

## GAUTENG DEPARTMENT OF EDUCATION

## SENIOR CERTIFICATE EXAMINATION

OCTOBER / NOVEMBER 2005  
OKTOBER / NOVEMBER 2005

PHYSIOLOGY HG

TIME: 3 hours

MARKS: 300

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**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 6 **or** Question 7.
  - Answer Question 1A (multiple-choice questions) on the **answer sheet** on the **inside cover** of your **answer book**.
  - Number your answers in accordance with the question paper.
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## SECTION A

Answer ALL the questions in this section.

**QUESTION 1A**  
**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:**

<del>A</del>	B	C	D
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- 1.1 The osmotic pressure of a solution is high when \_\_\_\_\_ .
- A. the water concentration is high
  - B. the concentration of the solutes are low
  - C. the solution absorbs water from its surroundings
  - D. it is a hypotonic solution
- 1.2 The star-shaped cells with minor and major processes that envelope the glomerular capillaries are the \_\_\_\_\_ .
- A. cuboidal epithelial cells
  - B. squamose epithelial cells
  - C. endothelial cells
  - D. podocytes
- 1.3 The collecting ducts join to from the \_\_\_\_\_ .
- A. pyramids
  - B. ducts of Bellini
  - C. vasa recta
  - D. convoluted tubules
- 1.4 This vessel carries oxygenated blood with a high concentration metabolic waste.
- A. Interlobar artery
  - B. Interlobar vein
  - C. Renal vein
  - D. Vena cava inferior
- 1.5 Ammonia forms part of the \_\_\_\_\_ .
- A. glomerular filtrate
  - B. filtrate in the distal convoluted tubule
  - C. filtrate in the Loop of Henle
  - D. blood in the vasa recta
- 1.6 One of the following substances does **NOT** form part of the glomerular filtrate.
- A. Urea
  - B. Glucose
  - C. Sodium
  - D. Albumin
- 1.7 The product of the breakdown of nucleic acids is \_\_\_\_\_ .
- A. ammonia
  - B. creatinine
  - C. uric acid
  - D. urochromes

- 1.8 This substance produced by the kidney stimulates the production of red blood cells in the bone marrow.
- A. Glutamin
  - B. Hippuric acid
  - C. Erythropoietin
  - D. Renin
- 1.9 The external sheath of connective tissue surrounding an entire nerve is the \_\_\_\_\_ .
- A. neurilemma
  - B. endoneurium
  - C. perineurium
  - D. epineurium
- 1.10 The part of the brain that controls peristalsis and swallowing is the \_\_\_\_\_ .
- A. hypothalamus
  - B. medulla oblongata
  - C. midbrain
  - D. pons of Varoli
- 1.11 The part of the brain that acts as a reflex centre for visual and auditory stimuli is the \_\_\_\_\_ .
- A. brain stem
  - B. occipital lobe
  - C. temporal lobe
  - D. thalamus
- 1.12 Rapid heart beat, protruding eye balls and profuse sweating are symptoms of \_\_\_\_\_ .
- A. hyperparathyroidism
  - B. hypoparathyroidism
  - C. hypothyroidism
  - D. Grave's disease
- 1.13 One of the symptoms of Addison's disease is \_\_\_\_\_ .
- A. a goitre
  - B. pigmented skin with muscular weakness
  - C. oedema
  - D. virilism

- 1.14 The hormone relaxin is secreted by the \_\_\_\_\_ .
- A. kidney
  - B. placenta
  - C. ovaries
  - D. testis
- 1.15 The embryonic membranes that form part of the umbilical cord at a later stage are the \_\_\_\_\_ .
- A. yolk sac
  - B. allantois and the yolk sac
  - C. chorion and the allantois
  - D. amnion and the chorion
- 1.16 The secretion of this structure contains fructose as an energy source for the spermatozoa.
- A. Prostate gland
  - B. Cowper's gland
  - C. Leydig cells
  - D. Seminal vesicles
- 1.17 The ovaries are held in position by the \_\_\_\_\_ .
- A. fallopian tubes
  - B. vagina
  - C. the broad and round ligaments
  - D. the vas deference
- 1.18 The hormone that inhibits the secretion of gastric juices in the stomach after the chyme has left the stomach is \_\_\_\_\_ .
- A. secretin
  - B. enterocrinin
  - C. gastrin
  - D. enterogastrin
- 1.19 The inner part of this gland has many blood vessels and is also supplied with sympathetic nerves.
- A. Ovaries
  - B. Testis
  - C. Adrenal gland
  - D. Parathyroid glands

- 1.20 The mechanoreceptors sensitive to touch are the \_\_\_\_\_ .
- A. Pacinian corpuscles
  - B. corpuscles of Ruffini
  - C. free nerve endings
  - D. Meissner corpuscles
- 1.21 Acromatosis is an eye defect due to \_\_\_\_\_ .
- A. the weakened ciliary muscles
  - B. lack of rods in the retina
  - C. the lack of red or green cones in the retina
  - D. a bulby lens
- 1.22 The part of the eye that secretes an oily substance is \_\_\_\_\_ .
- A. the lachrymal glands
  - B. the Meibom glands
  - C. the vitreous humor
  - D. the ciliary body
- 1.23 The parietal lobe is located behind the following structure/s.
- A. Fissure of Sylvius
  - B. Fissure of Rolando
  - C. Longitudinal fissure
  - D. Sulci
- 1.24 Secondary spermatocytes are the product of \_\_\_\_\_ .
- A. mitosis
  - B. the growth of spermatogonia
  - C. the first meiotic division
  - D. the second meiotic division
- 1.25 Temperature plays an important role during spermatogenesis. Which structure maintains a constant temperature in the male reproductive organs?
- A. Rete testis
  - B. Scrotum
  - C. Epididymus
  - D. Prostate gland
- 1.26 This layer of the skin is constantly producing new cells through mitosis.
- A. Stratum germinativum
  - B. Stratum comeum
  - C. Stratum granulosum
  - D. Dermis

