

CONTENTS

Preface

v

1. ATOMS, IONS, ACIDS, BASES AND SALTS

1.1

1. Atoms 1.2
 - 1.1 Atomic Number 1.4
 - 1.2 Mass Number 1.4
 - 1.3 Ions 1.4
 - 1.4 Isotopes 1.4
 - 1.5 Energy Levels 1.4
 - 1.6 Electron Excitation 1.5
2. The Nature of Chemical Bonds 1.6
 - 2.1 Ionic Bonding 1.6
 - 2.2 Covalent Bonding 1.7
3. Shapes of Methane and Water Molecules 1.9
4. Acids, Bases and Salts 1.15
5. Compounds of Life 1.18

Questions 1.20

2. INORGANIC COMPOUNDS

2.1

1. Elements of Life 2.2
2. Organ Mass 2.2
3. Inorganic Compounds 2.3
 - 3.1 Water (H_2O) 2.3
 - 3.2 Salts and Ions 2.10
 - 3.3 Gases 2.11

Questions 2.11

3. THE CELL: FUNCTIONAL ANATOMY

3.1

1. Introduction 3.2
2. Prokaryotic Cells 3.4
 - 2.1 Cell Wall 3.4

- 2.2 The Periplasm 3.5
- 2.3 Bayers Junctions 3.5
- 2.4 Protoplast 3.6
- 2.5 Cell Membrane 3.6
- 2.6 The Cytoplasm 3.7
- 2.7 Nuclear Material 3.8
- 3. Eukaryotic Cell 3.8
 - 3.1 Cell Theory 3.8
 - 3.2 An Animal Cell 3.10
- 4. Formation of Tissues and Organs 3.48
 - 4.1 Differentiation and Specialization 3.48
 - 4.2 Integration of Organ Function 3.48
 - 4.3 Homeostasis 3.48

Questions 3.49

4. CELLULAR ORGANIC COMPONENTS-I: CARBOHYDRATES

4.1

- 1. Introduction 4.2
- 2. Structure 4.2
- 3. Types of Carbohydrates 4.2
 - 3.1 Monosaccharides (Greek mono-"single" sacchar = Sugar) 4.2
 - 3.2 Oligosaccharides 4.6
 - 3.3 Polysaccharides 4.7

Questions 4.12

5. CELLULAR ORGANIC COMPONENTS-II: LIPIDS

5.1

- 1. Introduction 5.2
- 2. Classification 5.2
 - 2.1 Simple Lipids 5.2
 - 2.2 Compound Lipids 5.5
 - 2.3 Derived Lipids 5.9
- 3. Membrane Lipids 5.11
 - 3.1 Phospholipids 5.12
 - 3.2 Cholesterol 5.12
 - 3.3 Glycolipids 5.12
- 4. Lipids in Body 5.13
- 5. Function of Lipids 5.13
 - 5.1 Storage of Energy 5.13
 - 5.2 Cushion and Insulator for Organs 5.14
 - 5.3 Reserviors of Potential Chemical Energy 5.14
 - 5.4 Component of Membranes 5.14

Questions 5.14

6. CELLULAR ORGANIC COMPONENTS-III: PROTEINS**6.1**

1. Introduction 6.2
2. Structure 6.2
3. Functions of Proteins 6.2
4. Amino Acids the Building Blocks of Proteins 6.3
5. Peptide Bonds 6.6
6. Essential Amino Acids 6.8
7. Structure of a Polypeptide Chain 6.8
8. Domains in Proteins 6.13
9. Binding Sites of a Protein 6.13
10. Hypothetical Protein 6.15
11. Denaturation of Proteins 6.15
12. Renaturation of Proteins 6.15
13. Classification of Proteins 6.16
 - 13.1 Simple Proteins 6.16
 - 13.2 Conjugated Proteins 6.17
 - 13.3 Derived Proteins 6.17
14. Membrane Proteins 6.17
15. Protein Requirements 6.18

