Including examiner comments

R3101

PLANT TAXONOMY, STRUCTURE & FUNCTION

Level 3

Wednesday 8 February 2023

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.

Ofqual Unit Code M/505/2966

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ANSWER ALL QUESTIONS

MARKS

Q1 State **FIVE** distinct ways in which sexual reproduction in conifers differs from flowering plants, by completing the table below:

Conifers	Flowering plants	
		2
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		2
		2

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MARKS

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MARKS

Q2 a) State what is meant by the term 'thigmotropism'. **3**

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b) Describe the mechanism of thigmotropism in plant tendrils. **5**

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MARKS

c) State **TWO** benefits to the plant of thigmotropism. **2**

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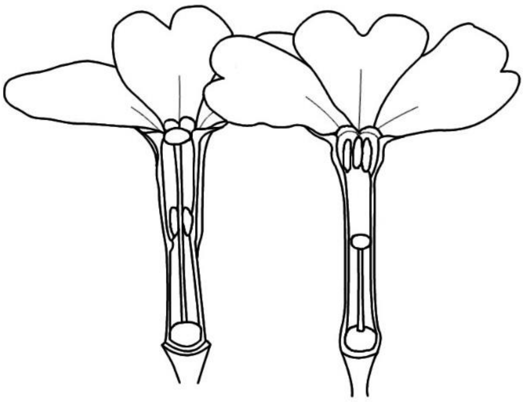
MARKS

Q3 a) Describe how cross pollination is favoured in the flowers shown below: **4**

Primula vulgaris flowers



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MARKS

b) Describe **TWO** other methods that plants use to favour cross pollination, giving a suitable **NAMED** plant example for **EACH**. **6**

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MARKS

Q4 a) State the significance of aerobic respiration in the post harvest storage of fruit. **2**

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b) State **TWO** differences between ‘climacteric’ and non-climacteric’ fruit giving a **NAMED** example of **EACH** fruit. **4**

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MARKS

c) Describe how the gaseous atmosphere can be manipulated to prolong storage time of fruits. 4

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MARKS

Q5 a) State the difference between the following terms, giving a **NAMED** plant example for **EACH:**

i) varietas and cultivar 4
ii) graft hybrid and interspecific hybrid 4

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MARKS

b) Explain what is meant by the term ‘naming authority’ giving a **NAMED** plant example. 2

Total Mark

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MARKS

Q6 a) Explain how the following environmental conditions affect the rate of transpiration from leaves:

i) low humidity **3**
ii) low soil moisture **3**

i)………………………………………………………………………………………

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MARKS

b) Explain how CAM plants are adapted to the environmental conditions listed in a). **3**

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c) Give a **NAMED** plant example of a CAM plant. **1**

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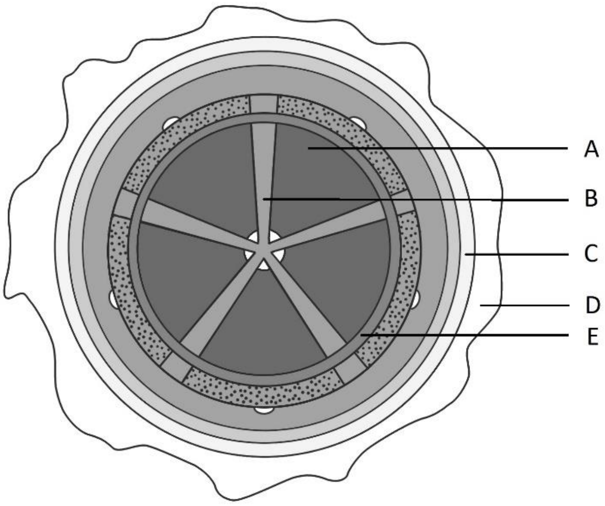
MARKS

Q7 a) Identify the features labelled A-E on the diagram of a woody stem below **5**

