GCE A2

Biology

January 2010

Mark Schemes

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NORTHERN IRELAND GENERAL CERTIFICATE OF SECONDARY EDUCATION (GCSE) AND NORTHERN IRELAND GENERAL CERTIFICATE OF EDUCATION (GCE)

MARK SCHEMES (2010)

Foreword

Introduction

Mark Schemes are published to assist teachers and students in their preparation for examinations. Through the mark schemes teachers and students will be able to see what examiners are looking for in response to questions and exactly where the marks have been awarded. The publishing of the mark schemes may help to show that examiners are not concerned about finding out what a student does not know but rather with rewarding students for what they do know.

The Purpose of Mark Schemes

Examination papers are set and revised by teams of examiners and revisers appointed by the Council. The teams of examiners and revisers include experienced teachers who are familiar with the level and standards expected of 16- and 18-year-old students in schools and colleges. The job of the examiners is to set the questions and the mark schemes; and the job of the revisers is to review the questions and mark schemes commenting on a large range of issues about which they must be satisfied before the question papers and mark schemes are finalised.

The questions and the mark schemes are developed in association with each other so that the issues of differentiation and positive achievement can be addressed right from the start. Mark schemes therefore are regarded as a part of an integral process which begins with the setting of questions and ends with the marking of the examination.

The main purpose of the mark scheme is to provide a uniform basis for the marking process so that all the markers are following exactly the same instructions and making the same judgements in so far as this is possible. Before marking begins a standardising meeting is held where all the markers are briefed using the mark scheme and samples of the students' work in the form of scripts. Consideration is also given at this stage to any comments on the operational papers received from teachers and their organisations. During this meeting, and up to and including the end of the marking, there is provision for amendments to be made to the mark scheme. What is published represents this final form of the mark scheme.

It is important to recognise that in some cases there may well be other correct responses which are equally acceptable to those published: the mark scheme can only cover those responses which emerged in the examination. There may also be instances where certain judgements may have to be left to the experience of the examiner, for example, where there is no absolute correct response – all teachers will be familiar with making such judgements.

The Council hopes that the mark schemes will be viewed and used in a constructive way as a further support to the teaching and learning processes.

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General Certificate of Education
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Module 4: Co-ordination, Biochemistry and Environment

[A2B11]

TUESDAY 19 JANUARY, AFTERNOON

MARK
SCHEME

/ denotes alternative points
; denotes separate points
Comments on mark values are given in bold

AVAILABLE MARKS

Section A

1 (a) Any two from

1. Vasodilation occurs;
   so that more heat radiates from the body;
2. Sweating occurs;
   heat is lost as the sweat evaporates;
3. Hair/feathers are lowered;
   so that there is no insulatory layer of air surrounding the body;
4. Metabolic rate reduced;
   so less heat is generated internally; [4]

(b) Any two from

- move into shade/water
- orientate themselves so that least area is towards the sun
- gaping occurs
- lighten body colour to reflect radiation [2] 6

2 (a) Sulphur dioxide/carbon dioxide; [1]

(b) Any two from

- damage to foliage with resulting tree death
- affects the solubility of certain mineral ions causing an imbalance of soil nutrients and resulting in tree death
- increased solubility of aluminium ions raising its concentration to toxic levels
- release of aluminium ions into waterways causing fish death due to asphyxiation (stimulates excessive secretion of mucous over gills)/ killing invertebrates
- other appropriate response [2]

(c) Any two from

- denitrification involves bacteria that remove oxygen from NO_3^-
- producing nitrite or nitrogen gas (as well as N_2O)
- occurs in anoxic/waterlogged conditions [2]

(d) Greenhouse effect involves global warming (melting of the ice caps resulting in raised sea levels/global climate change or examples of same) while ozone depletion increases UV radiation (resulting in increased skin cancer, melanoma/increased cataracts/inhibition of phytoplankton growth)/ other appropriate response; [1]

