GAUTENG DEPARTMENT OF EDUCATION

SENIOR CERTIFICATE EXAMINATION

PHYSIOLOGY HG

TIME: 3 hours

MARKS: 300

INSTRUCTIONS:

- The question paper consists of THREE Sections.

  SECTION **A**: 90
  SECTION **B**: 160
  SECTION **C**: 50

- Answer ALL questions in Sections **A** and **B**.
- You have a choice in Section **C**: Answer **either** Question 9 **or** Question 10.
- Answer Question 1 (multiple-choice questions) on the **answer sheet** on the **inside cover** of your **answer book**.
- Provide all labels with a corresponding number.
- Number your answers in accordance with the question paper.

SECTION A

Answer ALL the questions in this section.

QUESTION 1
MULTIPLE-CHOICE QUESTIONS

Four possibilities are given as answers to each of the following questions. Indicate the correct answer, by marking the relevant letter with a cross (**X**) on the **answer sheet** on the **inside cover** of your **answer book**.

EXAMPLE: Saliva is secreted in the _____ .

A. mouth
B. oesophagus
C. stomach
D. duodenum

ANSWER:

A	B	C	D

1.1 If the following two factors are not kept constant in the intra-and intercellular regions, proteins and enzymes will denature.

A. Temperature and carbonic acid concentration
B. Glucose and water concentration
C. Hormone and carbon dioxide concentration
D. Temperature and carbon dioxide concentration

1.2 Which of the following is produced by the skin?

A. Vitamin D and melanin
B. Melanin and renin
C. Ammonia and vitamin D
D. Lacrymal fluid and sweat

1.3 All the following substances are normal contents of urine, EXCEPT _____ .

A. nitrogenous waste
B. hormones
C. pigments
D. plasma proteins

1.4 The blood vessel that forms the interlobar artery is the _____ .

A. interlobar vein
B. arcuate artery
C. interlobular artery
D. renal artery

1.5 Which of the following structures secrete the enzyme renin when blood pressure in the afferent arteriole drops?

A. Loop of Henlé
B. Proximal convoluted tubule
C. Juxtaglomerular apparatus
D. Collecting ducts

1.6 Which hormone is secreted by the juxtaglomerular apparatus?

A. Oxytocin
B. Erythropoietin
C. Antidiuretic hormone (ADH)
D. Aldosterone

1.7 Neurotransmitters are released in the synaptic cleft and bind to _____ .

A. the presynaptic membrane
B. the base of the axon
C. the postsynaptic membrane
D. mitochondria

1.8 The central sulcus divides the cerebrum into _____ .

A. a temporal and parietal lobe
B. two hemispheres
C. a frontal and parietal lobe
D. an occipital and parietal lobe

1.9 The internal white matter of the cerebellum is the _____ .

A. arbor vitae
B. vermis
C. peduncle
D. aquaduct

1.10 Which one of the following statements is INCORRECT?

A. There are 8 cervical nerve pairs
B. There are 12 thoracic nerve pairs
C. There are 5 lumbar nerve pairs
D. There are 31 pairs of spinal nerves

Questions 1.11 to 1.13 refer to the diagram below.

