



FACULTY OF SCIENCE

BOTANY AND PLANT BIOTECHNOLOGY DEPARTMENT

LSFT0A3/LSFT0B3

LIFE SCIENCE 3A/3B FET

APK CAMPUS

ON-LINE NOVEMBER EXAM

MEMORANDUM

12 NOVEMBER 2020

DATE: 12 NOVEMBER 2020

SESSION: 11H30-15H00

ASSESSOR: MS J. WILLIAMSON

INTERNAL MODERATOR: MS. E. PRETORIUS

EXTERNAL MODERATOR: PROF. G LAUTENBACH

DURATION: 3½ HOURS

TOTAL MARKS: 180

NUMBER OF PAGES: 20 PAGES

Please read the following instructions carefully before you start:

1. When starting your exam send a WhatsApp on our WhatsApp group with your initials, surname, student number and the words started exam to acknowledge that you have started the exam and to act as starting register.
2. Answers can be typed or written, scanned and e-mailed to jwilliamson@uj.ac.za by the latest 16:00.
3. Send a WhatsApp on our WhatsApp group with your initials, surname, student number and the words submitted the exam to acknowledge that you have e-mailed the exam and to act as end register.
4. Answer all the questions in the question paper and work neatly
5. Read your questions carefully.
6. Good Luck.

QUESTION 1**[15]**

1.1 Choose the answer that best completes the statement or answers the question. Only write down the correct letter next to the appropriate question number on your answer sheet. (2 x ½ = 1)

1.1.1 For a couple of decades, biologists knew the nucleus contained DNA and proteins. The prevailing opinion was that the genetic material was proteins, and not DNA. The reason for this belief was that proteins are more complex than DNA. What was the basis of this thinking?

A. Proteins have a greater variety of three-dimensional forms than does DNA.

B. Proteins have two different levels of structural organization; DNA has four.

C. Proteins are made of 40 amino acids and DNA is made of four nucleotides.

D. Some viruses only transmit proteins.

E. A and B are correct.

1.1.2 For a science fair project, two students decided to repeat the Hershey and Chase experiment, with modifications. They decided to label the nitrogen of the DNA, rather than the phosphate. They reasoned that each nucleotide has only one phosphate and two to five nitrogens. Thus, labeling the nitrogens would provide a stronger signal than labeling the phosphates. Why won't this experiment work?

A. There is no radioactive isotope of nitrogen.

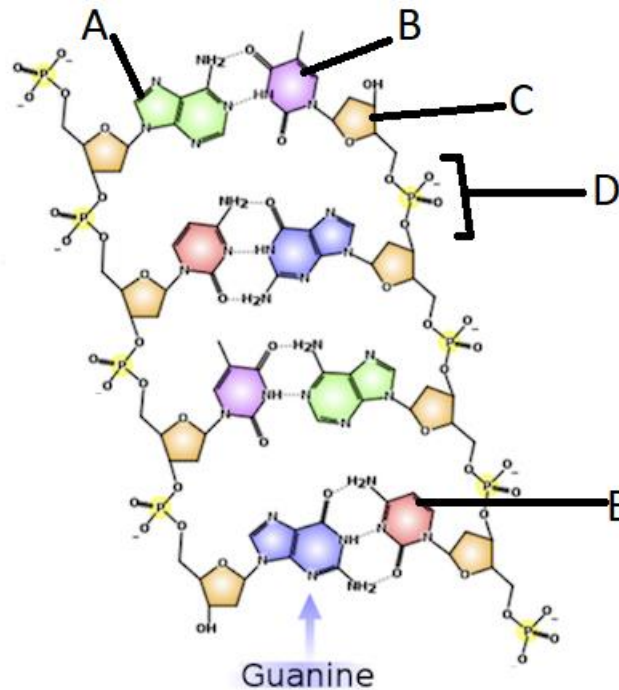
B. Radioactive nitrogen has a half-life of 100,000 years, and the material would be too dangerous for too long.