*Questions 6.18***7. ENZYMES AND COENZYMES****7.1**

1. Definition 7.2
2. General Properties 7.2
3. Use and Selection of Enzymes 7.2
4. Types of Enzymes 7.3
 - 4.1 Simple Enzymes 7.4
 - 4.2 Conjugative Enzymes or Holoenzymes 7.4
5. Sources and Sites of Action of Enzymes 7.4
6. Nomenclature of Enzymes 7.4
7. Classification of Enzymes 7.5
8. Mode of Action of Enzymes 7.6
9. Factors Affecting The Activity of Enzymes 7.8
10. Isozymes 7.11
11. Kinetics of Enzyme-Catalyzed Reactions 7.12
12. Allosteric Enzymes 7.15
13. Precursor Enzymes 7.17
14. Regulation of Enzyme Metabolism 7.18
 - 14.1 Regulation of Enzyme Activity 7.18

- 14.2 Regulation of Enzyme Synthesis 7.19
- 15. Coenzymes 7.22
- 16. Enzyme Engineering 7.27
 - 16.1 Proteins from Chemically Synthesized or Modified DNA Sequences 7.28
 - 16.2 Biocatalyst Immobilization 7.30

Questions 7.36

8. NUCLEIC ACIDS

8.1

- 1. Nucleotides 8.2
 - 1.1 Structures 8.2
 - 1.2 Types of Nucleotides 8.2
 - 2. Nucleic Acids 8.8
 - 2.1 Deoxyribonucleic Acid (DNA) 8.8
 - 2.2 Ribonucleic Acid (RNA) 8.20
 - 3. Replication of DNA 8.25
 - 3.1 Background and Historical 8.25
 - 3.2 Semiconservative Replication 8.27
 - 3.3 Prokaryotic DNA Polymerases 8.33
 - 3.4 Replication of Mitochondrial DNA 8.36
 - 3.5 DNA Repair 8.37
 - 4. Chromatin and Chromosomes 8.37
 - 5. The Genetic Code 8.40
 - 5.1 Split Genes of Higher Organisms 8.41
 - 5.2 Genetic Code of Mitochondria 8.41
 - 6. Protein Synthesis 8.42
 - 6.1 Transcription 8.43
 - 6.2 Translation 8.49
 - 6.3 Post Translational Modification 8.56
 - 7. Recombinant DNA Technology 8.56
 - 7.1 Restriction Enzymes 8.57
 - 7.2 Vectors 8.59
 - 7.3 Genes from Higher Organisms 8.63
 - 7.4 RAPDs (Random Amplified Polymorphic DNA) Using Random Primers 8.68
 - 7.5 DNA Sequencing 8.68
 - 7.6 Applications of Genetic Engineering 8.70
 - 7.7 Gene Therapy 8.73
 - 8. Mitochondrial Genome 8.82
- Questions* 8.86

9. METABOLISM

9.1

- 1. General Metabolism 9.2
 - 1.1 ATP: The Energy Currency of Life 9.2
 - 1.2 Biochemical Pathways as the the Organizational Units of Metabolism 9.4