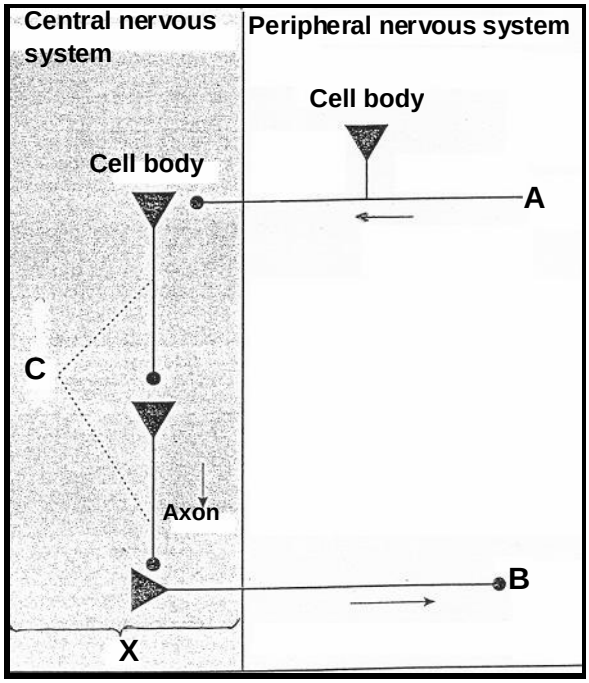


Figure 1.11: The functional classification of neurons

1.11 If A represents the receptor, what will B represent?

A. The effector
B. The spinal cord
C. The brain
D. The autonomic nervous system

1.12 C represents _____ .

A. monopolar neurons
B. sensory neurons
C. motor neurons
D. interneurons

1.13 Region X is the _____ .

A. spinal cord
B. cerebrum and spinal cord
C. cerebellum
D. medulla oblongata

1.14 The sense organ(s) responsible for the sense of balance is/are located in the _____ .

A. vestibule
B. cochlea
C. semicircular canals
D. Both A and C.

1.15 Olfactory receptors and taste buds are _____ .

A. thermoreceptors
B. chemoreceptors
C. nociceptors
D. mechanoreceptors

1.16 All the following are primary taste sensations, EXCEPT _____ .

A. sweet
B. bitter
C. salty
D. spicy

1.17 Multifocal lenses are prescribed for a person who suffers from _____ .

A. presbiopy
B. astigmatism
C. myopia
D. nyctalopia

1.18 Golgi tendon receptors are stimulated by _____ .

A. excessive muscle contraction
B. sharp light
C. loud sound
D. chemical substances

1.19 Which of the following is NOT a typical endocrine gland?

A. Pineal gland
B. Lacrymal gland
C. Parathyroid gland
D. Pancreas

1.20 The process of production of mature gametes in the ovaries is known as _____ .

A. spermatogenesis
B. mitosis
C. oogenesis
D. conception

1.21 The following structures secretes testosterone:

A. Cells of Cowper
B. Cells of Schwann
C. Cells of Leydig
D. Cells of Sertoli

1.22 Before copulation takes place, the spermatozoa are stored temporarily in the _____ .

A. seminal vesicle
B. prostate gland
C. Cowpers gland
D. epididymis

1.23 The organ(s) influenced by a vasectomy is / are the _____ .

A. vas deference
B. fallopian tubes
C. ejaculation tubes
D. epididymis

1.24 The organ(s) responsible for the homeostatic regulation of the pH, nitrogenous waste, salts and water in the body, is / are the _____ .

A. skin
B. kidneys
C. lungs
D. liver

1.25 The following substances must be kept constant as they are needed for respiration.

A. Water and salts
B. Salts and glucose
C. Carbon dioxide and oxygen
D. Glucose and oxygen

1.26 The accumulation of the following substance(s) result(s) in the decrease in the pH of the intra and extra cellular fluids.

A. Glucose
B. Carbon dioxide
C. Hormones
D. Water

1.27 Gastrin stimulates the following organ:

A. Gall bladder
B. Pancreas
C. Small intestines
D. Stomach

1.28 Cushing's syndrome is the result of _____ .

A. an overactive thyroid gland
B. an overactive adrenal cortex
C. overactive ovaries
D. an overactive parathyroid gland

1.29 Kidney stones are caused by _____ .

A. hyperparathyroidism
B. diabetes mellitus
C. dwarfism
D. osteoporosis

1.30 The temporal lobe is situated _____ .

A. behind the fissure of Rolando
B. below the fissure of Sylvius
C. in front of the fissure of Rolando
D. next to the longitudinal fissure

30x2= **(60)**

QUESTION 2

Indicate if the descriptions in **COLUMN 1** are applicable to only **A,** only **B, A** and **B** or **none** of the items in **COLUMN 2**.

Indicate your choice in the following way:

A if only A relates to the statement.
B if only B relates to the statement.
A and **B** if both A and B relate to the statement.
None if neither A nor B relates to the statement.

