Exam topic and answers

1. *Planes, directions, way of orientation in human body. Epithelial tissue*

There are 3 main types of axes. The sagittal axis, the transverse axis and the longitudinal/vertical axis. Then there are the planes, the sagittal plane and the sagittal plane comes from the sagittal axis. The median sagittal plane splits the body into 2 equal haves which runs down the middle of the skull, sternum, pelvis, etc. the sagittal plane runs parallel to the median laterally. The transverse plane is a cross sectional view of the body at any point horizontally. The frontal plane is the slice view of the body parallel to the forehead and the sternum. The directions tell us an approximate location and all have opposites. Superior ←→Inferior, posterior ←→ Anterior, Lateral ←→ Medial, Superficial ←→ Deep. Then there is positioning such as median or inter-medial. Superior is to be a above in relation to a location on a vertical axis, posterior is to the back from a location on the horizontal axis, laterally is away from the mid line of the body, superficial is towards the surface e.g. towards the skin. Then the median is the mid-line on the sagittal plane and the inter-medial is between 2 points.

Epithelial tissue is made up of polygonal, tightly attached cells and contain a small amount of the inter cellular matrix. Epithelial tissue's function is isolation, protection, transport (as it is surface covering and allows for bi-directional transport e.g. secretion). There are glandular epithelium (secretion), absorptive epithelium (absorption) and sensory epithelium.

2. *Humerus, Radius and Ulna*

The humerus, radius and ulna are all bone of the arm and are classified as long bones. The humerus is the upper arm bone which partly forms both the shoulder and elbow joint. It has a number of bony surfaces such as head of humerus, anatomical neck, intertubercular sulcus, greater/lesser tubercle, surgical neck, crest of greater/lesser tubercle, body of humerus, deltoid tuberosity, lateral/medial border, anteromedial/anterolateral surface, lateral supraepicondylar ridge, radial fossa, coronoid fossa, medial supraepicondylar ridge, lateral/medial epicondyle, capitulum of humerus, condyle of humerus and trochlea of humerus. The radius and ulna form the forearm and are both partly responsible for the elbow and wrist joint as well as the articulation between them both. The radius' boney surfaces are head of radius (articular circumference), neck, radial tuberosity, nutrient foramen, interosseous border, anterior border, anterior surface, radial styloid process, shaft, posterior border/surface, lateral surface, dorsal tubercle. The Ulna's bony surface's are olecranon, trochlear notch, coronoid process, radial notch, tuberosity of ulna, nutrient foramen, anterior surface, interosseous border, head, ulnar styloid process, shaft, medial surface, posterior border/surface and the supinator crest.

The ulna is located on the side of the digiti minimi (little finger) and the radius is on the side of the thumb.

3. ***Carpal bones, carpal canal. Metacarpal bones and fingers***

All of the bones in the hand are classified as short bones. The carpal (wrist) bones comprise of 8 bones:- the hamate, pisiform, triquetrum, lunate, trapezium, trapezoid, capitate and scaphoid.

The metacarpals form the palm and made up of 5 bones simply labelled 1-5 starting from the radial side to the thumb side. The fingers also known as phalanges are made up of 14 bones the thumb contains 2 phalanx (proximal and distal), where as fingers 2-5 have 3 each known as proximal, middle and distal. All of the phalanges are labelled 1-5 from the thumb side apart from the middle phalanges which are 2-5.

The carpal tunnel is made up from the scaphoid, lunate, pisiform, triquetral bones and is contained by the transverse carpal ligament. The carpal tunnel contains the superficial and deep flexor tendons, flexor pollicis longus tendon, median nerve and the flexor carpi radialis. It is then surrounded by the flexor retinaculum, ulnar artery and ulnar nerve just to mention a few. Now when one or more of these muscles become inflamed or swells it puts pressure on the median nerve causing it to become compressed or entrapped which is a condition known as carpal tunnel syndrome.

4. ***Shoulder joint, muscles acting on the shoulder joint***

The shoulder joint is made up of the glenoid fossa, corocoid process, acromion process (these three arise from the scapula) and the clavicle. There is a joint capsule formed by the glenohumeral ligaments (superior, median and inferior). There is a number of other ligaments that help form the ball and socket joint which is the shoulder joint:- coracoacromial ligament, coracoclavicular ligament, acromioclavicular ligament. The humeral head is held in place by different ligaments/tendons:- coracohumeral ligament, subscapularis, supraspinatus.

muscles	origin	insertion
Pectoralis minor		
Pectoralis major		
Subclavius		
Serratus anterior		
Deltoid		
Supraspinatus		
Trapezius		
Levator scapulae		
Rhomboid minor		
Rhomboid major		
Infraspinatus		
Teres minor		
Teres major		
Subscapularis		
latissimus dorsi		
Biceps brachii		
Coracobrachialis		
brachialis		
Triceps brachii		

The general functionality of the muscles of the shoulder girdle and shoulder is to offer full mobility of the arm and elevation and depression of the shoulder girdle.

5. *Elbows. Muscles acting on the shoulder joint*

The elbow joint is a composite joint, with the humerus, the radius and the ulna articulating in 3 partial joints:- humeroulnar joint – hinge joint with the trochlea forming the ball and the trochlear notch forming the socket. Humeroradial joint – multi-axial ball and socket joint involving the capitilum(ball) and the articular facet of the radius(socket). Proximal radioulnar joint – pivot joint involving the articular circumference of the head of radius (ball) and the radial notch of the ulna (socket).

The joint capsule encloses the cartilaginous articulating surfaces of all 3 bones. The capsule is reinforced by accessory ligaments. Two collateral ligaments are responsible for lateral stabilisation of the elbow joint. Medially the ulnar collateral ligament connects to the medial epicondyle of the humerus with the coronoid process (anterior part) and the olecranon (posterior part) of the ulna. The radial collateral ligament originates from the lateral aspect of the lateral epicondyle and radiates out to join the anular ligament of radius which is attached to the anterior and posterior part of the ulna to loop the head of radius. The anular ligament allows for guided rotational movements in the proximal radio-ulnar joint. (go to q4)

6. *Wrist, muscles of the hand*

The wrist is made up of 10 bones – the radius, ulna, scaphoid, triquetrum, capitate, hamate, lunate, pisiform, trapezoid, trapezium. In addition to the smaller joints between the different carpal/metacarpal bones. The wrist consists mainly of 2 joint the proximal wrist joint (radiocarpal) – it is a condyloid joint and connects the bones to the forearm (socket) with the carpus (joint head). Between the triquetrum and the ulna is a articular disk.

