Subject Title: Human Anatomy & Physiology Subject Code: 0809

Important Instructions to examiners:

1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling errors should not be given more Importance (Not applicable for subject English and Communication Skills.
4) While assessing figures, examiner may give credit for principal components indicated in the figure. The figures drawn by candidate and model answer may vary. The examiner may give credit for anyequivalent figure drawn.
5) Credits may be given step wise for numerical problems. In some cases, the assumed constant values may vary and there may be some difference in the candidate's answers and model answer.
6) In case of some questions credit may be given by judgement on part of examiner of relevant answer based on candidate's understanding.
7) For programming language papers, credit may be given to any other program based on equivalent concept.

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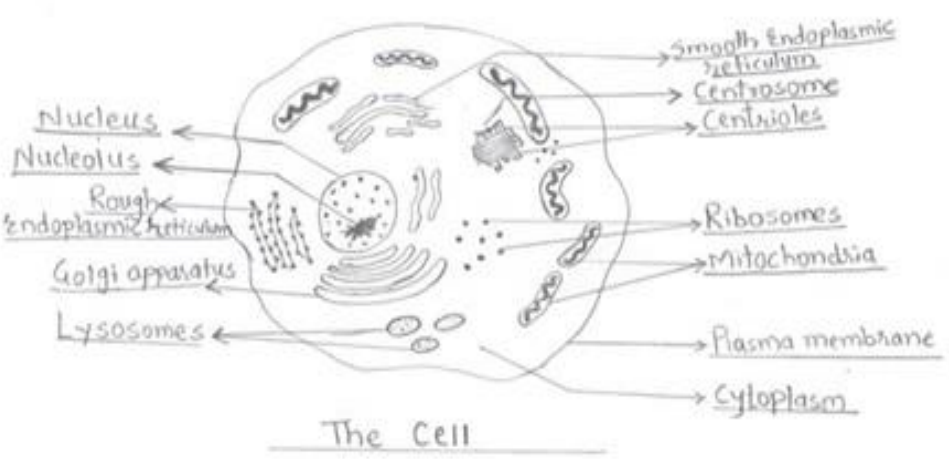
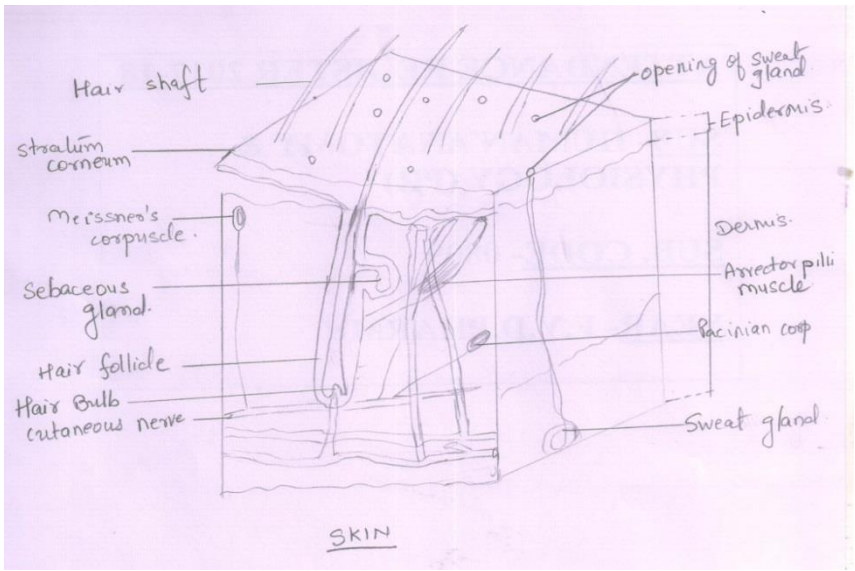
Q. No.	Sub Q. N.	Answer	Marking Scheme
1		**Solve any EIGHT of the following: (2marks each)**	**16M**
1	**a)**	**Give the functions of hypothalamus. (any four functions, 0.5 mark each)** Following are functions of hypothalamus: 1) It controls Autonomic nervous system 2) It controls appetite & satiety 3) Regulation of thirst 4) Maintenance of emotional behavior, personality and social behavior. 5) Regulation of body temperature 6) It regulates and controls release of hormones from pituitary gland. 7) It regulates biological clock 8) It controls sexual behavior	**2M**
1	**b)**	**Name the bones of lower limb.** 1- Femur, 1- tibia, 1- fibula, 1- patella, 7- tarsal bones, 5- metatarsal bone and 14 –phalanges	**2M**
1	**c)**	**Define Anatomy & Physiology. (1 mark each)** **Anatomy** -It is the study of structure of the body & its individual parts & their relation to one another. **Physiology** - It is the study of the functions of various parts and how they are integrated to produce a coordinated action of the whole body.	**2M**
1	**d)**	**Give the functions of tongue. (any 2 functions, 1 mark each)** The tongue plays important part in : Chewing(mastication),swallowing(deglutition),	**2M**