(e) Eutrophication/toxicity of nitrates in drinking water; [1] 7

	AVAILABLE MARKS

3 **(a)** The auxin moves down into the "receiving" agar block;
on the decapitated shoot the auxin moves down the left hand side;
causing elongation on that side (and so curvature); [3]

(b) **Any three from**
- when the shoot is "right-way-up" the auxin moves down into the "receiving" block, but not up if auxin is provided from below
- auxin movement is not simply by diffusion (since it does not always move from high to low concentration)
- when the shoot is "upside-down" the auxin does not move down, but is able to move up if auxin is provided from below
- auxin moves through the shoot (only) from the apical end/the shoot shows polarity (with respect to the movement of auxin) [3]

(c) Auxin movement is energy requiring/other appropriate response; [1] 7

4 **(a)** Decrease is 6400 (6.4) – 3200 (3.2) **[values read off graph]**;
3200 (decrease) ÷ 6400 (initial value) = 50% **[consequential to answers above]**; [2]

(b) Virus antigens recognised by B-lymphocytes;
which clone to produce memory cells (as well as plasma cells);
on subsequent exposure memory cells produce antibodies which neutralise the infecting virus particles/secondary response; [3]

(c) **Any two from**
- number of memory cells decrease over time
- booster vaccine activates the memory cells so that more are produced
- provide longer term immunity [2]

(d) An infected person may visit Britain/a person may visit an infected area;
if unvaccinated, the disease would be able to spread throughout the population; [2] 9

		AVAILABLE MARKS
5 **(a)** Glucose can generate ATP anaerobically; fatty acids generate more energy per unit mass/lipids are a more mass conservative energy store;	[2]	
(b) Hydrogen and then electrons pass along the respiratory chain; via carriers at successively lower energy levels; at specific steps in the chain sufficient energy is available to synthesise ATP/3 ATPs are produced from NADH and 2 ATPs from $FADH_2$;	[3]	
(c) **Any three from** • increased breathing • increased heart rate • vasodilation (locally in muscle) • more O_2 unloaded by oxyhaemoglobin (in response to low ppO_2) • unloading of O_2 from myoglobin	[3]	
(d) ATP is generated anaerobically as well as aerobically *(answer must refer to both pathways)*;	[1]	9
6 **(a)** A-band; I-band; Mitochondrion; Z-membrane/Z-disc; sarcomere;	[5]	
(b) **Any two from** • I-band shorter • H-band narrower • sarcomere shorter	[2]	
(c) Spreads the impulse throughout the muscle fibre/releases calcium ions; provides the energy for the detachment of the bridge/re-cocks the acto-mysin bridge;	[2]	9

	AVAILABLE MARKS
7 (a) Any three from • reabsorption of glucose (and amino acids) by active transport in the proximal convoluted tubule • reabsorption of water by osmosis in the proximal convoluted tubule • reabsorption of salts by diffusion in the proximal tubule/by active transport in either tubule • reabsorption of water from the collecting duct due to the osmotic gradient (established by the loop of Henle) [3]	
(b) (i) Glomerular pressure will increase; to increase filtration rate since more blood enters the glomerulus than can exit; [2]	
(ii) Urine production will increase; and blood pressure will decrease; [2]	
(c) (i) Increased blood pressure stimulates the release of ANP; results in an increase in urine output (decreases blood pressure); [2]	
(ii) Drinking water will increase the water potential of the blood; stimulating the hypothalamus to secrete less ADH/less ADH is released from the pituitary gland; there is a reduction in the permeability of the collecting ducts to water; less water is reabsorbed and so more is lost in the urine/copious, dilute urine is produced; [4]	13
Section A	**60**

Section B

AVAILABLE MARKS

8 Thirteen points (with at least four for limiting factors).

Biochemistry of photosynthesis:

