NAME : …… STREAM : ……

P530/2

**BIOLOGY PAPER 2**

S.6 APRIL/ 2019

$2^1/_2$ hours

**UGANDA ADVANCED CERTIFICATE OF EDUCATION**

BIOLOGY PAPER 2

2 hours 30 minutes.

**INSTRUCTIONS TO CANDIDATES:**

*Answer question one in section **A** plus three others from section **B**.*

*Candidates are advised to read the questions carefully, organize their answers and present them precisely and logically, illustrating with well labeled diagrams where ever necessary.*

*Write on the answer sheet , your name, stream and index number if any and the questions attempted in their order as shown in the table.*

| Question | Marks |
|---|---|
| | |
| | |
| | |
| | |
| Total | |

## SECTION A (40 MARKS)

**1.** A study was conducted on Hormonal changes in the menstrual cycle of a fertile female of reproductive age. Periodic changes in the levels of the gonadotrophin hormone, Follicle stimulating hormone (FSH) and two other steroid hormones, oestrogen and progesterone were studied over the 28 days of the menstrual cycle. The Hormonal changes are shown in Figure 1 below.

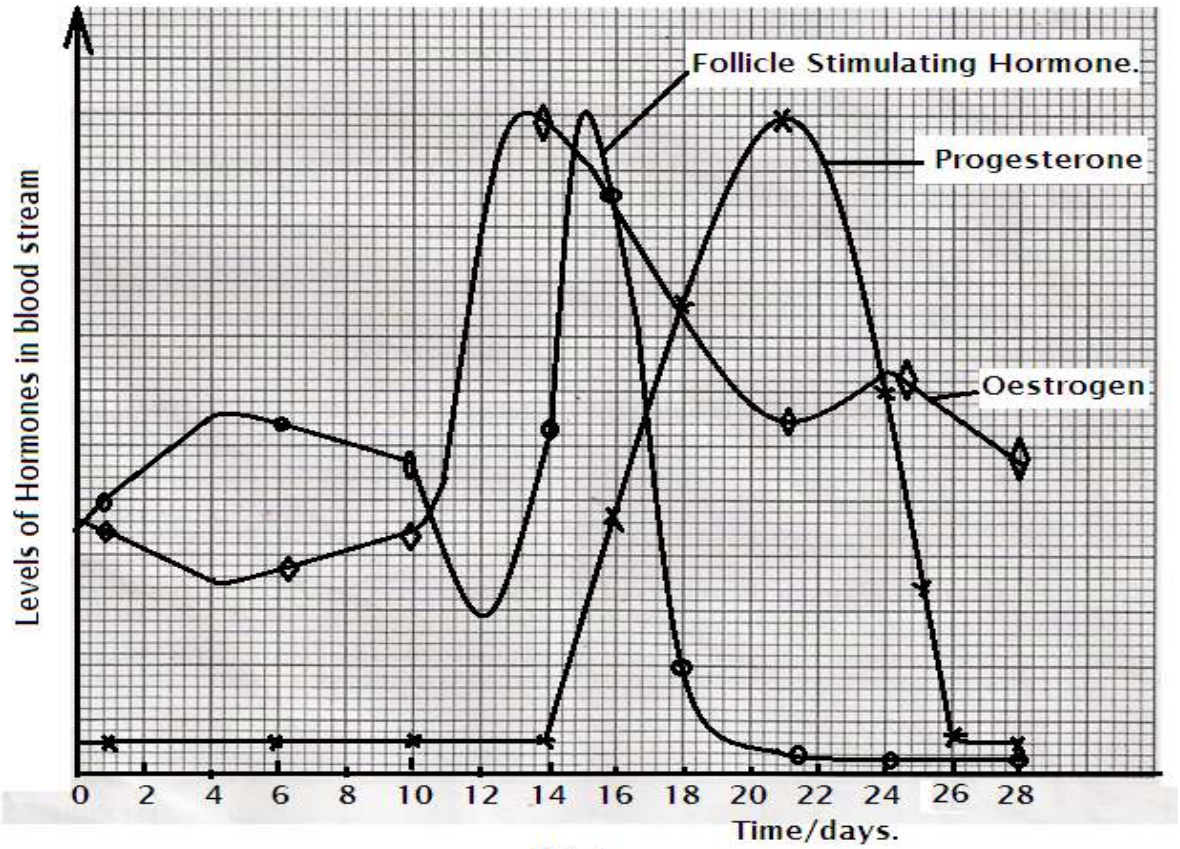


Fig. 1

(a) Compare the variations in the levels of the Oestrogen and Progesterone Hormones. (08 marks)

(b) Explain,

(i) Relationship between Follicle stimulating Hormone and Oestrogen in the 28 days of menstrual cycle. (12 marks)

(ii) Variations in the levels of progesterone Hormone throughout the menstrual cycle. (09 marks)

(c) Predict the changes in the levels of the three Hormones if fertilization occurs on the 17th day of the cycle. (03 marks)

(d) Suggest reasons for your answer in C above. (04 marks)