Distal wrist joint (midcarpal) also functions as a condyloid joint. Carpal bones of the proximal row articulate with the distal row.

The ligaments of the wrist and metacarpus are:-

Palmar/dorsal radiocarpal ligaments and palmar ulnocarpal ligament; Radial and ulnar collateral ligaments (from the styloid process); Palmar, dorsal and interosseous intercarpal ligaments; Radiate carpal ligament; Pisohamate ligament; Palmar and dorsal carpometacapal ligaments; Palmar, dorsal and interosseous metacarpal ligaments.

The range of movement in the carpal joint – radial/ulnar abduction 30^{o} each way, dorsal extension + palmar flexion 60^{o} each way.

The muscles of the hand are broken in to 3 groups:- thenar, palmar and hypothenar.

Thenar:- abductor pollicis brevis (median N.), flexor pollicis brevis (median/ulnar N.), opponens policis (median/ulnar N.), adductor pollicis (ulnar N.)

Palmar:- lumbricals I-IV (I, II median N./ III, IV ulnar N.), palmar interossei I-III ulnar N., dorsal interossei I-IV ulnar N.

Hypothenar:- palmaris brevis, abductor digiti minimi, flexor digiti minimi brevis, opponens digiti minimi. All of these muscles are innervated by the Ulnar Nerve.

7. ***General osteology, bone tissue, bone development***

There is 206 bones in the human body which are the skull and upper jaw 21 bones, 3 tiny bones in each ear, mandible, front neck bone (hyoid), backbone/spine has 26 separate bones, 12 pairs of ribs, breast bone, each upper limb has 32 bones and each lower limb has 31. There are 5 types of bone classifications:- long (e.g. humerus), short (e.g. carpals), irregular (e.g. vertebrae), flat (e.g. sternum) and sesamoid.

There are 2 types of connections between bones, continuous (synarthrosis) and discontinuous (diarthrosis, joint, articulation).

Synarthrosis – syndesmosis (connective tissue), synchondrosis (cartilage, hylain or fibre) or synastosis (ossification)

Diarthrosis – general structure -bony surfaces, cartilage, capsule, cavity, ligaments. It has 2 layers; internal – rich in blood vessels and fibres, outer – connective tissue fibres.

Accessory structures are things like disks, menisci, bursas, cartilingenous labrum, musculi articulares.

The type of joints are the uniaxial, biaxial and multi axial.

The formation of bones is known as ossification. There are 5 distinct stages 1. Formation of bone collar around the hyaline cartilage model, 2. Cavitation of the hyaline cartilage within the cartilage model. 3. Invasion of the internal cavities by the periosteal bud and spongy bone. 4. Formation of the medullar cavity as ossification continues; appearance of secondary ossification centres in the epiphysis in preparation for the next stage, 5. Ossification of the epiphysis; when completed hyaline cartilage remains only in the epiphyseal plates and articular cartilages.

8. ***Flexor and extensor muscles of the forearm***

Although the biceps brachii and brachialis are both flexors of the brachium they both also act of the elbow offering flexion. For the flexors of the forearm there are both superficial and deep layers. The superficial layer consists of the pronator teres, flexor carpi radialis/ulnaris, palmaris longus and superficial digitorum. For the deep layer there is the flexor digitorum profundus, flexor pollicis longus, and the pronator quadratus.

Like the flexors the extensors also have a superficial and deep layer. Superficial layer consists of the brachioradialis, extensor carpi radialis longus and brevis, extensor digitorum, extensor digiti minimi and extensor carpi ulnaris. The deep extensors consist of the abductor pollicis longus, extensor pollicis longus and brevis, extensor indicis and the supinator.

Now for the superficial extensors they all originate from some point on the medial epicondyle of the humerus with the exception of the muscles with 2 heads therefore have 2 origins which are the flexor carpi-ulnaris, flexor digitorum superficialis and the pronator teres which have radial and ulnar heads also. Also all of these muscles are innervated with the median nerve with the exception of the flexor carpi ulnaris which is innervated by the ulnar nerve.

The deep flexors differ as for the flexor digitorum profundus originates from the anterior surface of the ulna and interosseous membrane, and is innervated by both the ulnar nerve and the anterior interosseous nerve, the flexor pollicis longus originates from the anterior surface of the radius and is innervated solely by the anterior interosseous nerve, the pronator quadratus originates form the

distal part of the anterior surface of the ulna and is also innervated by the anterior interosseous nerve.

Now moving onto the superficial extensors all are innervated by the radial nerve. Also all these extensors originate from the lateral epicondyle of the humerus with the exception of the brachioradialis and the extensor carpi radialis and the extensor carpi ulnaris has 2 heads one of which originates from the olecranon. The brachioradialis originates from the lateral border of the humerus and the extensor carpi radialis originates form the lateral supracondylar ridge up to the lateral epicondyle.

The deep extensors are all innervated by the deep branch of the radial nerve. Apart from the supinator they all have a part origin on the interosseous membrane. The extensor pollicis longus, abductor pollicis longus and extensor indicis also have origins on the posterior surface of the ulna, the extensor pollicis brevis has a part origin on the posterior surface of the radius. The supinator is the only one that differs as it originates from the lateral epicondyle of the humerus and the supinator crest.

9. General myology, muscle tissue, structure of tendons

Musculature is an active component of movement, structures comprise of striated muscle (skeletal), tendons are dense connective tissues and connective tissue sheath is known as fascia. There are three types of muscle tissue which are smooth muscle, striated muscle and cardiac muscle. There function is to contract with origins in the mesoderm and are structured of cells or fibers.