Light harvesting:
- light is absorbed by chlorophyll and other pigments (within the photosystems)
- the different pigments absorb light in different parts of the spectrum/increase the range of wavelengths utilised/increase the efficiency of energy utilisation
- mostly red and blue light absorbed/green light reflected
- causing the excitation of electrons within the pigments (whereby their energy level is raised)
- excitation passes (resonates) through the pigments until it reaches the primary pigment/energy is funnelled towards the reaction centre (of the photosystem)
- within individual photosystems the primary pigment emits an electron to an electron acceptor

Light-dependent phase:
- from photosystem II (PSII) the electrons (after being accepted by plastoquinone) pass through a series of electron carriers/cytochromes
- this is coupled to the production of ATP (photophosphorylation)
- electrons from photosystem I (PSI) pass to NADP(H^+) (after being accepted by ferredoxin) to form NADPH
- electrons "lost" from PSI are replaced from photosystem II (PSII)/via the ETC
- reference to the dissociation of water (to hydrogen and hydroxyl ions)/ hydrogen ions combine with NADP to form $NADPH^+$
- electrons "lost" from PSII are replaced from hydroxyl ions/resulting in the release of oxygen

Light-independent phase (Calvin cycle):
- carbon dioxide is fixed by ribulose bisphosphate
- to form two molecules of glycerate phosphate
- which is reduced by NADPH to triose phosphate
- involving consumption of ATP
- $\frac{5}{6}$ of the triose phosphate is regenerated to ribulose bisphosphate
- the remaining $\frac{1}{6}$ is converted to C_6 sugars and other compounds

Limiting factors:
- light limits photosynthesis since without it no ATP or NADPH is produced
- for the GP to TP step
- carbon dioxide is a limiting factor since without it RuBP has nothing to fix
- so no GP is synthesised
- temperature is a limiting factor since it affects the action of enzymes
- within the Calvin cycle [13]

Consider QWC:

2 marks: The candidate expresses ideas clearly and fluently, through well-linked sentences and paragraphs. Arguments are generally relevant and well-structured. There are few errors of grammar, punctuation and spelling.

1 mark: The candidate expresses ideas clearly, if not always fluently. Arguments may sometimes stray from the point. There are some errors of grammar, punctuation and spelling, but not such as to suggest a weakness in these areas.

0 marks: The candidate expresses ideas satisfactorily, but without precision. Arguments may be of doubtful relevance or obscurely presented. Errors in grammar, punctuation and spelling are sufficiently intrusive to disrupt the understanding of the passage. [2]

	AVAILABLE MARKS
	15
Section B	**15**
Total	**75**

Rewarding Learning

ADVANCED
General Certificate of Education
January 2010

Biology

Assessment Unit A2 2

assessing

Module 5: Reproduction, Genetics and Taxonomic Diversity

[A2B21]

MONDAY 25 JANUARY, AFTERNOON

MARK SCHEME

Mark Scheme

AVAILABLE MARKS

/ denotes alternative points
; denotes separate points
Comments on mark values are given in bold

Section A

1 **Any five from**

	Mitosis	Meiosis
•	mitosis consists of one division	meiosis consists of two divisions
•	the number of chromosomes remains the same	the number of chromosomes is halved
•	homologous chromosomes do not split up	homologous chromosomes pair up to form bivalents
•	chiasmata do not form and crossing over never occurs	chiasmata form and crossing over occurs
•	daughter cells are genetically identical	daughter cells are genetically different from the parent cells
•	two daughter cells are formed	four daughter cells are formed
•	both haploid and diploid cells may undergo	cells must have homologous pairs [5]

5

2 **(a)** Micropropagation produces large numbers of genetically identical (cloned) plants; [1]

(b) Prevent the growth of fungi and bacteria (which would utilise nutrients and damage plant tissue); [1]

(c) Use of plant growth substances/auxins/cytokines; [1]

(d) **Any two from**
- possible to produce very large numbers of plants from a single explant/cost effective
- all plants possess the desired trait/are genetically identical
- all plants are disease-free
- plants can be propagated at different times of the year/overcomes seasonal restrictions for seed production or germination
- exotic plants (such as orchids) which are hard to produce from seeds can be propagated [2]