	COLUMN 1	COLUMN 2
2.1	Acts as a buffer if the pH decreases	A. Ammonia B. Ammonium
2.2	Conditioned reflex	A. Internal sphincter of bladder B. External sphincter of the bladder
2.3	Is/are deaminated	A. Glutamin B. Excess amino acids
2.4	Contains lots of mitochondria to provide energy	A. Cells of proximal convoluted tubules B. Synaptic end bulbs
2.5	Sensory neurons	A. Multipolar neurons B. Bipolar neurons
2.6	Pupil constricts	A. Circular muscles contract B. Parasympathetic stimulation
2.7	Is filled with perilymph	A. Middle-ear cavity B. Scala media
2.8	Is a steroid	A. Cortisone B. Oxytocin
2.9	Stimulates the breakdown of glycogen	A. Glucagon B. Insulin
2.10	Stimulates the secretion of bile	A. Gastrin B. Secretin

(10)

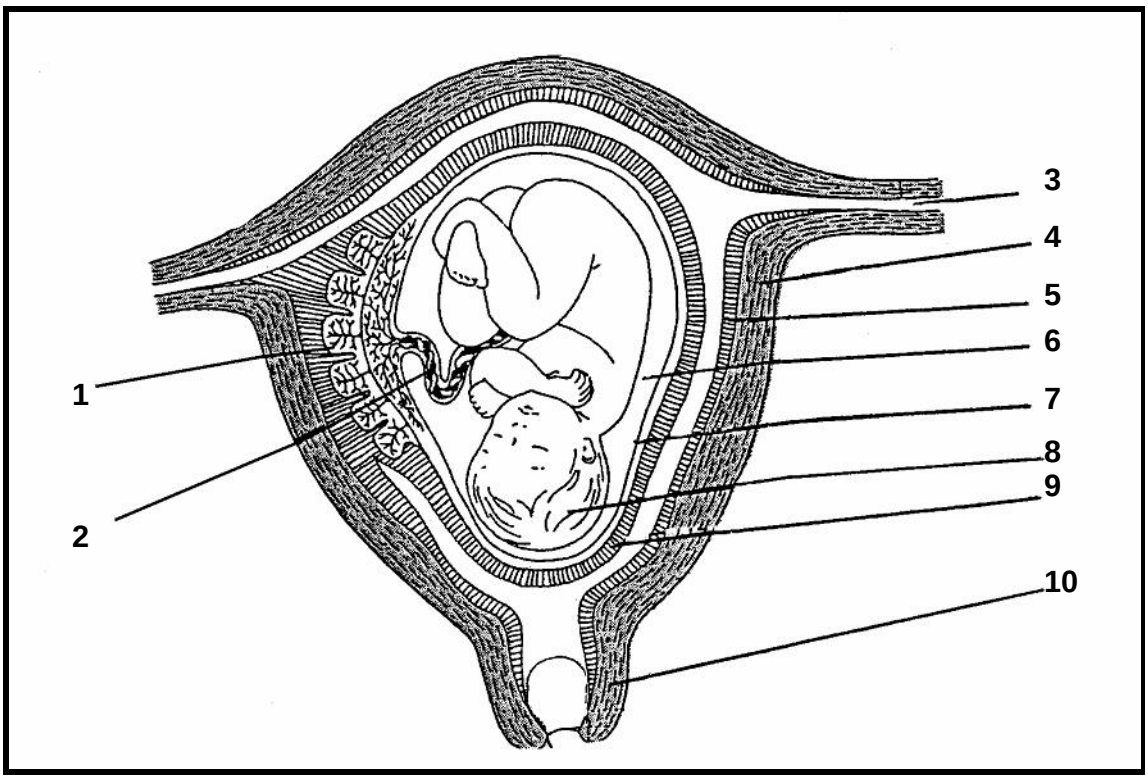
QUESTION 3

Give the correct **physiological term** for each of the following descriptions.

3.1 The structure that secretes progesterone and a little estrogen
3.2 The structure with hydrolytic enzymes that dissolves the zona pellucida during fertilization
3.3 The gland with exocrine as well as endocrine functions
3.4 The exocrine glands in the olphactoric region that secrete mucus
3.5 Taste buds that sense bitter tastes
3.6 The structures in the retina that contain iodopsin
3.7 The hormone that results in the same reactions as the sympathetic nervous system
3.8 The part of the brain that regulates biological rhythms and primary drives
3.9 The structure that isolates the axon to increase the speed at which impulses are conducted
3.10 The fibrous connective tissue layer that protects the kidney **(10)**

QUESTION 4

Study the diagram below and **label** numbers **1** to **10**.



