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ASSESSMENT and QUALIFICATIONS ALLIANCE

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) <u>On graph:</u>

'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 <u>clearly</u> (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} → 8 and C_{17} → 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	*Cavia*
Species	*porcellus*

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** SSBb Female **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; 4

If monohybrid: cross ⇨ 0 marks

(d) (i) There is no (significant) difference between observed and expected results / any difference is due to chance; 1

(ii) Correct answer: χ^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 χ^2 < critical value /
< value for P = 0.05, then difference is due to chance/not significant;
Accept null hypothesis;
OR If χ^2 > critical value /
> value for P = 0.05, then difference is significant/not due to chance;
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. = 1 mark
Ignore competition for "space"
Reduced photosynthesis; *Reject 'zero'*
Hedge plants harbour herbivores/pests;
Release of growth inhibitors; 3 max

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

Fewer <u>plant</u> species present / less diversity of <u>plants</u> / is a monoculture;
Fewer niches / less variation in habitat;
Fewer food <u>types</u>;
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: $NH_3 \rightarrow NO_2^-$; } / $NH_3 \rightarrow NO_3^-$ = 1 mark
$NO_2^- \rightarrow NO_3^-$; }
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