		speech & taste **Chewing (mastication) & swallowing (deglutition)** – It moves from side to side to move the food for chewing& force the food to the back of the mouth for swallowing. **Speech:** This is produced when the sounds produced by the vocal cords are amplified & manipulated by the tongue, cheek & lips. **Taste:** It has nerve endings of the sense of taste present in the papillae (taste buds) on the surface.	
1	**e)**	**Name different organs of respiratory system.** Nose, pharynx, Larynx, trachea, Bronchi (Two), bronchioles, alveoli, two lungs covered with pleura, muscles of respiration- intercostal muscles & diaphragm.	**2M**
1	**f)**	**Draw a well labelled diagram of a simple living cell**.  The Cell	**2M**
1	**g)**	**Name the bones forming shoulder joint.** Scapula & humerus. The glenoid cavity of scapula & ball of the humerus form shoulder joint.	**2M**
1	**h)**	**Mention disease caused by hyposecretion & hypersecretion of growth hormones.** Hyposecretion of GH: Before puberty, it leads to pituitary dwarfism in which the individual is of small stature but is well proportioned and mental health is not affected.	**2M**

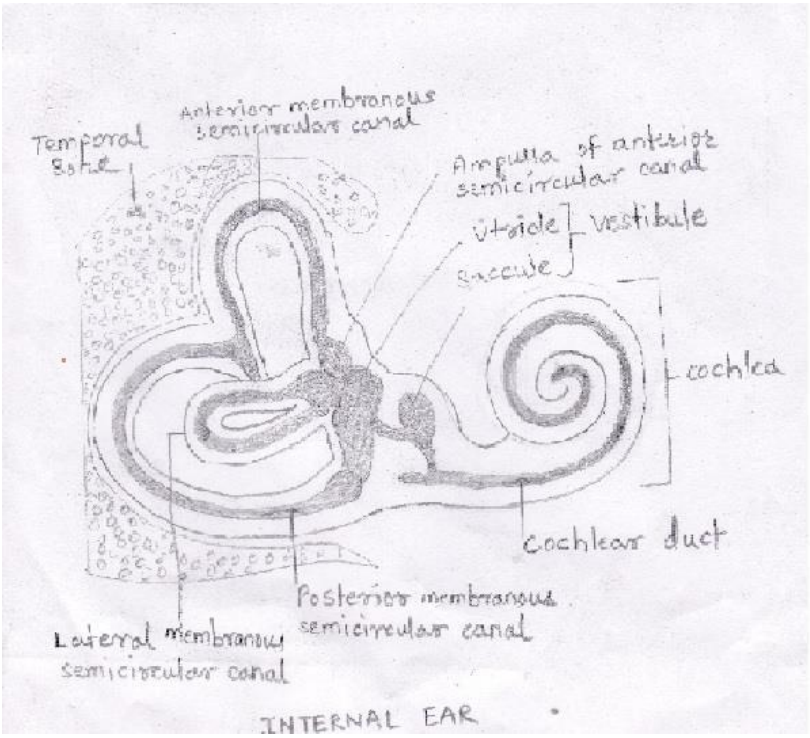
		After puberty, hyposecretion of GH causes trophic changes in the thyroid and adrenal glands and in gonads. Hypersecretion of GH: Before puberty, it causes gigantism in which the affected individuals may grow to heights of 2.1 to 2.4 m although body proportions remain normal. After puberty, hypersecretion causes acromegaly in which the bones and soft tissues of some organs thicken and coarsen; particularly it affects the hands, feet and tongue.	
1	**i)**	**Give the composition of intestinal juice**. Water, mucus, mineral salts**,** Enzymes: Peptidases, Sucrase, Maltase, Lactase, Lipase and enterokinase (enteropeptidase). pH 7.8 to 8.3	**2M**
1	**j)**	**Mention muscles of facial expression.** Occipitofrontalis, Levator palpebrae superioris, orbicularis oculi, buccinators, orbicularis oris, masseter, temporalis, pterygoid.	**2M**
1	**k)**	**How male urethra differs from female urethra.** Urethra is a canal/tube from the neck of the bladder to the exterior. The female urethra is approx. 4 cm. in length. The male urethra is 19-20 cm. The male urethra is associated with the urinary & reproductive functions & provides common pathway for the flow of urine & semen & therefore is longer than female urethra**.**	**2M**
1	**l)**	**Give the components of lymphatic system.** Lymph, lymph capillaries, lymph vessels, lymph trunks, lymph nodes, lymph organs- spleen & thymus gland, lymphoid tissue (MALT) e.g. tonsils.	**2M**