(10)

Figure 4.1 Developing foetus in the uterus

TOTAL FOR SECTION A: [90]

SECTION B
COMPULSORY

QUESTION 5

5.1 The hypophysis secretes trophic hormones that have a stimulating effect on other endocrine glands to secrete their respective hormones. The glands are regulated by a negative-feedback mechanism.

5.1.1 Name FOUR other endocrine glands that are regulated by the hypophysis. (4)

5.1.2 Name the trophic hormones responsible for the regulation of the above-mentioned glands. (4)

5.2 The hypophysis also secretes growth hormone that regulates growth in the human body. **Figure 5.2** is a graphic representation of growth in the body, especially in the brain and reproductive organs.

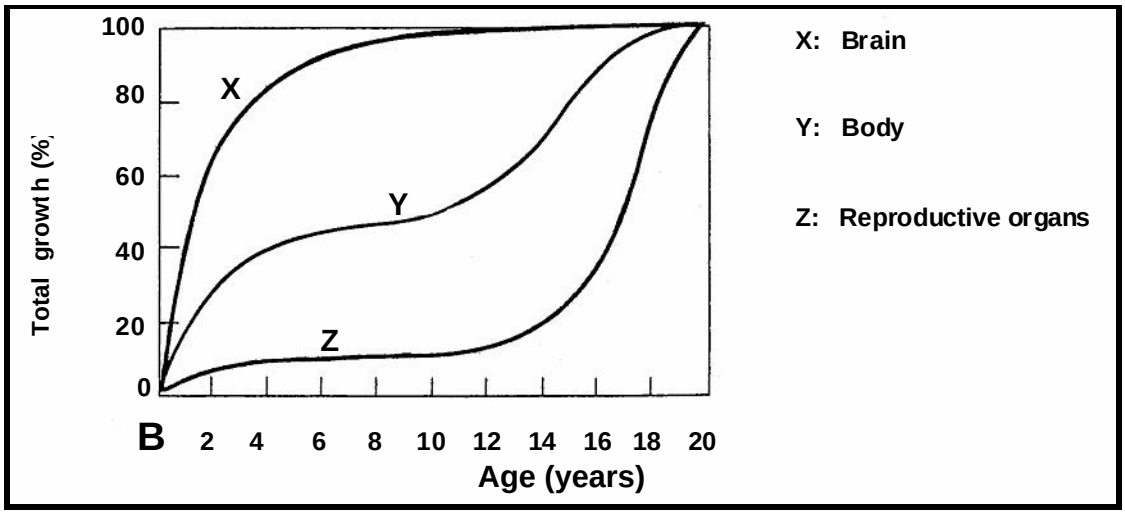


Figure 5.2: Rate of growth of different parts of the body

5.2.1 Name the part of the hypophysis that secretes growth hormone. (1)

5.2.2 What is the other name for growth hormone? (1)

5.2.3 Name TWO target organs of growth hormone. (2)

5.2.4 Name the hormone that will stimulate the calcifying of the bones in the body. (1)

5.2.5 (a) What is the abnormality called caused by the hypersecretion of growth hormone in adults? (1)

(b) Describe the symptoms of this abnormality. (3)

5.2.6 (a) What time/process does **B** in the graph represent? (2)

(b) At what age does the brain grow rapidly? (2)

(c) What is the percentage of brain growth during the first two years? (1)

(d) Specify the organs in boys and girls which develop rapidly during puberty. (3)

(e) What age on this graph represents puberty? (2)

(f) Name the TWO hormones that will play a role during the development of these organs in boys and girls during puberty. (2)

(g) Name FOUR secondary sex characteristics in males. (4)

5.3 5.3.1 What is the normal blood sugar level? (1)

5.3.2 Discuss the deficiency disease caused by the hyposecretion of insulin. (6)
(40)

QUESTION 6

6.1 6.1.1 Distinguish in table format between TWO types of receptor cells found in the eye regarding their structures and functions. (10)

6.1.2 Name the TWO antagonistic muscles found in the iris. (2)

6.1.3 Discuss what will happen in the iris if a person looks directly at the sun. (4)

6.1.4 Name the TWO types of fluid found in the eye. (2)

Diagram **A** is a graphical representation of the clarity of an image and of areas on the retina.

