



## **General Certificate of Education**

# **Biology/Human Biology 5411/5413**

## *Specification A*

**BYA5      Inheritance, Evolution and  
Ecosystems**

# **Mark Scheme**

*2007 examination - January series*

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**Question 1**

- (a) Habitat/environment + community (/described) /  
(all the) biotic and abiotic factors in an area/in an environment; 1
- (b) Reflected / absorbed by water;  
Reflected from producers;  
Transmitted / passes between chloroplasts/ between plants / too few chloroplasts;  
*(Reject "not absorbed" unqualified)*  
Wrong wavelength / some = heat / some = UV / used to evaporate water;  
Used to drive reactions of photosynthesis / lost in photosynthesis;  
Other limiting factor / named example – carbon dioxide / temperature; 2 max
- (c) Loss of energy/heat / use of energy / less energy to be passed on;  
In respiration;  
In excreta / excretion / urine / carbon dioxide;  
Inedible parts / indigestible parts / egesta / egestion / to decomposers; 2 max
- Total 5**

**Question 2**

- (a) (i) 6; 1
- (ii) On graph:  
'F' on vertical rise from 3 to 6 pg;  
'S' on vertical fall from 6 to 3 pg; 2
- (b) Crossing over / described;  
Independent/random assessment / independent/random segregation /  
described clearly (e.g. not just alignment); 2  
*Ignore reference to name of phase*
- Total 5**

**Question 3**(a) Table completed as below:

	$C^R$	$C^a$	$C^h$	$C^w$
$C^w$	$C^R C^w$ red	$C^a C^w$ apricot	$C^h C^w$ honey	$C^w C^w$ white
$C^h$	$C^h C^R$ red	$C^a C^h$ apricot	$C^h C^h$ honey	
$C^a$	$C^a C^R$ red	$C^a C^a$ apricot		
$C^R$	$C^R C^R$ red			

All genotypes correct; *IGNORE absence of C* = 1 mark  
 All phenotypes correct for candidate's genotypes;; = 2 marks  
 (minus 1 mark per error) 3

(b) 15; 1

**Total 4****Question 4**(a) Grana / granum / thylakoids / internal membranes / lamellae; 1

(b) Does not give undue emphasis to 'outliers' / to a one-off extreme result /  
 range only shows extremes / S.D. uses all values / mean uses all values /  
 can calculate confidence limits (of mean) /  
 S.D. shows spread about mean / reliability of mean /  
 S.D. allows stats. test / can test if differences are significant;

Use of data – e.g. 21 bubbles for green may be an anomaly /  
 21 or 7 is exceptional / 26 for violet is exceptional /  
 green has greater range but blue had greater S.D.; 2

(c)  $O_2$  gas comes (only) from  $H_2O$  / not from  $CO_2$  /  $CO_2$  goes only into glucose;  
 Equation does not have enough O (atoms) in  $H_2O$  / need 12 O (atoms) from  $H_2O$  /  
 equation indicates (some) O (atoms) from  $CO_2$ ; 2

**Total 5**

**Question 5**

- (a) Place quadrats at random coordinates / described;  
(Ignore throwing)  
Score mean no. of thistles per quadrat / total for all quadrats;  
Mean x 5000 / mean x (ratio of area of field : area of quadrat) /  
/ total x (ratio of area of field : area of all quadrats); 3
- (b) Initial sample too small / marked recapture sample too small;  
Small change in data would give large change in population estimate /  
leads to overestimate of population;  
Or  
Paint on shells → more visible to predators / paint toxic / paint comes off;  
→ overestimate of population size;  
Or  
One day too short;  
Too many marked snails recaptured → underestimate of population size /  
too few marked snails recaptured → overestimate of population size; 2 max
- Total 5**

**Question 6**

- (a) Small founder population / common ancestor(s) / described;  
Genetic/reproductive isolation / small gene pool / no immigration / inbreeding;  
(must qualify "interbreeding")  
  
High probability of mating with person having the recessive allele /  
allele for condition / high probability of inheriting 2 recessive alleles; 2 max
- (b) (i) Correct answer = 8.7 / 8.8 (%) ;;; 3 marks  
OR 0.087 / 0.088 ;;; 2 marks  
OR  
 $p + q = 1 / p^2 + 2pq + q^2 = 1 / p = 1 - 0.046 / q^2 = \frac{1}{480} / = 0.0021 / q = 0.046;$   
  
(Allow 'p' for 'q')  
Answer = 2pq / use of appropriate numbers; 2 marks 3 max
- (ii) All homozygous recessive die / all those with the condition die /  
none with the condition in the adult population / selective disadvantage; 1
- Total 6**