C. Avery et al. have already concluded that this experiment showed inconclusive results.

D. Although there are more nitrogens in a nucleotide, labeled phosphates actually have 16 extra neutrons; therefore, they are more radioactive.

E. Amino acids (and thus proteins) also have nitrogen atoms; thus, the radioactivity would not distinguish between DNA and proteins.

1.2 Study the following diagram and answer the questions that follow.



1.2.1 Identify the molecule above. (½)

Deoxyribonucleic acid

1.2.2 Label A, B and C. (1½)

A – Adenine B – thymine C – Deoxyribose sugar

1.2.3 Briefly describe how A and B is connected in this molecule. (1)

Double (½) hydrogen bond (½)

1.2.4 Why would it be correct to categorize B and E in the same group. (1)

Both are single ring structures which are called pyrimidines.

1.2.5 This molecule has the ability to replicate itself, why is this significant? (1)

It is important at the beginning of mitosis and meiosis to make sure each new cell has the same genetic information.

1.2.6 During the replication of this molecule what caused the following to occur: (2)

a. the uncoiling of the molecule? **Helicase**

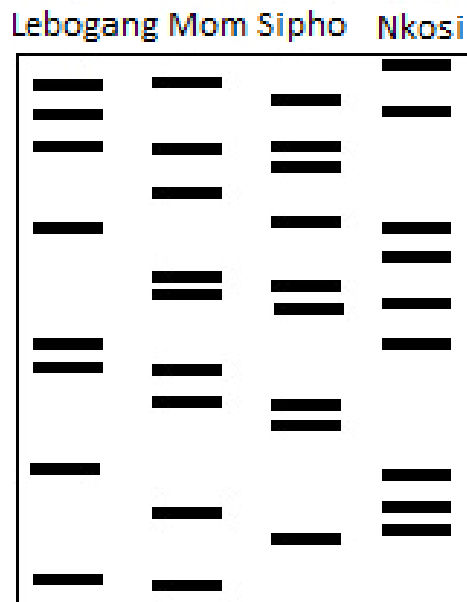
b. the prevention of the over winding of the replication bubble? **Topoisomerase**

c. addition of new building blocks to cause replication initially? **RNA primase**

d. addition of new building blocks to cause replication after initiation? **DNA polymerase 3**

1.3 Mrs. Tshablalala had a baby named Lebogang. She believes one of two men can possibly be the father of Lebogang. A paternity test was done and the results are shown

(3)



- This is called DNA fingerprinting.
- Nkosi is Legogang's dad because he shows 4 alleles in common with Lebogang and Sipho only 3.

1.4 Read the following statement and answer the questions that follow.

Molecular biologists use DNA manipulation to change genetic information of organisms.

(1)

(2)

- To cut the gene coding for insulin from a chromosome in the pancreatic cell.
- This is done with restriction enzymes.

(2)

Plasmid and is used to carry the new gene.

QUESTION 2

[15]

2.1 Differentiate between the following pairs of terms:

2.1.1 codon and anticodon

(4 x ½ = 2)

- **Codon – base triplet of an m-RNA and in complementary to the anticodon**
- **Anticodon – base triplet of the t-RNA and each anticodon is associated with a specific amino acid.**

2.2.1 transcription and translation of protein production

(4 x ½ = 2)

- **Transcription – The process whereby RNA copy the DNA template by forming m-RNA in the nucleus of the cell.**
- **Translation – The process of converting the information in mRNA to a sequence of amino acids that make up protein.**

2.2 The following questions is based on a simulation of protein production. In this simulation the production of somatostatin is illustrated. Somatostatin is a hormone, that is produced in the pancreas. You can use the table below to assist you in some sections of the question. (Hint: remember that an amino acid sequence has a starting code and stop code)

2.2.1 The information below illustrates the DNA strand template strand from a 5' to 3' for the gene somatostatin.

5' _____ 3'
ATG TAC GGT TGT AAG AAC TTC TTT TGG AAG ACT TTC

a. Using the DNA strand, determine the coding strand (3' to 5") for this gene. (8 x ½ = 4)

3' TAC ATG CCA ACA TTC TTG AAG AAA ACC TTC TGA AAG 5'

b. Work out the amino acid sequence of somatostatin.

