Variation and Selection
Mark Scheme 3

Level	IGCSE
Subject	Biology
Exam Board	CIE
Topic	Variation and Selection
Paper Type	(Extended) Theory Paper
Booklet	Mark Scheme 3

Time Allowed: 71 minutes

Score: /59

Percentage: /100

1   **(a)(i)**   **1.**

- slows down air movement/reduces wind effect AW;
- ref. to transpired water vapour trapped inside curled leaf AW;
- ref. to diffusion gradient reduced/humidity increased inside curled leaf;
- prevents water loss/less + transpiration/water loss/evaporation;
- reduces surface area + exposed AW;   **max. [2]**

2.

prevents evaporation/loss + of water from leaf; Ⓡ waterproof unqual.
reflects radiant light/reduces heating effect of sun AW;   **max. [1]**

   (ii)

better access AW to + water/mineral salts;   Ⓡ goes deeper unqual.
larger surface area for absorption; Ⓡ anchorage   **max. [1]**

2.

- ref. to storage of water;
- ref. to small surface area to volume AW;
- less water loss/less transpiration;
- ref. to ability to photosynthesise;   **max. [2]**

(b)

- less surface area;
- less light absorbed;
- less stomata;
- less absorption of carbon dioxide;
- less transpiration;
- less movement of minerals/water + from roots;
- less chlorophyll/chloroplasts;
- less photosynthesis; Ⓐ description   **max. [2]**

(c)(i)(ii)   MARK COLUMNS INDEPENDENTLY

description of process	name of process	variable that, if increased, would speed up the process
absorption of water from the soil	osmosis; Ⓐ diffusion	concentration of minerals in root hairs/ water in soil/temperature/transpiration (or any factor that increases it)/number of root hairs;;
using water to form glucose	photosynthesis;	light/conc. of carbon dioxide/temperature/water/chlorophyll/ chloroplasts;
movement of water vapour out of leaves	transpiration; Ⓐ diffusion Ⓐ evaporation	temperature/wind speed/ dryness of air/number of size of stomata; Ⓐ ref. to light/heat Ⓡ refs. to humidity

[6]

Total [14]

Question		Answers	Marks	Additional Guidance
2	**(a)**	body divided into/segmented three parts / head, thorax and abdomen (one pair of) antennae / feelers wings three pairs / 6 legs compound eyes	[max 3]	**R** segmented body unqualified *do not accept arthropod features*
	(b)	<u>arthr</u>opod / Arthropoda	[1]	**must have** arthr so accept arthropod but reject anthropod
	(c)	chromosome nucleus mitochondria chloroplast plasmid nucleolus		Note: Apply list rule
	(d)	**1** two groups: 1 – 6 and 11 & 12 migrate to New Zealand **2** 1 – 6, New Caledonia / indirect / migration A **3** 11&12, direct (Australia) / migration B **4** correct example of (evolutionary) relationship / DNA similarity, e.g. 13 & 14 most distantly related from others / 9 & 10 most closely related to each other **5** ref to, clade(s) / cladogram	[max 3]	

2	(e)				
		1	adapt to environment / conditions in new places are different		**A** conditions on different islands are different
		2	competition between individuals		
		3	struggle for existence		
		4	ref to variation		
		5	survival of fittest / those that are better adapted		
		6	survive		
		7	reproduce, pass on their alleles; **A** genes **I** traits		
		8	mutations / changes in DNA		
		9	change in the gene pool / AW		
			changes to physical / behaviour (of species), e.g. mating behaviour	[max 4]	Mpt 9 **R** changes of individuals
			[Total: 13]		

Question		Answers	Marks	Additional Guidance

3	**(a)**	*T. castane*
		
		1 wet / AW **;**
		
		2 *any evidence from the table*
		
		  e.g. hot: (A) 100% – (B)
		      warm: (C) 86% – (D) 13% /
		      cold: (E) 29% – (F) 0% **;**
		
		3 in **wet** conditions, **decreasing** survival with
		    decreasing temperature **;**
		
		4 *any suitable two points from the table*
		  (i.e. (A) 100% – (C) 86% – (E) 29%) **;**
		
		T. confus
		
		5 dry / AW **;**
		
		6 *any evidence from the table*
		  e.g. hot: (A) 0% – (B)
		      warm: (C) 14% – (D) 87% /
		      cold: (E) 71% – (F) 100% **;**
		
		7 in **wet** conditions, **increasing** survival with
		    decreasing temperature **;**
		
