

نموذج أجابة للفرقة الثانية حيوان خاص و حيوان\ كيمياء ساعات معتمدة.

اسم الامتحان:- تشريح وظيفى للحبليات.  
تاريخ الامتحان: ٢٤ / ١٢ / ٢٠١٣ م.؛ العاشرة صباحا.  
زمن الامتحان :- ساعتان.  
اسم الدكتور واضع الامتحان: ا.د/ سلوى ابراهيم عبد الهادى سعد.  
اسم الكلية: كلية العلوم – قسم علم الحيوان.

نموذج الأسئلة

Benha University  
Faculty of Science  
Zoology Department

First Semester, Jan., 2014  
Physiological Anatomy  
Time Allowed: 2 hrs.

Second year Zoology & Zoology\Chemistry science student

**Answer the following questions:-**

1. "The circulatory system of Mammalia is more complicated than in The other classes of phylum Chordata". Explain in detail the structure of heart and the venous system in case of *Oryctolagus cuniculus* to prove this statement. ( 11 marks).
2. Mention in detail the general characters of class Reptilia. (9 marks).
3. Compare between the nervous system of *Amphioxus lanceolatus* and *Petromyzon fluviatilis*. (10 marks).
4. Give a short account about three items only from the followings:-
  - a. The axial skeleton in case of *Scyliorhinus canicula*. (6 marks).
  - b. Swim bladders of fishes. (6 marks).
  - c. The respiratory system of *Colubba livia*. (6 marks).
  - d. How the circulatory system of Amphibia evolved from the same one of fishes. (6 marks).
  - e. Structure of *Ascidia*.

**With my best wishes,  
Prof. Dr. Salwa Ibrahim.**

---

أجابة السؤال الاول

### ***The heart***

The four-chambered mammalian heart (two auricles and two ventricles) is essentially similar to that of birds where the two sides of heart being completely separated from each other by interatrial ( interauricular ) and interventricular septa . A sinus venosus, present only during early development, is lacking in the fully mammalian heart and having been incorporated into the wall of the right auricle.

When the auricles are in a contracted state, a flap-like projection of each may be observed extending for a short distance over the ventricle , These are the auricular appendages.

As in birds, a bicuspid valve, consisting of the membranous flaps is found between the left auricle and left ventricle. In most mammals, also a tricuspid valve is located between the right auricle and right ventricle. Since a single valve is present in birds at this point, the presence of the tricuspid valve is a characteristic feature of the mammalian heart. Chordae tendineae attached to the irregular borders of the bicuspid and tricuspid valves and are connected at their other ends directly to the inner walls of the ventricles and the interventricular septum. Also they are connected indirectly to papillary muscles which are continuations of the muscular ridges lining the inner surface of the ventricles .

The right auricle receives the right and left precavals and the postcaval; while the left auricle receives the right and left pulmonary veins. The right ventricle gives a single pulmonary arch which divides into two branches , one for each lung; the left ventricle gives the left

aortic arch . Finally , a well - developed coronary system is present in the mammalian heart.

### **Venous system**

*Each precaval is formed by the union of:*

- 1- The internal jugular vein from the brain and runs in the neck .
- 2- The external jugular vein which is a large vein running along the side of the neck. It receives two branches which are the anterior ( internal ) and the posterior (external) facial veins , collecting blood from the face .
- 3- The subclavian vein from the fore- limb and the shoulder .
- 4- The internal mammary vein collecting blood from the upper side of the sternum .
- 5-The anterior intercostal vein receiving blood from the anterior intercostal spaces.
- 6- The azygos vein which connects the right precaval only (the left precaval lacks an azygos vein). The azygos vein runs close to the vertebral column and receives branches from the posterior intercostal spaces on both sides .

**The postcaval (posterior vena cava) receives the following veins:-**

- 1- The phrenic veins are a pair of small veins coming from the diaphragm .
- 2- The hepatic veins are three to four large veins from the liver.
- 3- The renal veins are two from the two kidneys .
- 4- The spermatic or ovarian veins are one pair from the testes or ovaries respectively. -
- 5- The iliolumbar veins are one pair from the posterior abdominal region.
- 6- The external iliac veins are one large pair from the hind limbs . Each receives a vesical vein from the urinary bladder . The external iliac

vein is a direct continuation of a femoral vein which extends along the inner border of the thigh .