Woody stem



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MARKS

b) State **ONE** function for **EACH** of the features labelled in a). **5**

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MARKS

Q8 a) Explain how successful pollination can be achieved in an apple orchard. **7**

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MARKS

b) Name the succulent false fruit produced by *Malus* genus. 1

c) Describe **TWO** distinct features of the false fruit named in b). 2

Total Mark

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MARKS

Q9 a) State what is meant by the term 'endogenous' plant growth regulator (PGR) **1**

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b) Describe the role of **NAMED** endogenous PGRs in **EACH** of the following processes**:**

i) autumn leaf fall **3**
ii) fruit set and development **3**
iii) the plant's response to drought **3**

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MARKS

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Q10 a) State the meaning of the term ‘plant tissue’. **MARKS** **1**

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b) List **THREE** distinct functions of epidermal tissue. **3**

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c)

Describe how the structure of epidermal tissue and cells enable it to carry out the **THREE** functions listed in b). **6**

Total Mark

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R3101

PLANT TAXONOMY, STRUCTURE & FUNCTION

Level 3

Wednesday 8 February 2023

Candidates Registered	**TBC**		**Total Candidates Passed**	TBC	49%
Candidates Entered	106	TBC%	Passed with Commendation	16	15%
Candidates Absent/Withdrawn	TBC	TBC%	Passed	36	34%
Candidates Deferred	TBC	TBC%	Failed	54	51%

General comments

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 penalized.

Questions - It is essential to read the question carefully and to note the **key words** before starting to write to ensure answers are relevant. Candidates should take account of the command statements in the question e.g. 'list', 'describe', 'explain', together with the mark allocation, to judge the depth of the answer required. Extra information, even if it is accurate, does not gain extra marks.
Where a number of answers were specified in the question and a candidate gave a list with more than that number, **only the first answers** in the list were marked, e.g. where the question stated 'Name **TWO** locations' or 'State **TWO** ways' only the first **TWO** answers were marked even if the correct answers were given further down. It is helpful (but not essential) if the answers are numbered in the text or separate paragraphs or bullet points are used.

Plant names - Where named plant examples were asked for, **full botanical names are required** to achieve full marks: genus, species and where appropriate variety, cultivar etc. needed to be written and spelt correctly. Where genus alone was given, all species in that genus need to show the characteristic asked for to gain any credit. **Common names were NOT accepted** and misspellings were penalised. Candidates needed to use unambiguous plant examples from sources such as the RHS Plant Finder and/or the RHS A-Z Encyclopaedia of Plants together with examples given in the syllabus and avoid obscure or difficult to verify plant examples, which risked being not credited.

Labels on diagrams must be carefully and correctly positioned to avoid ambiguity. Marks can be easily lost if this is not followed. Labels must actually touch the appropriate part of the diagram and must not be left hanging in mid air. Annotations on diagrams can be accepted as an alternative to description in the text as long as these are clear and answer the question. No marks were awarded for artistic merit or for unlabelled diagrams.

Continuation sheets - Where these have been included, it is vital that the relevant question number is included in the left hand margin if information written here is to be considered. These should also be attached to the answer booklet in the appropriate place and candidates should indicate in their answer booklet that they have written part of their answer on the attached sheet/s

Q1 State **FIVE** distinct ways in which sexual reproduction in conifers differs from flowering plants, by completing the table below:

MARKS

Conifers	**Flowering plants**	
		2
		2
		2
		2
		2

Q1

This question was generally well answered.

Good responses included the following for conifers:

- pollen is produced in male cones
- naked' seed /seed are held within cones
- plants are mainly monoecious
- a single fertilization occurs
- all are wind pollinated

In comparison with flowering plants where:

- pollen is produced by anthers/stamen
- seed are 'enclosed' /seed are held within a fruit/ovary
- plants may also be dioecious or produce hermaphrodite flowers
- a double fertilization process occurs
- there are a range of pollination vectors (not just wind)

Other valid answers were also credited. The term anemophily was accepted in lieu of wind pollination and entomophily for insect pollination.

