

# Natural and Artificial Selection

## Mark Scheme 4

Level	International A Level
Subject	Biology
Exam Board	CIE
Topic	Selection and evolution
Sub Topic	Natural and artificial selection
Booklet	Theory
Paper Type	Mark Scheme 4

Time Allowed : 59 minutes

Score : / 49

Percentage : /100

Grade Boundaries:

A*	A	B	C	D	E	U
>85%	77.5%	70%	62.5%	57.5%	45%	<45%

1 (a) 86 ;; -86

accept suitable working for one mark e.g.  $\frac{1400 - 190}{1400} \times 100$

or

accept 86.4 for one mark

[2]

- (b)
- 1 drought reduced available food or fewer small seeds produced ;
  - 2 finches with larger beaks survived or finches with smaller beaks died ;
  - 3 able to open tough fruits / ora ;
  - 4 able to feed on larger seeds / ora ;
  - 5 tough fruit / size of seed, acted as selection pressure ;

[3 max]

- (c) directional / evolutionary ;
- selection pressure acts on one extreme (of range) ;

[2]

**[Total: 7]**

CHEMISTRY ONLINE  
— TUITION —

<b>2</b>	<b>(a)</b>	1	population increases slowly at first / ref. lag phase ;	[5 max]
		2	(because) adjusting to pond environment ;	
		3	(then) steep increase / log phase / exponential increase / rapid growth or reproduction phase ;	
		4	(because) abundant food source / named other factor ;	
		5	stationary phase ;	
		6	fall in population size / death phase / decline phase ;	
		7	(due to) predation / build up of waste ;	
		8	competition for named resource ; e.g. food shortage	
		9	idea of further increase and fall / ref. population size may be cyclic ;	
	<b>(b)</b>		variation means the presence of different characteristics ; resulting in different survival rates / AW ; (leads to) reproductive, success / failure ;	[2 max]
				<b>[Total: 7]</b>

CHEMISTRY ONLINE  
— TUITION —

- 3 (a) 1 pools separate fish;  
2 reference to geographic isolation/allopatric;  
3 prevent interbreeding AW;  
4 no gene flow/AW;  
5 conditions different in the different pools;  
6 different characteristics selected for in the different pools;  
7 reference genetic drift; **4 max**
- (b) 1 conditions remain the same within each pool;  
2 idea of extreme phenotypes selected against/do not survive;  
3 only those fish well adapted to conditions in each pool survive; **3**
- (c) 1 reference competition between species/niche and competitive exclusion;  
2 reduction in number of species/not all species will survive;  
3 species restricted to different areas;  
4 all/most species survive;  
5 one species likely to be better adapted than all the other species;  
6 reference hybridisation/interbreeding/no interbreeding;  
*1 and 2 linked*  
*3 and 4 linked* **2 max**
- Total 9**

4 (a) (i) (a) habitat ;  
(a) populati ;  
producers/organisms ; [3]

(ii) (a) niche ;  
(an) ecosystem ; [2]

(b) (i) *energy losses from*

- 1 reflection (from leaf surface) ;
- 2 idea that some light, passes through (leaf)/misses chloroplasts/strikes non-photosynthetic tissue ;  
A suggestion that cell walls may not allow all of light through
- 3 heating plant ; I lost as heat to surroundings A converted to heat
- 4 evaporation ; A transpiration
- 5 not all light (reaching chlorophyll) is, the right wavelength (for photosynthesis)/AW/ absorbed by chlorophyll ;  
A idea that only a proportion of light energy is useable  
A absorbed and, lost as phosphorescence/lost as luminescence/re-emitted
- 6 ref. to photosynthetic process inefficient ; A loss of heat energy during photosynthesis
- 7,8 AVP ;; e.g. ref. to photorespiration  
ref. to factors that limit photosynthesis

[max 3]

