

SENIOR SECONDARY IMPROVEMENT PROGRAMME 2013



education

Department: Education

GAUTENG PROVINCE

GRADE 12

LIFE SCIENCES

LEARNER NOTES

The SSIP is supported by



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LEARNER NOTES

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SESSION 12

TOPIC: LIFE PROCESSES IN PLANTS AND ANIMALS – GENERAL REPRODUCTION AND PLANT REPRODUCTION

Learner Note: It is important that you know the definitions and understand the difference between sexual and asexual reproduction. You are expected to know the types of asexual reproduction. It is easier to split this into vegetative structures from stems, leaves and roots. Remember that no meiosis takes place during asexual reproduction. This means that there will be **no genetic variation**. You must be clear that for sexual reproduction gametes are formed by meiosis and fertilisation follows. This will result in genetic variation because of crossing over process during Prophase I of Meiosis and the random separation of homologous chromosomes during Metaphase I of Meiosis. Please focus on the importance of seeds. You need to know alterations of generations, plant life cycles for the moss and angiosperm, and make sure that you know the difference between complete and incomplete metamorphosis. Learn the diagram of the amniotic egg, and know the difference between Precocial and Altricial development. Stick to the time allocations for each question.

SECTION A: TYPICAL EXAM QUESTIONS

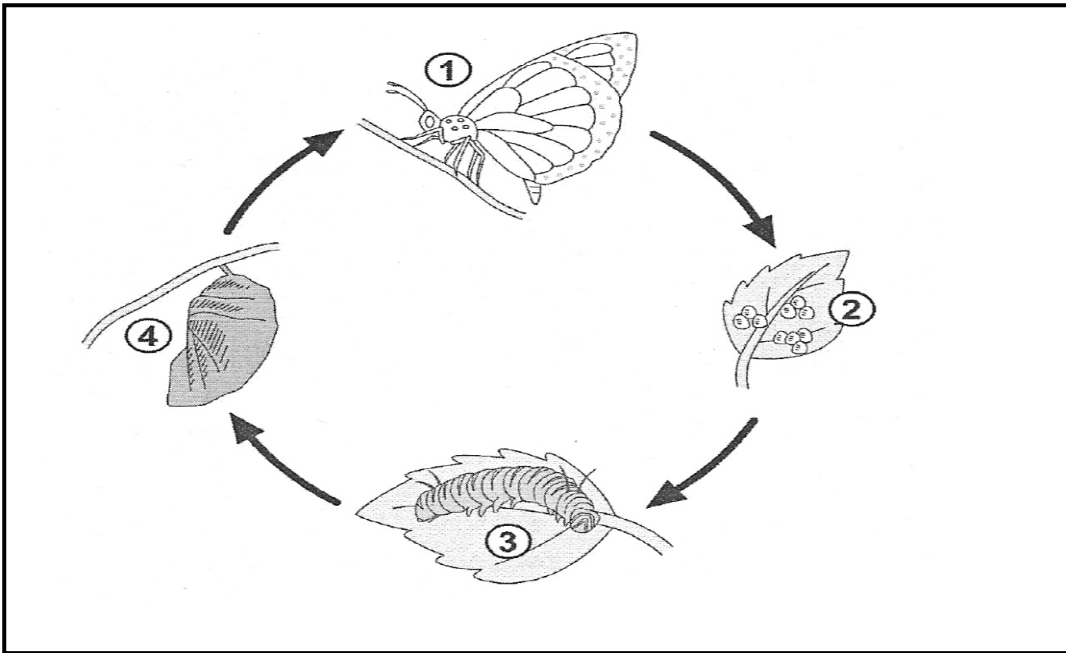
QUESTION 1: **25 minutes** *(Taken from various sources)*

- 1.1. Discuss the importance of seeds as a food source. (4)
 - 1.2. Name four types of stems that are organs of asexual reproduction and include an example of each. (8)
 - 1.3. Tabulate the advantages and disadvantages between sexual and asexual reproduction. (10)
 - 1.4. Briefly describe the difference between self-pollination and cross pollination. (3)
- [25]**

HINT: Remember that marks are allocated for drawing the table and placing the headings into the appropriate blocks. Always make sure that you compare the same type of characteristic in each point, and take careful note of the mark allocation

QUESTION 2: **10 minutes** *(Viva Life Sciences Grade 12)*

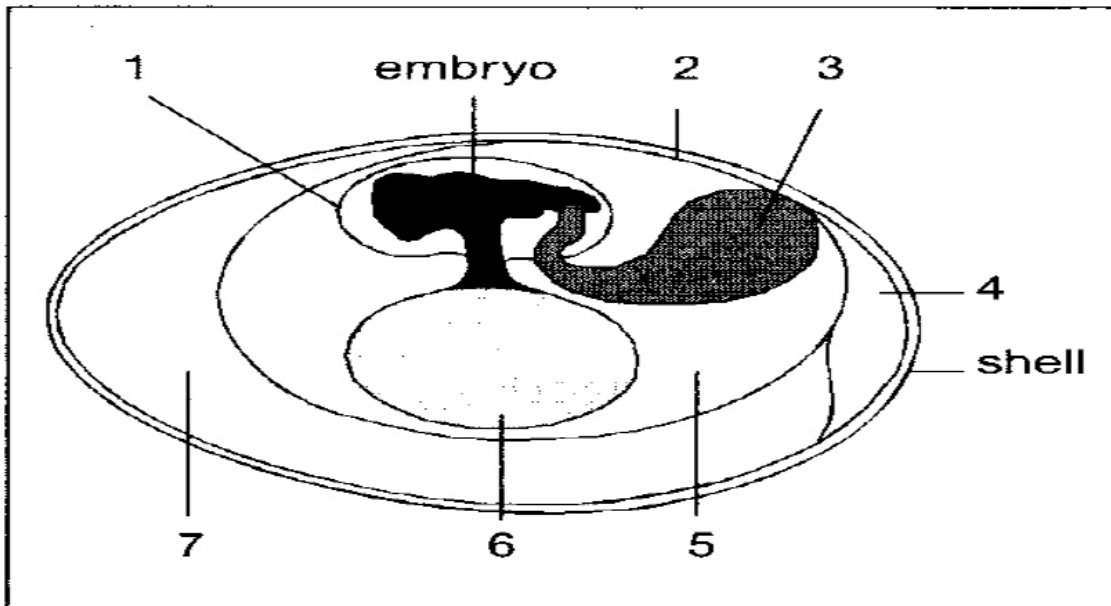
The diagram on the following page represents the life cycle of a butterfly.



- 2.1. Name the type of metamorphosis shown in this diagram. Explain your answer (4)
 - 2.2. Label the stages numbered 1 to 4. (4)
 - 2.3. Explain the major difference between complete and incomplete metamorphosis. (4)
- [12]

QUESTION 3: 22 minutes (Modified from Study and Master old Grade 11 syllabus)

The following diagram represents a section through an amniotic egg:



- 3.1. Identify the membrane numbered 1. (1)
- 3.2. What fills the space between the developing embryo and the membrane mentioned in QUESTION 3.1, and what is its function? (2)
- 3.3. Which number represents the allantois? State one function of this structure. (2)
- 3.4. Identify the membrane numbered 2, and state its function. (2)

- 3.5. Did internal or external fertilisation occur to produce the structure in the diagram? (1)
- 3.6. Explain the difference between viviparous and oviparous embryo development. (8)
- 3.7. Briefly explain the meaning of the terms:
- a) precocial young (3)
- b) altricial young (3)
- [22]

SECTION B: ADDITIONAL CONTENT NOTES

Ensure that you know the difference between **sexual** and **asexual** reproduction:

Reproduction type	Sexual reproduction	Asexual reproduction
Explanation	<ul style="list-style-type: none"> Two parents Requires the formation of haploid male and female gametes by the process of meiosis The process of fertilisation must take place A diploid zygote results and develops into an embryo that contains genes from both the male and the female Less offspring result (babies, fruits and seeds) 	<ul style="list-style-type: none"> One parent Requires vegetative structures that grow from the parent plant by mitosis – no gametes are produced No fertilisation is required – the offspring are as a result of mitosis The resulting offspring are diploid and identical to the parent Rapid production of large numbers of offspring
Advantage	<ul style="list-style-type: none"> The recombination of the chromosomes during meiosis and the random fusion of gametes during fertilisation results in offspring that show genetic variation 	<ul style="list-style-type: none"> Asexual reproduction is ideal for producing large numbers of identical offspring with desirable genetic characteristics, from one selected parent
Disadvantage	<ul style="list-style-type: none"> Male and female gametes may be prevented from fusing – so no offspring will be produced Genetic mutations may result in undesired characteristics in the offspring 	<ul style="list-style-type: none"> Offspring are identical to the parent and show no genetic variation

ASEXUAL REPRODUCTION IN FLOWERING PLANTS

Stems:

- **Rhizomes:** new plants grow from the **rhizome** (underground stem), e.g. **grasses**, which is a food source for herbivores like cattle, goats, sheep and buck.
- **Tubers:** an underground stem that stores food, e.g. the **potato plant**, produces tubers where lateral buds called 'eyes' develop on the tubers. A new plant will grow from each lateral bud. If pieces of potato that have lateral buds are cut and planted, a new potato plant will grow from each piece.
- **Bulbs:** are shortened underground stem with fleshy storage leaves, e.g: the **onion**. Small daughter bulbs develop from the mother bulb with the daughter bulb separating from the mother bulb and developing into a new plant.
- **Stolons** (runner): are horizontal stems with long internodes that lie above the ground. Adventitious buds develop at the nodes of the stolon where each bud will produce a new plant, e.g.: **strawberry plants**.

Leaves:

Some plants produce **plantlets** along their leaf margins, e.g: the **kalanchoe**. The little plants develop from the meristematic tissue in the leaf, and when the plantlets grow too heavy, they drop off the leaf onto the ground and grow.

Roots:

Some roots produce **suckers** that develop from **adventitious buds**, and grow above ground. Each sucker grows roots at the base of the stem and a new plant develops, e.g.: **apple trees, cherry trees, raspberry plants and blackberry plants**.

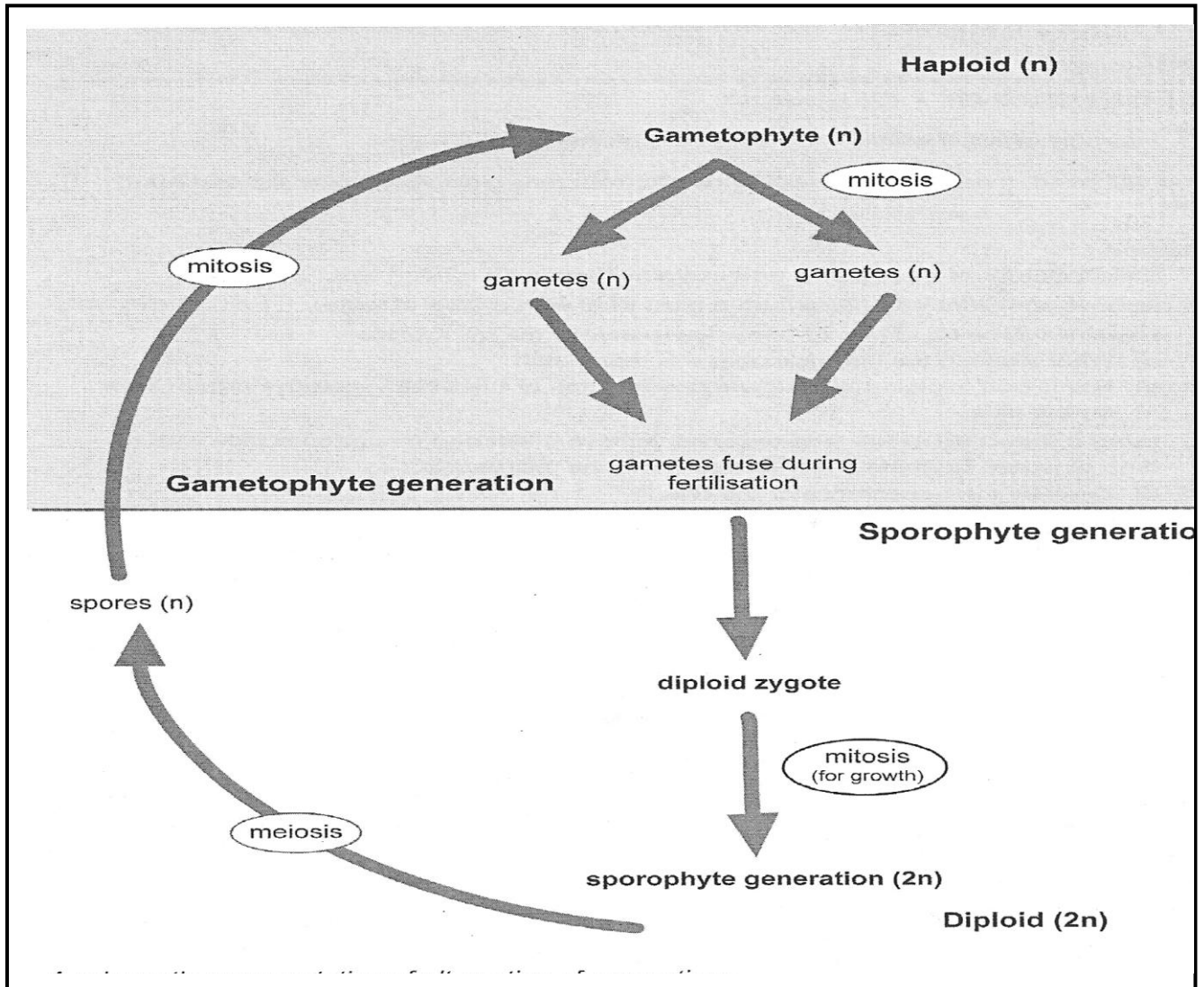
Comparison of Alternation of Generations in plants

	Gametophyte generation	Sporophyte generation
Moss	Dominant phase. Water is essential for fertilisation to occur.	Partly parasitic and develops from the gametophyte structure. Sporophyte structure undergoes meiosis to produce spores.
Fern	Gametophyte is a separate, thallus structure with male and female structures. Water is essential for fertilisation to occur. Sporophyte develops from the gametophyte structure.	Dominant phase. Sporophyte structure undergoes meiosis to produce spores.
Flowering plants	Gametophyte structures for male and female are part of the sporophyte. Gametes are produced. Fertilisation results in a diploid zygote that will develop into an embryo.	Dominant phase. Various adaptations exist to ensure pollination. Fruit and seeds are produced which grow into a new sporophyte structure.

LIFE CYCLES

Alternation of generations: is the alternating of a haploid with a diploid phase.

- Each phase has one distinct structure: a **gametophyte** that is **haploid**, and a **sporophyte** that is **diploid**.
- A haploid plant of a **gametophyte generation** will produce **gametes** by the process of **mitosis**.
- The gametes fuse to produce a **diploid zygote** which grows by **mitosis** into a **diploid sporophyte generation**.
- The sporophyte generation produces **haploid spores** by **meiosis**
- The haploid spores germinate into the next **gametophyte generation**.



Metamorphosis in insects: is a process of an **abrupt transition/change** from **one developmental stage to another**. In insects, it is a physical change from hatching into a larva to an adult. The body changes as cells **grow and differentiate** to adapt to a change of habitat or behaviour.

Complete metamorphosis

- The organism **changes completely** physically, during the four life stages: **egg, larva, pupa and adult (imago)**.
- Embryo develops in the **egg**. It hatches into a **larva** (caterpillar) and feeds. The larva will enter into the **pupal stage** inside its **chrysalis**. The body changes physically into the **adult** male or female, which is able to reproduce and lay eggs.
Examples: bees, moths, butterflies, mosquitoes, dragonflies and flies.
- **Advantages:** The juvenile and the adult forms live in **different habitats** and require **different food** sources. This **avoids competition** for food between the juvenile and the adult. Pupal stage is a **non-feeding stage** so a food shortage will not affect the development of the organism. The pupa covers and protects the organism from harsh, **unfavourable environmental conditions**.
- **Disadvantages:** The organism is **defenceless** while it is in the pupal phase.

