part (b) candidates were asked to state the function of the tissues labelled in part (a)

Correct responses for the function of part A were the transport of sugars or carbohydrates. Correct responses for the function of part B were the transport of both water and mineral salts.

In part (c) candidates were asked to state how they knew that the diagram was not a monocotyledonous plant.

Correct responses included, that the vascular bundles are in a ring, and are scattered in a monocotyledonous plant. That there was the presence of pith showing the stem is not a monocotyledonous plant. Other candidates correctly stated that the presence of cambium indicated that the stem in the diagram was not a monocotyledonous plant.

Incorrect responses included monocotyledonous plants do not have vascular bundles with scattered phloem and xylem, while other candidates incorrectly stated that the xylem was contained in the middle of a stem in a monocotyledonous plant, possibly because the candidate was confusing root and stem structure. Other candidates did not give the required amount of detail, for example the cells are arranged differently in a monocotyledonous plant. Such a response does not demonstrate the level of botanical knowledge required at Level 2 as it does not state which cells the candidate is referring to.

Question 6

Part (a) of this question was designed to assess the candidate's knowledge of the role of water within the plant. This part of the question was well answered with turgidity, cooling, uptake and movement of mineral nutrients and water being used in the photosynthetic process all being given as correct responses.

Candidates are reminded that when a question requests two factors, the first two answers only are considered by examiners. This practice reduces the length of time available to candidates to provide responses to other questions.

Some candidates failed to gain marks as the factors they suggested were too general to demonstrate a knowledge of the function of water in the plant. Examples of such responses included water is used to promote growth in the plant.

Part (b) of this question required the candidate to explain two environmental factors that increase the rate of transpiration in the plant. 1 mark was awarded for each factor, with a further mark being awarded for the explanation. This shows the importance of candidates correctly applying the requirements of the command word. RHS Qualifications have provided centres with guidance on the requirements of all command words at Level 2 and Level 3 on Quartz.

This part of the question was well answered with many candidates gaining the maximum of 4 marks. Correct responses included the concept that low relative humidity leads to an increase in transpiration, as does an increase in temperature. Some candidates put themselves at risk of losing marks by choosing factors that were too similar. While full marks were often awarded, candidates are advised, that when asked to state two factors their response should refer to ones that are distinctly different to demonstrate depth of knowledge.

Incorrect candidate responses included high winds as an environmental factor. This was marked as incorrect as high winds lead to stomatal closure to protect the plant from excessive water loss. (It should be noted that the concept that winds can increase air movement around the leaf, reducing relative humidity and so increasing transpiration was credited with 2 marks.) Many candidates incorrectly stated that photosynthesis (as a process) increases the rate of transpiration, while this would increase the water requirement from the roots, it would not increase the rate of water loss from the plant.

Some candidates lost marks by discussing factors that reduce, rather than increase the rate of transpiration. Other candidates failed to show an understanding of the reason(s) why higher temperatures/lower humidity/air movement could increase transpiration.

Some candidates suggested a factor, such as low humidity and stated this increases the rate of transpiration, however these answers did not explain the factors, for example by stating that low humidity increases the rate of transpiration as the concentration of water in the air

around the stomata will be lower, increasing the movement of water out of the stomata by diffusion.

Part (c) included many strong candidate responses. In this part of the question candidates were asked how planting density influences availability of water in a garden setting. Strong candidate responses discussed the impact of high planting densities increasing competition for water, while also shading the ground and so reducing evaporation. The role of dense foliage in deflecting rainfall, and the creation of humid microclimates were also included in strong responses.

Question 7

In this question candidates were asked in part (a) to name a suitable tree species to encourage wildlife in a domestic garden.

Candidates who suggested an appropriate tree, using the scientific plant name, gained a full mark. Correct candidate responses included:

- *Acer campestre*
- *Corylus avellana*
- *Malus domestica*
- *Crataegus monogyna*

Candidates who correctly suggested a tree, but who used the common name of the tree were awarded a half mark. Candidates are also reminded of scientific naming conventions with regard to the genus starting with an upper-case letter, and the species with a lower-case letter.

Where candidates stated more than one tree in their response, only the first named tree was marked.

In part (b) candidates were asked to justify their tree selection. Correct responses included:

- *Acer campestre*
  Leaves are used as a food source for aphids and so it attracts insectivorous wild birds. Insects live in the bark, and so it enhances biodiversity.

- *Malus domestica*
  Blossom, with pollen for pollinators. Fruit in the autumn as a food source.