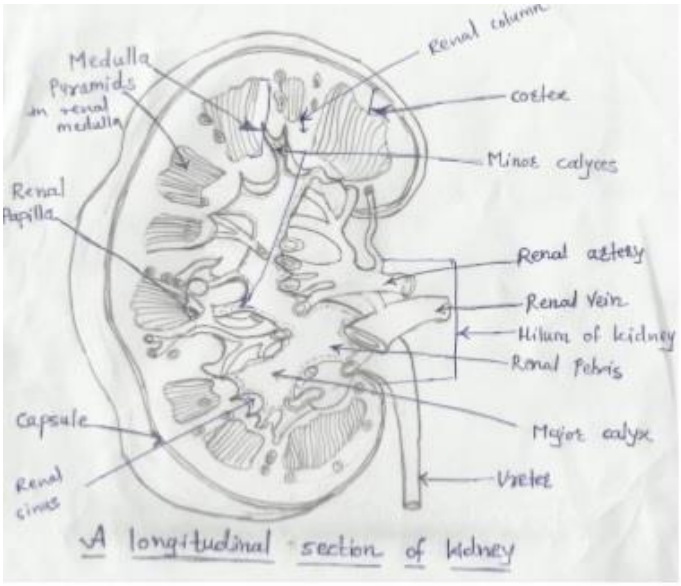
2		**Solve any FOUR of the following:(3marks each)**	**12M**
2	**a)**	**Explain digestion of proteins**. Digestion of protein is process of conversion of protein into amino acids by action of enzymes. Digestion of protein initiates in stomach and ends in small intestines. In Stomach: Acid from gastric juice converts enzyme pepsinogen into pepsin. This pepsin acts on protein and breakdown into polypeptides. In Small Intestines: By the action of enzyme enterokinase present in intestinal mucosa, chymotrypsinogen and trypsinogen from pancreatic juice get converted into chymotrypsin and trypsin. These enzymes convert polypeptides into bi-peptides and tri-peptides. Enzyme peptidase secreted by enterocytes of small intestine converts bi-peptides and tri-peptides into amino acids. These amino acids further absorbed into blood circulation. In this way digestion of protein takes place.	**3 M**
2	**b)**	**Draw and label L.S. of skin.**  	**3M**
2	**c)**	**Explain how urine is formed.** The Urine formation by kidney takes place in 3 steps:- 1) Glomerular Filtration 2) Selective reabsorption 3) Tubular secretion	**3M**

		1) Glomerular filtration: - The glomerular filtering membranes acts as an ultrafilters. The particles like colloidal, soluble and cell free substances, smaller than endothelial pores are filtered. However big particles like plasma proteins are not filtered. The filtration takes place with the pressure of 35 mm of Hg. This pressure results from different forces involved in glomerular filtration. The GFR i.e. glomerular filtration rate is 120 ml/min, thus producing 170-180 litres of filtrate in a day. **2) Selective reabsorption:-** Out of 170-180 litres of filtrate, about 99% is reabsorbed, resulting in formation of 1-1.5 litre of urine per day. The filtrate contain major amount of water, which is reabsorbed to the extent of 99%. Depending upon the extent to which various substances are reabsorbed they are classified as: **a)High threshold substances:** They get absorbed completely eg. Glucose and potassium(100%), water (99%), calcium and sodium chloride (98-99%). **b) Low threshold substances:** Absorbed to some extent eg. Urea , uric acid, phosphate. **c) No threshold substances:** These are not required by the body at all.eg. Creatinine, sulphates**.** **3)Tubular secretion:** The substances not required by body and not filtered in glomerular filtration are secreted by the tubules. Depending upon extent to which sodium ions are reabsorbed, potassium, & hydrogen ions are secreted, thus maintaining electrolyte balance of the body. Some metabolized substances like ammonia are also excreted. Thus the final filtrate of urine, is carried by collecting tubule to duct to the pelvis of kidney to ureter. The ureter opens in to urinary bladder where it is stored and finally excreted out.	
2	**d)**	**Name the bones forming thoracic cage (1.5 marks) & cranium.(1.5 marks)** **Bones of thoracic cage**: sternum -1, ribs-12 pairs & thoracic vertebrae-12. **Bones of cranium**- frontal bone-1, parietal bones-2, temporal bones-2, occipital bone-1, sphenoid bone-1, ethmoid bone-1.	**3M**
2	**e)**	**Give the role of oestrogen (1.5 marks) & progesterone in body.(1.5 marks)** **Role of Oestrogen in the body**- i) It promotes the development & maintenance of female reproductive system,	**3M**