Incomplete metamorphosis

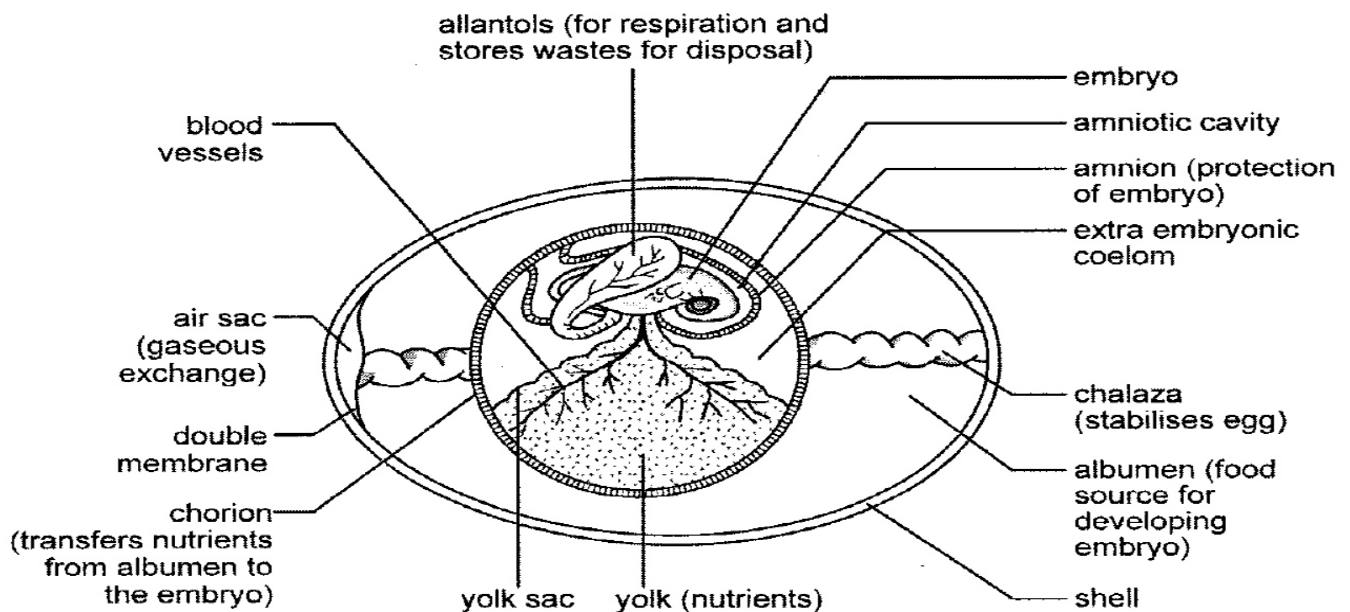
- The organism **changes gradually** physically, during the three life stages: **egg, nymph and adult (imago)**.
- The nymph often looks **similar** to the adult.
- **Examples:** cockroaches, locusts, toads and frogs.
- **Advantages:** the nymph has adaptive features to allow it to live in a **different habitat** and eat **different food** to the adult. This **avoids competition** between the nymph phase and the adult phase.
- **Disadvantages:** the nymph must grow and **moult** several times before it reaches maturity. During moulting, the organism cannot move until the exoskeleton is completely dry, so it is **vulnerable**.

Diversity of reproductive strategies in some animals

Different groups in the animal kingdom have developed reproductive strategies to ensure reproductive success and survival of the species. In order for sexual reproduction to take place, two individuals (one male and one female) must come together so that fertilisation can occur.

- **Courtship:** In animal species, courtship is a ritual for mate selection and mating. The male will generally initiate the courtship but the female selects her mate based on his 'display'. The courtship rituals may include complicated dances, soft pecking and head rubs, singing, noise making, fancy flying patterns, croaking, mock-fighting, real fighting and displays of 'good looks'. Note that courtship rituals can result in behavioural isolation which results when animals behave differently during mating rituals. Females will not become responsive to the male, so no mating will take place. **Examples of courtship:** Frogs croak; male reptiles are brightly coloured and 'dance' around the female. Birds: singing, peacocks display their tail feathers and weaver bird males build a nest. Mammals: females come into oestrus and release pheromones
- **External versus internal fertilisation**
 - **External fertilisation:** egg cell and the sperm cell fuse **outside** of the female's body. Egg cells are generally inside the egg structures. The female lays her eggs and the male deposits his sperm cells **over** the eggs. Examples are frogs and many species of fish.

- **Internal fertilisation:** egg cell fuses with the sperm cell **inside** the female's body. In some fish, most reptiles and all bird species, reproduction is internal but fertilisation is cloacal because eggs are produced. In mammals, **copulation** takes place when the male **inserts the penis** (copulatory organ) into the vaginal cavity of the female. Fertilisation takes place in the **fallopian tubes**.
- **Embryo Development:** Once fertilisation has taken place, the diploid zygote develops into an embryo. This development takes place in an **egg** or in the **uterus**.
 - **Viviparous:** the embryo develops **inside the uterus**. A placenta nourishes the embryo. The female **gives birth** to **live young** when the **gestation period** is complete.
 - **Oviparous:** **Eggs** with shells are **laid** outside the female's body into a nest and continue to develop, **hatching** when development is complete.
 - **Ovoviviparous:** The fertilised eggs remain in the **oviduct** of the female. The eggs have **no shell** and embryo feeds off the yolk (no placenta). When development is complete, the female **gives birth** to **live young**.
- **Amniotic Egg:** the amniotic egg has a porous leathery or hard eggshell to prevent the egg from drying out. There are three membranes: the **amnion** (protects embryo during development), **chorion** (transfers nutrients from the albumen to the embryo) and **allantois** (respiration and for waste disposal from embryo).
Examples: Insects – eggs are not amniotic; Fish and amphibians - eggs are jelly-like without a shell for external fertilisation; Reptiles – amniotic eggs when oviparous: Birds - amniotic eggs



Amniotic Egg Diagram

- **Precocial and Altricial:**
 - **Precocial:** young are mature and able to move directly after birth or hatching. They are able to fend for themselves and feed without parental care, for example, insects, fish, amphibians, reptiles. Some bird species, like ducks, chickens, geese and plovers, are precocial.

- **Altricial:** young are born helpless, cannot protect or feed themselves, or fend for themselves. Birds species like doves, finches, hawks and eagles and all mammals are altricial.
- **Parental Care:** Parents look after offspring to provide comfort, warmth, to feed and protect them. Examples: insects, fish, amphibians and reptiles – no parental care. Precocial and altricial birds have parental care, and mammals have long periods of protective nurturing where social behaviour and survival techniques are taught.

FLOWERS AS REPRODUCTIVE ORGANS

Pollination: before fertilisation, pollination must take place. This is the transfer of ripe pollen to a receptive stigma. Pollen is transferred by animals, birds, insects, water and wind.

There are two types of pollination:

- **Self-pollination** is the transfer of pollen from the anther to a receptive stigma of the **same flower** or the receptive stigma of a **flower on the same parent plant**.
- **Cross-pollination** is the transfer of pollen from the anther of one plant to the receptive stigma of a flower on **another plant** of the same species. Insects specialised for flower feeding, have appeared in fossil records at almost the same time as flowering plants. This means that as flowering plants evolved, so too did the insects that pollinated them.

Fertilisation: once pollination has takes place, **double fertilisation** takes place. One of the male gamete fuses with the female gamete in the ovary to form a **diploid zygote** – to form the embryo. The **ovule** develops into the **seed** and the seed coat (testa) develops from the integument of the ovule and protects the embryo. The **ovary** grows into the **fruit**. The second male gamete fuses with the two polar nuclei to form a **triploid endosperm nucleus** – provides nutrition for the developing embryo.

Seeds: a seed is a structure that surrounds, protects and nourishes the **embryonic plant** until it is able to photosynthesize. **Gymnosperm** means ‘**naked seed**’ because the seeds are not covered by fruit but are instead enclosed by the scales of the cone. **Angiosperm** means ‘**enclosed seed**’ because the seeds are protected by a fruit structure.

Significance of seeds:

- Seeds are a product of **sexual reproduction** and provide **genetic variation**.
- Provide **nourishment** for the developing embryo (food is stored in tissue called endosperm – which resulted from the **double fertilisation** process).
- Allow embryos to be **dispersed** to another location so that they are not competition to the parent plant
- **Protect** the embryo and ensures survival of adverse conditions while the seed is **dormant**
- Ensure **survival** of the species as each plant produces **many seeds** in its life cycle.

Importance of seeds as a food source:

- Seeds are an important source of food for humans, animals and birds.
- Peas, soya beans, lentils, oats, nuts and green beans are a rich source of proteins.
- Cereals, like wheat, maize and rice, are the staple diet food for many people and are often grown as a monoculture.
- Sorghum is used in the production of traditional and commercial beer.
- Sunflower and peanut seeds are used to produce cooking and salad oils.

Seed banks

- Seed banks maintain **biodiversity** and are very similar to gene banks or money banks.
- Seeds are stored in cool, dry and sterile conditions and kept at -10 to -20 °C, which may cause damage to the DNA in some plant species.
- Seeds of most species **remain viable** for more than 100 years in these conditions.
- Seed banks can be used to **store seeds** when the **crop yield is high**, like money in a savings account.
- When there is a need later, like a **natural disaster** (drought, volcanic eruption) **disease or pest infestation**, they can be released and planted.
- Seed banks are also used when a species is listed as **rare or endangered**, so that we are able to **protect biodiversity** and ensure the survival of the species.

IMPORTANT DEFINITIONS:

- **Gametophyte generation:** this generation is **haploid** and produces gametes by **mitosis**.
- **Sporophyte generation:** this generation is **diploid** and produces haploid spores by **meiosis**.
- **Metamorphosis:** a process of abrupt transition from one developmental stage to another. Metamorphosis can be complete (egg, larva, pupa and adult) or incomplete (egg, nymph and adult).
- **Viviparous:** embryo carried in the uterus and female gives birth to live young.
- **Oviparous:** egg with shells are laid outside the female's body and embryo develops inside the egg until ready to hatch.
- **Ovoviviparous:** shell-less fertilized eggs remain in the female's oviduct until embryo is developed, then female gives birth to live young.
- **Precocial:** young are mature and able to fend for themselves directly after hatching.
- **Altricial:** young are born helpless and require protective parental care.
- **Alternation of generations:** a life cycle alternating between the sporophyte generation (diploid) and the gametophyte generation (haploid)
- **Asexual reproduction:** reproduction without the fusion of sex cells e.g. budding, binary fission
- **Budding:** a form of asexual reproduction where new cells develop into an outgrowth on the parent plant
- **Dioecious:** means unisexual, where the male and female reproductive organs are borne on different plants
- **Cross-pollination:** pollen is transferred from one flower to another flower to enable fertilisation. The stamens and pistils ripen at different times to ensure that self-pollination does not take place
- **Monoecious:** applicable to flowering plants that have separate male and female flowers carried on the same plant
- **Plumule:** part of the plant embryo that develops into the shoot and later young leaves
- **Pollen grain:** microspores of flowering plants that contain the male gametes
- **Pollination:** transfer of pollen from the anther to a ripe and receptive stigma
- **Self-pollination:** when the pollen of a flower falls on the stigma of the same flower
- **Cross-pollination:** is the transfer of pollen from the anther of one plant to the receptive stigma of a flower on another plant of the same species.
- **Stamen:** male reproductive organ of a flower that carries the anther at the tip
- **Stigma:** end part of the ovary which receives pollen
- **Unisexual:** the stamens and pistils are located on separate flowers

SECTION C: HOMEWORK

QUESTION 1:**12 minutes***(Various sources)*

Select the correct answer from options A, B, C or D in the questions below:

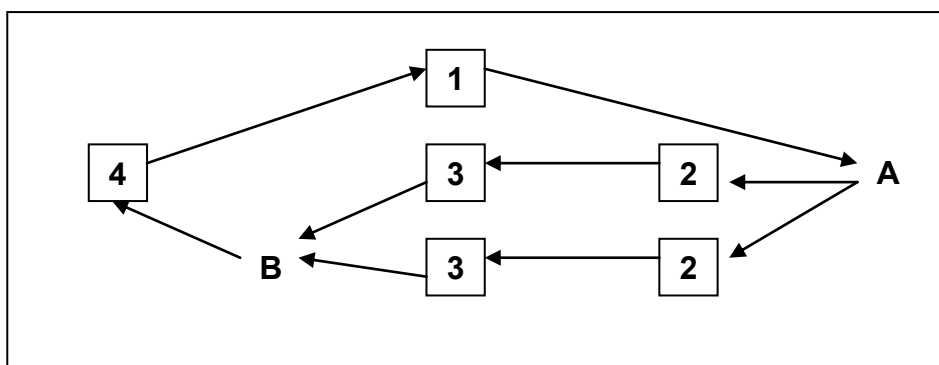
- 1.1. The testa of the seeds of Angiosperm develops from the...
 - A placenta
 - B integument
 - C ovary wall
 - D endosperm

- 1.2. Fertilisation in Angiosperms is known as 'double fertilisation' because:
 - A pollination of the stigma as well as fertilisation of the ovum occurs
 - B two male gametes are found in the pollen tube
 - C the ovum and one of the antipodal cells are fertilised
 - D the ovum and the primary endosperm cells are fertilised

- 1.3. The endosperm of the Angiosperms is the...
 - A haploid tissue of the embryo sac
 - B diploid product of fertilisation
 - C diploid tissue of the ovary
 - D nutritional tissue for the embryo

- 1.4. The two essential reproductive parts of a flower are...
 - A pistil and stamens
 - B corolla and ovary
 - C calyx and corolla
 - D corolla and stamens

Questions 1.5 to 1.8 refer to the schematic representation in the life cycle of an angiosperm.



- 1.5. If number 1 represents the adult angiosperm and 2 represents the microscopic gametophyte, then A must be the...
 - A spores
 - B gametes
 - C seed
 - D zygote

- 1.6. If the two number 2's are microscopic gametophytes in the flower then the two 3's are...
- A seeds and zygote
 - B ova and male gametes
 - C spores and pollen
 - D two embryos in the seed
- 1.7. **B** (in the diagram) restores the diploid number of chromosomes in the ...
- A zygote
 - B gametes
 - C seed
 - D spores
- 1.8. The structure numbered 4, which develops into the adult angiosperm at 1, is the ...
- A zygote
 - B spore
 - C seed
 - D endosperm
- 1.9. Plants are said to be more pure in their reproduction than animals. This is because plants...
- A reproduce by means of seeds
 - B reproduce vegetatively
 - C are cross-pollinated
 - D have more stable genes
- 1.10. The process of pollination is:
- A the transfer of ripe pollen from the anther to a receptive stigma
 - B the transfer of ripe pollen from the receptive stigma to an anther
 - C is the transfer of ripe pollen to a feeding insect
 - D self pollination ensures genetic variation and a larger gene pool
- 1.11. The following terms have reference to the following vertebrates:
- 1. viviparous
 - 2. oviparous
 - 3. ovoviviparous
- A Insects, fish and mammals are all oviparous
 - B Some reptile, birds and mammals are ovoviviparous
 - C All mammals are viviparous
 - D All reptiles are oviparous
- 1.12. How does the gametophyte generation of a plant species differ from the sporophyte generation?
- A It produces the spores
 - B It is diploid in all its cells
 - C It is always dependent on the sporophyte
 - D It is haploid in all its cells

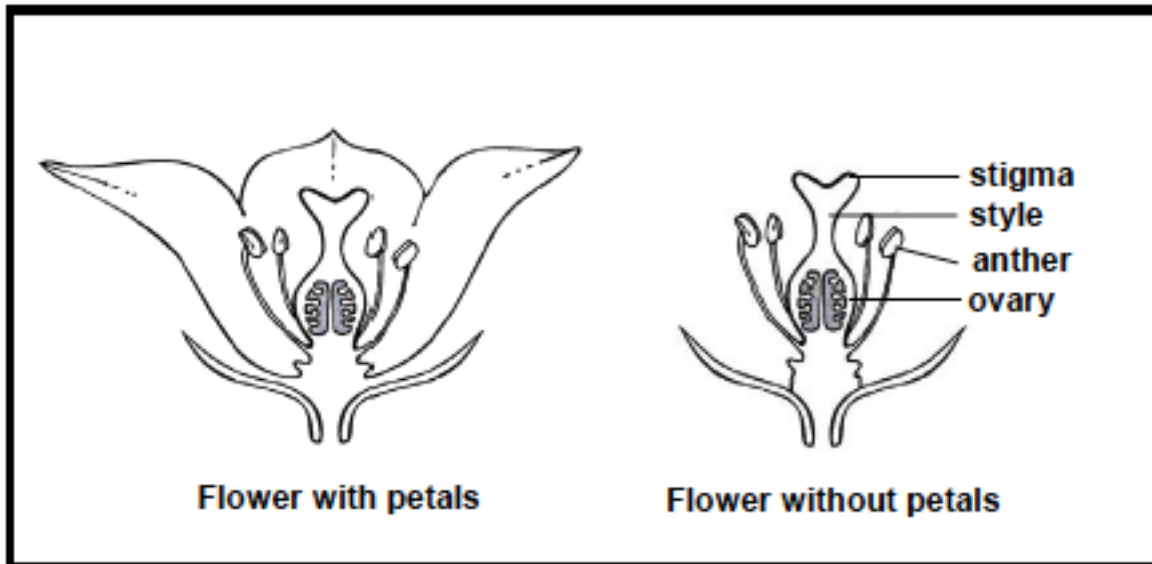
[12]

QUESTION 2: NOTES) 7 minutes (Taken from NSC Life Science November 2009

An investigation was done to determine the role of petals in insect pollination in apple flowers. When flowers are self-pollinated, the pollen tubes grow a little into the stigma and style, and fertilisation does not take place.

- 10 flowers with petals and 10 flowers without petals were used.
- After two days the flowers were prevented from further pollination.
- After seven days the extent of pollination and fertilisation was recorded.

The diagrams below show the appearance of the flowers with and without petals.



The results are shown in the table below.

	NUMBER	
	Flower with petals	Flower without petals
Pollen on stigma	158	25
Pollen tubes in the style	86	8
Ovules fertilised	38	4

- 2.1. Give an explanation for the presence of more pollen on the stigmas of the flowers with petals than on the flowers without petals. (2)
 - 2.2. Explain why there are more pollen tubes present in the styles of both types of flowers than the number of ovules fertilised. (2)
 - 2.3. State THREE ways in which this investigation could be improved. (3)
- [7]

SECTION D: SOLUTIONS AND HINTS TO SECTION A
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QUESTION 1

1.1.

- Seeds are an important source of food for humans, animals and birds. ✓
- Peas, soya beans, lentils, oats, nuts and green beans are a rich source of proteins. ✓
- Cereals, like wheat, maize and rice, are the staple diet food for many people and are often grown as a monoculture. ✓
- Sorghum is used in the production of traditional and commercial beer. ✓
- Sunflower and peanut seeds are used to produce cooking and salad oils. ✓

(any 4) (4)

1.2.