(e) Explain the significance of the three types of hormones as fertility drugs. (04 marks)

## SECTION B (60 MARKS)

**2** (a) Describe advantages and disadvantages of both internal and external fertilization in animals. (11 marks)

(b) Explain series of events that occur in the oviduct which leads to fertilization in mammals. (09 marks)

**3.**(a) Describe the chemical and structural components that lead to the existence of variety of carbohydrates in nature. (12 marks)

(b) Explain the importance of carbohydrates to plants. (08 marks)

**4.** (a) Compare hair pin counter current multiplier and counter current heat exchange system. (08 marks)

(b) Describe the process of osmo-regulation in humans. (12 marks)

5. (a) Describe the roles of various hormones in regulation to normal in blood,

(i) Glucose concentration. (08 marks)

(ii) Temperature. (05 marks)

(b) How does the mammalian kidney control at a set point low pH in blood. (07 marks)

**6** (a) Describe the structure of a cardiac muscle. (06 marks)

(b) Explain how modifications of plant organs provide support. (08 marks)

(c) Give advantages of Exoskeleton. (06 marks

END

**MARKING GUIDE**

P530/2

**BIOLOGY PAPER 2**

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**SECTION A (40 MARKS)**

**1.**A study was conducted on Hormonal changes in the menstrual cycle of a fertile female of reproductive age. Periodic changes in the levels of the gonadotrophin hormone, Follicle stimulating hormone (FSH) and two other steroid hormones, oestrogen and progesterone were studied over the 28 days of the menstrual cycle. The Hormonal changes are shown in Figure 1 below.