CHEMISTRY ONLINE  
— TUITION —

- (ii) 1 increased production of / more, biomass / plant matter / named (e.g. carbohydrate / cellulose / starch / oils) ; **R** more plants **I** more crop **I** food  
 2 (so) more energy / more energy stores ;  
     **A** more chemical energy produced  
     **A** higher energy  
     **A** suggestion that high PE crop may be more energy dense  
 3 more crop / greater yield, per unit, area / volume / time ; **A** each year  
 4 idea of (comparatively) less space required (for growing) ;  
 5 ref. to supplying increasing demand for, food / fuel ;  
 6 more, profit (for farmers) / economic / AW ; **I** cheaper  
 7 AVP ; e.g. efficient use of carbon dioxide

[max 2]

(iii) *credit all valid answers – this list is not exhaustive*

**e.g. compou**

**e.g. function of compou**

amino acids

production of proteins (for cell growth);  
**A** provide energy / for respiration

proteins

division / mitosis / increase in cell number /  
 increase in, biomass or yield / (cell) membranes ;  
**A** reproduction **A** cell cycle  
**A** (tissue) repair  
**A** provide energy / for respiration

enzymes

synthesis of, macromolecules or organic molecules /  
 anabolic reactions / for photosynthesis / for  
 respiration ;  
**A** named molecules e.g. carbohydrates / amino  
 acids / proteins / lipids / nucleic acids

[max 2]

(organic / nitrogenous) bases

component / synthesis of, nucleotides  
 component of, DNA / RNA / nucleic acids ;

nucleotides

component / synthesis of, DNA / RNA ;

DNA

re genes / genetic material / coded information /  
 genetic information, (for protein synthesis) ;

RNA

re transcription / translation / protein synthesis ;

(some) phospholipids

(for cell) membranes ; **R** lipids

ATP

synthe / anabolic reactions / active transport /  
 translocation / described ;  
**A** provide energy for reactions

chlorophyll

photosynthesis / light (dependent) stage ;

NADP

(in) photosynthesis / light (dependent) stage ;

NAD

(involved in) respiration ;

FAD

(involved in) respiration ;

auxin

growth hormone / cell elongation / cell division ;

cytokinin

growth hormone / root growth ;

[Total: 12]

- 5 (a) 1 reduces likelihood of harmful recessive alleles coming together ;  
 2 to prevent, inbreeding depression / reduced vigour ; **ora**  
 3 increases ability (of population) to adapt to changing environment ; **ora**  
 4 increases chances of survival when exposed to, pathogen / disease ; **ora** [max 3]
- (b) (i) *assume foothills unless otherwise stated*  
 1 frogs (in foothills) have low(er) body temperature ; **ora**  
 2 (lower temperatures) slow down, metabolic / enzyme-catalysed, reactions ; **ora**  
 3 because, kinetic energy / collision rate, is less  
**or**  
 fewer ESCs ; **ora** [max 2]
- (ii) 1 *idea of* initially foothill populations have greater mass than lowland populations ;  
 2 (foothill) max mass reached earlier ; **ora**  
 3 (foothill) max mass greater ; **ora**  
 4 paired comparative figures ;  
 e.g. [mp2] 37 days v 45 da  
 [mp3] 420 mg v 375 mg  
 day 37 foothills 420 mg v lowland 370 mg  
 5 after day 37 foothills decreases and lowland continues to increase in mass ; [max 3]
- (iii) 1 kept in identical (environmental) conditions ;  
 2 (so) genes must be / environment cannot be, causing the differences ; [2]
- (iv) 1 (foothill population) can cope with (the effect of) cool temperatures ;  
 2 time period available for, growth / metamorphosis, shorter in the foothills ;  
 3 more chance of metamorphosing before, autumn / cooler weather, arrives ; [max 2]
- (c) 1 tadpole / adults, from lowlands unlikely to survive in the foothills / AW ;  
 2 ref. to genetic differences (between the two populations) ; [2]

**[Total: 14]**