- Rhizomes ✓ e.g. ✓ grasses or any relevant example ✓
- Tubers ✓ e.g. the potato / sweet potato ✓
- Bulbs ✓ e.g. the onion or any other relevant example ✓
- Stolons /runner ✓ e.g. strawberry plants / Hen and Chicken plant or any other relevant example ✓

(4 x 2) (8)

1.3.

	Sexual reproduction	Asexual reproduction
Advantage	<ul style="list-style-type: none"> • The recombination of the chromosomes during meiosis ✓ and the random fusion of gametes during fertilisation ✓ results in offspring that show genetic variation ✓ 	<ul style="list-style-type: none"> • Asexual reproduction is ideal for producing large numbers ✓ of identical offspring ✓ with desirable genetic characteristics, from one selected parent ✓
Disadvantage	<ul style="list-style-type: none"> • Male and female gametes may be prevented from fusing – so no offspring will be produced ✓ • Genetic mutations may result in undesired characteristics in the offspring ✓ 	<ul style="list-style-type: none"> • Offspring are identical to the parent and show no genetic variation ✓

Plus 1 mark for correct headings/table**(10)**

1.4.

- **Self-pollination** is the transfer of pollen from the anther to a receptive stigma of the **same flower** ✓ or the receptive stigma of a **flower on the same parent plant** ✓
- **Cross-pollination** is the transfer of pollen from the anther of one plant to the receptive stigma of a flower on **another plant** ✓ of the same species.

**(3)
[25]**

QUESTION 2

2.1. Complete ✓ All stages of development are present ✓ / egg (1/2), larva (1/2), (✓) pupa (1/2) and adult (1/2) (✓) stages are present (4)

2.2. 1 – Adult butterfly ✓
 2 – Eggs ✓
 3 – Larva ✓
 4 – Pupa ✓ (4)

2.3.

Complete	Incomplete
The organism changes completely physically, ✓ during the four life stages: egg, larva, pupa and adult (imago) ✓	The organism changes gradually physically ✓ during the three life stages: egg, nymph and adult (imago) ✓

(4)

[12]

QUESTION 3

3.1. Amnion ✓ (1)

3.2. Watery fluid ✓ that protects the embryo during development ✓ (2)

3.3. No. 3 ✓ respiration / for waste disposal from embryo ✓ (2)

3.4. Chorion ✓ transfers nutrients from the albumen to the embryo ✓ (2)

3.5. Internal fertilisation ✓ (1)

3.6. **Viviparous:** the embryo develops **inside the uterus** ✓. A placenta nourishes the embryo. ✓ The female **gives birth** to **live** young ✓ when the **gestation period** is complete. ✓

Oviparous: **eggs** with shells are **laid** ✓ outside the female's body ✓ into a nest and continue to develop in the egg ✓, **hatching** when development is complete ✓ (8)

3.7. **Precocial:** young are mature ✓ and able to move directly after birth or hatching ✓ They are able to fend for themselves ✓ and feed without parental care ✓ (any 3) (3)

Altricial: young are born helpless ✓ cannot protect ✓, feed themselves ✓ or fend for themselves ✓ (any 3) (3)

[22]

SESSION 13

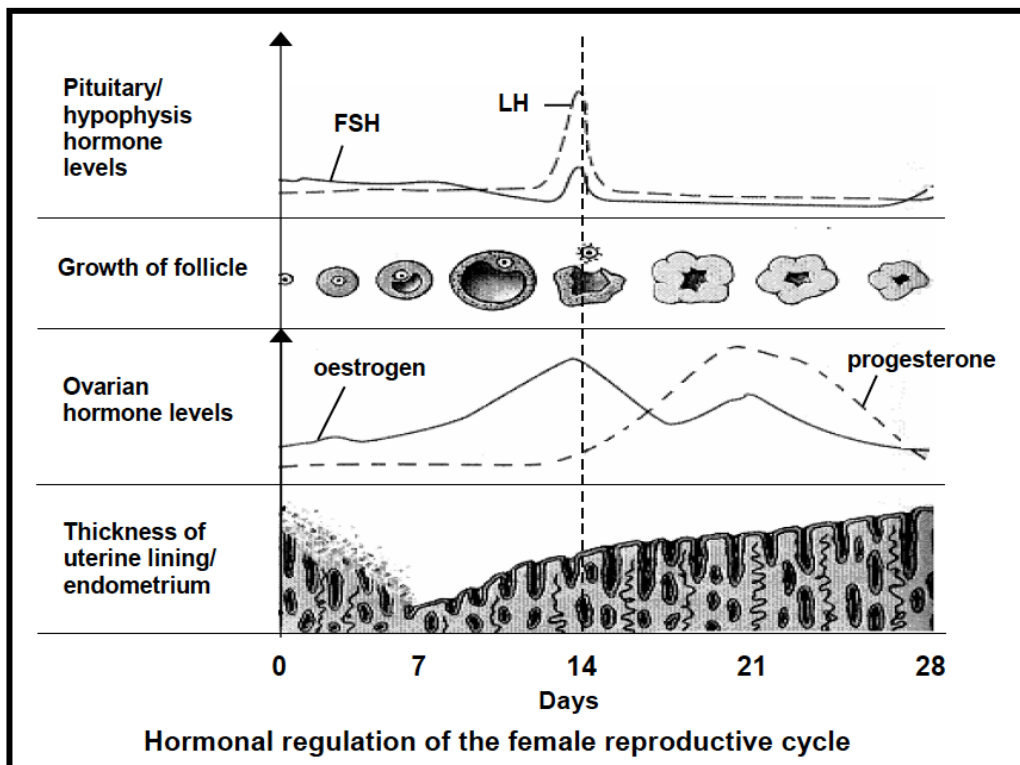
TOPIC: HUMAN REPRODUCTION

Learner Note: Make sure that you know the diagrams of the male and female reproductive systems, the sperm cell, the various hormonal graphs, the fertilisation to implantation diagram and the developing embryo diagram. The process of gametogenesis (oogenesis and spermatogenesis) is important, as well as the hormonal control of menstruation cycle. Try to complete the typical exam questions within the stated times for each question.

SECTION A: TYPICAL EXAM QUESTIONS

QUESTION 1: 13 minutes (Taken from NSC Life Science Nov. 2009 Paper 1)

Study the graph below, which shows the menstrual cycle and the influence of the different hormones on it.

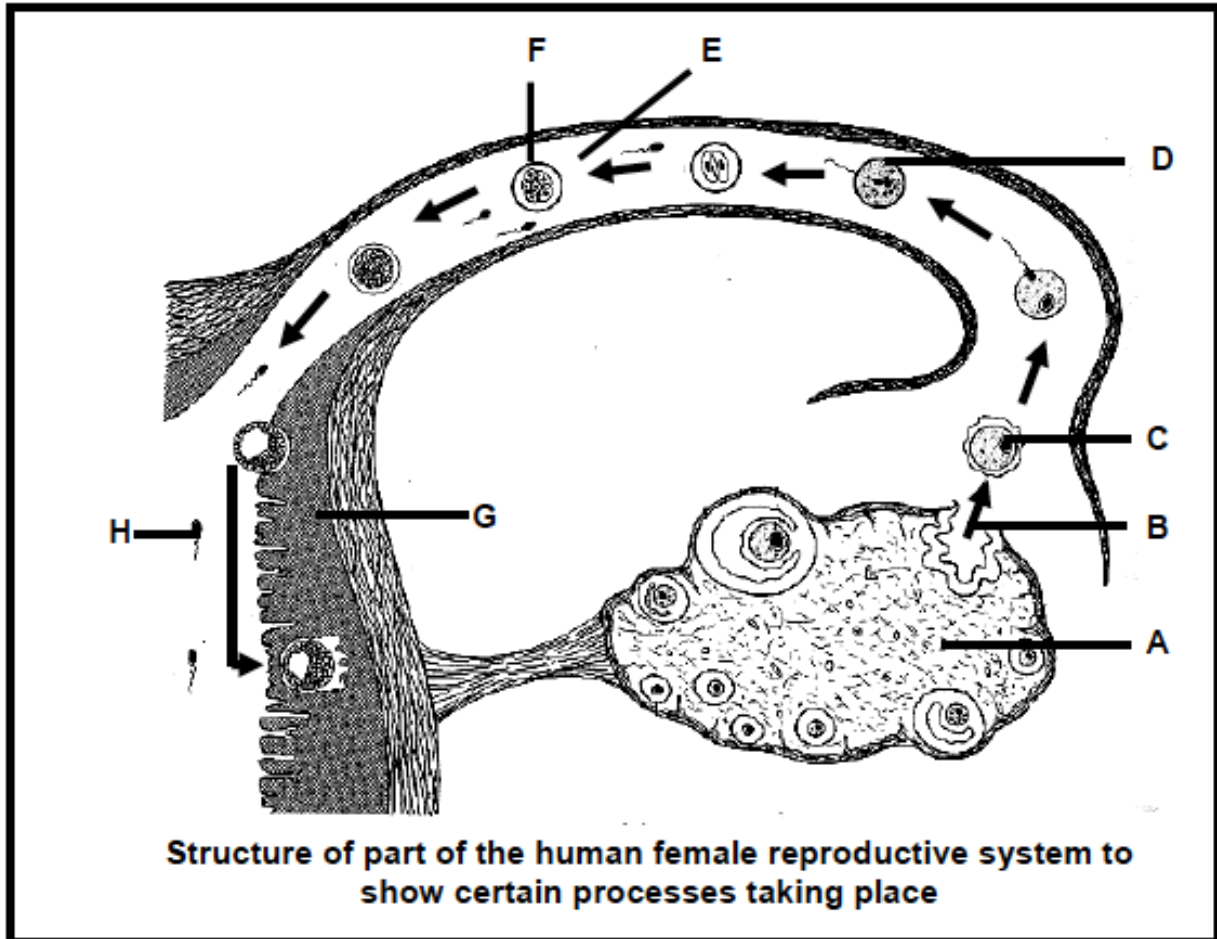


- 1.1. On which day does ovulation take place? (1)
- 1.2. Between which days does menstruation take place? (1)
- 1.3. State any ONE function of luteinizing hormone (LH). (1)
- 1.4. Describe the changes in the level of LH shown in the graph. (3)
- 1.5. Describe the relationship between the level of oestrogen and the endometrium from day 7 to day 14. (2)
- 1.6. Explain why it is necessary for the level of progesterone in the blood to increase after ovulation. (2)

- 1.7. Did fertilisation take place in the 28-day cycle illustrated in the graph? (1)
 1.8. Explain your answer to QUESTION 1.7. (2)
 [13]

QUESTION 2: 11 minutes (Taken from the NSC Exemplar 2008 Paper 1)

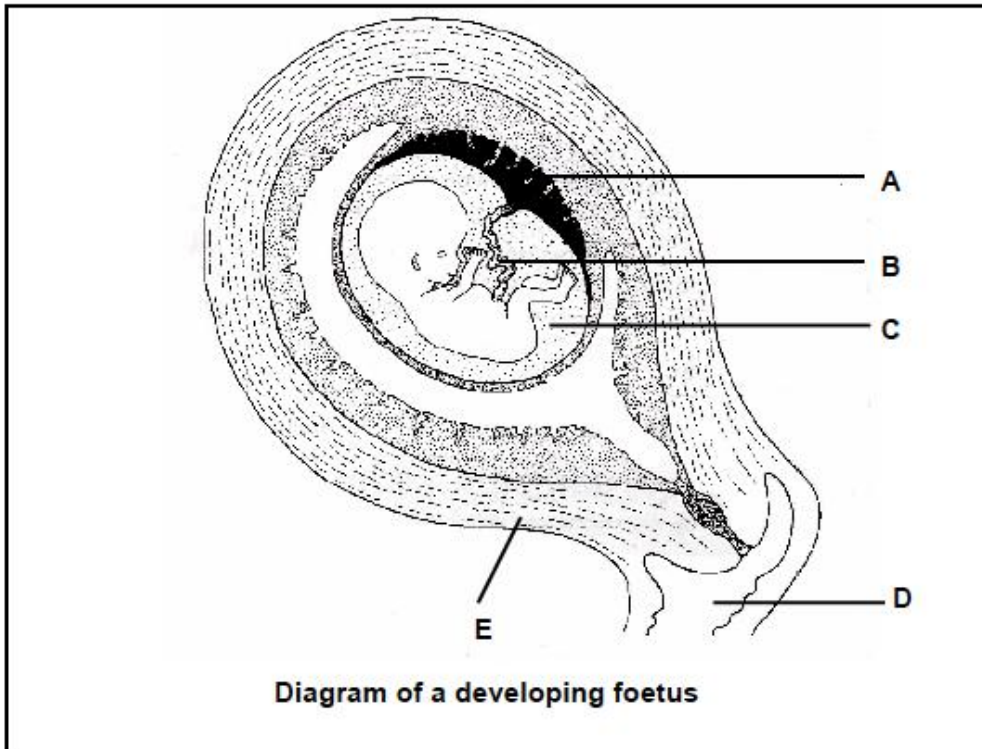
The diagram below represents a part of the human female reproductive system after copulation. Study the diagram and answer the questions that follow.



- 2.1. Give labels for parts A, E and G respectively. (3)
 2.2. Name the process that takes place at B. (1)
 2.3. When, during the menstrual cycle, does the process mentioned in QUESTION 2.2. take place? (1)
 2.4. Describe the process represented by D. (3)
 2.5. Write down the number of chromosomes that would be present in the nucleus of the following: (1)
 a) Cell C (1)
 b) One cell of F (1)
 c) Cell H (1)
 [11]

QUESTION 3: 8 minutes (Taken from NSC LS Preparatory Exam 2008 Paper 1)

Study the diagram of the developing foetus below.



- 3.1. Label structures A, B and D. (3)
- 3.2. Give TWO functions of the fluid found in C. (2)
- 3.3. Name the process by which some of the fluid from C is withdrawn by doctors to test for abnormalities in the foetus. (1)
- 3.4. Describe the function of E during the birth process. (2)
- [8]**

QUESTION 4: 23 minutes (Taken from Viva Life Sciences Grade 12)

The table shows the results of a survey of the different types of contraceptives used in a particular community:

Method	Number	Percentage
Pill	4321	86,4
IUD	157	3,1
Condom	320	6,4
Injections	112	2,2
Other	90	1,8

- 4.1 State a hypothesis for this survey. (2)
- 4.2 How would you get the information recorded in the table shown here? (1)
- 4.3 Which of the method/s represented in the table can be classified as a chemical method? (2)

- 4.4 Which method/s represented in the table will prevent the transfer of STDs? (2)
- 4.5 Draw a pie graph showing the percentage distribution of the different contraceptive methods. Show all your calculations. (14)
[21]

QUESTION 5: 10 minutes

Match column A with the statements in column B:

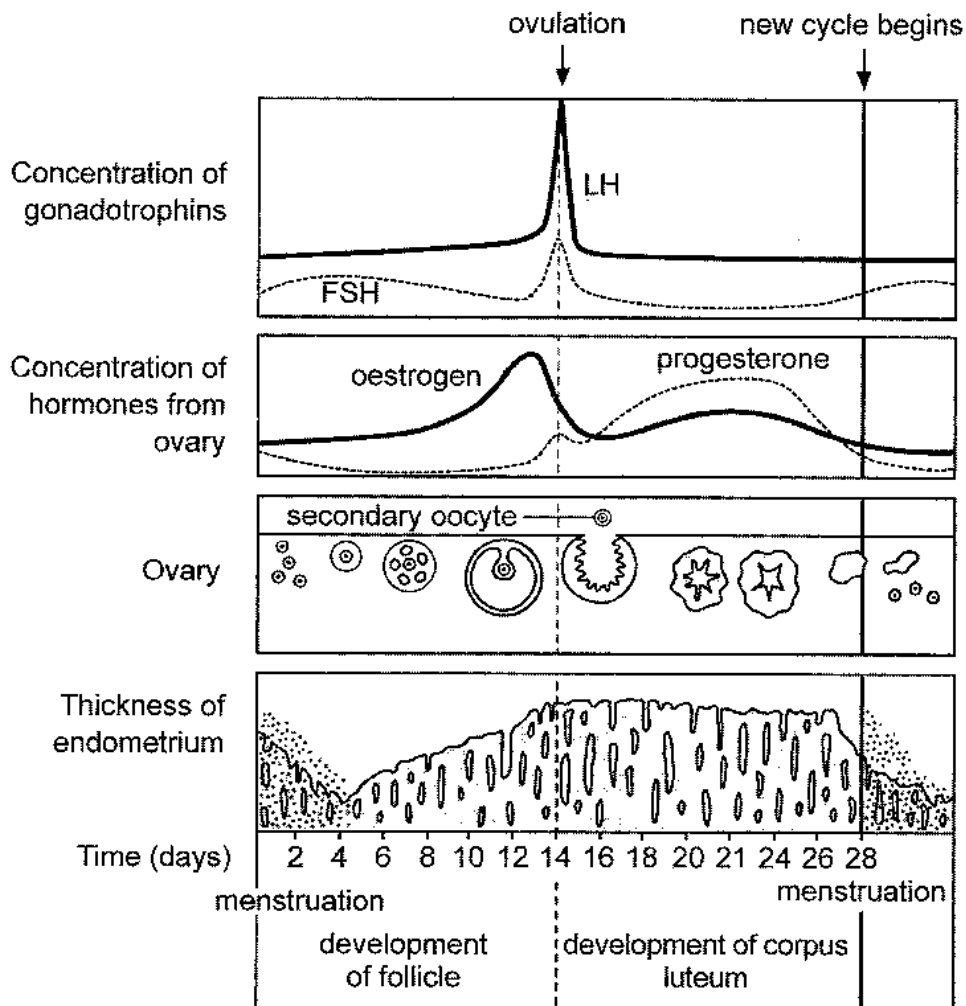
Column A	Column B
1. uterus	A. the external opening of the vagina
2. Fallopian tube	B. releases the egg cell during ovulation
3. testis	C. produces the hormone testosterone
4. cervix	D. development of the foetus takes place here
5. ovary	E. develops into the Graafian follicle
6. corpus luteum	F. organ enclosed by a scrotum
7. primary follicle	G. secretes progesterone
8. cells of Sertoli	H. provides nutrition of the sperm cells
9. epididymus	I. deposits sperm cells into the female
10. penis	J. transports egg cells from the ovary to the uterus
	K. region in the female that separates the vagina and the uterus
	L. produced by the Cowper's gland
	M. region where the sperm cells mature before release

[10]

SECTION B: ADDITIONAL CONTENT NOTES**HORMONAL CONTROL OF OOGENESIS:**

- Hormones control the 28 day **menstruation cycle**. Usually only one egg is released per cycle. Should both ovaries release an egg cell and both are fertilised, the result is paternal twins (unidentical). The menstruation cycle affects the ovaries and the uterus.
- **Gonadotrophin releasing hormone** (GnRH) stimulates the anterior pituitary gland to release follicle stimulating hormone (FSH) into the blood.
- **FSH** is transported to the ovaries (target organ) where it stimulates the development of the follicle.
- Granulosa cells in the developing follicle produce **oestrogen**. Oestrogen has two target organs, namely the uterus and the anterior pituitary gland.
 - Oestrogen causes the development of the endometrium in the uterus to prepare it for pregnancy.
 - Oestrogen inhibits the secretion of FSH by the anterior pituitary gland so that no further follicles are produced during the pregnancy. High oestrogen levels will trigger the secretion of luteinising hormone (LH).
- **LH** is released into the blood and is transported to the ovary, causing ovulation. **LH** stimulates the Graafian follicle to develop into the corpus luteum.

