Student Name: _____

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BIOLOGY 2020

Unit 2
Key Topic Test 5 – Pedigrees, genetic crosses and genetic decisions

Recommended writing time*: 45 minutes
Total number of marks available: 45 marks

QUESTION BOOK

* The recommended writing time is a guide to the time students should take to complete this test. Teachers may wish to alter this time and can do so at their own discretion.

Conditions and restrictions

- Students are permitted to bring into the room for this test: pens, pencils, highlighters, erasers, sharpeners and rulers.
- Students are NOT permitted to bring into the room for this test: blank sheets of paper and/or white out liquid/tape.
- A calculator is NOT permitted in this test.

Materials supplied

- Question and answer book of 12 pages.

Instructions

- Print your name in the space provided on the top of the front page.
- All written responses must be in English.

Students are NOT permitted to bring mobile phones and/or any other unauthorised electronic communication devices into the room for this test.

SECTION A – Multiple-choice questions

Instructions for Section A

Select the response that is correct for the question. A correct answer scores 1 mark, and an incorrect answer scores 0. Marks are not deducted for incorrect answers. If more than one answer is selected for any question, no mark will be given for that question.

Question 1

A tool to help determine the result of genetic cross is called a:

- **A.** probability
- **B.** pedigree
- **C.** phenotype.
- **D.** punnet square

Question 2

A test cross is:

- **A.** a cross between a dominant homozygous individual and an individual with an unknown genotype but a recessive phenotype.
- **B.** a cross between a recessive homozygous individual and an individual with an unknown phenotype but a known genotype.
- **C.** a cross between a heterozygous individual and an individual with an unknown genotype but a dominant phenotype.
- **D.** a cross between a recessive homozygous individual and an individual with an unknown genotype but a dominant phenotype.

Question 3

A dihybrid cross involves:

- **A.** one gene on one chromosome
- **B.** two genes on one chromosome
- **C.** two genes on two chromosomes
- **D.** none of the above

Question 4

Linked genes are best described as:

- **A.** genes for similar characteristics
- **B.** genes that are located on chromosomes near each other
- **C.** genes that are located close together on the same chromosome
- **D.** genes that are located on all chromosomes

Question 5
A likely consequence of linkage is that after a test cross with a known heterozygote:

- **A.** there will be a large proportion of offspring displaying parental characteristics but also some recombinant characteristics.
- **B.** there will be a small proportion of offspring displaying parental characteristics, but most will have recombinant characteristics.
- **C.** there will be an equal proportion of offspring displaying parental characteristics and those with recombinant characteristics.
- **D.** there will be no offspring displaying parental characteristics.

Information for questions 6, 7 and 8

There are 4 blood groups in the human ABO blood system. There is a gene on chromosome 9 that determines whether an individual has a particular antigen on its red blood cells.

Blood group	Antigen(s) present on the red blood cells
A	A antigen
B	B antigen
AB	A antigen and B antigen
O	None

The 4 blood groups alleles can be designated I^A, I^B, I^{AB} and i respectively.

Question 6
If a mother has the blood group A, her genotype could be:

- **A.** I^A, i
- **B.** I^A, I^{AB}
- **C.** i, i
- **D.** none of the above

Question 7
A daughter of the mother above has the blood group O. This means that the father must have the genotype:

- **A.** I^A, I^A,
- **B.** I^A, I^{AB}
- **C.** i, i
- **D.** none of the above

Question 8
The daughter (from Question 7) has a child with her partner and the doctor claims that the child has a blood group AB. Is this possible?

- **A.** yes
- **B.** no
- **C.** possibly
- **D.** do not know

Question 9
Shortly after birth all newborns are screened in Australia for a range of genetic abnormalities. This screening is only acceptable if which of the following is true:

- **A.** the newborn would benefit from swift diagnosis and initiation of treatment.
- **B.** the parents would prefer to know if their child has an abnormality.
- **C.** preparation for the demands the abnormality may put on the family later in the child's life have been considered and weighed.
- **D.** the information can be recorded on a national database.

Question 10
Which of the following scenarios does not describe a reason for genetic testing?

