



Life Sciences

SELF STUDY GUIDE 2

REPRODUCTION

1. REPRODUCTION IN VERTEBRATES
2. HUMAN REPRODUCTION
3. ENDOCRINE SYSTEM AND HOMEOSTASIS



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1. INTRODUCTION

The declaration of COVID-19 as a global pandemic by the World Health Organisation led to the disruption of effective teaching and learning in many schools in South Africa. The majority of learners in various grades spent less time in class due to the phased-in approach and rotational/ alternate attendance system that was implemented by various provinces. Consequently, most schools were not able to complete all the relevant content designed for specific grades in accordance with the Curriculum and Assessment Policy Statements in most subjects.

As part of mitigating against the impact of COVID-19 on the current Grade 12, the Department of Basic Education (DBE) worked in collaboration with subject specialists from various Provincial Education Departments (PEDs) developed this Self-Study Guide. The Study Guide covers those topics, skills and concepts that are located in Grade 12, that are critical to lay the foundation for Grade 12. The main aim is to close the pre-existing content gaps to strengthen the mastery of subject knowledge in Grade 12. More importantly, the Study Guide will engender the attitudes in the learners to learning independently while mastering the core cross-cutting concepts.

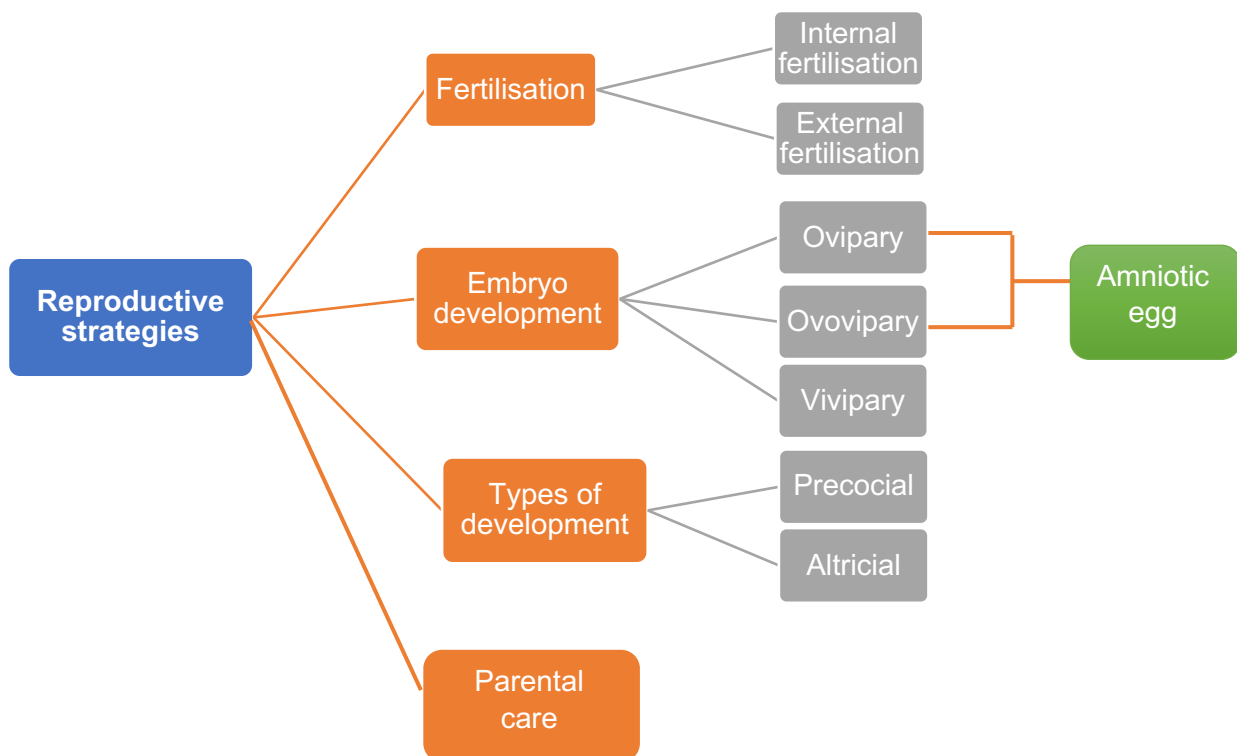
2. HOW TO USE THIS SELF-STUDY GUIDE

- There are five Self-Study Guides covering all Grade 12 topics:
 - Booklet One: DNA: Code of Life and Meiosis
 - **Booklet Two: Reproduction in Vertebrates, Human reproduction, Endocrine System and Homeostasis**
 - Booklet Three: Genetics and Inheritance
 - Booklet Four: responding to the Environment: Humans and Plants
 - Booklet Five: Evolution: Natural Selection and Human evolution
- You must use this Self-study Guide together with the *Life Sciences Mind the Gap Study Guide*.
- You need to study the content from the *DBE Grade 12 Textbook*, *DBE Examination Guidelines 2021*, and *Mind the Gap* for all the topics.
- Ensure you understand all the relevant concepts and content.
- This Self-study Guide focuses mainly on the skills you will need to answer the questions in examinations.
- There are exam technique and tips for each topic (*in italics*)
- These tips will guide you on how to approach certain question types in the Life Sciences Examination papers and tests:
 - How to master the relevant terminology
 - Drawing and interpreting of graphs
 - Interpreting tables
 - Interpreting diagrams
 - Genetics crosses and pedigree diagrams
 - Doing calculations
 - Scientific investigation questions
- At the end of each booklet, you will find typical examination questions and answers

3. REPRODUCTION IN VERTEBRATES (8 MARKS)

TERM	1	PAPER	1
DURATION	½ week	WEIGHTING	8 marks (5%)
LINKS TO PRIOR KNOWLEDGE/BACKGROUND KNOWLEDGE			
Grade 9 – Reproductive systems, Grade 12 - Meiosis			

3.1 KEY CONCEPTS/ MINDMAPS



3.2 TERMINOLOGY

Note: ensure that you know these definitions well.

BIOLOGICAL TERM	DESCRIPTION
Allantois	The structure in the amniotic egg that stores wastes
Amniotic egg	A type of egg where the embryo develops inside a fluid-filled sac which is surrounded by a shell
Zygote	The diploid cell formed by the process of fertilisation

DIFFERENTIATE BETWEEN RELATED TERMINOLOGIES

ALTRICIAL DEVELOPMENT	PRECOCIAL DEVELOPMENT
The reproductive strategy when offspring are not able to move and feed themselves at the moment of birth or hatching	The reproductive strategy when offspring are able to move and feed themselves at the moment of birth or hatching


ASEXUAL REPRODUCTION	SEXUAL REPRODUCTION
Type of reproduction that does not involve fusion of gametes	Type of reproduction that involves the fusion of a male gamete (sperm) and a female gamete (ovum).

EXTERNAL FERTILISATION	INTERNAL FERTILISATION
A type of fertilisation in which the nucleus of a sperm fuses with the nucleus of an ovum outside the body of the female	A type of fertilisation in which the nucleus of a sperm fuses with the nucleus of an ovum inside the reproductive system of the female


OVIPARY	OVOVIVIPARY	VIVIPARY
The reproductive strategy involving the laying of eggs	A type of reproduction whereby the egg hatches within the body of the female such that the young are born live.	A type of reproduction where the foetus develops inside the uterus



3.3 EXAMINATION TECHNIQUES AND TIPS

Fertilisation

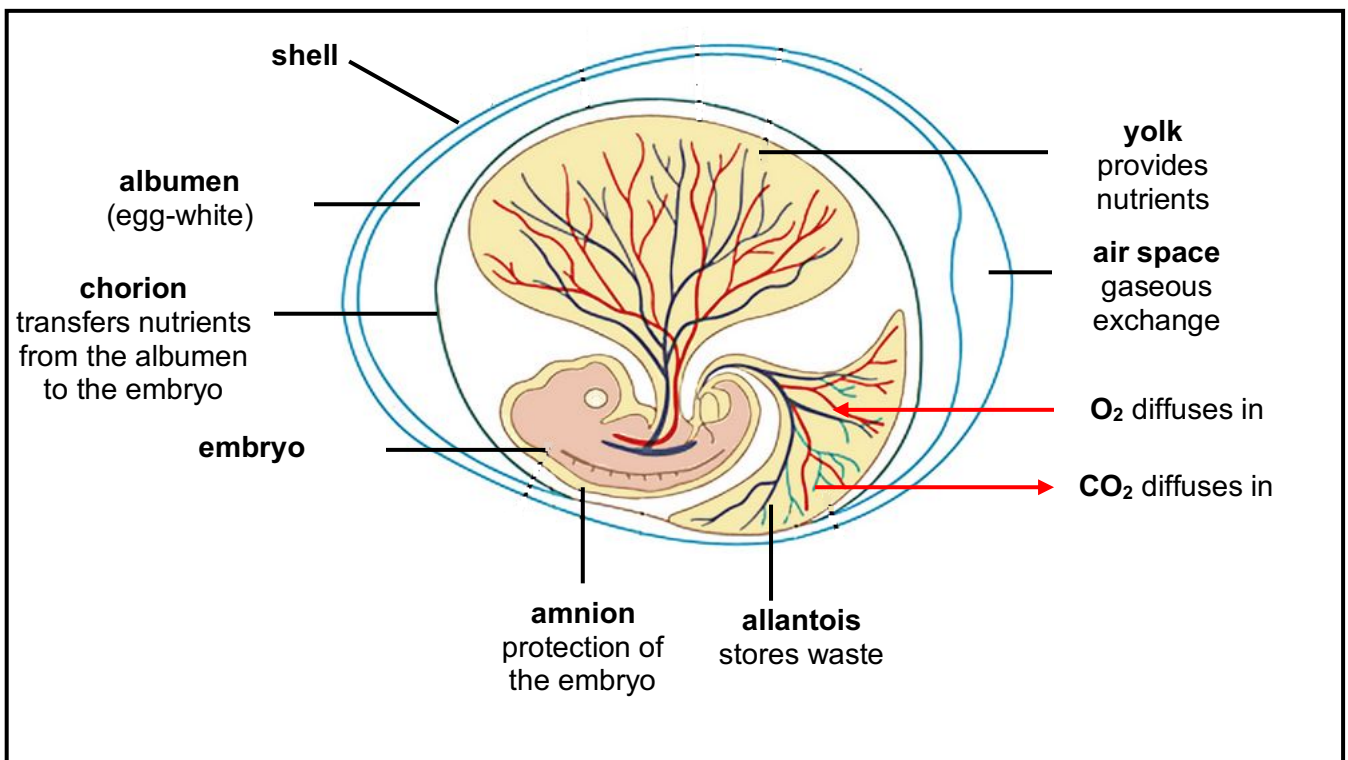
EXTERNAL FERTILISATION	INTERNAL FERTILISATION
Fertilisation occurs <u>outside the body</u> of the female.	Fertilisation occurs <u>inside the body</u> of the female.
Sperm cells are released <u>directly into the water</u> and fuse with the egg cell. (Water is required)	The sperm cell of the male is transferred <u>into the female</u> by sexual intercourse and fuses with the ovum. (No water is required)
Examples: aquatic animals like frogs, sponges, jellyfish, worms and fish.	Examples: mammals, birds and insects.
	

Embryo development

EXPLANATION		EXAMPLE
Ovipary	These are egg laying animals. The eggs are laid by the female and the embryo develops inside the egg. The hard outer shell serves as protection until the egg is ready to hatch.	Birds, reptiles and amphibians 

<p>Ovovivipary</p>	<p>A type of reproduction whereby the egg hatches within the body of the female such that the young are born live. Tip: 'ovo' refers to the egg and 'vivi' refers to the production of live offspring.</p>	<p>Sharks, lizards and some snakes</p> 
<p>Vivipary</p>	<p>A type of reproduction where the foetus develops in the uterus of the female and offspring are born live. The developing foetus gets all its nourishment from the placenta of the mother.</p>	<p>Most mammals (including humans), whales and kangaroos</p> 

Amniotic egg



A type of egg where the embryo develops inside a fluid-filled sac which is surrounded by a shell

PRECOCIAL DEVELOPMENT	ALTRICIAL DEVELOPMENT
<p>Development in birds that is complete such that the young are born <u>independent, with eyes open, with down feathers and able to move or feed</u> independently.</p> <p>This is due to the <u>large quantity of yolk</u> in the egg which lasts longer, allowing more time for development.</p>	<p>Development in birds that is incomplete such that the young are born <u>helpless, with eyes closed, without down feathers and unable to move or feed</u> independently.</p> <p>This is due to the <u>small quantity of yolk</u> in the egg which restricts the time available for full development. Altricial (gets all from parents)</p>
<p>Note: Eggs with more yolk provide more nutrients to embryos which means that they will be stronger when born and most likely precocial. The offspring will be strong, able to stand and feed itself.</p>	<p>Note: internal fertilisation can take place in both altricial and precocial development. Not only birds are precocial or altricial in development. Look at the evidence of the offspring.</p>
<p>Examples: birds, cattle, sheep, antelopes, buffalo, elephants, hippos and giraffe.</p> 	<p>Examples: birds, kangaroos, humans, owls, cats and dogs.</p> 

Parental care

In higher order animals. Parental care is a **behaviour that increases the survival of the young**. As a reproductive strategy, those animals which invest more energy prenatally (before birth) usually display very little parental care once young have been born. In animals where less energy is invested prenatally, most postnatal parental care is offered.

Parental care can be seen in the following examples:

- Building of nests and incubation of eggs
- Guarding from predators
- Teaching offspring

PRACTICE QUESTIONS

QUESTION 1 DBE, November 2015 (2), Paper 1

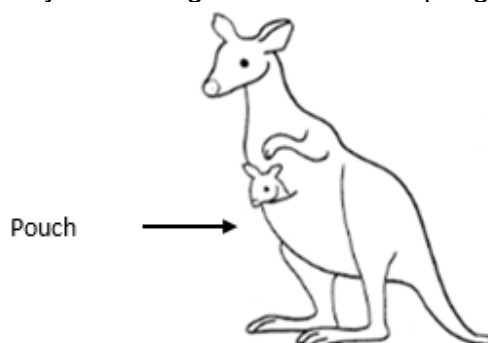
Read the passage below.

REPRODUCTIVE STRATEGY IN KANGAROOS

The red kangaroo reproduces by sexual reproduction. After mating, the fertilised egg undergoes gestation in the uterus. After 33 days of gestation, the red kangaroo gives birth to an offspring that is hairless, blind and only a few centimetres long.

The offspring moves from the vagina by following a trail of saliva secreted by the mother to a protective pouch where it remains for a year. During this time the offspring drinks milk from the mother who has teats in her

After 190 days it leaves the pouch.



When approaching this type of case study question, first read the questions then read the paragraph, thinking about the questions.

1.1 **State whether:**

(a) **Fertilisation in the red kangaroo species is INTERNAL or EXTERNAL** (1)

*Fertilisation takes place **inside** the female's body.*

Internal fertilisation ✓

(b) **The red kangaroo species is OVIPAROUS, OVOVIVIPAROUS or VIVIPAROUS** (1)

The foetus is attached to the mother by an umbilical cord and the young are born live not hatched from an egg.

Viviparous ✓

1.2 Give a reason for your answer to QUESTION 1.1(b). (1)

Foetus develops in the mother's uterus ✓

1.3 State TWO ways in which the survival of the offspring immediately after birth is ensured in the red kangaroo species. (2)

These answers you get directly from the extract

- Protected as it develops in the mother's pouch ✓

- Nourished with mother's milk ✓

} *parental
care*

3.4 TYPICAL EXAM QUESTIONS

QUESTION 1 (*Questions taken from various sources*)

1. Various options are provided as possible answers to the following questions. Choose the correct answer and write only the letter (A to D) next to the question number (1.1 to 1.3) in the ANSWER BOOK, for example 1. D.

1.1 The structure in the amniotic egg that supplies nutrients:

- A Shell
- B Allantois
- C Chorion
- D Yolk sac

1.2 Which ONE of the following involves the development of the young inside the uterus of the mother and where it receives nutrients through the placenta?

- A Ovipary
- B Vivipary
- C Ovovivipary
- D Amniotic egg

1.3 Below is a list of terms relating to reproduction

- (i) Precocial development
- (ii) Altricial development
- (iii) Amniotic egg
- (iv) Parental care

Which of the terms above refer to strategies used by birds that incubate their eggs in a nest and feed their young until they are able to fly?

- A (i), (ii), (iii) and (iv)
- B (i), (iii) and (iv) only
- C (ii), (iii) and (iv) only
- D (i), (ii) and (iii) only

(3 x 2)

(6)

QUESTION 2 (*Questions taken from various sources*)

2 Give the correct **biological term** for each of the following descriptions. Write only the term next to the question number (2.1 to 2.8) in the ANSWER BOOK.

- 2.1 The type of egg produced by reptiles that has extra-embryonic membranes
- 2.2 The type of development in birds where the hatchlings' eyes are open and their bodies are covered with down feathers
- 2.3 A type of fertilisation in which the nucleus of a sperm fuses with the nucleus of an ovum outside the body of the female
- 2.4 The type of development in birds where the young are incapable of moving around on their own
- 2.5 The type of fertilisation associated with vivipary
- 2.6 A behavioural pattern of animals feeding their young and protecting them from predators
- 2.7 Type of fertilisation that happens mostly in aquatic habitats when eggs are released from the female's body and are sprayed with sperm
- 2.8 The type of fertilisation where the ovum is fertilised inside the female reproductive organs

(8)

3 Indicate whether each of the statements in COLUMN I apply to **A ONLY**, **B ONLY**, **BOTH A AND B** or **NONE** of the items in COLUMN II. Write **A only**, **B only**, **both A and B**, or **none** next to the question number (3.1 to 3.6) in the ANSWER BOOK.

COLUMN I		COLUMN II	
3.1	Nutrition provided by the egg	A: B:	Ovipary Ovovivipary
3.2	A type of egg where the embryo develops inside a fluid-filled sac which is surrounded by a shell	A: B:	Precocial Altricial
3.3	Type of reproduction in vertebrates where the foetus is attached to and develops inside the uterus	A: B:	Vivipary Ovovivipary
3.4	A structure involved in gaseous exchange in the amniotic egg	A: B:	Allantois Amnion
3.5	Advantage(s) of the amniotic egg	A: B:	Provides nutrition Allows gaseous exchange
3.6	Requires the production of a large number of gametes to ensure survival of the species	A: B:	External fertilisation Internal fertilisation
			(6x 2)
			(12)

QUESTION 4 (DBE, Nov. 2019, Paper 1)

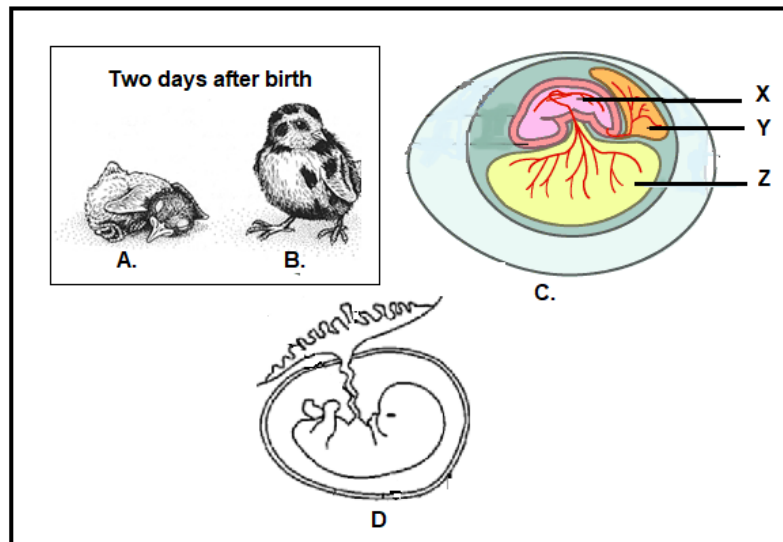
- 4 The table below shows a comparison of the composition of the amniotic egg in three different bird species.

COMPOSITION	BIRD SPECIES		
	1	2	3
Yolk (%)	17	36	22
Water content in yolk (%)	77	57	61
Energy (kcal/g)	1,04	1,44	1,14

- 4.1 Define *ovovivipary* (2)
- 4.2 Which ONE of the bird species (1, 2 or 3) most probably shows a precocial development reproductive strategy? (1)
- 4.3 Explain your answer to QUESTION 4.2. (2)
- 4.4 Which ONE of the bird species (1, 2 or 3) will possibly produce offspring requiring the highest degree of parental care? (1)
- (6)**

5

Study the diagrams below and answer the questions that follow.