**Question 7**

- (a) (i) **W** = carbon dioxide;  
*Ignore extra 'reduced NAD'*  
**X** = Krebs cycle; 2
- (ii) 6; 1
- (iii) On diagram:  
'Oxygen' on stage **Y**; 1
- (b) Correct answer = 0.69 / 0.7;; (2 marks)
- $RQ = \frac{CO_2}{O_2} = \frac{18}{26} = 0.70;$  (1 marks) 2
- (c) (i) More C-atoms → more Acetylcoenzyme A formed / shown by numbers /  
 $C_{15} \rightarrow 8$  and  $C_{17} \rightarrow 9$ ;  
More reduced NAD / reduced FAD formed;  
More (ATP) formed at stage Y / by oxidative phosphorylation /  
more (ATP) formed in Krebs cycle / by substrate-level phosphorylation; 3
- (ii) 8 Acetylcoenzyme A → 8 ATP via Krebs cycle/stage X/substrate-level  
phosphorylation;  
Minus 2 ATP used (in equation 2);  
OR '8 – 2' = 1 mark. 2
- (d) (i) Mitochondrion / mitochondria; 1
- (ii) On the diagram (figure 2):  
X in the matrix AND Y on the inner membrane; 1
- (e) ATP energy released in single reaction;  
ATP energy released in small quantities / manageable quantities /  
less energy wasted / less heat produced; 2
- Total 15**

**Question 8**

(a) Table completed as below:

Kingdom	Animalia / Animals
Phylum	Chordata
Class	Mammalia
Order	Rodentia
Family	Caviidae
Genus	<i>Cavia</i>
Species	<i>porcellus</i>

Column 1 correct;  
Column 2 correct;

2

(b) Mutation occurs;

Correct e.g. of isolating mechanism

- e.g. temporal – different breeding seasons / feeding times /  
ecological / behavioural – different courtship displays / different niches /  
habitats / feeding areas /  
mechanical – mismatch of reproductive parts /  
gamete incompatibility – sperm killed in female’s reproductive tract /  
hybrid inviability / hybrid infertility;

*Ignore references to “genetic isolation” or “reproductive isolation”*

Different selection pressures operate / changes in allele frequency /  
divergence of gene pools;

3

(c) Using candidate’s symbols for alleles –  
e.g. B = black, b = brown, S = short, s = long:

Parental genotypes correct: Male **A** Female **B**  
SSBb SsBB;

Gametes correctly derived from  
candidate’s parental genotypes: SB Sb SB sB;

offspring genotypes correctly  
derived from candidate’s  
suggested gametes – accept Punnett square or line diagram;

offspring genotypes correct: SSBB SsBB SSBb SsBb;

If monohybrid:  
cross  $\Rightarrow$   
0 marks

4

(d) (i) There is no (significant) difference between observed and expected results /  
any difference is due to chance;

1

(ii) Correct answer:  $\chi^2 = 2.57 / 2.58 / 2.6 / 2.56$  ; ; = 2 marks  
Both  $\frac{(O - E)^2}{E}$  correct = 9/7 / 1.286 / 1.29 / Allow 1.28; = 1 mark

2 max

- 
- (iii) Correct reference to 1 degree of freedom / use of a figure from row 1;  
EITHER if  $\chi^2 < \text{critical value}$  /  
< value for  $P = 0.05$ , then difference is due to chance/not  
significant;  
OR if  $\chi^2 > \text{critical value}$  /  
> value for  $P = 0.05$ , then difference is significant/not due to  
chance;  
Accept null hypothesis;  
Reject null hypothesis;

3

**Total 15**



**Question 9**

(a) Land exposed to wind/ rain;  
 Soil erosion / soil not stabilised by tree roots;  
 Less humus in soil;  
 Washing out minerals/nutrients / leaching;  
 Recovery difficult because long distance from reservoir of recolonising species /  
 described by example – e.g. long way for seeds to be blown /  
 harsh environment for recolonisers; 3 max

(b) (i) Blocks light / competition for light;  
 Takes water / competition for water;  
 Takes minerals / competition for mineral/nutrients; } / 'competition' unqualified.  
 Ignore competition for "space" = 1 mark  
 Reduced photosynthesis; *Reject 'zero'*  
 Hedge plants harbour herbivores/pests;  
 Release of growth inhibitors; 3 max

(ii) In cultivated alleys:  
 Abiotic factors more influential / named e.g. – temperature / water /  
 more harsh environment / less shelter / less stable / etc.;

Fewer plant species present / less diversity of plants / is a monoculture;  
 Fewer niches / less variation in habitat;  
 Fewer food types;  
 More competition for resources / less food available; 3 max

(iii) *If only chemical symbols – must be correct*  
*If symbols + words – ignore symbol*

Nitrogen-fixing bacteria:  $N_2 \rightarrow NH_3 / NH_4^+$ ;

Nitrifying bacteria:  $NH_3 \rightarrow NO_2^-$ ;  
 $NO_2^- \rightarrow NO_3^-$ ; } /  $NH_3 \rightarrow NO_3^- = 1$  mark  
 Oxidation / uses  $O_2$  / aerobic;

Decomposers: Breakdown/digest/hydrolyse protein/organic matter;  
 Deamination / produce  $NH_3 / NH_4^+$ ;  
 Secrete enzymes / extracellular;

} ONLY IN  
 CORRECT  
 CONTEXT

Final product =  $NO_3^-$  which can be taken up/used by plants;  
 Production of named organic N-compound – e.g. amino acid / protein / DNA; 6 max

**Total 15**