As a comparison table was included to record the ways in which the two plant groups differed, full credit could not be awarded for correct yet unpaired statements.

The fact that flowering plants 'have flowers,' and conifers 'have cones' could not be awarded the full mark allocation as this is implicit in the question.

Incorrect spelling of the terms monoecious and dioecious was common.

Negative statements were not credited, e.g., the fact that flowering plants do not produce cones.

It should be noted that whilst conifers are all wind pollinated, flowering plants have a range of pollination vectors, not just insects.

Q2 **MARKS**

a) State what is meant by the term ‘thigmotropism’. **3**

b) Describe the mechanism of thigmotropism in plant tendrils. **5**

c) State **TWO** benefits to the plant of thigmotropism. **2**

Q2

a)

This question was well answered, most candidates gaining three marks for stating that thigmotropism is a *directional, growth* response (rather than just referring to it as ‘a movement’) to an external *touch stimulus*.

Credit was given to candidates who described positive thigmotropism as growth towards an object which the plant or plant part is in contact with, whereas a negative response is where growth is in the direction away from the touch stimulus.

Often candidates did not give detailed enough answers especially in relation to ‘directional’ or ‘positive/negative’ growth. Some confused thigmotropism with phototropism.

b)

Most candidates were aware that the endogenous plant growth regulator auxin is involved in a trophic response, although some described phototropism growth response of a stem exposed to light rather than the thigmotropic response of plant tendrils and therefore could not be credited.

Three key points are the accumulation of auxin on the side of the tendril away from the point of contact, leading to greater *cell* expansion/ elongation on this side of the tendril. This results in the tendril curling around the support.

Note that the term ‘growth’ here could not be fully credited as this could imply cell division -which does not occur here- rather than cell expansion.

Credit was also given for stating that this is a positive thigmotropic response and for knowledge of auxin being produced at the apical meristem and its transport downwards from the tip. Few candidates knew that auxin is produced in the apical tip and transported down the shoot.

Clearly annotated diagrams were credited where relevant.

c)

Most candidates referred to thigmotropism in plant tendrils.
The most popular response was using stem or leaf tendrils or a twining stem to climb upwards to intercept more light for increased photosynthesis.
Many candidates struggled to provide a second benefit of thigmotropism.
These include the provision of a competitive advantage over other plants nearby, increasing the plants potential for pollination and seed dispersal; few candidates mentioned increased stability for lax or non woody stems, or protection from high winds. A benefit of a thigmotropic response in roots is to enable roots to grow

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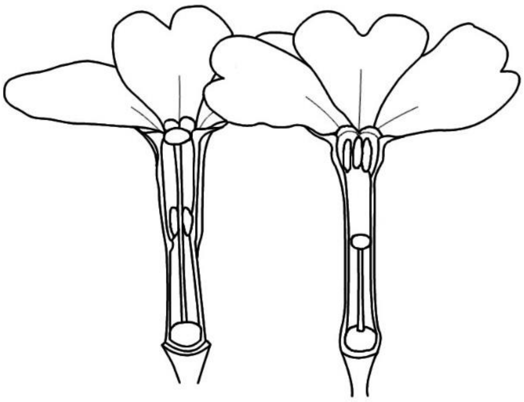
A full description of the benefit was necessary for full marks. Marks were often lost for not stating that climbing towards the light was to increase photosynthesis. Some candidates described nastic (non-directional) growth in response to the touch stimulus which could not be rewarded.

Q3 a) Describe how cross pollination is favoured in the flowers shown below: **MARKS 4**

<u>*Primula vulgaris* flowers</u>



b) Describe **TWO** other methods that plants use to favour cross pollination, giving a suitable **NAMED** plant example for **EACH**. **6**

Q3 **a)** This was not well answered unless candidates acknowledged that the diagram shows the two different flower forms (dimorphy) that are produced on different plants of *Primula vulgaris*.