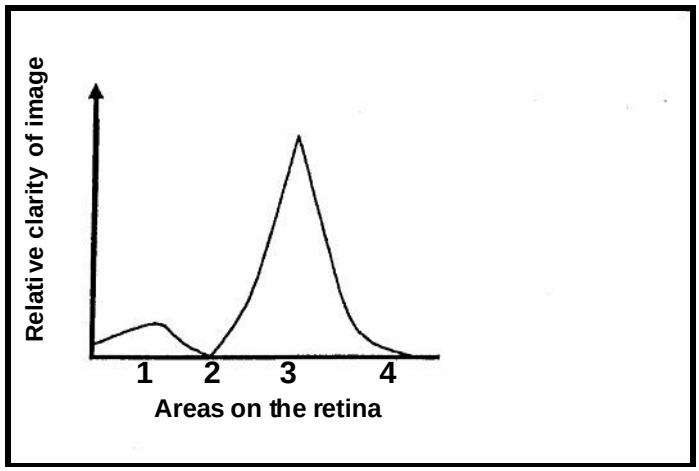


Diagram A: Graph of clarity of image and areas of retina.

6.1.5 At which structures on the retina will image formation take place as indicated on the graph in Diagram **A** at

(a) number 2; and
(b) number 3 respectively. (2)

6.2 **Figure 6.2.1** represents a cross-section through the cochlea and **Figure 6.2.2** represents a structure within the cochlea.

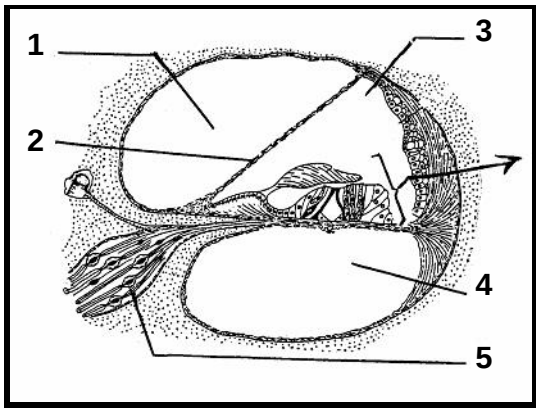


Figure 6.2.1: Cross-section through cochlea

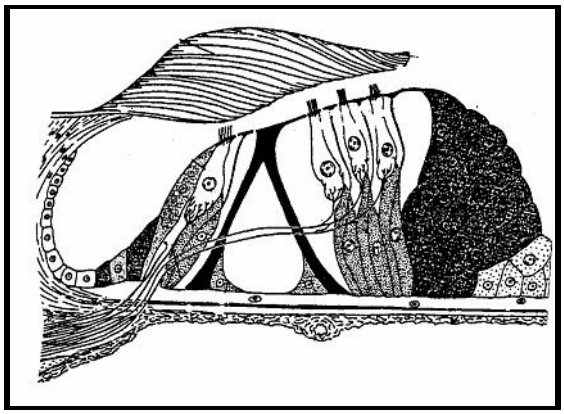


Figure 6.2.2: Structure within the cochlea

6.2.1 Label structures **1** to **5** in **Figure 6.2.1.** (5)

6.2.2 Provide **Figure 6.2.2** with an appropriate heading. (2)

6.2.3 Discuss what will happen with sound vibrations when they reach the oval window in the middle ear until it is interpreted as sound. (10)

6.2.4 Why can deafness be caused when a person is hit on the ear? (3)
(40)

QUESTION 7

7.1

A pregnancy has the best chance of a successful outcome if the blastocyst is implanted properly in the uterine wall. If implantation occurs outside the uterus, in the fallopian tube it results in an ectopic pregnancy. If the ectopic pregnancy occurs in the uterine tube it is a so-called tube pregnancy. When implantation occurs near the cervix resulting in the development of the placenta over the cervix, this condition is referred to as placenta previa. In the third trimester of pregnancy, as the placenta near the cervix separates from the uterine wall it often causes excessive bleeding that can be life-threatening to the mother and baby.

