Including examiner comments

R3101

PLANT TAXONOMY, STRUCTURE & FUNCTION

Level 3

Wednesday 7 February 2024

09:00 – 10:40

Written Examination

Candidate Number: .....

Candidate Name: .....

Centre Name: .....

IMPORTANT – Please read carefully before commencing:

i) The duration of this paper is **100** minutes;

ii) **ALL** questions should be attempted;

iii) **EACH** question carries **10 marks**;

iv) Write your answers legibly in the spaces provided. It is **NOT** necessary that all lined space is used in answering the questions;

v) Use **METRIC** measurements only;

vi) Use black or blue ink only. Pencil may be used for drawing purposes only. Ensure that all diagrams are labelled accurately with the line touching the named object;

vii) Where plant names are required, they should include genus, species and where appropriate, cultivar;

viii) Where a question requires a specific number of answers; only the first answers given that meet the question requirement will be accepted, regardless of the number of answers offered;

ix) Please note, when the word 'distinct' is used within a question, it means that the items have different characteristics or features.

ANSWER ALL QUESTIONS

MARKS

Q1 a) Name the main group in the Plant Kingdom to which mosses belong. **1**

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b) State **THREE** environmental conditions in which mosses thrive. **3**

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Please see over/…..

MARKS

c) Describe how **THREE** characteristics of mosses limit their growth to the conditions stated in b). **6**

Total Mark

Please turn over/….

MARKS

Q2 Describe how flowers are adapted for pollination in a **NAMED** plant by:

i) wind **5**
ii) flies **5**

i.....

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Please see over/…..

MARKS

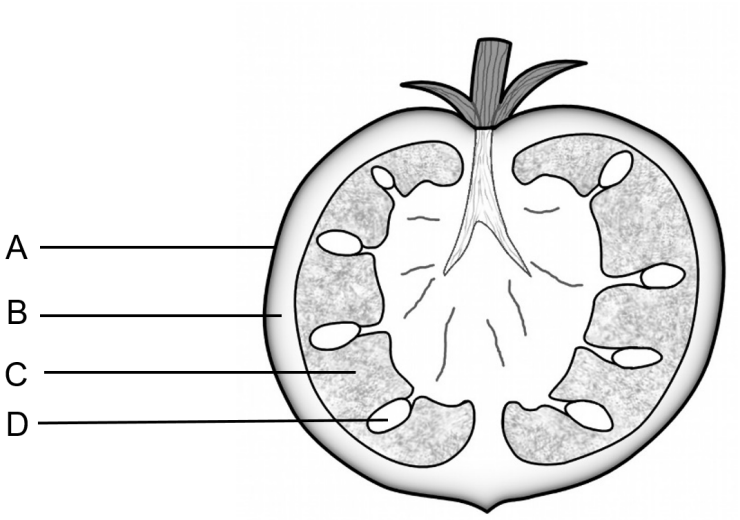
ii)……

Total Mark

Please turn over/…..

MARKS

Q3 a) Name the type of true fruit in the diagram below and give a **NAMED** plant example.



Name of fruit:

…… **1**

Plant example:

…… **1**

b) Name the features labelled A – D in the diagram in a). **4**

A……

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B……

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C……

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D……

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Please see over/…..

MARKS

c) Using a **NAMED** plant example of a false fruit describe the difference between this and a true fruit. **4**

Please turn over/…..

Total Mark

MARKS

Q4 a) State **THREE** environmental conditions that favour guttation. **3**

b) Explain the mechanism of water movement in guttation. **5**

Please see over/…..

MARKS

c) State **TWO** possible functions of guttation. **2**

Total Mark

Please turn over/….

MARKS

Q5 Describe the role of the epidermis of a leaf under the following headings:

i) control of water loss of a leaf **5**

ii) enabling optimum photosynthesis of a leaf **5**

i)..

Please see over/…..