		secondary sexual characteristics & the breasts. The secondary sexual characteristics include distribution of adipose tissue in the breasts, abdomen, mons pubis, & hips,. Voice pitch, a broad pelvis & pattern of hair growth on the head & body. ii) It increases protein anabolism including building of strong bones. It lowers blood cholesterol level. iii) Moderate levels inhibit both the release of GnRH by the hypothalamus and secretion of LH & FSH by the anterior pituitary. **Role of Progesterone in the body** – i) It along with with oestrogen to prepare & maintain the endometrium for implantation of a fertilised ovum & to prepare breasts for milk secretion. ii) High levels of progesterone inhibits secretion of GnRH & LH.	
2.	**f)**	**What will be the effect of parasympathetic nervous system stimulation on (1 mark each)** i) **Salivary gland**- increase in the secretion of saliva ii) **Heart** - Decrease in the rate & force of contraction. Constriction of coronary arteries reducing the blood supply to cardiac muscle iii) **Respiratory system**- Constriction of smooth muscle of bronchi.	**3M**
3		**Solve any FOUR of the following : (3 marks each)**	**12M**
3	**a)**	**Give the composition (1M) and functions of cerebrospinal fluid (2M)** **CSF: Composition**: Water, mineral salts, glucose, plasma proteins: small amounts of albumin and globulin, creatinine & urea in small amounts, and few leukocytes. Functions: 1) It supports and protects the brain and spinal cord. 2) It maintains a uniform pressure around these delicate structures. 3) It acts as a cushion and shock absorber between the brain & the skull. 4) It keeps the brain and spinal cord moist and there may be interchange of substances between CSF and nerve cells, such as nutrients and waste products.	**3M**

3	**b)**	**Give the functions of stomach (any 6 functions 0.5 x 6 =3M)** 1) Digestive function: Converts protein to peptones. 2) Storage function: temporary storage of food 3) Mechanical function: Churning allows mechanical breakdown of food. 4) Haematinic function: Secretes intrinsic factor for absorption of Vitamin B12 5) Absorptive functions: absorbs alcohol, certain drugs and small quantity of water. 6) Non-specific defense against microbes by Hydrochloric acid in gastric juice**.** 7) Secretion of gastrin hormone	**3M**
3	**c)**	**Name the arteries supplying blood to liver , kidney and intestine (1Mark each)** Arteries supplying blood to- **Liver:** Coeliac artery or hepatic artery **Kidney**: Left and right Renal arteries and **Intestine**: Superior mesenteric artery	**3M**

3	**d)**	**Draw a well labeled diagram of internal ear (3M)**  	**3M**
3	**e)**	**Explain, how kidneys help to maintain water balance of body (3M)** i) **Antidiuretic hormone:** If the blood osmotic pressure is raised, osmoreceptors in hypothalamus stimulates posterior pituitary gland and secretion of antidiuretic hormone increases, which causes more absorption of water in distal convoluted tubule and collecting tubule. Lower blood osmotic pressure inhibits secretion of Antidiuretic hormone. ii) **Aldosteone:** If the renal blood flow/blood pressure is low, renin angiotensin system is activated which stimulates adrenal cortex. Stimulation of adrenal cortex secretes aldosterone which acts on kidney tubules. It increases reabsorption of sodium which is followed by reabsorption of water. High renal blood flow/ blood pressure inhibits secretion of aldosterone. iii) **Atrial natriuretic peptide:** If the blood volume is raised, receptors in atria are stimulated and releases atrial natriuretic peptide which decreases reabsorption of sodium and water from proximal convoluted tubule and collecting ducts. Decrease in blood volume inhibits secretion of atrial natriuretic peptide.	**3M**