***Dokter in die huis*, Dr. J. van Elfen, 1993, 1st edition**

7.1.1 What does the so-called **ovum** consist of during ovulation? (2)

7.1.2 How many chromosomes are present in the ovum? (1)

7.1.3 Where does fertilization take place? (1)

7.1.4 Discuss the embryonic development from the moment fertilization has occurred until the blastocyst stage. (10)

7.1.5 Why is embryonic development in the fallopian tubes not possible? (2)

7.1.6 Why is it important that implantation does not occur near the cervix? (2)

7.1.7 Any sign of bleeding is an abnormality as menstruation does not occur during pregnancy. Explain why it could not be menstrual flow. (5)

7.2 Distinguish between FOUR types of secretions in the semen that are secreted by the male reproductive system. (8)

7.3 In the table below there is a column representing male structures and a column representing the equivalent female structures, e.g. **Spermatozoa --- Ovum**. Study the table then complete it by providing labels for numbers **1** to **5**. Write only the number and the correct answer in your answer book.

Structure in male body	Structure in female body
E.g. Sperm	Ovum
1	Secondary oocyte and 1st polar body
Spermatide	**2** and **3**
Testis	**4**
5	Oogonium

(5)

7.4 Why is it necessary for the ovum and spermatozoa to be a product of meiosis and not that of mitosis ONLY? (4)

(40)

QUESTION 8

8.1 You and your family are climbing in the Drakensberg and suddenly it starts to rain, the temperature decreases and it is getting COLD.
As a homoiothermic (endothermic) organism, your body temperature stays constant. Discuss the homeostatic role of the skin in maintaining constant body temperature. (15)

8.2 8.2.1 Explain why a person's skin turns brown when exposed to the sun while lying on a beach. (4)

8.2.2 Explain why the above-mentioned person's skin usually will peel off after exposure to the sun. (3)

8.3 Name FOUR types of exocrine glands found in the skin and discuss TWO functions of each. (12)

8.4 Discuss the TWO possible outcomes of the Corpus Luteum after ovulation has taken place. (6)

(40)

TOTAL FOR SECTION B: [160]

SECTION C

Answer only ONE question from this section. Choose either Question 9 **or** Question 10.
If you answer both questions, only the first one will be marked.

QUESTION 9

Read the following passage carefully and answer the questions that follow.

CEREBROSPINAL FLUID (CSF)

Organization
The brain and spinal cord are enclosed by three meninges. There are four ventricles inside the brain and the subarachnoid cavity that is filled with CSF.

Origin and production
The CSF is present in relative small amounts of liquid in the brain. Approximately 40% of the fluid is present in the ventricles and is produced by the choroid plexi. The rest is produced by the blood vessels in the pia mater and brain tissue.

Volume and pressure
An adult produces ± 0,4 ml / minute or 600 ml/day. The total volume of fluid present at any time is ±140 ml, of which 20 ml in the ventricles, 30 ml in the spinal subarachnoid cavity and the rest in the cranial subarachnoid cavity.
The CSF pressure is an average 1,4 kPa (140 mm water) in a horizontal position.

Composition
The composition of CSF is similar to the ultra-filtrate of the blood plasma; for example the total absence of proteins in the filtrate (fluid).

Hydrocephalus
This condition is characterized by the presence of an excessive amount of CSF intercranial. Hydrocephalus can be either congenital or can develop at a later age. This condition can develop due to:
a) Overproduction of fluid
b) Obstruction of fluid circulation
c) Disturbance of fluid absorption in the venous system.

Obstruction of the flow is the most common cause and is mostly found in the foramina or openings of the ventricles and the aquaduct of Sylvius. This causes the intercranial pressure.

Lumbar puncture
A lumbar puncture involves the withdrawal of CSF from the subarachnoid space in the lumbar region of the spinal cord. The CSF is then tested for the presence of blood cells, bacteria and other abnormalities. A sensor called a manometer can be connected to the needle to measure the pressure of the CSF inside the cavity. The lumbar puncture can also be used to introduce diagnostic agents such as radiopaque dyes for x-ray photography.