- **A.** Amelia has a family history of breast cancer
- **B.** Sarah and Tom are wanting to start a family and Tom has a relative with cystic fibrosis
- **C.** Determining the presence of all serious genetic diseases in all newborns in Australia
- **D.** Alice has some of the symptoms of Huntington's disease but does not have a diagnosis

SECTION B - Short-answer questions

Instructions for Section B
Answer all parts of the question in the space provided. Write using black or blue pen.

Question 1

When a doctor suspects that a person may be suffering from a genetic abnormality, they will often ask that person questions about their family history. This helps the doctor identify if it is a genetic abnormality or not. That is, is it passed from parent to offspring and in what manner is it inherited.

A **pedigree or family tree** is a useful way of charting the expression of particular characteristics in families. It shows the pattern of inheritance of characteristics. When certain patterns are observed over successive generations, a mode of inheritance can be determined. The symbols used in pedigrees represent the individuals within a family, as well as indicating which individuals possess particular characteristics. A pedigree is usually accompanied by a legend or key that is used to interpret the symbols used.

Cystic fibrosis is a disease that causes a build-up of thick mucus in the lungs. Sufferers may not survive beyond their teens. It is caused by a recessive allele.

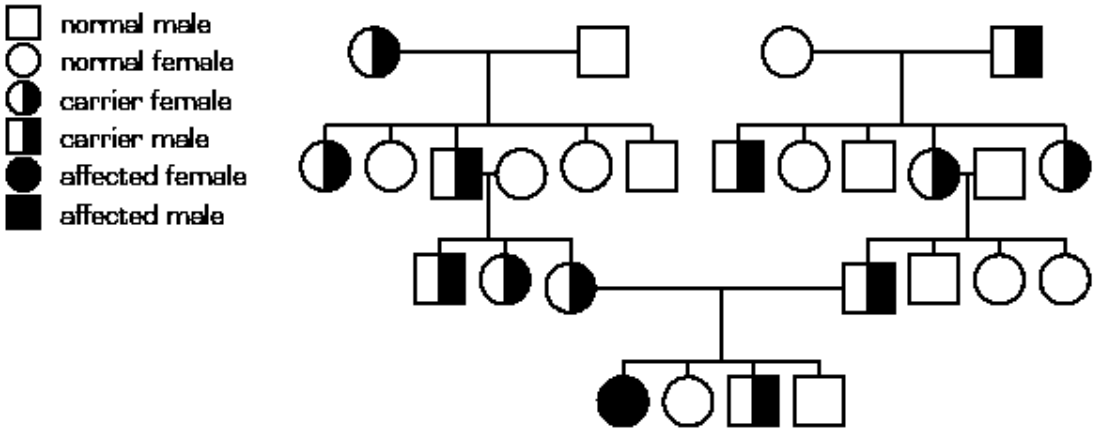
a. Explain what you understand by the statement "caused by a recessive allele".

_____

1 mark

The following pedigree or family tree shows those individuals that have the disease, those that do not and those that are called carriers.

b. Mark on this diagram the genotypes of all individuals using suitable symbols.



3 marks

c. Explain how the female in the last generation can be affected and yet her parents were not.

_____

_____

_____

_____

2 marks

Predictive genetic testing is done when a person is at risk of inheriting an abnormality (e.g. Huntington's Disease) because of a family history, but who has not yet developed the symptoms of the disease. The predictive test is taken only when there has been genetic counselling in collaboration with a medical specialist.

d. Identify two circumstances when a person may decide to undergo genetic testing

_____

_____

_____

_____

2 marks

e. Why is the collaboration with a medical specialist necessary?

_____

_____

1 mark

As our ability to use technology in genetics develops at an astounding rate we, as a society, need to ask ourselves should we be doing some things at all. The question of "just because we can do something, should we do it" is an ethical dilemma. The study of this dilemma is called bioethics. It is likely that in the future we will know more and more about our genetic status - our individual genome.

f. What is meant by the term 'genome'?

_____

_____

_____

_____

2 marks

g. Who do you think should have access to this information: the individual; doctors; government agencies; friends on Facebook or everyone?

_____

_____

_____

_____

1 mark

Total 12 marks

Question 2

a. Describe a 'dihybrid genetic cross.'

_____

_____

_____

_____

2 marks

b. Using the genes in pea plant for colour (purple is dominant to white) and height (tall is dominant to dwarf), state the genotypes involved in a dihybrid heterozygous cross.