3	**f)**	**What do you mean by (Each 1.5 M)** **i) Muscle contraction** It is either shortening of muscle or development of tension in muscle or both. A. Isotonic Contraction-contraction in which tension remains same whereas changes occurs in the length of muscle fiber. E.g. flexion of arm B. Isometric Contraction-contraction in which length of muscle fibers remain same and tension is increased. E.g. holding book by hand, pulling any heavy object **ii) Muscle fatigue** If the muscle is frequently stimulated to contract, its response to stimulus progressively decreases. Finally it may not contract by stimulation. Such a condition is called muscle fatigue.	**3M**
4		**Solve any FOUR of the following: (3marks each)**	**12M**
4	**a)**	**Draw and label the diagram of L.S. of kidney (3Marks)**  	**3M**
4	**b)**	**Give classification (1Mark) and functions (2Marks) of leukocytes.** WBCs are of two types based on the presence of granules in the cytoplasm as granulocytes and agranulocytes. They are further classified as - **Granulocytes** **Agranulocytes** 1. Neutrophils 1. Monocytes 2. Eosinophils 2. Lymphocytes 3.Basophils	**3M**

Functions of Leukocytes

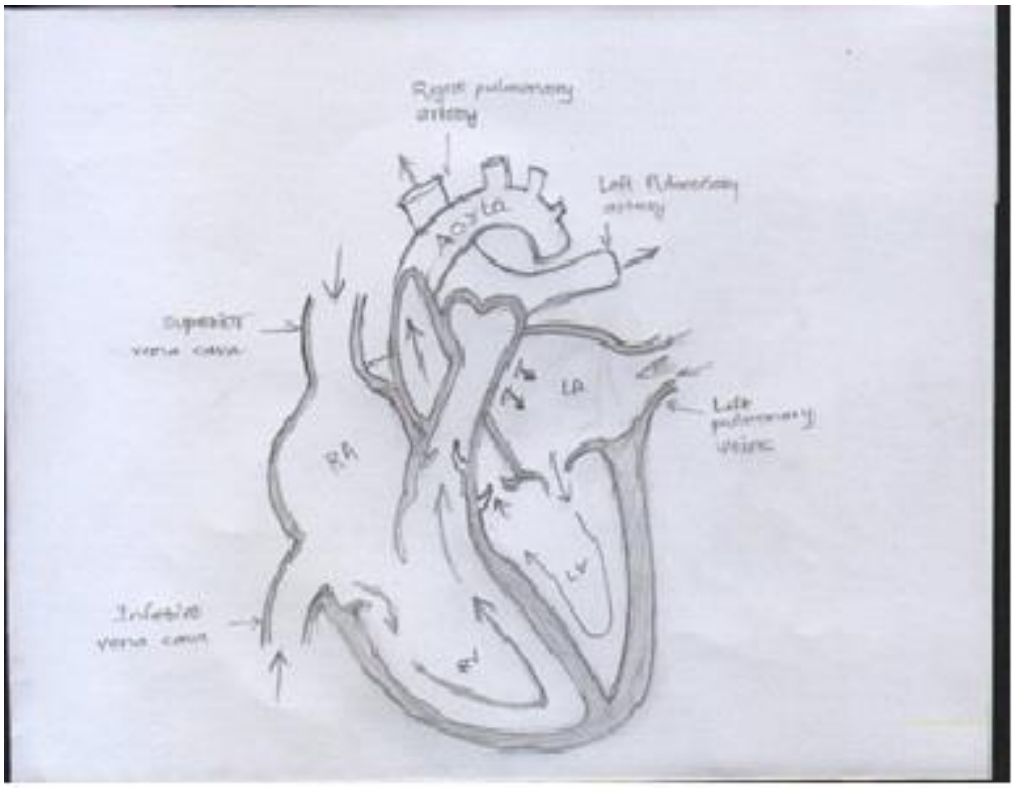
- Neutrophils: Phagocytosis: destruction of bacteria & also remove the cell debris.
- Eosinophils:-Phagocytize antigen-antibody complex, parasitic invasion; overcomes effects of histamine involved in inflammation during allergic reactions.
- Basophils:-liberate heparin, histamine & serotonin at inflammation site in allergic reactions, that intensify overall inflammatory response
- Lymphocytes: These develop into plasma cells which secrete antibodies
- Monocytes: Phagocytosis

4 c) Explain the role of anterior pituitary hormones in the body (3Marks) **3M**

Hormone	Functions
Growth Hormone/Somatotrophic hormone	It stimulates growth directly and in conjunction with other hormones.
Thyroid stimulating Hormone (TSH)/Thyrotrophic hormone	It controls growth & activity of thyroid gland
Adrenocorticotrophic hormone (ACTH)	It stimulates the adrenal cortex to produce their hormones
Gonadotrophic hormones i)Follicle stimulating hormone	In females, it stimulates the ovarian follicle to produce mature ovum and secretion of oestrogen. In males it stimulates spermatogenesis in testis
ii) Luteinising hormone/ICSH in males	In females it stimulates the corpus leutium to produce progesterone. In males, it stimulates interstitial cells to produce testosterone
Lactogenic hormone/prolactin	It has direct effect on mammary glands to produce milk