- 1.27 The loss of heat waves from a warm body to cooler surroundings through the air is called \_\_\_\_\_ .
- A. radiation
  - B. conduction
  - C. convection
  - D. evaporation
- 1.28 Bile pigment, urea and cholesterol are excretory products of the \_\_\_\_\_ .
- A. gall bladder
  - B. liver
  - C. skin
  - D. spleen
- 1.29 Microvilli are found on the inside border of cuboidal epithelial cells of the \_\_\_\_\_ .
- A. loop of Henle
  - B. proximal convoluted tubule
  - C. distal convoluted tubule
  - D. Bowman's capsule
- 1.30 Microtransport in the intracellular environment of the cell \_\_\_\_\_ .
- A. tissue fluid
  - B. cytosol
  - C. blood plasma
  - D. blood

30x2= (60)

### QUESTION 1B

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

- 1.31 The tough outer membrane that lines the cranium
- 1.32 The canal that connects the third brain ventricle with the fourth brain ventricle
- 1.33 The shallow, parallel convolutions on the outside of the cerebellum
- 1.34 The hole at the base of the cranium where the medulla oblongata enters the cranium
- 1.35 The part of the nervous system that regulates the activities of the smooth muscles, cardiac muscles and glands
- 1.36 The neurotransmitter released by sympathetic fibres
- 1.37 Any change in the external or internal environment which generates impulses
- 1.38 The part of the neuron that conducts impulses towards the cell body

- 1.39 The gaps between the Schwann cells which allow for faster transmission of impulses
- 1.40 The release of urine from the bladder which is also known as urination
- 1.41 The gland in the body which acts as an exo- as well as an endocrine gland.
- 1.42 The gland situated in the Turkish saddle in the skull
- 1.43 The thin membrane that surrounds the myelin sheath of an axon
- 1.44 The functional unit of the nervous system (14)

### QUESTION 1C

Study the diagram of the male reproductive system and label structures 1.45 to 1.52 and mention ONE function of each structure. (16)