- The corpus luteum secretes **oestrogen and progesterone**.
 - Progesterone ensures that the thickening of the **endometrium** is maintained and **glandular activity** is stimulated.
 - Progesterone **inhibits** the anterior pituitary gland from releasing LH. The release of progesterone causes the slight **rise in temperature** just after a female has ovulated.
- If fertilisation does not take place, the corpus luteum will **degenerate** causing a decrease in the levels of oestrogen and progesterone. The endometrium breaks down and tears away from the walls of the uterus, causing the bleeding associated with **menstruation**. This lasts for about five days.

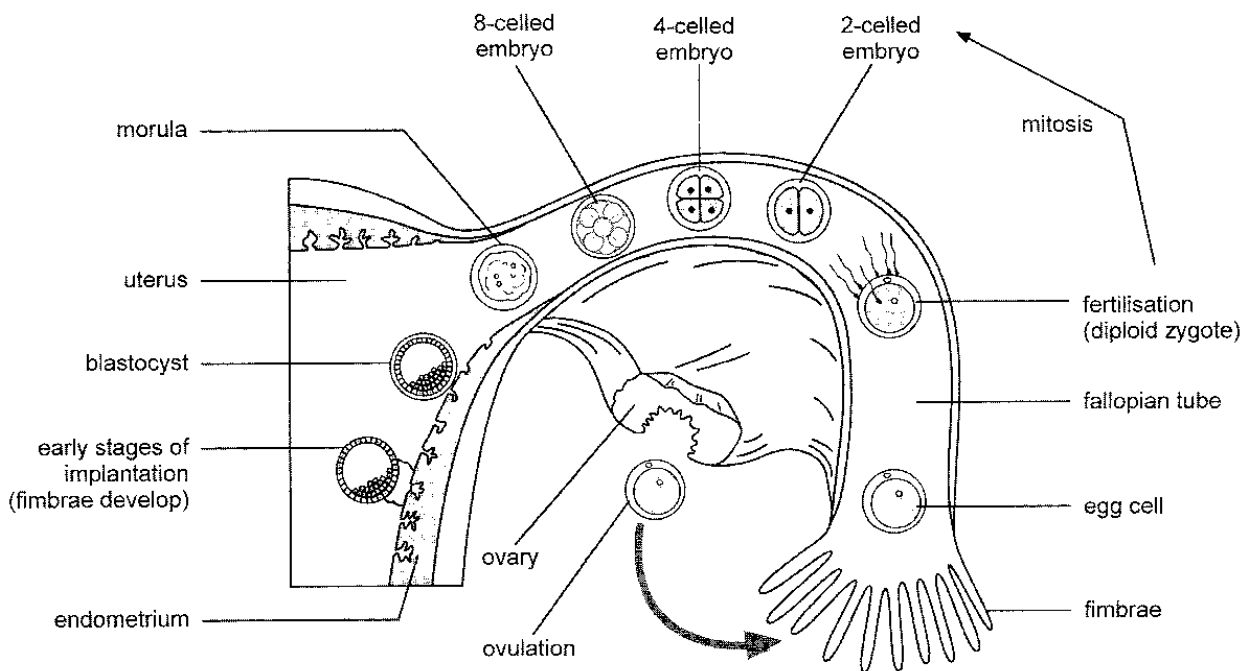


Changes occurring during the menstrual cycle, showing levels of the hormones FSH, LH, oestrogen and progesterone

[Make sure that you know these diagrams, as they are often asked in examinations.]

FERTILISATION

Meiosis takes place in the ovary and testes to produce **haploid gametes**. The sperm cell must enter the female body and make its way to the egg cell, so that **fertilisation** can take place to form a **diploid zygote**. Remember that humans require **internal fertilisation** for the reproductive process to take place. The zygote will be a combination of the **hereditary characteristics** of both the male and the female. The zygote will develop into an embryo and then a foetus by mitosis. The foetus will grow inside the uterus of the female's body for 40 weeks where it is well protected. This is called gestation or pregnancy. At full term, the female will give birth to **ensure survival and continuation** of the species.



Diagrammatic representation of ovulation to implantation

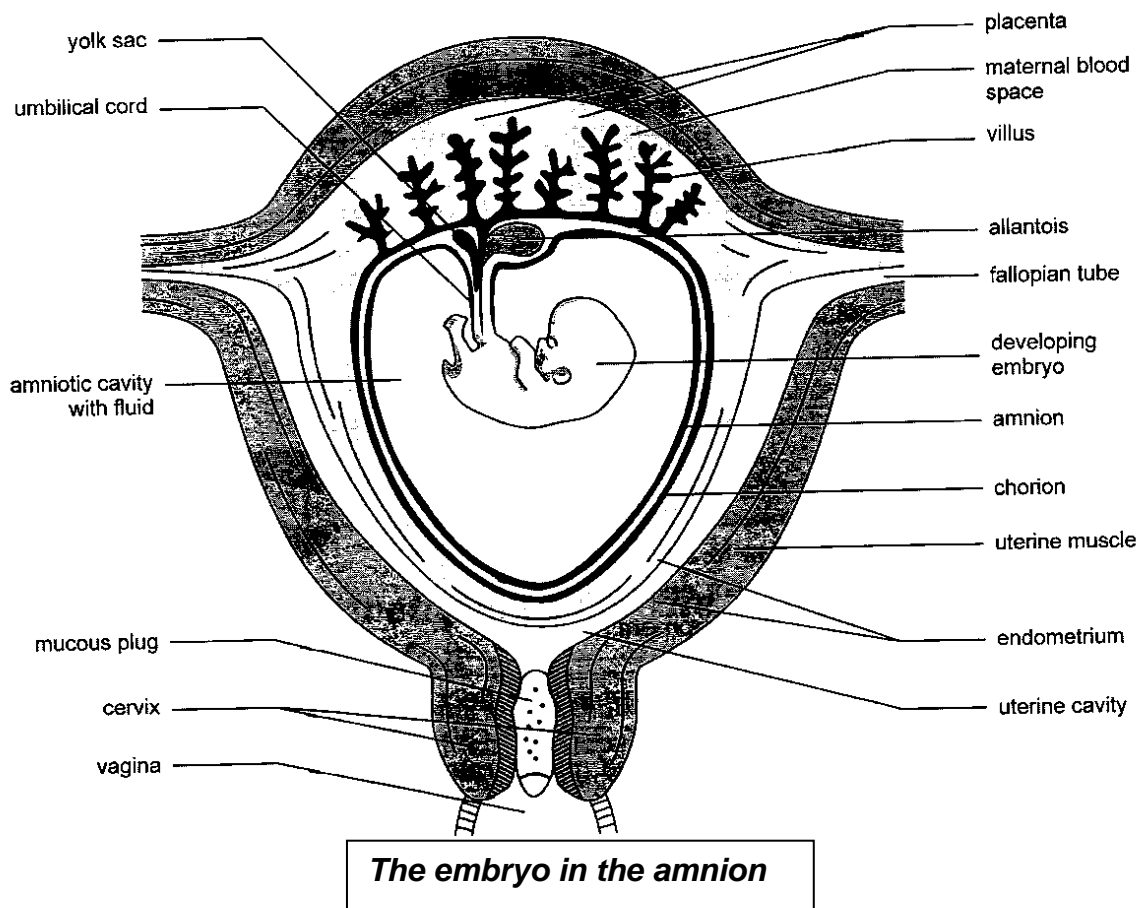
[NOTE: Please learn this diagram well as it is often asked. Remember that the egg cell and sperm cells are all haploid. Once fertilisation takes place, the zygote is diploid.]

Development of the placenta and amnion: The placenta is a structure that **forms a link** between the mother and the developing foetus. It ensures that there is **no direct transfer** of the mother's blood to the foetus. The placenta develops about 12 weeks after conception and allows for the safe exchange of a number of substances between the mother to the foetus through the **umbilical cord**:

- **Nutrients, oxygen, hormones and antibodies** from mother to foetus
- **Carbon dioxide and wastes** from the foetus to the mother, for excretion by the mother
- **Harmful substances** like nicotine from cigarette smoking, alcohol, drugs and viruses like rubella (German measles), hepatitis B and HIV can also move through the placenta.

The **amnion** is a membranous bag-like structure that develops around the embryo and is filled with **amniotic fluid**. It has the following functions:

- to **protect the embryo** by acting as a shock absorber
- regulating the embryo's **body temperature**.



THE BIRTH PROCESS

It is called **parturition** because the baby 'parts' with the mother's body. A hormone called **oxytocin** is secreted by the posterior lobe of the pituitary gland of the mother and causes uterine contractions and the **dilation of the cervix**. Labour begins with contractions, causing the **amnion to burst** ('water breaks'). The contractions force the baby down through the pelvic bones and the birth canal. Once the baby is born, the umbilical cord is clamped off and cut (umbilical cord connects the baby to the placenta). The mother has more contractions to expel the placenta which is commonly called the afterbirth. After birth, the mother produces a hormone called **prolactin** to stimulate milk production. For the first few days **colostrum is produced**. It is a fluid that contains antibodies, proteins and assists to clear out the baby's digestive tract. By the fourth day, normal milk is produced by the mammary glands. This production of milk is called **lactation**. Breast milk contains antibodies and all the nutrients required by the developing baby. HIV positive mothers may not breastfeed their babies as the virus is present in breast milk.

Multiple births: when more than one foetus develops, at the same time, in one uterus.

- dizygotic or fraternal twins – two egg cells and two sperm cells with each foetus having a separate placenta and embryonic membrane
- monozygotic or maternal twins – one egg cell and one sperm cell that cleaves to form two foetuses where they have a fused placenta and share a common embryonic membrane.
- Co-joined twins / Siamese twins – monozygotic twins where cleavage is incomplete resulting in the twins remaining joined at areas on the bodies.

BIRTH CONTROL

Method	Action	Failure rate	Advantages and disadvantages
Barrier methods			
Condom	A rubber sheath, which fits over the penis and prevents sperm from entering the vagina.	3% to 10% depending on whether it is used properly	May slip off or break during intercourse. Must be fitted before intercourse.
Diaphragm or Dutch cap	A flexible rubber dome which fits over the cervix of the female and prevents sperm from entering the uterus. It must be used with a spermicide, which kills sperm.	3% to 15%	Can be inserted a few hours before intercourse. Must be fitted by a doctor the first time to ensure that it is the correct size.
Hormonal methods			
The Pill	Contains oestrogen and progesterone. The pill inhibits the secretion of FSH, thereby preventing the development of the eggs and ovulation.	1%	Very reliable. Side effects like water retention, weight gain, skin pigmentation, headaches and strokes. Not recommended for smokers and women over the age of 40.
Mini-pill	Contains progesterone only so ovulation takes place but thickened cervical mucus prevents sperm from entering the uterus.	2%	Very reliable with a lower dose of hormones. Can be used by older women. Side effects are breakthrough bleeding between periods, headaches and slight water retention.

Implantation preventing methods			
IUD (intra-uterine device) or coil	A device made of copper or stainless steel which is inserted into the uterine wall by a doctor and which prevents implantation of the fertilised egg.	3%	Can be inserted and left for a long period of time. Side effects are heavy periods and discomfort. The IUD may grow into the uterine wall, or may dislodge and come out.
Natural methods			
Abstinence	No sexual intercourse.	0%	Very effective. No sexually transmitted diseases are transmitted. No side effects.
Rhythm method	Avoid sexual intercourse (abstinence) at time of ovulation.	20%	It is a natural method, but female cycles may vary and periods may be irregular. The Catholic Church accepts this method. No side effects.
Sterilisation methods			
Tube tying in females	The fallopian tubes are 'tied' or cut. This prevents the sperm from reaching the egg.	1%	The process is difficult to reverse. In some cases the 'tied' tubes come undone and fertilisation can take place. There are no side effects.
Vasectomy in males	Both vas deferens are cut.	1%	This is a simple procedure with no side effects. Semen is still released but sperm are absent. The process is very difficult to reverse.
Termination methods			
Morning-after Pill	The pill contains an anti-progesterone drug and must be taken no more than 48 hours after sexual intercourse.	20%	This pill may have long-term effects. A doctor prescribes it after a rape or when other means of protection were not used. This pill should only be used as a last resort.
Abortion	See discussion below for detailed explanation		

ABORTION DEBATE

Abortion is the premature and deliberate termination of a pregnancy. The abortion procedure is performed by qualified staff up to 12 weeks of pregnancy. It may be legally performed up to 24 weeks in cases where genetic deformities of the foetus are suspected or the mother is in physical danger. The mother should be **counselled** before and after the procedure. Whether abortion is acceptable to you or not will depend on your belief systems. The following are some of the 'pros' and 'cons' for the abortion debate.

Possible Anti-abortion points

- The unborn foetus is a living being from conception (fertilisation has taken place)
- The foetus has a brain, heart and other organs early in its development (by 10 weeks) and can, therefore, feel pain
- Abortion is legalised killing/murder since you are taking away a life
- Many religions and cultures do not condone abortion – this goes against their morality/ethics that could lead to conflict in the family
- The mother-to-be also experiences deep emotional trauma and depression long after she has aborted her child – even if she has made the choice to abort
- Why should abortion be condoned when there are many contraceptive methods available
- Couples that have sexual relations must be responsible/ if a baby is conceived, it should be accepted and loved, no matter what

Possible Pro-abortion points

- Abortion is legal in South Africa – it is enshrined in our constitution – women have a choice .
- The foetus does not have the status of a child in South Africa.
- Abortion is better than bringing an unwanted child into the world and abandoning it.
- The abandoned child could possibly have anti-social behaviour and become a problem.
- Sometimes women do not have a choice about the use of contraceptives / it is male controlled / she falls pregnant not out of choice / she is raped – abortion is the only option in this case.

[**NOTE:** Be sure to learn the table on birth control because you may be asked to compare various types of birth control. Abortion is a very topical debate. Make sure that if you are asked to give your view, that you only discuss being for **OR** against abortion. Never discuss both views unless you are asked to debate the topic.]

STDs

Sexually transmitted diseases (STDs) are diseases that are transferred by **sexual contact**. They are very common and widely spread. Research has found that the incidence of STDs has doubled since 2002. In the past, communities blamed prostitution for the spread of STDs but the latest findings point to the acceptance of sexual promiscuity and the apparent moral decline of societies.

STDs are caused by **viruses and bacteria** and are transferred by sexual intercourse. In some cases, the symptoms are not immediate, meaning a person is a carrier without being aware of it. STDs can be prevented by **abstinence**, the use of **condoms** and the improvement of moral standards.

	HIV/AIDS
General	HIV/AIDS is known as the killer of the twenty-first century. It is caused by a retrovirus called the human immunodeficiency virus (HIV), which in turn causes acquired immune deficiency syndrome (AIDS). AIDS is the final stage of the HIV infection where opportunistic diseases infect the body and the person finally dies. The virus is transmitted in body fluids like semen, breast milk, vaginal fluid and blood . The HIV is transferred from an infected mother to her unborn child. Touching, kissing, shaking hands, tears do not transfer HIV, nor do sneezing, coughing or mosquito bites.
Cause	The virus attacks the lymphocytes , which weakens the immune system, thereby reducing the body's resistance to illness. The infected person has no resistance to any diseases that may attack the body and will contract an illness like flu, TB, diarrhoea, some cancers or pneumonia. The immune system eventually stops working completely. It is the infection from the contracted diseases that causes death and not the HIV.
Symptom	<p>HIV shows no symptoms for up to 10 years. This time span from infection to symptoms depends on various factors:</p> <ul style="list-style-type: none"> ○ genetic make-up ○ level of immune function ○ physical health condition at time of infection <p>For several weeks after initial infection, there are no signs of infection. This is called the 'window period' where all tests will show negative. It can take up to six months for the test to show positive, in spite of the HIV being present. When HIV positive people show symptoms, it means that the disease has progressed to AIDS.</p> <p>The most common symptoms are:</p> <ul style="list-style-type: none"> ○ severe weight loss ○ diarrhoea and fevers ○ skin cancer may develop beginning with small swollen spots which spread over the whole body ○ organs begin to swell, especially lymph nodes ○ secondary illness infection that results in severe symptoms. For this reason, AIDS is often confused with malnutrition, skin cancer, TB, a bad cold or flu, and blood cancer.