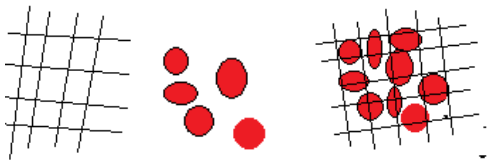
4	**d)**	**Mention the different cranial nerves** I. Olfactory - Sensory II. Optic - Sensory III. Occulomotor-Motor IV. Trochlear -Motor V. Trigeminal -Mixed VI. Abducent- Motor VII. Facial-Mixed VIII. Vestibulocochlear- Sensory IX. Glossopharyngeal- Mixed X. Vagus -Mixed XI. Accessory- Motor XII. Hypoglossal- Motor	**3M**
4	**e)**	**Name the different parts (1.5 M) of male reproductive system with their functions (1.5M)** **2 Testes**: spermatogenesis, secrete male hormone testosterone **2 Epididymis:** It is the site of sperm maturation **Scrotum:** Maintains optimal temperature for spermatogenesis **2 deferent ducts (vas deferens)** : Storage of sperms and also conveys sperms from epididymis to urethra **2 spermatic cords :** Suspends the testis in the scrotum **2 seminal vesicles** : accessory gland which secretes seminal fluid **2 ejaculatory ducts :** Eject spermatozoa & seminal fluid into prostatic urethra prior to	**3M**

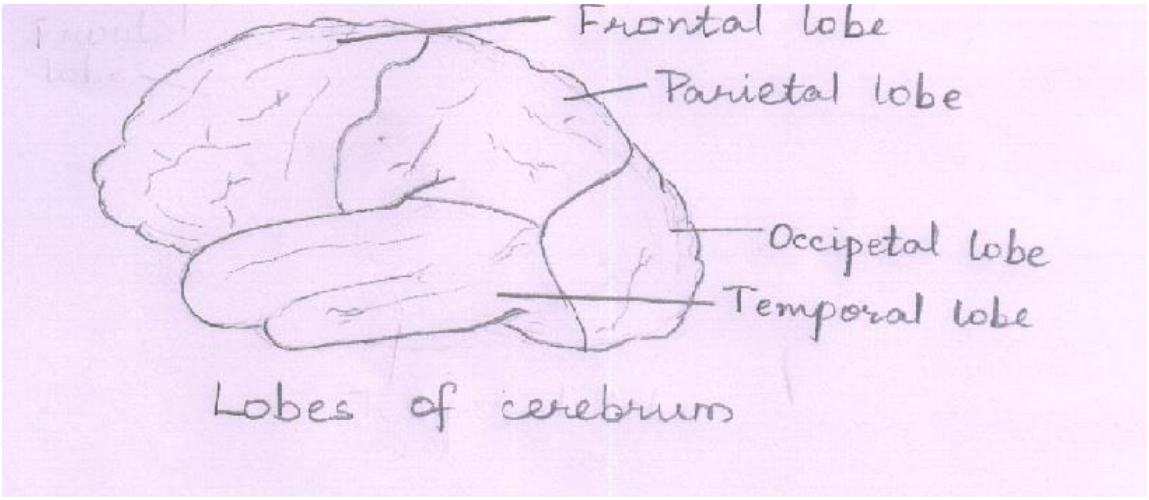
		ejaculation **1 prostate gland :** It secrets prostatic fluid **Urethra & penis:** introduces spermatozoa in vagina	
4	**f)**	**Define and give normal values of (any two) (1.5Marks each)** **i) Tidal volume** It is the volume of air moved in & out of lungs during normal breathing. Normal value is 500 ml. **ii) Vital capacity** This is the maximum volume of air which can be moved into & out of the lungs during forceful breathing. Normal value is about 3-5 lit. **iii) Residual volume** It is the volume of air remaining in lungs after forced expiration. Normal value is 1.2 L in males and 1.1 L in females	**3M**
5		**Solve any FOUR of the following :(3marks each)**	**12M**
5	**a)**	**Explain physiology of respiration.** The term respiration means exchange of gases between body cells & the environment. This involves two main processes. –**Breathing & exchange of gases**. Each breath consists of inspiration, expiration & pause. **Inspiration** The simultaneous contraction of intercostal muscles & diaphragm increases the capacity of thoracic cavity. This reduces the pressure in the lungs. To equalise the pressure the air from atmosphere enters the lungs. The process of inspiration is active as it needs energy for muscle contraction.it lasts for 2 sec. **Expiration** Relaxation of intercostal muscles & diaphragm results in decrease in the space in the lungs. As a result, the pressure inside the lungs increases as compared to atmospheric pressure. The air from the lungs is expelled from the lungs. This process is passive as does not require energy. The expiration lasts for 3 sec. After expiration there is **pause** & then the next cycle begins. **Exchange of gases** The exchange of gases take place between blood & air (external respiration) & between blood & cells (internal respiration).	**3M**