_____

_____

1 mark

c. Construct a punnet square to clearly show the results of the cross identified in part b.

4 marks

d. Describe the phenotypes that will arise from the cross in part c. and in what ratio.

_____

_____

_____

_____

2 marks

e. What would a basic cross like this indicate about the loci of the genes for height and colour?

_____

1 mark

f. If a test cross was conducted on one of the parent plants from this cross, what would the ratio of the phenotypes be then?

_____

_____

_____

_____

1 mark

g. In another cross, a smooth/yellow plant was crossed with a wrinkled/green plant to produce heterozygotes for both pea shape (smooth dominant to wrinkled) and pea colour (yellow dominant to green). These heterozygotes were then crossed, and it was noticed that the offspring were found to be mostly like the original parents but also some unlike the parental plants (recombinants), what would this indicate about the two genes?

_____

_____

1 mark

h. Explain how this could occur, using the specific notation for this type of situation.

_____

_____

_____

_____

_____

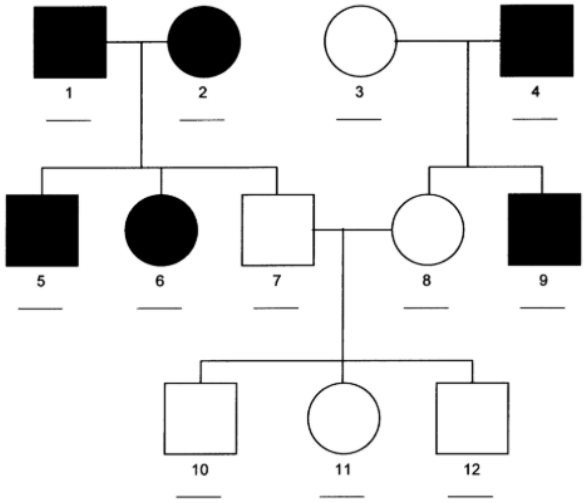
_____

2 marks

Total 14 marks

Question 3

Examine the following pedigree



a. Suggest and justify the mode of inheritance. It may help to write the genotypes next to certain individuals.

_____

_____

_____

_____

2 marks

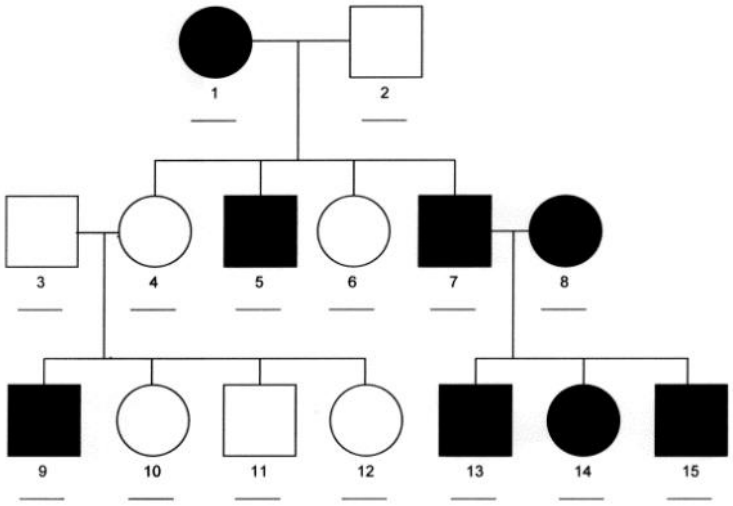
Red-green colour blindness means that a person cannot distinguish shades of red and green (usually blue-green) and their ability to see is normal. There are no serious complications, however, affected individuals may not be considered for certain occupations involving transportation or the Armed Forces where colour recognition is required. Males are affected more often than females, because the gene is located on the X chromosome.

b. What is the name given to this mode of inheritance?

_____

2 marks

The pedigree below represents colour blindness (a recessive trait) in a family. Individuals who are shaded in are colour-blind.



c. Explain how a female can be affected even though it is more prevalent in males.

_____

_____

_____

_____

_____

_____

2 marks

d. Using correct notation, add the genotypes for each of the individuals on the pedigree chart.

3 marks

Total 9 marks

END OF KEY TOPIC TEST