***Die Fisiologiese basis van geneeskunde*, 2de uitgawe 1979, B.J. Meyer**
***Anatomy & Physiology*, 7th edition 2003,G.A.Thibodeau**

9.1 Name and discuss the structure and the functions of the meninges. (12)

9.2 Name the different brain ventricles, state their positions and discuss how they are interconnected with each other and with the subarachnoid cavity. (10)

9.3 Calculate the amount of Cerebro-spinal fluid (CSF) produced every hour. (3)

9.4 Discuss the functions of Cerebro-spinal fluid (CSF). (5)

9.5 Why are proteins not found in Cerebro-spinal fluid (CSF)? (2)

9.6 9.6.1 What is **meningitis**? (2)

9.6.2 A lumbar puncture is done on a patient if he/she is suspected of having meningitis.

(a) In what region of the vertebral column is a lumbar puncture performed? (2)

(b) The spinal cord ends at the second lumbar vertebra and the rest of the nerves form a bunch resembling a horse's tail. What is this horse's tail called? (2)

9.6.3 (a) Name the cavity present in the middle of the spinal cord. (2)

(b) What are the results if the needle is inserted deeper than the subarachnoid cavity in the spinal cord? (2)

(c) What is the normal pressure of Cerebro-spinal fluid (CSF)? (2)

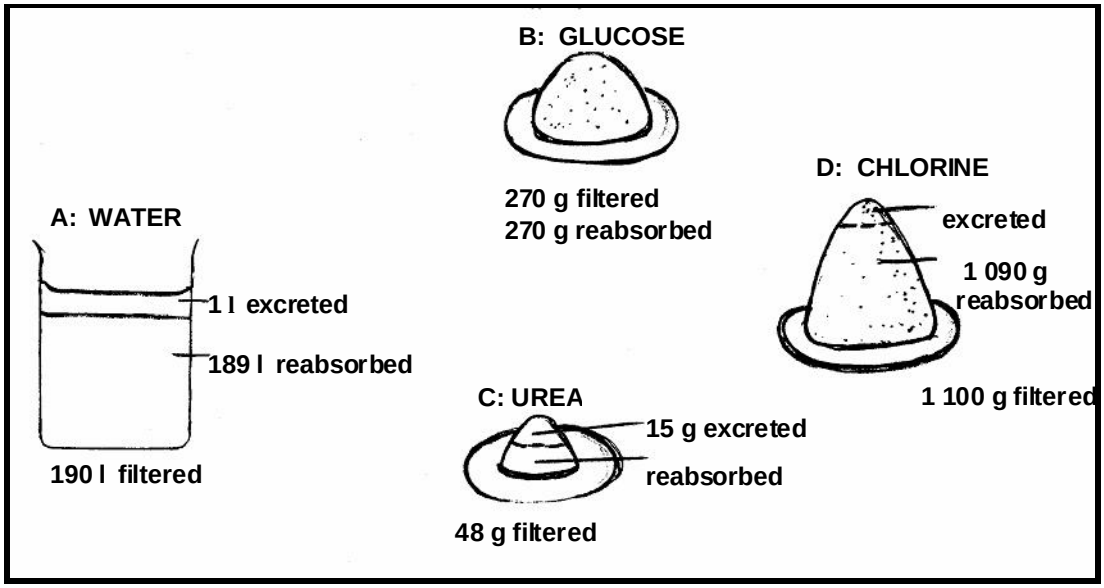
(d) Calculate the amount of Cerebro-spinal fluid (CSF) present in the cranial subarachnoid cavity. (3)

9.6.4 Name the possible reasons for developing hydrocephalus. (3)

(50)

QUESTION 10

The diagrams below represent different filtrate, reabsorbtion and excretion amounts of different substances in the nephrons.



10.1.1 TABULATE the amount of each substance that is filtered, reabsorbed and excreted in the nephron. (11)

10.1.2 Discuss how urea is produced. (5)

10.2 The diagram below indicates the blood supply to the nephrons in the kidney. Study the diagram and answer the questions that follow.