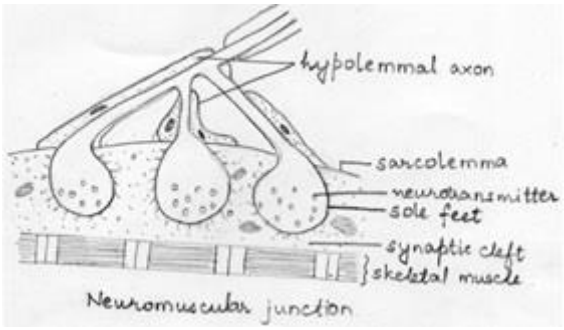
5	**b)**	**Describe with a neat diagram how circulation of blood takes place through heart.(1.5 description,1.5 diagram)** The superior vena cava (for upper body) and inferior vena cava (for lower body) receive deoxygenated /impure blood from various parts of the body through different veins. This deoxygenated/impure blood is poured into the right atrium of heart. The blood from right atrium enters the right ventricle through tricuspid valve, which prevents back flow of blood from ventricle into atrium. The deoxygenated/impure blood from right ventricle is forced into pulmonary artery through pulmonary valve. The pulmonary arteries divide into two branches, each enters the right and left lungs. In the lungs, the red blood cells (RBCs) release carbon dioxide and absorb oxygen. This oxygenated blood from the right and left lungs is collected by four pulmonary veins and poured into left atrium. From left atrium this blood enters into left ventricle through bicuspid valve which prevents back flow into left atrium. This oxygenated blood from left ventricle is forced into the aorta through aortic valve which prevents back flow of blood into left ventricle.  	**3M**

5	**c)**	**Enlist different types of blood cells with their normal values. (types 1.5, values1.5)** Blood cells are classified into 3 types: 1. Red Blood Cells (Erythrocytes) 2.White Blood Cells (Leukocytes) 3. Platelets (Thrombocytes) GRANULOCYTES 1.Neutrophils 2.Eosinophils 3.Basophils AGRANULOCYTES 1. Monocytes 2. Lymphocytes Normal RBC count: Male-4.5-6.5million/mm^3 Female-4.5-5million/mm^3. Normal WBC count: 4000-10,000/mm^3 Normal Platelet count : 1.5 – 4.0 lacs/mm^3	**3M**
5	**d)**	**Describe cardiac muscle in detail.** Cardiac muscles - They are found only in the heart where they are capable of constant rhythmic contractions. These muscle cells are arranged in the form of cylindrical units without sarcolemma. Cells have single nucleus.. The myofibrils have regions of different densities which gives striated appearance. The ends of the cells are in close contact with each other forming thick and dark lines known as intercalated discs.	**3M**
5	**e)**	**Explain physiology of hearing.** The auricle collects the sound waves & through external acoustic meatus directs them to tympanic membrane. These vibrations are transmitted & amplified through middle ear by movement of malleus, incus & stapes (auditory ossicles). The foot plate of stapes rocks to & fro into the oval window, setting the fluid wave in perilymph. Most of the pressure of this wave is transmitted to cochlear duct. This causes wave in endolymph resulting in stimulation of the auditory receptors in the hair cells in organ of Corti(spiral organ). The nerve impulses generated are passed by the eight cranial nerve to the brain.	**3M**

5	**f)**	**Define the terms : (1.5 marks each)** **i) Glaucoma** Glaucoma is increased intra ocular pressure due to impaired drainage of aqueous humor from the anterior chamber of eye. **ii) Night blindness** Night blindness is a condition of the eyes in which vision is normal in daylight but abnormally poor at night or in a dim light due to deficiency of vitamin A.	**3M**
6		**Solve any FOUR of the following :(4 marks each)**	**16M**
6	**a)**	**Describe the structure (2 marks)and functions of uterus.(2 marks)** It is a hollow muscular, pear-shaped organ situated in pelvis. It consists of three parts viz. body, fundus and cervix. The walls of uterus consist of three layers viz., perimetrium, myometrium and endometrium. Perimetrium covers most of the surface of uterus. There is a double fold of ligament (broad ligament) which laterally attaches uterus to the sides of the pelvis. Myometrium is the thickest layer of tissue in the uterine wall. It is a mass of smooth muscle fibres interlaced with areolar tissue, blood vessels and nerves. Endometrium consists of columnar epithelium and contains a large number of mucus secreting tubular glands. **Functions of uterus**: 1.Uterus serves as part of pathway for sperm deposited in the vagina to reach uterine tubes 2. It is site of implantation of fertilized ovum. 3. It is site of development of the fetus, during 40 weeks of gestation. 4. During labour uterus forcefully expels the baby with powerful rhythmic contractions. 5. During reproductive cycles, when implantation does not occur, the functional uterine lining is shed (menstruation).	**4M**