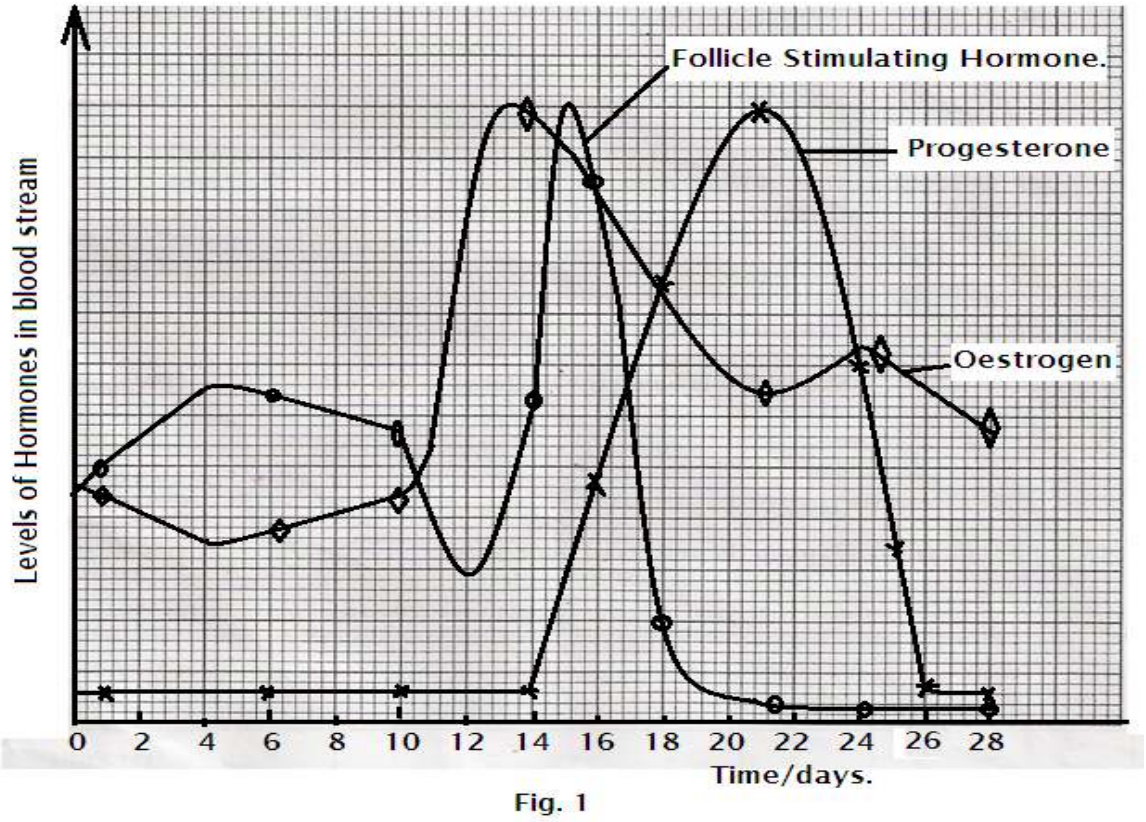


Fig. 1

**Figure 1**

**(f) Compare the variations in the levels of the Oestrogen and Progesterone Hormornes. (07 marks)**

**Similarities,**

- **In both the levels of progesterone and oestrogen hormones increased to reach a peak ;**
- **In both the levels of progesterone and oestrogen hormones reached peak/maximum ;**
- **In both the levels of progesterone and oestrogen hormones declined after the peak ;**

- Both the levels of oestrogen and progesterone decline/decrease between 24 and 26 days ;
- The levels of progesterone and oestrogen hormones is the same on 18 days ; and 24 days ;

@ 1 mark , max = 03 marks

**Differences;**

| Levels of oestrogen hormones | Levels of progesterone hormones |
|---|---|
| (i) decreases slowly from 1 upto 4 days and from 24.5 to 28 days, | (i) Remained constant from 1 to 4 days and from 24.5 upto 28 days ; |
| (ii) Increased from 4 days to 13.2 days, | (ii) Remained constant from 4 days to 13.2 days ; |
| (iii) Decreased rapidly from 14 upto 21 days, | (iii) Increased rapidly from 14 upto about 21 days ; |
| (iv) Two peaks reached, | (iv) One peak reached ; |
| (v) Increased from 21 to 24 days , | (v) Decreased from 21 to 24 days ; |
| (vi) Is higher from 1 upto 18 days and from 24 upto 28 days, | (vi) Is lower from 1 upto 18 days and from 24 upto 28 days ; |
| (vii) Is lower from 18 upto 24 days, | (vii) Is higher from 18 upto 24 days; |
| (viii) Attains peak earlier on day 13.2 day , | (viii) Attain peak later on day 21 ; |

@ 1 mark , maximum = 04 marks

(g) Explain,

(iii) **Relationship between Follicle stimulating Hormone and Oestrogen in the 28 days of menstrual cycle.** (14 marks)

(iv) **Variations in the levels of progesterone Hormone throughout the menstrual cycle.** (09 marks)