MARKS

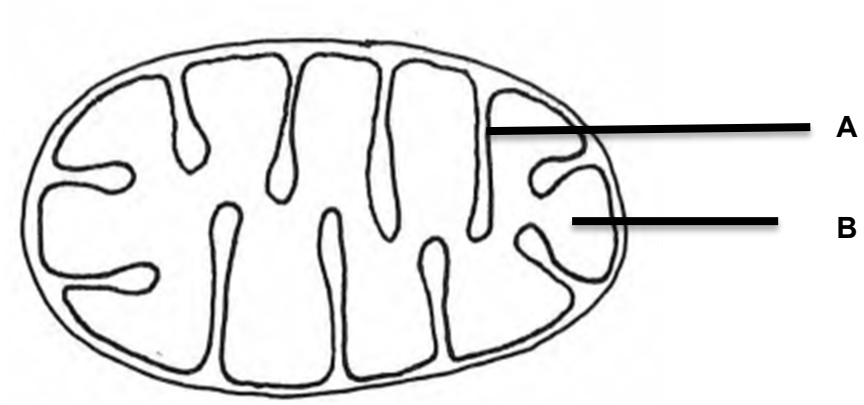
ii)

Please turn over/…..

Total Mark

MARKS

Q6 a) Identify the features labelled A and B on the diagram of a mitochondrion below: **2**



A……

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B……

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b) Outline the stages of aerobic respiration which take place in the: **2 4**

i) cell cytoplasm
ii) mitochondrion

i)……

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Please see over/…..

MARKS

ii)……

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c) State **ONE** benefit and **ONE** disadvantage of anaerobic respiration. **2**

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Total Mark

Please turn over/…..

MARKS

Q7 a) Describe **TWO** properties and **TWO** effects of the named plant growth regulators by completing the table below:

Plant growth regulator	**Abscisic acid**	**Ethene (ethylene)**	**MARKS**
Properties	**1.**	**1.**	**2**
	2.	**2.**	**2**
Effects	**1.**	**1.**	**2**
	2.	**2.**	**2**

Please see over/…..

b) State the difference between a growth retardant and a growth inhibitor in relation to plant growth regulators. **2**

Total Mark

Please turn over/…..

MARKS

Q8 a) Give a **NAMED** plant example for **EACH** of the following inflorescences:

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i) raceme
ii) spike
iii) umbel
iv) corymb

i)……

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ii)……

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iii)……

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iv)……

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Please see over/…..

MARKS

b) State **ONE** difference between:

i) a raceme and a spike **1**
ii) an umbel and a corymb **1**

i)……

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ii)……

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c) Name **TWO** other types of inflorescence giving a **NAMED** plant example for **EACH.** **4**

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Total Mark

MARKS

Q9 a) State what is meant by the term 'tropism' **2**

b) Explain the mechanism of a root's response to gravity. **6**

Please see over/…..

MARKS

c) **2**

State the significance of this response in a geminating seed.

Please turn over/…..

Total Mark

Q10 a) State the meaning of the following terms giving a **NAMED** example of **EACH** term: **MARKS**

i) family **2**
ii) species **2**

i)

ii)

Please see over/…..

MARKS

b)

State the difference between cultivar names and trade designations (selling names) giving a **NAMED** plant example for **EACH.** **6**

Total Mark

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General points

Where a plant example is chosen, it is important to write the FULL botanic name and not just a partial name, following the correct naming protocols.

Where named plant examples are required, **common names are not credited** at level 3. Spellings of scientific terms and botanic plant names need to be full and accurate - poor spellings may be penalised.

Where a number of answers are asked for e.g. **THREE** environmental conditions, only the first three in a list will be marked.

			MARKS
Q1		**Question**	
	a)	Name the main group in the Plant Kingdom to which mosses belong.	**1**
	b)	State **THREE** environmental conditions in which mosses thrive.	**3**
	c)	Describe how **THREE** characteristics of mosses limit their growth to the conditions stated in b).	**6**

a) Most candidates correctly stated Bryophyta or bryophytes although many found the spelling difficult. Other options were Musci or Bryopsida. Non - vascular plants was also accepted, although for a reduced mark

b) Environmental conditions most often chosen included shade, moisture/dampness, high humidity (not just humidity) and low nutrients. Sheltered was also accepted for a reduced mark.

c) Candidates who scored highly chose three characteristics of mosses and described how these limit growth in mosses in detail. Often candidates failed to make the connection between the moss characteristic and their low growth in terms of water at ground level. For example,
   - mosses do not have true roots, only rhizoids OR they have no vascular system so they have to absorb water and nutrients over their entire surface and therefore need to grow close to the ground.
   - Mosses do not have a waxy, waterproof cuticle and need to be surrounded by moisture or high humidity so would dry out easily if they grew too high
   - Mosses need water for reproduction as they need a water film for free swimming sperm

Some candidates confused cuticle with epidermis.

