**ATAR HUMAN BIOLOGY**

**Unit 2**

**Task 12 : Genetics & Inheritance Test**

**Name:**  **Weighting 5%**

**Date:**  **Mark /**

1. There are TWO sections in this test, Multiple Choice and Short Answer
2. This is a closed book assessment (no notes are allowed).
3. The time allowed to complete the test is 60 minutes.
4. Write your answers to the Multiple Choice section on the **separate** answer sheet provided.
5. Write your answers to the Short Answer section in space provided.
6. Write your answers to the Extended Answer section in space provided.

|  |  |  |
| --- | --- | --- |
|  | **Marks Allocation** | **Your Total** |
| **Multiple Choice** | 12 |  |
| **Short Answer** | 40 |  |
| **TOTAL** | 52 |  |

**ATAR HUMAN BIOLOGY UNIT 2**

**TASK 12 : REPRODUCTION & INHERITANCE**

**Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Multiple Choice Answer Sheet**

Answer all questions by circling the letter corresponding

to the most correct answer.

1. A B C D

2. A B C D

3. A B C D

4. A B C D

5. A B C D

6. A B C D

7. A B C D

8. A B C D

9. A B C D

10. A B C D

11. A B C D

12. A B C D

**Part A - Multiple Choice Questions (12 Marks)**

1. The genotype of an individual:
   1. is always the same as the phenotype.
   2. refers to the visible trait of that individual.
   3. is indicated by the presence of either an X or Y chromosome.
   4. refers to the composition of the genes.
2. Which of the following does not result in increased variation?
3. Crossing-over during meiosis.
4. Replication of chromosomes in the nucleus.
5. Random union of two gametes.
6. Random assortment of chromosomes during meiosis.
7. A family has five sons. The theoretical probability that the sixth child will be a daughter is:
8. one chance in two.
9. one chance in five.
10. one chance in six.
11. five chances in six.

Questions 4 and 5 refer to the following pedigree showing the inheritance of haemophilia.



1. What is the chance of female 5 being a carrier?
2. 0
3. 25%
4. 50%
5. 100%
6. If female 5 is a carrier and she marries a normal male, what are her chances of producing a haemophiliac child?
7. 0%
8. 25%
9. 50%
10. 100%
11. In which of the following situations would sex selection not be ethically recommended?
12. There is a history of Duchenne muscular dystrophy in a family.
13. The mother is a known carrier of haemophilia.
14. The family already has five children of the same sex.
15. The father is a haemophiliac.
16. The ability to roll the tongue is an autosomal dominant trait. A woman who cannot roll her tongue and a man who is heterozygous for tongue rolling have a child together. What is the chance that they will have a child who cannot roll their tongue?
17. 25%
18. 50%
19. 75%
20. 0%
21. A mutation is best described as:
22. a new characteristic appearing in an organism.
23. a permanent change in genetic material causing death.
24. a change in the mitotic process.
25. treatment by radiation.
26. An individual who is heterozygous for a genetic trait will:
27. be a carrier for the recessive trait.
28. not physically show the dominant trait.
29. not pass the recessive allele to their offspring.
30. only have offspring who are also heterozygous.
31. Red-green colour blindness is an X-linked recessive disorder. A mother with this condition will pass this allele to:
32. her daughters only.
33. her sons only.
34. none of her children.
35. all of her children.
36. If two individuals belong to Group AB and Group O respectively, then their offspring would belong to blood group:
37. O
38. AB
39. A or B
40. AB, A, or B

12. In some chickens, feather colour is controlled by codominance. When a black chicken mates with a white chicken, all of the offspring are covered in both black and white feathers.

A farmer mates a black chicken (BB) with a black and white (BW) chicken.

What are the predicted phenotypes of their offspring?

1. 75% of the offspring will be black and 25% of the offspring will be white.
2. 50% of the offspring will be black and 50% of the offspring will be black and white.
3. All of the offspring will be black and white.
4. All of the offspring will have black feathers.

