نموذج أجابة للفرقة الرابعة حيوان\ كيمياء نظام قديم.

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زمن الأمتحان :- ساعتان.
اسم الدكتور واضع الأمتحان: ا.د/ سلوى ابراهيم عبد الهادى سعد.
اسم الكلية: كلية العلوم – قسم علم الحيوان.

نموذج الأسئلة

Benha University — Ist. Semester, 2015
Faculty of Science — 4th Year Zool.\Chem.Student
Zoology Department — Time Allowed: 2hrs.

Comparative Anatomy

Please illustrate your answers with a clear labeled diagrams whenever possible.

Answer the following question:

1. **Explain in detail only** two **items from the followings:-**
   a.Exoskeleton of mammals. 10 marks.
   b.Color and glands of the skin.10 marks.
   c.Development of placoid scale and different types of scales in fishes. 10 marks.

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2. **Give a full description for the dermal bones of Tetrapoda skull (Dermatocranium). 25marks.**

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3. **Describe in detail the vertebral column in case of Tetrapoda. 30 marks.**

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4. **Give a brief account about the followings:-**
   a.Different types of reptilian skulls. 10 marks.
   b.Ways of attachement, replacement and types of the teeth. 15 marks.

With my best wishes,
Prof. Dr.Salwa Ibrahim

أجابة السؤال الاول(a)

***The* Exoskeleton of mammals :**

Mammals possess different kinds of exoskeletou. these kinds are :

1- Hairs : These comprise the chief exoskeleton of mammals, and they are not found in any other vertebrate. However, a number of mammals are devoid of hair, as **Cetacea, Sirenia** (aquatic mammals), elephants, **Hippopotamus and Rhinoceros,** although the embryos of some of these are entirely covered with hairs. Hairs vary in shape, size and color. Hairs may be shed seasonally as in most mammals.

2- Scales : Some mammals possess homy epidermal scales which resemble those of reptiles. These scales may cover the body as in the scaly anteater, or occur only on the tail as in rats, or on the feet as in kangaroos. The scaly parts are provided with few hairs. The armadillos are the only living mammals which possess an armour composed of both epidennal scales and dennal bony plates an in the turtles.

3- Claws, nails and **hoofs** : These are found in mammals at the end of toes and fingers, and are epidennal in origin. Claws resemble those of reptiles and birds, being composed of a dorsal convex unguis covering the last phalanx of the digit, and a ventral concave subunguis (sole). Nails are found in primates and man, and consist of a broad flattened unguis and usually no subunguis. Hoofs, found in ungulates, consist also of unguis which surrounds the front of the toe and a subunguis which is greatly enlarged and thickened and covers the ventral side of the toe.

4- Horns and antlers : These are structures of different origin and composition. There are keratin fiber horns or horns consisting of a core of bone from the frontal of the skull, covered with keratin. These are the hollow horns of ruminants, as in cattle, sheep and goats and in

antelope. Also there are the antlers of the deer which belong to another type. They consist of bone and are connected with the frontal. During their growth, the antlers are covered with skin called velvet, which carries short hairs. This velvet is shed when the antlers attain their full size. Fighting between animals causes breaking of antlers at a weak zone close to the skull, as for example in the mating season. A new larger set of antlers grows under the influence of sex hormones. Such weapons of antlers are usually restricted to the males, although in the reindeer (of the northern regions) they are found in both sexes. Antlers of the giraffe are short, unbranched and covered with permanent skin.

The horns are permanent and unbranched, and continue to grow from the malpighian layer between them and the bony core. Usually, there are sexual differences in size and shape of horns, especially in sheep and cattle.