- 1.3 The Evolution of Metabolism 9.6
- 1.4 Making of ATP by Cells 9.7
2. Processes of Metabolism 9.11
 - 2.1 Energy Transformation 9.12
3. Metabolism of Carbohydrates 9.15
 - 3.1 Emden-Meyerhof System of Glycolysis-The Anaerobic Part of Respiration 9.15
 - 3.2 Fermentation 9.18
 - 3.3 Krebs Cycle (Tricarboxylic Acid Cycle) 9.21
 - 3.4 Hydrogen Carrier and Electron Transport System (ETS) 9.23
 - 3.5 Glycogenesis 9.25
 - 3.6 Glycogenolysis 9.26
 - 3.7 Dicarboxylic Acid Shuttle 9.27
 - 3.8 Hexose Monophosphate Shunt 9.29
 - 3.9 Gluconeogenesis 9.31
 - 3.10 Control of Carbohydrate Metabolism 9.33
4. Metabolism of Fat 9.34
 - 4.1 Fat Catabolism 9.35
 - 4.2 α Oxidation of Fatty Acids 9.38
 - 4.3 ω Oxidation of Fatty Acids 9.38
 - 4.4 Anabolism of Fat 9.38
 - 4.5 Biosynthesis of Fatty Acids and Fats 9.39
 - 4.6 Lipogenesis 9.39
 - 4.7 Hormonal Regulation of Lipid Metabolism 9.40
5. Metabolism of Proteins 9.41
 - 5.1 Anabolism of Proteins (Hydrolysis of Proteins) 9.41
 - 5.2 Catabolism of Proteins 9.41
 - 5.3 The Ornithine Cycle (Krebs-Henseleit Cycle) 9.43
6. Metabolic Rate 9.44
7. Effect of Temperature 9.45
8. Interrelationship of Metabolism of Macromolecules viz., Carbohydrates, Fats and Proteins 9.46
9. The Liver and Pancreas 9.47
 - 9.1 Liver 9.47
 - 9.2 Pancreas 9.52

Questions 9.55

10. PHYSIOLOGY OF RESPIRATION

1. Introduction 10.2
2. Background and Definition 10.2
3. The Process of Respiration 10.2
 - 3.1 Problems of Gas Exchange 10.3
 - 3.2 Properties of Gases 10.3
4. Evolutionary Basis of Respiration 10.7

10.1

5. General Discussion about Respiratory System in Mammals 10.18
 - 5.1 Structures 10.18
 - 5.2 Movement of Air in Lungs 10.24
 - 5.3 Mechanism of Breathing in Man 10.25
 - 5.4 Gaseous Exchange in Lungs 10.25
6. Cellular Respiration 10.33
7. Regulation of Breathing 10.34
- Questions* 10.38

11. NUTRITION

11.1

1. Food 11.2
 - 1.1 Food as Fuel 11.2
 - 1.2 Basal Metabolic Rate 11.2
 - 1.3 Food for Fabrication 11.2
 - 1.4 Essential Nutrients 11.3
 - 1.5 Energy Needs/Requirements 11.4
2. The Constituents of Food 11.5
 - 2.1 Proteins 11.5
 - 2.2 Lipids 11.6
 - 2.3 Carbohydrates 11.7
 - 2.4 Nucleic Acids 11.8
 - 2.5 Enzymes and Co-Enzymes 11.8
 - 2.6 The Vitamins 11.8
 - 2.7 Minerals 11.25
3. A Healthy Diet 11.31
 - 3.1 Milk Products 11.31
 - 3.2 Margarine 11.31
 - 3.3 Meat 11.31
 - 3.4 Fish 11.31
 - 3.5 Eggs 11.32
 - 3.6 Cereals 11.32
 - 3.7 Bread 11.32
 - 3.8 Fruits and Vegetables 11.32
 - 3.9 Beverages 11.33
 - 3.10 Alcohol 11.33
4. Effects of Cooking 11.33
5. Effects of Freezing 11.33
- Questions* 11.35

12. PHYSIOLOGY OF DIGESTION

12.1

1. Introduction 12.2
2. Feeding 12.2
3. Feeding Mechanisms 12.3

4. Ingestion 12.4
5. The Evolution of Digestive Mechanisms 12.4
 - 5.1 Phagocytosis 12.5
 - 5.2 A Digestive Cavity (Intracellular Digestion) 12.5
6. Organization of of Vertebrate Digestive Systems 12.7
7. Functional Adaptations of the Alimentary Canal 12.11
8. Digestion Process 12.12
 - 8.1 Types of Digestion 12.13
9. Process of Digestion 12.14
 - 9.1 Salivary Phase 12.14
 - 9.2 Gastric Phase 12.21
 - 9.3 Intestinal Phase 12.30
 - 9.4 Defaecation 12.35
10. Absorption and Assimilation 12.37