Smooth muscle is phylogenetically the most ancient type and are made of spindle shaped cells, they offer slow, non-synchronised, involuntary contractions. Actin and myosin are not organised in registers and are normally found in organ walls with a nucleus in the centre of the cell.

Striated muscle tissue is a muscle tissue the features repeating functional units called sacromeres . sacromeres manifest as a series of bands visible along the muscle fibers which is responsible for the striated appearance. Cardiac muscle also comes under the same category as striated muscle although it is generally treated differently due to its slight difference. Contractions in normal striated muscles are voluntary where as with the cardiac muscle is contracted involuntary and is regulated by the sinoatrial nerve. During voluntary contractions a striated muscle is extended by the action of an antagonistic muscle and are connected to the skeleton via a tendon. The fibers of striated muscles are cylindrical shaped with blunt ends. Striated muscle also contains more mitochondria than smooth muscle and contains giant multinucleated cells. Cardiac muscle also has a nucleus at the centre of the cell and has many capillaries.

Muscles have many shapes: spindle triangular, quadrangular and flat. They can also be unipennate or bipennate. Uni pennate Is a muscle on one side of the tendon and bipennate is the muscle on either side of the tendon. The structure of a tendon starting superficially is a tendon sheath, outer fibrous layer, inner synovial layer and the mesotendon.

10. General syndesmology, cartilaginous tissue

11.Structure and types of joints

Joints usually increase the range of movement significantly. The are classified based on the shape of their articulating surface and/or the freedom of movement they allow. Based on the main axes of motion we can distinguish uniaxial, biaxial and multiaxial.

Hinge joint, cylindrical joint (ginglymus) – uniaxial joint, allows flexion and extension

Conoid joint/pivot joint – uniaxial joint, permits rotational movements

Condylar or ellipsoid joint – biaxial, permits extension, flexion, adduction, abduction, and restricted rotational movement

Speroidal or ball and socket joint – multiaxial joint, permits all movements

Plane joint – joint permits simple gliding movements in different directions

12.Blood supply of the upper limb

Arteries	Veins	
Axillary artery	*superficial*	*deep*
Brachial artery	basillic vein(R)	brachial
Radial ulnar	cephalic vein (U)	axillary
Palmar arches		

Arteries: the axillary artery begins at the outer border of the 1st rib as a continuation of the subclavian artery and supplies the integuments of the shoulder it then ends at the lower border of the teres major muscle where it then becomes the brachial artery which is the main arterial supply for the arm and it runs down to and slightly lateral to the cubital fossa where it the splits in to the radial artery and the ulnar artery. The radial artery runs down the radial side (thumb side) down to the wrist where it wraps around the distal end of the radius when it pierces through the interosseous membrane and continues into the palmar side of the hand where it forms the deep palmar arch with the deep branch of the ulnar artery which runs down the ulnar side (little finger side) to the wrist where it then forms the superficial palmar arch with a little branch of the radial artery.

The superficial veins form a plexus. The inner plexus is formed form the veins of the little finger and the outer plexus is formed form the veins in the thumb these then merge to form a superficial dorsal arch of veins, they then travel past the wrist to form the radial and ulnar veins. The ulnar vein then moves up the arm to form the basillic vein which travels up the medial side of the upper limb, the radial vein travels up laterally to form the cephalic vein which continues laterally on the lateral side of the upper limb. Both the cephalic and basillic vein are joined by the medial cubital vein near the elbow.

The deep veins consist of the brachial veins and the axillary vein. The brachial vein is formed by the ulnar vein and the radial vein uniting. The axillary vein is a large blood vessel that carries blood from the thorax, axilla (armpit) and the upper limb towards the heart and there are only 2 of these veins one on each side of the body.

The deep and superficial veins actually join. The brachial vein and the basillic vein join to form the axillary vein and the cephalic vein then drains into the axillary vein.

13.Innervation of the upper limb

The innervation of the upper limb is known as the brachial plexus. This plexus is formed by the union of the lower 4 cervical (C5-C8) and 1st thoracal (Th1) nerves and they are known as the roots. This runs from the axilla supplying the motorary and sensory fibers of the upper limb.

C5+C6 form the superior trunk, C7 forms the middle trunk and C8+Th1 form the inferior trunk. There is then a division which then form the chords which are lateral, posterior and medial. This then brings us to our terminal nerves which are the musculocutaneous, median, axillary, radial and ulnar.

The musculocutaneous nerve supplies the muscles on the front of the arm at the end branch is then becomes the lateral cutaneous nerve which supplies which becomes superficial and supplies the skin on the lateral aspect of the forearm.

The median nerve then primarily the flexor muscles of the forearm muscles and skin of the hand.

The axillary nerve is a large terminal branch that travels to the back of the arm to supply the muscles of the shoulder joint and some of the muscles in the shoulder girdle and the skin surrounding the shoulder.

The radial nerves mainly supplies the flexors of the upper limb and the skin in that region and the skin on the back of the hand (dorsal).

The ulnar nerves supplies the muscles on the medial side of the forearm and most of the muscles of the hand and some of the skin in those regions.

14.Vertebral column

Of the vertebral column there are 26 bones broken into 5 groups; cervical (CI-CVII), Thoracic (TI-TXII), Lumbar (LI-LV), Sacrum (5 fused vertebrae), coccgyx (fused of 3-4 vertebrae).

CI and CII are know as the atlas and the axis as they are the connection to the skull offering support and movement and are the only 2 that differ from the rest of the cervical vertebrae. The thoracic vertebrae articulate with 12 pairs of ribs and the sacrum offers articulation with the hip bones. When viewed in a sagittal plane curvatures of the spine are noticed cervical lordosis, thoracic kyphosis, lumbar lordosis and sacral kyphosis. Lordosis is a anterior curvature of the spine where as kyphosis is a posterior curvature.

Vertebrae are an irregular bone and consist of a vertebral body and a vertebral arch which generally has a spinous process, transverse process, lamina and the body and arch are connected via a pedicle.