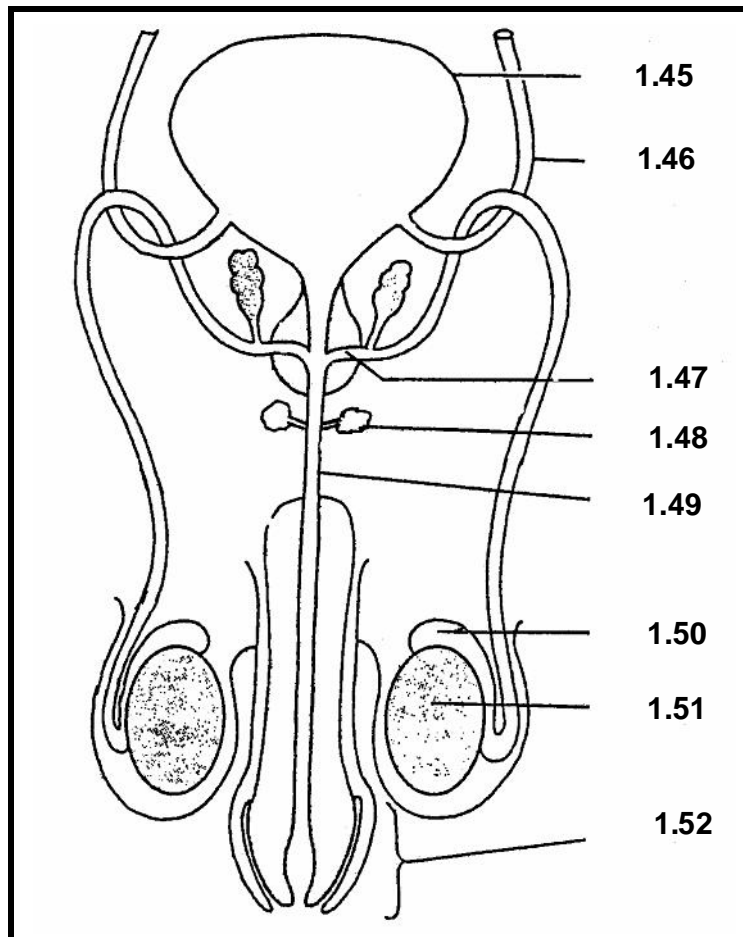


Figure 1C – Frontal view of the male reproductive system

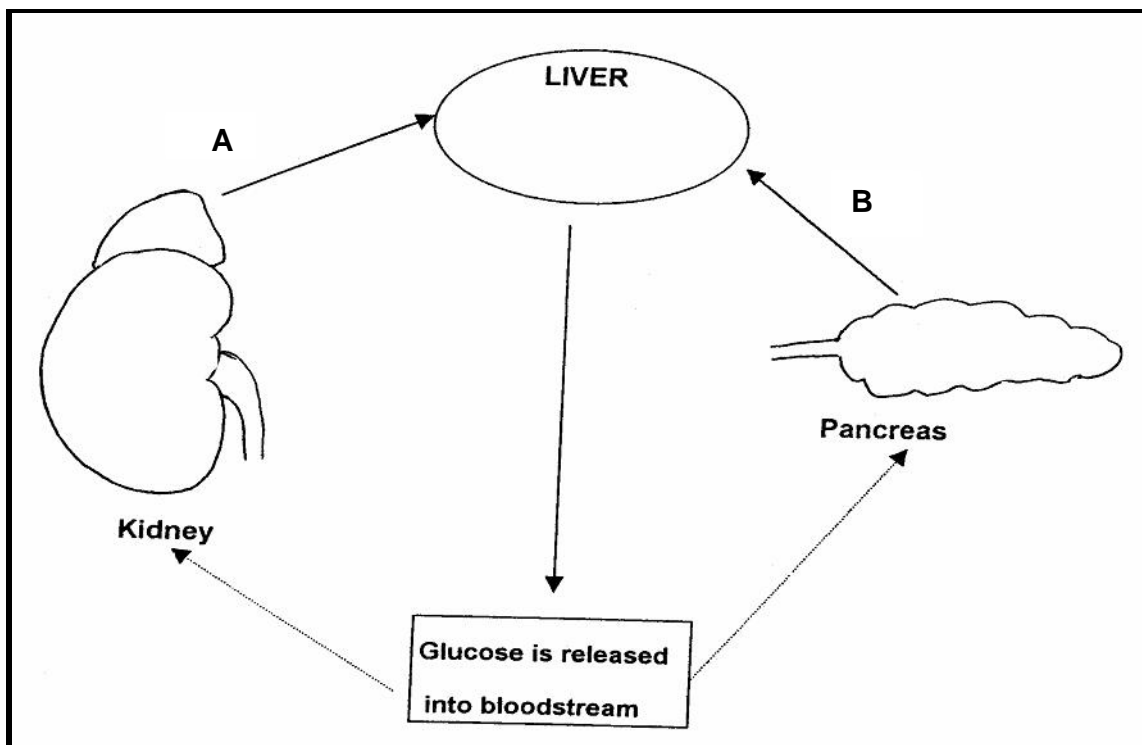
TOTAL FOR SECTION A: [90]

## SECTION B

Answer ALL questions in this section.

## QUESTION 2

- 2.1 The diagram below indicates two hormones, **A** and **B**, that have an influence on the blood sugar levels of a person.

