ST MARY’S UNIVERSITY

TWICKENHAM, LONDON

MSc Degree Examination students registered for

Level **Seven**

Title: **Clinical Physiology and Pathology**

Code: **PHP7002**

Semester: **One**

Date: **January 15th 2020** Time: **9:30 – 11:30 AM**

TIME ALLOWED: **TWO** HOURS

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| **Section 1:** Please answer **ALL** multiple-choice questions by answering A, B, C or D on the answer sheet provided. All multiple-choice questions are worth one mark each (20 marks).  **Section 2:** Please answer 5 short answer questions in the answer book provided; complete **ONE** question from each from sections A, B and C and choose **TWO** questions from section D. All questions are worth 8 marks each (40 marks).  **Section 3:** Long answer question, worth 40 marks. Please select **ONE** question from the choice of three and write in the answer book provided (40 marks). |

**Section One (20 marks)**

Please answer **ALL** of the multiple-choice questions, which are worth one mark each.

1. Select the INCORRECT statement regarding cell structure:
   1. Intracellular fluid (ICF) comprises 2/3 of fluid in the body and is divided into interstitial fluid, circulating blood plasma and lymph and includes small quantities of transcellular fluids as well.
   2. Extracellular fluid (ECF) is in constant motion due to fluid between capillaries and intercellular spaces along the concentration gradient.
   3. Water is the main solvent of ECF and ICF and contains anions and cations which are equally distributed
   4. ICF contains large amounts of K, Mg and phosphates
2. Choose the INCORRECT statement regarding bone histological structure:
   1. Trabecular bone best resists compressive forces, are found in vertebrae and have central and perforating canals.
   2. Compact bone is the majority of the skeleton and consists of concentric rings of lacunae connected to each other by canaliculi.
   3. Osteoblasts are cuboidal cells located along bone surface and comprise 4-6% of total bone cells
   4. Cancellous bone is more elastic than cortical bone with a high turn over rate, resistance to compression and larger surface area for mineral exchange.
3. Select the statement that is NOT correct about cartilage:
   1. Osteoarthritis (OA) is considered the loss of the articular cartilage and is caused by matrix degradation from aggrecanases which have not been clearly identified.
   2. Degradation of network of collagen and proteoglycan in OA cartilage leads to a loss in tensile strength and shear properties of cartilage
   3. Composition of Extracellular matrix ECM determines of the properties of cartilage and is made up of proteoglycans including aggrecan and type III collagen.
   4. Mature cartilage is considered a relatively quiescent tissue with differing turnover rates; it is high in the aggrecan-rich pericellular matrix of chondrocytes and low in the collagen-rich interterritorial and territorial matrices.
4. Which of these statements are NOT correct regarding embryonic ossification?
   1. Intramembranous ossification occurs in a connective tissue membrane from mesenchymal cells which differentiate into osteogenic cells then osteoblasts and form ossification centres
   2. Cartilage formation and ossification occurs during the sixth week of embryonic development
   3. Woven bone comprises foetal bones and is weak, rapidly formed bone which is then remodelled into lamellar bone
   4. At birth, bones are mainly cartilage with primary ossification centres and epiphyseal plates
5. Select the INCORRECT statement regarding the bone remodelling cycle:
   1. Tightly regulated process which replaces old bone with new bone in adults to maintain homeostasis.
   2. Low levels of vitamin D will cause bone formation to correct for excessive calcium absorption in the gut
   3. Osteoblasts regulate osteoid mineralisation after they form new bone.
   4. 85% of phosphate is stored in bones with less than 1% in ECF.
6. Which statement about Buffering in NOT correct:
   1. Buffer is a solution that can resist pH change and is able to neutralise small amounts of acid or base to help maintain homeostasis
   2. Strong acids HCL or bases NaOH dissociate in water and easily change pH in solution which is the same for physiologic compounds found in the body
   3. Main blood buffering system is bicarbonate ion buffer system which adjusts amount of CO2 dissolved in the blood and amount of bicarbonate anions HCO3- present in the blood
   4. Two forms of buffers (which binds H+ and removes it from solution if concentration rises OR releases H+ if concentration decreases) are fast acting chemical buffers and slower physiological buffers.
7. Select the correct statement - decreases in C02 concentration in the blood causes:
   1. Hypoventilation or failure to ventilate, suppression of breathing, weakness, coma
   2. A decrease in hydrogen ions, increasing pH and decreasing rate and depth of respiration
   3. Increased rate and depth of breathing, dizziness, tetany
   4. Increase in hydrogen ions, increase pH, increased rate and depth of breathing
8. Which statement is NOT correct during haemostasis:
   1. Platelets are freely circulating fragments formed from fragments of RBCs
   2. Vascular dilation is maintained by circulating nitrous oxide in the blood vessels
   3. Von Willebrand factor is a glycoprotein which helps platelet adhesion and formation of the platelet plug
   4. Platelets contain vasoactive granules which drive haemostasis and the tissue healing process and include prostaglandins, Tissue growth factor B and ADP
9. Which statement about tissue healing is NOT correct?
   1. Histamine is released by mast cells and causes increased blood flow and fluid infiltration
   2. Neutrophils are granulocytes and are used for phagocytosis after macrophage infiltration