			MARKS
Q2		**Question** Describe how flowers are adapted for pollination in a **NAMED** plant by:	

		i) wind ii) flies	**5** **5**

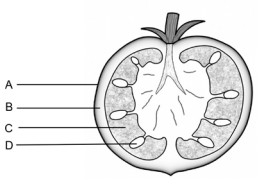
This question was generally well answered although not all candidates named a plant and some did not describe the named plant specifically.

i) Many candidates correctly gave the name of a grass e.g. *Stipa gigantea* or a tree e.g. *Corylus avellana*. Features of wind pollinated flowers include
- Reduced flowers which are dull green in colour (not 'no colour')
- Stamens and stigmas which hang outside the flower
- A feathery stigma
- Anthers with flexible filaments and hinged anthers, large amounts of light, smooth pollen.

Some candidates incorrectly described a conifer, which is not a flowering plant.

ii) Candidates had a choice of different types of fly-pollinated plants, and needed to match their descriptions to the specific flower.
Examples included: *Stapelia gigantea, Arum maculatum, Angelica sylvestris, Hedera helix*.
Aspects of flower colour, scent, trapping mechanisms, inflorescence, position of flower and opening time could all be described.
For example, for *Stapelia gigantea,* relevant adaptions to attract flies would be that, the flower mimics mammal skin with its texture and hairs the flower is flesh coloured, emits a strong smell of rotting flesh and is held close to the ground.
Candidates who logically explained the pollination mechanisms from the fly landing to successful pollination with relation to their chosen named plant, gained highest marks.

			MARKS
Q3		Question	
	a)	Name the type of true fruit in the diagram below and give a **NAMED** plant example	

		 Name of fruit……. Plant example……	**1** **1**
	b)	Name the features labelled A – D in the diagram in a)	**4**
	c)	Using a **NAMED** plant example of a false fruit state the difference between this and a true fruit.	**4**

a) Most candidates correctly named the fruit as a berry (not tomato) and the example as *Solanum lycopersicum* although other plants producing berries were also accepted.

b) Candidates who understood the structure of a fruit correctly identified the labels as
A = exocarp/epicarp (epidermis was also accepted),
B = mesocarp,
C= endocarp and
D= seed or ovule

c) Many candidates were unable to distinguish between a false fruit and a true fruit. The most common error was made by candidates stating that a false fruit is made of flower parts other than the ovary, whereas a false fruit is formed from an ovary **plus** other flower parts.
The false fruits most commonly chosen were *Fragaria x ananassa* and *Malus x domestica.* For *Fragaria x ananassa* the swollen fleshy part of the fruit is formed from the receptacle and the fruits /achenes are embedded in the surface of this.

			MARKS
Q4		**Question**	
	a)	State **THREE** environmental conditions that favour guttation	**3**
	b)	Explain the mechanism of water movement in guttation	**5**

	c)	State **TWO** possible functions of guttation	**2**

a) Candidates who scored highly listed three environmental conditions from among: low light levels, high soil moisture content, high humidity, low wind speed and low temperature. Marks were not awarded if the level (high or low) of each condition was not mentioned.

b) Marks were awarded for stating that guttation occurs under conditions of low transpiration commonly in early morning or dusk when stomata are closed. A detailed description was needed for full marks. Guttation occurs through uptake of water by osmosis into the roots, movement up the xylem and into the leaves by root pressure (a positive hydrostatic pressure) and release of water as droplets around the edge of leaves through hydathodes. Some candidates incorrectly stated transpiration pull, capillarity and adhesion/cohesion as the major for driving the process and some described transpiration instead.

c) The functions of guttation were not well stated. Some candidates stated that it was to store water or relieve water pressure in the leaf but few mentioned prevention of oedema or excretion of excess salts. Guttation can be a priming mechanism for transpiration in spring, or a means of removing air bubbles in the xylem, or that it enables nutrient uptake when transpiration is not active.

