Q.1 Name the bone cells. Describe the structure of osteoclast. Explain its role in osteopetrosis.

Region: Histology Sub-Region: Bone – Connective Tissue

KEY:

**Bone Cells:**
- Osteoblasts.
- Osteocytes.
- Osteoclasts.
- Osteogenic or Osteoprogenitor cells.

**Structure of Osteoclasts:**
These are formed in bone marrow and endosteum. These are large – sized cells (150 μm) with irregular cell membrane (ruffled border) due to finger-like processes of plasmalemmal infoldings. This helps in bone resorption. Osteoclasts are formed due to fusion of many circulating monocytes or tissue macrophages. Their cytoplasm is acidophilic with a foamy appearance. Each cell contains 5-50 nuclei.

**Role of Osteopetrosis:**
It is a genetic disorder where osteoclasts lack in ruffled borders, thus, the bone resorption is defective causing dense and heavy bones called marble bones. There is overgrowth, thickening and hardening of bones. This produces obliteration of bone marrow, cavities, depressed hemopoiesis with consequent anemia and frequent infections which may prove fatal.

Reference: Wheaters Histology
Q.2 Define Spermatogenesis. List the sites of maturation of sperms. Explain capacitation. Mention the sperm count, motility and morphology in fertile – range persons.  

1,1,1.5,1.5

Region: Embryology     Sub-Region: Gametogenesis

KEY:

**Spermatogenesis:** 1
It is the process of formation of sperms in the testes and is defined as the steps starting from mitosis of spermatogenesis till the release of sperms from the seminiferous epithelium.

**Sites of Maturation of Sperms:** 0.25x4
1. Testes.
2. Male Genital Tract (Tubules).
3. Seminal Plasma from male genital glands.
4. Female Genital Tract.

**Capacitation:** 1.5
It is an interaction or conditioning of sperms done by the environment (Secretions) of female genital tract to remove the glycoproteins coat and some other protein molecules of sperm-head plasmalemma. Thus, the plasmalemma eliminates macromolecules (proteins and glycoproteins). It enhances the speed of sperms and is a prerequisite for acrosomal reaction. It is completed in 5-6 hours.

**Seminal Parameters in Fertile Range:** 0.5x3
Count: > 48 million sperms/ml.
Motility: > 63% motile.
Morphology: >12% normal morphological features.

**References:** Embryology by Keith L. Moore
Q.3 Describe the various ways of origin of monozygotic twins. List five complications that may arise during this condition.  

Region: Embryology Sub-Region: Multiple Births

KEY:

**Origin of Monozygotic Twins:** 0.5x4
Two Blastomeres of one zygote separate.
Division of inner cell mass.
Division of bilaminar germ disc before appearance of primitive streak.
Division of trilaminar germ disc involving primitive streak.

**Complications During Monozygotic Twin:**
1. Twin Transfusion Syndrome. 0.5
2. Conjoined (Siamese) twins. 0.5
3. Prenatal mortality. 1
   a) Vanishing twin.
   b) Fetus papyraceus.
   c) Lithopedion.
4. Prenatal morbidity 0.5
   a) Prematurity.
5. Preterm Delivery. 0.5

Reference: Embryology by Keith L. Moore.
Q.4 Define Spiral (Twist) Muscles. Classify them giving examples from upper limb. Enumerate six structures present under cover of pectoralis major muscle. 

Region: Upper Limb, General Anatomy Sub-Region: Myology

**KEY:**

**Spiral Twist Muscles:** 0.5
In such muscles, the muscle fasciculi are angulated (twisted) during their course. They are responsible for rotatory movements.

**Types of Spiral Muscles:**
1. Spiral Muscles with 90° twist. 1
   i). Clavicular part of pectoralis major.
   ii). Trapezius.
2. Spiral Muscles with 180° twist. 1
   i). Sternocostal part of pectoralis major.
   ii). Lattissimus dorsi.
3. Spiral around a bone. 1
   i). Supinator.

**Structures Under Cover of Pectoralis Major Muscle:** 0.25X6
1. Musculocutaneous nerve.
2. Biceps brachii (tendon of long head and short head).
3. Coracobrachialis.
4. Median nerve.
5. Ulnar nerve.
6. Medial cutaneous nerve of forearm.
7. Thoracodorsal nerve.
8. Axillary artery.
10. Lateral thoracic artery.
11. Pectoralis minor.
12. Medial pectoral nerve.
15. Ribs and costal cartilages.
17. Superior thoracic artery.
19. Lateral pectoral nerve.
20. Thoracoacromial artery.
22. Coracoid process of scapula.

Reference: Clinical Anatomy by Keith Moore
Q.5 Draw and label the arterial anastomosis around elbow joint. Why anastomosis are usually present around the joints. 4, 1

Region: Upper Limb  Sub-Region: Angiology

KEY:

**Arterial Anastomosis Around Elbow Joint (Labelling):**
1. Profunda brachii artery.
2. Radial collateral artery.
3. Middle collateral branch of profunda brachii artery.
4. Radial recurrent artery.
5. Interosseus recurrent artery.
6. Radial artery.
7. Ulnar artery.
8. Posterior ulnar recurrent artery.
10. Inferior ulnar collateral artery.
11. Superior ulnar collateral artery.