   3. Phagocyte chemotaxis is the movement of phagocytes around the wound site
   4. Monocytes are precoursers to macrophages
10. Which statement regarding nerve action potentials is INCORRECT?
    1. Summation is when a sufficient amount of neurotransmitter is released into the cleft for neuroreceptors to bind with in order to generate an impulse in the post synaptic neurone.
    2. Receptor potentials occur when peripheral sensory receptors provide a graded response to a stimulus and have a threshold in stimulus amplitude that must be reached before a response is generated
    3. Postsynaptic potential (PSP) is the graded potential in the dendrites of a neuron that receive synapses from other cells and can be depolarizing or hyperpolarizing.
    4. Depolarization in a postsynaptic potential is called an inhibitory postsynaptic potential (IPSP) because it causes the membrane potential to move toward threshold.
11. Which statement about the brain is INCORRECT?
    1. Circle of Willis is a component of cerebral circulation and is comprised of 5 arteries (anastomosis of branches of 2 internal carotid and 2 vertebral arteries on inferior surface of brain)
    2. Cerebrospinal fluid flows through the ventricles and into the subdural space via medial and lateral apertures
    3. Carotid arteries contribute to about 80% of total brain blood flow, while 20% comes from vertebral arteries
    4. Cerebrospinal fluid is produced by endothelial cells found in the choroid plexus of each ventricle
12. Select the INCORRECT statement about the endocrine system:
    1. Endocrine function is integrated with the nervous system due to the linking function of the hypothalamus
    2. Anterior pituitary function uses trophic hormones to produce a response in target organs
    3. The hypothalamus does not produce hormones; all hormones are produced by the pituitary or target organs
    4. Endocrine system uses an anastomosis portal system for effective and quick communication.
13. Please select the INCORRECT statement regarding motor end plate:
    1. Acetylcholine is the neurotransmitter which is released into the synaptic cleft of motor neurons innervating a muscle fibre
    2. T tubules which propagate action potentials are similar in cardiac and skeletal muscle
    3. Calcium is stored in cisternae which forms a triad in skeletal myocytes and a diad in cardiac myocytes.
    4. Similar cross bridge formation occurs between actin and myosin filaments in both cardiac and skeletal muscle cells.
14. The dorsal column tract is responsible for the following sensation:
    1. Pain
    2. Proprioception
    3. temperature
    4. crude touch
15. Select the INCORRECT statement regarding the autonomic nervous system:
    1. Sympathetic system has lightly myelinated short preganglionic neurons which use Acetylcholine in synapses to the ganglion whereas the unmyelinated postganglionic neuron uses Noradrenaline
    2. Sympathetic nerve pathways have high levels of divergence with 1 preganglionic fibre affecting 20 post ganglionic neurons for widespread effects.
    3. Parasympathetic nervous system is responsible for rest and digest, is located in the brainstem and sacral spinal cord, and uses Acetylcholine in pre and postganglionic synapses
    4. Preganglionic nerves exit brainstem as cranial nerves and sacral region as spinal nerves before arriving at ganglions where they have long post ganglion neurons to the target organs.
16. Select CORRECT answer about the lungs:
    1. blood supply from pulmonary circulation contains oxygenated blood
    2. Pulmonary artery arises from the pulmonary trunk and carries deoxygenated arterial blood to the alveoli
    3. Pulmonary artery arises from the pulmonary trunk and carries oxygenated arterial blood to the alveoli
    4. Gaseous exchange requires ventilation or perfusion
17. Select the INCORRECT statement regarding Angiotensin II:
    1. Is a vasoconstrictor
    2. It increases renal blood flow limiting fluid loss and preserving blood volume
    3. Aldosterone is released from the adrenal cortex in response to angiotensin II
    4. Angiotensin II secretion is stimulated by decreases in blood pressure
18. Please select the correct statement about the renal system. Water reabsorption or loss can be controlled through changes in permeability of:
    1. Collecting ducts
    2. Proximal convoluted tubule
    3. Distal convoluted tubule
    4. Ascending loop of Henle
19. Select the incorrect statement regarding the Enteric nervous system (ENS):
    1. Enteric nervous system is known as the second brain and is mainly a division of the ANS with a mesh like system of neurons that governs the function of the GI tract
    2. Enteric nervous system can only function under control of sympathetic and parasympathetic systems
    3. Small intestine main function is absorption of minerals and nutrients and the lining is covered in villi which are in turn covered in microvilli
    4. Large intestine has four main functions: reabsorption of water and electrolytes, formation and temporary storage of faeces, maintaining resident gut population of bacteria and fermenting indigestive food by bacteria
20. Select the INCORRECT statement regarding the immune system:
    1. Viruses infective particles that contain DNA or RNA genomes and are inert unless they come into contact with a living cell
    2. Bacteria are multi-celled, prokaryotic living organisms that have a metabolism, have DNA, and can reproduce on their own
    3. Innate immune response is the initial response to disease and uses phagocytic and natural killers cells as well as inflammation and fever to fight off invaders
    4. The adaptive immune response occurs if the immune response is insufficient – also know as cell mediated immunity.

