UNIVERSITI KUALA LUMPUR
INSTITUTE OF MEDICAL SCIENCE TECHNOLOGY

# FINAL EXAMINATION

# MARCH 2025 SEMESTER

| | | |
|---|---|---|
| COURSE CODE | : | HDB10203 |
| COURSE TITLE | : | HUMAN GENETICS |
| PROGRAMME NAME | : | BACHELOR OF BIOMEDICAL SCIENCE (HONOURS) |
| DATE | : | 23 JUNE 2025 |
| TIME | : | 2:00PM - 5:00PM |
| DURATION | : | 3 HOURS |



## INSTRUCTIONS TO CANDIDATES

1. Please read the instructions given in the question paper CAREFULLY.
2. This question paper is printed on both sides of the paper.
3. This question paper consist of TWO sections.
4. Answer ALL questions for Section A.
5. Section B consist of four questions. Answer THREE (3) questions only.
6. Please write your answer on the answer booklet provided.
7. Please answer all questions in English only.
8. Please answer MCQ/EMQ questions using OMR sheet. ☐ *Tick if applicable*
9. Refer to the attached Formula/ Appendies. ☐ *Tick if applicable*

SECTION A (Total: 40 marks)

Answer ALL questions.

Please use the answer booklet provided.

1. A pair of replicated chromosomes differ from each other by _____.

   A. the precise sequence of the DNA within each of the chromosomes

   B. their staining patterns

   C. the position of the centromere within each of the chromosomes

   D. the identity and relative position of the genes present on each of the chromosomes

2. Which of the followings are potential genetic mechanism for converting a proto-oncogene into an oncogene?
   I. chromosomal translocation
   II. deletion of the proto-oncogene
   III. gene amplification of the proto-oncogene
   IV. point mutation of the proto-oncogene to hyperactive the proto-oncogene product

   A. I, III and IV only

   B. I, II and IV only

   C. I, II and III only

   D. II, III and IV only

3. Which of the following techniques are involved in the preparation of a karyotype?
I. Microarray
II. Fetoscopy
III. Amniocentesis
IV. Chorionic villus sampling

A. I and II only

B. I, II, III and IV

C. III and IV only

D. II and III only

4. A DNA strand with the sequence *AACGTAACG* is transcribed. What is the sequence of the mRNA molecule synthesized?

A. *AACGUAACG*

B. *TTGCATTGC*

C. *AACGTAACG*

D. *UUGCAUUGC*

5. The allele frequency of C is 0.4 and c is 0.6. If the population is in Hardy-Weinberg equilibrium, what is the frequency of heterozygotes?

A. 1.00

B. 0.48

C. 0.16

D. 0.24

6. The ability of a single gene to have multiple phenotypic effects is known as _____.

A. pleiotropy

B. multiple alleles

C. epistasis

D. incomplete dominance

7. A haplotype is a set of _____.

   A. SNPs on the same chromosome that tend to be inherited separately

   B. SNPs on the different chromosome that tend to be inherited together

   C. SNPs on the same chromosome that tend to be inherited together

   D. short tandem repeats on the same chromosome that tend to be inherited together

8. Which of the following is TRUE regarding tumor-inducing retroviruses?

   A. Cancer-causing genes encoded by the viral genome are called proto-oncogenes

   B. Viral genes that can cause cancer are different from other viral genes because they possess introns

   C. The enzyme reverse transcriptase is essential for transcribing the viral DNA into RNA

   D. Each type of viral gene that can cause cancer can potentially regulate the expression of cellular genes

9. Which of the following are TRUE regarding somatic cell gene therapy?
   I. The diseased gene will continue to be present in germline cells
   II. It will treat disease symptoms in an individual
   III. It is less complex than organ transplantation

   A. I and III only

   B. I, II and III

   C. I and II only

   D. II and III only

10. _____ removes the RNA nucleotides from the primer and adds equivalent DNA nucleotides to the 3' end of Okazaki fragments.

    A. Helicase

    B. Nuclease

    C. Ligase

    D. DNA polymerase I

11. Which of the following show the characteristic of a phenotypic ratio 9:3:3:1?

    A. Trihybrid crossing

    B. Linked genes

    C. Dihybrid crossing

    D. Monohybrid crossing

12. The ABO blood group system is an example of _____.

    A. pleiotropy

    B. multiple alleles

    C. epistasis

    D. incomplete dominance

13. A mutation that changes a codon into a stop codon is a _____ mutation.

    A. nonsense

    B. frameshift

    C. neutral

    D. missense

14. Huntington's disease is caused by a dominant allele. If one of the parents has the disease, what is the probability of the offspring having the disease?