أجابة السؤال الاول(b)

Color of the skin :

The color of the skin results from pigment found either in the skin itself as referred to above, or in its products which are the scales, plates, beaks, feathers or hair. Usually, the color is not evenly distributed over the body, but forms a pattern characteristic of a species. Sometimes, the color has an adaptive relationship with the surroundings making the animal difficult to see, e.g. tree frog. In the skin of many mammals, the pigment is found in the epidermal cells. The pigment of the hair is deposited during its growth, either uniformly or in alternating light and dark areas as in many rodents. The same case is found in feathers of birds. Lower vertebrates have pigment found in specialized cells in the dermis called clиromatophores, while epidermal cells are transparent to

allow the color to appear. There are different kind of clironatophores, these are the melanophores with brown or black melanin pigment, xanthophore with red or yellow pigment and guanophores which contain guanin crystals, which make reflection of light and thus appearing white.

Glands of the skin :

The glands of the skin are either unicellular or multicellular.

Unicellular glands are found in the skin of primitive vertebrates, where they secrete mucous on its surface. These unicellular glands are characteristic of fishes and early aquatic stages of **Amphibia.** However, multicellular poison glands are found in the skin of some teleosts (bony fishes), as for example at the base of the pectoral spines in some teleosts or on the dorsal spines among others. In the african lungfish **"Protopterus"** there are both unicellular and multicellular mucous glands. In **Amphibia,** the unicellular mucous glands are converted, during metamorphosis to the adult terrestrial stage, into multicellular and alveolar ones.

Here, there are two types of glands, the ordinary type secretes mucous, while the other is granular and pours thick poisonous secretion when stimulated. Reptiles have no skin glands, since they are in need to keep water in the body. The skin of reptiles is thus dry. The aquatic reptiles also (most turtles and crocodiles) have no mucous secretion. The only skin glands found among reptiles are the musk glands of **Crocodilia** (which are a pair of the ventral side of the lower jaw and another one in the cloaca in both sexes) and the cloacal stink glands of some turtles and snakes. Most lizards possess femoral pores on the

. ventral side of the thigh. These are considered by some authors to be integumentary glands formed by infolded epidermis near the middle of a scale. They are active during the mating season, where they secrete a

substance which stimulates the female, and thus they are vestigial in the female.

In birds, the skin glands are few. The commonly known ones are the uropygial glands found above the tail of some birds like the pigeons, ducks and chickens. The glands secrete oil which lubricates the feathers.

In mammals, there are tubular as well as alveolar (acinous) skin glands. Examples of the alveolar type, there are the sweat glands, the wax glands in the ear canal, and the mammary or milk glands. Of the alveolar type, there are the sebaceous or oil glands which are generally associated with hair in the follicles. Some oil glands are found where there are no hairs (e.g. edges of lips, rim of eyelids and genitalia). Oil glands are generally present in those mammals which have sweat glands.

Modified skin glands are found in many deep - sea fishes in the form of light - producing organs known as photophores, as for example in few small sharks and some members of the primitive teleosts. The light organ consists of a modified gland which produces a luminous secretion, a concave reflector with dark pigment enclosing it and a cluster of transparent cells over this, acting as a lens. Other enlarged cells nearer the surface form a transparent lens, which emits the light. The primary function of light organs is for recognition, among individuals, of a species since the patterns are different in various species. However, there is a special adaptation of the photophores for warning, defense and luring prey in various families.

أجابة السؤال الاول(**c**)

Exoskeleton of fishes :

Fishes are generally covered with scales, which are dermal in origin. Scales are composed of substances similar to bone. There are several kinds of scales :

1-Placoid scales : These scales are characteristic of elasmobranchs. The scale consists of a basal plate inserted in the dennis and a spine projecting to the outside. In the center of the scale, there is a pulp cavity for the entrance of blood vessels and nerve endings. The scales are composed of dentine. The dentine of the spine is shiny and thus considered to be covered by a thin layer of enamel, or the shiny material may be regarded as a hard kind of dentine .

Development of placoid scales :

It begins by an aggregation of dermal cells below the malpighian layer, to form a conical projection against the epidermis. This projection is known as the dermal papilla. The cells of the malpighian layer over the dermal papilla elongate into columnar cells, forming the so-called enamel organ. The outer cells of the dermal papilla secrete dentine of the scale, while the remaining of the papilla constitute the nutritive part in the pulp of the scale. The enamel organ secretes the enamel of the spine. By the secretion of more dentine from the dermal papilla, the scale increases gradually in size and pushes itself in the epidermis, until it pierces it and becomes exposed externally. At the same time, more dentine is secreted at the base of the scale forming the basal plate, which encloses the rest of the dermal papilla-leaving passage for blood vessels and nerves.