Some candidates failed to gain the full mark allocation by suggesting 'provides habitat', rather than suggesting what habitat was provided, or by discussing the use of products from the tree, for example bean poles from *Corylus avellana,* rather than relating their answer to justifying their selection of a named tree species to encourage wildlife. Other candidates simply stated the tree as being good for wildlife. Such responses do not indicate the level of technical horticultural knowledge required at Level 2.

In part (c) candidates were asked to explain how the size of the tree specified for planting can impact on sustainability. Many candidates struggled to gain high marks in this part of the question, indicating a gap in knowledge.

Correct responses included the specification of small planting stock leading to lower carbon and water footprints, reduced use of growing media and reduced use of plastics; with larger plants offering greater carbon capture, the provision of instant ecosystem services, and the need of more water to establish.

Some candidates interpreted the question to relate to the size of the tree at maturity, these candidates were credited with full marks for explanations that included larger trees offering enhanced ecosystem services, i.e. more nesting sites, that larger trees can produce more shade to houses, and would support a greater number of insects/species with food. Other correct responses included trees that are too large shading out other garden plants, thus reducing their flowering and limiting nectar and pollen sources.

Incorrect candidate responses included repetition of the justifications for tree selection, i.e. the provision of flowers as a source of nectar and pollen, or other justifications including the ability to make jams and jellies from the fruits.

Question 8

This question required the candidate to respond to the findings of a site assessment for the planting of a new garden.

Candidates were asked to suggest the potential impact of poor drainage on plant health and establishment. Candidates were also required to name a plant that would be suitable for cultivation in these conditions.

Correct candidate responses included:

- a lack of oxygen in the soil leading to anaerobic conditions
- the presence of Phytophthora (or other named disease)
- a poor uptake of plant nutrients.

Incorrect candidate responses included

- the site would be waterlogged
- the site would be wet
- the roots would be unable to bond with the soil.

Candidate responses that correctly suggested plants for sites with poor drainage with scientific names gained a full mark. Candidates suggesting a plant by genus only, or by common name were awarded half a mark.

Candidates were asked to suggest the potential impact of exposure to full sun on plant health and establishment. Candidates were also required to name a plant that would be suitable for cultivation in these conditions.

Correct candidate responses included:

- leaf scorch
- increased irrigation requirement during establishment

Candidate responses that correctly suggested plants for sites with exposure to full sun using their full scientific names gained one mark. Candidates suggesting a plant by genus only, or by common name were awarded half a mark.

Incorrect candidate responses included:

- the cuticle of the leaf is damaged
- the plant enjoys full sun

Some candidates suggested houseplants for the two given situations. If these were inappropriate as garden plants, no marks were awarded. Other candidates suggested palm

trees for the site exposed to full sun. As this term refers to a group of plants, rather than an individual plant, no marks were awarded.

Section C

The mean mark for Section C was as follows:

Q1 7.07
Q2 6.60
Q3 4.25
Q4 6.58

It is noted that the mean marks recorded in Section A and B are higher than the mean mark recorded in Section C. This demonstrates the effectiveness of the questions within this section as differentiators. It also suggests gaps in candidate's examination technique and technical knowledge which centres and candidates should be aware of.

In general, candidate responses that fully considered the requirements of the question, which were logical, detailed, and which made reference to appropriate horticultural terminology and concepts scored high marks.

Centres and candidates are reminded that all candidate answers are reviewed against the criteria set out below:

Indicative content

- Strength of response
- Integration
- Horticultural knowledge.

Strength of response:

Candidate responses should:

- develop a logical argument to answer the question
- draw on reliable information sources
- be relevant to the question
- express clarity of thought
- demonstrate knowledge of horticultural practices

Integration:

Candidate responses should integrate with other relevant areas of the syllabus.

The assessment ladder used for all Section C answers is shown overleaf.

Each question is considered in detail below.

