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(University of Choice)

MASINDE MULIRO UNIVERSITY OF SCIENCE AND TECHNOLOGY (MMUST)

MAIN CAMPUS

UNIVERSITY EXAMINATIONS 2021/2022 ACADEMIC YEAR

THIRD YEAR SECOND SEMESTER EXAMINATIONS

FOR THE DEGREE OF BACHELOR OF SCIENCE MEDICAL BIOTECHNOLOGY MAIN EXAM

COURSE CODE: BMB 321

COURSE TITLE: MEDICAL GENETICS

DATE: 20/04/2022 **TIME:** 12.00 -2.00 PM

INSTRUCTIONS TO CANDIDATES

This paper is divided into three sections, **A B** and **C,** carrying respectively: Multiple Choice Questions (**MCQs**), Short Answer Questions (**SAQs**) and Long Answer Questions (**LAQs**).

TIME: 2 Hours

MMUST observes ZERO tolerance to examination cheating

This Paper Consists of 5 Printed Pages. Please Turn Over.

SECTION A: MULTIPLE CHOICE QUESTIONS (20 MARKS)

1. Which of the following is an X-linked recessive disease?
A. Acute intermittent porphyria
B. Duchenne muscular dystrophy
C. Huntington disease
D. Marfan syndrome

2. Which of the following terms describes the occurrence of multiple organ systems being involved by a single disease-causing mutation?
A. Incomplete penetrance
B. Locus heterogeneity
C. Pleiotropy
D. Variable expression

3. A 25-year-old woman has mild expression of hemophilia A. A genetic diagnosis reveals that she is a heterozygous carrier of a mutation in the X-linked factor VIII gene. What is the most likely explanation for mild expression of the disease in this individual?
A. A high proportion of the X chromosomes carrying the mutation are active in this woman
B. Her father is affected, and her mother is a heterozygous carrier
C. Nonsense mutation causing truncated protein
D. One of her X chromosomes carries the SRY gene

4. In assessing a patient with osteogenesis imperfecta, a history of bone fractures, as well as blue sclerae, are noted. These findings are an example of
A. Allelic heterogeneity
B. Locus heterogeneity
C. Multiple mutations
D. Pleiotropy

5. Inversions that include the centromere are referred to as
A. Acrocentric
B. Pericentric
C. Paracentric
D. Metacentric

6. A 26-year-old woman has produced two children with Down syndrome, and she has also had two miscarriages. Which of the following would be the best explanation?
A. Her first cousin has Down syndrome.
B. Her husband is 62 years old.
C. She carries a reciprocal translocation involving chromosomes 14 and 18.
D. She carries a Robertsonian translocation involving chromosomes 14 and 21.

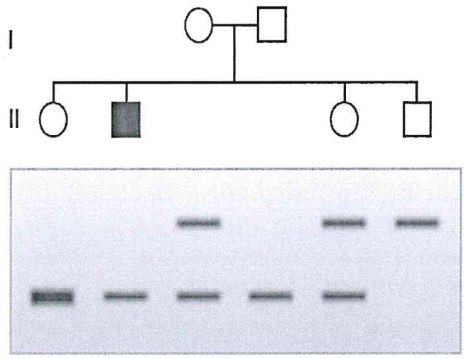
7. A 6-year-old boy has a family history of mental retardation and has developmental delay and some unusual facial features. He is being evaluated for possible fragile X syndrome. Which of the following would be most useful in helping establish the diagnosis?
A Genetic test for a trinucleotide repeat expansion in the fragile X gene
B IQ test
C Karyotype of the child's chromosomes
D Karyotype of the father's chromosomes

8. 38-year-old woman in her 15th week of pregnancy undergoes ultrasonography that reveals an increased area of nuchal transparency. Amniocentesis is recommended and performed at 16 weeks' gestation. The amniotic karyotype is 46, XYadd (18) (p.11.2), indicating additional chromosomal material on the short arm of one chromosome 18 at band 11.2. All other chromosomes are normal. What is the most likely cause of this foetal karyotype?

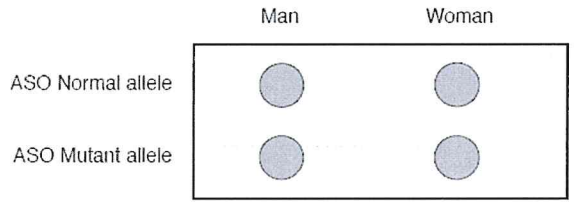
A A balanced reciprocal translocation in one of the parents
B A balanced Robertsonian translocation in one of the parents
C An isochromosome 18i (p) in one of the parents
D Nondisjunction during meiosis 1 in one of the parents

9. A man who has alkaptonuria marries a woman who has hereditary sucrose intolerance. Both are autosomal recessive diseases and both map to 3q with a distance of 10 cM separating the two loci. What is the chance they will have a child with alkaptonuria and sucrose intolerance?
A 0%
B 25%
C 50%
D 100%

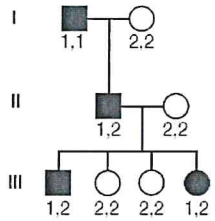
10. The pedigree below shows a family in which haemophilia A, an X-linked disorder, is segregating. PCR products for each member of the family are also shown for a short tandem repeat polymorphism located within an intron of the factor VIII gene. What is the best explanation for the phenotype of individual II-1?