**b(i)** From 1 to about 4 days ; as the levels of follicle stimulating hormones (FSH) increased gradually/rapidly the levels of oestrogen decreased gradually/rapidly ; decrease in levels of oestrogen stimulates Hypothalamus to secrete gonadotrophin releasing hormone (GnRH) ; Gonadotrophin releasing hormone stimulates secretion of FSH ; from the anterior lobe of pituitary gland ; High levels of FSH inhibits secretion of the oestrogen from ovarian follicles ;

From 4 to 10 days ; as the levels of oestrogen increases slowly, the levels of FSH decrease slowly ; but the levels of FSH remain relatively higher than oestrogen ; this is because FSH stimulate development of ovarian follicle which secreted less oestrogen ;

From 10 upto 12/13 days ; as the levels of FSH decreased rapidly the levels of oestrogen increased rapidly ; this is because FSH stimulated further development of the ovarian follicle ;which secrete more oestrogen ; oestrogen causes repair and growth of the endometrium ; and inhibits further secretion of follicle stimulating hormones (FSH) ; so that only one graafian follicle develops within the ovary ;

From 12 upto 15.2 days ; as the levels of FSH increased very rapidly to a peak the levels of oestrogen declined slowly ; this is because when the levels of oestrogen reached its peak at 13.2 days ; it stimulated hypothalamus to secrete more gonadotrophin releasing hormone causing a temporary rapid increase in secretion of FSH ; and Luteinizing hormone (LH) from the anterior lobe of pituitary gland ; called the ovulatory surge ; LH stimulates ovulation ; LH stimulates formation of corpus luteum ; which secretes progesterone ;

From15.2 upto 21.6 days ; as the levels of FSH declined rapidly the levels of oestrogen continued to decline ; high levels of oestrogen and increase in concentration of progesterone ; inhibit secretion of FSH from anterior lobe of pituitary gland ; FSH levels at its peak inhibit secretion of oestrogen from the ovaries ;

From 21.6 upto 28 days ; as the levels of oestrogen rises slowly and falls slowly/fluctuates and the levels of oestrogen remain higher the levels of FSH is lower and constant ; this is because corpus luteum secretes smaller amounts of oestrogen and high levels of progesterone ; inhibiting secretion of anterior lobe of pituitary gland to secrete FSH ;

@ ½ mark, maximum = 14 marks

*Accept when while or where as is used for a difference in trend and both for similar trends.*

**(ii)**At time of 1 day the levels of progesterone is low ; and between time of 1 day and 14 days the levels of progesterone remained constant ; this is because corpus luteum is not yet developed ; and the hormone progesterone is not secreted into the blood stream ;

From time of 14 days upto about 20.4 days levels of progesterone increased rapidly to reach its peak ; because corpus luteum is formed ; and it is secreting large amounts of progesterone hormones ;

From time of 20.4 to 26 days the levels of progesterone declined/decreased rapidly ; because corpus luteum is degenerating rapidly ; and further secretion of progesterone is inhibited/reduced greatly ;

Between time of 26 to 28 days the levels of progesterone remain constant ; no secretion of progesterone due tocorpus luteum completely degenerated ;

@ 1 mark , maximum = 09 marks

(h) **Predict the changes in the levels of the three Hormones if fertilization occurs on the 17th day of the cycle.** **(03 marks)**

- Levels of progesterone will increase gradually and then rapidly above the levels of oestrogen ;
- Levels of oestrogen will increase very gradually but slightly below the levels of progesterone ;
- Levels of Follicle stimulating hormone will decreased gradually and remain constant at very low levels ;

@ 1 mark = 03 marks

(i) **Suggest reasons for your answer in C above.** **(04 marks)**

Diploid zygote formed will develop into a blastocyst ; the cells of the outer layer of the blastocyts called trophoblasts ; secrete Human chorionic gonadotrophin hormone ; which will maintain the corpus luteum for some time ; secreting small amounts of oestrogen ; but larger amounts of progesterone ; a role later played by the placenta when formed ; Progesterone maintains the thickness of endometrium which sustains pregnancy ; oestrogen stimulates formation of receptor molecules in endometrium ; sensitive to oxytocin ; that will later cause birth ; FSH decrease to ensure no ovulation occurs during pregnancy/no development of graafian follicles take place during pregnancy ;