The essential difference shown here is the comparative length of the style -hence the term heterostyly- and the subsequent positioning of the stigma, and the different filament length and the resulting position of the anthers.

Many candidates correctly named the two flower forms as 'pin' (on the left) and 'thrum' and were credited for this.

Where these differences were correctly acknowledged, candidates were then able to describe *how* this favoured cross pollination.

Most correctly stated that this plant is insect pollinated, pollen being collected and transferred on different parts of the insect's body and is only deposited successfully on the alternative form of flower.

However, many candidates did not state the other key point which is that these flower forms occur on separate plants, an individual plant will therefore have flowers of *either* one form *or* the other which favours cross pollination (i.e., pollen transfer between *different plants*)

Some candidates incorrectly stated that the diagrams show separate male and female flowers and described monoecy or dioecy.

b) This part of the question was generally well answered. The method most described was dioecy, where there are separate male and female plants. Marks were lost where candidates confused the term monoecy with dioecy or provided incorrect plant examples, several confusing monoecious species such as *Corylus avellana* and dioecious species such as *Ilex aquifolium* and *Taxus baccata*.

Another correct example was dichogamy, where there is a sequential ripening of the male and female sex organs in a flower on a plant; protandry where stamens mature and shed their pollen before the stigma matures and becomes receptive - commonly named plant examples being *Zea mays, Hedera helix* and *Salvia officinalis*, or protogyny when stigmas mature before the stamens, plant examples being *Magnolia grandiflora, Plantago major* and *Malus sylvestris.*

Less commonly cited methods to prevent or reduce the likelihood of self-pollination include genetically controlled and chemical incompatibility mechanisms such as that encountered with many cultivars of *Malus domestica*, and mimicry, as seen in the orchids *Ophrys insectifera* and *Ophrys apifera.*

Some candidates described general adaptations for pollination e.g. scent, colour instead of methods favouring cross pollination whilst some described planting maize in blocks which was not asked for.

MARKS

Q4 a) State the significance of aerobic respiration in the post harvest storage of fruit. **2**

b) State **TWO** differences between 'climacteric' and non-climacteric' fruit giving a **NAMED** example of **EACH** fruit. **4**

c) Describe how the gaseous atmosphere can be manipulated to prolong storage time of fruits. **4**

Q4 This question was not well answered by many candidates.

a)

There were mixed responses to this part of the question, some very good.

Here, candidates were expected to identify the impact of aerobic respiration in post-harvest storage of fruit.
There was a general awareness that fruit continues to respire in storage and the more rapid the rate of respiration, the more rapid ripening of the fruit and the shorter the storage time, and this was sufficient for full marks for this part of the question.
Some candidates stated that if aerobic respiration of the fruit is not possible then anaerobic respiration occurs which results in fermentation and spoilage of the fruit, and this was also credited.

b)

Although many candidates correctly stated that climacteric fruits may be harvested before ripening because they can continue to ripen in storage, whereas non-climacteric fruit need to be harvested when ripe, only a minority of candidates could provide another difference.
In climacteric fruit such as *Solanum lycopersicum* and *Musa acuminata,* the respiration rate peaks at the onset of ripening, the rapid ripening being associated with a burst of ethylene, whereas non-climacteric fruit such as *Fragaria x ananassa* and *Citrus sinensis,* ripen steadily as they are not so sensitive to ethylene. Apples, *Malus domestica,* are considered climacteric fruit.
Pyrus communis was the most popular example of a climacteric fruit. Correct examples of non-climacteric fruit also included citrus (*Citrus x limon*), and Ribes spp. such as *Ribes nigrum.*

The association between the rate of fruit ripening and sensitivity to the plant growth regulator ethylene (ethene), was not well understood. Some candidates also confused the examples of plants which produce climacteric and non-climacteric fruit. Some candidates did not give the full comparison between climacteric and non-climacteric fruit so lost marks.

c)

Unfortunately, many candidates described the importance of temperature and how the atmosphere in fruit stores can be cooled, however the question asks how the *gaseous atmosphere* can be manipulated and therefore no marks could be awarded here. Similarly, some discussed control of pests and diseases which could not be credited.

