

# GCE 2005

## *January Series*



# Mark Scheme

## Biology Specification A

### BYA5 Inheritance, Evolution and Ecosystems

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*Dr Michael Cresswell Director General*

**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 small amounts of energy;  
*Do not credit “producing energy”* max 2
- (b) Formed when reduced NAD used to reduce / donate H ions to pyruvate / convert pyruvate to ethanol; 1
- (c) R.Q. =  $\frac{\text{amount CO}_2 \text{ produced}}{\text{amount O}_2 \text{ used}}$  ;  
Anaerobic respiration occurring;  
Produces CO<sub>2</sub> but doesn't use O<sub>2</sub> / more CO<sub>2</sub> produced than O<sub>2</sub> 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;  
*Ignore references to electron loss* 1

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<sub>2</sub> used in photosynthesis;  
increase amount of CO<sub>2</sub> 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) <sup>2</sup>	$\frac{(O - E)^2}{E}$
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
				$\frac{\sum (O - E)^2}{E} = 7.016$	

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

- (iii) Correct reference to three degrees of freedom;  
 0.05 probability level / p = 0.05;  
 $\chi^2$  exceeds critical/table value – results differ significantly from expected;  
 $\chi^2$  less than/equal to critical/table value – differences due to chance;  
 $\chi^2 >$  critical value: reject H<sup>0</sup> /  $\chi^2 <$  critical value: accept H<sup>0</sup>; 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)  $\frac{96 \times 77}{11}$  ; 672; 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;
  - +
  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  $-4^{\circ}\text{C}$  and (most) cyanogenic above  $+10^{\circ}\text{C}$ ;
  2. Cyanogenic plants' cells freeze below  $-4^{\circ}$ ;
  3. Releasing cyanide (into their own tissues);
  4. Damaging/killing plants / disrupting metabolism;
  5. Selective advantage not to produce cyanide at  $-4^{\circ}\text{C}$ ;
  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