GCE 2005
January Series

AQA

A S S E S S M E N T a n d
Q U A L I F I C A T I O N S
A L L I A N C E

Mark Scheme

Biology Specification A

BYA5 Inheritance, Evolution and Ecosystems

Mark schemes are prepared by the Principal Examiner and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation meeting attended by all examiners and is the scheme which was used by them in this examination. The standardisation meeting ensures that the mark scheme covers the candidates' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for the standardisation meeting each examiner analyses a number of candidates' scripts: alternative answers not already covered by the mark scheme are discussed at the meeting and legislated for. If, after this meeting, examiners encounter unusual answers which have not been discussed at the meeting they are required to refer these to the Principal Examiner.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of candidates' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

Further copies of this Mark Scheme are available to download from the AQA Website: www.aqa.org.uk

BYA5

Question 1

(a)	(i)	2 (molecules)	1

        (ii)   Cannot pass out of cell;
                Quickly/easily broken down (hydrolysed) / broken down in a on-step reaction /
                immediate source of energy;
                Stores / releases <u>small</u> amounts of energy;
                Do not credit "producing energy"   max   2

(b)   Formed when reduced NAD used to <u>reduce</u> / donate H ions to pyruvate / convert
             pyruvate to ethanol;   1

(c)   R.Q. = $\dfrac{\text{amount } CO_2 \text{ produced}}{\text{amount } O_2 \text{ used}}$;
             Anaerobic respiration occurring;
             Produces CO_2 but doesn't use O_2 / more CO_2 produced than O_2 used;   max   2

                                                                       Total 5 marks

Question 2

(a)   (Absorption of) light;   1

(b)   Inner membrane/cristae/stalked particles of mitochondria;   1

(c)   Plantae (plants) / Protoctista / prokaryotes;
             Processes are photosynthesis and respiration /
             plants/algae/(some) protoctistans/prokaryotes photosynthesise/have chlorophyll;
                                                                              2

                                                                       Total 4 marks

Question 3

(a)   **P** – denitrification;
             Q – Nitrogen fixation;   2

(b)   Ammonia formed by decay/decomposition/putrefying/ammonifying/by action of
             decomposers/saprobionts;
             On nitrogenous waste/urea *or* nitrogenous compounds (e.g. proteins, amino acids,
             DNA, ATP);   2

(c)   Oxygen added / hydrogen removed;   1
             Ignore references to electron loss

                                                                         Total 5 marks

Question 4

(a) (i) Continuous variation – range of values/not discrete categories/many categories/
          no gaps;   1

     (ii) Crossing over / chiasmata;
          Random segregation / independent assortment;
          In meiosis I and meiosis II;   max   2

(b)   Range influenced by single 'outlier' (*accept anomaly*) / converse for S.D.;
          S.D. shows dispersion/spread about mean;
          Range only shows highest and lowest values/extremes;
          S.D. allows statistical use;
          Tests whether or not differences are significant;   max   2

                                                                          Total 5 marks

Question 5

(a)   Pyramid correctly drawn and trophic levels labelled;   1
          Must be in proportion, and labelled using:
          Phytoplankton / Zooplankton / Herring OR
          Producer / Primary Consumer / Secondary Consumer OR
          Candidate's own 'key'

(b)   Idea of rapid reproduction to replace population/standing crop / so they don't
          become extinct;
          Idea of supplying energy/biomass to zooplankton;
          Idea of taking account of energy losses between trophic levels;   max   2

(c)   Cell wall;
          Ribosomes;
          Membrane-bound organelles (*accept 2 different examples*);
          Nucleus/component of nucleus;
          Plasma membrane;
          ER;   max   2

                                                                          Total 5 marks

Question 6

(a)   Removal of forest removes many ecological niches/habitats/food sources/shelter;
          Reduces numbers of species that can exist in the area;   2

(b) (i) Reduce amount of CO_2 used in photosynthesis;
          increase amount of CO_2 produced in combustion/decomposition;

     (ii) Less respiration;
          By plants/animals/decomposers;   max   3

                                                                          Total 5 marks

Question 7

(a)   Parental genotypes: Gg nn   gg Nn   ;
             Gamete genotypes   Gn   gn   gN   gn   ;

	gN	gn
Gn	Gg Nn Grey, normal	Gg nn Grey, vestigial
gn	gg Nn Ebony, normal	gg nn Ebony, vestigial

All offspring genotypes correct;
All offspring genotypes correctly derived;   4

(b)   (i)   There is no difference between observed and expected results;   1

       (ii)