Questions 12.39

13. PHYSIOLOGY OF MUSCLE CONTRACTION

13.1

1. Introduction 13.2
2. Structure of The Skeletal Muscle 13.2
 - 2.1 Components of Muscle Fibre 13.2
 - 2.2 Types of Striated Muscle Fibres 13.9
 - 2.3 Regulation of Fast and Slow Fibres by Nerves (Trophic Action) 13.9
3. Sliding Filament Theory of Contraction (Mechanism of Muscle Contraction) 13.10
 - 3.1 Maintenance of the Length of the Filaments during Contraction 13.10
 - 3.2 Excitation-Contraction (EC) Couplings 13.11
 - 3.3 Energy Requirement for all these Activities 13.12
4. Regulation of Muscle Contraction 13.13
 - 4.1 Effect of Calcium Ions on Myosin Activity 13.14
 - 4.2 The Troponin (Tn) Tropomyosin (Tm) System 13.15
 - 4.3 Role of ATP 13.16
5. Summary of Steps Involved in Contraction and Relaxation of a Skeletal Muscle Fibre 13.18
6. Sources of Energy for Muscle Contraction 13.18
7. Work and Heat Production by Muscle 13.20
8. Heat Production by Muscle 13.20

Questions 13.21

14. GENERAL ACCOUNT OF BODY FLUIDS

14.1

1. Types of Body Fluids 14.2
2. Fluid Compartments 14.2
3. Constituents of Fluids 14.2

- 3.1 Water 14.2
- 3.2 Electrolytes 14.4
- 4. Movement of Body Fluids 14.10
 - 4.1 Between Plasma and Interstitial Compartments 14.10
 - 4.2 Between Interstitial and Intracellular Compartments 14.13
- 5. Tissue Fluid Balance 14.13
- 6. Acid-Base Balance 14.14
 - 6.1 Buffer Systems 14.15
- Questions 14.16*

15. BLOOD AND LYMPH

15.1

- 1. Introduction 15.2
- 2. Functions of Blood 15.2
- 3. Composition and Volume of The Blood 15.2
 - 3.1 Functions of Plasma Proteins 15.5
- 4. Blood Substitutes 15.5
- 5. Blood Cells 15.5
 - 5.1 Erythrocytes 15.5
 - 5.2 Leucocytes 15.14
 - 5.3 Morphologic Changes Associated with Lymphocyte Activation 15.19
 - 5.4 Mononuclear Phagocytes 15.21
 - 5.5 Blood Platelets 15.22
- 6. Lymphatic System 15.23
 - 6.1 Functional Anatomy of Lymphoid Tissues 15.24
 - 6.2 Birth of Lymphocytes 15.24
 - 6.3 Thymus 15.25
 - 6.4 The Bursa of Fabricius 15.26
 - 6.5 Circulation of Lymphocytes 15.26
 - 6.6 Mode of Action of Lymphocytes 15.29
- 7. Blood Plasma 15.33
- 8. Reticuloendothelial System (RES) 15.34
- 9. Haemostasis and Wound Healing (Blood Clotting) 15.34

Questions 15.37

16. PHYSIOLOGY OF CIRCULATION

16.1

- 1. Introduction 16.2
- 2. The Functions of Circulatory System in Vertebrates 16.2
 - 2.1 Nutrient and Waste Transport 16.2
 - 2.2 Transport of Oxygen and Carbon Dioxide 16.2
 - 2.3 Maintenance of Temperature 16.3
 - 2.4 Circulation of Hormones 16.4
- 3. Closed and Open Circulatory Systems 16.4

4. Types of Circulation 16.4
 - 4.1 Systemic Circulation 16.4
 - 4.2 Pulmonary Circulation 16.5
 - 4.3 Advantages of Double Circulation (both Systemic and Pulmonary Circulations together) 16.5
5. The Cardiovascular System 16.6
 - 5.1 Heart 16.7
6. Blood Vessels 16.35
 - 6.1 Arteries and Arterioles 16.35
 - 6.2 Microcirculation 16.37
7. Blood Pressure 16.40
 - 7.1 General 16.40
 - 7.2 Measurement of Blood Pressure 16.42
 - 7.3 The Baroreceptor Reflex 16.44
 - 7.4 Volume Receptors 16.45
 - 7.5 Regulation of Blood Distribution 16.47
 - 7.6 The Pulse 16.47