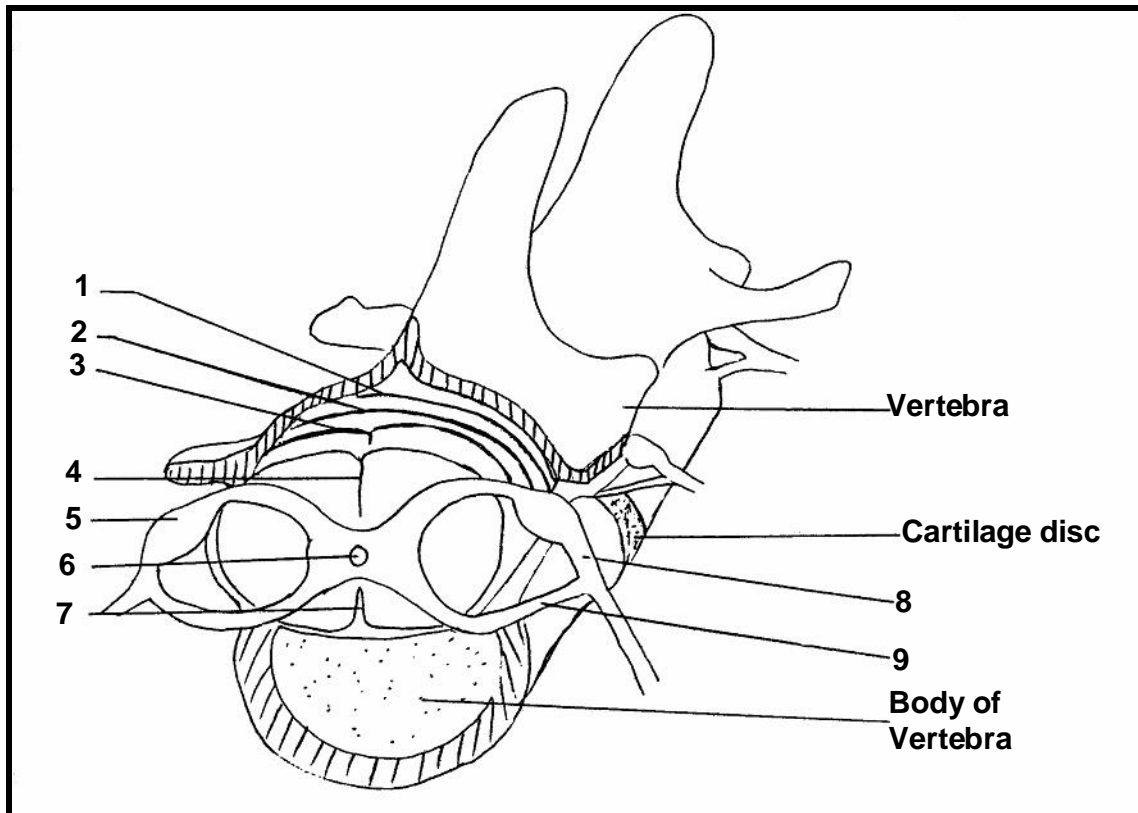


**Figure 2.1: Hormones that have an influence on the bloodsugar levels of man.**

- 2.1.1 Name hormones **A** and **B**. (2)
- 2.1.2 a) Name the gland and region of the gland that secretes hormone **A**. (2)
- b) Give another name for hormone **A**. (1)
- c) Discuss SEVEN other functions of hormone **A**. (7)
- 2.1.3 Which part of the autonomic nervous system has the same effect on the body as hormone **A**? (1)
- 2.2 Draw a neat, labelled diagram of a sensory neuron. (7)



- 2.3 The diagram below represents a diagram of a cross-section through the vertebral column.



**Figure 2.3 Cross section through the vertebral column**

- 2.3.1 Label structures numbered 1 to 7. (7)
- 2.3.2 Discuss the functions of the spinal cord. (5)
- 2.3.3 What will be the effect on the body if
- no. 8 is permanently damaged? (2)
  - no. 9 is damaged? (2)
- 2.3.4 Cranial nerve VIII is the Vestibulocochlear nerve which is a sensory nerve. Cranial nerve VII is the facial nerve which is a mixed nerve.
- Name the TWO organs served by cranial nerve VIII. (2)
  - What is meant by a **mixed nerve**? (2)

**(40)**

## QUESTION 3

- 3.1 The graph below reflects the results of an experiment conducted in a temperature-controlled room with a constant air temperature of 42° C. The purpose of the investigation was to determine the influence of blood cooling of the core and skin temperature. When a constant body temperature was reached at 42°C, the person ate large portions of ice cream which cooled his blood.