(e) **Any two from**
- isolation of the desired gene (e.g. cut using restriction endonuclease)/use of reverse transcriptase
- use of a vector to introduce the gene into a plant cell/reference to *Agrobacterium tumefaciens*/T_i plasmid/'shotgun' method
- digestion of cellulose cell wall to facilitate introduction of the vector
- selection of the plants containing the desired gene [2]

7

				AVAILABLE MARKS
3	**(a)**	A: Coelom B: gut lumen/cavity	[2]	
	(b)	D: ectoderm E: mesoderm F: endoderm **Three for [2], two for [1]**	[2]	
	(c)	Endoderm; ectoderm;	[2]	
	(d)	**Any two from** • the coelom in annelids separates inner from outer tissues • highly branched gut reduces diffusion distance in platyhelminthes • platyhelminthes are flattened and so diffusion distance is small • platyhelminthes have a large surface area to volume ratio	[2]	
	(e)	**Any two from** • annelids possess a through gut, while platyhelminths have a blind ending gut/annelids have a mouth and an anus, platyhelminths only a mouth • in platyhelminths the gut is branched • in annelids digestion is entirely extracellular/in platyhelminths digestion is completed intracellularly • annelids show some regional specialisation	[2]	10

AVAILABLE MARKS

4 (a) (i) Frequency of heterozygotes = 2pq;
$= 2 \times (2.5 \times 10^{-5}) \times 1\ [0.999975] = 5\ [4.999875] \times 10^{-5}$; [2]

(ii) $5\ [4.999875] \times 10^{-5} \times 62 \times 10^{6} = 3100\ [3099.9225]$; [1]
Answer to (ii) is consequential to answer in (i)

(iii) The figure for heterozygotes includes those in whom the disease has yet to manifest itself;
the number of cases is the number of those diagnosed with symptoms of the disease;
Candidates must provide an explanation which distinguishes those diagnosed and those carrying the allele but not yet showing symptoms of the disease. [2]

(b) Selection is unlikely to operate against the allele/family history;
since individuals affected will have parented children before the disease is manifested;
or
Reference to availability of testing/family history;
avoiding having children represents selection against the allele;
The mark for selection should only be awarded if the reasoning is appropriate. [2]

(c) The person whose parent has the disease has a 50% chance of having the H allele (and so developing the disease);
if they have the disease (and they can be tested for it) then their children will have a 50% chance of inheriting the allele; [2]

(d) Any two from
- pre-natal testing may allow identification of a carrier so that the foetus may be aborted
- some may not agree with abortion
- preimplantation genetic diagnosis (PGD) of embryos (with IVF) would allow only an embryo without the H allele to be implanted
- post-natal testing may allow identification of a carrier so that the individual may receive counselling
- some may view that the knowledge of impending disease is unduly stressful
- other appropriate response [2] 11

5 **(a)** Class, genus;
Animalia, undulatus; [2]

AVAILABLE MARKS

(b) Codominance is the situation in which two alleles in the heterozygous condition produces a phenotype different from either homozygote;
distinguished in a cross between the two homozygous forms (dd × DD)/ heterozygotes when crossed produce both other phenotypes (1:2:1 ratio);
sex-linkage is the situation in which the alleles of a gene are located on the chromosome determining gender/X chromosome;
distinguished when a cross shows the trait to be inherited differently into males and females/distinguished by undertaking reciprocal crosses; [4]

(c) ddX^oX^o;
DdX^+Y; [2]

(d) Two types of female gametes: DX^o, DY;
four types of male gametes: DX^+, DX^o, dX^+, dX^o;
Punnett square showing offspring genotypes;
green colour forms correctly shown;
non-opaline/opaline forms correctly shown;
gender correctly shown;