(10 x ½ = 5)

MET PRO THR PHE LEU LYS LYS THR PHE STOP

		Second letter				
		U	C	A	G	
First letter	U	UUU } Phe UUC } UUA } Leu UUG }	UCU } Ser UCC } UCA } UCG }	UAU } Tyr UAC } UAA Stop UAG Stop	UGU } Cys UGC } UGA Stop UGG Trp	U C A G
	C	CUU } Leu CUC } CUA } CUG }	CCU } Pro CCC } CCA } CCG }	CAU } His CAC } CAA Gln CAG }	CGU } Arg CGC } CGA } CGG }	U C A G
	A	AUU } Ile AUC } AUA } AUG Met	ACU } Thr ACC } ACA } ACG }	AAU } Asn AAC } AAA Lys AAG }	AGU } Ser AGC } AGA } Arg AGG }	U C A G
	G	GUU } Val GUC } GUA } GUG }	GCU } Ala GCC } GCA } GCG }	GAU } Asp GAC } GAA Glu GAG }	GGU } Gly GGC } GGA } GGG }	U C A G

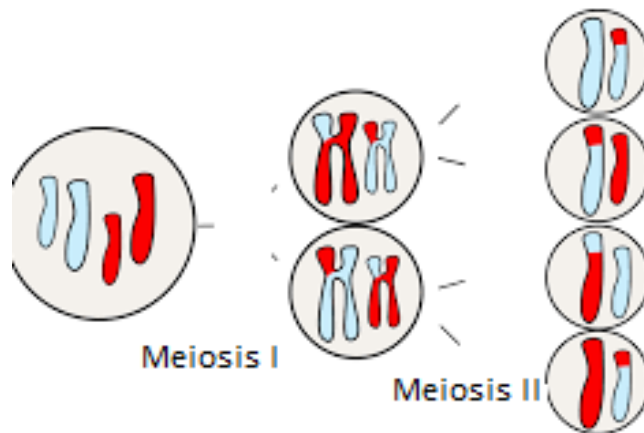
2.3 Where in the cell does the process of somatostatin take place? (2)

- **Transcription – nucleoplasm of the nucleus of the cell**
- **Translation – at the ribosomes in the cytoplasm of the cell**

QUESTION 3

[15]

3.1 Study the diagram showing the general process of Meiosis below and answer the questions that follow.



3.1.1 How many chromosomes are present in the parent cell? (1)

4

3.1.2 What makes the chromosomes homologous in the parent cell? (3)

- **Two chromosomes in a parent cell that matched in:**

- length,
- centromere position, and
- gene locations (locus).

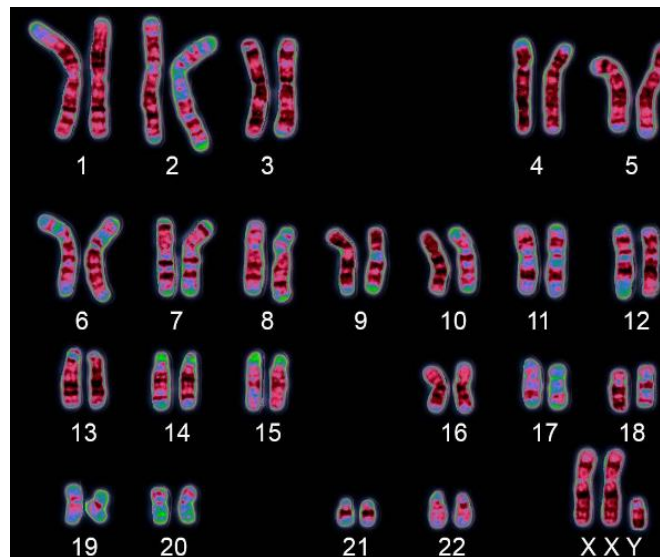
3.1.3 Describe the differences between the parent cell and the cells at the end of Meiosis I.(5)

- Parent cell has 4
- unduplicated chromosomes and
- the daughter cells at the end of Meiosis I have 2
- duplicated chromosomes
- which underwent crossing over each.