6	b)	**Give the composition of blood (1.5marks) and explain how blood clot is formed. (2.5 marks)** **Composition of blood**:-It is composed of liquid matrix plasma (55%) & different cells suspended in it (45%). Plasma: - Composition:- Water-90-92%, plasma proteins, inorganic salts, nutrients, waste material, hormones & gases. Blood Cells: - Red blood cells / Erythrocytes, white blood cells / leucocytes and Platelets or Thrombocytes. **Mechanism of blood clotting**- Whenever there is damage to the blood vessel, there is formation of rough surface. When blood platelets come in contact with this surface, they get injured and release the substance called thromboplastin. In the presence of thromboplastin & calcium the inactive plasma protein prothrombin is converted into thrombin. This thrombin helps conversion of plasma protein fibrinogen to fibrin. The fibrin is insoluble & it forms threads. The threads of fibrin form a net, in which blood cells are entangled. This mass forms a blood clot. This mechanism involves many blood clotting factors. **Prothrombin+ Calcium+ Thromboplastin → Thrombin** **(inactive) (from damaged tissue) (active)** **Thrombin acts on** ↓ **Fibrinogen → Fibrin** **(soluble) (insoluble)** **Fibrin+ Blood Cells → Clot** 	**4M**

6	**c)**	**Draw a well labeled diagram of cerebrum showing all the lobes.**  	**4M**
6	**d)**	**Give composition (2 marks)and functions of pancreatic juice.(2 marks)** Composition of pancreatic juice – water, mucus, mineral salts, enzymes – lipase and amylase and inactive enzyme precursors- trypsinogen and chymotrypsinogen. **Functions** – • Digestion of proteins – Trypsinogen and chymotrypsinogen are activated by enterokinase to active proteolytic enzyme trypsin and chymotrypsin. These enzymes convert polypeptides to tripeptides, dipeptides and amino acids. • Digestion of carbohydrates – Pancreatic amylase converts all polysaccharides to disaccharides. • Digestion of fats – Lipase converts fats into fatty acids and glycerol.	**4M**
6	**e)**	**Define shock. (1 mark) Explain different types of shock.(3 marks)** Shock occurs when the metabolic needs of the cell are not met with. There is reduction in the circulating blood volume, in the blood pressure & cardiac output. Different types of shock are : • Hypovolemic shock: when the blood volume reduces due to severe haemorrhage, vomiting diarrhea, or burns. • Cardiogenic shock**:** cardiac output is reduced due to damaged heart muscle e.g.	**4M**

		myocardial infarction. • Septic shock**:** due to severe infection, the toxin is released which causes severe vasodilatation or depression of myocardial muscle. • Neurogenic shock**:** due to sudden pain, emotional experience or spinal anesthesia. The reduced sympathetic activity or increased parasympathetic activity reduces the heart rate & cardiac output. Vasodilatation reduces the blood supply to the brain causing fainting. • Anaphylactic shock**:** is a severe allergic reaction to substances like penicillin, peanuts etc. release of histamine & bradykinin causes vasodilatation, & severe bronchoconstriction.	
6	**f)**	**What is neuromuscular junction? (1 mark)Explain physiology of neuromuscular junction. (3marks)** **Neuromuscular junction**: The neuromuscular junction is the synapse between a large myelinated nerve and skeletal muscle fibre.  **Physiology of neuromuscular junction**:. Near the termination in the muscle, the axon branches into tiny fibres that form the motor end plate near the muscle fibre. When a nerve impulse reaches neuromuscular junction, the neuro transmitter released is Acetyl choline at this junction. This changes the permeability of the cell membrane to sodium & calcium ions; as a result the muscle becomes depolarized. This causes muscle contraction. The acetyl choline is hydrolyzed by enzyme acetylcholine esterase .The calcium ion concentration is decreased in the muscle which causes repolarization which leads to relaxation of muscle. .	**4M**