@ ½ marks = 04 marks

(j) **Explain the significance of the three types of hormones as fertility drugs.** **(03 marks)**

They can be provided to mature female individuals as synthetic chemicals that can stimulate ovulation ; they either provide gonadotrophins such as FSH which stimulate the development of follicles ; or they provide a chemical which inhibit natural production of oestrogen ; lack of oestrogens results in production of more FSH which stimulates follicular development ;

@ 1 mark, max = 03 marks.

**TOTAL = 40 MARKS**

## SECTION B (60 MARKS)

(a)Describe advantages and disadvantages of both internal and external fertilization in animals. (11 marks)

ADVANTAGES OF INTERNAL FERTILIZATION,

- Embryos are protected from hostile environment /predators/damage ;
- Embryos easily obtain nutrients ;
- High chances for fertilization/reliable/efficient ;
- Reduces wastage of gametes ;
- Rapid growth due to optimum temperature ;
- Promotes parental care ;

@ 1 mark , max = 03 marks

DISADVANTAGES OF INTERNAL FERTILISATION,

- Embryos are vunerable to toxic chemicals produced by mother ;
- When the mother dies, the foetus also dies ;
- The foetus may contract infections from the mother ;
- Mothers are deprived of nutrients which the foetus obtain from them ;
- Delays fertilization since it relays on courtship ;
- Long gestation period causes few offsprings to be produced ;
- Mothers may be exposed to predation during periods of pregnancy ;

@ 1 mark , max = 04 marks

ADAVANTAGES OF EXTERNAL FERTILISATION.

- Survival of the embryo and foetus do not depend on tha for the mother ;
- Embryos/foetus cannot be damaged by toxic chemicals secreted by the mother ;
- Embryos/fetuses are exposed to adequate food supply ;
- Permit dispersal of organisms widely ;
- Parents are not deprived of nutrients ;
- Faster adaptations to the environment ;
- Many offsprings are produced ;

@ 1 mark , max = 04 marks

DISADVANTAGES OF EXTERNAL FERTILISATION,

- Growth and development of embryos/foetus may be limited by harsh external conditions ;
- Predation of embryos/foetus may not occur ;
- Leads to wastage of gametes ;
- Low chances of fertilization, so its not reliable and in-efficient ;
- There are cases of scarce nutrients for the embryos/foetus ;
- Leads to competition for food between adults and embryos/foetus ;

- Only a few offsprings survive ;
- It limits parental care ;

@ 1 mark , max = 04 marks

(b) Explain series of events that occur in the oviduct which leads to fertilization in mammals. (09 marks)

Sperms get into contact with the secondary oocyte/the acrosome membrane of the sperm fuses with the one next to it ; acrosome membrane ruptures releasing hydrolytic enzymes/digestive/protease ; sperm head binds to special receptors on the surface of the zona pellucida ; the hydrolytic enzymes digest the path through the zona pellucida ; one sperm penetrates into the cytoplasm cytoplasm of the secondary oocyte ; cortical granules (lysosomes) in the cytoplasm of the secondary oocyte release enzymes ; which cause zona pellucida to thicken and harden/fertilization membrane is formed/the enzymes also destroy the sperm receptors on the surface membrane of secondary oocyte ; the secondary oocyte undergoes second meiotic division to form haploid ovum and a polar body ; the haploid nucleus of the sperm fuses with a haploid nucleus of the ovum ; a diploid zygote is formed ;

@ 1 mark , max = 09 marks

3. (a) Describe the chemical and structural components that lead to the existence of variety of carbohydrates in nature. (12 marks)

