

This examination paper consists of 4 pages.

Appendices: none

Permitted materials: none

The number of answers for each question must match the number shown in brackets to the right.

1. **The double helix is**

- a protein structure
 - a nucleic acid structure
 - stabilized by ionic bonds
 - stabilized by hydrogen bonds
 - stabilized by base stacking
 - an inflexible structure
- (3)

2. **Ribonucleic acids**

- are less stable than deoxyribonucleic acids
 - do not form double helices
 - are synthesized by DNA polymerases
 - are normally not highly expressed
 - contain uracil instead of thymine
- (2)

3. **Housekeeping proteins**

- are only found in specialized cells
 - regulate gene expression
 - transport toxic compounds out of cells
 - have general biochemical functions in cells
- (1)

4. **DNA polymerases**

- occur in all cells
 - are involved in transcription of genomes
 - require ribonucleotides to function
 - are used in sequencing of DNA
- (2)

5. **Bacteriophage λ**

- is a retrovirus
 - is a temperate phage
 - consists of DNA and protein
 - infects only cells of *E. coli*
 - has a genome size of ≈ 500 kb
 - produces ≈ 1000 new viruses in a cell after infection
- (3)

6. **The polymerase chain reaction (PCR)**
requires a DNA polymerase
was introduced in the 1970s
can be used in sequencing of DNA
can amplify large segments (> 20 kb) of DNA
requires 4 primers (2)
7. **The following elements are classified as genome wide repeats**
telomeres
long terminal repeats
microsatellites
pseudogenes
DNA transposons
retroelements
centromeres (3)
8. **The human genome**
has a size of $\approx 3.2 \times 10^9$ bp
contains about 5×10^4 genes
consists of 24 chromosomes
contains more than 3×10^6 transposons
has an average gene density of 50 genes per 10^6 bp (3)
9. **Organelle genomes**
are all approximately 100 kb in size
do not contain introns
are all circular
are found in all eukaryotic cells (1)
10. **Retroviruses**
can convert RNA into DNA
contain a DNA genome
infect only mammals
contain a DNA polymerase
do not integrate their genome into the host genome (2)
11. **Linkage analysis**
requires at least two versions of a DNA sequence
requires sequences located on different chromosomes
is the basis of genetic mapping
produces an STS map (2)

12. Microsatellites

- are genome-wide repeats
 - can be up to 500 bp in size
 - can be used in physical mapping of genomes
 - can move (transpose) to another site in the genome
 - consist of short (< 14 bp) repeat units
- (2)

13. Prokaryotic genomes

- are always circular
 - are organized in nucleosomes
 - are normally smaller than 2×10^6 bp
 - contain DNA transposons
 - contain operons
- (2)

14. Eukaryotic nuclear genomes

- are associated with HU proteins
 - range from ≈ 10 Mb to $\approx 100\,000$ Mb in size
 - consist of linear and circular chromosomes
 - contain minisatellites
- (2)

15. Protein-protein interactions can be detected by

- microarrays
 - DNA chips
 - the yeast two hybrid system
 - mass spectrometry
 - phage display
- (2)

16. Open reading frames (ORFs)

- are DNA sequences
 - are amino acid sequences
 - can be easily identified in prokaryotic genomes
 - specify "functional" RNA
- (2)

17. RNA interference

- is a method for overexpressing genes
 - uses double-stranded RNA
 - is used to assess the function of genes
 - is primarily used in bacteria
 - affects processing of ribosomal RNA
- (2)

18. Reverse transcriptase

- is an RNA polymerase
- is a DNA polymerase
- is present in all viruses
- binds to DNA
- uses ribonucleotides

(1)

19. Nucleosomes contain

- histidines
- histones
- ribosomal RNA
- DNA
- telomeres
- 30 nm fibers

(2)

20. Operons

- contain groups of genes
- contain at least two promoters
- are transcribed into a single transcript
- are frequent in nuclear DNA
- are translated into a single polypeptide

(2)

21. A genomic library consists of

- the gene sequences of a genome
- all sequences of a genome
- all DNA fragments that have been sequenced
- all the proteins encoded by a genome

(1)

Total number of correct answers: (42)