5.1 Name the parts labelled:

(a) X

(1)

(b) Y

(1)

5.2 What is the function of part Z?

(1)

5.3 Write only the LETTER/S of the diagram/s that represent/s:

(a) Ovipary

(3)

(b) Vivipary

(1)

5.4 Write only the LETTER of the diagram that represents precocial development.

(1)

(8)

3.5 SOLUTIONS

REPRODUCTION IN VERTEBRATES

QUESTION 1

1.1. D✓✓

1.2. B✓✓

1.3. C✓✓

(3 x 2) (6)

QUESTION 2

2.1 Amniotic egg✓

2.2 Precocial✓

2.3 External✓fertilisation

2.4 Altricial✓

2.5 Internal✓

2.6 Parental care✓

2.7 External fertilisation ✓

2.8 Internal✓fertilisation

(8x 1) (8)

QUESTION 3

3.1 Both A and B ✓✓

3.2 None✓✓

3.3 A only✓✓

3.4 A only ✓✓

3.5 Both A and B✓✓

3.6 A only✓✓

(6 x 2) (12)

QUESTION 4

- 4.1 Eggs are retained/hatch in the female body and the young are born live✓✓ (2)
- 4.2 2✓ (1)
- 4.3 - The egg has the highest yolks/energy content✓
- that will allow maximum development before hatching✓ (2)
- 4.4 1✓ (1)
- (6)**

QUESTION 5

- 5.1 (a) Embryo✓ (1)
(b) Allantois✓ (1)
- 5.2 Providing nutrients to the developing embryo ✓ (1)
- 5.3 (a) A✓, B✓, C✓ (3)
(b) D✓ (1)
- 5.2 B✓ (1)
- (8)**

4. HUMAN REPRODUCTION (41 MARKS)

TERM	1	PAPER	1
DURATION	3 weeks	WEIGHTING	41 marks (28%)
LINKS TO PRIOR KNOWLEDGE/BACKGROUND KNOWLEDGE			
Grade 9 – Reproductive systems, grade 12 - Meiosis			

4.1 KEY CONCEPTS/MINDMAPS



4. 2 TERMINOLOGY

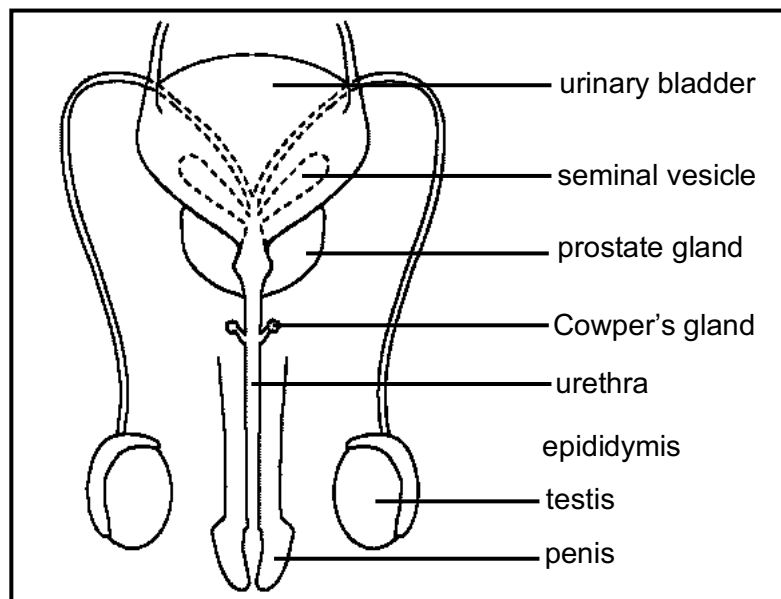
BIOLOGICAL TERM	DESCRIPTION
Acrosome	The vesicle which contains enzymes found in the head of a sperm cell
Amniotic fluid	A fluid that protects the human embryo against injuries and large-scale temperature changes
Blastocyst/blastula	A hollow ball of cells formed from the zygote
Chorion	The outermost membrane found around the embryo/foetus
Chorionic villi	Finger-like extensions of the chorion which extend out into the placenta
Copulation	The introduction of the male sex organ into the female sex canal, followed by a discharge of semen.
Endometrium	The inner lining of the uterus where implantation of the embryo occurs
Extra embryonic membranes	The membranes that form from the embryo which assist in the development of the embryo
Fallopian tube	Part of the female reproductive system where fertilisation occurs
Fertility	The ability to conceive children.
Fertilisation	When the nucleus of the sperm cell fuses with the nucleus of the ovum
Follicle stimulating hormone/FSH	The hormone responsible for the development of follicles in the ovary
Gestation	The period between fertilization and birth when the foetus develops in the womb
Implantation	The attachment of the fertilized ovum or blastocyst to the wall of the uterus at the start of pregnancy
Luteinising hormone/LH	The hormone responsible for ovulation and the formation of the corpus luteum
Oestrogen	The hormone that causes the thickening of the endometrium and is produced by the Graafian follicle
Oogenesis	The production of female gametes through meiosis
Prolactin	A hormone produced by the pituitary gland/hypophysis that stimulates milk production in human females
Puberty	The stage in humans when sexual maturity is reached in males and females
Spermatogenesis	The production of male gametes through meiosis
Testosterone	A hormone that stimulates the maturation of sperm and stimulates puberty in males
Vas deferens	The male reproductive tube that connects the testis with the urethra
Zygote	The diploid cell formed by the process of fertilisation

4.3 EXAMINATION TECHNIQUES AND TIPS

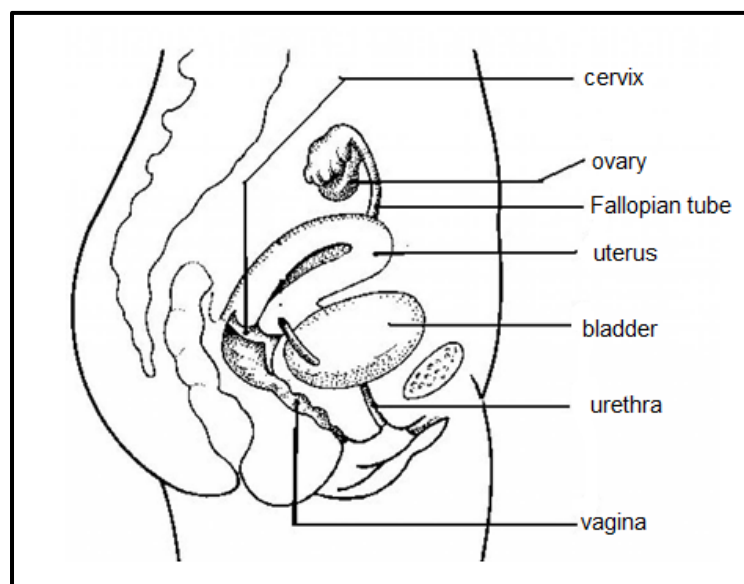
Male and female reproductive systems

You need to know the diagrams of the male reproductive system (side and front view), sperm cell, female reproductive system and ovum. Refer to Mind the GAP and the DBE Gr 12 textbook for detailed diagrams with structures and their functions. (pg. 19-21 MTG, DBE textbook pg. 73, 75, 78-79)

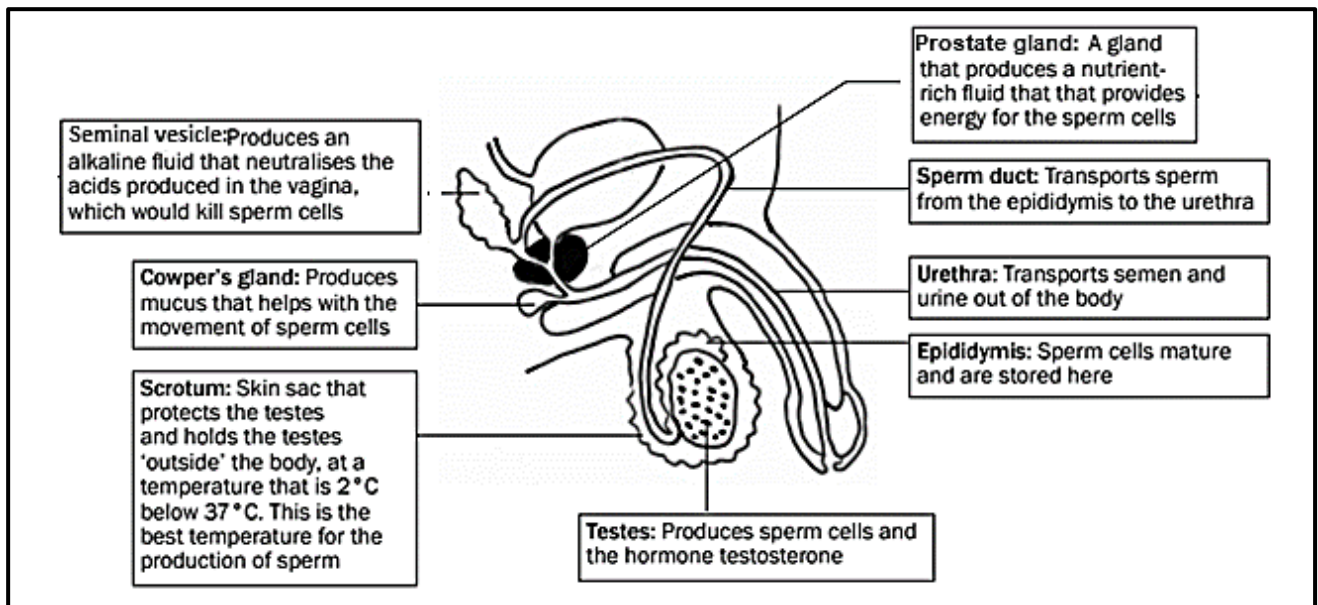
Below are diagrams with their functions for the side and front views of the male and female reproductive systems.



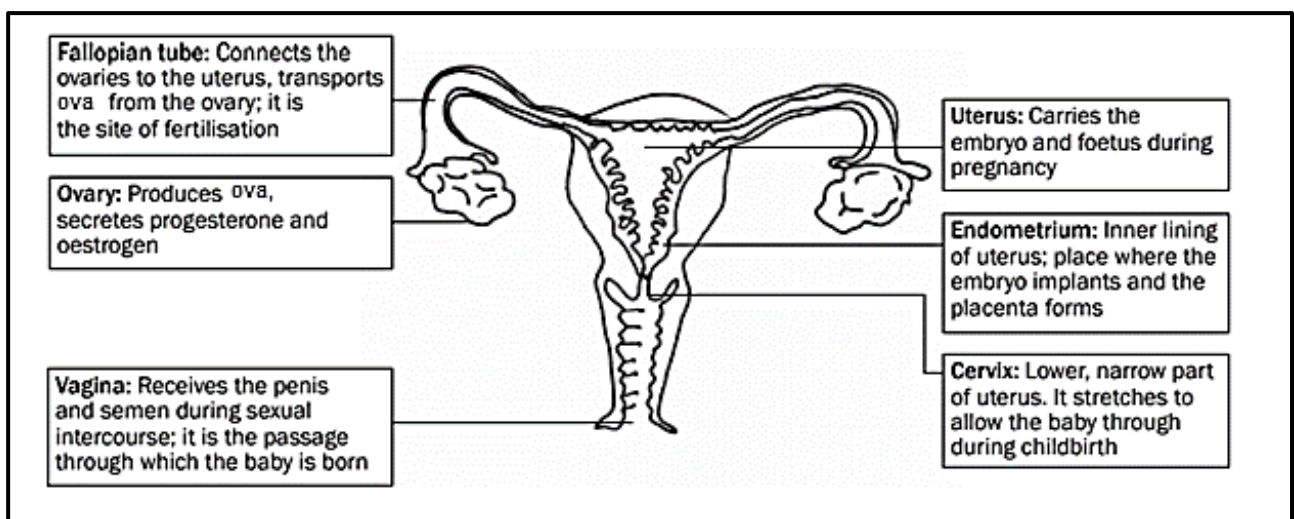
The male reproductive system: front view



The female reproductive system: side view

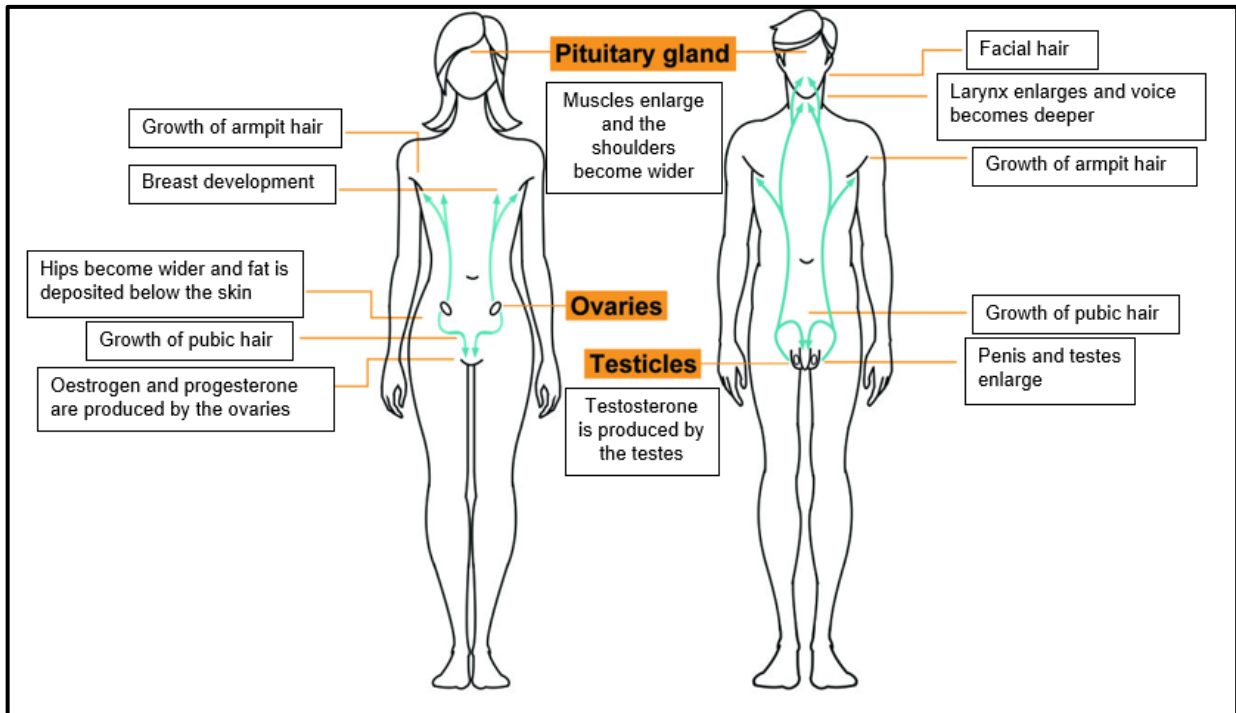


The male reproductive system: side view with functions



The female reproductive system: front view with functions

Puberty (refer to the 2021 Examination guideline pg. 10, DBE textbook pg. 77)



Gametogenesis (refer to the Examination guideline, DBE textbook Pg. 77-80)

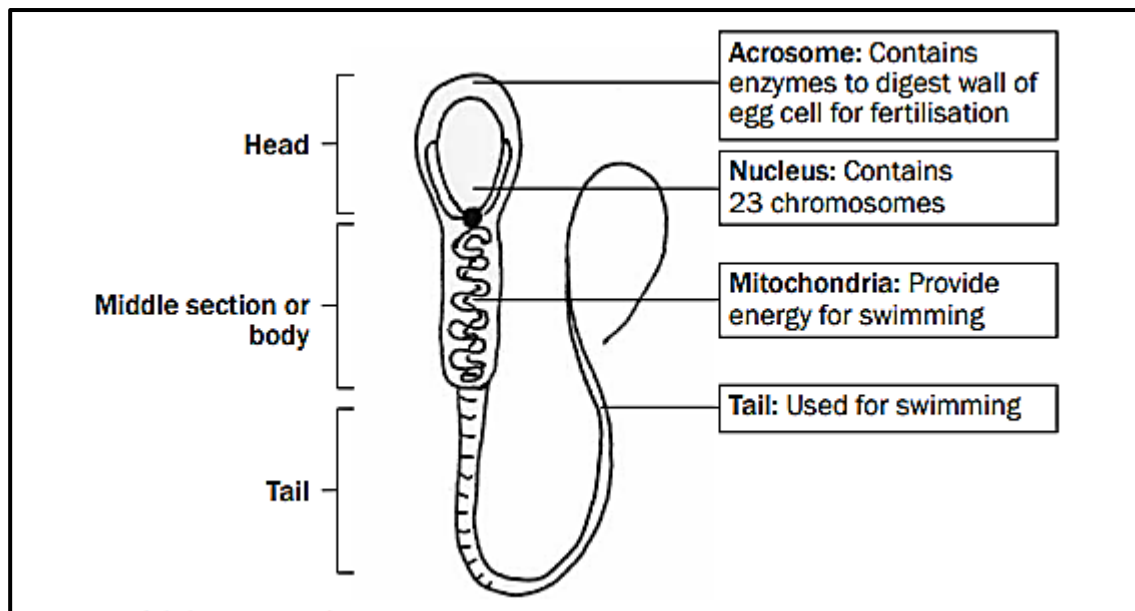
Gametogenesis = Spermatogenesis + Oogenesis. This topic is linked to meiosis.

Formation of gametes (gametogenesis) by meiosis:

- Male gametes formed by spermatogenesis
- Female gametes formed by oogenesis

Spermatogenesis:

- Under the influence of testosterone
- diploid cells in the seminiferous tubules of the testes undergo meiosis
- to form haploid sperm cells



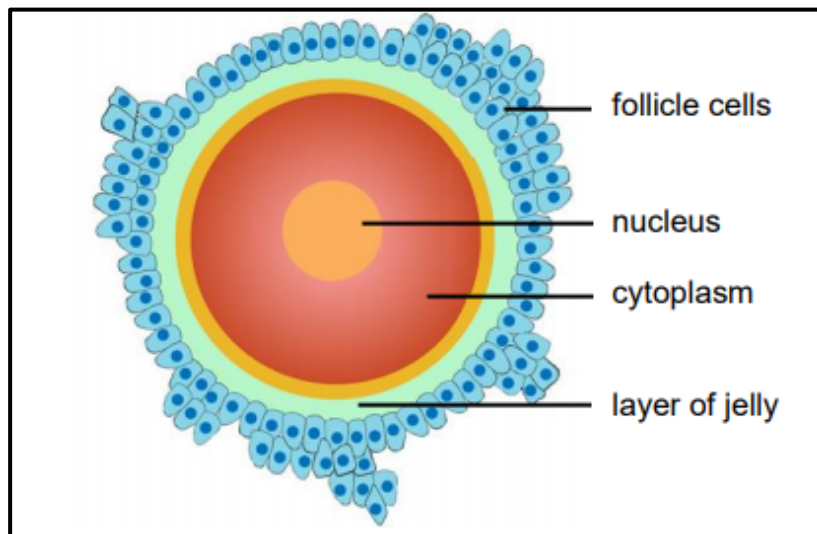
The structure of a sperm

Be advised that when asked for the structural suitability of sperm, two marks are generally allocated to each structural adaptation of the sperm, one mark for the part/structure and the second mark for the role it plays, as shown in a few of the answers below:

STRUCTURE	THE ROLE IT PLAYS
The acrosome	Contains enzymes to dissolve a path into the ovum
The tail	Enables sperm cells to swim to the ovum
Many mitochondria in the middle piece	To provide energy for the sperm movement

Oogenesis:

- Diploid cells in the ovary undergo mitosis
- to form numerous follicles.
- At the onset of puberty
- and under the influence of FSH,
- one cell inside a follicle enlarges and undergoes meiosis.
- Of the four cells that are produced, only one survives to form a mature, haploid ovum.
- This occurs in a monthly cycle.



Structure of an ovum

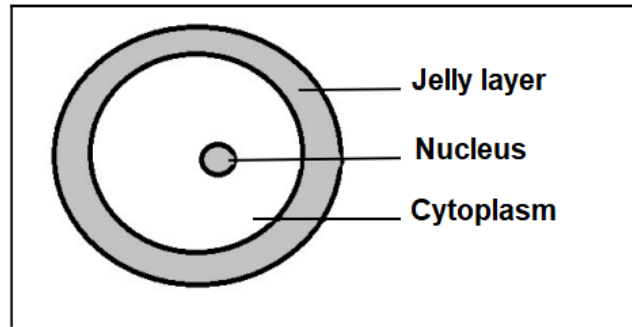
STRUCTURE	FUNCTION
Layer of jelly	Provides protection for the early developmental stages of the fertilised ovum
Cytoplasm	Nourishes the ovum
Haploid nucleus	Contains 22 autosomes and one sex chromosome (X chromosome)

Drawing skill

You must be able to draw and label the ovum and sperm cell.