It is thus evidence that the placoid scales are dermal and epidennal in origin. Their development indicates also that they are homologous with vertebrate teeth.

The placoid scales grow to a certain size, and are then shed and new scales replace the old ones in between.

2- Cosmoid scales :

These were only found in extinct fishes. They consisted of three layers which are outer dentine, middle vascular bone and inner lamellate bone. The dentine is called cosmine.

3-Ganoid scales

These consist of lamellate bone covered by lamellae of ganoin. The scales are rhomboid plates, fitted closely together in rows and they hinder the movement of the body. They are hard and shiny. They are found in ganoid fishes, e.g. **Polypterus.**

4- Cycloid scales :

These are thin and flexible overlapping plates with concentric ridges. They consist of an outer hard bony layer, and an inner layer of fibrous connective tissue, which affords flexibility. The posterior edge is the free one. These scales are found in **Holostei, Dipnoi** and some **Teleostei.**

5-Ctenoid scales :

These scales are found in about half of the bony fishes. They are similar to the cycloid scales, with the exception that they carry spines on their posterior free edges.

The age of a fish can be detennined by studying the concentric ridges of the scales.

أجابة السؤال الثانى

Dermal bones of the tetrapod skull (Dermatocranium)

Dermal bones first appear in bony fishes as large scales in the head region. These scales sink gradually to the inside and become close to the chondrocranium. The dermal bones arise in the mesenchyme directly, without passing on the cartilaginous condition.

In primitive tetrapod skull, e.g. Stegocephalia, the dermal bones can be regarded as homologous to the dermal bony scales of bony fishes, and they carry the same names. The skull of primitive tetrapods is perforated only by nostrils, orbits and a parietal or epiphyseal foramen. The temporal region, that region just behind the orbit, possesses no foramina. Thus the skull is of the anapsid type.

The dermal bones in the primitive tetrapod skull can be classified under the following categories :

1-Median dorsal series : These are from the nostrils backwards : the nasals, frontals, parietals and postparietals.

2- Circumorbital series : These bones are situated around the orbit. These are the lacrymal, prefrontal, postfronlal, postorbital and jugal.

3-Temporal region :

This region situated along the parietal laterally, where are found the intertemporal, supratemporal and tabular. Outside the temporal series, is found the squamosal bone.

4- Bones of the upper jaw :

The dermal bones of the upper jaw cover the palatoquadrate cartilage. In tetrapod skull, the upper jaw is fused to the skull. Therefore, the dermal bones of the upper jaw form the marginal bones of the skull, and may be termed the maxillary arch. These are from front backwards : premaxillae, maxillae, jugals and quadratojugals.

5-Bones of the palate : The dermal bones of the palate cover the cartilage bones, and thus form the roof of the mouth cavity, constituting the palate. Just behind the internal nares, there are the prevomers,

followed by pterygoids and the single median parasphenoid. Laterally, there are palatines and ectopterygoids (or transpalatines). Palatal vacuities develop, for example the interpterygoid vacuities between the pterygoid. Modem amphibians have large palatal vacuities characteristic of their skulls.

6-Lower jaw :

It becomes covered by dermal bones. At its posterior end, is found the articular as the only cartilage bone. In the skull of primitive tetrapods, there was a great number of dermal bones forming the lower jaw, these were the dentary, splenial, postsplenial, angular, supra-angular on the outer side. On the inner side of the lower jaw, there were the pre articular and three coronoids (corouoid, intercoronoid and precoronoid).

It is to be mentioned here, that no dermal bones form in connection with the hyoid or other following gill arches.