Questions 16.47

17. PHYSIOLOGY OF INTEGRATION

17.1

1. Introduction 17.2
2. The Nerve Cells (Neurons) 17.3
 - 2.1 Cell Body 17.3
 - 2.2 Cell Processes 17.3
 - 2.3 Types of Neurons 17.5
 - 2.4 Functional Properties of Neurons 17.6
 - 2.5 Other Components of Nervous Tissue 17.7
 - 2.6 Structure of Nerve Fibres 17.7
3. Membrane Potentials 17.8
4. Nervous Transmission 17.9
 - 4.1 Resting Membrane Potential 17.9
 - 4.2 Ion Processes for the Establishment of Distribution 17.10
 - 4.3 Changes in Membrane Potential 17.11
 - 4.4 Restoration of Resting Potential 17.14
 - 4.5 Threshold 17.14
 - 4.6 Duration of Action Potentials 17.14
 - 4.7 Propagation of Action Potentials 17.15
 - 4.8 All-or-None "Law" 17.16
 - 4.9 Phases of the Action Potential 17.18
 - 4.10 Saltatory Conduction 17.18
 - 4.11 Differences Between Saltatory Conduction and Cable Conduction 17.18
 - 4.12 Refractory Period 17.19
5. The Synapse 17.20

- 5.1 Chemicals Synapses 17.21
- 5.2 From Synapse to Neural Circuit 17.43
- 6. Reflex Arc 17.43
- Questions 17.45

18. PHYSIOLOGY OF RECEPTOR SYSTEM

18.1

- 1. Introduction 18.2
 - 1.1 Sensory Modality 18.2
 - 1.2 Encoding Time 18.2
 - 1.3 Sensing Temperature 18.3
 - 1.4 Sensing Forces 18.3
 - 1.5 Transduction 18.3
 - 1.6 Amplification of Signal 18.3
 - 1.7 Reception 18.4
 - 1.8 Transmission 18.4
 - 1.9 All-or-None-Law 18.4
 - 1.10 Information Coding 18.5
 - 1.11 Shape of Response of the Generator Potential 18.5
 - 1.12 Frequency of Firing 18.6
 - 1.13 Sensory Areas in the Brain 18.6
- 2. Somatosensation 18.7
 - 2.1 Classification of Somatosensory Receptors 18.8
 - 2.2 Transduction by Somatosensory Receptors 18.11
 - 2.3 Somatosensory Pathways to the Brain 18.11
- 3. Touch 18.13
- 4. Pain 18.13
 - 4.1 Pain Receptors 18.13
 - 4.2 Pain Perception 18.13
 - 4.3 Referred Pain 18.14
- 5. Photoreceptors 18.15
 - 5.1 General Structure of the Eye 18.15
 - 5.2 Effects of Light on the Visual Pigments (Retinal Rod Excitation) 18.20
 - 5.3 Effect of Dark on the Visual Pigments 18.22
 - 5.4 Night Blindness 18.23
 - 5.5 Theories of Transduction 18.23
 - 5.6 Summary of Chemical Basis of Receptor Excitation 18.24
 - 5.7 Duplicity Theory of Vision 18.24
 - 5.8 Afterimages 18.26
 - 5.9 Colour Blindness 18.26
 - 5.10 Pathways for Nerve Impulses From Retina to the Brain 18.27
 - 5.11 Projection of Retinal Cells to the Visual Cortex 18.30
 - 5.12 The Optical System of the Eye 18.30
 - 5.13 Lens 18.30
 - 5.14 Binocular Vision 18.34