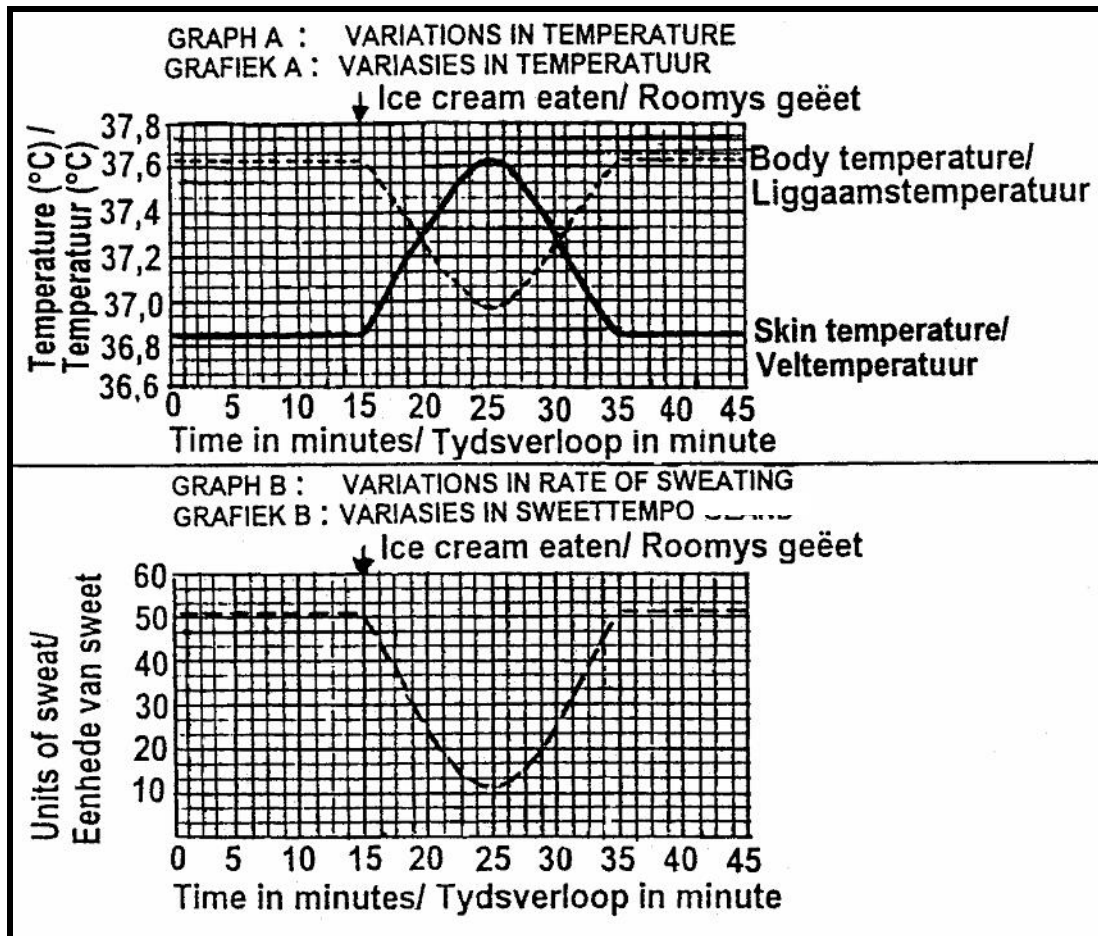


Figure 3.1: Influence of blood cooling of the core and skin temperature

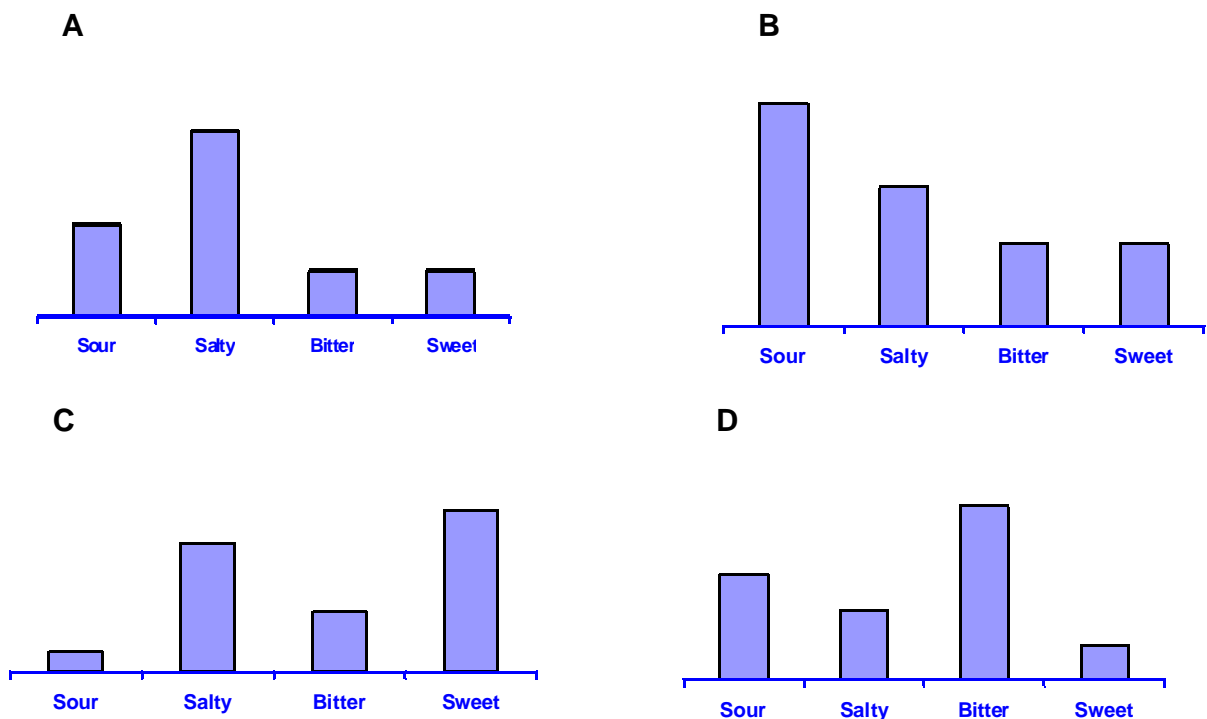
- 3.1.1 What was the estimated internal body temperature of the person during the first 15 minutes? (2)
- 3.1.2 What was the estimated rate of sweating of the person during the first 15 minutes? (2)
- 3.1.3 Briefly mention what happened to the following between the 10<sup>th</sup> and 25<sup>th</sup> minute: (2)
- The internal body temperature (2)
  - The skin temperature (2)
  - The rate of sweating (2)

- 3.1.4 Explain how the brain, through negative feedback, rectifies the body temperature of the person from the 15<sup>th</sup> to 35<sup>th</sup> minute. (20)
- 3.2 The skin is the largest sense organ in the body and plays an important role in temperature regulation. Discuss FIVE other functions of the skin. (5)
- 3.3 Define the following terms:
- a) Endothermic (2)
  - b) Homeostasis (3)
- (40)**

**QUESTION 4**

The four basic modalities of taste are sensed most accurately in particular regions of the tongue. The salty taste of food is caused by the presence of sodium ions. A sour taste however, is caused by the presence of hydrogen ions. Most organic molecules, particularly sugars, taste sweet to various degrees. A bitter taste is provoked by quinine.

- 4.1 The following bar graphs indicate the degree at which the different tastes are sensed on different regions of the tongue. Study bar graphs **A** to **D** and complete the table below.



**Figure 4.1: Graphic representation of taste regions on the tongue**

Redraw the table and complete it as follows:

Graph	Strongest Taste	Region on tongue	Substance causing the taste	Papilla sensing the taste
A.				
B.				
C.				
D.				

(16)

- 4.2 4.2.1 Name the type of receptors referred to in question 4.1. (1)  
 4.2.2 Describe how the sensation of taste is brought about. (8)

4.3 Why is it possible to immediately detect the presence of a hair in one's mouth? (2)

4.4 In an investigation, a person was placed in a darkened room and had his left eye covered. A bright torch was switched on for 20 seconds, after which the diameter of the person's right pupil was measured. This procedure was repeated several times at one minute intervals between each measurement and with the distance between the torch and the eye being changed. The results are presented in the bar chart below.

