

一、選擇題 (每題2分，共50分)

1. When DNA is heated, the hydrogen bonds break and allow the two strands of DNA to separate from one another. Which sequence of DNA would be most resistant to heating, and therefore, stay double stranded longer?
 - a. AATTGGCC
 - b. ATGCATTC
 - c. AGGAGCTC
 - d. TGGCTTAG
 - e. TACCAATT

2. The individual credited with first observing the cell nucleus is _____.
 - a. Anton van Leeuwenhoek
 - b. Robert Brown
 - c. Matthias Schleiden
 - d. Theodor Schwann
 - e. Rudolf Virchow

3. The tight packing of chromatin into the chromosomes visible during nuclear division is possible due to links between ____ proteins.
 - a. Cdk
 - b. H1 histone
 - c. H3 histone
 - d. H4 histone
 - e. nonhistone

4. If a cell contains 84 sister chromatids at metaphase of mitosis, how many chromosomes will be present in each nucleus in late telophase?
 - a. 168
 - b. 84
 - c. 42
 - d. 21
 - e. cannot be determined from the information given

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5. Colchicine, a chemical extracted from the autumn crocus (*Colchicum autumnale*), inhibits the formation of microtubules. Mitotic cells exposed to colchicine will therefore be arrested at ____.

- a. anaphase
- b. interphase
- c. prophase
- d. telophase
- e. metaphase

6. The microtubules making up the mitotic spindle attach to specialized structures called ____ that are found in the centromere region of the chromosome.

- a. nucleosomes
- b. centrosomes
- c. kinetochores
- d. chromatids
- e. centrioles

7. During prokaryotic cell division, two chromosomes separate and are distributed to the two ends of the cell by ____.

- a. the action of the mitotic spindle
- b. an unknown mechanism
- c. attachment to actin
- d. attachment to separating membrane regions
- e. formation of a newly made cell wall

8. Which statement describes a difference between meiosis I and meiosis II?

- a. DNA is replicated during meiosis II but not during meiosis I.
- b. Homologous chromosomes separate during meiosis I; sister chromatids separate during meiosis II.
- c. Meiosis I produces diploid cells; meiosis II produces haploid cells.
- d. Chromosomes align along the equatorial plane of the cell in meiosis I but not in meiosis II.
- e. Crossing-over occurs during meiosis II but not during meiosis I.

9. Homologous chromosomes undergo recombination during ____.
- a. prophase II
 - b. metaphase I
 - c. metaphase II
 - d. both prophase I and II
 - e. prophase I
10. Nondisjunction during meiosis I results in ____.
- a. the generation of an extra daughter cell
 - b. a change in the status of a daughter cell from diploid to haploid
 - c. a change in the status of a daughter cell from haploid to diploid
 - d. one pole of the cell receiving neither member of a homologous pair of chromosomes
 - e. a gamete that cannot fuse with another gamete
11. If a species has 42 pairs of chromosomes, how many maternal and paternal chromosome combinations are possible during independent assortment?
- a. 42^2
 - b. 2^{42}
 - c. 2^{21}
 - d. 21^2
 - e. 84^2
12. Assuming a single cross-over event, the completion of meiosis produces ____.
- a. three daughter cells with parental chromosomes and one daughter cell with a recombinant chromosome
 - b. four daughter cells with recombinant chromosomes
 - c. two daughter cells with parental chromosomes and two daughter cells with recombinant chromosomes
 - d. one daughter cell with parental chromosomes and one cell with recombinant chromosomes
 - e. two daughter cells, each with recombinant chromosomes

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13. Pairs of alleles are found at a particular ____ on a pair of ____.
- a. gene; gametes
 - b. base; homozygous genes
 - c. nucleotide; genes
 - d. locus; homologous chromosomes
 - e. sister chromatid; homologous chromosomes
14. A ____ individual is always part of a testcross.
- a. heterozygous
 - b. homozygous recessive
 - c. homozygous dominant
 - d. self-fertilized
 - e. dihybrid
15. A parent has a genotype of $RrYy$. What is the probability of this individual producing a gamete with the RY genotype?
- a. 1/2
 - b. 1/4
 - c. 3/4
 - d. 1/8
 - e. 0
16. Your father is heterozygous for a recessive disorder. You know your mother has two "good" alleles. What is the probability that you will have the disorder?
- a. 0%
 - b. 25%
 - c. 50%
 - d. 75%
 - e. 100%