**Short Answer Section (48 marks)**

**Question One (5 marks)**

The type of hair a person inherits is controlled by a pair of alleles. When two people with wavy hair are crossed the following phenotypic ratios are present in their offspring: 25% curly hair, 25% straight hair and 50% wavy hair.

1. What could the genotypes of the wavy haired parents be? Eg WS (1m) (1 mark)

b) Justify what type of inheritance is exhibited in the appearance of the hair (2 marks)

incomplete /codominance (1 mark)

three different phenotypes / wavy hair parents produces two other phenotypes (1 mark)

c) Draw a punnet square to show the possible offspring of a wavy haired person crossed with a curly haired person. (2 marks)

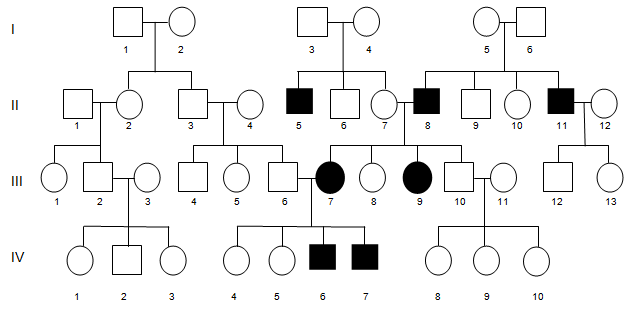
Wavy hair WS W S

Curly hair WW (1 mark for key) W WW WS

Straight hair SS W WW WS (1 mark for punnet)

**Question Two (5 marks)**

Below is a pedigree chart showing a family history of Ocular Albinism.



1. Using the pedigree chart, determine the mode of inheritance and explain how you were able to determine this. (3 marks)

Sex-linked recessive

II 5, II 8 and II 11 have the condition but parents don’t – therefore parents carrying, gene recessive

More boys than girls have it, girls that have it father does and mother could be carrier

1. Determine the probability that person III: 12 will inherit Ocular Albinism. Show all working in your answer. (2 marks)

Dad has it, mum unknown – if mum a carrier = boy 50% chance, if mum not a carrier – 0% chance boy will get it (1 mark), (1 mark) for punnet square

**Question Three (7 marks)**

Pedigree charts are extremely useful for individual family members to identify if they might be a carrier of diseases and conditions that they do not want to pass on to offspring. If individuals are concerned and there is a risk then they can use DNA profiling to help identify is they are in fact a carrier.

a) Explain what is meant by DNA profiling. (2 marks)

creating a fingerprint/barcode pattern of a person’s DNA

identify base sequences looking for/identify pattern of DNA for comparison

b) Apart from testing for genetic disease where else could DNA profiling be used? (1 mark)

Paternity tests/forensic analysis

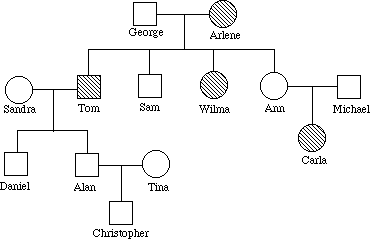
c) Outline the method that is used to profile a piece of DNA, include all steps and how they help to form the DNA profile. Diagrams can be used. (4 marks)

* + collect a sample of DNA
  + insert in the negative end of gel phoresis tray/gel of phoresis tray
  + turn on power – as DNA negative will move towards positive end
  + smaller pieces move further/smaller pieces move quicker
  + creates a bar code pattern in the gel

Any four statements

**Question Four (8 marks)**

The pedigree below traces the inheritance of neurofibromatosis. Neurofibromatosis (NF) refers to a number of inherited conditions that are clinically and genetically distinct and carry a high risk of tumour formation, particularly in the brain. Affected individuals, indicated here by the filled-in circles and squares, show symptoms of this condition.