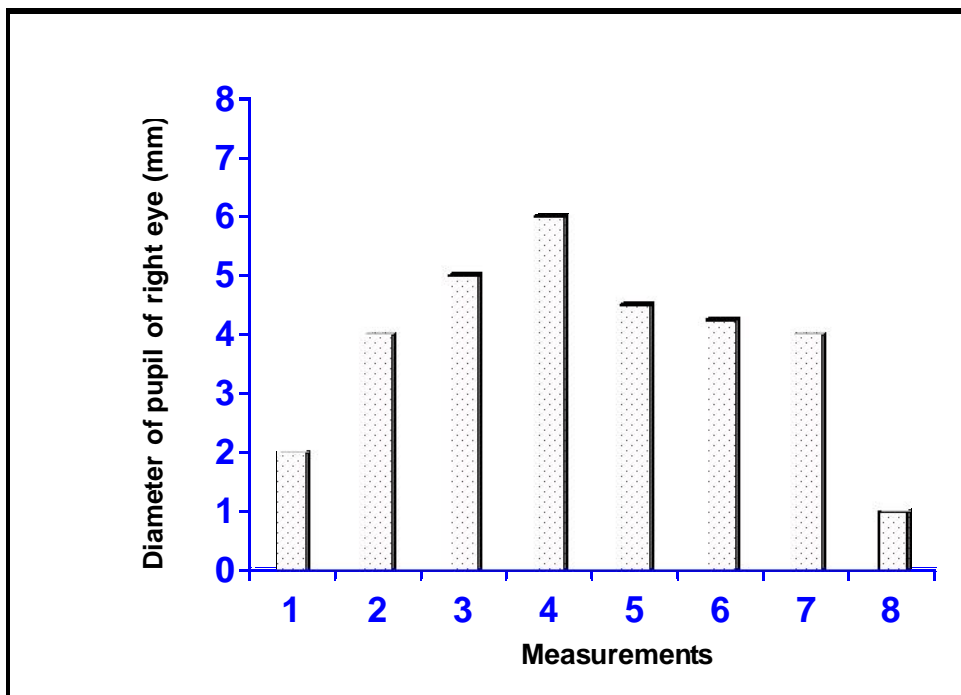


Figure 4.4: Graphic representation of the changes in the size of the pupil.

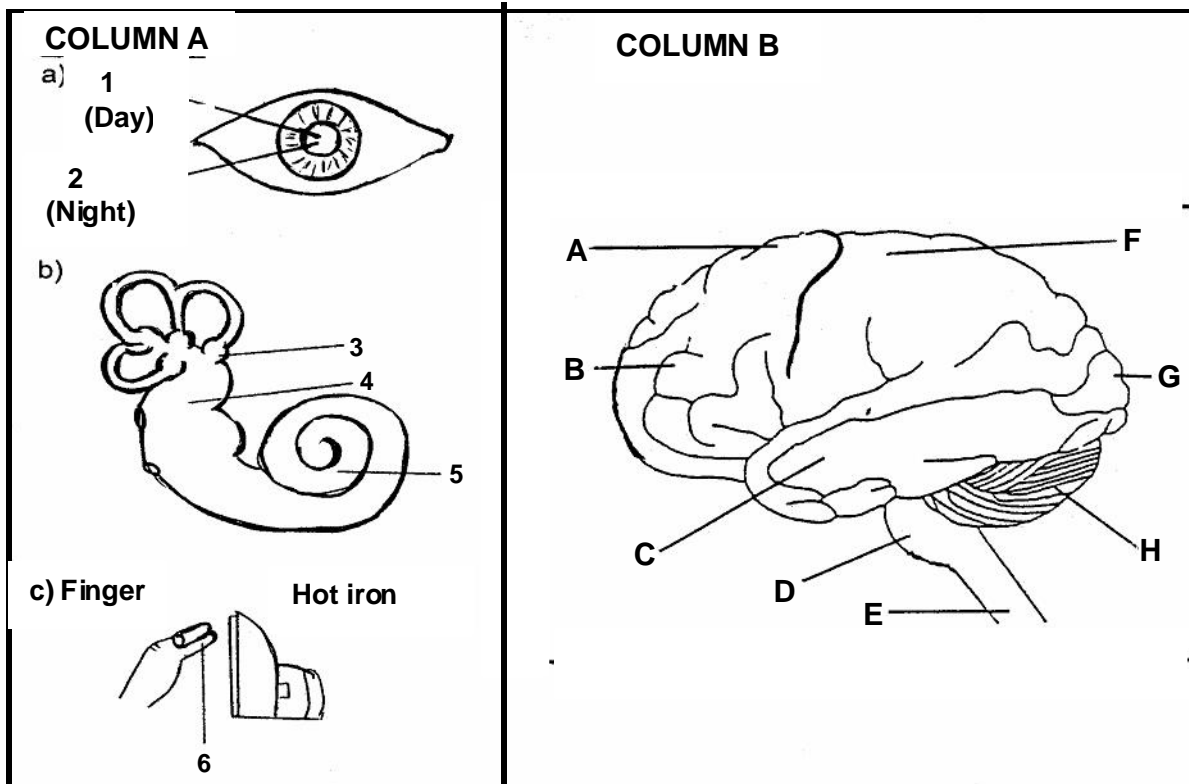
4.4.1 Between which TWO measurements did the following changes in the diameter of the pupil occur?