In the vertebral column the vertebra are separated by inter vertebral disks and this connection is known as synchondrosis which is a type of continuous bony connection. The disks are made of 2 sections anulus fibrosus and nucleus pulposus with a thin layer of hyaline cartilage between the disk and the vertebrae.

The atlanto occipital joint isd an ellipsoid joint allowing for flexion an extension and slight lateral flexion. The atlanto-axial joint allows for 50% of cervical rotation, flexion of 10^{o} (approx.) and very limited extension.

15.Chest cavity, diaphragm, respiratoric movements

The chest cavity is made up of a number of different bones and muscles. Bones that contribute to the formation of the chest cavity are the TI-TVII vertebrae, 12 pairs of ribs , costal cartilage, sternum, manubrium and the xiphoid process. Of the pairs of ribs there are 7 true ribs and 5 false 2 of which are also floating ribs (not connected to the sternum). The superior thoracic aperture (opening at the top of the cavity) is bordered by ribs 1, manubrium, TI and the costal cartilage of ribs 1. The inferior thoracic aperture (opening of the lower part of the chest cavity) is bordered by the distal cartilaginous ends of ribs 7-10, ribs 11-12, TXII and the xiphoid process.

The respiratory muscles involved are three types the intercostalis muscles, diaphragm and the accessory muscles. The intercostalis muscles consist of internal and external parts, the external ones help to elevate the ribs and help to reinforce the intercostal space during deep inspiration and the internal ones help to depress the ribs and reinforce the intercostal space during deep expiration.

The diaphragm consists od 2 parts the central part and the muscular part. The central part consists of the caval hiatus for the inferior vena cava which is located roughly around TVIII, the muscular part has 3 sub-groups the sternal part, costal part and lumbar part in relation to there locations. The sternal part allows for the passage of the superior epigastric artery and the lumbar part has an esophogeal hiatus for the esophagus (at TXII), aortic hiatus for the aorta and a thoracic duct (at LI).

The movement of the chest or thorax during inspiration is out and up and expiration is down and in.

(refer to bucket and water pump)

The accessory muscles consist of the sternocleidomastoid, scalene muscles (inspiration) and the abdominal muscles (expiration).

16.Muscles of the back. Movements of the vertebral column

back muscles are broken into 3 main groups the superficial, deep and transversospinal.

The superficial has the trapezius, levator scapulae, rhomboid minor/major, latissimus dorsi.

The deep has another 3 sub-groups of the spinalis, longissimus and the iliocostalis.

Then the transversospinalis which are the semispinalis (2 types), multifidi and the rotatores.

The movement of the spinal column is based on the zygapophyseal (facet) joint between the vertebrae and movement differs with the different regions:- cervical region allows for all movements such as flexion, extension, lateral flexion and rotation. The thoracic region allows for lateral flexion and rotation but no flexion or extension. And the lumbar region allows for just flexion and extension. The spinal column also has a number of covering structures (ligaments) supporting it such as the

anterior/posterior longitudinal ligaments, ligament of flava, inter spinalis, supraspinous ligament and ligamentum nuchae.

17.Bones of the lower limb

The leg consists of 4 bones the femur, fibula, tibia and the patella and the foot has 26 bones which are the talus, calcaneus, navicular, cuboid, 3 cuneiforms (these first ones are the tarsal bones), 5 metatarsals and 14 phalanges. Also part of the hip bone articulates with the femur and is counted as part of the lower limb making a total of 31 bones in the lower limb. The hip articulates with the head of femur forming the hip joint (ball and socket) then the distal end of the femur articulates with the tibia and patella forming the knee joint (hinge/pivot). The tibia (shin bone) articulates with the fibula at both ends but distally they both articulate with the talus bones forming the ankle joint (talotibiofibular joint).

The femur is the longest bone in the human body and a few of is most important surfaces starting proximally are the head, neck, greater trochanter, lesser trochanter, intertrochantric line, inter trochanteric crest. Then on the shaft pectineal line, gluteal tuberosity, linea aspera, medial/lateral supraconylar line, adductor tubercle. Then the distal end there is the medial/lateral condyles, medial/lateral epicondyles, intercondylar fossa.

The tibia has starting from the proximal end the medial/lateral condyle, intercondylar tubercles, tibial tuberosity, intercondylar eminence, soleal line, groove for tibialis posterior tendon, medial malleolus and the radial notch.

The fibula has three sides broken into different compartments labelled the anterior surface, medial surface and the posterior surface. Its bony landmarks from the proximal end are the head, neck, interosseous border, nutrient foramen, malleolar groove, articular facet and the lateral malleolus.

18. Connective tissue

Function: connects organs, fills in spaces, storage and protection.

Structure: cells + extracellular matrix

Origin: mesoderm

The extracellular matrix is made up of fibers and ground substances. Fibers: collagen, elastic and reticular.

There are different types of these tissues - loose connective tissue, adipose tissue and dense connective tissue.

Loose connective tissue: location – below the dermis of the skin, respiratory and urinary tracts, between muscles, arounds blood vessels, nerves and joints.

Adipose tissue: location – deep in the skin especially to the sides, buttocks and breasts. And padding around the eyes and kidneys.

Dense connective tissue: location – between skeletal muscle and skeleton (tendons), between bones (ligaments), covering skeletal muscles and capsules of internal organs. This tissue has a regular and irregular part and the type depends on the arrangement of bundles.

19.Blood and blood vessels

Blood is made up of 2 things cells + extracellular matrix (plasma). Cells take up 45% (either red blood cells, white blood cells or platelets) and plasma is 55% (90% water, ions, proteins, gases, nutrients, waste and hormones).

Erythrocytes are RBC and are biconcave with no nucleus and only live for about 120 days. Leukocytes are WBC and also broken down into granulocytes and agranulocytes.

Granulocytes have a segmented nucleus and granules inside the cytoplasm which are 3 different types – neutrophil, basophil and eosinphyl.

Neutrophils engulf and destroy bacteria and other pathogens. Most abundant type of WBC and plays a large role in fighting many types of infection.

Basophils is the immunological response to parasites and contains mediators of inflammatory response and binds to the IgE produced in response to allergens. Triggers rapid exocytosis of granule contents.