3.1.4 How many daughter cells are produced at the end of Meiosis II and are they how are they different to the parent cell? (2)

- 4
- The parent cell is diploid and the daughter cells are haploid

3.2 Study the following diagram and answer the questions that follow.



3.2.1 What disorder does the person with this karyotype suffer from? Give a reason for your answer. (2)

Klinefelter syndrome – two XX chromosomes and one Y chromosome.

3.2.2 Briefly explain what caused this disorder answered in question 3.2.1? (2)

Non-disjunction – the sex chromosomes did not separate normally during Meiosis.

QUESTION 4
[15]

4.1 A married couple both has normal color vision, but their daughter has red-green colorblindness. The husband sues the wife for divorce on grounds of infidelity. Can genetics provide evidence supporting his case? Explain by also including genetic cross.

P1(1) $X^H X^h$ (1) x $X^H Y$ (1)

Meiosis(1)

Gametes (1) X^H X^h (1) X^H Y (1)

F1 generation(1)

	X^H	X^h
X^H	$X^H X^H$	$X^H X^h$
Y	$X^H Y$	$X^h Y$

(1)

Genotype of F1 Phenotype of F1(1)

$X^H X^H$ (1) Girl normal

$X^H X^h$ (1) Girl normal

$X^H Y$ (1) Boy normal

$X^h Y$ (1) Boy colourblind

Therefore the father has ground to sue the mother, his daughter will not be blind, even if the mother is a carrier.(1)

QUESTION 5
[15]

5.1 Three (3) processes occur in an embryo after fertilization. Describe the first of these processes in detail, add diagrams to enhance your description. (10)

- **Cleavage**
- **A period of rapid cell division without growth.**
- **This creates a hollow ball of cells**
- **called a blastula.**
- **The blastula consists of many smaller cells called blastomeres**
- **The hollow part of the blastula is filled with fluid and called a blastocoel.**
- **CELL DIVISION OF A FERTILIZED EGG FORMING A BLASTULA**



• (a) Fertilized egg (b) Four-cell stage (c) Early blastula (d) Later blastula

- Two types of cleavage
- Meroblastic cleavage,
- incomplete division of the egg,
- occurs in species with yolk-rich eggs, such as reptiles and birds.
- Holoblastic cleavage,
- complete division of the egg,
- occurs in species whose eggs have little or moderate amounts of yolk, such as sea urchins and frogs

5.2 Briefly discuss the process that occurs after the rapid cell division process of a zygote.

(5)

- Gastrulation rearranges the cells of a blastula(1) into a three-layered embryo, called a gastrula(1), which has a primitive gut (archenteron)(1) and opens in a blastopore (1).
- The three embryonic layers are:
- The ectoderm (1) forms the outer layer
- The endoderm(1) lines the digestive tract.
- The mesoderm (1) partly fills the space between the endoderm and ectoderm.

QUESTION 6

[15]

6.1 Choose the alternative that best completes the statement or answers the question. Only write down the correct letter next to the appropriate question number. (6)