- a) Biggest increase (1)  
 b) Smallest decrease (1)

- 4.4.2 At which measurement was the torch
- a) furthest away from the eye? (1)
  - b) nearest to the eye? (1)
- 4.4.3 Suggest a reason why the height of the graph for measurements 2 and 7 is the same? (1)
- 4.4.4 Describe the general relationship that exists between the diameter of the pupil and the distance of the torch from the eye. (3)
- 4.4.5 Discuss TWO types of colour blindness in humans. (5)
- (40)**

**QUESTION 5**

- 5.1 The diagrams in **Column A** represent different sense organs with their receptors. **Column B** represents parts of the central nervous system. When receptors 1 to 6 are stimulated, they convert the stimuli into impulses which are then sent to different regions in the brain to be interpreted.



- 5.1.1 Identify receptors **1 to 6** from **Column A** as well as the part of the brain that will interpret the stimuli. Redraw the table below in your **answer book** and complete it as indicated.

<b>COLUMN A</b>	<b>COLUMN B</b>
<b>NAME OF RECEPTOR</b>	<b>PART OF BRAIN</b>
e.g. Proprioceptor	F
1.	
2.	
3.	
4.	
5.	
6.	

(12)

- 5.2 5.2.1 Name the exocrine gland present in the ear and explain the function of its secretion. (4)

- 5.2.2 Explain how the secretion can cause temporary deafness. (2)

- 5.3 The maintenance of a constant sodium concentration is one of the homeostatic functions of the kidney. Discuss the role of the kidney when a person has a low blood pressure due to a low sodium concentration. (12)

- 5.4 Ovulation takes place on the fourteenth day of the menstrual cycle.

- 5.4.1 In what stage is the developing ovum just after ovulation? (2)

- 5.4.2 Describe what happens during the process of fertilization. (8)

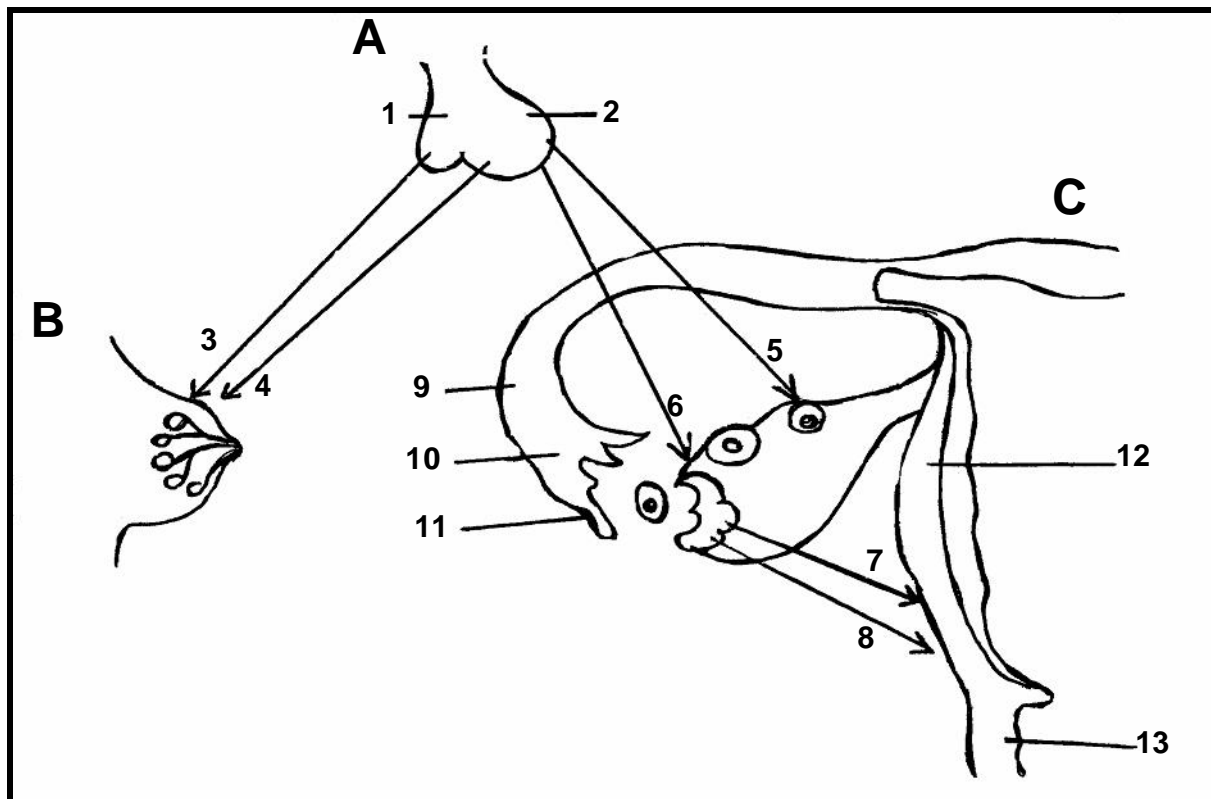
**[40]****TOTAL FOR SECTION B: [160]**

## SECTION C

Answer Question 6 **OR** Question 7.

