UNIVERSITI KUALA LUMPUR
INSTITUTE OF MEDICAL SCIENCE TECHNOLOGY

FINAL EXAMINATION

MARCH 2025 SEMESTER

COURSE CODE	:	HGB20203
COURSE TITLE	:	BASIC HUMAN GENETICS
PROGRAMME NAME	:	BACHELOR OF ENVIRONMENTAL HEALTH (HONS)
DATE	:	02 JULY 2025
TIME	:	9:00AM - 12:00PM
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*

THERE ARE 17 PAGES OF QUESTIONS INCLUDING THIS PAGE

SECTION A (Total: 40 marks)

Answer ALL questions.

Please use the answer booklet provided.

1. 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. Erwin Chargaff

   B. Alfred Hershey and Martha Chase

   C. Oswald Avery, Maclyn McCarty and Colin MacLeod

   D. Frederick Griffith

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

   A. Helicase

   B. Nuclease

   C. DNA polymerase I

   D. Ligase

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

   A. ATP, RNA and DNA

   B. Proteins, ATP and DNA

   C. Alpha glucose, ATP and DNA

   D. Proteins, triglycerides and testosterone

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

   A. Introns

   B. Uracil

   C. The AUG codon

   D. Cytosine

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

   A. Dihybrid crossing

   B. Linked genes

   C. Trihybrid crossing

   D. Monohybrid crossing

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

   A. *THECATATTHERAT*

   B. *THERATATETHECAT*

   C. *THETACATETHERAT*

   D. *THECATARETHERAT*

7. A haplotype is a set of _____.

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

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

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

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

8. Chromosomes and genes share all of the following characteristics EXCEPT _____.

   A. their copy numbers in the cell decrease after meiosis, and increase during fertilization

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

   C. they both undergo segregation during meiosis

   D. they both pair up with their homologues during the prophase of mitosis

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

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

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

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

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

10. The normal alleles of genes such as *c-ras* and *c-myc* produce proteins that regulate the cell cycle. When these genes are overexpressed, or when they produce proteins that function as dominant activators, the cell is _____.

    A. pre-disposed to become cancerous

    B. immune from becoming cancerous

    C. cancerous

    D. cancerous and pre-disposed to become cancerous

11. 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'; 3'

B. 5' to 3'; 5'

C. 5' to 3'; 3'

D. 3' to 5'; 5

12. 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 IV only

B. I, II and III only

C. II, III and IV only

D. I, III and IV only

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

A. frameshift

B. nondisjunction

C. point

D. nonsense

14. There is good evidence for linkage when _____.

A. two genes occur together in the same gamete

B. genes do not segregate independently during meiosis

C. two characteristics are caused by a single gene

D. two genes work together to control a specific characteristic

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

A. neutral

B. nonsense

C. missense

D. frameshift

16. A metacentric chromosome has its centromere _____.

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

B. near in the middle

C. at two distinct locations

D. at the very upper tip

17. Which of the following are the 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 activity

A. II, III and IV only

B. I, II and III only

C. I, III and IV only

D. I, II and IV only

18. Normal (non-mutant) tumor-suppressor gene often function _____.
I. in the stimulation of cell division
II. as negative regulators of cell division
III. in the maintenance of genome integrity
IV. as positive regulators of cell division

A. I and IV only

B. I and II only

C. I, II and III only

D. II and III only

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

A. III and IV only

B. II and III only

C. I and II only

D. I, II, III and IV

20. In natural populations, most genes are _____.

A. polymorphic

B. recessive

C. dominant

D. monomorphic

21. Which of the following statements is TRUE regarding the proto-oncogenes?

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

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

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

D. Proto-oncogenes are unavoidable environmental carcinogens

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

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

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

C. their staining patterns

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

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

A. half of his sons

B. all of his sons

C. all of his daughters

D. half of his daughters

24. 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

25. 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. I, II, III, IV

B. IV, I, II, III

C. IV, II, I, III

D. I, IV, III, II

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

A. *AACGTAACG*

B. *UUGCAUUGC*

C. *AACGUAACG*

D. *TTGCATTGC*

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

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

28. 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

29. 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. 38

B. 12

C. 10

D. 24

30. 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. 1/2

B. 1/1

C. 3/4

D. 1/4

31. 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. nucleic acid

D. enzyme

32. 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. 0.16

B. 1.00

C. 0.24

D. 0.48

33. 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 is the common type of mosaicism that occurs in every male?

A. Y-linked mosaicism

B. X-linked mosaicism

C. Somatic mosaicism

D. Gonadal mosaicism

34. 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
IV. It will inherited to the next generation of offspring through meiosis

A. I, II and IV only

B. I, II and III only

C. I and III only

D. II, III and IV only

35. A mitotic Cdk-cyclin complex _____.

A. triggers entry into mitosis

B. inhibits chromosome condensation

C. prevents the destruction of proteins

D. activates the nuclear envelope

36. The complementary base found at the fourth nucleotide (marked *) in a sequence transcribed from the DNA template strand 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. G

B. T

C. U

D. C

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

A. multiple alleles

B. pleiotropy

C. epistasis

D. incomplete dominance

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

A. multiple alleles

B. pleiotropy

C. incomplete dominance

D. epistasis

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

A. 1/2

B. 1

C. 0

D. 1/6

40. Familial cancer is caused by _____.

A. a mutation in somatic cells only

B. a mutation in germline cells only

C. two germline mutations

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

SECTION B (Total: 60 marks)

Answer THREE (3) questions only.

Please use the answer booklet provided.

Question 1

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

(a) Discuss 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, do not change the individual's phenotype. Apply your understanding of reciprocal translocation to justify the scenario.

(5 marks)

Question 2

Genetic material consists of chromosomes, which are made of DNA wrapping around complexes of histones. They are observed by staining cells that have been arrested at specific phases of mitosis.

(a) When studying living cells in a laboratory, researchers sometimes use drugs as a way to make cells remain at a particular state of the cell cycle. For example, amphidicolin inhibits DNA synthesis and causes them to remain in the G1 phase because they cannot replicate their DNA. Explain in which phase of the cell cycle – G1, S, G2, prophase, metaphase, anaphase, or telophase, would you expect somatic cells to stay if the following types of drugs were added.

i. A drug that inhibits microtubule formation.

(3 marks)

ii. A drug that inhibits cytokinesis.

(3 marks)

iii. A drug that prevents chromosomal condensation.

(3 marks)

iv. A drug that allows microtubules to form but prevents them from shortening.

(3 marks)

(b) You are responsible for studying an unknown organism and need to extract the genome. The first step involves identifying which part of the organism is the candidate to be the genetic materials. Discuss the four key characteristics of the genetic materials that you will use in your study of the unknown organism.

(8 marks)

Question 3

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 4

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 .

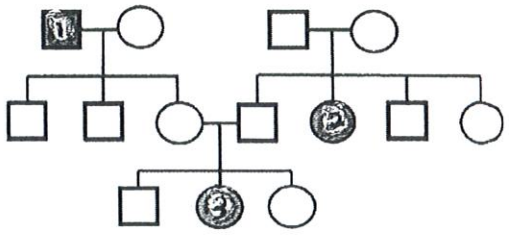

Figure 2: Pedigree of X disease

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

(1 mark)

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

(3 marks)

END OF EXAMINATION PAPER