	DX^+	**DX^o**	**dX^+**	**dX^o**
DX^o	**DDX^+X^o olive-green, non-opaline, male**	**DDX^oX^o olive-green, opaline, male**	**DdX^+X^o dark-green, non-opaline, male**	**DdX^oX^o dark-green, opaline, male**
DY	**DDX^+Y olive-green non-opaline, female**	**DDX^oY olive-green opaline, female**	**DdX^+Y dark-green non-opaline, female**	**DdX^oY dark-green opaline, female**

[6] 14

	AVAILABLE MARKS
6 (a) Any four from • bracken extracts inhibit seed germination • especially of Scots pine • while effect on Douglas fir is minimal • seedling growth is reduced in Scots pine (and to a lesser effect in Douglas fir) • there is no effect on seedling growth in Sitka spruce/bracken, if anything, stimulates growth • comparisons would need to be tested statistically (e.g. t-test, graphical analysis using confidence limits) • other appropriate response [4]	
(b) Any three from • equal amounts of bracken parts (leaves, shoots and roots) should be used • bracken parts crushed to obtain an extract/shredded/treated equitably • controls with no bracken/water added to make comparisons • sufficient seeds used to ensure reliable results • percentage germination compared with controls and between leaf, stem, and root treatments [3]	
(c) Bracken toxins are stored in the larvae (in a site where they cannot affect their physiology; detected by ants/unpalatable to ants; [2]	
(d) Any four from • sporophyte is the dominant generation • sporophyte consists of leaves, stem (rhizome) and roots/gametophyte consists of a prothallus (with rhizoids) • sporophyte contains sporangia (within sori)/gametophyte contains gametangia (archegonia and antheridia) • sporophyte is the asexual stage in the cycle/gametophyte is the sexual stage • meiosis produces spores in the sporophyte/mitosis produces gametes in the gametophyte • sporophyte possesses terrestrial adaptations (waxy cuticle/stomata)/ gametophyte lacks a waxy cuticle or stomata • sporophyte is diploid, gametophyte is haploid [4]	13
Section A	**60**

Section B

AVAILABLE MARKS

7 Thirteen points (with at least five from each section).

Evolutionary change in populations:
- populations are genetically variable/genetic variation is the basis for evolutionary change
- in competition for resources with other members of the population
- natural selection acts on the variation in a population
- of the different forms of natural selection it is directional selection which brings about evolutionary change
- where a non-modal form, not previously favoured, is now selected for
- this can be due to an environmental change
- the form being selected for survives more frequently to reproduce
- and so passes more of its genes to future generations
- in this way the frequency of alleles will change over time
- and the population remain adapted to its environment
- it is the change in allele frequency which constitutes evolutionary change
- in different environments the same species will often have different variants

Specification:
- in the theory of allopatric speciation
- populations become geographically isolated
- environment conditions differ in the geographically isolated areas
- selection pressures in the two areas differ (favouring different variants within the populations)
- resulting in divergence of the two populations' gene pools
- for long enough to accumulate sufficiently different allele frequencies to behave as different species
- different species are genetically isolated/cannot generally interbreed
- this isolation is maintained by some reproductive isolating mechanism
- or other secondary isolating mechanism (such as behavioural isolation)
- polyploidy has resulted in the formation of new species in plants
- where a previously sterile hybrid
- has fertility restored with chromosome doubling
- since meiosis can resume/viable gametes can be formed [13]

Consider QWC:

2 marks: The candidate expresses ideas clearly and fluently, through well-linked sentences and paragraphs. Arguments are generally relevant and well-structured. There are few errors of grammar, punctuation and spelling.

1 mark: The candidate expresses ideas clearly, if not always fluently. Arguments may sometimes stray from the point. There are some errors of grammar, punctuation and spelling, but not such as to suggest a weakness in these areas.