If you answer both questions, **only the first one** will be marked.

## QUESTION 6



**Fig 6.1: Diagrams A, B and C represent the hormonal interaction between the pituitary gland (hypophysis) and the female reproductive system.**

- 6.1 Identify the parts of the hypophysis that are numbered **1** and **2**. (2)
- 6.2 Identify the hormones numbered **3** and **4** and discuss their role during lactation. (4)
- 6.3 Gynaecologists promote breast feeding not only for the benefit of the baby but it also helps the uterus to return to its original shape. Discuss this statement. (4)
- 6.4 Label structures **9**, **10**, **11** and **13**. (4)

- 6.5 Organ number **12** has different layers and regions.
- 6.5.1 Name the respective layers of this organ. (3)
- 6.5.2 Name the respective regions of this organ. (3)
- 6.6 Name the male gonadotropin secreted by structure **2** and discuss its functions. (3)
- 6.7 Name **THREE** methods of contraception that a male can use. (3)
- 6.8 Hormones **5, 6, 7** and **8** play an important role during the menstrual cycle.
- 6.8.1 Explain how the concentration of hormones **5, 6, 7** and **8** change if fertilization takes place and discuss the role of each hormone during this stage. (10)
- 6.8.2 During the first trimester (three months of pregnancy) the ovaries must remain intact if pregnancy is to continue. During later months of pregnancy (beyond the first three months) the ovaries may be removed without ending pregnancy. Explain why. (6)
- 6.9 Discuss the anatomical structure of the testis. (8)
- (50)**



## QUESTION 7

The functional unit of the kidney is the nephron. The pressure in the afferent arteriole is about 100 mmHg and the glomerular pressure is normally 70 mmHg while the pressure in the efferent arteriole is 18 mmHg. The pressure lowers further and becomes 13 mmHg in the peritubular capillaries.

The pressure in the Bowman's capsule is about 14 mmHg.

Because of the high pressure in the glomerulus, it functions in much the same way as the arterial endings of the tissue capillaries, with fluid filtering continually out of the glomerulus into the Bowman's capsule. On the other hand, the low pressure in the peritubular capillary system causes it to function much in the same way as the venous end of the tissue capillaries, with fluid being absorbed continually into the capillaries.

In both kidneys of man, the total volume of water flowing in each segment of the tubular system each minute (under normal resting conditions) are the following:

Glomerular filtrate	125 ml/min
Flowing into the loops of Henle	25 ml/min
Flowing into the distal tubules	18 ml/min
Flowing into the urine	1 ml/min

Adapted from: Guyton, A.C. (1971) *Textbook of medical physiology*, Fourth edition

- 7.1 Name the FOUR main functions of the kidneys. (4)
- 7.2 Use both the information from the extract and the diagram to answer the following questions. Show all calculations.

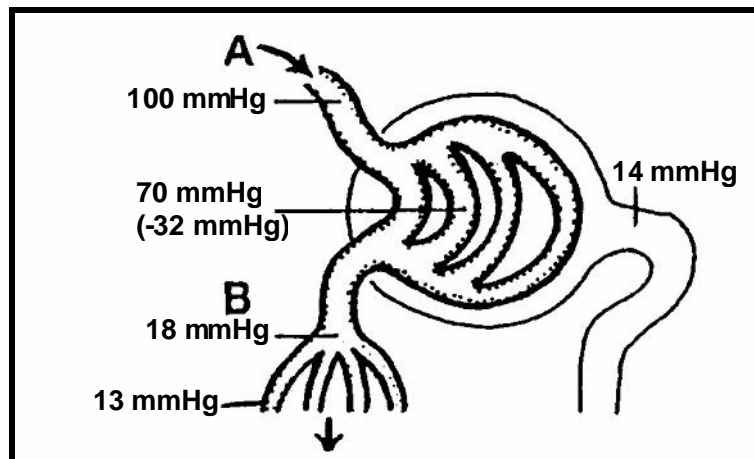


Fig. 7.2: Malpighian body

- 7.2.1 What is the net filtration pressure that forces the fluid into the Bowman's capsule? (2)
- 7.2.2 What quantity of the fluid in the glomerulus filters in 1 hour to the Bowman's capsule? (3)

- 7.2.3 (a) Calculate the quantity of urine produced (in litres) per day (in 24 hours). (4)
- (b) How will the volume of urine produced per day differ from the above volume during a hot summer's day? (2)
- (c) Explain the hormonal influence that brings about the change in urine production mentioned in Question 7.2.3 (b). (11)
- (d) Name THREE components of the fluid in the glomerulus which do not filter through into the Bowman's capsule. (3)
- (e) To enable ultra filtration to take place, two conditions apply:
- a high pressure
  - as well as a micro filter.
- Discuss how the Malpighian body is adapted to function as a microfilter system. (3)
- 7.2.4 Explain the difference between the volume of fluid in the glomerular filtrate and the volume of fluid in the loop of Henle. (Give calculation as well) (3)
- 7.2.5 A prisoner goes on a hunger strike and refuses to eat or drink anything. He tries to commit suicide by suffocating himself with his pillow. Name and discuss FIVE factors in his tissue fluid that will be influenced by the above-mentioned actions. (15)

**(50)****TOTAL FOR SECTION C: [50]****TOTAL: 300****END**