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A2 Biology OCR

Unit F215: Control, genomes and environment

Module 1.2 Meiosis and variation

Answers

1. (a) (i) *gene*
length of DNA;
codes for a (specific), polypeptide / protein / RNA; max 1

allele
alternative form of a gene;
found at a, locus / particular position on, a chromosome; max 1

(ii) *assume allele refers to coat colour allele*

(coat colour) gene / alleles, only on X chromosome;
A *no (coat colour), gene / allele, on Y chromosome*
male cats, XY / only have one X chromosome;
males have only one (coat colour) allele / cannot have two (coat colour) alleles;
need black and orange alleles for tortoiseshell colour; 2

(b) parental genotypes $C^rC^r \times C^wC^w$;
gametes C^r, C^w;

F_1 genotypes <u>and</u> phenotypes 1 mark:

F_1 genotypes (all) C^rC^w
F_1 phenotypes (all) pink;

F_2 genotypes <u>and</u> phenotypes 1 mark:

gametes C^r, C^wC^r, C^w;
F_2 genotypes C^rC^r C^rC^w C^rC^w C^wC^w
F_2 phenotypes red pink (pink) white;

F_2 ratio 1:2:1;
accept other symbols if key given.
accept r and w as symbols without key. 6

(c) (i) 65; 130; 65; 3

(ii) 0.138 + 0.007 + 0.061; (*or other suitable working*)
0.206 – 0.208;
2 marks for correct value if no working shown
ecf for both marks but calculated value must be to three decimal places 2

(iii) support, figure lower than 5.991 / figure lower than critical value;

***R** 'support' on its own.*

ecf applies if value in (ii) is incorrect 1

[16]

2. named characteristic;
named environmental factor; *(mark first answer only)* 2
[2]

3

i) crossing over; *treat chiasma(ta) as neutral* 1

(ii) prophase; 1

(iii) have different, alleles/base sequence of DNA;
A *sister chromatids have same alleles/non sister have different alleles* 1
[3]

4

two different genes represented in each gamete ie Q or q and R or r;
four correct combinations ie Q and R, Q and r, q and R, q and r; 2
[2]

5

(a) *linkage*
(two or more) genes / loci, on same chromosome; **R** alleles
do not assort independently (in meiosis) / inherited together;

crossing over
reciprocal exchange of portions of, chromatids / DNA; **A** swapping alleles
between (paternal and maternal) homologous chromosomes; **A** bivalent
in prophase I (of meiosis); *max 2* max
3

(b) anthers removed (before maturity) (to produce male sterility);
male sterilisation; *genetic or, PGS / hormone*
pollen transferred by hand;
plants isolated;
flowers bagged (before and after pollination); max 3

(c) (i) **R** 'chance' alone

chance fertilisation;
chance re picking 50 offspring;
chance re other traits affecting survival;
AVP; e.g. position effect, different gene interactions affecting expression,
effect of crossing over on numbers of other classes max 1

(ii) *award two marks if correct answer (16%) is given without working*

recognition of recombinant classes;

$\frac{32}{200} \times 100$;

=16%; max 2

(iii) 1,2 $\frac{A}{a}\frac{B}{b} \times \frac{a}{a}\frac{b}{b}$;; **A** (AB)(ab) × (ab)(ab)

3 both chromatids per chromosome shown;
4 crossover shown;

5 result of crossover shown;

6 most / 84%, gametes A B and a b [× a b]; **A** AB and ab
7 = parental;

8 few / 16%, gametes A b and a B [× a b]; **A** Ab and aB
9 = recombinant;

10 ref 16 map units apart / close together; max 6

[15]

6

marking points 1,6 and 9 must be linked to correct statements as to what is taking place in these stages to gain the mark.

1 prophase 1 ;
2 synapsis / homologous chromosomes pair up / bivalents form ;
3 crossing over ;
4 chiasma(ta) occur ;
5 DNA / alleles, exchanged ; **A** linked genes separated ;
6 metaphase 1 ;
7 independent / random, assortment ;
8 bivalents line up on equator, independent of each other / randomly ;
9 metaphase 2 ;
10 independent assortment of chromatids ;
11 chromosome mutation ;
12 named example ; e.g. non-disjunction
13 AVP ; e.g. ref to non-sister / non-identical, chromatids. max 7

QWC – clear well organised using specialist terms ;

award the QWC mark if four of the following are used in correct context
prophase, metaphase, homologous, bivalent, chiasma, crossing over, independent assortment 1

7

(i) Q, S, P, N, M, R ; 1

(ii) *accept correct names of stages*

Q ; **A** prophase 1
M ; **A** anaphase 2
Q / S ; **A** prophase 1 / metaphase 1
S ; **A** metaphase 1
R ; **A** telophase 2 5

(iii) DNA replication ;
synthesis of proteins / named protein ; **A** transcription / translation
synthesis of membrane ;
synthesis of, organelle(s) / named organelle ;
respiration ;
AVP ; e.g. centrioles replicate ; max 2

[8]