أجابة السؤال الثالث

In tetrapods, the vertebral column is differentiated into several regions especially in Aves and mammals. The vertebrae are characterized by complete bony centra and presence of pre-and post-zygapophyses for articulation between successive vertebrae.

Modern Amphibia:

More primitive amphibians and salamanders (Caudata) have a continuous notochord surrounded by ossified centra. The centra carry neural arches dorsally, while ventrally they carry haemal arches in the tail. Between the successive centra, there are intervertebral disc of cartilage which may develop from the interdorsals and interventrals. The sacrum in Caudata and Salientia consists of one or two modified turnk

vertebrae carrying sacral ribs, which meet the ilium laterally on each side. In Salientia, the vertebrae are nine in number or even lesser. Sometimes , the number is reduced to six which is the least number among all vertebrates owing to fusion or loss.

In Anura, the vertebrae are procoelous. Few forms have opisthocoelous vertebrae. The vertebrae are eight trunk, one sacral and an urostyle of fused caudal vertebrae. Apoda have a very large number of amphicoelous vertebrae.

Reptiles :

In the vertebral column of reptiles. The first two vertebrae are the atlas and axis. Centrum of atlas separates from its neural arch and fuses with the centrum of the axis to form the odontoid process of the latter vertebra. Around the odontoid process of the axis the ring-shaped atlas can rotate. Up and down movements of the skull take place at the joint between it and the atlas , i.e. at the condyles.

The vertebral column is characterized by the following :

1. Presence of ribs in most reptiles from the third vertebra until the sacrum, without capitulum and tuberculum. Usually, the cervical ribs are reduced to short spines which may be fused with their vertebrae leaving a vertebrarterial canal between the rib articulations and the centra.

2. Sacrum consists mainly of two vertebrae, each carrying a pair of neural ribs. Reptiles, without hind limbs and accordingly without pelvis, lack a sacral region. In turtles, the carapace is fused with all the trunk vertebrae.

Aves:

Usually, twelf to sixteen vertebrae with their ribs fuse into a synsacrum which is a characteristic feature of birds. The synsacrum

consists not only of sacral vertebrae, but also of the lumbar vertebrae, the last thoracic and some caudals.

In birds, the vertebrae are variable in number. In the earliest bird "Archeopteryx", the cervical ribs articulated by two heads. However, in modern birds the ribs fuse with the vertebrae. The tail in Archeopteryx was long with freely movable vertebrae. In modern birds, however, the tail is reduced to a few free vertebrae followed by a pygostyle of several fused caudal vertebrae.

Vertebrae in birds are heterocoelous (saddle - shaped ends of centra), but the atlas vertebra is precocious.

Mammilla:

Vertebral column is differentiated into five regions: cervical, thoracic, lumbar, sacral and caudal, except in whales where sacrum is lacking. Cervical vertebrae are almost seven in number. They carry ribs which fuse with the centra having vertebrarterial canal. Thoracic vertebrae, oftenly thirteen in number, carry transverse processes which articulate with a facet on two adjoining centra. Lumbar vertebrae have long neural spines and transverse processes. Sacrum is usually small, consisting of three or four fused vertebrae. It is absent in Sirenia and Cetacea (whales) because of the absent of hind limbs.

Centra in mammals are amphiplatyan. In the cervical region of ungulates, the vertebrae are opisthocoelous.

أجابة السؤال الرابع الجزئية (a)

Skull of Reptilia :

The skull of primitive reptiles resembles that of primitive amphibians. The openings in the primitive reptilian skull were also the

nostrils, the orbits and the parietal foramen. Such a skull is known as anapsidian skull, found in extinct reptiles and still present in the case of **Chelonia.**

During the evolution of the reptilian skull, fenestration occurred in the temporal region, forms were found with an upper fossa (parapsida), other with a lower or infratemporal fossa (synapsida) and still other forms with two temporal fossae (diapsida). Therefore, these three types of skulls evolved from the anapsid type.

1- Parapsid skull :

It was found in extinct reptiles, an upper temporal fossa existed. This fossa is bounded laterally by the postorbital and squamosal.

