



General Certificate of Education

Biology/Human Biology 6411/6413 *Specification A*

BYA5 Inheritance, Evolution, Ecosystems

Mark Scheme

2006 examination - January series

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.

BYA5

Question 1

- (a) First meiotic division (**A**) will show cells with chromosomes appearing as double structures/two chromatids still joined / chromosomes in **A** and chromatids in **B** /homologous pairs are separating;
Must be in context of anaphase
Diploid number of chromosomes /appropriate number for **A** and **B**;
Allow reverse argument for second meiotic division
If answer is unqualified, assume that it refers to cells at A, since this is the logic of the question. 2
- (b) Crossing over / chromatids exchange sequences of DNA / chiasmata;
Random/independent segregation/assortment (of chromosomes) / chromosomes from homologous pairs move independently at meiosis I;
And meiosis II; max 2
- (c) Haemophilia (allele) on X chromosome / not on Y chromosome;
Sperm **P** may carry a Y chromosome / child may inherit Y chromosome from father; 2
- Total 6
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Question 2

- (a) (i) Population is the total number of organisms/individuals of a species/tigers in an area (at a given time); 1
- (ii) (Deforestation involves) habitat destruction/ destruction of niches;
Some prey animals move out or die / fewer suitable prey for tiger/ less food for tiger;
Reduces tiger population if prey biomass falls below 600 (tonnes per km²); 3
- (b) Kingdom, phylum and class (*terms may be in any order*); 1
- Total 5
-

Question 3

- (a) Group of physically/physiologically similar individuals / genetically similar;
Can (inter)breed;
To produce fertile offspring; max 2
- (b) Allopatric speciation involves isolation of populations by a geographical/physical feature;
Sympatric speciation - inhabit same area;
Isolated by differing reproductive patterns / suitable example (seasonal, temporal, behavioural);
Second suitable example; max 3
Note must be either differing reproductive patterns for 1 mark or two examples gains 2 marks
If wrong way round then max 2
- Total 5
-

Question 4

- (a) (i) $\frac{\text{Increase in biomass}}{\text{time}}$; 1
- (ii) Approximately 10% of energy passed (from phytoplankton to zooplankton) ;
Energy lost as heat/in respiration/in excretory products/ to decomposers; 2
not urine/movement
- (b) Membership of Protocista is often by exclusion from other kingdoms; 1
- Total 4
-

Question 5

- (a) Increase in number of species;
Increase in numbers of some species; 2
- (b) Initial environment hostile / few organisms adapted;
These organisms change the environment / suitable example;
More niches / more habitats;
Allowing other organisms to become established; max. 3
- Total 5
-

Question 6

- (a) Parents genotypes Aabb aaBb ;
Gametes formed Ab ab aB ab ;
if parental genotypes wrong allow correctly derived gametes only
- Offspring genotypes AaBb Aabb aaBb aabb
and
Offspring phenotypes 1 Walnut ; 1 Pea : 1 Rose : 1 single ; 3
*Just **one** mark for offspring genotypes **and** phenotypes*
If parents not diploid, no marks gained
- (b) Correct answer 0.6, however derived, scores 2 marks
Wrong answer, but evidence of correct working (e.g. $p^2/q^2 = 0.36$) scores 1 mark 2
- Total 5
-

Question 7

- (a) (i) *Selecting the nettle plant:*
 Random number table avoids bias in placing of quadrat;
 ‘Nearest centre’ avoids bias in choosing plant to measure;
1 mark for “method avoids bias” 2
- (ii) *Measuring the sixth leaf:*
 To allow valid comparison/so as not to introduce another variable;
 Reduces/avoids influence of growth/age;
 Reduces/avoids influence of light/shading; max. 2
- (b) (i) Definition of range + SD / effect of outliers on range + SD;
 Ranges are similar in both areas;
 Suggests that variation within populations is similar;
 SD smaller in area of high light intensity;
 Shows that area of high light intensity is a more uniform population; 4
- (ii) Standard error (of the mean); 1
- (c) (i) 1.164 / 1.16 / 1.2 , however derived = 2 marks
 0.83 – 0.86 / 1.1, however derived = 1 mark **or**
Evidence of correct use of both sets of figures, but inappropriate answer = 1 mark 2
- (ii) (Reduced NADP and ATP) used in light-independent reactions;
 To convert GP to triose phosphate / $\text{PGA} \rightarrow \text{PGAL}$;
 Reduction by reduced NADP / reduced NADP supplies hydrogen ions/atoms;
 ATP supplies energy;
 (Some) triose phosphate converted to hexose/glucose; max 4
- Total 15

Question 8

- (a) (i) P = 3;
Q = acetylcoenzyme A; 2
- (ii) 36 ATP, however derived = 2 marks
30 ATP, however derived = 1 mark 2
- (iii) *Correct statement in the context of aerobic respiration or anaerobic respiration concerning:*
Oxygen as terminal hydrogen/electron acceptor;
Operation of electron transport chain/ oxidative phosphorylation;
Fate of pyruvate;
Krebs cycle;
Significance of ATP formed in glycolysis; max. 3
- (b) (i) Thick walls exclude oxygen;
Produced by photosynthetic cells (of fern and *Anabaena*);
Contain no chlorophyll so do not photosynthesise;
Do not produce oxygen;
Oxygen would inhibit nitrogen fixation process; max. 3
- (ii) Decomposers/ bacteria/fungi/saprobionts (in fields);
Convert protein/organic nitrogen (in cells of fern) into ammonium ions (*allow ammonia*);
Ammonium ions (ammonia) converted to nitrite;
Nitrite converted to nitrate;
Allow 1 mark for $NH_3/NH_4^+ \rightarrow NO_3^-$
By nitrifying bacteria / correctly named;
Nitrate used to form protein / amino acids in rice;
Link between application of fern and protein/cells of rice;
Decomposers respire (suitable substrate) and release CO₂;
Used in photosynthesis by rice; max. 5
- Total 15
-

Question 9

- (a) Excitation of chlorophyll molecule/electrons/ energy of (pairs of) electrons raised to higher energy level;
Electron(s) emitted from chlorophyll molecule;
Electron(s) to electron transport chain;
Loss of energy by electron(s) along electron transport chain;
Energy lost by electron(s) is used to synthesise ATP;
From ADP + P_i;
“By electrons” need not be stated in each marking point if it can be reasonably inferred that the candidate is referring to electrons max. 5
- (b) Little green light reaches bottom as absorbed by surface dwellers / water;
Red and blue not absorbed and so penetrate;
Variation in pigments of sediment dwellers;
Bacteria with chlorophyll at an advantage;
As chlorophyll absorbs red and blue;
(Survive to) reproduce in greater numbers;
Pass on advantageous alleles/genes in greater numbers / increase in frequency of advantageous alleles in subsequent generations;
Increase in frequency/numbers of bacteria with chlorophyll; max. 6
- (c) Addition (*allow insertion*) and deletion;
Extra base added, base removed, both correctly related to mutation;
Frameshift occurs/all bases after point of mutation move up/back;
DNA triplets *after point of mutation* are altered;
mRNA codons *after point of mutation* altered;
Change in primary structure; max. 4

Total 15