Eosinophils attack and kill parasites as well as phagocytize allergens and antigen antibody complexes (reduces inflammation and allergic reactions).

Erythrocytes are filled with haemoglobin which is a protein that functions is gas transport (e.g. oxygen), and contain a plasma membrane protein spectrin and other proteins that give erythrocytes their flexibility and ability to change shape when needed.

There are 3 types of blood vessels arteries, veins and capillaries.

Arteries carry blood from the heart at high pressure through a narrow lumen. The wall is thick and consists of 3 layers tunica – intima, media and externa. And also contain a large amount of elastic fibers with no valves.

Veins carry blood towards the heart under low pressure which is why they require non-return valves, the pressure is low due to a wider lumen but the walls are much thinner and the 3 layers of wall are the same as the artery and has a small amount of elastic fibers.

Capillaries allow for material exchange with different tissues under low pressure the lumen is only 1 cell wide and the wall is only one tunica intima 1 cell thick it also has no valves or elastic fibers.

20.Abdominal muscles. Inguinal canal

external oblique has an origin on the outer surface of 5^{th}-12^{th} ribs and inserts on the outer lip of the iliac crest and the rectus sheath. Internal oblique has an origin on the intermediate line of the iliac crest and the anterior superior iliac spine then it inserts on the lower borders of the 10^{th}-12^{th} ribs and the linea alba. The transverse abdominis originates on the inner surface of the 7^{th}-12^{th} ribs, inguinal ligament and the anterior superior iliac spine then inserts on the rectus sheath, linea alba an

the pubic crest. The rectus abdominus originates on the cartilage of the 5^{th}-7^{th} ribs and xiphoid process the inserts between the pubic symphysis and the pubic tubercle.

All of these abdominal muscles are active in expiration during the breathing process and in someway or another the movement of the lumbar spine.

The inguinal canal is a cylindrical canal situated above the medial half of the inguinal ligament and in both sexes carry the ilioinguinal nerve and is normally larger in males. The walls have 4 sides:- superior is the internal oblique and transverse abdominis muscles. The anterior wall is the external oblique aponerosis. The inferior wall is the inguinal ligament and the posterior wall in the transversalis fascia and the parietal peritoneum.

It also contains a superficial and deep inguinal ring which also contain either the spermatic cord or round ligaments of the uterus.

21.Hip: bones and joints

The hip bone starts off as 3 separate bones the ilium, ishium and the pubis. There is definitive fusion of a Y shaped growth plate which normally occurs between the 16^{th} and 18^{th} year. There are many bony structures on them:-

Ilium: iliac tuberosity, body of ilium, acrurate line, iliac fossa, articular surface for sacrum, ligament attachment site, posterior superior iliac spin, posterior inferior iliac spine, anterior superior iliac spine, anterior inferior iliac spine, iliac crest, tuberculum of ilium, greater sciatic notch, gluteal surface.

Ishium: body of ishium, ramus of ishium, ishial spine, lesser sciatic notch, ishial tuberosity.

Pubis: body of pubis, pubic crest, inferior pubic ramus, superior pubic ramus, pectineal line, obturator groove, pubic tubercle.

It can also be broken into 3 anatomical parts: abdominal part, articular part and pelvic part. The articular part is also a part of the pelvic part. The 2 hip bones are joined by the sacrum and the pubic symphysis. The joint between the sacrum and the hip is known as the sacroiliac joint. With men and women the shape of the pelvis changes slightly in that a woman has more of a circular pelvic inlet and a mans is smaller and heart shaped. The pelvis has a greater and lesser sciatic foramen which are named due to the greater and lesser sciatic notches and what passes through them and are separated by the sacrospinous ligament, the obturator canal is formed by the obturator membrane and the subinguinal hiatus which is closed off by the inguinal ligament.

The hip joint is a ball and socket joint and there is a ligament of head of femur which inserts in the fovea of the femur helping to keep it in the joint. The joint is made up of the acetabular fossa/ligament, lunate surface and the acetabular labrum. The extra capsular ligaments that protect the joint are the iliofemoral, ishiofemoral and pubofemoral ligaments. Which help when the leg is extended the ligaments twist forcing the head of femur further into the joint for added support.

22.Knee joint, muscles acting on the knee

The knee is a trochoginglymus (hinge & pivot) joint and is formed by the articulation of the femur and the tibia. The joint has menisci to protect the joint the medial meniscus is more C-shaped and the lateral is almost a full ring. It also contains a few intracapsular ligaments: anterior cruciate ligament, posterior cruciate ligament, transverse ligament and posterior meniscofemoral ligament. The extracapsular ligaments consist of the tibial collateral ligament and the fibular collateral ligament. The patella (knee cap) is a separate bone of the knee that is hed in place by the patellar ligament, an extracapsular ligament and the oblique popliteal ligament. The joint also has 3 main bursa: prepatellar bursa, infrapatellar bursa and the suprapatellar bursa. The joint allows for flexion, hyperextension and even slight voluntary rotation. The muscles that act on the knee come in 2 groups flexors and extensors.

Extensors: the quadriceps femoris is a group of 4 muscles the rectus femoris, vastus medialis, vastus lateralis and the vastus intermedius.

Rectus femoris has 2 origins of short head at the anterior inferior iliac spine and the reticular head at the cranial rim of the acetabulum, the vastus medialis has an origin on the medial lip of the linea aspera, the vastus lateralis has an origin on the greater trochanter and the vastus intermedialis has an origin on the anterior surface of the thigh. This group of muscle all have the same insertion on the patella and tibial tuberosity via the patellar ligament. The tensor fascia latae doesn't really move the knee but offers added stabilisation when extended.

Flexors: the hamstrings group has 3 muscles the biceps femoris, semitendinosus and the semimembranosus. These three muscles have the same origin at the ishial tuberosity but the biceps femoris has 2 heads therefore a second origin which is the middle third of the lstersl lip of the linea aspera. The insertions however do change the biceps femoris inserts on the head of fibula, the semitendinosus superficially at the medial condyle of tibia and the semimembranosus deep at the medial condyle of the tibia.