Practice Question: Draw a labelled diagram of an ovum.

Marking guideline:



Criteria for marking diagram

Criteria	Marks
Correct diagram (ovum)	1
Any 2 correct labels	2

(3)

You need to be able to draw and label the sperm cell and ovum. Remember all drawings must:

- Include a caption
- Be drawn in pencil and labelled in pen. Label lines must not cross.
- Be large and fill half a page

Menstrual cycle

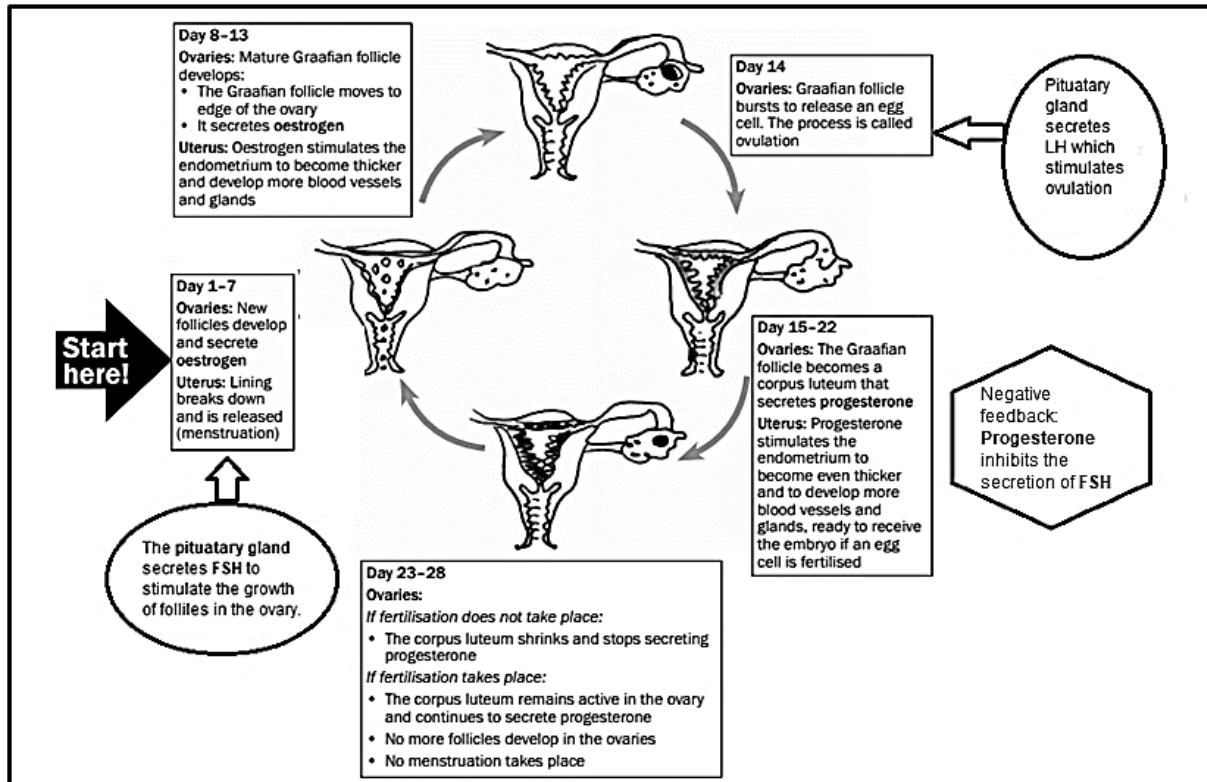
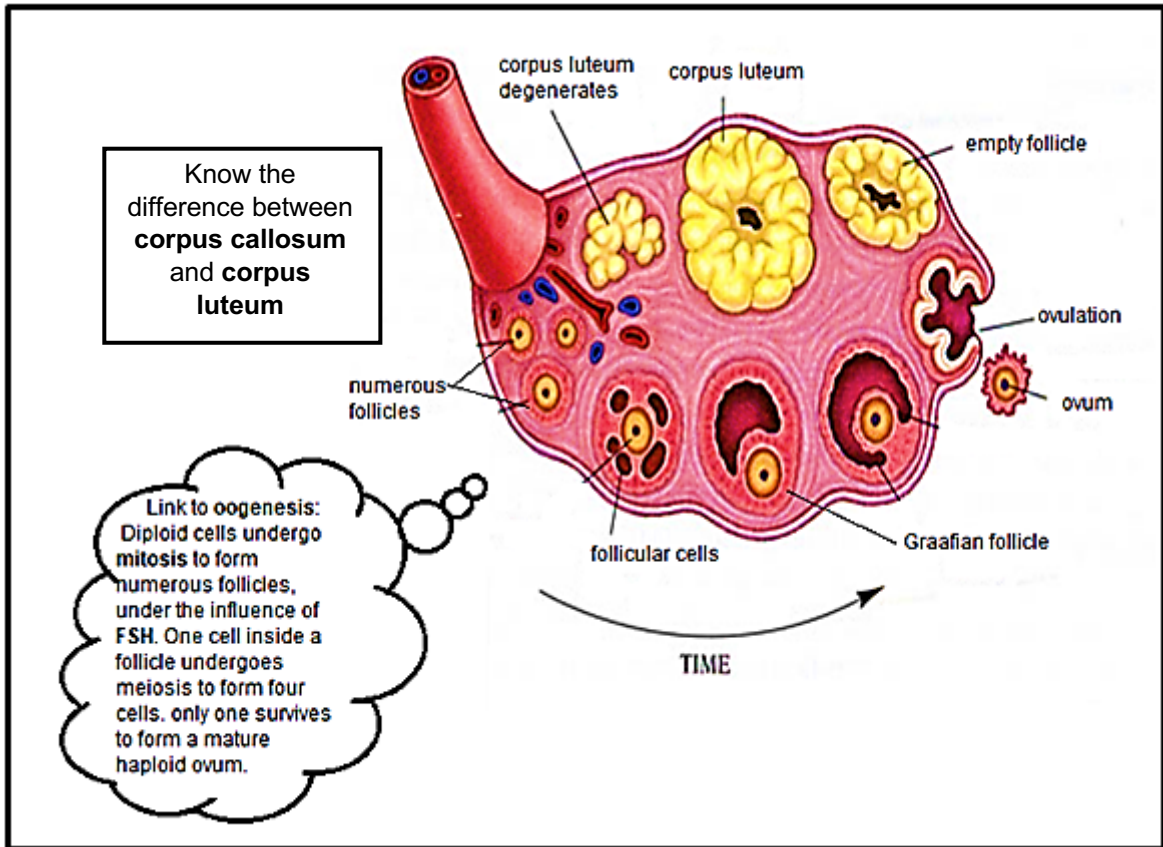
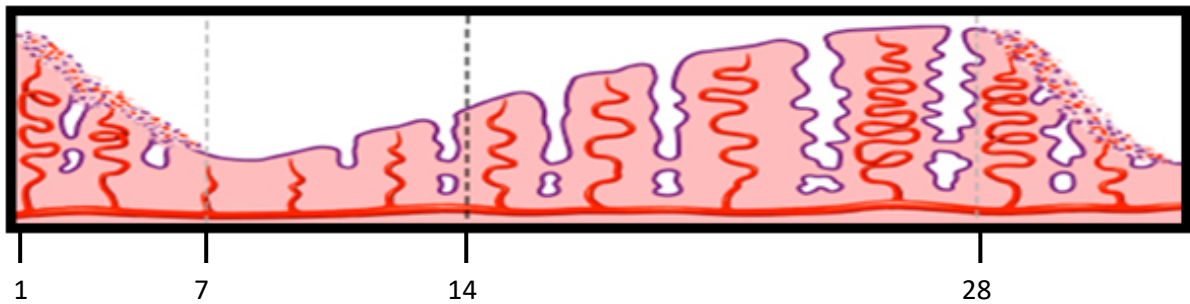


Diagram showing the ovarian cycle, uterine cycle and hormones involved of the menstrual cycle



Diagrammatic representation of the ovarian cycle



A diagram indicating the sequence of the uterine cycle starting from day 1 to day 28

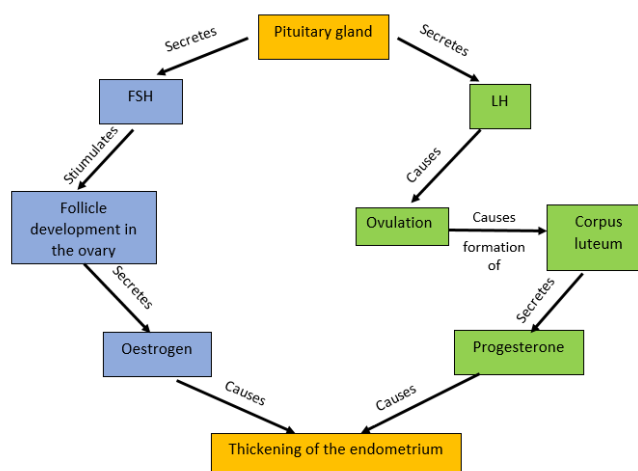
DAY	EVENT
1 - 7	Menstruation: lining breaks down and is released
8 - 13	Oestrogen stimulates the endometrium to become thicker, more glandular and vascular
15 - 22	Progesterone stimulates the endometrium to become even more thicker, more glandular and vascular to receive a fertilised ovum

Hormones involved in the menstrual cycle: FSH, LH, Oestrogen and Progesterone (FLOP)

Note: Remember this when you approach the endocrine system and homeostasis.

GLAND	HORMONE	FUNCTION
Pituitary gland	FSH (Follicle stimulating hormone)	Stimulates the development/growth of the follicle
Pituitary gland	LH (Luteinising hormone)	Stimulates ovulation
Ovary (developing follicle)	Oestrogen	Thickening of endometrium
Ovary (Corpus Luteum)	Progesterone	Maintains the thickness of the endometrium.
Placenta (Pregnancy)	Progesterone	Maintains pregnancy by maintaining the thickness of the endometrium.

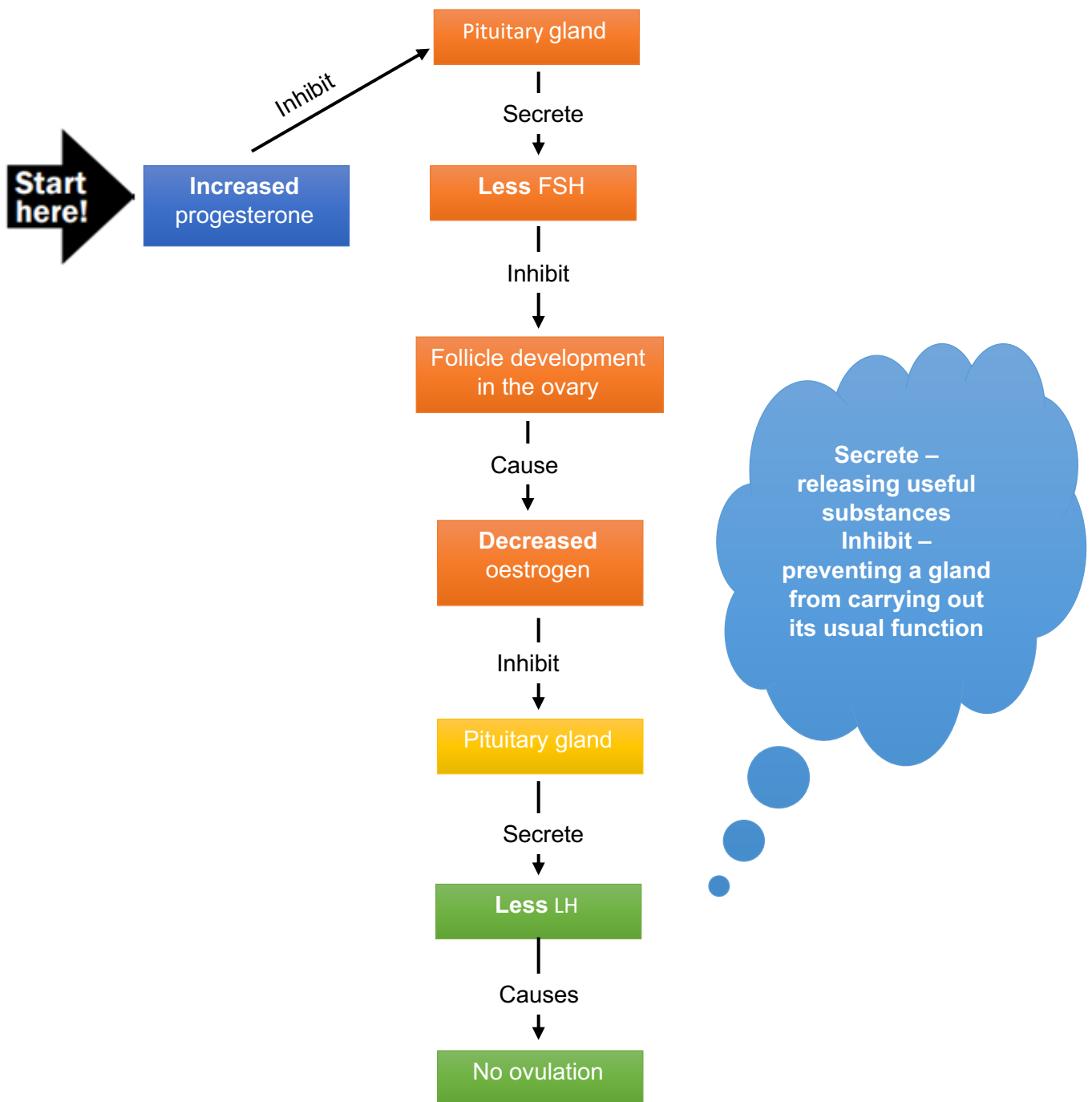
Refer to **MTG Pg 23** and the **DBE Gr 12 textbook Pg 80 to 85** for the diagram showing the level of the ovarian and pituitary hormones during the menstrual cycle. Below is a flow diagram representation of the interactions of the hormones in the menstrual cycle.



Flow diagram showing the Interactions of the hormones in the menstrual cycle

Negative feedback of FSH and progesterone

If the ovum is fertilised, the corpus luteum remains active and continues to secrete progesterone. The increased level of progesterone inhibits the pituitary gland from secreting FSH (decreased FSH in the blood) which results in no follicle development in the ovary. No ovulation will take place. When the levels of **progesterone drop**, the pituitary gland is **no longer inhibited** (FSH secretion increases in the blood) A new follicle starts to develop.



Flow diagram showing negative feedback

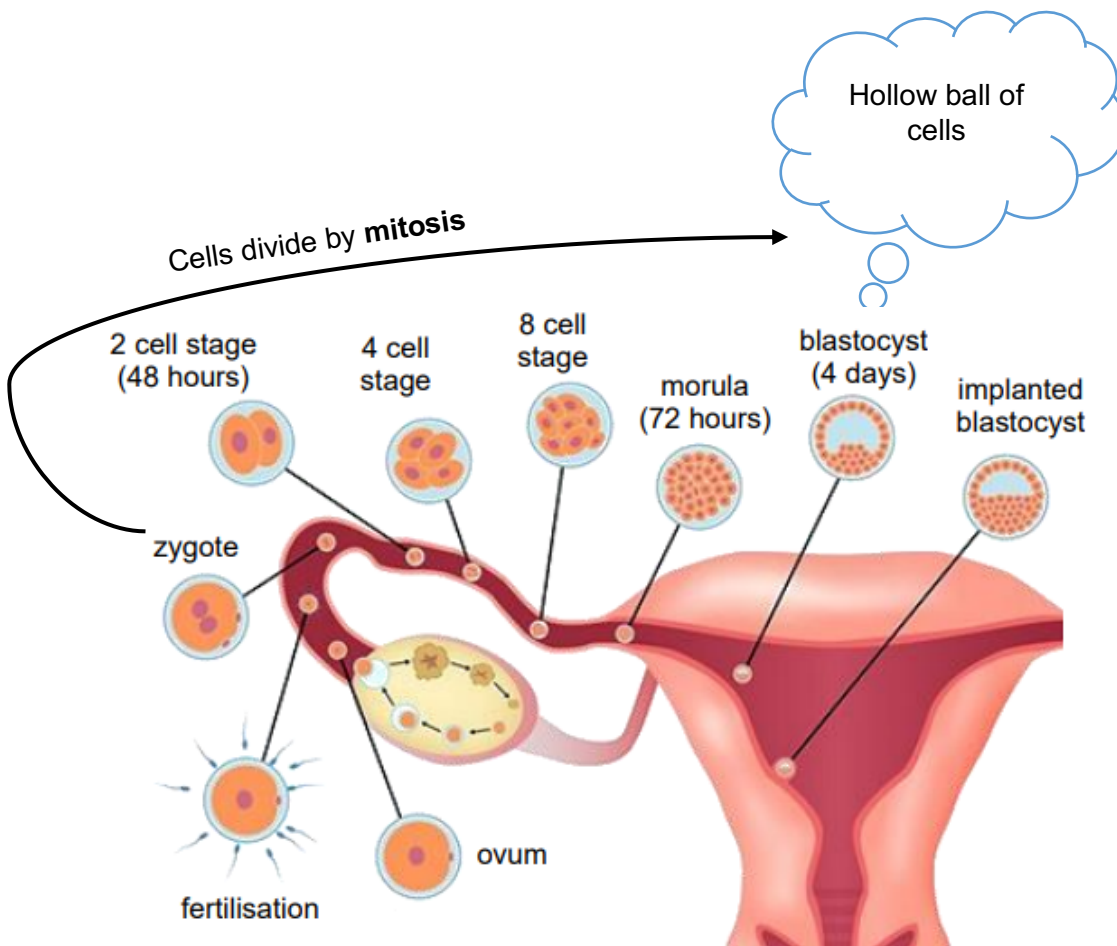
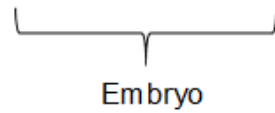
Fertilisation, development of zygote to blastocyst and implantation

(Refer to MTG Pg. 25 and DBE Gr 12 textbook Pg. 87 and 88)

Fertilisation is when the **nucleus** of the sperm cell fuses with the **nucleus** of the ovum. Fertilisation results in the formation of a diploid zygote which further develops by **mitosis** into a blastocyst.

Know the sequence of development:

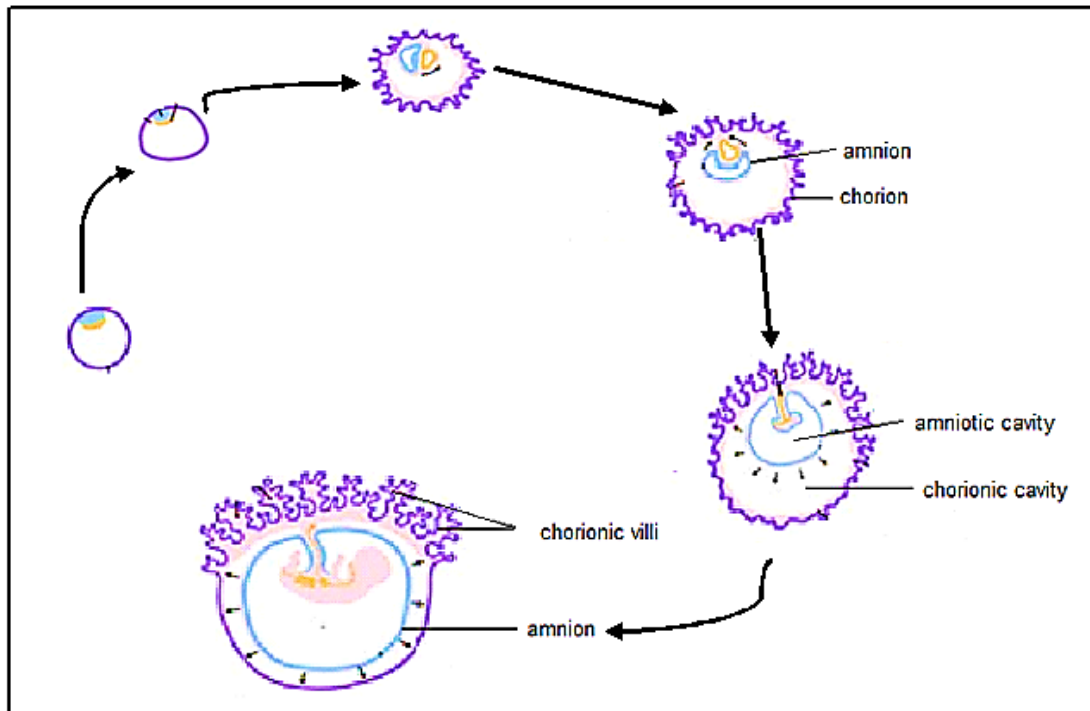
Zygote → Morula → Blastocyst (*not blastocyte*) → Foetus



Fertilisation and development of the blastocyst

Gestation (Refer to DBE Gr 12 textbook Pg. 89 and 90)

After implantation, **extra-embryonic membranes** develop from the developing embryo. These are the **chorion** and the **amnion**. **Chorionic villi** (finger-like projections) from the chorion of the embryo will grow into the uterus tissue of the mother to form the placenta.