Band	Mark range	Summary	Description
4	12 - 15	Fully developed (Total)	**A highly detailed, comprehensive, fully relevant response, addressing all aspects of the question** ☐ No irrelevant or incorrect material or observations at the top end of the mark range: otherwise only very minor errors/omissions (which do not detract from an otherwise strong response) ☐ Full integration/clear links demonstrated with other appropriate topics as required: a holistic approach ☐ Advanced current professional horticultural knowledge/principles demonstrated (and evidence of advanced material beyond the specification at the top end of mark range) ☐ Consistent use of correct and appropriate technical language.
3	9 -11	Mainly developed (Solid)	**A reasonably detailed and fairly comprehensive response, with mostly relevant observations, addressing most of the key elements of the question** ☐ Some minor evidence of irrelevant or incorrect material or observations (in what is otherwise a good response), with occasional lack of detail/omissions at times ☐ Secure evidence of some appropriate integration with other topics but some linked topic areas are occasionally overlooked or incorrect associations are made: a partially holistic approach ☐ Current professional horticultural knowledge/principles demonstrated most of the time, with occasional errors, but largely appropriate explanations and application ☐ Correct and appropriate technical language demonstrated most of the time, with some minor errors.
2	6 - 8	Rudimentary (Basic)	**A largely basic response with some relevant observations, addressing some key elements of the question** ☐ Some significant evidence of irrelevant or incorrect material and frequent lack of detail, with some key areas overlooked ☐ Occasional evidence of correct integration with other topics, but many areas are overlooked and incorrect associations made: little evidence of a holistic approach ☐ Current professional horticultural knowledge/principles demonstrated some of the time, but with frequent errors, and only basic explanations or application ☐ Correct and appropriate technical language only partially demonstrated but limited. Some key errors.
1	0 - 5	Undeveloped (Unsatisfactory)	**A largely poor response with few relevant observations, addressing few of the key elements of the question** ☐ Material is largely irrelevant or incorrect and lacking in any detail, with many key areas overlooked ☐ No, or very little evidence of correct integration with other topics, with many areas overlooked and incorrect associations made: no evidence of a holistic approach ☐ No or little evidence of current professional horticultural knowledge/principles demonstrated, with poor or incorrect explanations or application ☐ Little (if any) technical language demonstrated. Often incorrect. Key errors.

Question 1

This was a very popular question amongst candidates.

Candidates who selected to answer this question were required to describe the impact of climate change on plant selection. The question gave candidates an additional steer by suggesting that answers should include plant resilience to extreme weather conditions events using the scientific name of plant species.

Candidates who scored marks within the higher bands gave highly detailed, comprehensive, fully relevant responses. They integrated their knowledge of best practice, sustainability, plant science, plant health, plant nutrition and plant specification into their responses.

Candidates who scored marks in the higher bands considered a wide range of relevant factors to the question. These included:

- the role of lifecycle adaptations and the external parts of the plant in resilience to climate change
- the impact of climate change on rates of photosynthesis and respiration
- the impact of climate change on environmental conditions
- biosecurity and the spread of new pests and diseases
- the impacts of climate change on soil nutrient availability, soil management and soil erosion

Candidates who scored marks in higher bands also outlines approaches relating to

- the development of plant based criteria to inform plant specification
- demonstrated knowledge of how climate change impacts on weather patterns/causes extreme weather events
- related extreme weather events to how a horticulturist would select plants on a sustainable basis
- discussed hardiness ratings
- made reference to resistant hybrids/cultivars/varieties

When assessing candidates, markers took account of either depth or breadth of knowledge in relation to the above points, (crediting candidates who gave narrower but highly detailed answers with equivalent marks to candidates who suggested a wider range of considerations.

All candidates were expected to refer to named examples when referring to plants.

Question 2

This was a less popular question amongst candidates.

Candidates who selected to answer this question were required to respond to a scenario and discuss the testing of soil for pH. Candidates were expected to apply their horticultural knowledge to explain the impacts poor growth, and finally to discuss how amending soil can impact on soil ecology.

Candidates who scored marks within the higher bands gave highly detailed, comprehensive, fully relevant responses. They integrated their knowledge of health and safety, best practice, sustainability, plant science, plant health, plant nutrition and plant specification into their responses.

Candidates who scored marks in the higher bands considered a wide range of relevant factors to the question. These included:

- A detailed account of the process of testing soils for pH. This included the collection of samples against a known, published standard, such as the ADAS technique. A full and detailed account of the testing of a sample, including, mixing, drying and testing protocol was included.

  Some candidates failed to demonstrate the required level of detail simply stating a sample is taken and tested. Other suggested inappropriate methods for professional horticultural situations, for example the use of red cabbage juice in place of universal indicator solution.

- Candidates who scored marks in the higher bands fully considered the likely causes for poor growth. These included factors including:

    - the impact of soil pH on nutrient availability
    - the impact of plant species (calcifuge) on nutrient uptake
    - the range of nutrient deficiencies that could present
    - the impact of incorrect pH on plant health
    - the impact of incorrect pH on plant growth
    - the impact of incorrect pH on flowering

- Candidates were also asked to discuss how amending soil pH impacts on soil ecology. Some candidates failed to gain maximum marks by omitting reference to this area in their answers.