6.1.1 In humans, the follicular cells that remain behind in the ovary following ovulation become _____

A. ovarian endometrium shed at the time of menses.

B. a steroid-hormone synthesizing structure called the corpus luteum.

C. the thickened portion of the uterine wall.

D. swept into the fallopian tube.

6.1.2 Testosterone is synthesized primarily by the _____

A. sperm cells.

B. hypothalamus.

C. Leydig cells.

D. anterior pituitary gland.

6.1.3 Among human males, both semen and urine normally travel along the _____

A. vas deferens.

B. urinary bladder.

C. seminal vesicle.

D. urethra.

6.1.4 Organisms with a reproductive pattern that produce shelled amniotic eggs generally ____

A. end up having a higher embryo mortality rate than do organisms with unprotected embryos.

B. invest most of their reproductive energy in the embryonic and early postnatal development of their offspring.

C. invest more energy in parenting than do placental animals.

D. produce more gametes than do those animals with external fertilization and development.

E. lower their embryo mortality rate to less than one in a thousand.

6.1.5 Among these contraception methods, which has the highest risk of accidental pregnancy?

A. diaphragm

B. condom

C. coitus interruptus

D. vasectomy

E. rhythm method

6.1.6 Increasing and holding the temperature of the scrotum by 2°C, near the normal body-core temperature, would _____

A. reduce the fertility of the man by impairing the production of gonadal steroid hormones.

B. reduce the fertility of the man by impairing spermatogenesis.

C. reduce the fertility of the man by impairing by abolishing sexual interest.

D. increase the fertility of the affected man by enhancing the rate of spermatogenesis.

E. have no effect on male reproductive processes.

6.2 In each of the following cases, give the function of the hormone, mention where the hormone is produced and where does the hormone functions.

6.2.1 Gonadotropin-releasing hormone (in females)

(3)

- is secreted and produced by the hypothalamus
- directs the release of FSH and LH
- from the anterior pituitary gland (work in pituitary gland).

6.2.2 Follicle stimulation hormone (in females) (3)

- is secreted and produced by antuitary gland
- regulate processes in the gonads and the production of sex hormones.
- Work in gonads – ovaries

6.2.3 Testosterone (3)

- Produced and secreted by the Leidig cells in testis
- regulates the production of GnRH, FSH, and LH through
- Work in Testis

QUESTION 7

[15]

7.1 Choose the alternative that best completes the statement or answers the question. Only write down the correct letter next to the appropriate question number. (6)

7.1.1 Integration of simple responses to certain stimuli, such as the patellar reflex, is accomplished by which of the following?

A) Spinal cord

B) Hypothalamus

C) Corpus callosum

D) Cerebellum

E) Medulla

7.1.2 Which part of the vertebrate nervous system is most involved in preparation for the fight-or-flight response?

A) Sympathetic

B) Somatic

C) Central

D) Visceral

E) Parasympathetic

7.1.3 Which system controls smooth and cardiac muscles of the digestive, cardiovascular, and excretory systems?

A) Central nervous system

B) Peripheral nervous system

C) Autonomic nervous system

D) Parasympathetic nervous system

E) Sympathetic nervous system

7.1.4 Which of the following ions are directly involved in the generation of an action potential?

A. sodium ions (Na^+) and calcium ions (Ca^{++})

B. sodium ions (Na^+) and potassium ions (K^+)

C. sodium ions (Na^+) and chloride ions (Cl^-)

D. calcium ions (Ca^{++}) and potassium ions (K^+)

7.1.5 The abilities to use and understand language, make decisions, and engage in conscious thought are located in the _____.

A. the midbrain

B. cerebrum

C. hypothalamus

D. thalamus

7.1.6 A young boy receives an injury to the back of his head and is now having problems with balance, equilibrium, and muscular coordination. What area of the brain has probably been injured?