Treatment	<p>At present, a drug called AZT is used to block the HIV replication in the early stages. AZT works by blocking the action of reverse transcriptase, the enzyme needed by the retrovirus for incorporation into the host cell's DNA. Pregnant mothers are given AZT, and babies are treated with AZT after birth. Treatment in later stages is restricted to the secondary illness infection. There is no known cure for HIV/AIDS.</p> <p>People who have contracted HIV/AIDS are afraid of the disease and also the response of others. They need support, understanding and care. However, when caring for people who are infected, the following rules must be applied to ensure your safety:</p> <ul style="list-style-type: none"> ○ Keep cuts and wounds covered ○ Do not share needles, toothbrushes, razors or blades with an infected person ○ Always use rubber gloves when cleaning sores, wounds, vomit, faeces or blood of an infected person
Prevention	<p>Education programmes conducted across the world to inform people of HIV/AIDS. Multiple sex partners are discouraged and monogamy (one sexual partner) is promoted. People are advised to practise 'safe' sex and use condoms at all times. Condoms are being made readily available at clinics, hospitals, places of work and most public toilets. Sterile hypodermic needles are distributed free of charge to drug addicts</p>
	GONORRHOEA
General	<p>This is the most common of the STDs, as there are many strains of the bacteria that cause this disease. A person may develop immunity to one strain but be infected with another. Infected pregnant women may give birth to babies with eye diseases which can lead to permanent blindness.</p>
Cause	<p>Gonorrhoea is caused by a bacterium called <i>Neisseria gonorrhoeae</i>. Infection results from direct sexual contact. It is rarely transmitted by indirect contact with toilet seats or towels.</p>
Symptom	<p>Within 7 to 20 days after exposure the bacteria produce an antigen called exotoxin and causes redness and swelling of the genitalia.</p> <p>Males: infection begins in the urethra with frequent urination, severe burning sensation and a discharge of mucus. Infection then spreads to the prostate gland, seminal vesicles and epididymis. Abscesses develop which may lead to sterility.</p> <p>Females: no immediate symptoms occur. The infection spreads to the uterus and fallopian tubes, leaving dense scar tissue, which can result in sterility. If untreated, the gonorrhoea spreads to other organs affecting the heart valves, the joints and also the meninges of the brain.</p>
Treatment	<p>Antibiotic: penicillin and tetracycline spectinomycin</p>

	SYPHILIS
General	Syphilis causes death in 5 to 10 per cent of infected people if untreated. Pregnant women transmit the syphilis to the unborn baby through the placenta – prenatal syphilis. About 50 per cent of the infected babies die shortly before or after birth.
Cause	A bacterium called <i>Treponema pallidum</i> is transferred during direct sexual contact . It generally enters the body through a break in the skin or mucus membrane. Within 24 hours, it invades the lymph and circulatory systems, spreading throughout the body.
Symptom	There are four stages: <ul style="list-style-type: none"> ○ Primary stage: three weeks after infection with a primary chancre, a small, painless ulcer on the genitals. This chancre is very infectious and any sexual contact leads to infection of the sexual partner. The chancre heals quickly. ○ Secondary stage: two months after infection with flu-like symptoms and a mild rash. In some cases, lesions develop in the mucus membrane of the mouth and the genitals. This stage is highly contagious as the lesions contain millions of bacteria. ○ Latent Stage: there are no apparent symptoms now. The bacteria begin to invade the organs of the body. ○ Advanced stage: lesions called gummas develop on the heart, the skin, liver and spleen. The central nervous system may become infected and this leads to insanity and finally death. Severe lesions of the organs will cause death.
Treatment	Scrapings of the chancre and blood tests will identify the bacteria. Blood tests show the presence of an antibody called regain , produced when a person is infected. An antibiotic like penicillin is prescribed during the primary stage of infection. Once lesions occur, permanent damage to the organs cannot be repaired.

TERMINOLOGY & DEFINITIONS

Corpus luteum: structure that results when the Graafian follicle releases the egg cell during ovulation. The corpus luteum also secretes progesterone if the egg is fertilised

Follicle stimulating hormone: (FSH) produced by the anterior lobe of the pituitary gland and causes the maturing of the follicle surrounding the oocyte and stimulates the supply of nutrients

Gametogenesis: the formation of gametes

Gonadotrophic hormones: hormones secreted by the pituitary gland to control reproductive cycles and processes in males and females

Luteinising hormone (LH): a hormone produced by the anterior lobe of the pituitary gland that stimulates the release of oestrogen into the bloodstream which causes ovulation

Menstrual cycle: this cycle begins with menstruation and continues for 28 days. It is controlled by hormones to co-ordinate the release of the mature egg cell with the readiness of the uterus for implantation, if fertilisation takes place

Menstruation: when there is no fertilisation, the lining of the uterus is shed to prepare for the next cycle. This results in a flow of blood that lasts for approximately 5 days.

Oestrogen: a hormone secreted by the ovaries, causing ovulation

Oogenesis: the process to produce haploid egg cells in the follicles of the ovary

Progesterone: a hormone secreted by the corpus luteum when the egg cell is fertilised to ensure pregnancy

Copulation: the insertion of the male reproductive organ into the female reproductive organ to transfer sperm to the egg cell

Fertilisation: fusion of two haploid gametes (sperm cell and egg cell) to form a diploid zygote

Internal fertilisation: fertilisation that occurs inside the body of the female, inside the Fallopian tube

Pregnancy: it is the development of the embryo inside the uterus. It can also be called gestation.

Vasodilation: is the increase of blood volume causing the penis to become erect. The erect penile tissue closes the valve of the urethra to prevent the possibility of urination during ejaculation of the sperm cells.

Amnion: fluid-filled sac where the embryo develops in the uterus

Amniotic fluid: fluid surrounding the foetus in the amnion

Placenta: a structure that grows from the wall of the uterus to prevent direct contact of the mother's blood with that of the foetus.

Umbilical cord: links the placenta to the developing foetus

Afterbirth: the mass of placenta and membranes that are expelled from the uterus after the birth of a baby

In vitro fertilisation (IVF): This is when one or more eggs is fertilised outside the woman's body and transferred into the uterus for development and growth.

Dizygotic or fraternal twins: (di = two) when more than one egg is released during ovulation and fertilised. The developing foetuses share the same uterus, but each foetus has a separate placenta and their own amnion. The twins are not identical;

Monozygotic or maternal twins: (mono = one) when one egg is fertilised and the egg zygote or blastocyst separates into two structures, identical twins will result. The twins have the same sex and be identical in genetic inheritance and appearance. The placenta will be fused with a common embryonic membrane.

Conjoined twins: Sometimes the splitting of the embryo into two (monozygotic twins) is not complete, resulting in the twins remaining joined at areas and they may even share internal organs. The conjoined twins are called Siamese twins.

Contraception: (also called birth control) various methods are used to prevent conception and the development of the embryo.

STDs: sexually transmitted diseases

Abstinence: no sexual intercourse takes place

Monogamy: when people only have one sexual partner

Opportunistic diseases: diseases that attack the body when the immune system is suppressed

Sexual promiscuity: when people have multiple sexual partners

SECTION C: HOMEWORK**QUESTION 1: 20 minutes***(Taken from various sources)*

1. In mammals, fertilisation takes place in the
 - A Fallopian tubes
 - B vagina
 - C uterus
 - D ovary
2. During the development of the embryo, the function of the amnion is to
 - A give rise to the placenta
 - B protect the embryo against harmful chemical substances
 - C enclose the fluid which protects the embryo against injury
 - D prevent the developing embryo from moving about
3. The following is NOT a function of the placenta of mammals:
 - A transports nutrients to the embryo
 - B removes waste products from the embryo
 - C protects the embryo against mechanical injury
 - D protects the embryo against harmful chemical substances
4. The fusion of an egg cell and a sperm cell is known as
 - A copulation
 - B cleavage
 - C fertilisation
 - D ovulation
5. The human embryo obtains:
 - A nutrients and oxygen from the mother's blood
 - B nutrients and CO₂ by diffusion across the placenta
 - C yolk and albumen from the allantois
 - D nutrients and oxygen by diffusion across the placenta
6. The human foetus is immediately surrounded by the...
 - A allantois
 - B amnion
 - C chorion
 - D placenta
7. The human foetus is surrounded by
 - A amniotic fluid
 - B air
 - C wastes
 - D mother's blood
8. Fertilisation occurs when the....
 - A sperm penetrates the ovum
 - B sperm makes contact with the ovum
 - C nucleus of the sperm fuses with the nucleus of the ovum
 - D fertilisation membrane has formed around the ovum

9. Which of the following pairs indicates a reproductive structure and its function accurately?
- A Fallopian tube – production of sperm
 - B Vagina – fertilisation
 - C Uterus – development of the embryo
 - D Testes – production of the ovum
10. The main function of the amnion and amniotic fluid is:
- A shock absorber
 - B medium that removes excretory waste
 - C medium from which oxygen is obtained for the growing embryo
 - D medium in which secretions take place
11. Which of the following is not an example of a sexually transmitted disease?
- A Tuberculosis
 - B Syphilis
 - C AIDS
 - D Gonorrhoea
12. The 'window period' is when the body does not show any signs of infection of the HIV/AIDS virus for up to _____ after initial infection even with blood tests:
- A 7 weeks
 - B 6 months
 - C 12 weeks
 - D 8 months
13. Gonorrhoea is transmitted through direct sexual contact as well as through contact with toilet seats and towels.
- A True
 - B False
14. An AIDS infected person will contract illnesses such as:
- A flu
 - B pneumonia
 - C TB
 - D all of the above
15. Contraception pills work effectively because the hormone progesterone in them...
- A stops the development of the egg cell
 - B prevents the thickening of the endometrium wall
 - C impedes the movement of sperm in the fallopian tube
 - D increases the movement of sperm in the fallopian tube
16. Mother to child transfer of HIV is an area of great concern. Which of the following statements is true?
- A HIV is sometimes transferred through the birthing process or breastfeeding
 - B AZT is a drug that prevents the HIV from being passed from the mother to the developing foetus
 - C AZT is administered to the foetus during the first trimester of pregnancy
 - D A Caesarean section is not the preferred method of birth for an HIV positive mother because there is too much blood

17. Which of the following is the hormone responsible for the birth process?
- A prolactin
B oestrogen
C progesterone
D oxytocin
18. Dizygotic twins....
- A result when one egg cell is fertilisation and separates into two structures
B will be identical in genetic inheritance and appearance
C result when two or more eggs are fertilisation
D will always be the same sex
19. The following are various forms of contraception:
- (i) condoms
(ii) the pill
(iii) IUD
(iv) abstinence
(v) vasectomy
- Which of the following contraception methods will reduce the risk of transferring STDs?
- A (i), (ii) and (iii)
B (i) and (v)
C (i) and (iv)
D (i), (iii) and (iv)
20. Which of the following statements about abortion is incorrect?
- A It is the premature and deliberate termination of a pregnancy
B Counselling is not necessary once the mother has made her choice
C Abortions may only be performed up to 12 weeks of pregnancy under normal circumstances
D Abortions are only legally performed by qualified medical staff

(20 x 1) = [20]

QUESTION 2: 6 minutes (Taken from NSC LS Exam November 2009 Paper 1)

Choose an item from COLUMN II that matches a description in COLUMN I.

COLUMN I	COLUMN II
1. The type of reproduction involving a male gamete that fuses with a female gamete	A gestation B identical
2. The type of fertilisation that occurs outside the body in a glass petri dish in a laboratory	C placenta D cancer
3. The type of twins formed as a result of the fertilisation of two ova	E sexual F fraternal/ dizygotic/ non-identical
4. The muscular, hollow organ in mammals in which the embryo develops	G in-vitro H asexual
5. The period of development of an embryo between fertilisation and birth	I uterus
6. Forms as a result of uncontrolled division of cells	

[6]

QUESTION 3: 16 minutes*(Taken from Viva Life Science G12)*

Some sexually transmitted diseases (STDs) are increasing world-wide. The table below indicates the number of people infected with two common bacterial STDs.

Year	Number (per 100 000 people) infected with syphilis	Number (per 100 000 people) infected with gonorrhoea
1986	50	150
1990	150	280
1994	200	150
1998	220	100

- 3.1. On the same system of axes, draw TWO line graphs to compare the number of people infected with syphilis and gonorrhoea from 1986 to 1998. (13)
- 3.2. Describe the trends shown in both graphs for EACH of the two diseases. (3)
- [16]

SECTION D: SOLUTIONS AND HINTS TO SECTION A
QUESTION 1

- 1.1 Accept day 14 or day 15✓ (1)
- 1.2 Days 0 - 7✓ or 1 - 7 or 0 - 6 or 1 - 6 (1)
- 1.3 - Stimulates development of Graafian follicle✓
 - Causes the follicle to burst open✓/stimulates ovulation
 - Stimulates the formation of the corpus luteum✓ (1)
- (Mark first ONE only)**
- 1.4 - LH levels remain low✓/more or less constant up to day 12/13
 - Then it increases✓ sharply up to day 14
 - After which it decreases and remains low✓/more or less constant (3)
- 1.5 As the oestrogen level increases✓
 the thickness of the endometrium also increases✓ (2)
- 1.6 Maintains the increase in the thickness✓/blood supply/glandular nature of the endometrium
 for greater chances of implantation✓/maintaining pregnancy
- OR**
- Inhibits the production of FSH✓
 preventing further ovulation✓in this cycle (2)
- 1.7 No✓ (1)
- 1.8 The progesterone level✓has dropped✓/ is not maintained
- OR**
- Corpus luteum✓ has started to degenerate✓
- OR**
- FSH✓ level starts to increase✓ towards the end of the cycle (2)
- [13]**

QUESTION 2

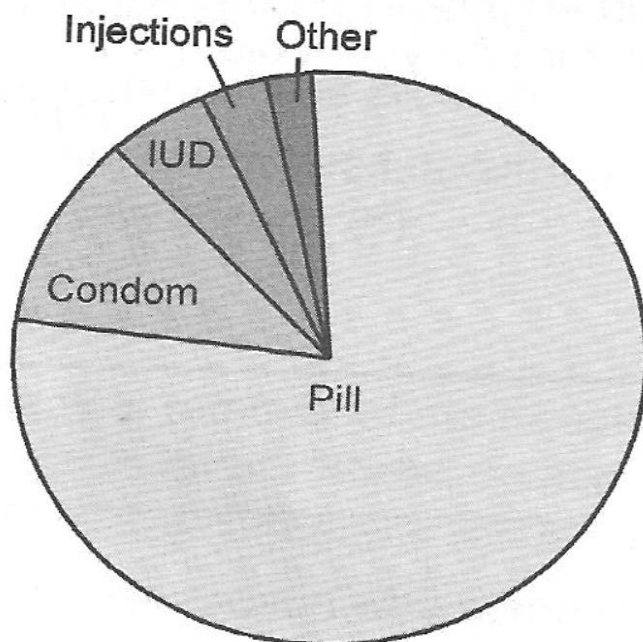
- 2.1 A- Ovary ✓, E- Fallopian tube ✓, G- endometrium ✓, (3)
 2.2 Ovulation ✓ (1)
 2.3 Day 14/middle of the menstruation cycle ✓ (1)
 2.4 Fertilisation ✓, takes place. The sperm ✓(haploid/n) fuses with the (haploid/n) egg cell/ovum ✓to form a diploid zygote (2n) ✓ **(any 3 points)** (3)
 2.5 a) 23 chromosomes ✓ (1)
 b) 46 chromosomes ✓ (1)
 c) 23 chromosomes ✓ (1)
[11]

QUESTION 3

- 3.1. A Placenta ✓
 B Umbilical cord ✓
 D Vagina ✓ (3)
 3.2 - Acts as a shock absorber ✓
 - Regulates embryo's body temp / keeps temp constant ✓ (2)
 3.3. Amniocentesis ✓ (1)
 3.4. Oxytocin released by posterior lobe of Pituitary gland ✓. Causes uterine contractions, push baby out through the birth canal. ✓ (2)
[8]

QUESTION 4

- 4.1. The pill ✓is the most commonly used contraceptive in the community ✓ (2)
 4.2. Design a questionnaire. ✓ (1)
 4.3. The pill and injections ✓✓ (2)
 4.4. Condom ✓✓ (2)
 4.5. Survey of different types of contraception



Pill: 86.4%:
 $86.4 \times 360 = 31104/100 = 311^0$

IUD: 3.1%:
 $3.1 \times 360 = 1116/100 = 11^0$

Condoms: 6.4%:
 $6.4 \times 360 = 2304/100 = 23^0$

Injections: 2.2%:
 $2.2 \times 360 = 792/100 = 8^0$

Other: 1.8%:
 $1.8 \times 360 = 648/100 = 7^0$

Calculations	1 mark for each calculation (5)
Correct type of graph	1
Title / heading is correct	1
Correct proportions for each slice	1 mark for each slice (5)
Each sector is labelled or a key is given	1
Each amount/percentage is indicated on the graph	1

(14)

[21]**QUESTION 5**

- 5.1. D
 5.2. J
 5.3. F
 5.4. K
 5.5. B
 5.6. G
 5.7. E
 5.8. H
 5.9. M
 5.10. I

[10]

SESSION 14**TOPIC: POPULATION ECOLOGY: SPECIES, POPULATION AND COMMUNITY,
POPULATION SIZE, HUMAN POPULATION AND SOCIALISATION**

Learner Note: Please ensure that you are able to do the calculations required within this section. Make sure that you know your definitions well, and are able to apply your knowledge.