- 5.15 The Evolution of the Eye 18.34
- 6. Hearing and Equilibrium 18.34
 - 6.1 Hearing 18.34
 - 6.2 Equilibrium 18.44
 - 6.3 Hearing Abnormalities 18.47
- 7. Taste 18.48
 - 7.1 Primary Taste Sensation 18.48
 - 7.2 The Taste Buds 18.49
 - 7.3 Taste Reflexes 18.50
- 8. Olfactions 18.50
 - 8.1 Transduction of Chemical Energy by the Olfactory Receptors 18.51
 - 8.2 Pathway from the Olfactory Receptor to the Brain 18.51
 - 8.3 Theories of Olfaction 18.52

Questions 18.54

19. INTRODUCTION TO IMMUNE SYSTEM

19.1

- 1. Introduction 19.2
- 2. Definitions 19.2
- 3. Antigens or Immunogens 19.3
- 4. Components of Immunity 19.5
 - 4.1 Non-specific or Innate Immunity 19.6
 - 4.2 Specific Immunity or Acquired Immunity 19.24
- 5. Failure of The Immune System 19.54
- 6. Monoclonal Antibodies 19.58
- 7. Major Histocompatibility Complex 19.60
- 8. Immunization 19.64
- 9. Auto Immunity 19.70
 - 9.1 Tolerance 19.71
 - 9.2 Clonal Deletion 19.71
 - 9.3 Cellular Basis of Tolerance 19.72
 - 9.4 Autoimmune Diseases 19.72
- 10. Hypersensitivity 19.73
 - 10.1 Type I Hypersensitivity: Anaphylactic Reaction 19.74
 - 10.2 Type II Hypersensitivity: Antibody-Dependent Cytotoxicity 19.79
 - 10.3 Type III Hypersensitivity: Immune Complex-Mediated 19.80
 - 10.4 Type IV Hypersensitivity: Cell-Mediated 19.84
- 11. Tumour Immunology 19.90
 - 11.1 Nature of Tumour Immunity 19.91
 - 11.2 Evasion of Immunologic Cytotoxicity 19.93
 - 11.3 Immune Surveillance of Tumours in Humans 19.94

Questions 19.95

20. CHEMICAL COORDINATORS**20.1**

1. Introduction 20.2
 - 1.1 Hormones 20.3
 - 1.2 Pheromones 20.5
 - 1.3 Local Regulators 20.5
 - 1.4 Growth Factors 20.6
 - 1.5 Prostaglandins 20.7
2. Hormone Action 20.9
 - 2.1 Mechanisms of Hormone Action 20.9
 - 2.2 Steroid Hormones 20.13
 - 2.3 Peptide Hormones and Second Messengers 20.17
3. Hormones of hypothalamus (Hypothalamic-pituitary Axis) 20.22
 - 3.1 Releasing Hormones of Hypothalamus 20.24
 - 3.2 Inhibitory Hormones of Hypothalamus 20.25
 - 3.3 Regulation of Hypothalamic Releasing Hormones 20.25
4. Hormones of Pituitary 20.25
 - 4.1 Hormones of Anterior Pituitary 20.27
 - 4.2 Intermedin or Melanocyte Stimulating Hormone (MSH) 20.35
 - 4.3 Hormones of Posterior Pituitary – Neurohypophysis 20.35
5. Thyroid Hormones 20.36
 - 5.1 Synthesis of Thyroid Hormones 20.38
 - 5.2 Regulation of the Thyroid Activity 20.39
 - 5.3 Mode of Action of Thyroid Hormones 20.40
6. Adrenal Hormones 20.40
 - 6.1 Catecholamines (Stress Physiology and Hormone Control) 20.41
 - 6.2 Adrenal Steroids 20.41
 - 6.3 Cortisol 20.42
 - 6.4 Aldosterone 20.42
 - 6.5 Adrenal Androgens 20.43
7. Parathyroid Hormone 20.43
8. Hormones of the Gastrointestinal Tract 20.45
9. Pancreatic Hormones 20.45
 - 9.1 Insulin 20.46
 - 9.2 Glucagon 20.48
10. Hormones of Kidney 20.50
 - 10.1 Erythropoietin 20.50
 - 10.2 Dihydroxycholecalciferol 20.50
11. The Gonadal Steroids 20.51
12. Brain Peptides 20.51
13. The Pineal Gland 20.51
- Questions 20.52