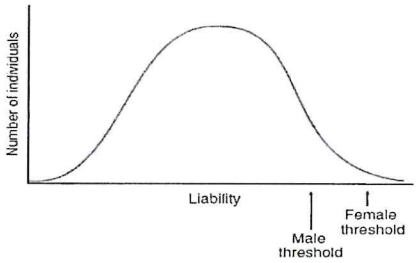
11. Two phenotypically normal second cousins marry and would like to have a child. They are aware that one ancestor (great-grandfather) had PKU and are concerned about having an affected offspring. They request ASO testing and get the following results. What is the probability that their child will be affected?



12. A family with an autosomal dominant disorder is typed for a 2-allele marker, which is closely linked to the disease locus. Based on the individuals in Generation III, what is the recombination rate between the disease locus and the marker locus?



13. Pyloric stenosis is five times more common in males than in females in certain Japanese populations. The liability curve for the development of this condition in that population is shown below: Within this population, which of the following is most at risk for the development of disease?



14. In studying a large number of families with a small deletion in a specific chromosome region, it is noted that the disease phenotype is distinctly different when the deletion is inherited from the mother as opposed to the father. What is the most likely explanation?
A. Imprinting
B. Mitochondrial inheritance
C. Sex-dependent penetrance
D. X-linked dominant inheritance

15. Waardenburg syndrome is an autosomal dominant disorder in which patients may exhibit a variety of clinical features, including patches of prematurely grey hair, white eyelashes, a broad nasal root, and moderate to severe hearing impairment. Occasionally, affected individuals display two eyes of different colours and a cleft lip and/or palate. Patients who possess a mutation in the *PAX3* gene on chromosome 2 can present with all of these disparate signs and symptoms. Which of the following characteristics of genetic traits is illustrated by this example?

A. Anticipation
B. Pleiotropy
C. Incomplete penetrance
D. Locus heterogeneity

16. Endonuclease activation and chromatin fragmentation are characteristic features of eukaryotic cell death by apoptosis. Which of the following chromosome structures would most likely be degraded first in an apoptotic cell?
A. Barr body
B. 10-nm fiber
C. 30-nm fiber
D. Centromere

17. The cells that have no nucleus are known as:
A. Eukaryotic cells
B. Proliferative cells
C. Prokaryotic cells
D. Animalcules

18 A large, three-generation family in whom multiple members are affected with a rare, undiagnosed disease is being studied. Affected males never produce affected children but affected females do produce affected children of both sexes when they mate with unaffected males. What is the most likely mode of inheritance?
A. Autosomal dominant, with expression limited to females
B. Y-linked

C. Mitochondrial
D. X-linked dominant

19. A woman brings her 16-year-old daughter to a physician because she has not yet begun menstruating. Although her parents are both 1.75 meters, the patient is 1.5 meters and has always been below the 50th percentile in height. Physical examination reveals no breast development. She has no problems in school and is of normal intelligence. What is the most likely underlying basis for her condition?
A. A 45, X karyotype
B. A balanced reciprocal translocation
C. A balanced Robertsonian translocation
D. Two Barr bodies

20. A couple has one son, who is age 7. Multiple attempts to have a second child have ended in miscarriages and spontaneous abortions. Karyotypes of the mother, the father, and the most recently aborted fetus are represented schematically below. What is the most likely explanation for the most recent pregnancy loss?

A. Aneuploidy in the fetus
B. Fetus identified as a reciprocal translocation carr
C. Nondisjunction during oogenesis in the mother
D. Partial monosomy and trisomy in the fetus

SECTION B: SHORT ANSWER QUESTIONS (40 MARKS)

1. Elucidate common symbols used in genetic pedigrees [8 Marks]
2. a) List any four diseases that result from a delayed age onset. [4 Marks]
   b) Briefly describe imprinting in Prader-Willi syndrome. [4 Marks]
3. a) Describe chromosomal nomenclature. [4 marks]
   b) Briefly describe X-inactivation. [4 Marks]
4. Discuss briefly advances in molecular cytogenetics. [8 Marks]
5. Describe how recurrent risks for multifactorial diseases is assessed. [8 Marks]

SECTION C: LONG ANSWER QUESTIONS (40 MARKS)

1. Citing relevant examples, give a detailed account of numerical chromosomal abnormalities. [20 Marks]
2. Discuss polymorphic markers and linkage analysis. [20 Marks]
3. Compare and contract reciprocal and Robertsonian translocations. [20 Marks]