Carbohydrates are organic compounds of life ; they consist of the elements carbon, hydrogen and oxygen ; with a general formular Cx(H2O)y ; the elements are bonded to form a single sugar unit called monosaccharides ; with a general formula $(CH_2O)n$ ; where n determines the number of the carbon atoms which are variable and therefore existence of various monosaccharides ; a monosaccharide consisting of 3Carbon atoms in their structure are called Trioses ; they include, Glyceraldehyde phosphate/Dihydroxyacetone phosphate ; 5carbon atom monosaccharides are pentose sugars ; like Ribose/Deoxyribose/Ribulose ; 6carbon atom monosaccharides are hexose sugars ; like glucose/fructose ;

Some monosaccharides contain aldehyde functional groups ; and are called aldoses like glucose molecule ; while others contain the ketone functional groups ; and are called keoses like the fructose ;

Some carbohydrates are Disaccharides ; formed when two monosaccharides are condensed ; through glycosidic bonds ; such as sucrose from two molecules of glucose and fructose/maltose (Glucose + glucose)/ Lactose (Galactose + Glucose ;

Carbohydrates can also be polysaccharides ; formed from condensation of many monosaccharides by glycosidic bonds ; like starch a stoage compound in plant cells/Glycogen in animals/chitin ;

@ ½ mark , max = 12 marks

(b) Explain the importance of carbohydrates to plants. (08 marks)

- Glucose is oxidized during cellular respiration to generate energy inform of ATP ;
- Carbohydrates like starch are storage components in plants ;
- Cellulose are carbohydrates that form structural components in cell wall provide rigidity for extra support ;
- Carbohydrates such as pectins are important in binding cell walls together thus increasing support in plant structure ;
- Carbohydrates like sucrose are important in maintaining high osmotic pressure such as plant cells obtain water by osmosis from neighbouring cells ;
- Sucrose is the form in which carbohydrates are transported within plants ;
- Pentose sugars like Ribose and Deoxyribose are carbohydrates which form components of RNA and DNA which are genetic materials that control characteristics in plants ;
- Ribulose is a carbohydrate which combines with phosphate to form RuBP which is a carbondioxide acceptors increasing photosynthetic rates ;

@ 1 mark , max = 08 marks

**4 (a)** Compare hair pin counter current multiplier and counter current heat exchanger system. (08 marks)

Differences,

| Hair pin counter current multiplier | Heat exchange system |
|---|---|
| - The two systems involved are loops of henle, the descending and ascending loops of henle, | - The two systems involved are blood vessels, arteries and veins ; |
| - The two systems are filled with renal fluids, | - The two systems are filled with blood as the fluid ; |
| - Occurs in the kidneys, | - Occurs in the body extremities such as the feet |
| - For maximum water conservation, | - For temperature regulations in cold environment ; |
| - Mineral salts are exchanged between renal fluids in descending and ascending loops of henle, | - Heat exchange occurs between the arterial and venous blood ; |
| - Exchange of salts take place by | - Exchange of heat takes place by diffusion ; |

| | |
|---|---|
| both diffusion and active transport,<br>- Occurs during hot and cold conditions , | - Occurs during extreme cold temperature condions ; |

@ 1 mark , maximum = 04 marks

Similarities,

In both/both hair pin counter current and heat exchange system,

- The fluid in the two systems flow in opposite directions ;
- There is an increase in concentration in one system while in the other system there is decrease in concentration of the same substance ;
- Exchange of materials can occur by diffusion ;
- Exchange of materials take place between the two system of fluids ;
- The system are filled with fluids ; and exchange of materials occur between them ;
- Both involve blood vessels ;

@ 1 mark , maximum = 04 marks

(b) Describe the process of osmo-regulation in humans. (12 marks)

When salt concentration of blood has become higher ; due to excessive sweating/large intake of salt in the diet ; osmoreceptors in hypothalamus detects this rise in salt concentration in blood ; and send impulses to posterior lobe of pituitary gland ; antidiuretic hormone (ADH)/vasopressin is secreted into blood stream ; in presence of ADH in the kidney, the walls of distal convoluted tubule and collecting duct ; become more permeable to water and urea ; urea diffuse out of urine in collecting duct into tissue fluids in the medulla ; raising concentration in this regions ; more water is reabsorbed into kidney cortex and medulla and carried back into blood stream ; by osmosis ; lowering salt concentration in blood back to normal ;