Development of the extra-embryonic membranes

GESTATION

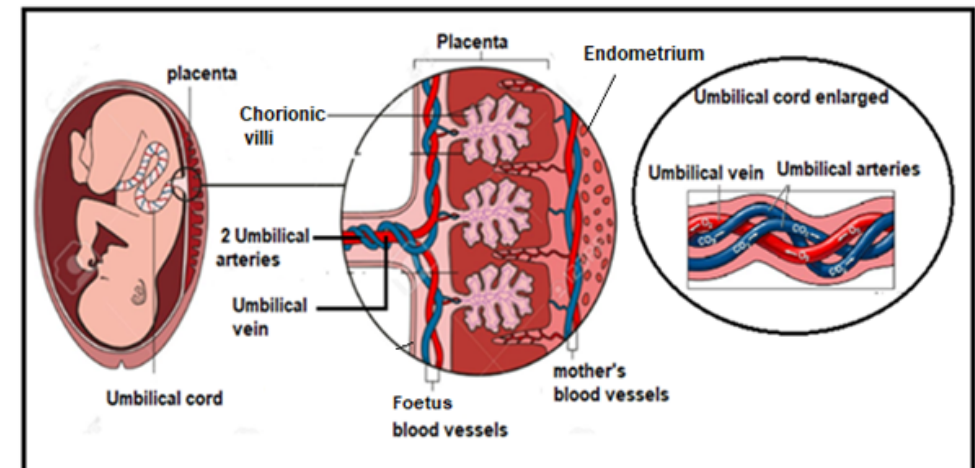
The period of development of the foetus in the uterus which takes place from conception to birth.

PREGNANCY

Pregnancy refers to all the changes (hormonal, physical, emotional) that take place in the body of a female as a result of the developing foetus.

The placenta is attached to the embryo by the **umbilical cord**. See diagram below.

Umbilical arteries carry carbon dioxide and metabolic waste to the placenta. **Umbilical vein** carries oxygen and nutrients from the placenta to the foetus.



The placenta and umbilical cord

Placenta
Structure: An oval, vascular structure in the uterus that nourishes the foetus.
Function: - Gaseous exchange between mother and foetus
 - Providing nutrients to foetus
 - Secreting progesterone

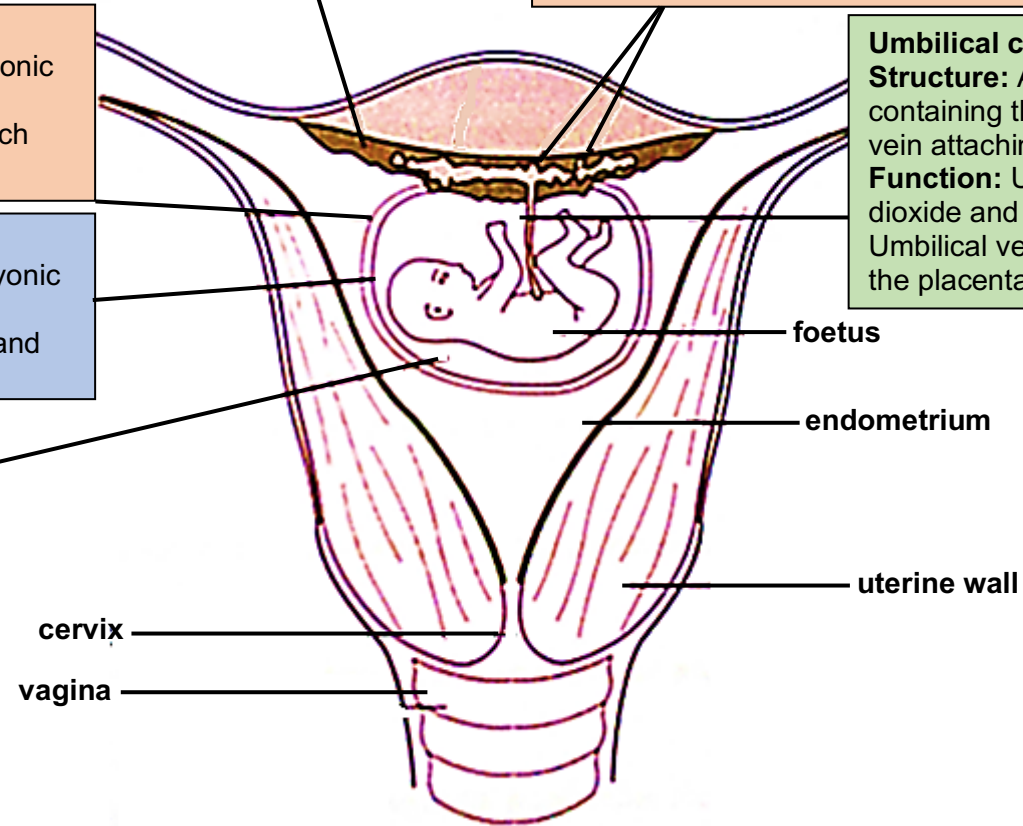
Chorionic villi
Structure: Finger-like projections of the chorion which project into blood spaces in the uterus of the mother.
Function: Provide maximum contact with maternal blood. Forms part of the placenta.

Chorion
Structure: The outermost extra-embryonic membrane covering the amnion.
Function: Forms the chorionic villi which forms part of the placenta.

Amnion
Structure: The inner most extra-embryonic membrane.
Function: Secretes the amniotic fluid and protects the developina foetus.

Amniotic fluid
Structure: The fluid contained inside the amniotic sac.
Function: - Shock absorber
 - Protect foetus against large temperature changes
 - Protects foetus against desiccation

Umbilical cord
Structure: A flexible cordlike structure containing the umbilical arteries and umbilical vein attaching the foetus to the placenta.
Function: Umbilical arteries carry carbon dioxide and metabolic waste to the placenta. Umbilical vein carries oxygen and nutrients from the placenta to the foetus.

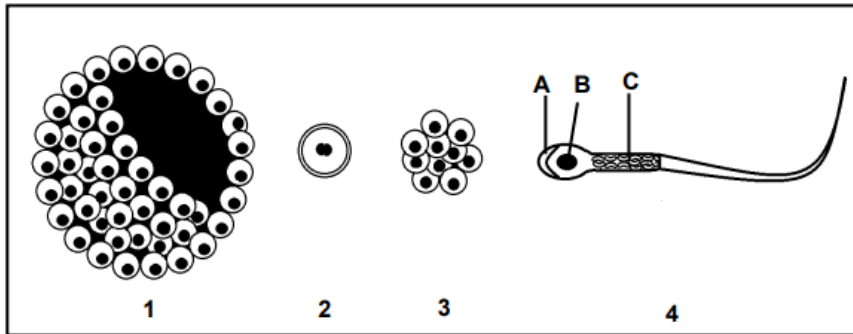


Foetus in uter

PRACTICE QUESTIONS

QUESTION 1 (DBE P1 Nov 2020)

1. The diagrams below show structures formed during human reproduction.



The first thing you do when answering a diagrammatic question, is identify all the labels.

- 1.1 Identify part A. (1)
Acrosome ✓

- 1.2 Name the organelle found in large numbers in part C. (1)
You first need to identify what C is, then you identify which organelle is found within it.

Mitochondria ✓

- 1.3 Give the NUMBER (1, 2, 3 or 4) only of the diagram that represents the following: (1)
(a) Morula (1)
(b) Structure that will implant in the uterus (1)
Identify the structure and then look for it in the diagram.
(c) Blastula/blastocyst (1)

Read the instruction of the question carefully. The examiner only requires the NUMBER.

- (a) 3 ✓
(b) 1 ✓
(c) 1 ✓

- 1.4 Give the LETTER and NAME of the part that will enter the ovum during fertilization. (2)

Read the instruction of the question carefully. The examiner only requires the LETTER and NAME.

B ✓ - nucleus ✓

- 1.5 Name the type of cell division that occurred to produce the structure in diagram 3. (1)

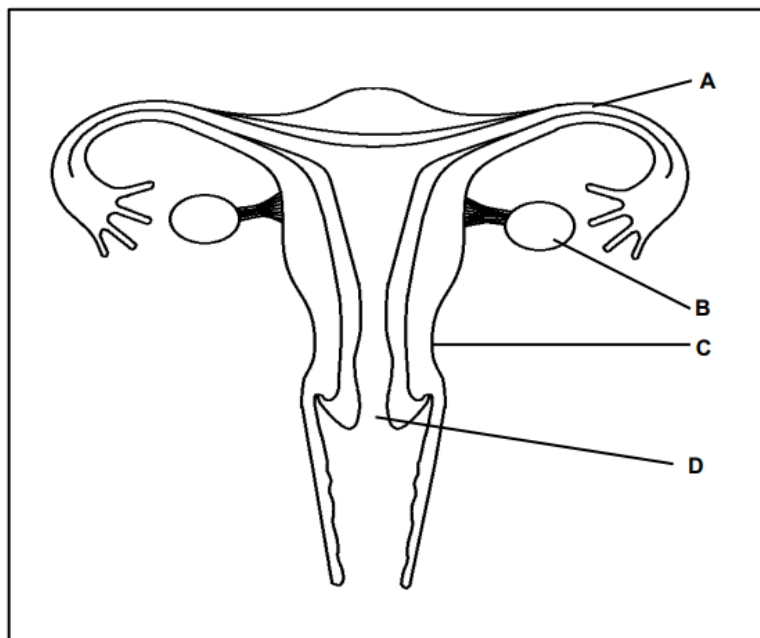
First identify diagram 3. There are two types of cell division, namely meiosis and mitosis. They are commonly confused. This is a ball of cells which is the morula which divides by mitosis. Remember that meiosis is involved in the formation of gametes.

Mitosis ✓

(8)

QUESTION 2 (DBE P1 NOV 2020)

- 2 The structure below represents a part of the female reproductive system.



- 2.1 Identify part D. (1)

You must be able to label and know the difference between the cervix, vagina and the vulva.

Cervix ✓

2.2 **State ONE function of part A** (1)

You first need to identify what A is and then write down the function of it.

- Transfers the ovum/embryo to the uterus✓
- Place where fertilisation takes place✓

2.3 **Describe the process of oogenesis as it occurs in part B.** (4)

The answer to this question is stated as is in the Examination guideline.

Describe questions expect you to give a detailed account of a process or relationship.

- Under the influence of FSH✓
- Diploid cells in the ovary undergo mitosis✓
- To form numerous follicles✓
- One cell inside the follicle enlarges and undergoes meiosis✓
- Of the four cells that are produced, only one survives to form a mature haploid ovum✓

2.4 **State ONE way in which structure C is suited for its function during pregnancy.** (1)

First identify structure C, then identify the functions specifically during pregnancy.

- It is hollow organ✓
- It has a muscular wall✓
- It has a blood-rich lining/endometrium✓

2.5 **A person undergoes a surgical operation to remove part B on both sides.**
Explain why this person will not menstruate. (3)

First you need to identify why the person will not menstruate. It is because there is no endometrium. Then you need to think about the steps involving the endometrium to not be formed. Remember that explain questions want you to answer in a cause-and-effect manner.

- No follicle will develop ✓
- No oestrogen produced ✓
- And no progesterone produced ✓
- Therefore, the endometrium will not develop ✓* to be shed during menstruation

Compulsory mark ✓*1

QUESTION 3 (DBE P1 NOV 2020)

3. Male hormone contraceptive (birth control) pills have been in development for over 50 years. The pills contain a substance called TU, which inhibits the secretion of testosterone. There is, however, no product available on the market yet, mainly due to many side effects associated with the product.

An investigation was done to determine how TU affects male fertility. The procedure was as follows:

- 308 healthy, male volunteers were selected.
- A sperm count for each volunteer was done initially.
- Each volunteer was given 500 mg of TU monthly over a period of 12 months.
- During the period of the investigation, the volunteers were asked to wear loose-fitting trousers and underwear made of the same light fabric.
- A sperm count was done weekly over a period of 24 months.
- The average sperm count was calculated per volunteer.

NOTE: Sperm count refers to the total number of healthy sperm per ml of semen and is an indication of male fertility.

- 3.1 **Identify the dependent variable in the investigation.** (1)

You first read the passage and then identify the AIM. The aim usually begins with 'The investigation was done to determine the...'. This sentence is made up of the independent and dependent variables. Dependent variable refers to the effect of the independent variable.

Male fertility✓

- 3.2 **State how the dependent variable in QUESTION 3.1 was measured.** (1)

Measuring the sperm count✓

- 3.3 **Name TWO other factors that should be considered when selecting volunteers.** (2)

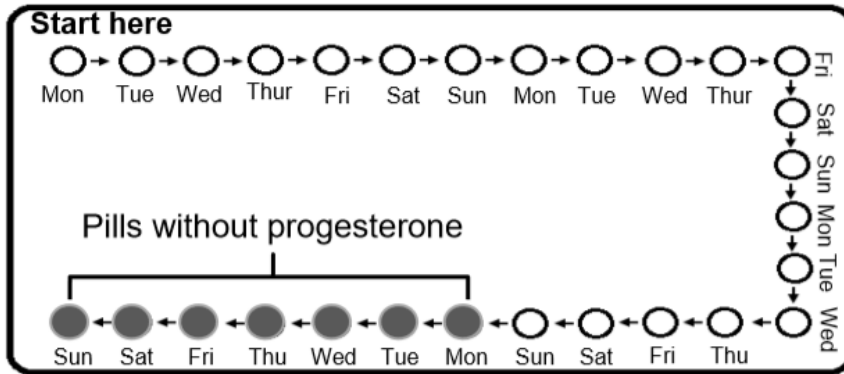
Read the question carefully. You are being asked for TWO OTHER factors. You cannot name factors stated in the paragraph. You cannot write anything referring to the health of the volunteers as the paragraph states that they are healthy, but your answer must still be relevant to the question.

- Age✓
- Diet✓
- Level of activity✓

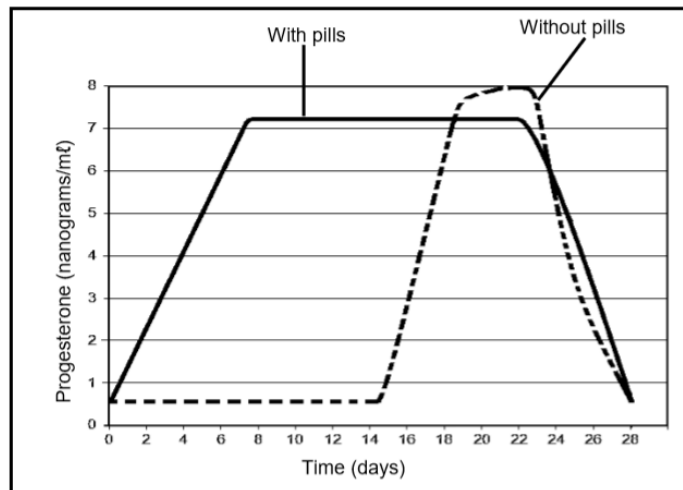
- 3.4 **Explain how TU reduces fertility.** (2)
Fertility means the ability to conceive children. First you need to read the paragraph and identify what TU does. then write what will that result in.
- TU inhibits the secretion of testosterone✓ *from the paragraph*
 - Without testosterone spermatogenesis/production of sperm cannot take place✓ /no sperm will be produced.
- 3.5 **Explain why wearing tight-fitting trousers will decrease male fertility.** (2)
The scrotum allows for the testes to be kept 2-3 °C lower than body temperature to allow for production of normal sperm. If the clothes are too tight, it will cause the temperature to increase which in turn decreases the sperm count. Avoid using words like no sperm or immature sperm produced as it is not scientifically true to this question. Remember explain questions expect you to answer in a cause and effect manner.
- The higher temperature of the testes✓ due to the tight underwear - cause
 - could decrease the sperm count✓ /sperm production/lead to the production of abnormal sperm - effect
- 3.6 **Suggest ONE reason for doing the sperm count for an additional 12 months after stopping the TU treatment.** (1)
- To determine how long it takes the sperm count to return to normal✓ when the treatment stops
 - To see if the sperm count returns to normal✓ when the treatment Stops
- 3.7 **The contraceptive options that are currently available for men are limited to condoms and vasectomy. Vasectomy involves the cutting and tying of both the vas deferens. Explain how a vasectomy prevents pregnancy.** (2)
The question is asking you to explain the effect of cutting the vas deferens. First you need to think of what the function of the vas deferens is, but you do not write it in your answer like that. Remember that if the vas deferens is cut, then it will not be able to carry out its function.
- No sperm will be transported✓
 - from the epididymis to the urethra✓
 - Semen without sperm will be released✓

QUESTION 4 (DBE P1 NOV 2019)

4. Contraceptives are used to prevent pregnancy. Some females use pills that contain progesterone. In one packet there would be 28 pills, of which 21 contain different concentrations of progesterone according to the day in the cycle and the remaining 7 will contain no progesterone. A female has to take one pill daily at the same time in a given sequence, as shown below:



The graph below shows the difference in the progesterone levels during a menstrual cycle of a woman taking contraceptive pills and a woman not taking contraceptive pills.



- 4.1 **Oestrogen levels between days 8 and 22 will remain low in the woman who takes contraceptive pills. Explain why this is the case.**

This question involves the extension of the negative feedback of progesterone and FSH. You first have to analyse the graph and identify increased progesterone. When formulating your answer, remember to indicate the high or low levels of the hormones involved. Explain questions require you to answer in a cause and effect manner.

(4)

- The high levels of progesterone✓ in the pills - cause
- will inhibit the secretion of FSH from the pituitary gland✓ - effect
- No follicle will develop✓- effect
- and hence no oestrogen will be secreted✓ - effect

4.2 **Ovulation took place on day 14 in the woman not taking contraceptive pills.**

Explain the evidence in the graph that supports this conclusion.

Look at what happens to the graph after day 14. You will see the progesterone levels increase. Where is the progesterone coming from? It comes from the corpus luteum, which is formed because ovulation had taken place. (2)

- The increase in the progesterone level✓
- indicates that corpus luteum has been formed✓

4.3 **Suggest ONE reason for including pills with no hormones in the contraceptive pill packet.** (1)

Read the question carefully. It is asking for only ONE reason which means they only want one idea or fact. You need to apply what you already know about the function of hormones and apply it to a new situation.

- Women will stay in the habit of taking a pill every day ✓/ will not forget to take the progesterone containing pills
- to allow for menstruation to occur ✓

4.4 **Describe the development of a zygote until implantation occurs.**

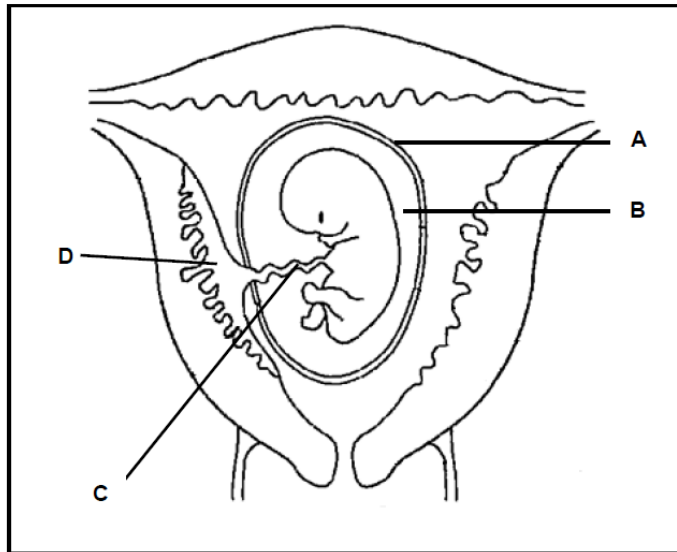
*This is stipulated in the examination guideline. Remember to keep a logical sequence when asked to **describe** a process. Fertilisation has already occurred so shouldn't be included in your answer.* (4)

- Zygote divides by mitosis ✓
- To form a ball of cells ✓
- Called the morula ✓
- Which further divide to form a hollow ball of cells ✓
- Called the blastula /blastocyst ✓

(11)

QUESTION 5 (GDE, Exemplar 2021, Paper 1)

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



5.1 **Identify**

a) **A**

Chorion ✓ (Tip: chorion is the out extra-embryonic membrane whereas the amnion is the inner)

(1)

b) **B**

Amniotic fluid ✓

(1)

5.2 **Name THREE functions of B.**

(3)

Functions of the amniotic fluid.