There was an awareness that reducing oxygen in fruit stores and within packaging will reduce the rate of aerobic respiration and therefore prolong storage times. Few candidates accurately distinguished between controlled and modified atmosphere storage or that the removal of ethylene (ethene) using scrubbers is particularly beneficial when storing climacteric fruit.

Packaging was the most popular method chosen. Controlled atmosphere storage (CA), where the atmosphere is continuously monitored and amended in a sealed environment, and modified atmosphere storage, which is sealed but with no further amendment, were generally not referred to by name although these were described in some answers. Candidates lost marks by not following through in their answers to say that the storage method described *prolonged* storage (not just *affected* it).

MARKS

Q5 a) State the difference between the following terms, giving a **NAMED** plant example for **EACH:**

i) varietas and cultivar **4**
ii) graft hybrid and interspecific hybrid **4**

b)

Explain what is meant by the term 'naming authority' giving a **NAMED** plant example. **2**

Q5 **a**)

i) Not many candidates could clearly explain the difference between varietas and cultivar which is that varietas are naturally occurring variations within a species that arise in the wild, whereas a cultivar is a variation that can be created/'bred' by plant breeders or occur in and be collected from the wild (e.g., naturally occurring mutations), but which must be *maintained* by cultivation.
Describing a cultivar as 'man-made' is not an adequate response at level 3. The correct naming and writing and spelling of plant examples for varietas proved to be problematic for many. Examples include: *Ceanothus thyrsiflorus* var. *repens, Prunus persica* var. *nucipersica. Betula utilis* var. *jacquemontii* was accepted although it has recently been recognised as a subspecies.

More candidates correctly named a plant cultivar than a varietas, e.g., *Catalpa bignonioides* 'Aurea', *Corylus avellana* 'Contorta'. Some candidates incorrectly wrote the trade designation or selling name rather than the registered cultivar name, and could not be rewarded unless the cultivar name was also written, e.g., *Choisya ternata* Sundance (where the cultivar name is 'Lich') *Rosa* Dublin Bay (cultivar name 'Macdub'), *Rosa* Gertrude Jekyll (cultivar name 'Ausbord'). This was the case for numerous examples of *Rosa* where few candidates could give a correct cultivar name.

ii) Many candidates found it difficult to clearly describe a graft hybrid. It is not sufficient to say it is a means of asexual reproduction only or a 'happy accident'.

The difference between a graft hybrid and an interspecific hybrid is that:

A graft hybrid is produced by *vegetative reproduction* (grafting). After grafting the scion of one genus onto a compatible rootstock of *a genetically different yet related genus*, the new tissue which forms from the union has cells/genetic material that persists each of the two genetically different parents- so a graft hybrid simultaneously contains the DNA of the two parents in separate cells in its meristems.
Alternatively, a graft hybrid can be described as *a chimaera.*

There are not many examples of graft hybrids, the two most common being +*Laburnocytisus* (where *Chamaecytisus purpureus* is grafted onto *Laburnum anagyroides*) and + *Crataegomespilus*, (which is a graft hybrid between hawthorn and medlar); graft hybrids are denoted by the + symbol in front of the hybrid name.

Many candidates described the grafting of a scion of an apple cultivar onto a rootstock such as MM106 or grafting of roses. This simple grafting is between species of the same genus and does not create a graft hybrid.

An interspecific hybrid on the other hand is *produced by sexual reproduction* between separate species from the *same genus.* The vegetative cells of interspecific hybrids are all identical, each cell containing the recombinant DNA from both parents.