7- The internal iliac veins are one pair from the back of the thighs .

A hepatic portal circulation is present. Blood from the intestine , stomach and spleen is collected by several branches which unite to form the hepatic portal vein which enters the liver. There is no renal portal circulation in the rabbit and in all mammals in general. Also two pulmonary veins from the two lungs open in the left auricle .

---

#### أجابة السؤال الثانى

There are several characters of class Reptilia which distinguish it from class Amphibia . These are :

- 1- The skin in Reptilia is dry, cornified and provided with horny scales. These scales are composed of horny substance and they are formed by the outer layer of the epidermis which becomes the horny layer. While in Amphibia the skin is very rich in glands, the skin of reptiles contains only very few glands which are found only at a certain area of the body such as the femoral glands (they are present on the ventral side of the thigh). Also the skin in Reptilia is not at -all used in respiration .
- 2- There are two pairs of limbs. Each one of them consists of five digits ending with horny claws which are modified to running , crawling or clinging , limbs are paddle - like in marine turtles, reduced in some lizards and absent in few other lizards and in all snakes
- 3- Respiration is carried only by the lungs . The respiratory movements are produced by the ribs .

- 4- There is only one single median occipital condyle. Where in Amphibia the skull is provided with two occipital condyles.
- 5- As generally the lower jaw of reptiles is composed of several bones, since its posterior edge is called the articular. It carries out the articulation with the skull.
- 6- The ventricle is incompletely divided into two chambers. The , crocodiles only have two separate ventricles.
- 7- Presence of twelve pairs of cranial nerves.
- 8- Body temperature is variable.
- 9- Fertilization takes place internally and each egg is large in size with a sufficient amount of yolk . Most of reptiles lay eggs ( oviparous) . In some lizards and snakes the eggs are retained in female for its development, but the embryos are nourished from the yolk of the eggs (ovoviviparous) .

---

### أجابة السؤال الثالث

#### **Nervous system of *Amphioxus* :**

It is in the form of a hollow tube lying directly above the notochord. The cavity of this tube is the central canal. At the anterior end the canal dilates into a brain vesicle. It is separated from the spinal cord by a cavity known as the dorsal dilatation which is covered only by connective tissue .

The brain gives off two pairs of cranial nerves which are sensory in function . The first arises from the anterior part of the brain , while the second arises from its roof. They are both distributed to the snout.

The spinal cord gives off paired spinal nerves. These consist of the dorsal nerves which are sensory and motor to supplying the skin and the transverse muscles and pass between the myotomes, and the ventral nerves chiefly motor passing into the myotomes and lie opposite to myotomes. These nerves alternate on the two sides due to the asymmetry of the myotomes. These nerves do not unite outside the cord and the dorsal nerves carry no spinal ganglia.

### **Sense organs :**

The anterior wall of the brain vesicle contains a mass of pigment known as the anterior eye spot which is not sensitive to light. There are small groups of pigmented organs occur at intervals along the ventral wall of the spinal cord (Posterior eye spots). Each of which consists of a pigmented beaker-shaped cell and a sensory cell. These spots are sensitive to light and the animal can determine the direction of retic. The ciliated funnel (olfactory pit) lies at the anterior end of the brain vesicle. It opens to the exterior in the dorsal surface of the left side of the snout. The olfactory pit is considered as an organ of smell. Also Hatschek's pit is supposed to be an organ of taste, but this is very doubtful.

The oral cirri and velar tentacles carry papillae which are groups of sensory cells and are sensory to touch. The papillae of the velar tentacles are chemoreceptors having an olfactory function. In the same time sensory cells are found scattered in the epidermis. Some of these cells are concerned with determining the nature of the sand in which the animal will burrow. *Amphioxus* has no auditory organs.

### **Nervous system of *Petromyzon*:-**

The brain of the lamprey is not well developed. It lies above and anterior to the tip of the notochord. The brain divided into three distinct regions which are the fore-brain, mid-brain and hind brain.