1. Given the information in the pedigree, name the type of inheritance neurofibromatosis displays and provide a reason for your answer. (2 marks)

Recessive autosomal (1 mark)

Carla has the condition but her parents don’t , therefore parents carrying allele = recessive (1 mark)

1. Could it have been possible for Sandra and Tom to have a child that developed neurofibromatosis? Draw a punnet square and use it to explain your reasoning. (3 marks)

|  |  |  |
| --- | --- | --- |
|  | b | b |
| B | Bb | Bb |
| B | Bb | Bb |

|  |  |  |
| --- | --- | --- |
|  | b | b |
| B | Bb | Bb |
| b | bb | bb |

**1 mark – it depends whether Sandra is a carrier**

**1 mark – if Sandra homozygous dominant, 0% chance of children having neurofibromatosis**

**1 mark – if Sandra is heterozygous, 50% of children having neurofibromatosis**

**-1 mark max if no Punnett squares**

c) The karyotype shown above was taken from an individual with Turner Syndrome. Turner’s syndrome is caused by a “monosomy X mutation”, explain what kind of mutation this is. (1 mark)

where individual inherits only one X-chromosome

chromosomal mutation on the sex chromosome – non-disjunction

(1 mark) appropriate answer

d) Explain why women with Turners syndrome have red-green colour blindness more frequently than women who do not have the mutation. (2 marks)

red green colour blindness is a X-linked recessive disease (1 mark)

if only one X chromosome only need to inherit from one parent, if have two X-chromosomes will need to inherit from two parents which occur less frequently (1 mark)

**Question Five (9 marks)**

Tay-Sachs is an autosomal recessive disorder. A couple with a history of Tay-Sachs in their families undergoes genetic screening before trying to conceive a baby.

1. It is found that Ellyn is a carrier for Tay-Sachs and her partner Noel is homozygous normal. Using a punnet square, predict the probability of their future children having the disease. Show full working out including genotypes and phenotypes ratios. (4 marks)

|  |  |  |
| --- | --- | --- |
|  | B | B |
| B | BB | BB |
| b | Bb | Bb |

Tay Saches : Normal probability 0%

0 : 4 **(1 mark)**

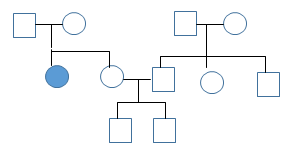
BB:Bb

2 : 2

**(2 marks)**

**(1 mark)**

1. The genetic counsellor drew a pedigree to show the couple how Tay-Sachs has been inherited in their families. In the space provided, draw the pedigree diagram the counsellor would have drawn. Include three labelled generations in the pedigree. (4 marks)

* Ellyn’s parents and Noel’s parents.
* The couple and their siblings. Ellyn is the younger of two girls; her sister was affected with Tay-Sachs. Noel is the oldest child, with a younger sister and an even younger brother who are all normal.

I

* The couple have two sons.

II

Indicate the individuals who have Tay-Sachs by shading the relevant circles or squares.

III

1 mark for key, 1 mark for generations, 2 marks for correct layout (each mistake remove 1 mark)

1. What would the genotypes be for Ellyn’s parents? (1 mark)

Father: heterozygous any letter Mother: heterozygous any letter

**Question Six (6 marks)**

The ABO blood group system can be used as an example for two different types of genetic inheritance.

1. Describe these two types of inheritance using the ABO blood group system as an example for both (4 marks)

1 mark – complete dominance/dominant recessive

1 mark - A and B antigens dominant over O (no antigens), O recessive

1 mark – co-dominance

1 mark – A and B antigens both displayed on the surface of RBC’s/neither A or B dominate both expressed

1. Complete the punnet square below to explain how it is possible for two parents, one with blood type A and one with blood type B, to produce four children with four different blood types. (2 marks)

|  |  |  |  |
| --- | --- | --- | --- |
| *Punnet Square*  *Blood Types* | | Female | |
| **IA** | **i** |
| Male | **IB** | **IAIB** | **IBi** |
| **i** | **IAi** | **ii** |

1 mark – punnet square

1 mark - if both parents are heterozygous for their blood type, then there are 4 possible genotypes due to the variety of dominance/inheritance displayed in blood type inheritance

**END OF TEST**