A. 1/4

B. 1/2

C. 1/1

D. 3/4

15. Cytosine makes up 38% of the nucleotides in an organism's DNA sample. Approximately,what is the percentage of the nucleotides in this sample will be adenine?

A. 24

B. 12

C. 38

D. It cannot be determined from the information provided

16. RNA polymerase moves along the template strand of DNA in the _____ direction, and adds nucleotides to the _____ end of growing transcript.

A. 3' to 5'; 5'

B. 5' to 3'; 5'

C. 3' to 5'; 3'

D. 5' to 3'; 3'

17. Sickle-cell disease is a genetic disorder caused by _____ mutation.

A. frameshift

B. point

C. nonsense

D. nondisjunction

18. A man who carries an X-linked allele will pass it on to _____.

A. all of his sons

B. half of his sons

C. all of his daughters

D. half of his daughters

19. Which of the following is the CORRECT order of DNA replication within a eukaryotic cell?

I. Complementary nucleotides bind to each of the two strands
II. Sugar phosphate bonds from between the nucleotides
III. The newly formed DNA molecules are semi-conserved
IV. Unwinding of the DNA molecule forms two single strands

A. IV, II, I, III

B. IV, I, II, III

C. I, II, III, IV

D. I, IV, III, II

20. A chromosome that is metacentric has its centromere _____.

A. at two distinct locations

B. at the very upper tip

C. near in the middle

D. near one end, but not at the very tip

21. Normal (nonmutant) tumor-suppressor gene often function _____.
I. in promoting of cell division
II. as negative regulators of cell division
III. in the maintenance of genome integrity

A. I, II and III

B. I and II only

C. I only

D. II and III only

22. In natural populations, most genes are _____.

A. dominant

B. recessive

C. polymorphic

D. monomorphic

23. Which of the following are part of the eukaryotic transcription initiation complex?
I. snRNP
II. Promoter
III. TATA box
IV. RNA polymerase

A. I, II and III only

B. I, II and IV only

C. I, III and IV only

D. II, III and IV only

24. Which statement is TRUE regarding the proto-oncogenes?

A. Proto-oncogenes are unavoidable environmental carcinogens

B. Cells produce proto-oncogenes as a by-product of mitosis

C. Proto-oncogenes are necessary for normal control cell division

D. Proto-oncogenes protect cells from infection by cancer-causing viruses

25. The F1 offspring of Mendel's classic pea cross always looked like one of the two parental varieties because _____.

A. each allele affected the phenotypic expression

B. the traits blended during fertilization

C. one allele was completely dominant over another

D. different genes interacted to produce the parental phenotype

26. Familial cancer is caused by _____.

A. a mutation in somatic cells only

B. two germline mutations

C. a mutation in germline cells only

D. a germline mutation plus a somatic mutation in the affected tissue

27. Which of the following is analogous to a frameshift modification of the sentence *THECATATETHERAT*?

A. *THECATATTHERAT*

B. *THERATATETHECAT*

C. *THECATARETHERAT*

D. *THETACATETHERAT*

28. Normal (nonmutant) tumor-suppressor gene often function _____.
I. in promoting of cell division
II. as negative regulators of cell division
III. in the maintenance of genome integrity

A. I and II only

B. I, II and III

C. I only

D. II and III only

29. Which of the following investigator(s) discovered that DNA from any species shows the amount of adenine equals the amount of thymine, and the amount of guanine equals the amount of cytosine?

A. Frederick Griffith

B. Erwin Chargaff

C. Alfred Hershey and Martha Chase

D. Oswald Avery, Maclyn McCarty and Colin MacLeod

30. Which of the following members of the group has nitrogenous base adenine?

A. Alpha glucose, ATP and DNA

B. ATP, RNA and DNA

C. Proteins, ATP and DNA

D. Proteins, triglycerides and testosterone

31. There is good evidence for linkage when _____.

A. genes do not segregate independently during meiosis

B. two characteristics are caused by a single gene

C. two genes occur together in the same gamete

D. two genes work together to control a specific characteristic

32. In a cross *AaBbCc* X *AaBbCc*, what is the probability of producing the genotype *AABBCC*?

A. 1/16

B. 1/64

C. 1/32

D. 1/4

33. The complementary base found at the forth nucleotide (marked *) in a sequence transcribed from the DNA template strand below would be _____.
*Refer Below - Figure1 : DNA template and its complimentary strand .*