The popliteus originates on the lateral condyle of femur and inserts on the posterior surface of tibia superior to the soleal line. The satorius originates on the anterior superior iliac spine and inserts superficially at the medial condyle of tibia same as the gracilis which has an origin on the body of pubis, inferior pubic ramus.

23.Tibia and fibula. Tarsal bones

The tibia and fibula are both categorised as long bones and are the bones of the lower part of trhe leg. They are both parts of the knee and the ankle joints. The tibia and fibula both have a number of bony structures used for attachment of ligaments, tendons and articulation. The tibia has 2 superior articular surfaces anterior/ posterior intercondylar areas, medial/lateral condyles, tibial tuberosity, medial/anterior border, medial/lateral/posterior surface, interosseous border, shaft, fibular notch, inferior articular surface, articular facet, medial/lateral intercondylar tubercle, soleal line and the malleolar groove.

The fibula has the head, apex of head, 2 articular facets (proximal/distal), neck, medial crest, interosseous border, nutrient foramen, medial/lateral/posterior surface, anterior/posterior border, shaft, malleolar fossa, malleolar groove and the lateral malleolar.

The foot is sectioned into 3 groups, tarsus with the tarsal bones, metatarsus with the metatarsals and the toes with the phalanges. The tarsus comprises of the talus, calcaneus, navicular, cuboid, 3

cuneiforms(medial, intermedial and lateral). Clinically the forefoot is distinguished from the hind foot and separated by the articular line in the tarsometatarsal joints. Also between the tarsal bones there is a transverse tarsal joint which separates the talus and calcaneus from the rest of the tarsal bones. These bones help to form the ankle joint (talocrural and talocalcanonavicular) which allow for the movement of the ankle.

24.Extensor and flexor muscles of the thigh

Look at q22.

Pectineus originates pectin pubis and inserts at the lesser trochanter and the pectineal line of the thigh, adductor brevis originates from inferior pubic ramus and inserts on the proximal third of the linea aspera, adductor longus originates from pubis up to the pubic symphysis and inserts at the middle third of the linea aspera, adductor magnus originates from the inferior pubic ramus, ramus of ishium and the ishial tuberosity it inserts on the proximal 2/3's of the medial lip of linea aspera and the medial epicondyle of thigh.

25.Extensor and flexor muscles of the leg

Tibilalis anterior: O- lateral surface of the tibia, interosseous membrane, I – metatarsal 1, medial cuneiform

Extensor hallucis longus: O – lateral surface of tibia, interosseous membrane, I – distal phalanx of big toe

Extensor digitorum longus: O – lateral condyle of tibia, border of fibula, interosseous membrane, I – dorsal aponerosis of 2^{nd} – 5^{th} toe

These 3 muscles are innervated by the deep fibular nerve.

Fibularis longus: O – head of fibula, proximal 2/3 of fibula. I – tuberosity of metatarsal 1, medial cuneiform.

Fibularis brevis: O – distal half of the fibula. I – tuberosity of metatarsal 5

These are innervated by the superficial fibular nerve.

Triceps surae:

Gastrocnemius: O – condyles of femur. Soleus: O – proximal 1/3 of fibula, posterior surface of tibia. Plantaris: O – lateral condyle of femur.

These muscles all insert on the calcaneal tuberosity and are innervated by the tibial nerve.

Popliteus: O – lateral condyle of femur. I – posterior surface of the tibia superior to the soleal line.

Tibialis posterior: O – interosseous membrane, tibia and fibula. I – tuberosity of navicular, plantar surfaces of cuneiforms, metatarsals I-IV.

Flexor digitorum longus: O – posterior surface of fibula and tibia. I – distal phalanx of 2^{nd} – 5^{th} toe.

Flexor hallucis longus: O – distal 2/3 of the posterior surface of fibula, interosseous membrane. I -distal phalanx of big toe.

These muscles are also innervated bit the tibial nerve.

26.Muscles of the foot

Adductor hallucis: O – metatarsophalangeal joints of 3^{rd}-5^{th} toe, cuboid, lateral cuneiform. I – lateral sesamoid bone of metatarsophalangeal joint, proximal phalanx of big toe.

Flexor digitorum brevis: O – plantar aspect of the calcaneal tuberosity. I – middle phalanx of 2^{nd}-5^{th} toe

Quadratus plantae: O – plantar aspect of calcaneus. I – lateral margin of flexor digitorum longus

Lumbricals I-V: O – tendons of the flexor digitorum longus (I: single head II-V: double). I – medial side of the proximal phalanx of 2^{nd}-5^{th} toe.

Plantar interossei I-III: O – plantar aspect of the metatarsals. I – medial sixde of the proximal phalanx 2^{nd}-5^{th} toe.

Dorsal interossei I-IV: O – adjacent sides of the metatarsals I-V facing each other. I – proximal phalanx of 2^{nd}-5^{th} toe (2 bilateral, 3,4 lateral).

Adductor digiti minimi: O – calcaneal tuberosity. I – tuberosity of metatarsal V, proximal phalanx of 5^{th} toe.

Flexor digiti minimi brevis: O – base of metatarsal V. I – proximal phalanx of 5^{th} toe

Opponens digiti minimi: O – base of metatarsal V, plantar ligament. I – metatarsal V

27.Pelvis, statics of the pelvis

Pelvic ligaments: obturator membrane, sacrotuberous ligament, sacrospinous, iliolumbar

Greater sciatic foramen (above piriformis): superior gluteal nerve, artery, vein

Lesser sciatic foramen: obturator internus muscle tendon.

Lesser sciatic foramen(below piriformis): sciatic nerve, inferior gluteal nerve, artery, vein, pudental nerve, posterior femoral cutaneous nerve.

Obturator canal: obturator nerve and vessels.

Sub-inguinal hiatus: psoas major, iliacus, pectineus, femoral artery/vein, lymphatics femoral nerve, fermoral branch of the genitofemoral nerve, lateral cutaneous nerve of the thigh.

The ilioinguinal nerve passes over the medial end of the inguinal ligament.