			MARKS
Q5		**Question** Describe the role of the epidermis of a leaf under the following headings: i) control of water loss of a leaf	 **5** **5**

		ii) enabling optimum photosynthesis of a leaf	

A knowledge of the structure of the epidermis of a leaf was essential to answer this question together with a statement of why this reduces water loss or enables optimum photosynthesis. There could be some cross-over between the two sections and this was acknowledged in the marking.

i) Candidates who scored well described the epidermis producing a waxy (cutin) waterproof cuticle and the cells being tightly packed with no air spaces in between. Discussion of the role of stomata and guard cells in controlling water loss was also rewarded. Few candidates mentioned adaptations of the epidermis such as sunken stomata or leaf hairs with their effects of reducing transpiration due to increased humidity next to the leaf.

ii) Many candidates incorrectly stated that the epidermis contains chloroplasts whereas it is actually transparent and photosynthesis takes place in the mesophyll cells beneath. The epidermis is one cell thick and the cells flattened so that light transmission is not impeded. Candidates could also state that the stomata regulate water loss so that turgidity is maintained and wilting avoided, to maximise light interception. Stomata also open to allow diffusion of carbon dioxide into the leaf when light is available, enabling optimum photosynthesis.

			MARKS
Q6		**Question**	**2**
	a)	Identify the features labelled A and B on the diagram below: <u>A plant mitochondrion</u>	

	b)	Outline the stages of aerobic respiration which take place in the: i) cell cytoplasm ii) mitochondrion **c)** State **ONE** benefit and **ONE** disadvantage of anaerobic respiration	**2** **4** **2**

a) Most candidates correctly identified A as a crista and B as the matrix in the mitochondrion although some confused this with a chloroplast. A few confused the organelle with an entire cell.

b) i) Candidates who scored highly stated that in the cytoplasm, glucose is split into pyruvate molecules with some production of ATP. This is called glycolysis. Only two marks were available for this section so long descriptions were not necessary.

Ii)More detail was needed in this section for 4 marks. Essential points were that pyruvate enters the mitochondrion where it is further broken down. CO_2 and water are produced in the presence of oxygen creating ATP and heat. Marks could also be awarded for more detailed answers stating that the initial process is the Krebs cycle and that this is followed by oxidative phosphorylation and H transfer is carried out by NAD and FAD.

c) Almost all candidates were able to correctly state that anaerobic respiration allows plants to survive in low oxygen conditions though they did not always mention that this was for a limited time, often due to waterlogging. Most stated that a disadvantage is that little energy is produced (but did not mention that further growth or metabolic activity would be limited) and that ethanol is produced which is toxic. A number of candidates confused ethanol with ethylene and mentioned senescence instead.

			MARKS
Q7		**Question**	
	a)	Describe **TWO** properties and **TWO** effects of the named plant growth regulators by completing the table below:	

Plant growth regulator	**Abscisic acid**	**Ethene (ethylene)**

2
2

	b)	**Properties**	**1.** **2.**	**1.** **2.**	**2** **2**
		Effects	**1.** **2.**	**1.** **2.**	**2**
		State the difference between a growth retardant and a growth inhibitor in relation to plant growth regulators			

This question was not well answered with very few candidates gaining high marks

a) Candidates often confused properties and effects of the PGRs and few were able to describe two of each.

Abscisic acid moves around the plant (non-polar) and is produced in all plant organs. It is continuously broken down and remade and acts antagonistically to gibberellic acid. Better candidates described its main effects in detail, namely triggering stomatal closure in water-stressed plants and promotion of dormancy in seeds and buds. Prevention of seeds germinating on the plant (vivipary) was less well known. Some mistakenly gave leaf abscission as an effect.

Most candidates correctly stated that ethylene is a gas, but few knew that it is transported around the plant as a soluble precursor (ACC) which is converted within cells. Also, that it commonly interacts with auxin. Almost all candidates knew the effect of ethylene triggering ripening in fruits and some were also able to describe promotion of leaf abscission and senescence. Few candidates mentioned inhibition of sprouting in potatoes and onions, flower formation in some species or epinasty.

b) Very few candidates correctly stated that growth retardants have a *reversible* effect whereas those of growth inhibitors are *permanent*. Most candidates instead described the effects of commercial application of PGRs on various crops or their mode of action**.**