Feature	Observed (O)	Expected (E)	(O – E)	(O – E)^2	$\dfrac{(O-E)^2}{E}$
Grey, normal	241	250	9	**81**	0.324
Grey, vestigial	220	250	30	**900**	3.6
Ebony, normal	272	250	22	**484**	1.936
Ebony, vestigial	267	250	17	**289**	1.156
				$\dfrac{\Sigma (O-E)^2}{E} = 7.016$	

$\chi^2 = 7.016 / 7.02$;;   2
[All $(O - E)^2$ values correct = 1 mark]

       (iii) Correct reference to three degrees of freedom;
              0.05 probability level / p = 0.05;
              χ^2 exceeds critical/table value – results differ significantly from expected;
              χ^2 less than/equal to critical/table value – differences due to chance;
              $\chi^2 >$ critical value: reject H^0 / $\chi^2 <$ critical value: accept H^0;   max   3

(c)   (i)   Change in base sequence / change in sequence of nucleotides;

       (ii)   Name of mutation (one mark) plus explanation (one mark) x 2
              Any two of the following:

              Addition *(allow insertion)*;
              (Extra base inserted) causes frameshift / results in non-functional protein / no protein;

              Deletion;
              (Base deleted / omitted / missed out) causes frameshift / results in non-functional protein / no protein;

              Substitution;
              (Base replaced with a different one) so only one triplet affected / possibly still codes for same amino acid / protein possibly still functional / one different amino acid;

              Also allow
              Inversion;
              (Bases *within a triplet* reversed) so only one triplet affected / possibly still codes for same amino acid / protein possibly still functional;

                                                                                    max   4

                                                                            Total 15 marks

Question 8

(a)   Population – organisms of one species in an ecosystem/habitat/area;
                   Community – organisms of all species / all populations in an ecosystem/habitat/
                   area;   2

(b)   (i)   No immigration/migration *(Ignore references to emigration)*;
                   No reproduction *(Ignore references to death)*;
                   Idea of mixing;
                   Marking does not influence behaviour / increase vulnerability to predation;
                   Sample/population large enough;   max   2

         (ii) $\underline{96 \times 77}$;   672;
                     11   2
                   Correct answer (however derived) scores 2 marks.
                   Incorrect answer with evidence of correct method scores 1 mark.

(c)   Principle of randomly placed quadrats;
                   Method of producing random quadrats; *(Reject 'throwing')*
                   Valid method of obtaining no. dandelions in given area (mean per quadrat/total no.
                   in many quadrats);
                   Multiply to give estimate for total field area;   max   3

(d)   (i)   Niche of A – 1;
                   Niche of B – 3;
                   Too small for B / too hot for A – 4;
                   Too large for A / too cold for B – 2;   2
                   All four correct = 2 marks; any 2 correct = 1 mark

         (ii)   Original population living in one area / 2 species evolved in the area;
                   Idea of genetic variability;
                   Concept of reproductive isolation;
                   Possible mechanism;
                   Gene pools become increasingly different;
                   Until interbreeding does not produce fertile offspring;   max   4

                                                                                   Total 15 marks

Question 9

(a)   1. Occurs in an unchanging environment;   1

+

                 2. (Initial range of values in which) mean is best adapted;

                 3. Selection against extremes / selection for the mean;

                 4. Mean/median/mode unaltered

                 5. Range/S.D is reduced;

                 6. Repeated over many generations;

                 7. Increasing proportion of populations becomes well adapted to environment;

                                                                        max   4

(b)   1. Dominant alleles will be expressed in heterozygotes;

                 2. Any cyanogenic plant must possess both dominant alleles;

                 3. Any cyanogenic plant must produce both enzymes;

                 4. Any acyanogenic plant will be missing at least one dominant allele;

                 5. Will not produce one or both enzymes;

                 6. Any acyanogenic plant cannot complete the pathway / any cyanogenic plant can complete the pathway;

                                                                        max   5

(c)   1. All plants are acyanogenic below -4ºC and (most) cyanogenic above +10ºC;

                 2. Cyanogenic plants' cells freeze below -4º;

                 3. Releasing cyanide (into their own tissues);

                 4. Damaging/killing plants / disrupting metabolism;

                 5. Selective advantage not to produce cyanide at -4ºC;

                 6. Slugs present at higher temperatures / not usually present/inactive at lower temperatures;

                 7. Cyanide production kills/deters slugs;

                 8. Advantage only at higher temperatures;

                                                      max   5

                                                        Total 15 marks