0 marks: The candidate expresses ideas satisfactorily, but without precision. Arguments may be of doubtful relevance or obscurely presented. Errors in grammar, punctuation and spelling are sufficiently intrusive to disrupt the understanding of the passage. [2] 15

Section B	**15**
Total	**75**

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General Certificate of Education
January 2010

Biology

Assessment Unit A2 3A

assessing

Module 6A: Synoptic Paper

[A2B31]

TUESDAY 28 JANUARY, MORNING

MARK SCHEME

AVAILABLE MARKS

/ denotes alternative points
; denotes separate points
Comments on mark values are given in bold
Comments on marking points are given in italics

BIOLOGY

Assessment Unit A2 3A

assessing

Module 3A: Practical Processes

Section A

1 **(a)** Bathing in water/orientation to reduce exposed surface/moving into the shade/thermal gaping/develop a lighter body colour/body raising (from hot sand);
basking in the sun/orientation so maximal surface exposed to sun/clustering/curling up/moving underground/develop a darker body colour; [2]

(b) **(i)** **Any two from**
- reference to muscle contraction/metabolic rate increase
- reference to ATP usage
- inefficiency of energy transfer (20% of chemical energy transfers to the mechanical energy of contraction/most energy – 80% – is 'lost' as heat) [2]

(ii) At a lower temperature the speed of contraction would be too low to support flight/reference to speed of contraction/kinetic theory/optimal temperature for enzyme activity; [1]

(c) **Any five from**
Description:
- wings beat faster at lower temperatures/converse
- metabolic rate is greater at lower temperatures/converse
- there is only a slight decrease in body temperature at lower air temperature/body temperature remains relatively constant

Explanation:
- greater wing-beat frequency (at lower temperatures) generates heat
- so increasing metabolic rate
- higher heat generation at lower temperatures compensates for greater heat loss
- the relatively constant body temperature is indicative of endothermy
- and maintains the muscle tissue at a suitably high temperature

For the explanation marking points, candidates must indicate the causal relationship [5] 10

AVAILABLE MARKS

2 **(a)** t = 2.045 (for p = 0.05, df = 29);
upper limit is 130, lower limit is 80 ($105 \pm 2.045 \times 12.2 = 105 \pm 25$)
[consequential of the answer above];
limits drawn appropriately on the graph
[consequential of the answer above]; [3]

(b) The mean for variety C is the most reliable **[consequential of answer in (a) above]**;
the most narrow limits indicating the most reliable mean; [2]

(c) Yes, the means appear to be significantly different;
since the confidence limits do not overlap; [2]

(d) Sweetness/shelf-life/colour/texture/other appropriate response; [1]

(e) **(i)** Addition of $(o-e)^2/e$ for each strain (0.81 + 0.54);
x^2 value is 1.35; [2]

(ii) The results follow the expected proportions/triploid strain is 50% greater in mass than the diploid strain;
as $p > 0.05$ ($0.9 > p > 0.5$); [2]

(iii) Triploid strains have three sets of chromosomes while diploid strains have two sets of chromosomes/and so have larger nuclei and larger cells; [1] 13

AVAILABLE MARKS

3 **(a)** **(i)** **Any two from**
- plants are autotrophic/photosynthetic/possess chlorophyll, while fungi are heterotrophs
- the composition of the cell wall in fungi is chitin, while in plants it is cellulose
- no fungal cells possess flagellae, while antherozoid cells (in mosses and ferns) have flagellae
- fungi possess centrioles, while plant cells do not
- other appropriate difference [2]

(ii) **Any two from**
- fungal cells possess a cell wall, while animal cells do not
- animals have ingestive metabolism/possess a gut cavity into which food is ingested/animal digestion can be extracellular and intracellular while in fungi it is always extracellular
- no fungal cells possess flagellae, while animal cells (sperm) may have flagellae
- animals are mobile, while fungi are sessile
- other appropriate difference [2]

(b) Digestive enzymes are secreted onto the organic matter;
products of digestion are absorbed into the body of the fungus; [2]

(c) **Any two from**
- strains differ genetically
- some strains will be resistant to blight
- suggested adaptation for resistance, e.g. smaller stomata/thicker cuticle
- so spread of the disease would have been prevented [2]

(d) Antibiotics prevent bacteria from competing with the fungi for food;
both fungi and bacteria are decomposers/feed on dead organic matter; [2]

(e) Human (eukaryotic) ribosomes have a different structure from bacterial ribosomes; [1]

(f) Most strains of infectious bacteria are resistant to penicillin/reference to the evolution of resistance;
Not use of term 'immunity'. [1] 12

AVAILABLE MARKS

Section B

4 Thirteen points

Points must refer to cellular structure and its relationship with function.