- Shock absorber ✓
 - Moisturising/Prevents desiccation of the foetus ✓
 - Thermoregulatory- protects against extreme temperature changes ✓
 - Allows for movement ✓
- Any

(2)

5.3 **Name TWO substances transported by the artery in structure C.**

Structure C is the umbilical cord.

- Deoxygenated blood ✓
- Waste products ✓

5.4 **What is the function of part D?** (2)

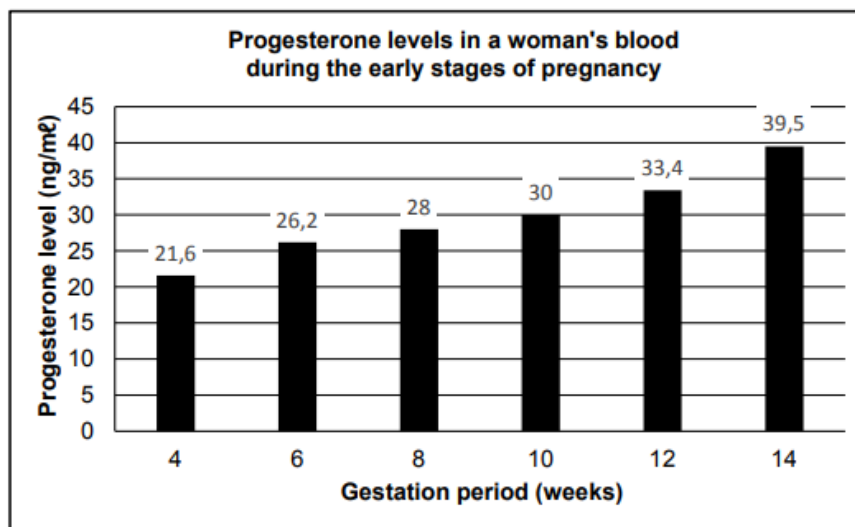
Part D is the placenta.

- Nutrition/nutrients diffuse from maternal blood to foetus✓
- Gaseous exchange✓
- Excretion/wastes are carried away from the foetus✓
- Protection against harmful pathogens and chemicals✓
- Endocrine function/secreted progesterone and oestrogen✓ Any

(9)

QUESTION 6 (DBE, May-June 2018, Paper 1)

6.



6.1 **Name TWO structures responsible for producing progesterone during pregnancy.** (2)

- Corpus luteum✓
- Placenta✓

(Mark first TWO only)

6.2 **Describe the general trend in the change in progesterone levels in the woman's blood during the early stages of pregnancy.** (1)
When asked to describe a 'trend', you should look at what is happening to the graph, is it increasing, decreasing or staying the same.

Progesterone levels are increasing✓

6.3 **Describe the negative feedback mechanism that occurs between progesterone and FSH during pregnancy.** (2)
Describe questions do not require an explanation.

- High levels of progesterone✓
- inhibits the secretion of FSH✓

- 6.4 **State the importance of the negative feedback mechanism described in QUESTION 6.3.** (1)

To prevent the growth of a new follicle✓/ovulation during the pregnancy

- 6.5 **Calculate the percentage increase in progesterone levels between week 4 and week 14. Show ALL calculations.** (3)

$$39,5 - 21,6✓ = 17,9$$

$$\frac{17,9}{21,6} \times 100✓ = 82,9✓\% \text{ (Accept 83\%)}$$

- 6.6 **The woman's progesterone level in week 16 was ng/mL.**

- (a) Explain why this woman should be concerned about the decrease in progesterone levels.** (2)

- The endometrium/uterine lining/placenta will not be maintained✓
- Menstruation will begin✓/the placenta will detach/ she will have a miscarriage

- (b) Suggest ONE way in which this problem could possibly be treated by a doctor.** (1)

Give the woman progesterone supplements✓

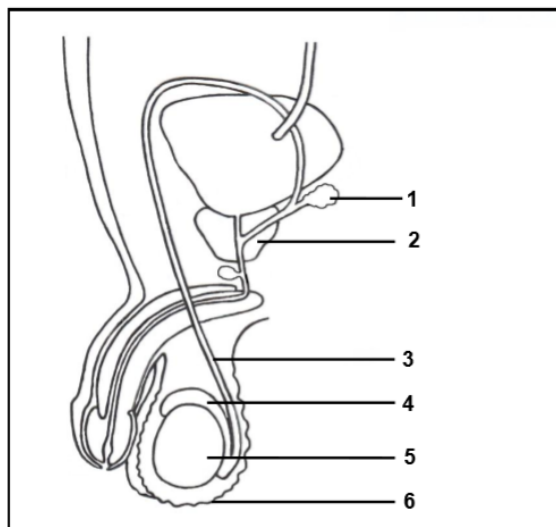
(12)

4.4 TYPICAL EXAM QUESTIONS

QUESTION 1 *(Questions taken from various sources)*

Various options are provided as possible answers to the following questions. Choose the correct answer and write only the letter (A to D) next to the question number (1.1 to 1.5) in your ANSWER BOOK, for example 1.6 D.

QUESTION 1.1 AND 1.2 ARE BASED ON THE DIAGRAM OF THE HUMAN MALE REPRODUCTIVE SYSTEM BELOW



Which part stores sperm until maturation?

1.1

- A 3
- B 4
- C 5
- D 6

- 1.2 A man who had cancer underwent surgery to remove part 1 and part 2.
The man. . .
- A will be able to release semen not containing sperm and therefore cannot reproduce.
 - B cannot reproduce because he will produce abnormal sperm. cannot
 - C reproduce as his sperm will not be able to survive the acidic conditions of the vagina.
 - D will be able to reproduce but his sperm will not be able to move fast as they will not have energy.
- 1.3 Which ONE of the following is a function of amniotic fluid?
- A Transports oxygen to the developing foetus
 - B Protects the foetus from temperature changes
 - C Produces progesterone and oestrogen
 - D Protects the foetus from disease
- 1.4 Which of the following are hormones that directly stimulate the development of the endometrium?
- A FSH and LH
 - B Progesterone and oestrogen
 - C FSH and progesterone
 - D LH and oestrogen
- 1.5 A function of the placenta is to ...
- A transport waste from mother to foetus.
 - B form the chorion.
 - C secrete progesterone.
 - D secrete the fluid that surrounds the foetus. (5 x 2) **(10)**

QUESTION 2 (*Questions taken from various sources*)

Give the correct **biological term** for each of the following descriptions. Write only the term next to the question number (2.1 to 2.7) in your ANSWER BOOK.

2.1 The finger-like projections that develop from the outer extra-embryonic membrane

2.2 A structure in the female reproductive system where semen is deposited during copulation

2.3 A hormone that stimulates the mammary glands to produce milk

2.4 The period of development of the foetus in the uterus

2.5 The stage when secondary sexual characteristics develop in males and females

2.6 A hormone that stimulates the development of the corpus luteum

2.7 The inner lining of the uterus where implantation of the embryo occurs

(7)

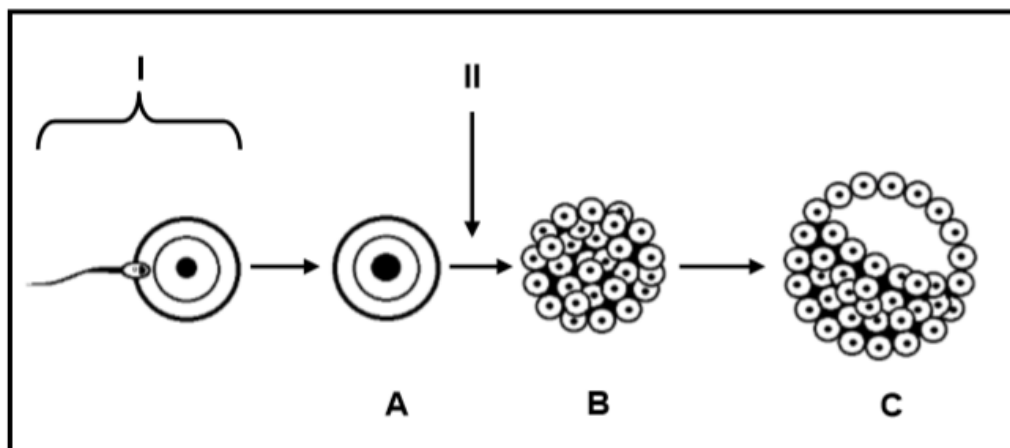
QUESTION 3 (Questions taken from various sources)

Indicate whether each of the statements in COLUMN I applies to **A ONLY**, **B ONLY**, **BOTH A AND B** or **NONE** of the items in COLUMN II. Write **A only**, **B only**, **both A and B**, or **none** next to the question number (3.1 to 3.3) in the ANSWER BOOK.

COLUMN I		COLUMN II	
3.1	The blood vessel that transports oxygenated blood from the placenta to the foetus	A B	Umbilical vein Umbilical artery
3.2	A hormone that stimulates the maturation of sperm	A B	Prolactin Testosterone
3.3	Produces a nutrient rich fluid that provides energy to sperms	A B	Cowper's gland Epididymis

(3x2) 4

QUESTION 4 (DBE, Nov. 2018, Paper 1)

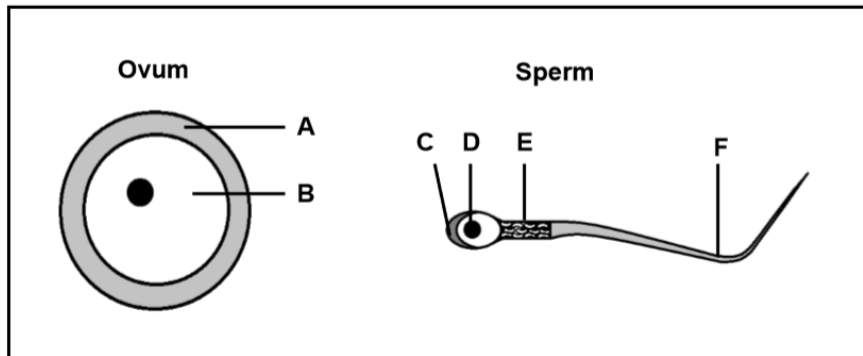


- 4.1 Identify the process taking place at I in the diagram above. (1)
- 4.2 State the type of cell division that takes place at II in the diagram above. (1)
- 4.3 Name TWO functional extra-embryonic membranes that are produced by structure C. (2)

- 4.4 Identify the stage of development indicated by:
- a) A
 - b) B
 - c) C
- (3)

- 4.5 Name the part of the female reproductive system where the events in the diagram above usually take place.
- (1)
(8)

QUESTION 5 (DBE, Nov. 2019, Paper 1)



- 5.1 Identify part:
- (a) A
 - (b) B
 - (c) C
- (3)

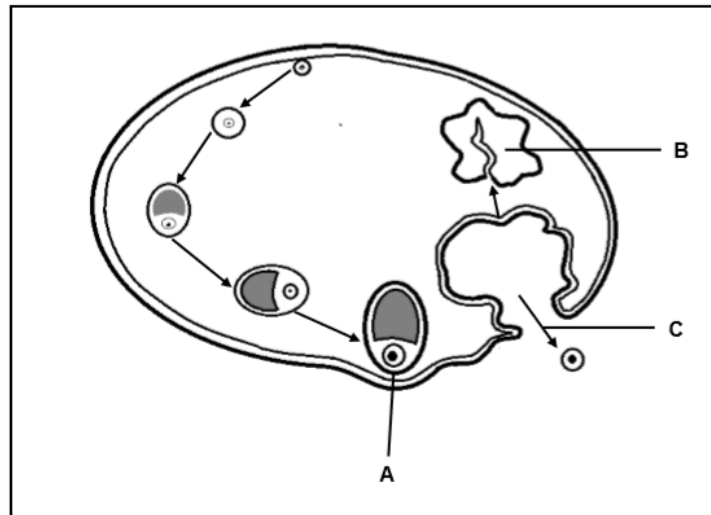
- 5.2 Name the process involving meiosis that leads to the formation of an ovum.
- (1)

- 5.3 Write down only the LETTER of the part of the sperm that enters the ovum.
- (1)

- 5.4 Write down only the LETTERS of TWO parts that enable the sperm to move towards the ovum.
- (2)
(7)

QUESTION 6 (DBE March 2018, Paper 1)

The diagram below represents the sequence of events that takes place during the ovarian cycle of a female



Give the name of the:

- 6.1 (a) Hormone that controls the development of structure A
 (b) Process taking place at C

Describe the change that takes place in the uterus as the result of the hormone secreted by structure A. (2)

6.2

Structure B degenerates if fertilisation does not take place. (2)

Explain the implications of this for the:

6.3

- (a) Ovarian cycle
 (b) Uterine cycle

(3)

(3)

(10)

4.5 SOLUTIONS

HUMAN REPRODUCTION

QUESTION 1

- 1.1 B✓✓
- 1.2 C✓✓
- 1.3 B✓✓
- 1.4 B✓✓
- 1.5 C✓✓

(5 x 2)

(10)

QUESTION 2

- 2.1 Chorionic villi✓
- 2.2 Vagina✓
- 2.3 Prolactin✓
- 2.4 Gestation✓
- 2.5 Puberty✓
- 2.6 LH (lutinising hormone)✓
- 2.7 Endometrium✓

(7)

QUESTION 3

- 3.1 A✓✓
- 3.2 B✓✓
- 3.3 None✓✓

(6)

QUESTION 4

- 4.1 Fertilisation✓ (1)
- 4.2 Mitosis✓ (1)
- 4.3 Chorion✓ (2)
- Amnion✓
- 4.4 a) Zygote✓
b) Morula✓
c) Blastocyst/blastula✓ (3)
- 4.5 Fallopian tube✓ (1)
- (8)**

QUESTION 5

- 5.1 a) Jelly layer✓/zona pellucida
b) Cytoplasm✓
c) Acrosome✓ (3)
- 5.2 Oogenesis✓ (1)
- 5.3 D✓ (1)
- 5.4 E✓ ; F✓ (2)
- (7)**

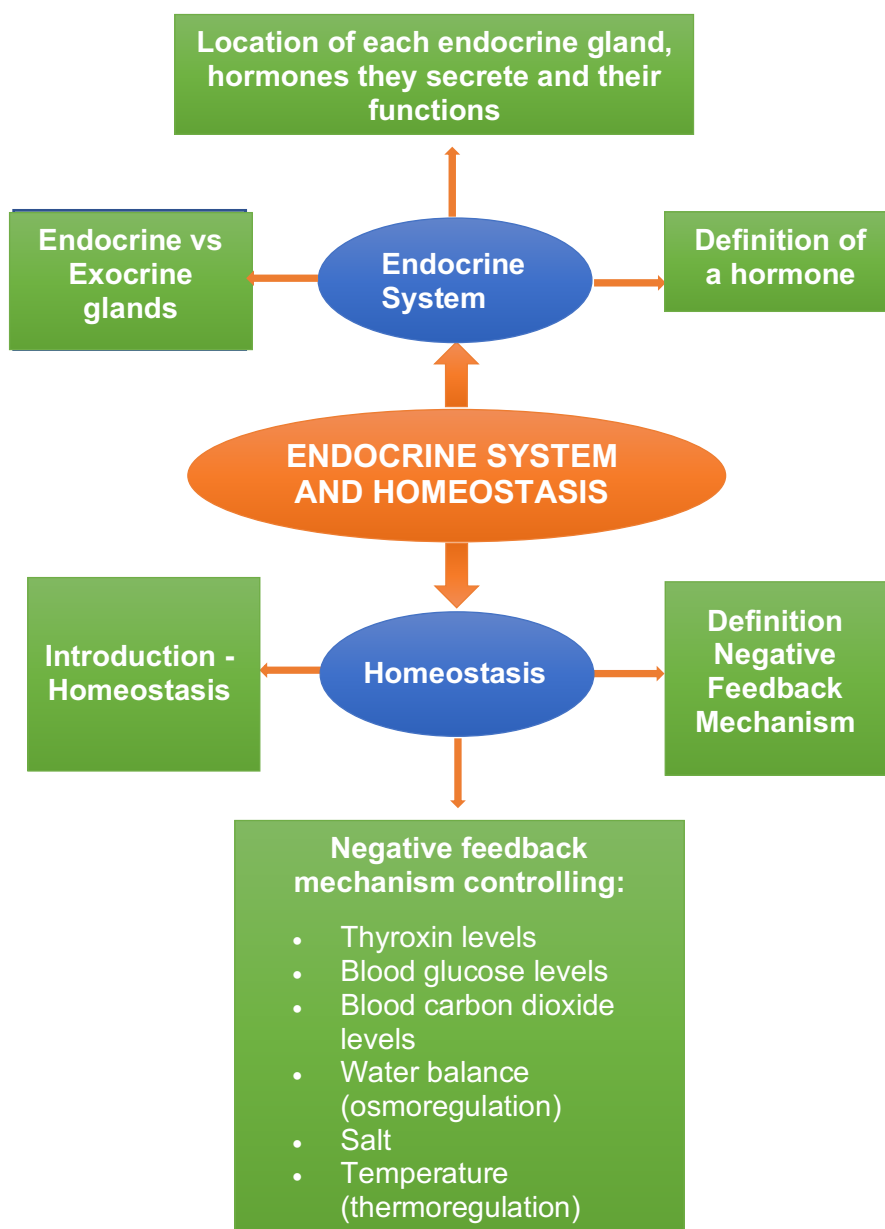
QUESTION 6

- 6.1 a) FSH✓
b) Ovulation✓ (2)
- 6.2 - It causes the endometrium✓
- To become thicker✓ (2)
- 6.3 a) The levels of progesterone drop✓
Therefore, FSH secretion is no longer inhibited✓
A new follicle starts to develop✓ (3)
- c) The levels of progesterone drop✓
Therefore, the endometrium is no longer maintained✓
and menstruation takes place✓ (3)
- (10)**

5. ENDOCRINE SYSTEM AND HOMEOSTASIS

TOPIC: ENDOCRINE SYSTEM AND HOMEOSTASIS			
TERM	2 & 3	PAPER	1
DURATION	8 hours (2½ weeks)	WEIGHTING	34 marks (23%)
LINKS TO PRIOR-KNOWLEDGE/BACKGROUND KNOWLEDGE:			
Grade 11: Animal Nutrition, Homeostatic control in nutrition, gaseous exchange and excretion			
Grade 12: Human Nervous system, Reproductive System			
RESOURCES			
Mind The Gap Study Guide pg. 53-61, DBE Textbook pg. 200-236, Past NSC, SC & Provincial Question Papers (2017-2020)			

5. 1 KEY CONCEPTS/ MINDMAPS



5. 2 TERMINOLOGY

BIOLOGICAL TERM	DESCRIPTION
Coordination	Joint linking and working together of systems and activities within the body to bring about a harmonious response.
Endocrine system	A system responsible for chemical co-ordination and regulation of various activities in the body
Hormones	Organic chemical messengers secreted directly into the blood by an endocrine gland.
Target organs	Organs which respond to specific hormones received through the bloodstream
Homeostasis	It is the process of maintaining a constant internal environment within narrow limits, despite changes that take place internally and externally.
Negative feedback mechanism	When there is an increase from normal, a corrective mechanism causes a decrease and vice versa to maintain a balanced system.
Osmoregulation	Regulation of water balance in the internal environment
Antagonistically	To work in opposite ways; if one hormone causes an increase of a substance, the other hormone will cause a decrease of that substance, e.g. insulin and glucagon thermoregulation the control of the body temperature to keep it as close to 37°C as possible

DIFFERENTIATE BETWEEN RELATED TERMINOLOGIES

ENDOCRINE GLANDS	EXOCRINE GLANDS
Ductless glands secreting hormones directly into bloodstream.	Secrete substances into ducts that lead into cavities in the body or lead directly to the external environment. (Examples: sweat glands, mammary glands, the liver, salivary glands and the pancreas.)