28.Structure of the foot, mechanism of walking

During walking many anatomical features of the lower limbs contribute to minimizing fluctuations in the body's centre of gravity and thereby reduce the amount of energy needed to maintain locomotion and produce a smooth efficient gait. They include the pelvic tilt in the coronal plane, pelvic rotation in the transverse plane, movement of the knees towards the midline, flexion of the knees, and complex interactions between the hip, knee and ankle. As a result during walking the body's centre of gravity normally fluctuates only 5cm in both vertical and lateral directions.

29.Blood supply of the lower limb

Arterial supply begins as the external iliac artery passes beneath the inguinal ligament where it then becomes the femoral artery and it continues down throught the adductor canal where it then becomes the popliteal artery which is the main supply for the knee joint. It then passes beneath the tendinous arch of the soleus where it the branches and forms the anterior/posterior tibial arteries. The anterior tibial artery passes through the proximal end of interosseous membrane to reach the anterior extensor muscles and then continues down the leg to become the dorsalis pedis artery. The posterior tibial artery then provides the strong fibular artery once it reaches the medial malleolus it branches to form the medial/lateral plantar arteries which then merge to form the deep plantar arch.

The venous supply – the deep veins generally accompany respective arteries, until you reach the popliteal fossa where only 1 is found. It all begins from the dorsal venous network of the foot and starting with the deep veins we have the great and small saphenous veins. The great saphenous vein originates on the anterior of the medial malleolus and continues up the medial side of the leg where it drains into the femoral vein at the femoral triangle. The small saphenous vein originates posterior to the lateral malleolus and continues up the leg posteriorly to the fibula where it drains into the popliteal vein.

Then superficially we have the anterior tibial vein which arises also from the dorsal venous network of the foot. It continues up the tibia until it reaches the top of the interosseous membrane which it pierces to move posteriorly to the popliteal fossa where it then becomes the femoral vein whivch continues up the medial side of the thigh until it passes below the inguinal ligament and becomes the external iliac vein.

30.Innervation of the lower limb

The lower limb innervation is mainly made up of 2 plexuses the plexus lumbalis and the sacral plexus but as the roots become trunks the 2 plexuses merge. Plexus lumbalis is T12-L4 and sacral plexus is L5-S4. The rest is the coccygeal plexus.

Iliohypogastricus – T12, L1

Ilioinguinalis - L1

Genitofemoralis – L1,L2

Cutaneous femoralis lateralis – L2, L3

Femoralis – L1, L2, L3, L4

Obturator – L2, L3, L4

Gluteus superior – L4, L5, S1

Gluteus inferior – L5, S1, S2

Ishiadicus – L4, L5, S1, S2, S3

Cutaneous femoris posterior – S1, S2, S3

Pudendal – S2, S3, S4

Annococcygei – S4, S5, Co1

The ishiadicus nerve also branches to become the fibularis – L4, L5, S1, S2; and the tibialis – L4, L5, S2, S3.

31.Hernial canals, femoral trigone

The femoral trigone is made up of 4 sides and has 3 main components passing through it. The femoral artery, vein and nerve. Where it then feeds into the adductor canal until it exits through the adductor hiatus.

Base: inguinal ligament, medial: adductor longus, lateral: satorius, floor: iliopsoas, pectineus.

Inguinal herniation is a protrusion of abdominal cavity contents through the inguinal canal. Indirect inguinal hernia: from the lateral inguinal fossa, through the deep and superficial inguinal rings, and can be congenital or acquired.

A direct inguinal hernia come from the medial inguinal fossa through the superficial inguinal ring and can only be acquired.

Then there is a femoral hernia which arises inferiorly to the inguinal ligament and passes through the femoral canal, the sac may contain preperitoneal fat, omentum and small intestine and has an increased prevalence in females. But it is not very common maybe 1 of every 20.

32.Structure of the skull: neurocranium

This has 5 parts: - frontal, parietal, temporal, occipital and sphenoidal. The temporal bone is located to the side of the skull behind the eyes where the ears are and is made up of 2 part the squamous part and the mastoid part. There is also a petrous part located inside the skull (not visible) which has three angles like a triangle and is also one of the densest bones in the human body and houses components of the inner ear.

Then the sphenoidal bone is located just infront of the temporal bone above the mandible and internally has different parts such as the greater and lesser wings the body of it is known as the sella turcica and what looks like tails is known as the pterygoid process. This bone is noted for looking like a bat or butterfly and also forms part of the orbit.

The frontal bone consists of 4 parts. Above the supraorbital margin the bilateral superciliary arch bulges out. A part protrudes medially downwards and forms a part of the medial margin of the orbit

and a lateral aspect of the bone joins with the zygomatic process to form the lateral margin of the orbit.

The parietal bone is formed by 2 parts which fuse together with age by way of the sagittal suture.

The occipital bone occupies most of the posterior part of the skull. Part of which is known as the squamous part and also the interparietal bone which is joined by the lamboid suture.

33.Structure of the skull: viscerocranium

The viscerocranium in broken in to 9 parts: the maxilla, mandible, ethmoidal, zygomatic, nasal, lacrimal, palatine, vomer and inferior nasal concha.

The ethmoidal bone is an unpaired bone in the skull that seperates the nasal cavity from the brain. It is located at the roof of the nose between the 2 orbits and is very lightweight due to its spongy structure.

The maxilla is the upper jaw bone located between the orbits and the oral cavity. It helps form the lower and medial borders of the orbits. The alveolar process creates a lower margin that helps support the teeth.

The mandible is the lower jaw bone and consists of a body and the rami of mandible. The body of mandible is composed of the alveolar parts which support the teeth and base of the mandible beneath. The mandible is held in place solely by muscles and ligament and only at one point.

The zygomatic bone (cheekbone) is a paired bone which articulates with the maxilla, temporal bone, sphenoid bone and the frontal bone. It is situated at the upper/lateral part of the face and forms the prominence of the cheek and part of the lateral wall and floor of the orbits.