SECTION A: TYPICAL EXAM QUESTIONS**QUESTION 1: 20 minutes** *(Taken from Viva Life Science Grade 12)*

The table below shows the population of rats in a mealie field over a period of ten years.

Year	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
Population	30	40	80	130	140	130	95	115	110	110

- 1.1. Use the table above to draw a graph. (12)
 - 1.2. What type of growth form is shown by this graph? (1)
 - 1.3. Indicate the carrying capacity of the mealie field on the graph. (2)
 - 1.4. List FOUR abiotic factors that affect the carrying capacity of an area. (4)
- [19]

QUESTION 2: 6 minutes *(Taken from Viva Life Science Grade 12)*

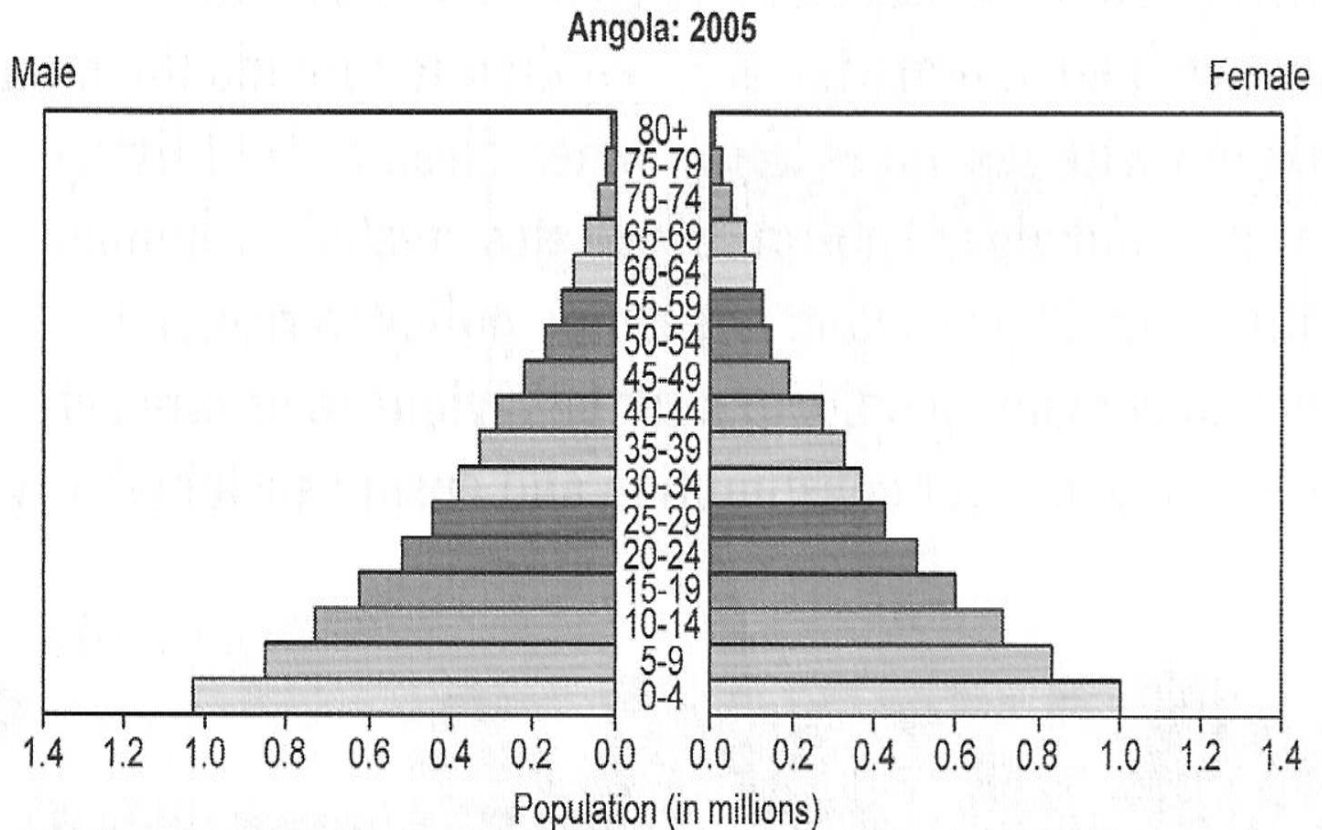
A farmer has a game farm and wants to establish the number of impala that he has.

- On a set date, they build an enclosure.
- They then set out on horseback and round up 50 impala.
- Once the impala are safely in the enclosure, the animals are marked and set free.
- After two weeks, the animals are rounded up for the second catch of 42 impala.
- 10 marked animals are found in the second catch.

- 2.1. Calculate the estimated population of impala that the farmer has on his game farm. Show all your calculations. (4)
 - 2.2. How will the farmer be able to improve the accuracy of the estimated population size of the impala that live on his farm? (2)
- [6]

QUESTION 3: 15 minutes*(Taken from Viva Life Science Grade 12)*

Study the pyramid of population size in Angola and answer the questions that follow:

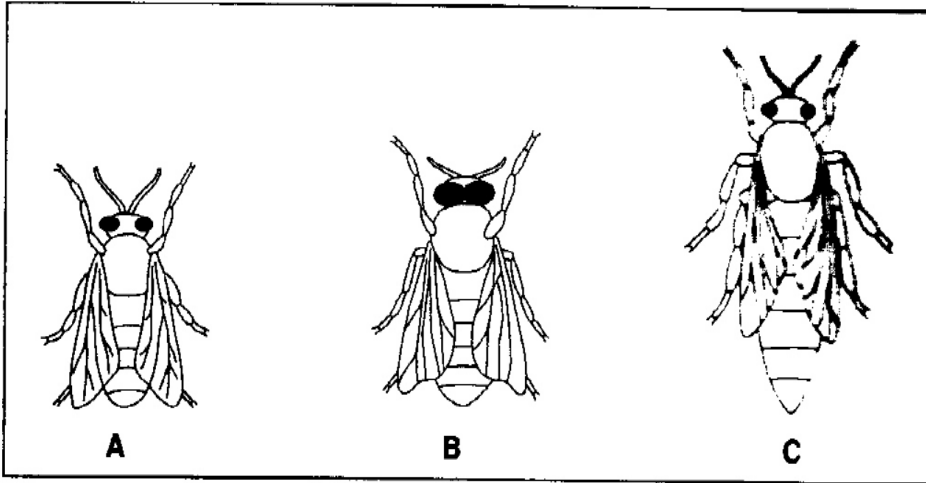


Source: U.S. Census Bureau, International Data Base.

- 3.1. What percentage of the female population is aged between 15 and 19 years?
Show calculations. (2)
 - 3.2. Which age group makes up approximately 20% of the male population? Show calculations. (2)
 - 3.3. What number of the female population is aged between 65 – 69? (2)
 - 3.4. What is the difference in population size between females in the age group 0-4 and 45-49? (2)
 - 3.5. Provide two reasons why the mortality rate is so high for the age group 0-4. (2)
 - 3.6. Which group, male or female has the greater percentage reaching old age? (1)
 - 3.7. Provide two reasons for your answer to Question 3.6 above. (4)
- [15]

QUESTION 4:**14 minutes***(Modified from unknown source)*

Study the diagrams of the three castes of individual bees that live in a bee colony and answer the questions that follow



- 4.1. Identify the castes marked A, B and C and state one function of each. (6)
- 4.2. Which one of the three castes has no sting? (1)
- 4.3. How does the queen bee ensure that only one queen develops to the stage of laying eggs? (1)
- 4.4. Name the special substance that is fed only to the queen bee. (1)
- 4.5. Discuss social organisation in animal packs especially with regard to pack leadership. (5)
- [14]

SECTION B: ADDITIONAL CONTENT NOTES

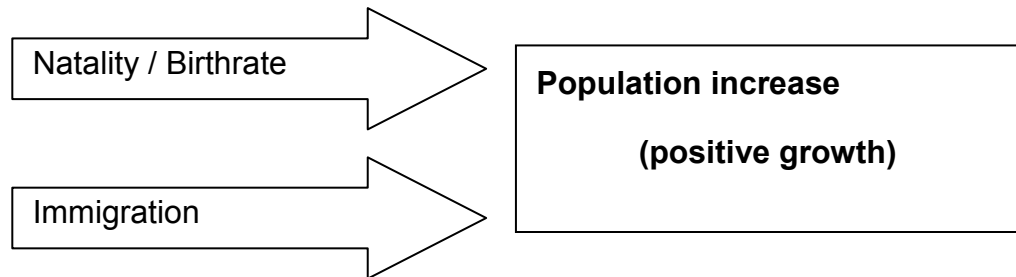
Community structures within ecosystems

The living organisms in an environment are called the **biotic factors**, for example plants and animals. The non-living factors are called the **abiotic factors**, for example air, light, water, soil and temperature. An interaction takes place within a community as individuals compete for abiotic factors, food, shelter and space. This will result in **specialisation** within species for a particular mode of life.

Population parameters are the factors that affect the increase or decrease in the population size. The size and density of a population is expressed in numbers or biomass. **Biomass** is determined by multiplying the **number of organisms** with the **average mass** of the individuals in the population.

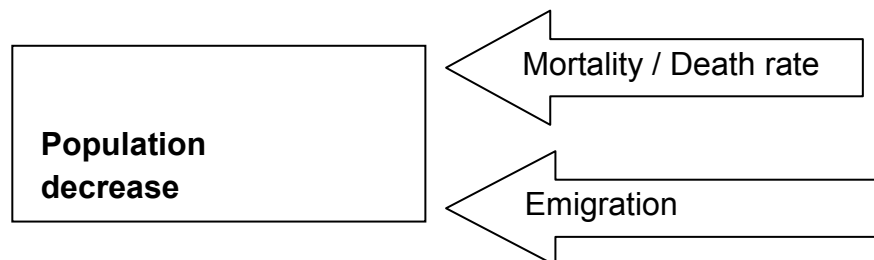
Population increase

- **Birth rate or natality** is the natural ability of a population to increase in numbers. This depends on the ability to reproduce. In the case of bacteria and viruses, the rate of reproduction depends on favourable conditions and can be measured over a short period of time. In higher organisms, the **fecundity** of the females will affect the rate of reproduction.
- **Immigration** occurs when individuals move from one area **into** another area **permanently** and make this their habitat. The new individuals are able to join with the population and increase the numbers.



Population decrease

- **Death rate or mortality** causes the population to decrease. It is expressed as the number of deaths over a specific period. The mortality of a population may be due to a number of factors such as lack of food, shelter, space, increase in disease and predation. The numbers decline because individuals die and are not replaced at the same rate.
- **Emigration** occurs when conditions become unfavourable (lack of food, water, shelter and space). Individuals in a population may **leave** the habitat **permanently** in favour of a better one.



Migration is the relocation of a population, based on the temperature and availability of food. It is **temporary** and based on **seasonal changes**. Swallows and geese migrate from one region to another to a warmer climate. Here food is more abundant. When this region cools down and autumn approaches, they relocate back to the first region.

Population stability

When natality is **equal** to mortality over a period of time, the population is said to be **naturally stable**. The size of a population can be regarded as stable and constant because of the impact of **environmental resistance**. The environment is never constant as the impact of food, shelter, disease and predation changes. Seasonal changes play a very important role in the size of a population. Animals may die in winter, causing a decrease in the numbers. In spring, the new babies are born causing an increase in the population again.

Environmental resistance will become apparent as members of the population compete for resources such as food, water, shelter and space. When the environmental resistance prevents the population from increasing, the **carrying capacity** of the habitat has been reached. The **carrying capacity** is the number of individuals of a population that can be comfortably supported by the environment. Carrying capacity changes according to food supply, competition, seasonal weather patterns and impact of disease.

The **key factors** that are responsible for fluctuations in population size are **rainfall, snow and drought**. If the population density varies greatly from year to year, then it is classified as **unstable**. If the population density **does not change** much from year to year, then it is classified as **stable**. Humans or a natural disaster sometimes alter the carrying capacity of the environment. Fewer organisms are able to survive in the specific area, so we say that the carrying capacity has **decreased** due to environmental resistance **increasing**.

Fluctuations in populations: Plants are the basic food source on our planet and are classified as **producers**. In food chains, energy transfer is restricted by the rate of photosynthesis which is dependent on radiant energy, CO₂, H₂O and mineral salts. This **limits** the food produced by green plants and directly influences the number of organisms that require plants for nutrition.

Density parameters: fluctuations within a population near the equilibrium phase are normal. To remain stable, each pair of sexually reproducing individuals must produce two surviving offspring per lifetime where the offspring each survive to sexual maturity. This will keep most species at a **constant density** and ensure that there are enough resources.

Density describes the number of individuals of a population, located in the same area within a specific time period. Factors that regulate population growth when the population density is high are called **density-dependent factors**. Factors that regulate population size, that are **not related** to population density, are called **density-independent factors**.

Density-dependent factors

These factors prevent overpopulation to maintain a **stable** population. Larger population numbers will cause an **increase** in mortality, causing the population density to **decrease**. The population stabilises and the carrying capacity is maintained. The need will increase as population increases and approaches carrying capacity. Density-dependent factors are:

- **Food and water:** The greater the number of individuals, the more food and water is needed.
- **Competition:** The greater the number of individuals, the more they compete for resources ensuring survival of the fittest.
- **Space and shelter:** The greater the number of individuals, the less space and shelter is available which results in high levels of stress. Stress causes a decrease in the fertility and natality rate of the population.
- **Predation:** The survival of the predator depends on the number of prey available. The larger the prey population, the easier it is for the predator to catch the prey. Less prey results in the predator having to work harder to catch its food and may result in the predator starving.
- **Disease:** Disease spreads quickly when overcrowding occurs.

Density-independent factors

These factors are **not related** to the population density and are **independent** of the numbers of a population. They affect a population **regardless** of the number of individuals. If a veld-fire burns in an area, the plants and animals will die. If a river floods, it makes no difference whether there are ten animals or a thousand living on the banks of the river. The river will flood and the animals will be washed away.

The density of the population has no impact on density-independent factors. Biologically, all populations are density-dependent. However, density-independent factors will affect population numbers by causing a drastic decrease in the population size. The population is able to recover after the event and stabilise at the carrying capacity. Density-independent factors are:

- **Natural catastrophes:** This includes droughts, hurricanes, earthquakes and floods. The population density is reduced non-biologically.
- **Climate:** Severe temperatures affect population numbers. During a very cold winter, individuals within a population will die even though food may be available. The strongest survive, so natural selection occurs. Adverse climates may also cause a food shortage. In this case, the weaker individuals within a population die of starvation.

Factors that limit population size

A population also consists of individuals that are at various stages within their life cycle. The individuals within a population are not necessarily evenly spread throughout the habitat. Throughout the world, there is also a **misdistribution** of resources and **inefficient use** of natural resources by the human population. This can be overcome to an extent, with education in correct farming methods, pest control and conservation of natural resources.

Abiotic factors

Plant populations are directly affected by abiotic factors such as rainfall, temperature, light intensity and fertility of the soil. Animal and human populations are affected by seasonal changes.

Biotic factors

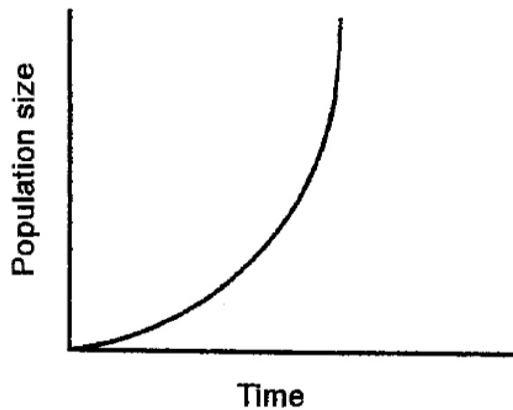
Plants are affected when animals and caterpillars eat the leaves resulting in a reduction in the ability to photosynthesise. Plants are also affected by parasites, fungus infections and diseases. Animals are affected by the availability of **food, shelter, predation, parasitism** and **diseases**. The fittest and hardiest of the species survive.

Population growth patterns

Each population shows a characteristic **growth pattern**, which is influenced by the **environment** and the **rate of reproduction**. We are going to look at two types of growth patterns, namely geometric and logistic growth forms.

Geometric growth pattern

This is **exponential growth** resulting in the shape of a 'J' on a graph. The graph indicates a **rapid increase** in population and then **stops abruptly** due to environmental resistance because of a lack of resources, seasonal changes or pollution by faeces.