**Why Anastomosis Around the Joints:**
Obstruction of blood flow through a major artery occurs during movement at a joint. In such conditions, blood by-passes through the anastomosing vessels to the distal region of limb.

Reference: Clinical Anatomy by Keith L. Moore.
Q.6 Define Growing End of a long bone. Name them in the long bones of lower limb. Mention the direction of nutrient canal and ossification timing at growing ends of these bones.

**Growing End Of Long Bones:**
Each long bone has two ends; ossification begins earlier and is completed later at one end, as compared to other end. The end with early appearance and late disappearance of ossification centre is known as growing end, except fibula.

**Growing End in Long Bones of Lower Limb:**
1. Lower end of femur. 
2. Upper end of tibia. 
3. Upper end of fibula.

**Direction of Nutrient foramen:**
1. Recurrent (upwards) in femur. 
2. Downwards in tibia. 
3. Anomalous in fibula.

**Ossification Timings:**
1. Lower end of Femur: Already present at birth and joins shaft at 18th-20th year. 
2. Upper end of Tibia: Already present at birth, joins shaft at 16th -18th year. 
3. Upper end of Fibula: Appears at 3rd-4th year and joins shaft at 17th-19th year.

Reference: Clinical Anatomy by Keith L. Moore.
Q.7 Enumerate six structures passing underneath the Flexor Retinaculum of foot. Explain entrapment neuropathy at this position.

**Region:** Lower Limb  
**Sub-Region:** Foot

**KEY:**

**Structures Passing Underneath Flexor Retinaculum:**
- Tibialis Posterior.
- Tendon Flexor Digitorum Longus.
- Posterior Tibial Artery.
- Veins accompanying posterior tibial artery.
- Tibial nerve.
- Flexor hallucis longus.

**Entrapment Neuropathy at Flexor Retinaculum:**
It is the compression of tibial nerve underneath flexor retinaculum leading to tarsal tunnel syndrome. It occurs due to edema and tightness at the ankle involving the synovial sheaths of the tendons of muscles in the posterior compartment of the leg. The area involved is from the medial malleolus to the calcaneus. Heel pain results due to this compression.

**Reference:** Clinical Anatomy by Keith L. Moore.
Q.8 Draw and Label the fibre tracts in a transverse section of spinal cord at its Cervical Enlargement. Mention the effects of the lesion of Lateral Spinothalamic Tract.

Region: CNS  Sub-Region: Spinal Cord

**KEY:**

**Labelling Of Drawing Of Section Of Spinal Cord (White Fibre Tracts):**

**Tracts in Anterior Funiculus:**  1
1. Ventral Corticospinal tract.
2. *Tectospinal tract.
3. *Vestibulospinal tract.
4. *Olivospinal tract.
5. Ventral Spinothalamic tract.

**Tracts in Lateral Funiculus:**  1
7. *Spino tectal tract.
8. Ventral spinocerebellar tract.
10. Lateral spinocerebellar tract.
11. Lateral corticospinal tract.

**Tracts in Posterior Funiculus:**  1
13. Fasciculus gracilis.
14. Fasciculus cuneatus.
*(Optional to mention)*

**Effects Of Lesion Of Lateral Spinothalamic Tract**

1. At the segment of lesion: Ipsilateral somatosensory analgesia and thermoanesthesia. 1

2. One segment below the lesion: contralateral somatosensory analgesia and thermoanesthesia. 1

Reference: Clinical Anatomy by Keith L.Moore

Snell’s Neuroanatomy
Q.9 Enumerate the topographical basal nuclei of Cerebral Hemisphere. Mention the oscillatory Neuronal circuits involved in Parkinsonism. Describe the biochemical and treatment aspects of this disorder.

**Region:** CNS  
**Sub-Region:** Cerebral Hemisphere

**KEY:**

**Basal Nuclei of Cerebral Hemisphere:**  
1. Corpus Striatum:  
   a) Caudate nucleus.  
   b) Lentifor nucleus.  
      i). Putamen.  
      ii). Globus pallidus.

2. Amygdela.  
3. Clastrum.  

**Oscillatory Neuronal Circuit for Parkinsonism:**  
These circuits are involved between globus pallidus, nucleus ventralis intermedius of thalamus and cerebral cortex. After execution of a motor activity by cerebral cortex, the substantia nigra suppresses globus pallidus. In Parkinsonism, substantia nigra fails to suppress the globus pallidus leading to emergence of above-mentioned oscillatory neuronal circuits due to overactivity of thalamic NVI nucleus.
Biochemical Aspect:  
1. Acetylcholine secreted by fibres of cerebral cortex ending on globus pallidus (excitatory).
2. Dopamine secreted by nitrostriate fibres causing inhibition.

Treatments:  
1. Anticholinergic drugs: these are not used due to severe systemic side effects.
2. Dopaminergic drugs: Ideal.

Reference: Clinical Anatomy by Keith L. Moore  
Gray’s Anatomy