2- Synapsid skull:

It was found in extinct reptiles and in mammal-like reptiles **(Therapsida).** The temporal region is fenestrated by a single fossa, but the fossa lies more ventral, i.e. lateral. It is bounded laterally by the jugal and quadratojugal bones.

3-Diapsid skull :

This type of skull is existed in extinct reptiles and three orders of the living reptiles. These orders are **Crocodilia, Squamata and Rhynchocephalia.** In fourth living order **(Chelonia)** the skull is anapsidiantype.

Between the upper and lower temporal fossae, there are the postorbital and squamosal bones forming an arch known as upper temporal arcade, while the arch lateral or ventral to the lower temporal fossa is called the lower temporal arcade formed by the jugal and quadratojugal.

In Squamata (Lacertilia and Ophidia), the skull is modified from the diapsid type. But in **Lacertilia,** the lower temporal arcade is lost and the

quadrate bone is movable, hence a streptostylic skull is established. Also in **Ophidia,** both the 1'Ower and upper temporal arcades are lost, and thus the upper and lower temporal fossae are confluent. This leads to a more mobile quadrate and a more streptostylic of the skull.

أجابة السؤال الرابع الجزئية(ب)

There are different types of dentition.

a- Acrodont dentition, where the attachment is on the rim only, as in most fishes and amphibians.

b- Pleurodont dentition, where the attachment is on the inner margin of the bone, as in most lizards.

c- Thecodont dentition, where the teeth lie in sockets by cement deposited by dermal cells, as in crocodiles, toothed birds and mammals. The tooth does not push down into the bone, but the bone grows up around the root of the tooth.

Replacement of teeth :

There are three kinds of replacement of teeth :

a- Polyphyodont, where there is a series of developing teeth beneath the functioning tooth. When the latter falls, it is replaced by a new tooth just below. This kind of replacement is found in many fishes, amphibians and some reptiles (lizards and snakes).

b- Diphyodont, where there are only two sets of teeth, the deciduous or milk teeth and the permanent ones. This is found in mammals generally.

c- Monophyodont, where there is one set of teeth. This is found in few mammals, e.g. moles, some rodents and toothed whales.

Types of teeth :

Teeth are of several types among different vertebrates. Sharks have sharp conical teeth resembling placoid scales. Rays have grinding teeth with flat or rounded surfaces for crushing molluscs.

Most bony fishes have conical teeth, found in single row or several rows or in patches. Some bony fishes lack teeth.

Among **Amphibia,** the limbless **Apoda and Salamander** have two rows of teeth in upper jaw and in the lower. Most frogs have a single row of small teeth in the upper jaw and none in the lower. Toads are toothless. Tadpoles have rows of horny nibbling teeth on the skin outside the mouth not to be considered as true teeth.

In Reptilia, the primitive groups as well as **Rhynchocephalia and Squamata** have a palatal and marginal teeth above. Poisonous fangs are found.in certain snakes and in vipers. In **Chelonia** teeth are lacking.

Birds have no teeth, although found in ancestral ones where the dentition was thecodont, i.e. teeth with sockets. **Thecodont** dentition was also found in mammal-like reptiles " Therapsida", as the case in mammals. **Therapsida** had also adaptive forms of teeth as in mammals, i.e. incisors, canines, molars, the so-called heterodont condition which is of a high degree of specialization in mammals.

Among mammals, monotremes are toothless, except the duckbill which has temporary teeth. Marsupials have about 50 teeth as in **Opossum.** This is the primitive number. Placental mammals have started with fourty four teeth. In advanced types, the number is reduced, for example in apes and man, the dental formula becomes : 2-1-2-3/2-1-2-3. Rodents have lost the more lateral incisors, the canines and more anterior premolars, having a wide gap called diastema between the single enlarged pair of incisors and the cheek teeth-formula is 1-0-1-3/1-0-1-3.

In toothed whales, the teeth become secondarily increased in number, and lost their differentiation, becoming homodont.

أنتهت الأجابة النموذجية لأسئلة الأمتحان .