GLUCAGON	INSULIN
A hormone secreted by the pancreas which increases the blood glucose level by converting glycogen to glucose	A hormone secreted by the pancreas which decreases the blood glucose level by converting glucose to glycogen

GLUCAGON	GLYCOGEN
A hormone secreted by the pancreas which increases the blood glucose level by converting glycogen to glucose	A storage form of carbohydrates in animal cells

VASOCONSTRICTION	VASODILATION
The narrowing of the blood vessels in the skin that decreases the amount of blood flowing to the skin in humans when the environmental temperature is low	The widening of the blood vessels in the skin that increases the amount of blood flowing to the skin in humans when the environmental temperature is high

5.3 LINKS TO PRIOR-KNOWLEDGE/BACKGROUND KNOWLEDGE

Grade 11

- In animal nutrition, you learnt the structure and function of the digestive system. One of the accessory organs of the digestive system you studied was the pancreas, which serves as both an *exocrine* and an *endocrine* gland.

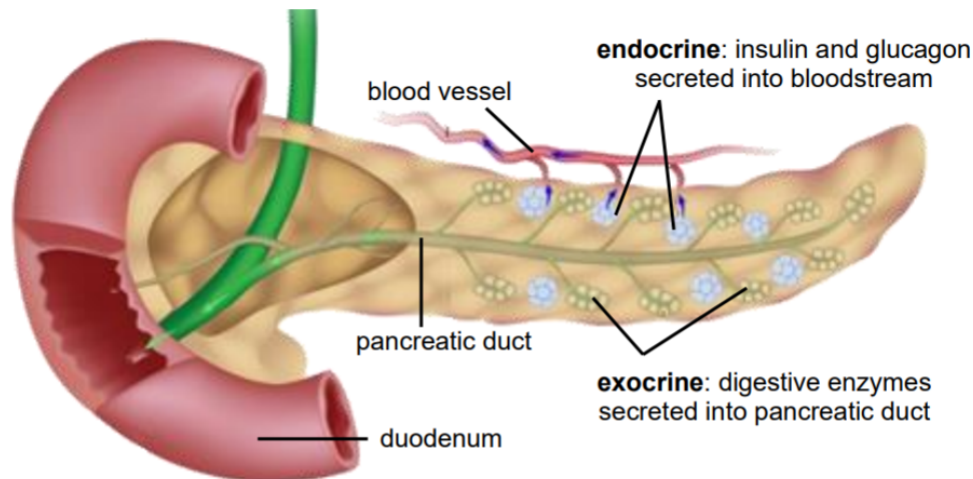


Figure 11: The pancreas showing its function as both an endocrine and exocrine gland

(See Fig 11 pg. 215 DBE Textbook)

- The focus this year is on the function of the pancreas as an endocrine gland, where the Islets of Langerhans secrete the hormones insulin and glucagon to regulate blood glucose levels.
- In gaseous exchange you learnt about exchange of gases oxygen and carbon dioxide, and the homeostatic control of blood carbon dioxide level
- In excretion you learnt about the structure of the kidney and the function of the nephron in urine production. You also learnt about the role of the hormone ADH in regulating water balance (osmoregulation) in the body.

Grade 12

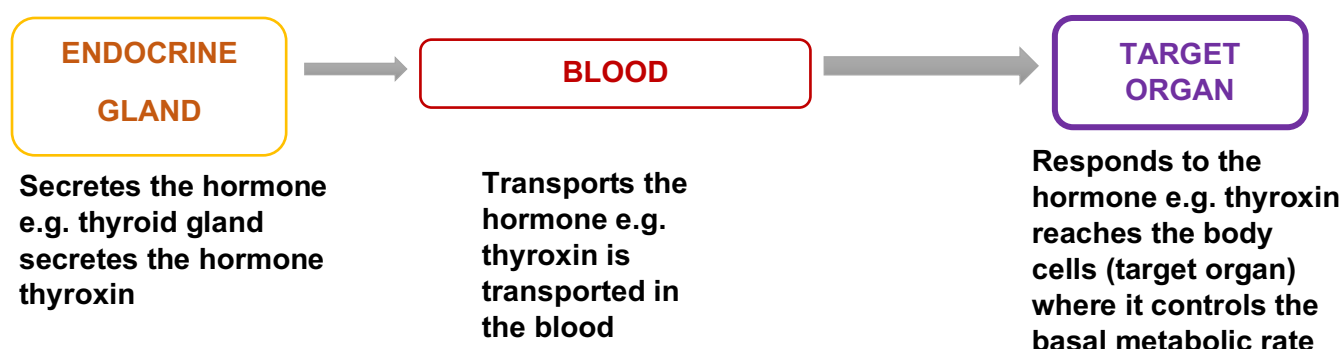
- In nervous system, you learnt about the role of the hypothalamus:
 - As the part of the brain which serves as a control centre for hunger, thirst, sleep, temperature, emotions. The focus for this chapter is on the involvement of the hypothalamus in the control of body temperature (thermoregulation)
 - As the part of the brain that secretes the hormone ADH that is involved in osmoregulation
- In human reproduction you learnt about the negative feedback of the hormones **FSH** and **progesterone**. When the levels of **progesterone increases** (as it is secreted by the corpus luteum) it will **inhibit** the secretion of **FSH** by the pituitary gland, which will in turn **inhibit** the development of another **follicle** in the ovary.

5.4 EXAMINATION TECHNIQUES AND TIPS

5.4.1 ENDOCRINE SYSTEM

The endocrine system (Mind the Gap pg. 53; DBE Textbook pg. 200)

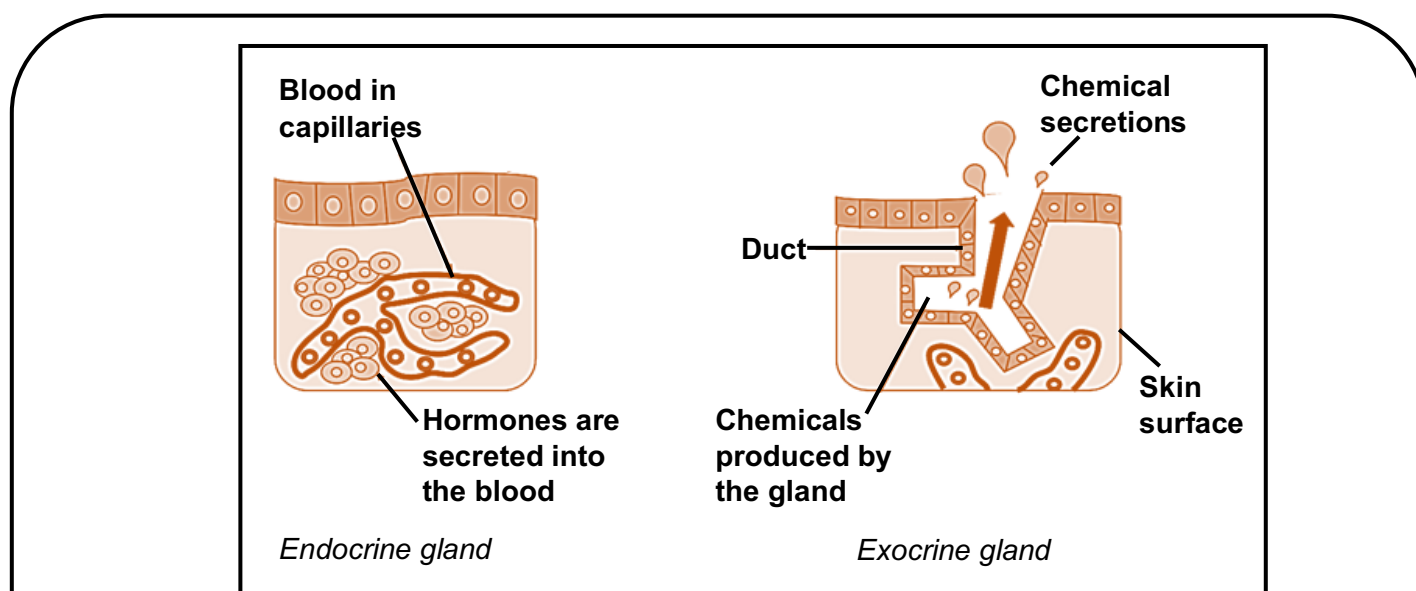
The endocrine system works in conjunction with the nervous system. The endocrine system is responsible for **chemical coordination**, regulating the functioning of all the organs in the body.



Relationship between the components of the Endocrine System

Can you think of how you can apply this diagram to other endocrine glands e.g. pancreas, adrenal glands etc.?

Differences between endocrine and exocrine glands



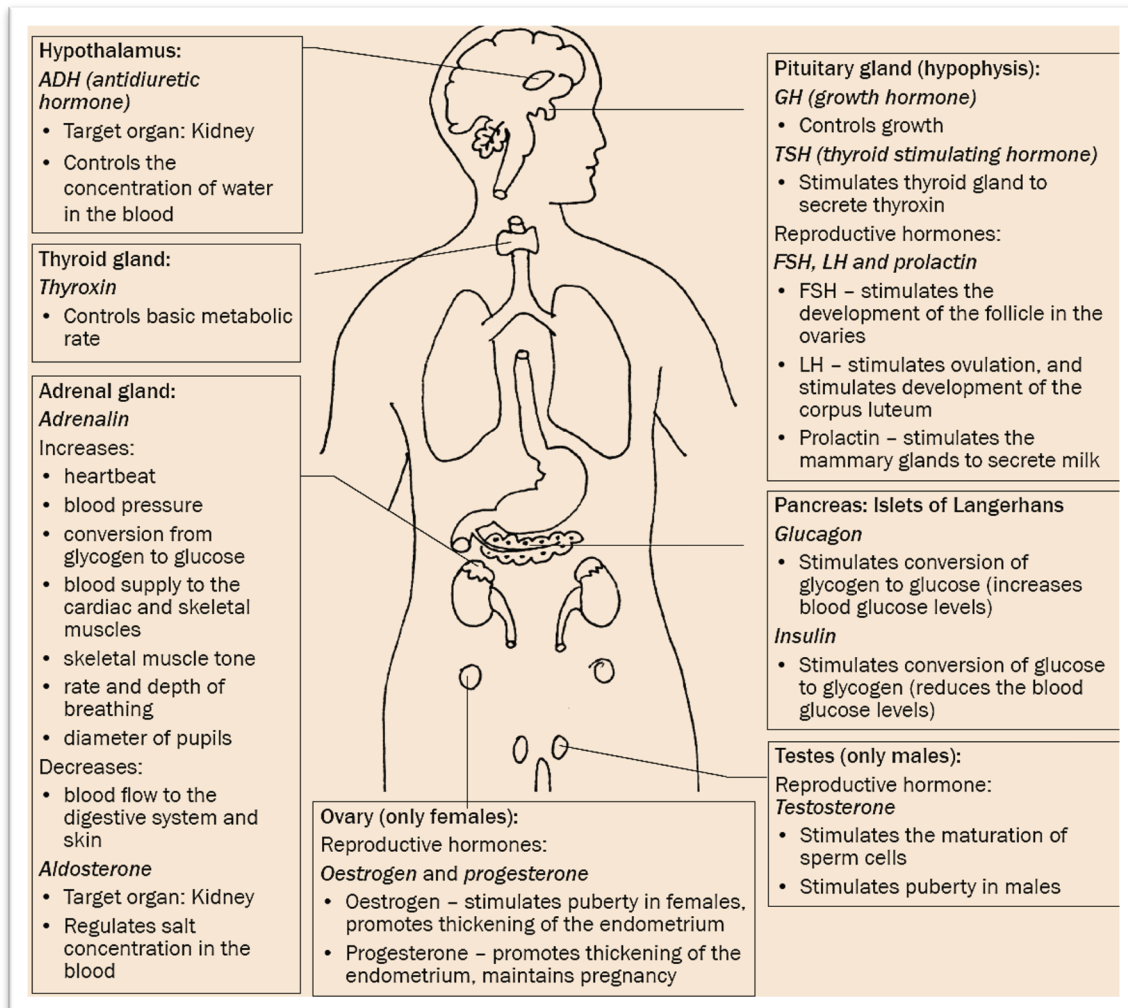
Differences between nervous system and endocrine system

ENDOCRINE SYSTEM	NERVOUS SYSTEM
<ol style="list-style-type: none">1. Made up of glands2. Produces hormones3. Hormones are transported by the blood4. Effects are slower and more general5. Hormones control long-term changes (e.g. growth)	<ol style="list-style-type: none">1. Made up of nerves2. Produces nerve impulses3. Impulses are transmitted along the nerves4. Effects are very quick and very specific5. Nerve impulses control short-term changes (e.g. sneezing, lifting your arm)

You must know each of the following hormones, the gland where each is secreted and what its function is:

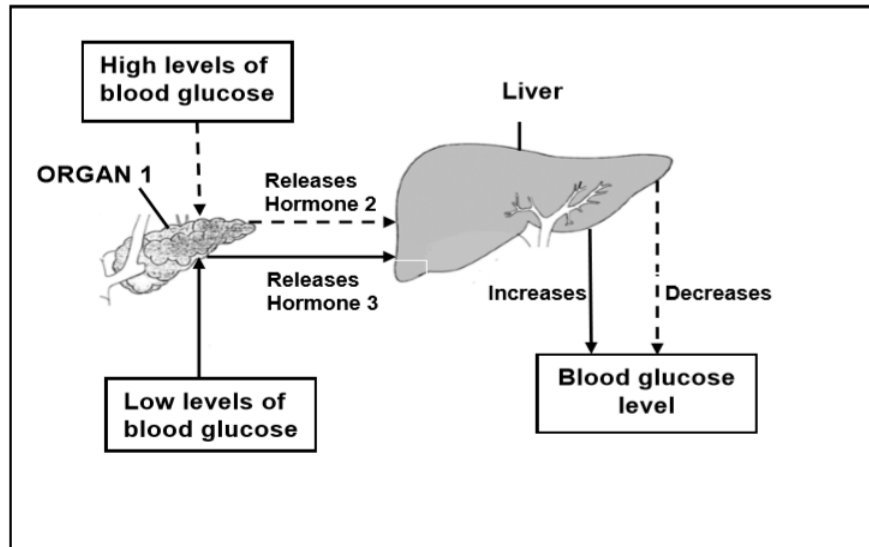
- | | |
|-------------------|------------------|
| 1. ADH | 10. Prolactin |
| 2. Thyroxin | 11. LH |
| 3. Adrenalin | 12. Glucagon |
| 4. Aldosterone | 13. Insulin |
| 5. Growth hormone | 14. Testosterone |
| 6. TSH | 13. Oestrogen |
| 7. FSH | 14. Progesterone |

Diagrammatic representation of all the endocrine glands in the human body. Know this diagram well:



PRACTICE QUESTIONS

1 Study the flow diagram below



Identify:

1.1 **Organ 1**

Organ 1 releases hormone 2 and 3 which control blood glucose levels

Pancreas✓

1.2 **Hormone 2**

Hormone 2 decreases blood glucose level

Insulin✓

NOTE: correct spelling is essential. Glucagon is often confused with glycogen

1.3 **Hormone 3**

Hormone 3 increases blood glucose level

Glucagon✓

1.4 **The disorder caused when organ 1 fails to release sufficient amounts of hormone 2**

Diabetes Mellitus✓

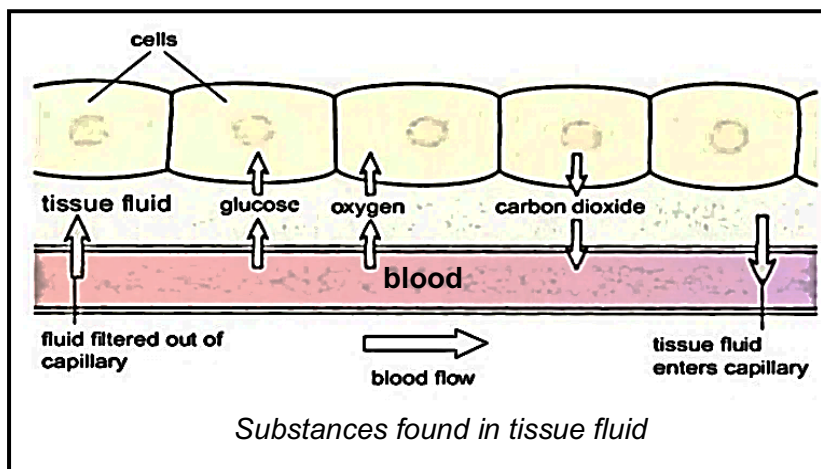
1.5 **The mechanism that controls the levels of glucose in the body**

Negative feedback mechanism✓

5.4.2 HOMEOSTASIS

WHAT IS HOMEOSTASIS?

- Homeostasis is the process of maintaining a constant, internal environment within narrow limits, despite changes that take place internally and externally so that the cells can function properly.
- The internal environment refers to the tissue fluid that surrounds the cells of the body.



- To allow cells to work properly the composition of tissue fluid must stay the same i.e. remain constant

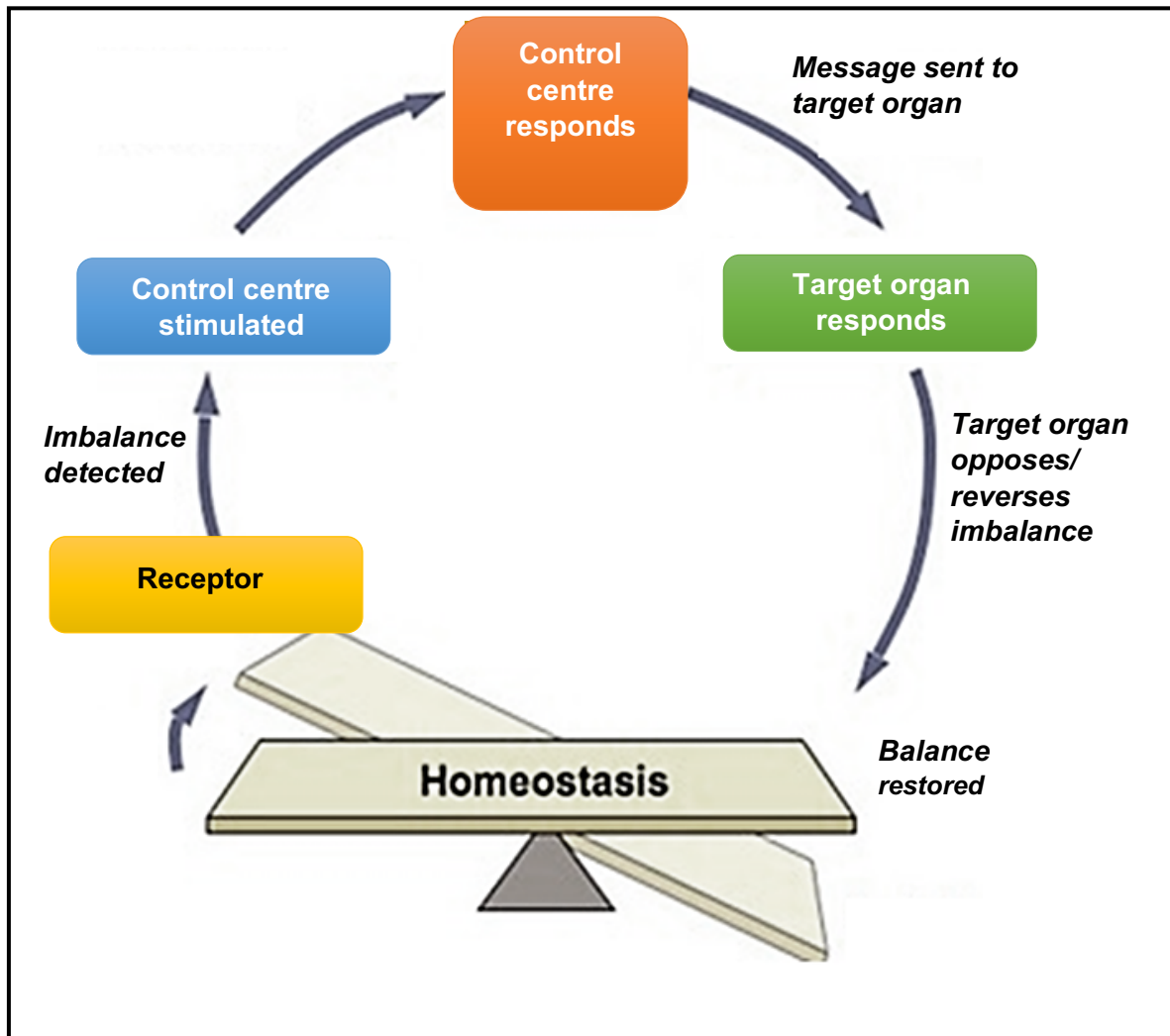
Some of the factors that must be kept constant are:

- Glucose levels
- Carbon dioxide levels
- Water concentration
- Temperature

How is the Internal Environment kept constant?