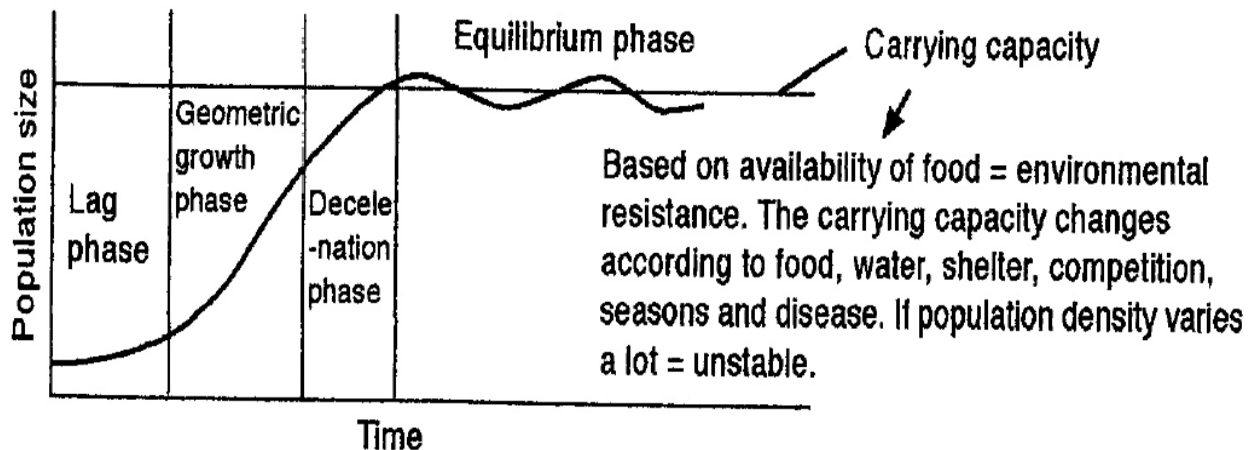


The numbers of the population decrease rapidly once **environmental resistance** sets in. Geometric growth patterns are normally characteristic of organisms that reproduce by **binary fission or asexually by mitosis**. Once the environment has stabilised and the population has decreased to an acceptable number, an increase in the growth pattern begins again. In the case of bacteria when an antibiotic is used, the entire population dies and growth comes to a rapid halt. If the course of antibiotics is not completed, there is a chance that some bacteria are not killed. If only one organism survives, the whole infection will begin again. If there is no environmental resistance to keep the bacteria population in check, it will increase exponentially.

Logistic growth pattern

This growth pattern can also be called the **sigmoid graph** and takes the shape of an **'S'** curve. It will show an upper maximum limit and has five distinct stages or phases.

- **Initial lag phase:** The population growth is very slow. During this phase the population has few reproducing individuals. They must acclimatise to the area and find a mate. After mating, the gestation period takes time.
- **Accelerated or geometric growth phase:** The population growth is at a maximum rate. Little or no environmental resistance is present. The natality rate is high.
- **Deceleration growth phase:** The birth rate slows down due to environmental resistance such as competition for food, space, increased predation and/or parasitism. The natality rate is still higher than the mortality rate.
- **Equilibrium phase:** The population is stable. Natality is equal to mortality. The **carrying capacity** of the environment is reached at this phase.
- **Death phase:** In some cases, the graph may indicate a dramatic downward slope after the equilibrium phase has been reached. It is not just a fluctuation in the population numbers. The death phase may indicate **extinction** of a species as all the individuals of the population die. This is caused by extreme **environmental resistance** due to disease, pollution, drought or human impact.



Determining population size

The principles of ecology are based on **qualitative** and **quantitative data** obtained from studies carried out on animals, plants and the abiotic environment. Based on research findings, we can monitor, evaluate and manage environments and the populations that inhabit them. We can determine **survival strategies** and manage the **population changes** over time.

First, the **numbers** of the population must be established. The distribution of individuals in a population greatly affects the reliability when determining the population size. There are three types of distribution of individuals in a population:

1. **Regular distribution** shows a normal and **even distribution** throughout the area. The animals mark out a small area around themselves and defend this area **territorially**.
2. **Random distribution** shows a distribution pattern where the location of an individual is not affected by the locations of other individuals. **No territoriality** is evident.
3. **Cluster distribution** shows a distribution where individuals group together in clusters across a defined area. This is a trend with **social animals** such as a pride of lions or herd of elephants. Seeds that develop from fruit show the same tendency as the fruit falls on the ground and new plants develop in a group.

The investigator cannot use the same method to determine the number of weevils in a bag of flour as the number of elephants in the Kruger National Park. We **estimate** the weevil population, but **count** the elephant population. We establish population size using various methods. The choice of method will depend on:

- the **accuracy** required
- the **type of organism**
- the specific **habitat** involved.

Direct techniques

When organisms are **large** enough to count accurately and the individuals **do not move around** too much, we can use the direct technique. This requires that each individual of the population be counted. This is called the **census method**.

When we count animals, we must **define** the area and count the individuals as **quickly** as possible. If the area is too large or the animals move around, we can take **aerial photos** from an aeroplane or helicopter. We can then count the individuals directly from the photos and avoid counting one individual twice. Game rangers can also determine the population numbers by counting footprints and animal droppings.

We use the census method when:

- the animals are **large**
- they inhabit a **fixed area**
- they can be counted **quickly and easily**.

Indirect techniques: used to **estimate** the population size. **Samples** of the individuals are counted accurately and then the total population is calculated using a simple formula.

There are two common types of indirect techniques:

- quadrant method
- mark-recapture-mark method.

Quadrant method

To establish the number of daisies in a field, or the number of grass and weeds in a given area, the quadrant method is used to determine the **species density** and the **species frequency** of more than one species at a time.

Species density: is the number of individuals of a species found in a **given area**. You can compare different areas and different species when you have obtained the results.

Species frequency: is the number of individuals of a species found in **each quadrant**. It is the distribution of the species. If the species is found in every tenth quadrant, then the frequency is 10% of the total area.

The quadrant method involves counting the individuals found in a number of **1 m × 1 m squares** that are **randomly spaced** over the **total area**.

- Use nails and string to mark out this **1 m² area**.
- Select each quadrant at **random** (turn your back on the area and throw a stone over your shoulder – your quadrant will be where the stone lands).
- Repeat this procedure until you have covered approximately **10% of the total area**.
- **Accuracy** is very important when you count the sample in each quadrant.

Use the following formula for calculating the total estimated population:

$$\text{Estimated population} = \frac{\text{numbers in sample} \times \text{total size of area}}{\text{size of quadrant}}$$

Where the number in a sample is the average of the numbers for all the quadrants, for example:

$$1 + 2 + 6 + 8 + 4 + 3 + 2 + 1 + 2 + 4 = 33 \div 10 \text{ quadrants} \\ = 3,3 \text{ rounded to the nearest number} = 3$$

The reliability of this method depends on the following:

- Quadrants must be selected at **random**.
- Each individual inside each quadrant must be **accurately counted**.
- Quadrants must cover at least **10% of the total area**.
- The **total area** must be known.

Mark-recapture-mark method (Peterson's index):

The mark-recapture-mark method is used to establish the **estimated** population size of animals that **do not remain** in the **same area permanently** or animals that are **not always visible**. Think about fish in a pond or impala that are spread across the Kruger National Park.

Using this method:

1. We **catch, mark and release** the animals.
2. The animals are allowed time to **mix** with the rest of the population.
3. After a time, we capture a **second sample** and count the individuals where **marked and unmarked animals** will be in the second sample.
4. We can use the following formula to calculate the estimated population size:

$$N = \frac{C \times M}{R}$$

N = Estimated population size

C = Total number of individuals in 2nd catch

M = Total number of individuals in 1st catch

R = Number of marked individuals in 2nd catch

$$\text{Estimated population} = \frac{\text{total of second catch} \times \text{total of first catch}}{\text{marked in the second catch}}$$

The reliability of this method improves with each recapture of the individuals:

$$\frac{\text{total of the third catch} \times \text{total of the second catch}}{\text{marked in the third catch}}$$

The more times that the steps are repeated, the more accurate the estimation of the population size will be.

Always mark the individuals in a way that will **not harm** them or prevent them from living normally. It is important that the method of marking stays visible until the individuals are recaptured. Methods of tagging include:

- paint that is non-toxic and waterproof (snails, tortoises)
- rubber rings on the legs of birds
- plastic tags through the ears of buck
- branding an emblem on the animal's rump
- shaving hair in a distinctive pattern
- aluminium discs on the operculum of fish.

We can only use the mark-recapture-mark method on organisms when:

- the population numbers do **not change** rapidly
- the area is **closed**, with no immigration or emigration
- the individuals have a **lifespan** which is long enough for you to capture, mark, release and recapture.

The recapture process must be completed in a period, which is long enough to ensure that the marked individuals have time to mix with the rest of the population. It must not be too long as birth and deaths affect the counting process.

Human population growth

Humans are reducing the carrying capacity of the earth at an alarming rate due to pollution, abuse of natural resources and usage of fossil fuels. Scientists have theorised that with the exponential growth of the human population, declined energy resources and food shortages, we will be faced with catastrophes by 2030. In 2005, research data by the UN states that more than 855 million people were suffering from poverty and malnutrition in the world.

Ecological Footprint:

Human population growth has serious implications for the natural environment. As the human population increases, so does the demand on the ecological resources and the capacity of our planet to regenerate these resources to maintain a carrying capacity. The **ecological footprint (EF)** is the measure of the demand of the human population on the ecosystems. EF assesses the productive land and marine area required to provide the human population with resources (food, living space, etc.) and also to absorb the wastes created by human activities. The EF is used to determine policy to regulate nations, to educate people, to alter behaviour to ensure carrying capacity, prevent over-consumption and ensure sustainability.

Human Population Increase:

The United Nations expects the world population to increase to about 9 billion by 2040. Based on these statistics, scientists estimate that the EF is increasing at 1,3 times faster than the planet can renew the ecological resources.

Developed countries like those in the Western world (Europe, Asia and America) produce far more food than the population can consume. Between 1980 and 2000, food production rose by 2,8% while the population only increased by 0,8%. In developing countries like in Africa, many are faced with food shortages and famine because of droughts, the pressures on the environment, lack of technology and poor economies.

Between 1980 and 2000, food production rose by 1,4% and the population increased by 3,6%. Countries are faced with three options: grow more food to sustain the needs of the population; reduce the population size until it is able to support its people; and import food from other countries. The carrying capacity of the country must be increased or environmental resistance will cause an increase in mortality. Very often, developing countries do not have the economic structure and funds that wealthy developed countries have. Feeding schemes and financial assistance is given to the developing countries that are in need. However, this is not sustainable in the long term.

Note that an increase in the survival of people over childbearing age will not affect population growth. If the mortality rate of children decreases, it will mean that more children survive to reproduce. This will result in population changes and growth.

Social organisation

Social organisation is a term that describes the **role**, **function** and **status** within a population to ensure the survival of the group. Let us look at examples of social organisation where the whole community benefits:

Animal herds:

A **herd** (of buck, elephants, buffalo, etc.) is a large group of animals and shows **collective** animal behaviour. This provides **protection** against predators as only the animals on the outside of the group are in danger, while those that are nearer the centre are protected. In elephant populations, the oldest female is called the **matriarch** because she is the most dominant and leads the herd.

Bird flock

Flocks of birds (for example, geese, finches and swallows) show a similar social organisation to herds. In the case of geese, during migratory flights, they fly in a V shape to assist with wind-resistance. The lead position is alternated between all the stronger males in the flock, so as the leader gets tired, he moves out of the point to the end and is replaced with a fresher bird. The flock also provides **protection** against predators.

Animal packs

Packs (of wild dogs, wolves, lions, etc.) are far more successful when hunting prey, as there is strength in numbers to cut off one animal and bring it down. There is also protection of the offspring as all the adults will protect the pack fiercely. Packs are far smaller in number than herds. There is a **ranking order** and intense loyalty within the pack, which is led by the **alpha-male**. The dominant breeding pair forms a family unit that includes their offspring. When young pack members are of a certain age, they move into a new territory to start their own family unit. There is no sexual tension in the pack and, therefore, leadership by the alpha-male is accepted. The **dominant breeding pair** leads the pack, with their signals and behaviour imitated by the younger members. Hunting strategies are learned from other pack members. One disadvantage of working as a pack means that when prey is hunted and caught, all the members must share the food. This results in an eating order, where the strongest males will eat first, then the females, and the young and weak will be left with what remains on the carcass.

Insect colonies

Bee colonies have three castes or social groups:

- The **queen** lays all the eggs. The queen is a larva that develops from a fertilised egg and is fed on a nutritious substance called royal jelly. The first mature queen to emerge from her cell kills all the other possible queen larvae with her sting. She leaves the hive for her nuptial or mating flight. After mating, she returns to the hive. Her abdomen swells and she starts laying eggs. A queen lays up to 3 000 eggs a day for her lifespan of about 4 years.
- The **drones** are fertile males that develop from unfertilised eggs (a process called parthenogenesis). Drones cannot feed themselves, so the worker bees must feed them. They have no stings and function only to mate with the queen. After mating, part of the drone's gut is ripped out when he tries to fly away from the queen, resulting in death.
- The **worker bees** are the smallest physically. They are sterile females that develop from fertilised eggs. The first three weeks from hatching, they develop into adult workers. They live for about 6 weeks and perform functions inside the hive for the first three weeks and outside for the remaining three weeks. The roles and functions of the worker bees are:

Inside the hive:

- **Nurse bees (first 12 days):** Clean out empty cells, feed drones, feed larvae.
- **Cleaner and builder bees (next 6 days):** Clean hive, produce wax to build new cells, convert nectar into honey.
- **Guardians (next 3 days):** Guard the entrance to the hive, protect the hive and regulate the temperature inside the hive by fanning their wings.

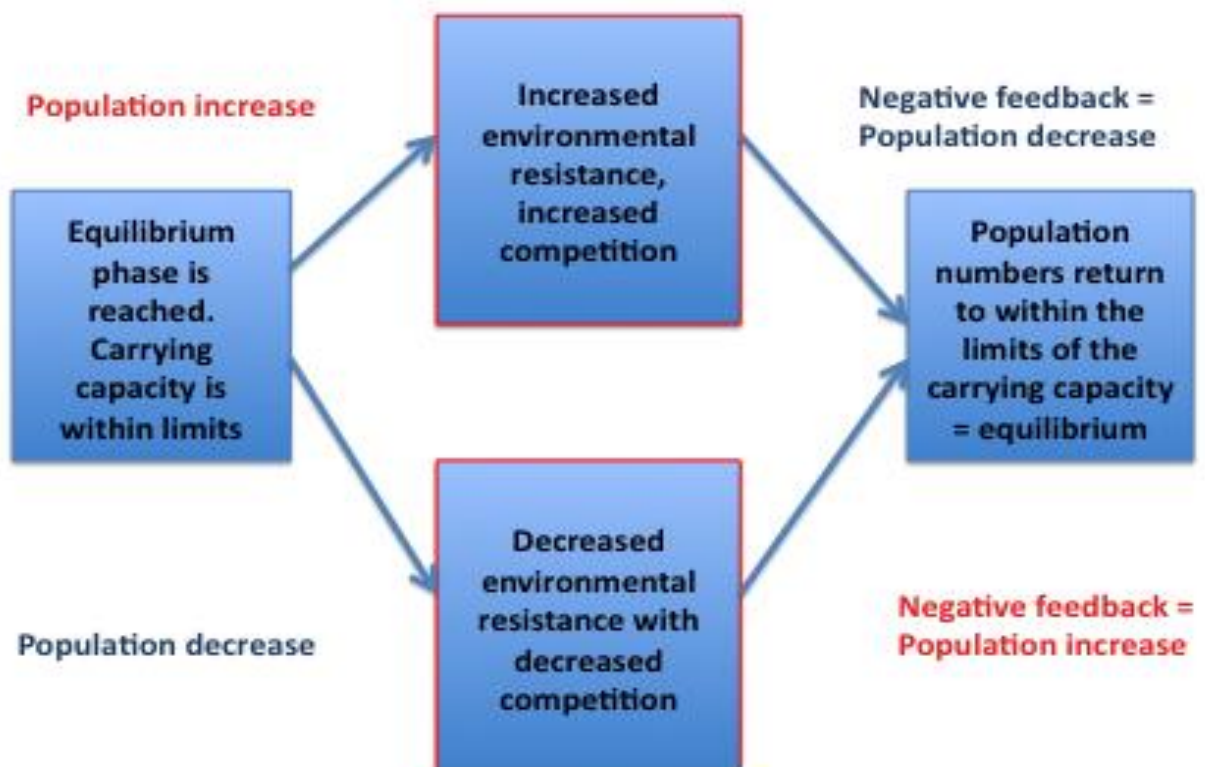
Outside the hive:

- **Field bee (21 days):** Searching, gathering and processing food. After this time, she dies, literally from over-work.

Interactions in a Community

The survival of a species depends on maintaining the population numbers. Various relationships occur between different species, when they cohabit (live together) in a specific environment. The term **symbiosis** means to 'live together'. Within any given ecosystem, organisms **directly or indirectly depend** on each other in a fine balance for survival. Scientific evidence proves that **symbiotic organisms** have adapted and evolved in response to each other within a community. This process is called **co-evolution**.

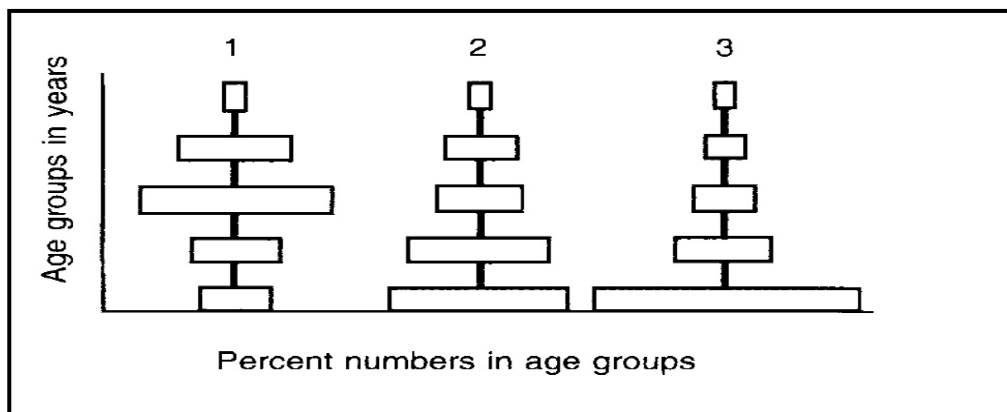
Selection is a process where some organisms survive and others do not. Organisms that are physically and behaviourally better suited to the environment have a better chance to survive and reproduce. The good characteristics are passed on to the next generation. The **population increases** and the resources of the environment become limited. The carrying capacity is reached and environment resistance occurs. This results in an increase in **intraspecific** and **interspecific competition**. The organisms that are stronger will succeed in keeping the resources they need. They will survive and reproduce to create a population that is genetically strong and stable. As the population increases, so does the number of parasites and predators. Predators will have an increase in available food. Parasites and diseases spread easily between members of the large population causing a decrease in numbers.