The fore - brain ( prosencephalon ) consists of the foremost part (telencephalon ) and attached to the posterior end of which is found a triangular structure (diencephalon).

In return to telencephalon , on each side , it divided into an anterior olfactory bulb and a posterior olfactory lobe. At the roof of the diencephalon are found two ganglia habenulae. The pineal eye is attached to the right ganglion habenulae. This eye has a small vesicle form and the roof of which forms a lens. The wall forms a retina and the connection between it and the right ganglion represents an optic nerve . The parapineal eye is situated below the pineal eye and it is connected with the left ganglion habenula. These two eyes are'-incapable of forming accurate images as the lateral eyes do , but they are able to differentiate the intensity of light . The skin of the head covering the pineal and parapineal eyes is transparent. The pituitary gland is attached to the ventral side of the diencephalon .

The mid - brain ( mesencephalon) is formed of two optic lobes. At the middle of the mid- brain there is a gap which is covered by a special membrane called the middle choroid plexus . The hind-brain (rhombencephalon) is formed of the cerebellum and the medulla oblongata . The cerebellum is represented only by a slight fold . The medulla oblongata is well developed. In its roof there is a large cavity which is covered by another membrane called posterior choroid plexus. The medulla oblongata is continuous posteriorly with the spinal cord. Ten pairs of cranial nerves are present

The spinal cord has a band-like shape . The dorsal roots of the spinal nerves alternate with the ventral roots, and do not unite with them to form a trunk ( the dorsal roots are opposite the myosepta and the ventral opposite the myotomes). The ventral roots contain many large fibers and smaller ones which run in the septa and may serve as muscle

sense organs. The dorsal roots consist of sensory fibers with nerve cells collected into dorsal root ganglion .

---

أجابة السؤال الرابع الجزئية (أ)

***The skull ( chondrocranium ) :***

It consists of the cranium , sense capsules (neurocranium) and visceral arches ( viscerocranium ) . The cranium is an elongated box surrounding the brain . Its roof possesses a large opening ( anterior fontanelle ) , The cranium is fused anteriorly with the two olfactory capsules and posteriorly with the two auditory capsules. Between the olfactory and auditory capsules are found two large depressions one on each side ( the orbit) inside which the eyes are located . The foramen magnum is found at the posterior end of the cranium . There are two occipital condyles, on the two sides of the foramen magnum , that articulate with the first vertebra . The brain case is perforated by several foramina for the passage of the cranial nerves and blood vessels.

The visceral arches are seven in number. They surrounded and protect the pharynx. The first arch is called the mandibular arch ; the second one is known as the hyoid arch and the last five are known as the branchial arches. The mandibular arch consists of four piece of cartilage; two dorsal (the palatoquadrates ) meet each other anteriorly and form the upper jaw and two ventral ones (Meckel's cartilage ) are fused together anteriorly to form the lower jaw. The second visceral arch is formed of five piece of cartilage; two hyomandibulars, two ceratohyals and one basihyal in the floor of the mouth .

Each one of branchial arches consists typically of four piece of cartilages on either side as the following :-



- 1- The pharyngobranchial is found in the roof of the pharynx, the last two of them are united together.
- 2- The epibranchial in the dorso-lateral wall of the pharynx.
- 3- The ceratobranchial in the ventro-lateral wall of the pharynx.
- 4- The hyobranchial in the ventral wall of the pharynx.

There is no hyobranchial for the last branchial arch . The last two pairs of hyobranchials and the fifth ceratobranchials join a median basibranchial plate.

The epibranchial and ceratobranchial carry a number of rays ( branchial rays ) . These rays are found on all the branchial arches except the last. The upper and lower jaws carry several rows of teeth.

### **Vertebral column :**

It is divided into two distinct regions :

- 1- The trunk region is composed of the trunk vertebrae
- 2- The tail region is composed of the caudal vertebrae .