Candidates were generally more successful when naming an interspecific hybrid e.g., *Crocosmia* x *crocosmiiflora*, *Tilia x europaea.*

However, some incorrectly wrote the names of intergeneric hybrids such as x *Cuprocyparis leylandii* instead of an interspecific hybrid*.*

b) Candidates were rewarded for stating that this indicates the person who *first published* this particular plant name for this plant, for example *Caltha palustris* L. or *Rumex obtusifolius* L. (where L stands for Linnaeus), *Primula vulgaris* Huds. (after William Hudson), *Buddleja davidii* Franch. (after Adrien René Franchet).
Some candidates provided long explanations of how various plant names have been changed over many years but this was not required for the two marks available here.
Some candidates misinterpreted the meaning of ‘naming authority’ and discussed the role of international organisations responsible for naming plants and consequently gained no marks.

In general names of plant examples were very poorly written.

Q6 a) Explain how the following environmental conditions affect the rate of transpiration from leaves: **MARKS**

i) low humidity **3**
ii) low soil moisture **3**

b) Explain how CAM plants are adapted to the environmental conditions listed in a). **3**

c) Give a **NAMED** plant example of a CAM plant. **1**

Q6

Most candidates could adequately describe the effect on transpiration of low humidity and low soil moisture although few described *changes* in the steepness of the water gradient from the inside to the outside of the leaf, or from soil to air and its relationship to rates of transpiration.

a) **i)** The essential point here is that in general low humidity increases transpiration rate.

Marks were also given for explaining why this is, e.g., water vapour/air inside leaf has a higher relative humidity than outside of the leaf which increases the gradient of water vapour concentration or water potential. Also, that stomata may close if the humidity in the atmosphere becomes very low (where more water is being lost than being supplied) in which case transpiration will cease.

ii) The essential point here is that low soil moisture will reduce the transpiration rate.

Marks were then awarded for an explanation of the lower water potential gradient between the soil and air, or the fact that at *very* low soil moisture content (when there is no more available water in the soil pores), the stomata will close, and transpiration will then cease.

Many candidates attempted to describe water movement between soil and cells/osmosis rather than looking at the gradient across the plant from soil to air.

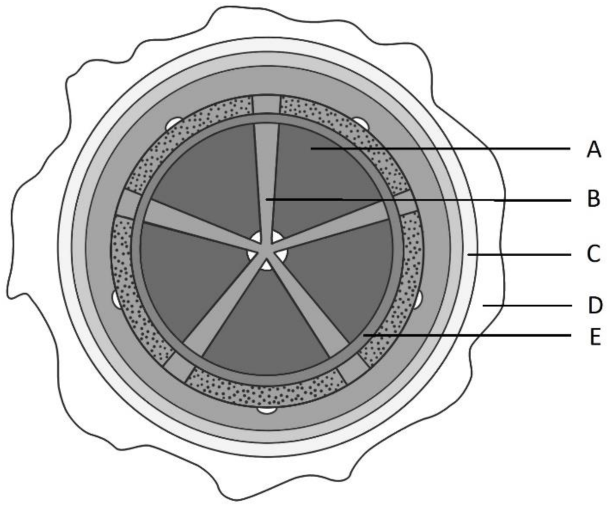
b) This part of the question was not well answered by many candidates, whilst some did not attempt an answer. It was apparent that some were not familiar with the term ‘CAM plant’.
Crassulacean Acid Metabolism (CAM) photosynthesis pathway occurs in most succulent plants which live in xerophytic environments.
Candidates were expected to state that the stomata of ‘CAM plants’ close during the day and open at night (reverse stomatal opening) when it is cooler to reduce water loss by transpiration, and this is when CO_2 is taken in and fixed as a four-carbon molecule C4 molecule.
At this point some candidates became confused with C4 photosynthesis metabolism and did not therefore obtain full marks.

Few candidates stated that it is malic acid which is stored in cell vacuoles at night which is what then leads to succulence of the plant material (which allows storage of water in the arid conditions in which these plants usually live) and also leads to the bitter taste which deters herbivores.

