



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*
 All phenotypes correct for candidate's genotypes;;
 (minus 1 mark per error)

= 1 mark
 = 2 marks

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 $\times$ 5000 / mean $\times$ (ratio of area of field : area of quadrat) /
 / total $\times$ (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 $\rightarrow$ more visible to predators / paint toxic / paint comes off;
 $\rightarrow$ overestimate of population size;
 Or
 One day too short;
 Too many marked snails recaptured $\rightarrow$ underestimate of population size /
 too few marked snails recaptured $\rightarrow$ 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**
SSBbFemale **B**
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 = $9/7 / 1.286 / 1.29 / \text{Allow } 1.28$; = 1 mark

2 max

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;
- 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