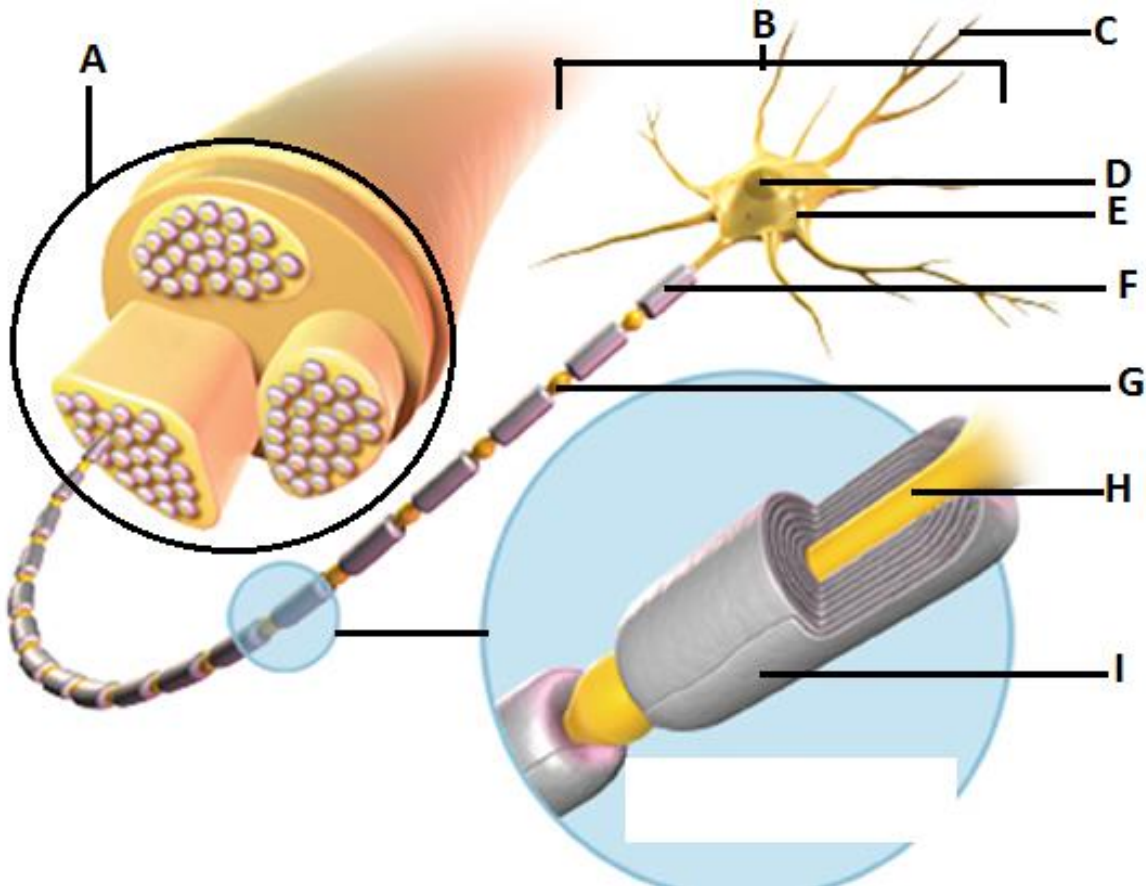
A. medulla oblongata

B. corpus callosum

C. cerebrum

D. cerebellum

7.2 Study the diagram below and answer the questions that follow.



7.2.1 Supply the number and name of the structure which:

(10 x ½ = 5)

a. mainly composed of fats. I / F – Myeline sheath

b. consists of several nerve cells. A – nerve

c. transmits impulses towards the cell body of a neuron. C – Dendrite

d. is involved in salutatory conduction. G – nodes of Ranvier

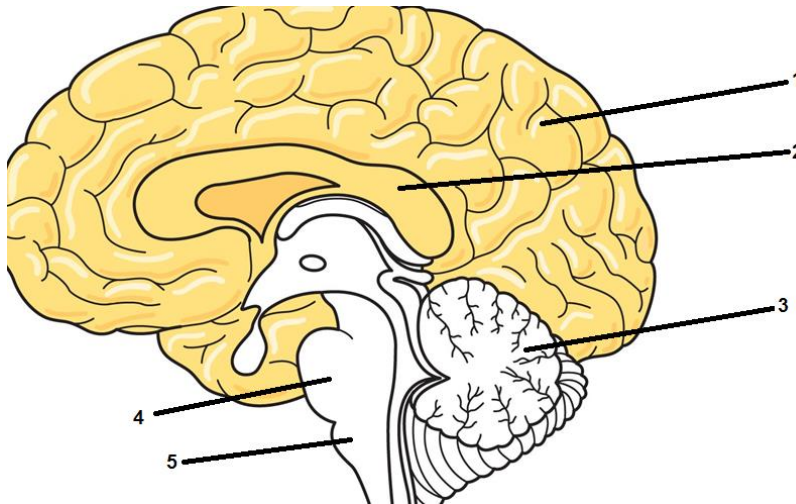
e. have many processes. B – motor neuron/ multipolar neuron