**Section Two (40 marks)**

Please answer **ONE** question each from sections A, B and C and then select any **TWO** from section D. Please write the answers in the booklet provided.

Section A Musculoskeletal systems (Choose **ONE**)

1. Explain how the histological organisation of cartilage maintains cartilage health. Discuss the structural and mechanical features of cartilage then describe how this differs between elastic and articular cartilage. (8 marks)
2. A 12-year-old boy has fallen off his bike and has a spiral fracture in his radius. Describe the different types of healing that can occur for fractures, then describe from micro to macro the stages of healing his fracture should go through. What complications could occur? (8 marks)

Section B Cardiovascular and Respiratory systems (Choose **ONE**)

1. In the lungs, oxygen passes from the alveoli to the blood. Describe the specialised features and functions of each structure and explain how the process is both rapid and efficient. (8 marks)
2. Using graph format, describe the stages, functions and features of the cardiac cycle. Then explain how alterations in lung compliance can affect cardiac cycle structure and function. (8 marks)

Section C Neurological system (Choose **ONE**)

1. You are cycling and suddenly see a car speeding straight towards you. Explain the roles and structures of the limbic system and sympathetic nervous system from sensory perception to your initial physiological reaction of jumping out of the way. What aspects are involuntary and what are voluntary?
2. A man has sustained a concussion after falling out of a tree. Give an overview of the structures that protect the brain and explain the function of each. What structures are potentially compromised during concussion? (8 marks)

**Section D** (Choose **TWO**)

1. Give an overview of the endocrine system from hypothalamus to target organs. Then describe the HPA axis and give an overview of the trophic hormones produced through the axis and the role, function and location of hormones produced in the adrenal glands. (8 marks)
2. Using graph format, describe the four stages of an action potential occurring in skeletal muscle compared to that occurring in cardiac muscle. Compare and contrast each stage, and ensure you include the ions and anions involved and direction of flow. (8 marks)
3. Give an overview of the structures and corresponding functions necessary to maintain glucose homeostasis in the body, then, explain how it is both regulated and stored (micro to macro). What happens when it goes wrong? (8 marks)
4. Explain the bone remodelling cycle, including the structures and functions of the mechanisms utilised to maintain homeostasis. Then describe the influence of the immune system on this cycle and any effects on homeostasis. (8 marks)

**Long answer question**

Please answer **ONE** out of **THREE.** Ensure you use references and a critical approach to substantiate your answers (40 marks).

1. You are walking in the park when you are prickled by a stinging nettle. Give an overview of how the sensory and nociceptive information is recognised and then actioned in the brain. Please ensure you consider the afferent and efferent function and integration of structures from micro to macro – i.e. mechanoreceptors to correct brain areas and the response to maintain homeostasis. Then, critically evaluate the difference between the reflex response and the conscious response to this injury. (40 marks)
2. Tendon and ligament injuries make up between 30-50% of musculoskeletal injuries.  Describe how mechanical structure and function differs between the two tissues; ensure you consider the mechanical and structural properties from a micro and macro viewpoint. Then, critically discuss the overlapping phases of tissue healing (micro to macro) for these tissues and give an overview of factors that could improve this process. (40 marks)
3. Cardiovascular and respiratory dysfunction is increasingly common in the general population. Give an overview of the structure and function of the cardiac cycle and explain how it correlates to respiratory structure and function. Then, critically discuss the effect of COPD on both cardiac and respiratory function. What are the effects on ventilation and perfusion? (40 marks)

**END OF EXAMINATION**