- By **NEGATIVE FEEDBACK MECHANISMS**
- Negative feedback mechanisms operate in the human body to detect changes or imbalances in the internal environment and to restore the balance.

General sequence of events in a negative feedback mechanism:



Examples of Negative Feedback Mechanisms that are prescribed in the CAPS Document and Examination guidelines: See Mind The Gap pg. 56 -59, DBE Textbook pg. 209-219.

We will use the Regulation of the water balance in the internal environment (Osmoregulation) as an example

Remember that **osmoregulation** refers to **maintaining a water balance**.

In the **human body osmoregulation** is brought about using the **nephron of the kidney**.

1. Regulation of Water Balance in the Blood

GENERAL NEGATIVE FEEDBACK MECHANISM		NEGATIVE FEEDBACK MECHANISM REGULATING LOW LEVELS OF WATER IN THE BLOOD
Step 1	An imbalance is detected	Blood has less water than normal
Step 2	A control centre is stimulated	Osmoreceptors in the hypothalamus are stimulated
Step 3	Control centre responds	The impulses from the hypothalamus are sent to the pituitary gland which secretes more ADH
Step 4	Message sent to target organ/s	ADH travels in the blood to the kidneys
Step 5	The target organ responds	ADH increases the permeability of the collecting ducts and the distal convoluted tubules of the kidneys
Step 6	It opposes/ reverses the imbalance	More water is reabsorbed and passed to the surrounding blood vessels
Step 7	Balance is restored	The water level in the blood returns to normal

TIP: When asked to describe the regulation of water balance when the water level in the blood is high, Steps 1, 3, 5 & 6 will be opposite to what is written in the table above

For all the other examples of negative feedback follow the steps illustrated in the table above and apply them to the given example.

Endocrine System Disorders – Refer to DBE Textbook pg. 219 -223

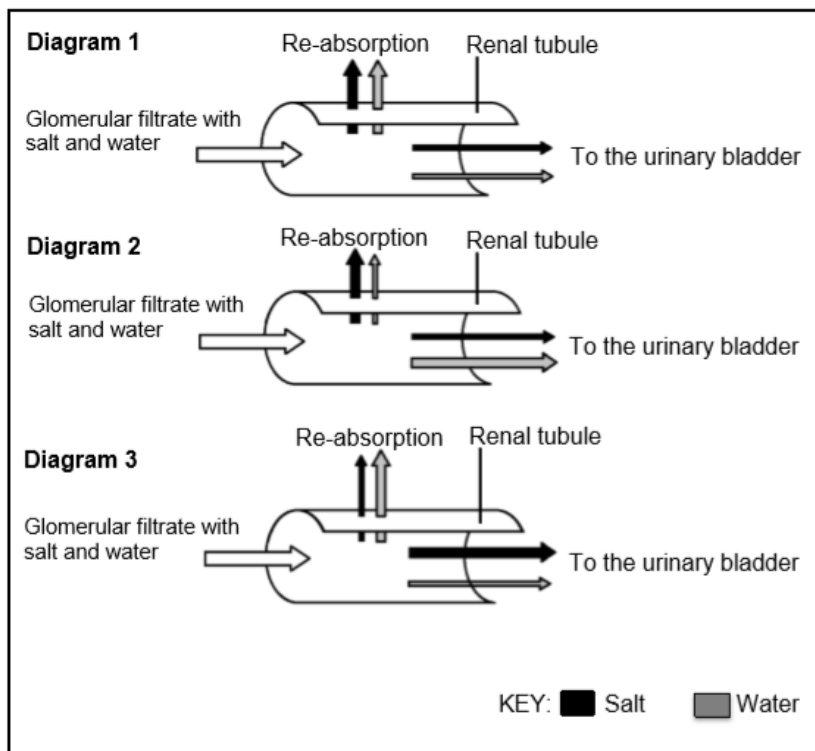
PRACTICE QUESTIONS

2 QUESTION 3.1 (DBE, Nov. 2019, Paper 1)

The diagrams below show the re-absorption of salt and water through the tubules of a nephron in the kidney under three different conditions. The width of the arrows represents the amounts of salt and water.

TIP: Read the opening statement carefully. This question requires some prior knowledge of the function of the nephron studied in Grade 11. Re-absorption is a process that occurs in the kidney tubule which removes the useful substances e.g. glucose, amino acids, salts, water etc. from the filtrate and the substances enter the bloodstream so that they are not lost in urine.

In this question you need to understand the significance of the different widths of arrows representing the amounts of salt and water reabsorbed into the blood to be reused in the body and amounts that enter urinary bladder to be excreted in urine as illustrated in the diagram below.



TIP: Analyse the Key

- Black arrows indicate salt
- Grey arrows indicate water
- Width/ thickness of the arrow indicates the amount of salt or water. Therefore, the wider the arrow the more salt or water is reabsorbed or excreted in urine

2.1 **Name the hormone in a human body that is responsible for controlling the:**

(a) **Water content**

ADH✓

Common Error: Some candidates gave the answer as 'adrenalin' instead of 'aldosterone'.

(1)

(b) **Salt content**

Aldosterone✓

(1)

2.2 **Name the gland that secretes the hormone in QUESTION 2.1(b).**

(1)

Adrenal✓ gland

2.3 **Which diagram (1, 2 or 3) would represent a person who had eaten salty chips on a hot day without any intake of water?**

(1)

First analyse the scenario given:

Salty chips mean there is too much salt in the blood, meaning less reabsorption of salt into the blood and more salt enters the urinary bladder to be excreted in urine.

Now look at the width of the black arrows in diagrams 1,2 &3. Choose the diagram that has a black arrow with the narrowest width pointing to reabsorption and the widest black arrow pointing to the urinary bladder.

3✓

2.4 **Explain your answer to QUESTION 2.3**

*The action verb used here is 'Explain' meaning that the answer must be expressed in **cause-effect** or **statement and reason** sequence*

- The **blood** will have a high salt content✓ - Cause
- and therefore less/no aldosterone will be secreted✓ - Effect
- resulting in less salt reabsorbed into the blood✓/more salt excreted in the urine - Effect

- The blood will have less water than normal✓ - Cause
- and therefore more ADH will be secreted✓ - Effect
- making the kidney tubules more permeable✓ - Effect
- resulting in more water reabsorbed into the blood✓/less water will Leave the body with the urine - Effect

Any

(5)

(9)

- Examiners like to ask scientific investigative questions in this topic. Make sure that you know the following key concepts:
 - **Independent variable**
Refers to the factor that is being investigated. This factor is usually manipulated by the investigator either at the start of or during the course of the investigation. The independent variable appears on the X-axis of a graph.
 - **Dependent variable**
Refers to the effect of the independent variable. This effect is usually measured in some way and appears on the Y-axis of a graph.
 - **Reliability and Validity**
 - What is reliability?**
The idea behind reliability is that any significant results of an investigation must be more than a once-off finding and be repeatable. Reliability is increased by certain factors in the experimental design that ensure that the same results will be generated by other investigators that perform the same investigation under the same set of conditions.
For questions that require learners to state how the reliability of an investigation could have been improved, the following answers may apply depending on the nature of the investigation:
 1. Repeat the investigation
 2. Take many readings and use the average
 3. Randomly select a sample
 4. Increase the sample size
 5. Increase the period of the investigation
 - **What is Validity?**
Validity questions **how** the experiment/investigation was carried out. Have all the factors/variables been controlled/fixed except the variable/factor being tested? Is the design for the investigation appropriate? The way to achieve the above is to ensure that **all the factors** in the investigation have **been kept constant except the factor being tested**.
If the question asks how the investigators *ensured* reliability or validity, this requires looking back on what was *already done*. Answers should therefore be obtained from information provided in the description of the experimental design in the question paper.
If the question asks how the investigators *should ensure* reliability or validity, this requires making suggestions on what can be done *in future* which was not done by the investigators already.

QUESTION 3. 2 (DBE, Nov. 2019 Paper 1)

3

Read the extract below.

People with Type I diabetes mellitus are usually insulin-dependent (must inject themselves with insulin to control their blood glucose levels). It has been determined that these people also lose their ability to secrete glucagon within five years of being diagnosed and they become glucagon deficient.

During a stressful situation adrenalin is secreted, which has the same effect as glucagon on the blood glucose levels.

AIM: Always starts with 'To'...

An investigation was conducted to determine the influence of adrenalin on the blood glucose levels of Type I diabetics who were also glucagon deficient.

The investigation was conducted as follows:

- 100 male patients with Type I diabetes mellitus, who were also glucagon deficient, participated in the investigation.
- They were then given the same amount of food and water at the same time for a period of three days.
- Their blood glucose levels were measured on the morning of the third day.
- A solution with a low concentration of adrenalin was then administered intravenously (injected).
- After 20 minutes, the blood glucose concentration in each person was measured again.
- The blood glucose levels before and after administering adrenalin were compared.

TIP: As you read through the investigation try to identify the different aspects of a scientific investigation such as the aim, dependent and independent variables, controlled variables i.e. factors that were kept the same. Think about planning steps that may have been followed before designing and conducting the experiment. Underline these as you read through.

- *In this question the AIM of the investigation is underlined in the first two lines. Remember the aim always starts with 'To...'*
- *From the aim TWO variables can be deduced:
Independent Variable (the manipulated variable) – Adrenalin
Dependent variable (reacts to the effect of the independent variable) – Blood glucose*
- *The number of male patients used indicates the sample size. If the sample size is large, it improves reliability of the investigation as you have more data to work with*

- *All the patients were male with Type 1 diabetes and glucagon deficient – this improves validity as the variables were controlled (kept constant/ the same) i.e. gender of the patients, suffered from the same condition*
- *Other controlled variables – same: amount of food, amount of water, time, period of investigation*
- *Blood glucose levels were measured before patients were given adrenalin (independent variable). Therefore this serves as the **control part** of the investigation. Remember a control is set up like the experiment but the independent variable is excluded. It is used for comparison to determine that it is only the independent variable that is responsible for the results of the experiment. This also helps to improve validity of the investigation*
- *Blood glucose measured after adrenalin was given constitutes the **experiment part** of the investigation*

Once you have all this background it becomes easier to answer the questions.

3.1 **Name the gland that secretes glucagon.** (1)

Pancreas✓

3.2 **Identify the independent variable in the investigation.** (1)

Adrenalin

3.3 **State THREE other factors that should have been kept constant during the investigation.** (3)

Same:

- Type of food given
- Concentration of adrenalin
- Amount of adrenalin
- Measuring tools used
- Person measuring the glucose concentrations
- Levels of activity
- Age of patients
- Body mass of patients
- Health condition of patients

ERROR/MISCONCEPTIONS
 candidates could not differentiate between the factors that were kept constant as opposed to the factors that should have been kept constant during the investigation

Any

(Mark first THREE only)



This means only the 1st THREE answers given will be marked as the questions stipulates that you must state THREE factors. If you give more than 3 answers and one of your top three answers is incorrect, you will not be awarded a mark for the 4th answer

3.4 **Explain why the blood glucose levels were measured before injecting adrenalin on the third day.** (2)

Remember the action verb 'explain' requires a cause-effect or statement-reason answer

- Provides a baseline✓/starting level/point of reference/control - Statement
- to compare with the effect of injecting adrenalin✓ - Reason

3.5 **Explain why the adrenalin was injected instead of given orally.** (3)

This is a higher-order application question which requires learners to apply what they have learnt to a new situation. In this case you must think about what type of molecule is adrenalin or how it is transported to reach the target organ to make a deduction as to why it is better to give it as an injection rather than orally.

- Hormones are proteins✓ - Statement
- and will therefore be digested✓/denatured making it ineffective - Reason

OR

- Since it enters the blood directly✓ - Statement
- it will reach the target organs faster✓ - Reason

3.6 **Explain what would the expected results be after adrenalin was injected into the patients.** (2)

Think about the function of adrenalin in relation to blood glucose control which is that of promoting conversion of glycogen to glucose

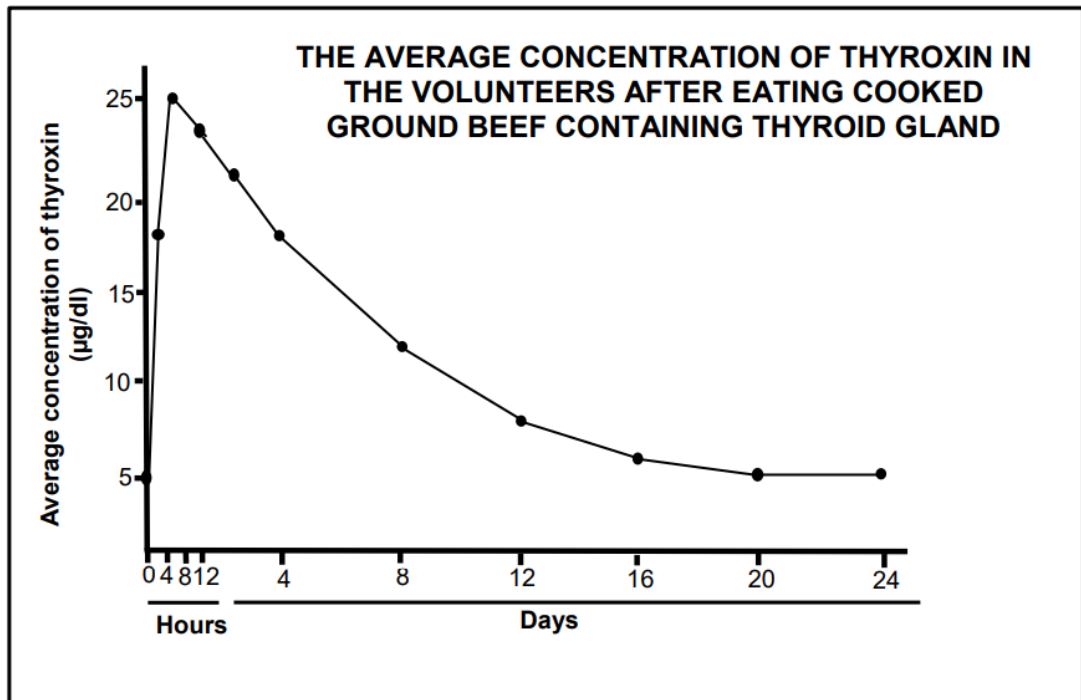
- The blood glucose levels will increase✓ - Statement
- because an increase in adrenalin stimulates the conversion of glycogen to glucose✓ - Reason

3.7 Give a reason for the use of 100 patients in the investigation instead of only 10 patients.
100 is a large sample size compared to 10 (1)

Increases reliability✓ of the results

QUESTION 2.3 (DBE, NOV 2020, Paper 1)

4



Read the extract below.

AN OUTBREAK OF THYROTOXICOSIS

Thyrotoxicosis is a medical condition caused by high levels of thyroxin in the blood. There was a sudden increase in the number of reported cases of this condition in one city. They suspected that this was due to people eating ground beef (minced meat) from a local butcher. The butcher added the thyroid glands of cattle when he produced the ground beef. Some people who ate this ground beef showed symptoms of increased heart rate, excessive sweating and weight loss.

Doctors conducted an investigation to determine if the ground beef caused the thyrotoxicosis. The normal thyroxin levels of 5 volunteers were measured. They were then given cooked ground beef from the butchery to eat. Their thyroxin concentration was measured every **4 hours on day 1** and then **once a day for the next 23 days**. The average thyroxin levels was calculated and recorded.

The results are shown in the graph below.

- 4.1 **Give the average normal thyroxin concentration ($\mu\text{g/dl}$) in the blood of the volunteers.**
This question requires you to read off the graph. The average normal thyroxin will be the reading at time 0 before the volunteers were given the beef. (1)

5 \checkmark $\mu\text{g/dl}$

- 4.2 **Calculate the percentage increase of the average thyroxin concentration in the first 8 hours after eating the ground beef. Show ALL working.** (1)

Here you are required to calculate the percentage increase. Sometimes you can be asked to calculate the percentage decrease. The formula you must use is given below

$$\% \text{ increase or decrease} = \frac{\text{difference between the two values}}{\text{Initial value}} \times 100$$

NOTE: Make sure that you start with the bigger value and subtract the smaller value even when calculating percentage decrease to avoid getting a negative answer.

$$\frac{25-5}{5} \} \checkmark \times 100 \checkmark$$

$$= 400 \checkmark \%$$

OR

$$\frac{24-5}{5} \} \checkmark \times 100 \checkmark$$

$$= 380 \checkmark \%$$

Accept a range between:

- 24 and 25 for the first value
- 380% and 400% for the answer

ERROR/MISCONCEPTIONS
 The candidates lacked the skill to interpret the graph and do the calculation.

- 4.3 **Explain why thyrotoxicosis causes weight loss.**
This is a higher order question which required application of knowledge to a new situation. Here you must make the link that a high thyroxin concentration will increase the metabolic rate by using more glucose during cell respiration. Therefore, less glucose will be stored, and fat will also be broken down to supply glucose, leading to weight loss.

- Thyrotoxicosis increase the metabolic rate \checkmark / rate of cellular respiration
- More glucose is used \checkmark
- Less glucose is stored \checkmark
- Fat is broken down \checkmark causing weight loss

Any

(3)

4.4 **Explain the expected concentration of TSH in the blood 8 hours after eating the ground beef.** (4)

Read off the average concentration of thyroxin 8 hours after eating ground beef. This will help you to determine if level of thyroxin is high or low and then use negative feedback mechanism to explain your answer. As can be seen from the graph the level of thyroxin 8 hours after eating beef is high. So start explaining the effect of high thyroxin concentration in the blood.

- The high levels of thyroxin✓in the blood
- causes the pituitary gland✓/hypophysis
- to secrete less TSH✓into blood
- causing the level of TSH to decrease✓

QUESTION 3.3 (DBE, NOV 2014, Paper 1)

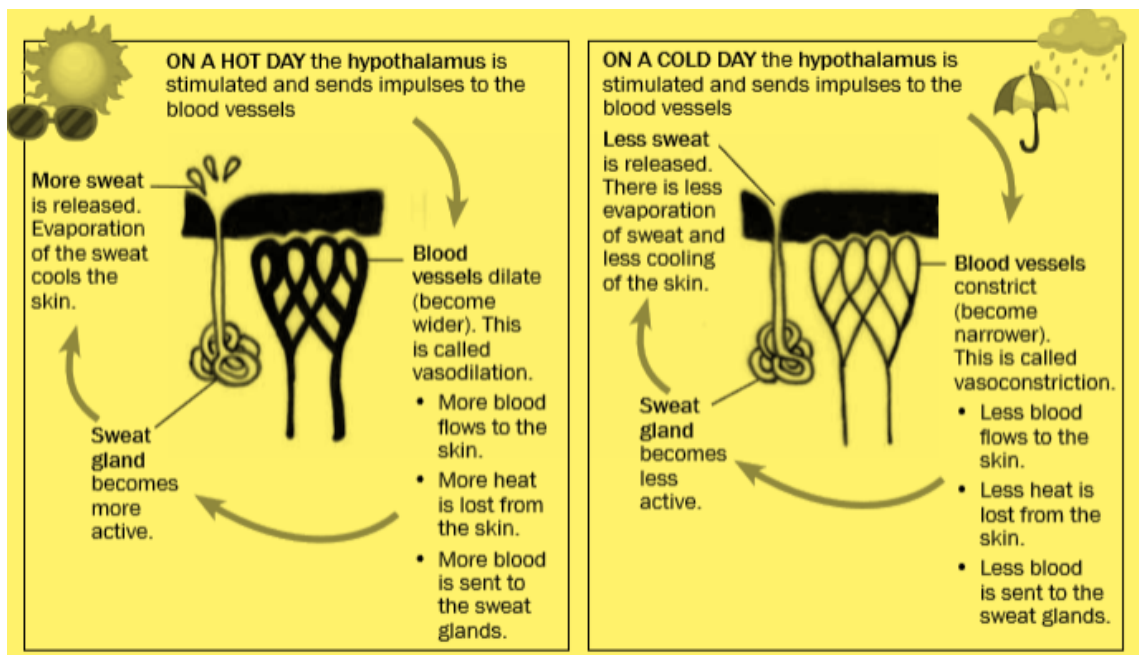
5 The table below shows how body temperature is regulated by the hypothalamus by influencing heat production and heat loss.