MARKS

Q7 a) Identify the features labelled A-E on the diagram of a woody stem below **5**

<u>Woody stem</u>



b) State **ONE** function for **EACH** of the features labelled in a). **5**

Q7

a) There was an obvious divide here between those who had a good understanding or the arrangement and naming of the tissues in a woody stem and those with little knowledge who did not obtain many marks.

A- secondary xylem, 'xylem' only being awarded half mark

B- medullary ray- full mark awarded for 'ray', medullary commonly being mis-spelt

C- phellogen (or 'cork cambium'), 'cambium' only being worthy of half mark

D- phellem (or 'cork'); 'Bark' was not credited as the 'bark' comprises all the tissues outwards of and including the phloem

E-vascular cambium ('cambium' receiving half marks)

Cork cambium and cork were often confused by candidates

Candidates commonly failed to correctly name the outermost phellem/cork layer (D) as well as incorrectly naming the secondary xylem (A) as 'pith' and the vascular cambium (E) as 'secondary xylem'.

Many confused the terms (and functions) of phellogen and phellem and periderm (which is the 'outer bark' comprising the phellogen and its products: phelloderm and phellem).

			MARKS
Q8	a)	Explain how successful pollination can be achieved in an apple orchard.	**7**
	b)	Name the succulent false fruit produced by *Malus* genus.	**1**
	c)	Describe **TWO** distinct features of the false fruit named in b).	**2**

Q8 a)

This question was generally well answered, particularly part a) which links to more practical aspects of apple crop production. Marks were awarded for anything that can practically improve the cross pollination of apple trees by insect pollination vectors.

Better candidates were aware that most apple trees need to be cross pollinated as most are self-incompatible so there needs to be at least two different compatible cultivars (not species) that flower at the same time (same or adjacent pollination groups). Some also raised points relevant to producing fruit from triploid cultivars where at least two compatible diploid cultivars need to be planted in the orchard as triploid produce sterile pollen.

The more practical aspects were the most commonly cited examples which include bringing bee-hives into the orchard at flowering time, providing shelter from strong winds, avoidance of frost pockets, avoidance or 'correct' application of pesticides, particularly when the trees are in bud/flower. Planting wildflowers and other plants in an orchard to extend the period when pollen and nectar are available can be considered as having a positive effect on provision of pollinators although some studies indicate that this can detract pollinators from apple trees if they flower at the same time. The planting of family trees was accepted although this is more common practice where a gardener might only have space for one apple tree rather than when growing trees in an orchard.

Hand pollination was not accepted as this is not practical at an orchard level.

b) The name of 'the succulent false fruit produced by apples' is a pome. This was penalised when mis-spelt as 'pomme'. Several candidates stated 'apples' or *Malus domestica* and received no mark.

c)

Most candidates were aware that the 'fleshy part' was not formed exclusively from the ovary of the flower but struggled to clearly state that this forms primarily from the swollen receptacle and only a few acknowledged that the mesocarp and epicarp are also fleshy and located just outside the cartilaginous endocarp -the endocarp being the 'core' of the apple. Credit was also given for the remains of the calyx, corolla, or pedicel which are remain attached on the mature fruit, although the correct botanic terms were required rather than 'flower parts', or 'flower stalk'.

Some misused the term pericarp (all the tissues formed from the ovary).

Candidates appeared to be unaware of the term 'hypanthium' which more accurately describes the swollen receptacle.

MARKS

Q9 a) State what is meant by the term 'endogenous' plant growth regulator (PGR) **1**

b) Describe the role of **NAMED** endogenous PGRs in **EACH** of the following processes**:**

i) autumn leaf fall **3**
ii) fruit set and development **3**
iii) the plant's response to drought **3**

Q9

This was an unpopular question and was not answered by some candidates.

a) Most candidates knew that endogenous PGRs are naturally synthesized within the plant and were awarded one mark.

b) One mark was given for each PGR which is involved in each section. Where candidates failed to name the correct PGR no marks could be rewarded, resulting in low marks for this part of this question.

i) Ethylene/ethene promotes leaf abscission as it stimulates the development of the leaf abscission layer.