And when salt concentration in blood is low ; osmoreceptors in hypothalamus detects it and impulses send to the posterior lobe of pituitary gland causes secretion of less ADH into blood stream ; and the walls of distal convoluted tubule and collecting duct remain less permeable to water and urea ; less water is reabsorbed back into blood stream ;

When less water enters the blood by osmosis, the blood volume and pressure decreases ; stimulating group of secretory cells (juxtaglomerular complex) located between afferent arterioles and distal convoluted tubule ; to secrete an enzyme rennin ; causing the plasma globulin to form the hormone angiotensin ; angiotensin stimulates the secretion of the

hormone aldosterone ; from the adrenal cortex ; causing reabsorption of sodium into blood capillaries ; which is accompanied by large influx of water into blood capillaries ;

Higher concentration of sodium in blood, increases blood volume and pressure ; secretory cells in the kidney are less stimulated ; less rennin is secreted/less angiotensin is formed ; less aldosterone is secreted into blood ; less sodium is reabsorbed into blood/less sodium is absorbed back into blood ; sodium concentration is lowered in blood ; causing less water reabsoebed into blood stream , blood volume and pressure is lowered ;

More concentrated blood stimulates the thirst center in the hypothalamus ; increasing the sensation of thirst and more water is drunk ; allowing more water to be reabsorbed into blood stream ; and when blood is less concentrated, the thirst centre is less stimulated ; less feeling of thirst causes little water to be drunk ; little water is reabsorbed into blood stream ;

@ $^1/_2$ mark , maximum = 12 marks

5. (a) Describe the roles of various hormones in regulation to normal in blood,

(i) Glucose concentration. (08 marks)

(ii) Temperature. (05 marks)

(b) How does the mammalian kidney control at a set point low pH in blood. (07 marks)

6 (a) Describe the structure of a cardiac muscle. (06 marks)

Cardiac muscle consists of muscle fibres which are made up of myofibrils/myofilaments ; the myofibrils contain actin and myosin filaments ; which gives the muscle fibres stripped appearance ;

Muscle fibres posses one or two nuclei ; many large mitochondria ; individual muscle cells/muscle fibres are separated by the cell surface membranes called intercalated discs ; the muscle fibres branch and cross connect with each to form a complex net –like arrangements ;

@ 1 mark = 06 marks

Acc well labeled diagram.

(b) Explain how modifications of plant organs provide support. (08 marks)

Xylem vessels/tracheids/sclerenchyma are found at the central regions of the roots ; and in the mid-ribs/net veins of leaves ; they are arranged in ring forms or scattered in the stems of plants ; they are highly lignified ; adding extra mechanical strength ;

Stems of herbaceous plants contain numerous thin walled parenchyma cells, when these cells are fully filled with water they become turgid, providing extra support ;

Collenchyma located at the periphery in the cortex (cortical regions) of the roots/stems/leave cells have extra cellulose deposited at their corners for extra strength ;

Roots of some plants develop into prop roots like maize plant/buttress roots/deep roots for firm anchorage providing support ;

Leaves of some plants like passion fruits ; develop into tendrils to wind around stems or other structures to provide support ;

Some plants posses stems which are big to support the shoot system of the plant ;

@ 1 mark , max = 08 marks

(c) Give advantages of Exoskeleton. (06 marks)

- It prevents water loss due to presence of wax ;
- It maintains the shape of the insects there by making locomotion more efficient ;
- It is jointed for flexibility during locomotion ;
- It provides surface for muscle attachment ;
- It is hard and offers protection to internal organs from mechanical injuries and friction ;
- Some exoskeleton are coloured and this provides easy camouflage for protection against predators ;
- Colour texture of the exoskeleton is important in temperature regulation ;

@ 1 mark , max = 06 marks