Endothelial cells of capillary:
- flattened cells/pavement
- reducing diffusion distance
- facilitating exchange with surrounding tissue

Epithelial cells of alveoli:
- consist of a squamous epithelium/are very thin
- reducing diffusion distance
- facilitating gaseous exchange

Columnar epithelial cells in the villus:
- inner surface consists of a brush border/microvilli
- providing a huge surface area
- for the absorption of the products of digestion in the gut
- goblet cells are invaginated
- aids storage and secretion of mucus

Red blood cells:
- extremely small/biconcave disc
- providing a large SA:V ratio for the absorption of oxygen
- lack of nucleus allows small size/leaves more space for haemoglobin

Neurones:
- have long processes called axons/dendrons
- and insulating Schwann cells (between nodes of Ranvier)/myelin
- aid the quick transmission of impulses through the body/allows saltatory conduction

Muscle cells:
- are relatively long cells containing myofibrils
- particularly dense in striated muscle/branched in cardiac muscle
- create a pulling force/convert chemical energy into mechanical energy

Proximal convoluted tubule cells in the kidney:
- possess microvilli/brush border on the inner surface (towards lumen)
- and basal infoldings on the surface bordering the capillary
- facilitates reabsorption of glucose, water and ions

Rods and cones:
- possess lamellae which support pigments
- increase surface area of exposed pigments
- rods have processes for links to single neurone

Cnidocysts in Cnidaria:
- cnidocysts contain coiled 'darts'
- which are barbed
- used to paralyse prey

AVAILABLE MARKS

Root hair cells:
• possess a convoluting outer surface
• providing a large surface area
• for absorption of water and ions

Xylem vessels:
• consist of adjoined cells with no cross walls
• to facilitate the pull of water and ions up the plant
• with lignified walls to prevent collapse

Phloem sieve-tubes:
• consist of adjoined cells with perforated cross walls/sieve plates
• lack a nucleus and dense cytoplasm (when mature)
• to facilitate the transport of sugars and other organic solutes throughout the plant

Epithelial cells in the leaf (including stomata):
• secrete a waxy cuticle to reduce transpirational lose of water
• lack chloroplasts so that light penetrates to the mesophyll layers within the leaf
• act as a protective layer for the leaf
• guard cells control aperture of stoma

Palisade mesophyll cells:
• cylindrical, densely packed cells
• with large numbers of chloroplasts
• for the effective absorption of light

Spongy mesophyll cells:
• irregular, loosely arranged cells
• with air pockets to facilitate gaseous exchange
• and containing chloroplasts for photosynthesis

Collenchymatous and schlerenchymatous cells:
• collenchyma consists of cells with thickened cellulose walls (particularly at corners)
• schelerenchyma consists of cells with (secondary) lignified walls
• act as supporting tissues within the plant

Cell ultrastructure:
• highly active cells have numerous mitochordria
• for active transport/muscle contraction/any appropriate example
• secretory cells have prominent Golgi bodies
• secretion of digestive enzymes/mucin/other appropriate example
• cells with prominent rough ER produce much protein
• for example in plasma cells producing antibodies/other appropriate response
• cells which undertake the digestion of material in vacuoles have many lysosomes
• for example phagocytes digesting ingested bacteria
• plant cells possess a large vacuole
• to maintain turgidity

Any other appropriate cell type:
See above regarding the depth required [13] 13