Marks were only awarded for auxin for a description of its role in *preventing* abscission.

ii) Auxin promotes fruit set and development, and as it also has a role in preventing fruit abscission this was also credited.

Gibberellin was often incorrectly named here**.**

The role of ethylene in fruit ripening was also accepted where candidates stated this was the final stage of fruit development.

iii) Abscisic acid (ABA) - which was often incorrectly spelt- triggers stomatal closure which is the plants immediate response to drought. This is produced in roots and transported in the xylem to the leaves when there is a lack of available water in the soil but can also be produced in the shoots. The build-up of ABA in the leaves stimulates a rapid closure of the stomata.

Candidates who described how roots can be stimulated by various PGRs to grown down deeper into the soil were not rewarded as it does not constitute an immediate 'drought response'.

MARKS

Q10 a) State the meaning of the term 'plant tissue'. **1**

b) List **THREE** distinct functions of epidermal tissue. **3**

c) Describe how the structure of epidermal tissue and cells enable it to carry out the **THREE** functions listed in b). **6**

Q10 a)

Most candidates correctly defined the term 'plant tissue,' stating that this is a group of cells that work together to perform a common / specific function. Some spent time providing examples although this was not required to obtain the single mark here.

b)

Candidates were expected to provide a list of three functions, one mark being allocated for each correct function. Correct answers included:

- Protection
- Decreasing water loss
- Allowing gaseous exchange of carbon dioxide and oxygen

Uptake of mineral nutrients and water (by root hairs) was rarely listed.

Many candidates did not recognise that in part b) it was only a *list* of three functions that was required, and they went into more detail which was then often repeated in part c), thus wasting time and effort. This emphasises the benefit of reading the full question before starting to write.
Some candidates repeated the 'protection' function- e.g., protection from herbivores / being eaten and also protection from disease, which are not 'distinct'.
'Holding organs together' and providing structural support (often where epidermis and bark tissues had been confused) are incorrect, and the quality of being transparent 'to allow photosynthesis' is not considered to be a *function*. Cell division /meristematic function was incorrectly given by some and others incorrectly stated that epidermis contains chloroplasts.

c)

It was expected that candidates would indicate in turn which of the *structural* characteristics of epidermal tissue enable each of the three functions listed/stated in part a).

For example, for protection from entry of fungal spores, epidermal cells are tightly packed with no air spaces between them and covered by a water proof cuticle which is water shedding so less chance of fungal spores germinating.

For decreasing water loss, the epidermal cell secretes a waxy cuticle, and also may have epidermal hairs to trap a moist layer of air close to the leaf surface, thus decreasing transpiration through stomata.

For allowing gaseous exchange, guard cells control opening and closing of stomatal pores which regulates uptake of carbon dioxide for photosynthesis and release of oxygen.

Many candidates just gave a detailed description of epidermis without linking it to function. Some confused epidermis with the cork layer in woody stems and talked about lenticels rather than stomata.

Many candidates provided more general statements of the structural characteristics of epidermal tissue which were not always linked to specific functions or alternatively linked one structural factor to several functions, e.g., the presence of stomata controlled by guard cells, open to allow gaseous exchange and close to control water loss. As this is just one structural characteristic, credit could only be given for only one of these functions.

Another popular response was a thick waxy cuticle (many candidates incorrectly stated that the epidermis produces the wax suberin rather than cutin) can provide protection from the entry of disease pathogens such as fungal spores as well as decreasing the rate of water loss.

There are several other examples which were rarely mentioned, such as *sunken* stomata which increase humidity around the stomata thus reducing water loss, and root hairs which provide a large surface area to increase the rate of water uptake by roots.

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