21. PHYSIOLOGY OF RENAL EXCRETION**21.1**

1. Introduction 21.2
2. Definition of Excretory System 21.2
3. Excretion in Vertebrates 21.2
 - 3.1 Kidneys: The Excretory Organs in Human Beings 21.2
4. Detailed Structure of a Nephron 21.5
5. Renal Excretion (Urine formation) 21.9
 - 5.1 Chemical Part 21.9
 - 5.2 The Mechanical Part 21.10
6. Urea 21.16
7. The Urine 21.18
8. Osmoregulation 21.19
9. The Evolution of Kidneys Among Vertebrates 21.22
 - 9.1 Ammonotelic animals 21.22

*Questions 21.25***22. PHYSIOLOGY OF REPRODUCTION****22.1**

1. Definition 22.2
2. Purpose of Reproduction 22.2
3. Sexual Maturation (Puberty) 22.2
4. Male Reproductive System 22.2
 - 4.1 Structure and Functions 22.2
 - 4.2 Spermatogenesis 22.5
 - 4.3 Spermateliosis 22.6
 - 4.4 Maturation and Capacitation of a Spermatozoan 22.8
 - 4.5 Structure of Spermatozoan 22.8
 - 4.6 Semen 22.10
 - 4.7 Source of Energy for Motility 22.10
 - 4.8 Male Hormones 22.10
5. The Female Reproductive Tract 22.13
 - 5.1 Ovulation and Luteinization 22.15
 - 5.2 The Eggs 22.16
 - 5.3 Role of Nurse Cells 22.20
 - 5.4 Follicle Cells 22.21
 - 5.5 Yolk 22.21
 - 5.6 Role of Hormones 22.21
 - 5.7 Sexual Cycle 22.22
 - 5.8 Menstrual Cycle 22.23
 - 5.9 Hormones of Ovary 22.23
6. Reproduction 22.25
 - 6.1 The Male Act 22.25

- 6.2 Ejaculation 22.27
- 6.3 The Orgasm in Females 22.27
- 6.4 Climax 22.27
- 6.5 Resolution 22.28
- 7. Fertilization 22.28
 - 7.1 Activation and Capacitation of Spermatozoa 22.29
 - 7.2 Acrosomal Reaction 22.30
 - 7.3 Sperm Egg Adhesion 22.31
 - 7.4 Fate of Sperm Mitochondria 22.32
 - 7.5 Physiological Polyspermy 22.32
 - 7.6 Blockage of Polyspermy 22.33
 - 7.7 Cortical Reaction 22.33
 - 7.8 In Vitro Fertilization in Human Beings 22.35
- 8. The Gestation Period 22.36
- 9. Parturition 22.40
- 10. Lactation 22.42
- 11. Evolution of Sex 22.43
- 12. Contraception and Birth Control 22.47
- Questions* 22.51

23. ANIMAL CELL CULTURE AND BIOTECHNOLOGY

23.1

- 1. Animal Cell Culture 23.2
 - 1.1 Stages of Culture 23.2
 - 1.2 Types of Cultures 23.3
 - 1.3 Requirement of Cell Culture Laboratory 23.3
 - 1.4 Media 23.4
 - 1.5 Cryopreservation 23.5
 - 1.6 Contamination 23.9
 - 1.7 Use of Animal Cell Cultures 23.12
 - 1.8 Stem Cells 23.12
 - 1.9 Tissue Engineering 23.17
- 2. Animal Biotechnology 23.25
 - 2.1 Introduction 23.25
 - 2.2 Transgenic Animals and Their Uses 23.25
 - 2.3 Examples of the Transgenic Animals and their Applications 23.26
 - 2.4 Applications of Transgenic Animals 23.34

Questions 23.35

Index

I.1