		8 *any suitable two points from the table*
		  (i.e. (A) 0% – (C) 14% – (E) 71%) **;**
			[max 4]	**Note: marking points are linked in pairs**
				e.g. MP1 pairs with M
				
				Note: at least two data points within species are required as 'evidence'
				ignore ref. to temperature for MP1 and MP2
				
				ignore ref to temperature for MP5 and MP6

Question			Answers	Marks	Additional Guidance
3	**(b)**		competition ; example of competition (food / space) ; one species better adapted / AW ;	[2]	**R** 'survive better' unqualified **A** survival of the fittest in context of adaptation
	(c)	**1**	red-brown black , Aa x aa ;		**Note:** marking points 1, 2, 3 are free-standing. MP 4 is linked to MP 3.
		2	A , a + a / a,a ;		*allow* **ECF from MP1 to MP2**
		3	Aa , aa		*allow* **ECF from MP2 to MP3**
		4	red-brown, black ; 1:1 / AW ;	[4]	*allow* **ECF from MP3 to MP4**
	(d)		mutation ; mutation, rare event ; (white) <u>allele</u> is recessive / *ora* ; only expressed in homozygote recessive ; selection ; disadvantage / AW ;	[max 2]	**R** gene **A** correct ref to parents – both must be heterozygous / homozygous / one of each **A** reason for being so
	(e)		decomposition ; bacteria / fungi, release enzymes / digest ; breakdown protein (in faeces) → amino acids ; deamination ; amino acids → ammonia ; breakdown urea → ammonia (+ carbon dioxide) ; (undigested) carbohydrate (in faeces) respired ;	[max 4]	**A** bacteria / fungi are decomposers **A** feed saprophytically
				[Total: 16]	

4   **(a** (length of) DNA / part of chromosome / on a chromosome ,
              that codes for a <u>protein</u> *or* <u>polypeptide</u> *or* <u>enzyme</u> / controls a characteristic **;**   **[1]**

     (b) $H^N H^S$ x $H^N H^S$ **;** *accept N and S*

          H^N, H^S + H^N, H^S **;**   gametes must be clear *accept on dotted line or in Punnett square*

          $H^S H^S$ **;**   *ecf from correct gametes if wrong parental genotype*   **[3]**

     (c)   *check http://www.sicklecellsociety.org/education/healthpr.htm for AVPs*

          1   red (blood) cells become, sickle shaped / distorted / AW **;   R** abnormal unqualified
          2   in areas of low oxygen concentrations / in tissues **;**
          3   fewer / less elastic / less flexible / short-lived, red blood cells **;**   *ora*
          4   less haemoglobin **;**
          5   <u>blood</u> / <u>haemoglobin</u>, less efficient at transporting oxygen **; R** no oxygen
          6   less respiration **;   R** no respiration
          7   less energy / fatigued / exhaustion / less active / feeling faint *or* tired / breathless **;**
          8   <u>capillaries</u> are blocked **;**
          9   pain **;**
          10   death of tissues linked to blood supply **;**
          11   'sickle cell crisis' **;   A** 'attacks needing oxygen'
          12   slow / poor, growth **;**
          13   susceptible to infections **;**
          14   reduced life span **;**
          15   AVP **;**
          16   AVP **;**   **[4 max]**

4	(d)	1	*idea that* areas with high percentage of sickle cell (allele) are places with malaria ;
		2	H^SH^S / homozygous recessive, reduced life span because of <u>sickle cell anaemia</u> ;
		3	H^NH^N / homozygous dominant / without H^S , susceptible to malaria / AW ;
		4	H^NH^S / heterozygous / carrier/ with H^S, resistant / not affected / less susceptible ;
			A H^SH^S **R** immune / immunity
		5	H^NH^S (carrier) survive <u>and</u> have children / H^NH^N *or* H^SH^S do not ;
		6	H^NH^S / carrier, pass on the allele / H^S ;
		7	(if H^NH^S x H^NH^S) 1 in 4 chance of, H^SH^S / homozygous recessive ;
		8	2 in 4 / 50% / ½ , have advantage of resistance to malaria ; **[5 max]**

	(e)	1	*idea that* distinct groups / categories ; ref to bar chart
		2	*either* sickle cell anaemia (H^SH^S), sickle cell trait (H^NH^S), normal (H^NH^N) /
			or normal, anaemic ; **A** 'some people have disease, some do not'
			A 'some people have the <u>allele</u>, some do not'
		3	no intermediates / no continuous scale of anaemia / AW ;
		4	genetic condition / environment has no effect (or its expression) ;
			A ref to small number of, genes / alleles, involved **[3 max]**

[Total: 16]