  Candidates who scored marks in the higher bands discussed:

    - the impact of soil pH on macro-organisms

- the impacts of soil pH on soil micro-organisms
- the reduced impact of organic materials to acidify the soil, i.e. pine needles
- the increased impact of stronger chemicals, i.e. sulphur
- the wider sustainability issues relating to soil ecology

When assessing candidates, markers took account of either depth or breadth of knowledge in relation to the above points, (crediting candidates who gave narrower but highly detailed answers with equivalent marks to candidates who suggested a wider range of considerations.

All candidates were expected to refer to named examples when referring to plants.

Question 3

This was a less popular question amongst candidates.

Candidates who selected to answer this question were required to respond to a scenario where a garden was reviewing its maintenance plan for the establishment of new plantings. Candidates were expected to discuss best practice, health and safety and plant health within their responses.

Some candidates related their answers to plant selection and the planting process which was not required in the question. The assessment ladder makes reference to irrelevant material and overlooking key areas such as the maintenance of plants. Some candidates did not refer to maintenance at all in their answers and so gained low marks.

Candidates who scored marks within the higher bands gave highly detailed, comprehensive, fully relevant responses. They integrated their knowledge of health and safety, best practice, sustainability, plant health, and plant nutrition into their responses.

Strong candidate responses included:

- consideration of the maintenance of new plantings, with specific reference to Best Practice, Health and Safety and Plant Health.
- post planting interventions are discussed to include pruning/adoption of best practice/water management/mulching/irrigation.
- scouting to monitor plant health, the identification of establishment issues, the presence of Pest or disease.
- weed control linking which was linked to best practice, plant health, health and safety and included considerations relating to the competition effects from weeds
- the installation of plant support structures and training

When assessing candidates, markers took account of either depth or breadth of knowledge in relation to the above points, (crediting candidates who gave narrower but highly detailed answers with equivalent marks to candidates who suggested a wider range of considerations.

All candidates were expected to refer to named examples when referring to plants.

Question 4

This was a very popular question amongst candidates.

Candidates who selected to answer this question were required to use their knowledge of flower structures to describe how flowers are designed to encourage pollination by bees and other insects. Candidates were also required to discuss how growers might optimise pollination in an apple orchard, and finally to discuss how climate change might impact on bee populations in the orchard.

Candidates who scored marks within the higher bands gave highly detailed, comprehensive, fully relevant responses to each of the sections within the question. Candidates who scored lower marks often gave incomplete answers or gave basic or unsatisfactory responses to the optimisation of pollination or how climate change might impact on bee populations in the orchard sections of the question. These omissions demonstrated a lack of candidate knowledge.

Candidates who scored marks in the higher bands considered a wide range of relevant factors to the question. These included:

- discussions on how flower structures are adapted to pollination by bees/pollinators, including:
    - reference to the position and function of nectaries and nectar guides
    - discussions relating to scent and colour
    - explanations relating to flower structure and flower shape to encourage pollination by bees.

Some candidates made generalised statements such as suggesting a named plant has good floral structures for bee pollination, without going to explain why this is the case, thereby demonstrating knowedge.

- Candidates who suggested a wide range of measures, or showed depth of knowledge by considering a narrower range of interventions in detail on how pollination can be optimised in named fruit crops, scored high marks.

  This included concepts such as:

    - planting wild flowers to encourage pollinating insects to visit the orchard during blossom time.
    - minimising use of pesticides, care with the timing of pesticides
    - the provision of shelterbelts
    - the avoidance of frost pockets
    - correct selecting of pollinator partners
    - the concept of pollinator groups

- Strong candidate responses gave consideration to how a changing climate might impact on pollination to include:
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    - discussions relating to the impact of temperature change on bee/pollinator populations
    - the impact of extreme weather events on bee/pollinator populations
    - the impact of changing rain patterns in the flight of bees/pollinators
    - the reduction in forage plants, or loss of habitat generally on pollinator populations
    - the increased risk/presence of bee/pollinator diseases
    - the impact of climate change on migration/populations of invertebrates/pollinators moving etc.

When assessing candidates, markers took account of either depth or breadth of knowledge in relation to the above points, (crediting candidates who gave narrower but highly detailed answers with equivalent marks to candidates who suggested a wider range of considerations.

All candidates were expected to refer to named examples when referring to plants.