



General Certificate of Education

Biology / Biology (Human) 6411 / 6413

Specification A

**BYA5 Inheritance, Evolution and
Ecosystems**

Mark Scheme

2009 examination - January series

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Question 1

(a) In table, in sequence:

Animalia / Animals;
 Fungi;
 Prokaryotae / Prokaryotes; 3
Q Ignore references to bacteria

(b) (i) Class = Mammalia **AND** Family = Equidae ; 1
Q Allow if candidate puts correct answers in table only

(ii) Mule has 63 chromosomes / mule has odd number of chromosomes /
 horse and donkey have different number of chromosomes / gametes have
 different number of chromosomes;
 (Leads to) errors occur in meiosis / gamete formation / correct description;
 Mule is non-fertile / is sterile / cannot reproduce; 3
Q Ignore references to mule being viable

Total 7

Question 2

(a) Anaphase and since (chromosomes) are separating;
 (Anaphase) I and homologous chromosomes present / cell is diploid /
 pairs of chromatids still joined;
OR Anaphase I (no reasons / incorrect reasons) 1 mark
2 max

(b) 0.13; 1
Q Allow $0.52 \div 4$

(c) (i) qrDE qrdE QRDe QRde ;; 2 marks
OR If incorrect, but one allele from each gene in each of four
 (genetically different) gametes ; 1 mark 2 max

(ii) Produces variation in offspring / example described;
 Different adaptations in offspring / some offspring better adapted /
 allows for changing environment / different environment / example described; 2

Total 7

Question 3

- (a) ATP;
Reduced NADP / NADPH / NADPH₂; 2
- (b) (i) Change in GP/RuBP occurs in the dark / 200 s (to approx. 250 s) ;
GP rises / RuBP falls; 2
Q Ignore statements referring to periods in the light
- (ii) GP falls / RuBP rises when light restored / at 1700+ seconds;
RuBP falls in the dark;
GP / RuBP constant in first light period; 2 max
- (c) GP converted into other substances / used in respiration;
Q Cancel if TP or RuBP suggested 1
- Total 7

Question 4

- (a) (i) Water ; 1
- (ii) Krebs cycle / citric acid cycle / TCA cycle; 1
- (iii) Mitochondrion / mitochondria;
Q Ignore cristae/matrix 1
- (b) 3;
2 pyruvate formed per (6-C) glucose (and no CO₂ lost yet) /
pyruvate minus CO₂ → a (2-C) acetyl unit / two pyruvates release 6 CO₂ /
one pyruvate releases 3 CO₂; 2
- (c) RQ = $\frac{\text{Carbon dioxide}}{\text{Oxygen}}$;
- RQ = $\frac{6}{6}$ / CO₂ = O₂; 2
- Q If formula for RQ is inverted, second mark can still be awarded**
- (d) (i) 34; 1
- (ii) Energy released in a single reaction / energy (released) in small quantities /
energy (released) in manageable quantities; 1
- Total 9

Question 5

(a) (i) Moose population (much) greater than wolf population – due to energy / material loss up food chain;

(At 1st) Moose population rises as wolf population falls – due to less predation;

(Later) Moose population falls/levels off as wolf population rises – due to increased predation; 3

If none of the above allow one mark for moose population rises as wolf population falls and (later) moose population falls as wolf population rises;

(ii) Wolf population size is (very) small / correct value given;
Not representative / not reliable / will give wrong answer;

Suitable explanation – too few wolves in (1st / 2nd) sample / small change in catch would cause large change in estimate

Q Accept argument via numerical example

/ sensible suggestion – e.g. wolves in packs so non-random mixing
/ can use direct observation to count
/ trap-happy wolves / trap-shy wolves
/ population change between samples
/ births/deaths;

Q Accept births/ deaths but ignore references to immigration / emigration 3

(iii) Increase followed by a decrease / plateau; 1

(b) Correct answer = 1008;;;; 4 marks

OR Correct use of $p + q = 1$ / $p^2 + 2pq + q^2 = 1$ / answer = $2pq$ ($l = 0.42$);
 $q^2 = 0.09$ / $q = 0.3$;
Use of 2400 (from graph); 3 marks max

OR (Candidate's number from graph) x 0.42;;;; 3 marks
4 max

(c) (i) **aa** likely to have more offspring / more likely to reproduce;
aa pass on **a** allele to offspring; 2