			MARKS
Q8		**Question**	
	a)	Give a **NAMED** plant example for **EACH** of the following inflorescences: v) raceme vi) spike	**4**

		vii) umbel viii) corymb	
	b)	State **ONE** difference between: iii) a raceme and a spike iv) an umbel and a corymb	**1** **1**
	c)	Name **TWO** other types of inflorescence giving a **NAMED** plant example for **EACH.**	**4**

This question was generally well answered:

a) Almost all candidates were able to give a suitable plant example. The most popular were:

Raceme – *Digitalis purpurea*
Spike – *Acanthus mollis*
Umbel – *Daucus carota*
Corymb – *Sambucus nigra*

b)

i) Most candidates correctly stated that individual flowers in racemes are attached by pedicels (or something similar) whereas flowers in spikes are not. Many candidates confused the terms describing the attachment of the flowers in an inflorescence. The pedicel attaches the flowers to the rachis and the whole inflorescence is attached to a peduncle which connects to the stem. These terms were often used interchangeably and incorrectly.

ii) Better candidates stated that in an umbel the pedicels are attached at a single point whereas in a corymb the pedicels are spread along the stem. Many candidates described the flat-topped structure of corymbs but these are also possible in an umbel so the length of the pedicels can vary in both.

c) Almost all candidates could name two other examples of an inflorescence with examples, the most popular being

Capitulum – *Helianthus annuus*
Panicle – *Syringa vulgaris*
Verticillaster – *Phlomis fruticosa*

Plant names, capitulum and verticillaster were rarely correctly spelled.

			MARKS
Q9		**Question**	
	a)	State what is meant by the term ‘tropism’	**2**
	b)	Explain the mechanism of a root’s response to gravity.	**6**
	c)	State the significance of this response in a geminating seed	**2**

a) Few candidates gained full marks, most failing to state that this is a growth response although many mentioned it is directional and in response to a stimulus, often giving examples of the environmental stimulus.

b) Better candidates described the mechanism in detail. Essential points were:

This is positive gravitropism (geotropism).
Auxin is the plant growth regulator involved. Auxin accumulates in the underside of the root in response to gravity and inhibits cell expansion, so the root bends down.

Additional marks could be awarded for stating that auxin is produced in the root tip and translocated along the root. Many correctly mentioned that the direction of gravitational pull is detected by statocytes, cells containing statoliths/amyloplasts (starch grains) found in the root cap. This was generally well known although there were variable spellings here.

c) Most stated that in a germinating seed, gravitropism enables the root/radicle to grow down (not always stating in search of water and minerals) and the shoot/plumule to grow up (again, not always stating towards the light for photosynthesis).

			MARKS
Q10		**Question**	
	a)	State the meaning of the following terms giving a **NAMED** example of **EACH** term:	
		i) family	**2**
		ii) species	**2**
	b)	State the difference between cultivar names and trade designations (selling names) giving a **NAMED** plant example for **EACH.**	**6**

a) Most candidates correctly stated that a family is a collection of genera or that it is the rank above genus, and that a species is a group of plants within a genus with characteristics in common. Species can also interbreed. The ending of a plant family name was often misspelt; it ends in -aceae e.g. Rosaceae, and some candidates gave a species epithet instead of a full species name so could not gain a mark.

b) Candidates who scored highly clearly differentiated between cultivar names and trade designations and gave separate examples of each.

The definition of cultivar (cultivated variety or plant bred by humans) was often given and was rewarded. Further marks were given for stating that cultivar names are governed by ICNCP rules (International Code of Nomenclature for Cultivated Plants) and can be registered with registration societies for that specific genus. They are legally protected having undergone Plant Breeders Rights where they are tested for uniqueness, stability and uniformity. An example could be *Prunus* x *subhirtella* 'Autumnalis' or *Miscanthus sinensis* 'Gracillimus'

Most candidates understood that a trade designation is an additional name given to a plant where the cultivar name is less acceptable for marketing reasons. Trade designations have not undergone Plant Breeders Rights and they are not registered with an authority. Most candidates chose *Choisya ternata* **Sundance** as an example but few mentioned that this is written in a different font without inverted commas. Some candidates also gave *Choisya ternata* 'Lich' as the example of a cultivar.

On the whole spellings and the correct style of writing both cultivars and trade designation names were poor.

Candidates should be aware that many rose names are trade designations.

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