17. Mouse pigmentation is subject to epistasis of the *B* alleles by the *d* alleles. *B* (black) is dominant over *b* (brown), and *D* is dominant over *d*. Homozygous *d* is epistatic to the black and brown genes. Given this information, what genotype(s) result in a white mouse (no pigment)?

- a. *BBdd* only
- b. *Bbdd* only
- c. *bbDD* only
- d. *bbDd* only
- e. *BBdd* and *Bbdd*

18. Adjacent nucleotides on a strand of DNA are connected to each other by a(n) _____.

- a. hydrophobic interaction
- b. phosphodiester bond
- c. hydrogen bond
- d. peptide bond
- e. ionic bond

19. Which nucleotide sequence is complementary to the DNA sequence 5'-GACGTT-3'?

- a. 5'-TCATGG-3'
- b. 3'-TCATGG-5'
- c. 3'-CTGCAA-5'
- d. 3'-AGTACC-5'
- e. 5'-TTGCAG-3'

20. DNA polymerase _____.

- a. synthesizes a short RNA segment to begin DNA replication
- b. adds nucleotides to the 5' end of an existing strand to synthesize a new DNA strand
- c. adds nucleotides to the 3' end of an existing strand to synthesize a new DNA strand
- d. seals nicks between adjacent segments of DNA
- e. unwinds the DNA double helix at the origin of replication

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21. DNA replication is said to be semiconservative because ____.
- the number of nucleotides within genes remains constant
 - half of the DNA in a cell comes from one parent and the other half from the other parent.
 - the same process of DNA replication is used by all organisms
 - the total amount of DNA within an individual remains the same
 - each new DNA molecule is composed of one old strand and one new strand
22. Reiji Okazaki discovered what are now called "Okazaki fragments" produced during DNA replication. These fragments are ____.
- short lengths of new DNA on the leading strand
 - RNA primers on the lagging strand
 - RNA primers on both the lagging and leading strand
 - short lengths of new DNA on the lagging strand
 - RNA primers on the leading strand
23. Individuals with xeroderma pigmentosum inherit a defective DNA repair mechanism. As a consequence, ____.
- they are sterile
 - their cells have no proofreading abilities during DNA replication
 - Okazaki fragments produced during DNA replication cannot be joined
 - they easily develop skin cancer when exposed to sunlight
 - their telomeres are shorter than average
24. The genetic code is said to be degenerate because ____.
- some codons that do not specify an amino acid
 - most amino acids are represented by more than one codon
 - the code varies considerably between different organisms
 - the code is commaless, with no indicators of spaces between codons
 - the code varies considerably between different cell types within a multicellular organism
25. The TATA box is a key element of the ____ of most eukaryotic protein-coding genes.
- terminator
 - coding region
 - promoter
 - transcription start point
 - introns

二、問答題 (每題10分，共50分)

1. Describe the roles of the following enzymes during DNA replication: ligase, single-stranded binding proteins (SSBs), DNA polymerase III, primase, DNA helicase.
2. Although Watson and Crick are credited with the discovery of the structure of DNA, they based this discovery on the bench work of many other scientists of the time. Name at least two different pieces of knowledge that Watson and Crick used in their discovery that was based on work from other scientists.
3. Compare and contrast the cellular locations, templates, and products of transcription and translation in prokaryotes and eukaryotes.
4. A couple wants to start a family, but they are concerned that their child might have cystic fibrosis, which is a recessive trait. After taking a family history, you determine that while neither of them have the disease, the woman had a sister with cystic fibrosis (with unaffected parents), and the man's father also had cystic fibrosis. What do you tell them?
5. Describe the meiotic events that generate genetic diversity in gametes.