

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)