The nasal bones are 2 small oblong bones, varying in size and form in different individuals, they are situated side by side in the middle of the upper part of the face and form by their junction the ‘bridge’ of the nose. They are joined by the internasal suture.

The lacrimal bone is the smallest and most fragile bone in the face and is roughly the size of the little finger nail. It is situated at the front part of the medial wall of the orbit and it has 2 surfaces and 4 borders. Tears or lacrimal fluid from the lacrimal gland (tear duct) passes through here.

Posterior to the maxilla lies the palatine bone which comprises of 2 plates: the horizontal plate creates the posterior part of the palate (bony palate), the perpendicular plate extends vertically upright (perpendicular to the horizontal plate) and is the posterior medial margin of the maxillary sinus.

The vomer forms the largest part of the bony nasal septal skeleton. This flat and trapezoid bone connects cranially with the perpendicular plate of the ethmoidal bone and at its posterior aspect with the sphenoidal bone. It also borders at the palatine process and horizontal plate of the palatine bone.

The inferior nasal concha extends horizontally along the lateral wall of the nasal cavity and consists of a lamina and spongy bone. It sits on the bony plate known as the septum separating the nasal cavity into 2 bilateral and symmetrical anatomical caves.

34. Nasal cavity

The entrance is the piriforme aperture and the exit is the choanae. The cavity is formed by: nasal septum – made up of bony and cartilaginous structures, the bones are the perpendicular plate of the ethmoidal bone and the vomer.

Common nasal meatus: it is divided by the superior, middle and inferior nasal conchas.

The walls are made up of : superior wall – nasal bone, frontal bone, cribriforme plate of the ethmoidal bone and body of the sphenoidal bone. Inferior wall – hard palate (maxilla + palatine bone). Lateral wall – nasal conchae (superior, middle: ethmoidal bone, inferior: separate bone).

As part of this are the paranasal sinuses: the frontal, sphenoidal, maxillary and ethmoidal sinuses.

35.Orbit

The walls of the orbit (eye socket) are formed by:

Roof – frontal bone (orbital plates), sphenoidal bone (lesser wing)

Floor – body of maxilla, palatine bone

Medial wall – ethmoidal bone, lacrimal plate, frontal process of the maxilla

Lateral wall – sphenoidal bone (greater wing), zygomatic bone

The entrance is known as the aditus orbitae. There are 2 important foramina, 2 fissures and one canal surrounding the globe in the orbit which contain structures crucial to normal eye function:

Supraorbital foramen – supraorbital nerve

Infraorbital foramen – infraorbital nerve

Superior orbital fissure – major pathway for intercranial communication, contains a number of cranial nerves for eye movement via the extraocular muscles.

Inferior orbital fissure – maxillary nerve, infraorbital artery/vein

Optic canal – optic nerve, ophthalmic artery

The supraorbital and infraorbital foramen are also potential pathways for cancer or infections to pass on to the brain.

36.Sutures. Pterygopalatine fossa

The main sutures of the skull consist of:

Coronal – connects the frontal bone with the parietal bone

Sagittal – connects the 2 parts of the parietal bones

Lamboid – connects the parietal bone with the occipital bone (squamous part)

Squamous – this is the connection between the squamous part of the temporal bone with the parietal bone

Connections of the pterygopalatine fossa :

Middle cranial fossa then form the foramen rotundum which the maxillary nerve passes through. Connects with the nasal cavity to form the sphenopalatine foramen which some arteries and nerves pass through. Connects with the external surface of skull to form the pterygoid canal which the greater petral nerve passes through. Connects to the orbit and forms the inferior orbital fissure another maxillary nerve passes through. Connects to the oral cavity to form the greater palatine canal which just has nerves and arteries passing through. Connects with the infra temporal fossa to form the pterygomaxillary fissure which allows nerves to pass through.

There are 2 pterygopalatine fossa's one on either side and are both cone shaped depressions.

37.The base of the skull

The base of the skull can be broken into 3 parts: anterior cranial fossa, middle cranial fossa and posterior cranial fossa. And these sections contain a number of different structures.

Anterior cranial fossa: cristi galli, cribiforme plate

Middle cranial fossa: sella turnica, superior orbital fissure, foramen rotundum, foramen ovale, foramen spinosum, sulcus nerve, petrosus superior/inferior.

Posterior cranial fossa: internal acoustic meatus, clivus, foramen magnum, foramen jugulare, sulcus sinus sigmoideus, sulcus sinus transversus.

The anterior cranial fossa is sectioned off (bordered) by the frontal bones to the lesser wing of the sphenoidal bone. The middle cranial fossa then continues from the lesser wing to the pars petrosa of the temporal bone. The posterior cranial fossa then begins at the pars petrosa and finishes at the occipital bone.

38.Muscles of the head

there are 2 main main types: mimetic muscles and the muscles of mastication. The mimetic muscles control facial musclesand the masticatory muscles control the movement of the jaw bone and support it during e.g. chewing.

Mimetic muscles: epicranius muscle (frontal belly), orbicularis oculi muscle, levator labii suspensor, orbicularis oris muscle, levator anguli oris, and the buccinator muscle. All these muscles are innervated by the facial nerve (cranial nerve VII).

As for the muscles of mastication there is the temporalis, masseter (2 parts), medial pterygoid, lateral pterygoid (2 parts). These muscles are all innervated by the mandibular nerve(V/3).

The difference between these 2 muscle groups the muscles of mastication have a distinct origin and insertion where as the mimetic muscles insert onto the skin and can change slightly from person to person.

The temporalis originates from inferior to the inferior temporal line and inserts on the coronoid process of the mandible.

The masseter has 2 parts the superficial originates from the inferior margin of the zygomatic arch and inserts on the masseteric tuberosity, the deep however originates from the inner surface of the zygomatic arch and inserts on the inferior margin of the mandible.

The medial pterygoid originates from the pterygoid fossa and inserts on the pterygoid tuberosity.

The lateral pterygoid has 2 parts the upper originates from the infra temporal crest of the sphenlid and inserts on the disc and capsule of trhe temporomandibular joint, the lower originates on the lateral plate of the pterygoid process and inserts on the pterygoid fovea.