BODY TEMPERATURE (°C)	HEAT PRODUCTION (JOULES PER SECOND)	HEAT LOSS (JOULES PER SECOND)
36,4	320	5
36,6	260	5
36,8	150	35
36,9	90	90
37,0	90	100
37,2	90	180
37,4	90	310

[Adapted from Cambridge Biology, 2002]

5.1 **Are the blood vessels that supply blood to the skin constricted or dilated when the body temperature is 36,4 °C?** (1)

Be reminded of thermoregulation and how temperature is controlled in hot or cold conditions. The following diagram from Mind The Gap will assist you in remembering the sequence of events during thermoregulation



Now look at the table. 36.4°C is lower than the normal body temperature, therefore we will look at thermoregulation under cold conditions. From the table you can see that at 36.4°C heat production is the greatest (320 joules per second) and less heat is lost to the environment (5°C). This is an indication of what happens under cold conditions. Therefore under cold conditions the blood vessels will be...

Constricted✓

5.2 **Explain the advantage of the diameter of the blood vessels (constricted/dilated) mentioned in your answer to QUESTION 5.1.1.**


Cause-effect or statement-reason answer is required

- Less blood flows✓ to the skin
- so less heat is lost to the environment✓ by radiation
- Less sweat is formed✓ because less blood flows to the sweat glands
- therefore less evaporation✓ of sweat
- and hence less cooling✓ of the skin
- Body heat is conserved✓

Any

(4)

5.3 **Heat loss is the greatest at 37,4 °C. Explain how the body is able to increase heat loss 37,4°C is a high temperature. Think about thermoregulation under hot conditions. For increased heat loss the blood vessels must be dilated. Think about the significance of the blood vessels being dilated and formulate your answer as suggested below**



Avoid using
'message sent to'
Use nerve impulses

- Hypothalamus is stimulated✓
- sends **nerve impulses** to the blood vessels of the skin to dilate✓/
vasodilation occurs
- More blood flows✓ to the surface of the skin
- More heat is lost by radiation✓ from the skin surface
- More sweat is formed✓ because more blood flows to the sweat glands
- and therefore more heat is lost by increased evaporation✓ of sweat

Any

(4)

(9)

5.5 TYPICAL EXAM QUESTIONS

QUESTION 1 (*Questions taken from various sources*)

1. Various options are provided as possible answers to the following questions. Choose the correct answer and write only the letter (A to D) next to the question number (1.1 to 1.3) in the ANSWER BOOK, for example 1.4 D.

1.1 Which ONE of the following hormones controls metabolic rate?

- A Testosterone
- B Thyroxin
- C Growth hormone
- D Insulin

1.2 A person experiences the following symptoms:

- Loses weight easily
- Is always hungry
- Never feels cold

The most likely explanation for this combination of symptoms is that the person ...

- A secretes too much growth hormone
- B has an overactive thyroid gland.
- C is diabetic and just had an insulin injection.
- D has an underactive hypothalamus.

1.3 Which of the following are functions of adrenalin?

- A Influences the pupil size and controls the amount of water lost by the body through the kidneys
 - B Increases the blood sugar level and blood pressure
 - C Decreases metabolic rate and blood sugar level
 - D Affects growth and increases muscle tone
- (3 x 2) (6)

QUESTION 2 (*Questions taken from various sources*)

2 Give the correct **biological term** for each of the following descriptions. Write only the term next to the question number (2.1 to 2.7) in the ANSWER BOOK.

2.1 The system in the body that regulates processes by secreting hormones directly into the blood

2.2 The hormone that is secreted in a person's body in response to a dangerous situation

2.3 The gland that secretes the hormone that is responsible for male puberty

2.4 The substance that glucose is converted to when blood glucose levels are too high

The gland that secretes insulin

2.5

A hormone which regulates the salt balance in the human body

2.6

A hormone that stimulates the maturation of sperm

(7)

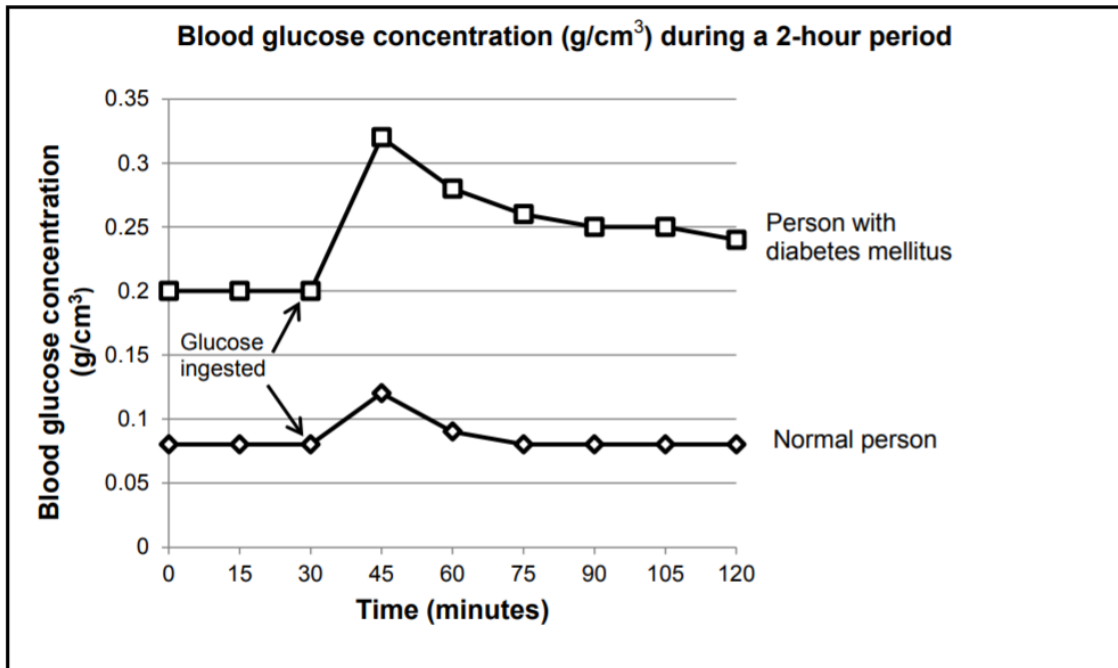
3

Indicate whether each of the statements in COLUMN I apply to **A ONLY**, **B ONLY**, **BOTH A AND B** or **NONE** of the items in COLUMN II. Write **A only**, **B only**, **both A and B**, or **nonnext** to the question number (3.1 to 3.7) in the ANSWER BOOK.

COLUMN I		COLUMN II	
3.1	Hormones secreted by the pituitary gland	A:	Prolactin
		B:	Growth hormone
3.2	Hormones secreted by hypothalamus	A:	Adrenalin
		B:	Aldosterone
3.3	Hormones secreted by the ovaries	A:	FSH
		B:	Progesterone
3.4	TSH levels increase	A:	More thyroxin is secreted
		B:	Less thyroxin is secreted
3.5	The state of the blood vessels in the skin of a human when the environmental temperature is high	A:	Constricted
		B:	Dilated
3.6	The gland that secretes the hormone responsible for salt regulation in blood	A:	Pituitary gland
		B:	Thyroid gland
3.7	More aldosterone secreted	A:	Less sodium absorbed
		B:	More sodium absorbed

(7x2) = 14

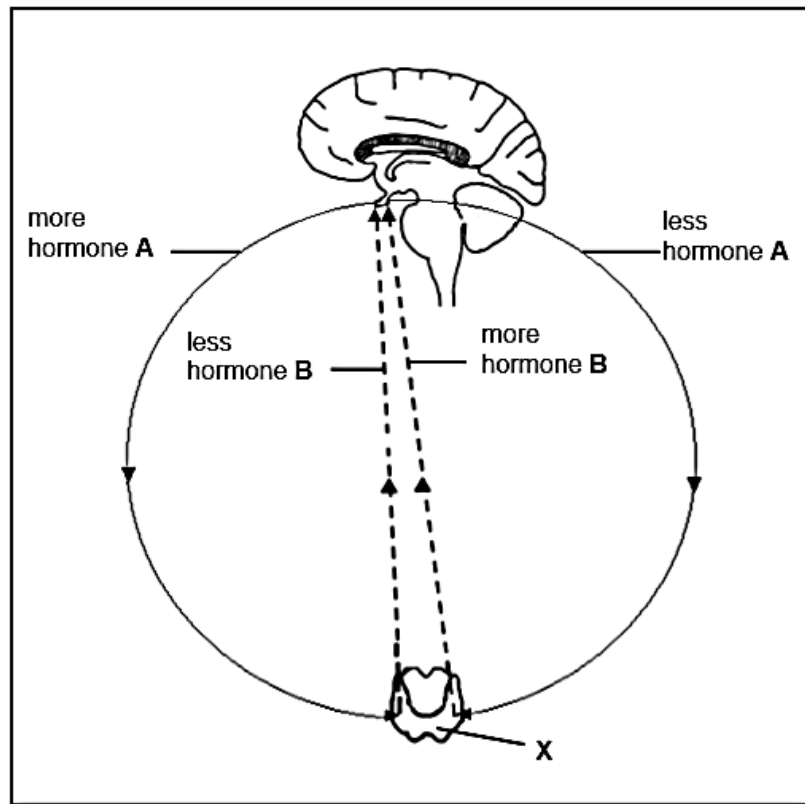
- 4 The graph below shows the blood glucose concentration in a normal person and in a person with diabetes mellitus. Both persons ingested 100 ml of glucose solution at 30 minutes.



[Adapted from *Cambridge Biology 2*, 2001]

- 4.1 What is the blood glucose concentration (g/cm^3) of the person with diabetes mellitus at 90 minutes? (1)
- 4.2 How many minutes after the ingestion of glucose did the glucose concentration reach its highest level in the normal person?
- 4.3 Describe TWO differences in the pattern of the blood glucose concentration for the person with diabetes mellitus and a normal person. (4)
- 4.4 Explain the reason for the differences mentioned in QUESTION 4.3. (2)
- 4.5 Name a hormone that has the opposite effect to that of insulin. (1)
- (9)**

- 5 The diagram below shows the hormones involved in the homeostatic control of metabolism in the human body. X is a gland found around the larynx in the neck.



- 5.1 Identify EACH of the following:
- (a) The gland that secretes hormone **A** (1)
- (b) Hormone **B** (1)
- 5.2 Name the mechanism in the diagram that regulates the level of hormone **B**. (1)
- 5.3 Half of gland X was surgically removed in a person.
- State TWO possible effects that this would have on the secretion of the hormones referred to in the diagram above. (2)
- (5)

6 An investigation was conducted to compare the glucose concentration in the blood of two people, Mo and Thabiso, before and after ingesting glucose.

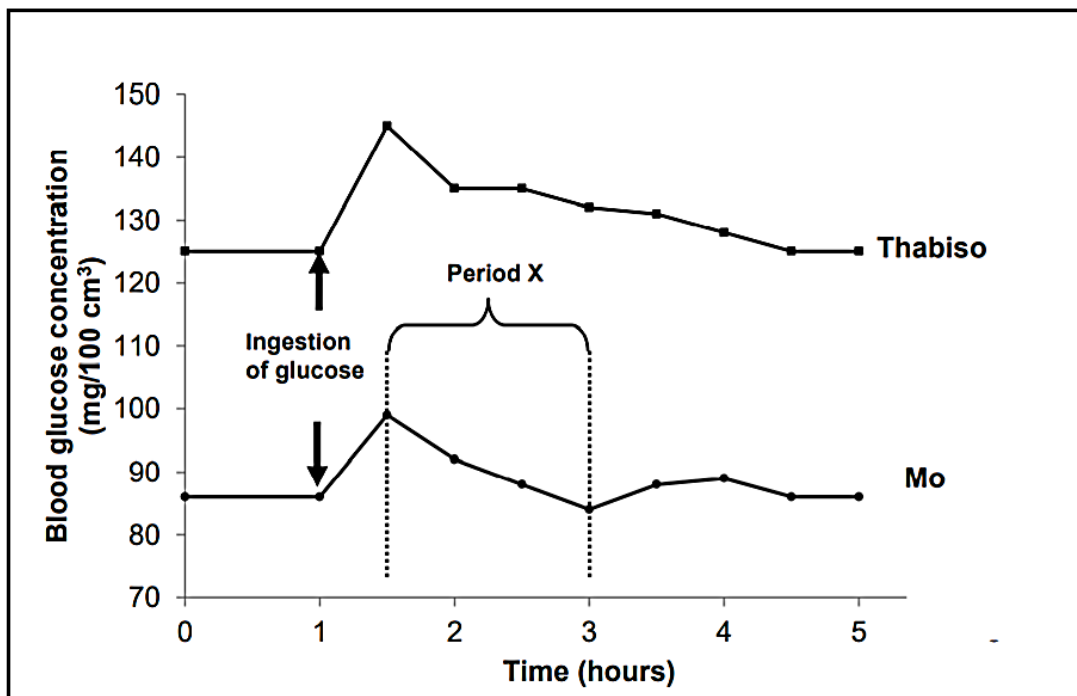
The following procedure was followed:

- The glucose concentration in their blood was measured at the start of the investigation and again 1 hour into the investigation.
- One hour into the investigation each of them was given 50 ml of a glucose solution to drink.
- For the next 4 hours after ingesting the glucose solution the glucose concentration in their blood was measured every 30 minutes.

The results are shown in the graph below.

The **arrows** indicate when they drank the glucose solution.

NOTE: The normal glucose concentration in blood is between 80 and 120 mg/100 cm³.



- 6.1 Provide a suitable title for this graph. (2)
- 6.2 By how much did Thabiso's blood glucose concentration level increase (in mg/100 cm³) after drinking the glucose solution? Show ALL working. (2)
- 6.3 How long did it take Mo's blood glucose concentration level to return to its original level after ingesting the glucose solution? (1)
- 6.4 (a) Who (Thabiso or Mo) has diabetes mellitus? (1)
- (b) Give ONE observable reason for your answer to QUESTION 6.4 (a) (1)
- 6.5 Explain the changes in Mo's glucose level during period X. (4)
- (11)**

5.6 SOLUTIONS

ENDOCRINE SYSTEM AND HOMEOSTASIS

QUESTION 1

- | | | | |
|----|---|---|--|
| 1. | 1.1
1.2
1.3 | B✓✓
B✓✓
D✓✓ | (3 x 2) (6) |
| 2 | 2.1
2.2
2.3
2.4
2.5
2.6
2.7 | Endocrine✓ system
Adrenalin✓
Testosterone✓
Glycogen✓
Pancreas✓
Aldosterone✓
Testosterone✓ | (7x 1) (7) |
| 3 | 3.1
3.2
3.3
3.4
3.5
3.6
3.7 | B only✓✓
None✓✓
B only✓✓
A only ✓✓
B only✓✓
None✓✓
B only✓✓ | (3 x 2) (14) |
| 4 | 4.1
4.2
4.3
4.4
4.5 | 0.25✓mg/cm ³
15✓minutes
- Blood glucose level of a person with diabetes mellitus is higher✓than that of a normal person at all times✓
- There is a greater increase in the blood glucose level of a person with diabetes mellitus after ingestion of glucose✓ compared to the normal person✓
- It takes longer for the blood glucose level to stabilise for the person with diabetes mellitus✓ compared to a normal person✓
(Mark first TWO only)

- Because the person with diabetes mellitus does not produce insulin✓/is insulin resistant
- therefore blood glucose is not converted to glycogen✓

Glucagon✓/ Adrenalin | (1)
(1)
(4)
(2)
(1)
(9) |

5	5.1	(a) Pituitary✓/ hypophysis	(1)
		(b) Thyroxin✓	(1)
	5.2	Negative feedback✓ mechanism	(1)
	5.3	- Less hormone B ✓/ thyroxin secreted	(2)
		- More hormone A ✓TSH will be secreted	(5)
6	6.1	Comparison of the blood glucose level of two people✓ over 5 hours✓/before and after ingesting glucose	(2)
	6.2	(145 – 125) ✓ (Accept numbers in range 144 -146 for the first value and 124 -126 for the second value) = 20✓ mg/100 cm ³ (Accept answer according to the values given by learner)	(2)
	6.3	Accept any answer from 1,7 to 1,9✓ hours /102 – 114minutes/ 1h42min – 1h54min	(1)
	6.4	(a) Thabiso✓	(1)
		(b) - His glucose level is higher than the normal range✓ - It takes longer for his glucose level to come down to its original level✓	Any (1)
		(Mark first ONE only)	
	6.5	- When his glucose level is high✓/ 99/98mg/100cm ³ - insulin✓ is secreted into the blood - to convert excess glucose into glycogen ✓ in the liver - and to stimulate the cells to absorb more glucose✓ - thus decreasing the blood glucose level✓	(4) (11) Any

ACKNOWLEDGEMENT

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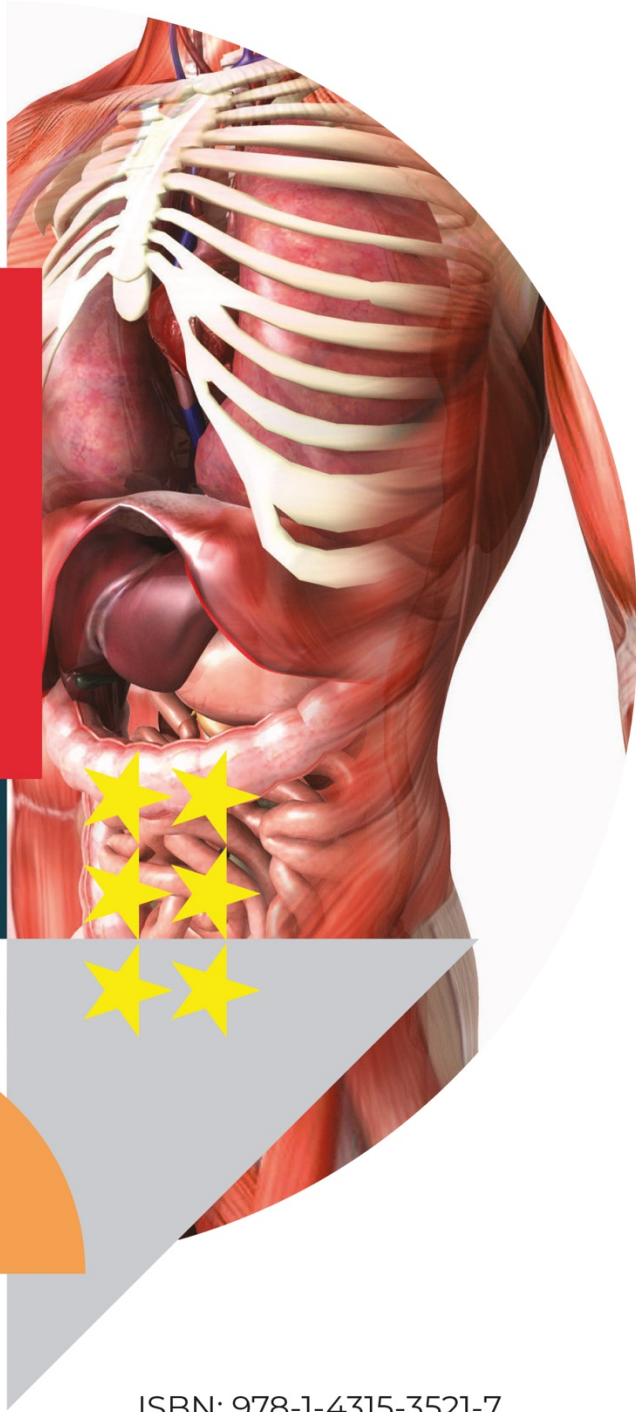
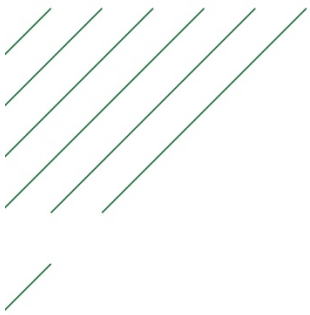
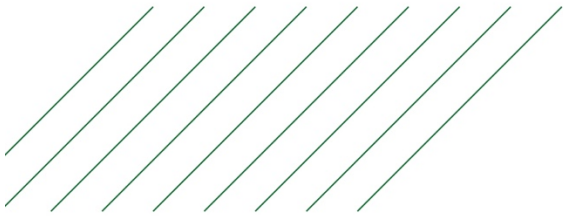
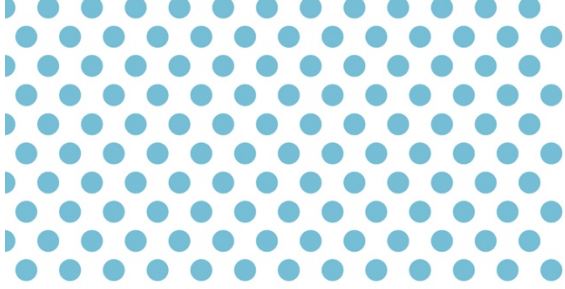
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- Gauteng Grade 12 Life Sciences Exam Kit
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