T G G A T G G A C ⟵ DNA template strand
*

Figure 1: DNA template and its complimentary strand

A. C

B. G

C. T

D. U

34. A woman has six sons. The chance that her next child will be a daughter is _____.

A. 0

B. 1/2

C. 1

D. 1/6

35. Chromosomes and genes share all of the following characteristics EXCEPT?

A. They both undergo segregation during meiosis

B. They are both present in pairs in all diploid cells

C. They both pair up with their homologues during the prophase of mitosis

D. Their copy numbers in the cell decrease after meiosis, and increase during fertilization

36. If a change occurs in a base sequence of a DNA, it might cause a different _____ to be substituted in a protein.

A. amino acid

B. ribosome

C. enzyme

D. nucleic acid

37. A mitotic Cdk-cyclin complex _____.

A. activates the nuclear envelope

B. inhibits chromosome condensation

C. triggers entry into mitosis

D. prevents the destruction of proteins

38. All of the following are found in prokaryotic mRNA EXCEPT?

A. Uracil

B. Introns

C. Cytosine

D. The AUG codon

39. Mosaicism is when a single genotype contributes to the phenotype of an organism. This will determine how many cells are involved, where they are located, and which genes are affected. Which of the following types of mosaicism occurs in every male?

A. Somatic mosaicism

B. X-linked mosaicism

C. Gonadal mosaicism

D. Y-linked mosaicism

40. Which of the following is analogous to telomeres?

A. The two ends of a shoelace

B. The pull tab on a soft drink

C. The central spindle that a CD fits around while in the case

D. The mechanism of a zipper that allows the separated parts to be joined

SECTION B (Total: 60 marks)

**Answer THREE (3) questions only.**

**Please use the answer booklet provided.**

**Question 1**

Gregor Mendel is the father of genetics with the discovery of heritable factor that is passed from one generation to the next generation.

(a) Explain how genes, nucleic acids and nucleotides are related.

(10 marks)

(b) Describe the effect of the following on inheritance pattern.

i. Maternal and epigenetics.

(3 marks)

ii. Mitochondria.

(3 marks)

iii. Genomic imprinting.

(3 marks)

(c) State ONE (1) example of a disease with recessive trait.

(1 mark )

Question 2

A human disease known as cystic fibrosis is inherited as a recessive trait. An unaffected couple have a first daughter with the disease.
Using the information provided, answer the following questions:-

(a) Draw a pedigree including their genotypes to predict that the next two sons of the unaffected couple will not inherit the disease.

(5 marks)

(b) Explain how the unaffected couple able to produce an affected daughter.

(5 marks)

(c) Calculate the probability of the two sons in (a) will not have the disease.

(6 marks)

(d) Figure below shows a pedigree of an X disease in humans. Answer the following questions.
***Refer Below - Figure2 : Pedigree of X disease. .***

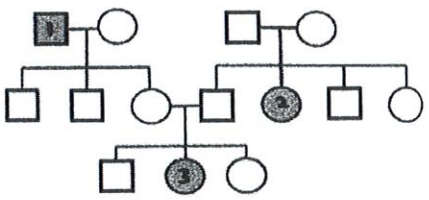

Figure 2: Pedigree of X disease.

i. Determine the pattern trait of the inherited X disease.

(1 mark )

ii. Determine the genotype for individual 1,2 and 3.

(3 marks)

Question 3

Deoxyribonucleic acid (DNA) is a polymer composed of two polynucleotide chains that coil around each other to form a double helix.

(a) Explain why the DNA strand is called complementary and antiparallel.

(10 marks)

(b) Below is the sequence of a template strand.
$^{5'}$ATGCGTGACTAATTCG$^{3'}$

i. Write the sequence of the DNA in double-stranded form.

(2 marks)

ii. Using the given DNA sequence, describe the process of transcription and translation that leads to protein synthesis.

(8 marks)

Question 4

On rare occasions, a chromosome can suffer a small deletion that removes the centromere.

(a) Explain why a chromosome without a centromere is not transmitted very efficiently from mother to daughter cells.

(10 marks)

(b) Explain in general why changes in chromosome structure and/or number tend to affect an individual's phenotypes?

(5 marks)

(c) Some changes in chromosome structure, such as reciprocal translocation, does not change the individual's phenotype. Explain this scenario.

(5 marks)