7.2.2 Briefly name and describe the function of structure H

(2)

- **Axon ($\frac{1}{2}$)**
- **Transmits impulses ($\frac{1}{2}$) away from the cell body ($\frac{1}{2}$) of the neuron**
($\frac{1}{2}$)

7.3 Study the diagram below and identify the part with the function or structural characteristic stated below: (supply the number and name of the chosen part) (2)



7.3.1 Provides communication between the right and left cerebral hemispheres.

2 – Corpus callosum

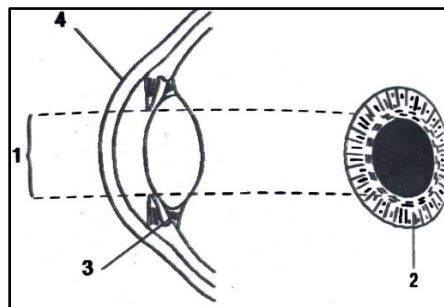
7.3.2 Regulates sneezing.

5 – Medulla oblongata

QUESTION 8

[15]

8.1 Study the diagram below and answer the questions that follow.



8.1.1 Identify the type of section represented by the first diagram. (1)

Longitudinal section

8.1.2 Identify the parts numbered 1- 4 (4 x ½ = 2)

- **1 – Pupil**
- **2 – Iris**
- **3 – Suspensory ligaments**
- **4 – Cornea**

8.1.3 Give the functions of each of the following parts, numbered____ (3)

a. 2

Regulates the size of the pupil and therefore light entrance

b. 3

Contract and relax to change the shape of the lens

c. 4

Refract light rays to allow the image of the object to fall on the retina

8.1.3 Name the conditions responsible for:

a. The size of the pupil in the diagram (briefly explain) (2)

Light intensity – bright light decreases the size of the pupil because on the contraction of the circular muscles of the iris and relaxation of the longitudinal muscles of the iris.

Dim light increase the size of the pupil because of the relaxation of the circular muscles of the iris and the contraction of longitudinal muscles of the iris.

b. The shape of the lens in the diagram (briefly explain) (7)

- **The distance of the object looked at**
- **The eye undergoes accommodation to change the shape of the lens**
- **NEAR VISION**
 - **Longitudinal Cilliary muscle contracts**
 - **Suspensory ligaments relax**
 - **Lens becomes more concex (rounded)**
- **DISTANCE VISION**
 - **Longitudinal Cilliary muscle relax**
 - **Suspensory ligaments pull tight**
 - **Lens becomes flat (less convex)**

QUESTION 9

[15]

9.1 What causes a tympanic membrane to vibrate?

(1)

Sound waves

9.2 Name the ossicle that is in contact with the:

(2)

9.2.1 fenestra ovalis?

Stapes

9.2.2 eardrum?

Malleus

9.3 Name the fluids found in the:

(4)

9.3.1 different canals of the part of the ear responsible for hearing.

Perilymph in scala vestibuli and scala tympani and endolymph in scala media

9.3.2 middle ear

No fluid just air

9.4 What absorbs the pressure of the liquid set up in the lower canal of the ear?

(1)

Fenestra rotunda

9.5 What will be the result if the ossicles of the human ear fuse? (briefly explain)

(3)

The vibrations of the tympanic membrane will not cause the required vibrations of the ossicles and the oval window will also not vibrate, so the person will not be able to hear.

9.6 When an athlete who competes in the 100 m sprints has to come to a standstill, which part of the human ear is responsible for helping the athlete to maintain their balance. Briefly explain the process.