The trunk vertebra bears a biconcave (amphicoelous ) centrum through its center the compressed notochord (notochord rudiment) runs . The notochord is not constricted between the centra of the successive vertebrae. The centrum is formed by the invasion of the notochordal sheath by cartilage . Then the notochord gradually decreases in size until it disappears in the adult animal. Some mesodermal cells is appeared around the notochord to form a skeletogenous tissue which is more condensed at four places, two dorsal above the notochord and two ventral below it. These are two basidorsal and two basiventral respectively .

The two basidorsals extend dorsally forming the neural arch enclosing the neural canal which includes the spinal cord, and carrying at its apex a dorsal process ( neural spine ) . In trunk region the basiventrols extend laterally forming the transverse process, but in the tail region they extend ventrally forming the haemal arch surrounding the caudal artery and vein,

and carrying at its lower edge a ventral process ( haemal spine ) . Small ribs are attached to the transverse processes of the trunk vertebrae .  
Skeleton of the median fins :

Median unpaired fins are supported by a number of rods of cartilage ( radials ) . Outer to the radials are found hexagonal plates arranged in one or two rows. Following these hexagonal plates are found elongated minute horny rays ( ceratotrichia) . These horny rays are found in two series .

-----  
أجابهة السـؤال الرابعـع الجزئـية ( ب )

#### **Swim bladders of fishes :-**

The air bladder in various fishes shows a wide diversity in structure and function. This air bladder is a gas filled diverticulum which arises from the pharyngeal or esophageal region of the digestive tract. A swim bladder may be single (many teleost fishes) or bilobed (polypterus and protopterus), and may open into the digestive tract dorsally (many teleost fishes), ventrally (Epiceratodus, polypterus and protopterus), or not at all (many teleost fishes). It may be large and extends along the length of the body cavity or may be so small. It usually lies directly beneath the vertebral column, dorsal aorta and kidney, but outside the coelom. Swim bladders which retain the connection with the digestive tract, are called physostomous and those which are completely closed are physoclistous. The swim bladder in higher fishes represents a specialized modification of the lung but the presence of the latter is a primitive characters. Although in some of the lower fishes the swim bladder functions chiefly as an accessory respiratory organ, it may serve as a hydrostatic organ and in certain cases, as an organ for sound production and sound reception as well. The modified swim bladders of higher fishes seem to play little part

in respiration and serve entirely as hydrostatic or organs of equilibrium enabling the fish to swim at different levels with little effort.

In Tilapia the swim bladder is a thin-walled elongated sac, silvery white in colour. It has no connection with the esophagus (physoclystic type). The swim bladder contains oxygen gas. The gases inside the swim bladder are secreted by a special organ (red body or red gland). It is found near the anterior end of the swim bladder. The red gland contains a network of blood capillaries. This receives blood from the coeliac artery and it gives its blood to the hepatic portal vein.

The oval is a special organ, in some fishes, for the absorption of gas from the swim bladder. It is found near the posterior end of the swim bladder. The oval receives blood capillaries from the dorsal aorta and it gives its blood capillaries to the posterior cardinal vein. During the circulation of blood, oxygen is absorbed from the bladder to the blood stream. So by regulation both the red gland and oval, the quantity of gases inside the swim bladder can be regulated.

---

أجابة السؤال الرابع الجزئية (ج)

#### **The respiratory system of *Columba*:-**

The opening of this system (glottis) is found behind the tongue. It leads to the larynx which is supported by the cricoid and arytenoids cartilages. The larynx leads into the long trachea supported by complete ossified rings. At the posterior part of the trachea, there is the syrinx which is the sound producing organ in birds. The syrinx is not found in any other vertebrates class. The trachea is biforked, directly after the syrinx, into two bronchi, and leads to the two lungs. The two bronchi are connected with nine large thin-walled sacs (air-sacs); two cervicals

lying at the base of the neck, two anterior thoracics cover the ventral surface of the anterior parts of the lungs, two posterior thoracics lie posterior to the former, two abdominals which are the largest and lie dorsal to the intestine, and one interclavicular air - sac lies between the two clavicles . These air sacs are connected with the air spaces which are found inside the bones. This arrangement provides a large quantity of air which makes the respiration quite efficient and it makes the bird a light organism and not a heavy one . The air - sacs do not furnish a respiratory surface , since their walls are smooth and have a poor blood supply . They are furnished with oxygenated blood. Air-sacs may play a significant role in temperature regulation by serving as an internal cooling device. The bronchi are supported by incomplete cartilage rings. The lungs are comparatively small in size . They are spongy and not simple sacs.