(ii) Any two from:

Mutation;
Small population / small gene pool / founder effect / genetic bottleneck / genetic drift;
(Differential) immigration / emigration / gene flow; 2 max

Total 15

Question 6

- (a) (i) Parental genotypes correct: **BbNn** and **BbNn** ;
 Gametes correct for candidate's P genotypes: e.g. **BN Bn bN bn** (for both parents);
 Offspring genotypes correct!
derived from candidate's
 suggested gametes ;

e.g.	BN	Bn	bN	bn
BN	BBNN	BBNn	BbNN	BbNn
Bn	BBNn	BBnn	BbNn	Bbnn
bN	BbNN	BbNn	bbNN	bbNn
bn	BbNn	Bbnn	bbNn	bbnn

Identification of 'blue' as **BBnn / Bbnn** ; 4
Q Ignore monohybrid cross

- (ii) 0.09 / 9 % / $\frac{3}{32}$;;; 3

- OR** ① Correct proportion of 'blue' from candidate's completed table in (a) (i);
 ② Correct probability of female given as 0.5 / $\frac{1}{2}$;
 ③ Correct calculation of candidate's answer to ① x 0.5;

- (b) (i) Any two from:
 This is a test-cross / a back-cross;
 Lilac is double recessive / only has recessive alleles / is **bbnn** / produces only **bn** gametes;
 Allows allele from blue parent to determine offspring phenotype / if Megan is homozygous, all offspring will be blue / if Megan is heterozygous, some offspring will be lilac;
2 max

- (ii) No difference between observed and expected / any difference is due to chance; 1

- (iii) Any value between 1.33 and 1.34;; = 2 marks
 Accept $1.32 / \frac{4}{3} / 1\frac{1}{3}$

OR:

Both $\frac{(O - E)^2}{E}$ correct = $\frac{4}{6} / 0.67$; = 1 mark
 Accept $0.66 / \frac{2}{3}$

- (iv) Candidate chooses 1 degree of freedom / accept via corr. ref. to figures from 1 deg. fr. line;
 If χ^2 less than critical value / χ^2 less than value for $p = 0.05$ / correct value of p from table; 3
 Accept null hypothesis since difference due to chance / insignificant;
 Accept 2^{nd} and 3^{rd} marking point if correct converse explanation given for
 calculated value of χ^2 that is greater than the critical value / greater than value for $p = 0.05$

Total 15

Question 7

- (a) Uses CO₂ to perform photosynthesis / CO₂-fixation;
Making organic substances / named example / permanent tissues / wood; 2
- (b) (i) Any three from:
- ① Less food (quantity) / more competition for food;
 - ② Fewer food types;
 - ③ Loss of niches / habitats;
 - ④ Changes in microclimate / loss of shelter / greater influence of abiotic factors / named example more extreme / more hostile / exposed to predators ; 3 max
- (ii) Any three from:
- ① Trees protect soil from rain / felling exposes to rain;
 - ② Leaching of ions;
 - ③ Erosion of soil / mud slides;
 - ④ Low nutrients / low humus in soil at start / most of nutrients were in trees;
 - ⑤ Cropping (maize) removes nutrients from soil; 3 max
- (c) Any seven from:
1. Nitrogen-fixing bacteria / *Rhizobium* / *Azotobacter* ;
 2. N₂ → NH₃ / NH₄⁺ **OR** (if lightning) N₂ → NO₂⁻ / NO₃⁻ ;
 3. NH₃ / NH₄⁺ → organic-N / correct e.g. of organic-N in bacterium / in legume ;
 4. Organic-N broken down by decomposers / is decomposed ;
 5. Organic-N → NH₃ / NH₄⁺ ;
 6. Nitrifying bacteria / *Nitrosomonas* / *Nitrobacter* ;
 7. Convert NH₃ / NH₄⁺ → NO₂⁻ } [OR NH₃ / NH₄⁺ → NO₃⁻ = 1 mark]
 8. Convert NO₂⁻ → NO₃⁻ ;
 9. Aerobic / use of O₂ ;
 10. NO₃⁻ absorbed by roots ;
Q Allow NO₂⁻ / NH₄⁺ absorbed by roots
 11. NO₃⁻ combines with organic substance(s) in maize plant → amino acids ; 7 max

Q If correct chemical names that are given are associated with incorrect chemical symbols, ignore symbols.

Total 15