(4)

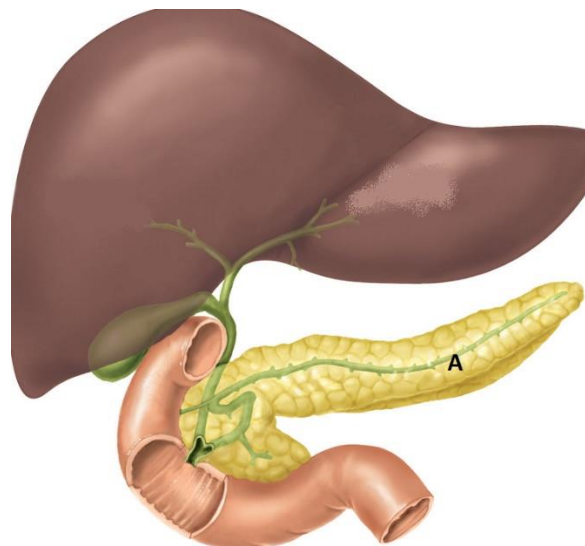
- **Macula – receptor cell in utricle and saccule**

- If a person stops suddenly,
- the endolymph in the utricle and saccule move around,
- the otolithic membrane moves,
- bending the stereocilia,
- which sends an impulse through the vestibular nerves
- to the cerebellum of the brain to maintain balance.

QUESTION 10

[15]

10.1 Study the diagram below and answer the questions that follow.



10.1.1 Which organ is represented by A?

(1)

Pancreas

10.1.2 Organ A is responsible for chemical coordination of the human body. Briefly explain this statement. (14)

- The pancreas consists of exocrine tissue with ducts
- that produce and release digestive juice (pancreatic sap) into the duodenum,
- and endocrine tissue
- without ducts that secrete hormones directly into the bloodstream.

- The endocrine tissue is known as the Islets of Langerhans and it secretes two hormones: Insulin and glucagon (antagonistic hormones).
- If blood sugar (glucose) level is high.
- Insulin is secreted.
- Insulin stimulates the uptake of glucose by the cells (liver, muscle and adipose)
- In the liver and muscles it is stored as glycogen.
- Muscle cells break it down for energy.
- Fat cells convert it to glycerol for the forming of fat.
- Therefore insulin lowers the blood sugar level.
- When the blood sugar level is low.
- Glucagon is secreted into the blood.
- Glucagon stimulates the liver cells to convert glycogen into glucose for energy production.
- Therefore glucagon raises the blood sugar level.

QUESTION 11

[15]

11.1 How do Cytokinins retard the aging of some plant organs?

(3)

- by inhibiting protein breakdown.
- stimulating RNA and protein synthesis.
- and mobilizing nutrients from surrounding tissues.

11.2 Name and briefly discuss two (2) of the many effects of ABA.

(4)

- Seed dormancy
 - Seed dormancy ensures that the seed will germinate only in optimal conditions
 - In some seeds, dormancy is broken when ABA is removed by heavy rain, light, or prolonged cold.
- Drought tolerance
 - ABA is the primary internal signal that enables plants to withstand drought

11.3 What is apoptosis?

(2)

- The programmed destruction of cells, organs, or whole plants
 - By a burst of the plant hormone ethylene
- 11.4 Name three (3) processes controlled by blue-light photoreceptors. (3)
- hypocotyl elongation,
 - stomatal opening, and
 - phototropism
- 11.5 Which plant pigment regulates its response to avoid shade? (1)

Phytochromes

- 11.6 Give an example of a plant that “recruits” predatory animals to help defend them against specific herbivores? (2)

A maize leaf “recruiting” a parasitoid wasp as a defensive response to an armyworm caterpillar, an herbivore or any realistic example.

QUESTION 12

[15]

- 8.1 Name the theme you have chosen for Unit 6 and give reasons why you chose this theme (why is it applicable to the school syllabus)? (2)

Name and 2 reasons

- 8.2 What should the learner know after the completion of your Unit 6? (Answer briefly in point form) (4)

Point form and logic outcomes stated

- 8.3 Draw and label any of the structures applicable to your Unit 6. (4)

Heading (1), Accurate drawing (1), labels correct (2)

- 8.4 Set a small test of 10 marks with answers on your Unit 6. (5)

Test correct, clear, accurate with memo

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