-----  
أجابة السؤال الرابع الجزئية (د)

The circulatory system of Amphibia is characterized by presence of two streams of blood, one oxygenated and the other partially oxygenated enter the heart ( a double type of circulation ) . In amphibians the sinus venosus has shifted its position so that it opens into the right auricle. The system of bloodvessels coming from the lungs to the heart and those emerging from the heart to the lungs is called the pulmonary circulation (smaller circulation) . Another circulation ( systemic or larger circulation), in which the blood vessels are distributed to the body in general and then returned to the heart, is present.

The embryonic stages of fishes and members of the higher classes have a six pairs of aortic arches connect dorsal and ventral aorta. But the

number six may be regarded as the primitive number for vertebrates. In most sharks only five aortic arches persist, the first one is degenerated. Although five afferent branchial arteries are present on each side, there are usually four pairs of efferent vessels. In teleosts and most other fishes only the last four pairs of aortic arches remain ( numbers one and the second reduced to small branches of the third one).

The aortic arches in Amphibia and the remaining vertebrate classes, do not break up into afferent and efferent portions, since in these higher forms internal gill lamellae do not develop , In Amphibia , the first, the second and the fifth aortic arches disappear. Also the connection between the third and the fourth aortic arches on each side degenerated. In the same time the anterior continuations of the ventral aorta become the external carotid arteries . The third aortic arch with the anterior portion of the connection on that side becomes the internal carotid artery. The portion of the ventral aorta from which the internal and external carotids arise becomes the common carotid. The fourth aortic arches persist as the systemic arches which unite posteriorly to form the dorsal aorta. On each side, the arch number six sends a branch to the developing lung and to the skin to become the pulmocutaneous artery.

The venous system of Amphibia is based on the same plane of Dipnoi (lung fishes). The lateral abdominal veins fuse to form the anterior abdominal vein . The posterior cardinal veins are replaced by the posterior vena cava. The cuvierian ducts are transformed to anterior venae cavae.

---

أجابة السؤال الرابع الجزئية (ى)

### **Structure of Ascidia**

This class includes a peculiar group of widely distributed marine animals known as sea squirts or ascidians. *Ascidia* in its adult state bears little resemblance to a typical chordate. It lacks a notochord and its nervous system is reduced to a small ganglionic mass. There is only the pharynx with numerous gill slits in its walls which gives evidence of its chordate relationships. An adult specimen is round or oval and has two openings or siphons. A stream of water enters the larger incurrent siphon (mouth) and leaves through the smaller excurrent siphon (atriopore). The entire body is covered by a capsule or tunic. This is composed of a substance called tunicin, secreted by the cells of the mantle beneath it. The greater part of the cavity is occupied by the pharynx. The nerve ganglion lies embedded in the mantle in the region between the siphons which is the dorsal side of the animal. The neural gland opens by means of a duct into the pharynx. This gland has been homologized with the pituitary gland of vertebrates. A ciliated groove, the endostyle, extends along the midventral line of the pharynx to the esophagus.

Beside the pharyngeal gill apparatus, there are other chordate characters which are found in larva stage. The ascidian larva has the appearance of an amphibian tadpole. The head of the larva corresponds to the entire body of the adult. The larva possesses a notochord which is constricted to the tail, a hollow dorsal nerve cord, and a pharynx with gill slits opening to the outside. After a swimming period it finally attaches itself to some object and becomes sessile. The tail with fins is absorbed into the body. The notochord disappears and the hollow dorsal nerve cord is reduced to a single ganglion. The only one of the three essential chordate characters which persists is the pharynx with its numerous gill slits communicating directly with the exterior. This phenomenon is called retrogressive metamorphoses.

-----  
أنتهت الأجابة النموذجية لأسئلة الأمتحان .