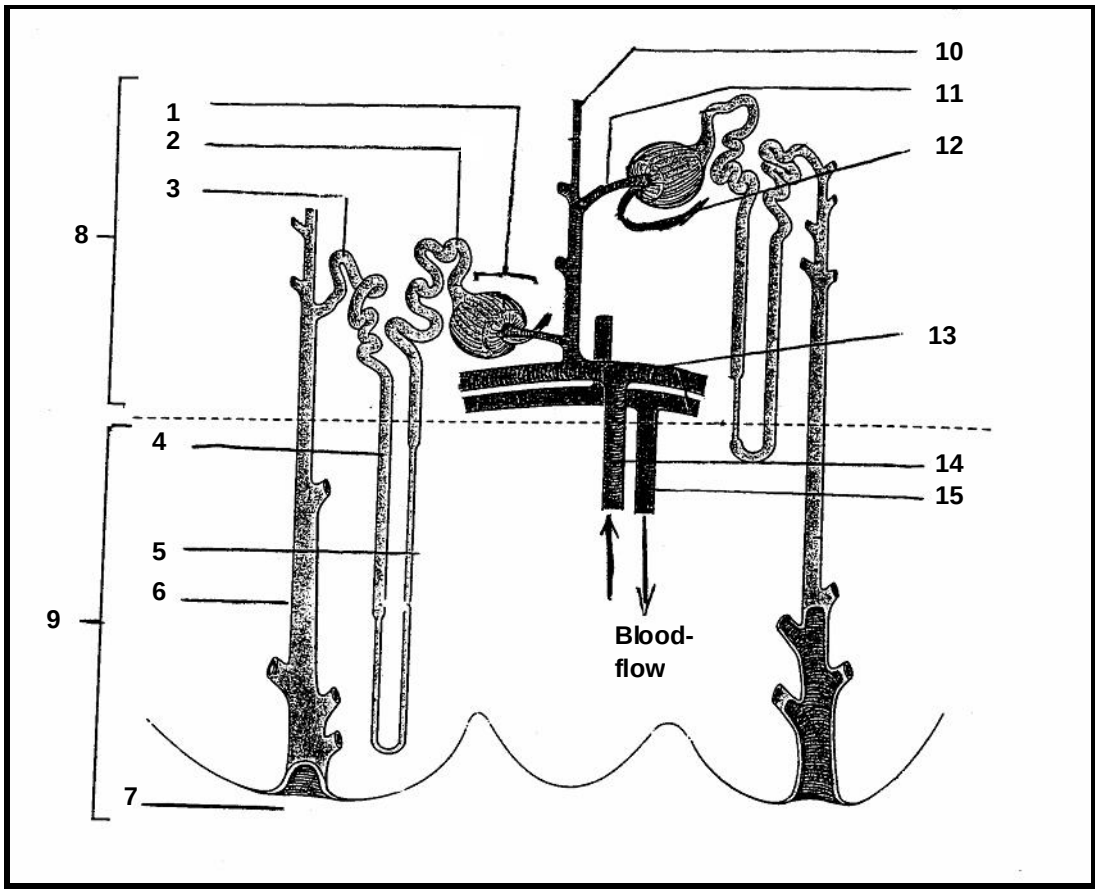


Figure 10.2: Blood supply to the nephrons

10.2.1 Label blood vessels numbered **10**, **14** and **15**. (3)

10.2.2 Name the blood vessel structure that is situated between numbers **11** and **12**. (2)

10.2.3 (a) Identify structures **3** and **6** respectively. (2)

(b) Discuss the control of water loss, osmoreceptors and anti-diuretic hormone (ADH) in order to maintain water equilibrium. (10)

10.2.4 (a) Which process takes place inside structure **1**? (2)

(b) Discuss in detail how structure **1** is adapted to fulfil its function effectively. (10)

10.2.5 (a) Which network of blood vessels is formed by blood vessel **12** if it surrounds the rest of the nephron? (1)

(b) Why must it coil around the nephron before leaving the kidney? (4)
(50)

TOTAL FOR SECTION C: [50]

TOTAL: 300

END