SECTION C: HOMEWORK**QUESTION 1: 16 minutes***(Taken from various sources)*

1. The size of a population can decrease due to
 - A natality
 - B immigration
 - C emigration
 - D increased reproduction
2. Which of the following collections of organisms can be regarded as a population?
 - A beetles, flies, butterflies
 - B Grass, buck, lions
 - C Termites in a termite nest
 - D Locusts, frogs, snakes
3. A group of individuals of the same species, which interbreed is defined as:
 - A a population
 - B an environment
 - C a community
 - D an ecosystem
4. Which of the following is a density-dependent factor?
 - A fire
 - B drought
 - C predation
 - D temperature
5. The mark-recapture-mark method of population size estimation can be considered reliable only if....
 - A animals become trap-shy and cannot be caught
 - B animals are left for a year before recapture
 - C no immigration occurs
 - D markings are temporary
6. Which of the following do NOT apply to the mark-recapture-mark method to establish the size of a population? It....
 - A is a direct technique to estimate population size.
 - B comprises the counting of part of the population.
 - C comprises more than one counting session of the population.
 - D provides an estimation of the total size of the population
7. A rabbit population will NOT increase in numbers when the....
 - A number eaten by predators is less than the number being born
 - B immigration rate exceeds the mortality rate
 - C natality rate is higher than the mortality rate
 - D emigration rate exceeds the natality rate
8. Emigration is the
 - A increase in population size
 - B migration of animals
 - C permanent movement of individuals of a population out of a habitat
 - D movement of people from country to country

9. Which of the following is a density-independent factor?
A Predation
B Lack of space
C Competition for food
D Flood
10. The maximum number of individuals of a species that can be supported by a habitat, is referred to as the....
A community
B environmental resistance
C carrying capacity
D ecological niche
11. Social insects ...
A form highly organised groups
B are of the same type of individuals, lacking social instincts
C live on their own
D form partially organised groups
12. Which of the following are not social insects?
A Ants
B Locusts
C Termites
D Honey-bees
13. The most productive ecosystems are those having...
A a relatively large autotrophic component
B efficient predator prey relationships
C less autotrophs than heterotrophs
D few decomposers
14. The diagram illustrates types of age pyramids. Which age pyramid illustrates a declining population with a larger number of older individuals?



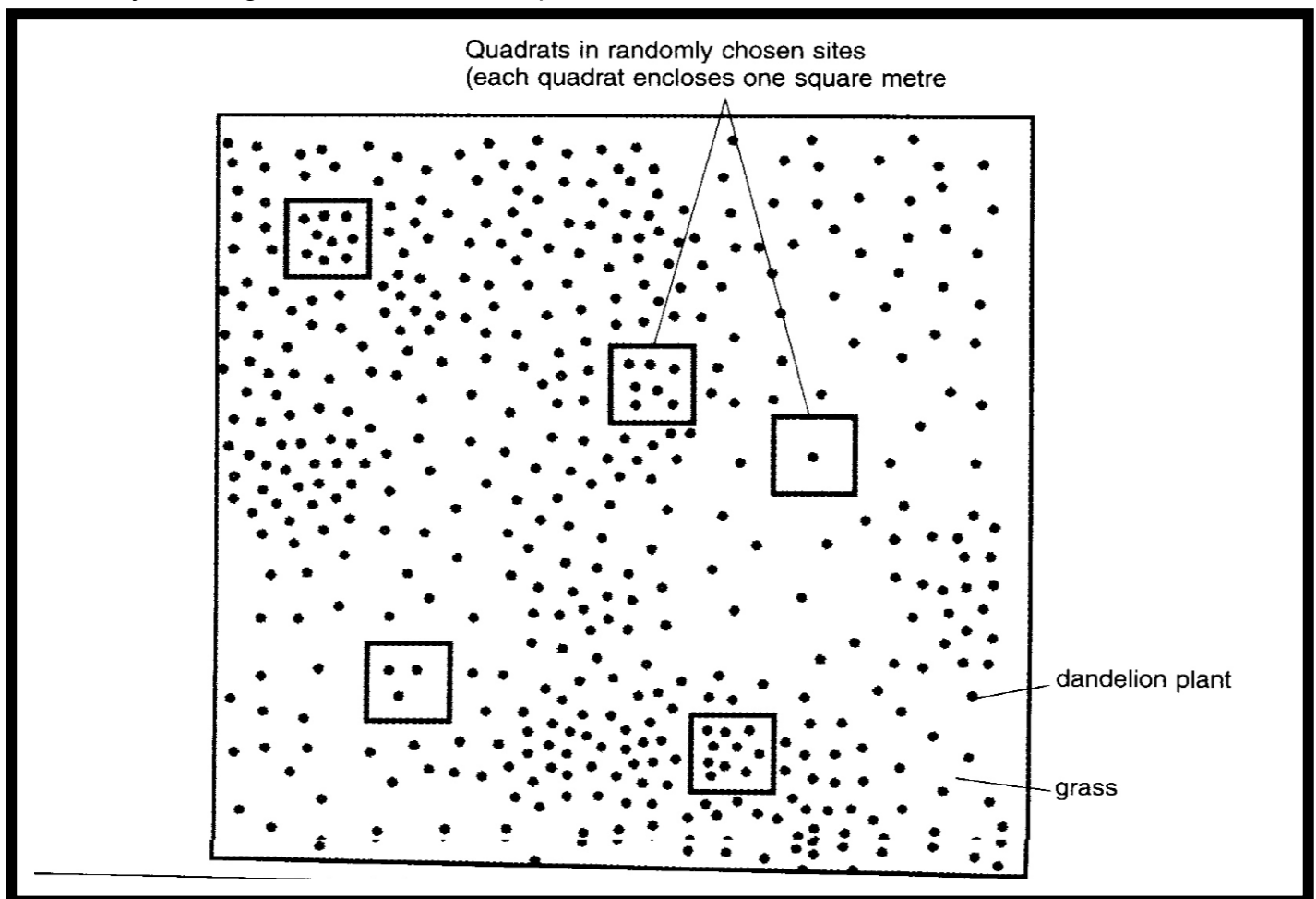
- A 1
B 2
C 3
D 1 and 3

15. The rapid growth of the human population over the past two centuries has occurred largely due to:
- A increased world-wide birth rates
 - B increased world-wide death rates
 - C increased immigration
 - D increased emigration rates
16. Environmental resistance
- A prevents a new population from immigrating into a new habitat
 - B is the sum of the factors inhibiting population growth
 - C causes the development of resistant properties under favourable environmental conditions
 - D ensures the survival of the fittest.
- (16x1) [16]

QUESTION 2: 17 minutes (*Taken from Study and Master Grade 12 old syllabus*)

The following diagram shows a plot of lawn 10 metres x 10 metres. Each dot represents a dandelion plant (a weed) growing between the grass plants of the lawn. Five quadrats (each of an area 1 square metre) were selected at random and were used to estimate the total number of dandelion plants growing on the lawn.

Study the diagram and answer the questions that follow:

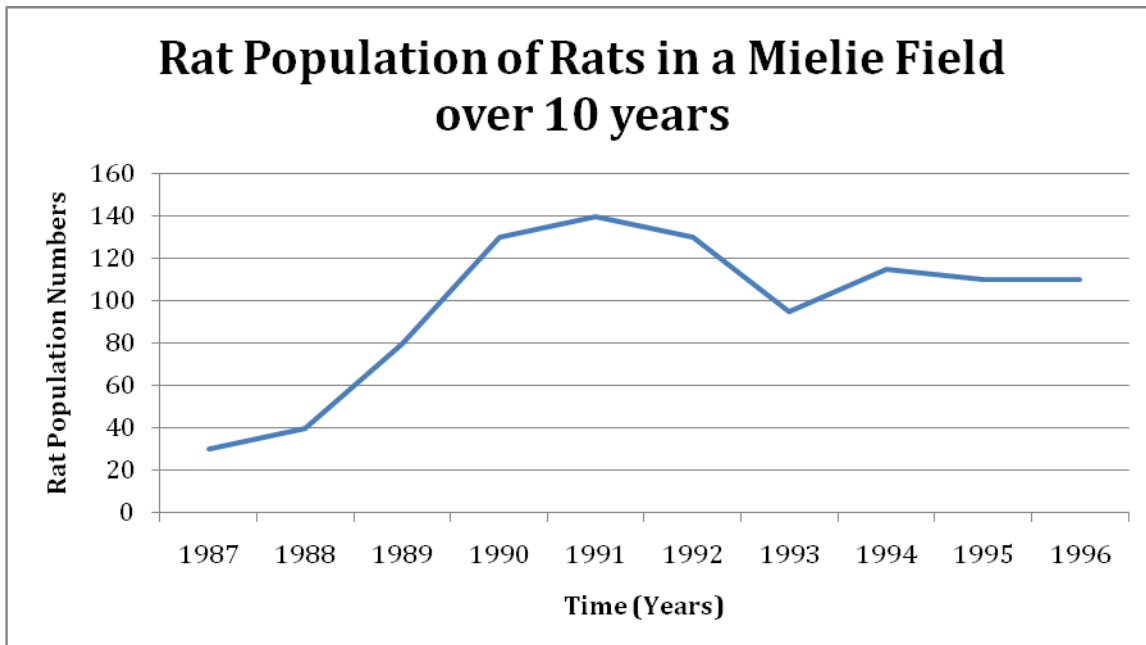


- 2.1. Calculate the area of the lawn. Show all your calculations. (3)
- 2.2. Estimate the total number of dandelion plants growing on the lawn using only the information provided by the randomly chosen quadrants. Show all your calculations. (8)
- 2.3.1. What method has been used to estimate the size of the dandelion population? (1)
- 2.3.2. Is the method used an indirect or direct technique? (1)
- 2.4. State FOUR requirements that are necessary to ensure that this method used, would be accurate and valid. (4)
- [17]

SECTION D: SOLUTIONS AND HINTS TO SECTION A

QUESTION 1

1.1.



Marking Rubric:

A	Correct type of graph	1
B	Title of the graph	1
C	Correct label for X-axis	1
D	Correct label for Y-axis	1
E	Correct units for X-axis	1
F	All points are joined	1
G	Appropriate scale for the X-axis	1
H	Appropriate scale for the Y-axis	1
I	Drawing of the graph	1 – 1 to 2 points are plotted correctly 2 – 3 to 5 points are plotted correctly 3 – 6 to 8 points are plotted correctly 4 – all 10 points are plotted correctly
	Total:	12 marks

- 1.2. Logistic (1)
 1.3. Carrying capacity should be indicated on the graph at 130 ✓ rats ✓ (2)
 1.4. Soil, water, humidity, temperature, light – (any 4) (4)
[19]

QUESTION 2

2.1.
$$N = \frac{C \times M}{R}$$

Est. population = $\frac{\text{total of second catch} \times \text{total of first catch}}{\text{marked in the second catch}}$ (1)

= $\frac{42 \times 50}{10}$ (1)

= 210 impala (1)

- 2.2. The reliability of this method improves with each recapture of the individuals (1)
 The more times that the steps are repeated, the more accurate the estimation of the population size will be (1)

[6]**QUESTION 3**

3.1. 0,6 million of 1,0 million
 $\frac{0,6 \times 100}{1,0}$ (1) = 60% (1)

3.2. 45 to 49 years = 0,20 of 1,10 (1) = 18% (1) (2)

3.3. 100 000 females (2)

3.4. 0 to 4 years = 1,0
 45 to 49 years = 0,2
 $1,0 - 0,2 = 0,8$ (1)
 800,000 females (1) (2)

3.5. Disease / malnutrition / civil war / lack of health care / lack of education of parents (any 2) (2)

3.6. Males (1)

3.7. Females: more stress / look after young so exposed to children diseases/ work very hard physically / poor health care in rural areas / poor living conditions / malnutrition (any 2) (2 x 2) (4)

[15]

QUESTION 4

- 4.1. A – Worker ✓ – gathering of food/feed drones and larvae/clean
hive/guardians of hive entrance ✓
B – Drone ✓ – mate with the queen / reproduction ✓
C – Queen ✓ – lay eggs / reproduction ✓ (6)
- 4.2. Drones (1)
- 4.3. The first mature queen to emerge from her cell kills all the other possible queen
larvae with her sting ✓ (1)
- 4.4. Royal jelly ✓ (1)
- 4.5. Animal packs (wild dogs, wolves, lions, etc.)
- There is a **ranking order** and intense loyalty within the pack ✓
 - Pack is led by the **alpha-male** ✓
 - The dominant breeding pair forms a family unit that includes their offspring ✓
 - When young pack members are of a certain age, they move into a new territory to start their own family unit ✓
 - There is no sexual tension in the pack and, therefore, leadership by the alpha-male is accepted ✓
 - The **dominant breeding pair** leads the pack, with their signals and behaviour imitated by the younger members ✓
 - Hunting strategies are learned from other pack members ✓
 - One disadvantage of working as a pack means that when a prey is hunted and caught, all the members must share the food ✓
 - This results in an eating order, where the strongest males will eat first, then the females and the young and weak will be left with what remains on the carcass ✓
- (Any 5)** (5)
[14]

SESSION 15**TOPIC: INTERACTION IN A COMMUNITY – PREDATION, COMPETITION, SYMBIOSIS AND ECOLOGICAL SUCCESSION**

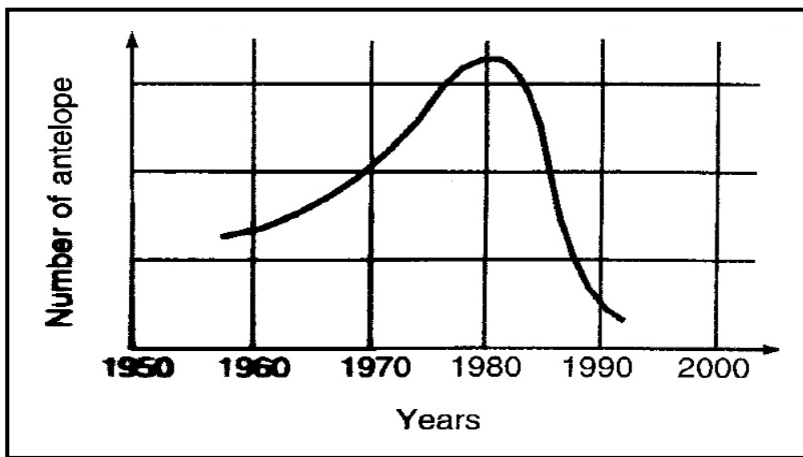
Learner Note: Make sure that you know the definitions producers, consumers and decomposers. Know predation, and remember that there should always be more prey than predators. Competition – know the difference between interspecific and intraspecific competition. Know the definition of resource partitioning and the relevance to survival. For symbiosis, please ensure that you know the difference between parasitism, mutualism and commensalism and examples of each. For ecological succession, know the difference between autogenic and allogenic succession. You must be able to explain and apply primary and secondary succession processes.
PLEASE - make sure that you do the homework questions.

SECTION A: TYPICAL EXAM QUESTIONS**QUESTION 1: 15 minutes***(Taken from various DoE Exam papers)*

- 1.1. Intraspecific competition is
 - A. an example of a predator-prey relationship
 - B. competition between members of the same species
 - C. the survival of the fittest
 - D. competition between members of different species
- 1.2. Competition for the same resources between individuals of the same species, is known as....
 - A. intraspecific competition
 - B. interspecific competition
 - C. environmental resistance
 - D. ecological footprint
- 1.3. When certain individuals of a population survive, irrespective of the pressure of the environment, it is called....
 - A. natural selection
 - B. succession
 - C. intraspecific competition
 - D. density-dependent factors
- 1.4. When kudu (browsers) and springbuck (grazers) live in a camp of 400 ha in Vaalbos Park...
 - A. the springbuck will die out through interspecific competition
 - B. the numbers of both species will increase logistically if the population ratio between the two species remains constant
 - C. both species will show the geometric growth form
 - D. their population density will be controlled by intraspecific competition within the two species
- 1.5. The replacement of one community by another, until a climax stage is reached, is called
 - A. predation
 - B. competition
 - C. stratification
 - D. succession

- 1.6. Which of the following is the first seral stage of primary succession?
- A. Volcanic bare rock
 - B. A flooded river-bed
 - C. A forest after a veldfire
 - D. An abandoned meadow land
- 1.7. Commensalism refers to a symbiotic association in which...
- A. both organisms benefit
 - B. one organism benefits while the other is harmed
 - C. both organisms are harmed
 - D. one organism benefits while the other neither benefits or is harmed
- 1.8. Which of the following is the best example of mutualism:
- A. insects on a flower
 - B. fleas on a dog
 - C. a cheetah catching an impala
 - D. a monkey in a tree
- 1.9. An ectoparasite...
- A. lives within a host
 - B. lives externally on its host
 - C. visits the host at intervals
 - D. does not cause harm to its host
- 1.10. When Remora-sucker fish are transported by a shark and so gain advantage, it is an example of:
- A. predation
 - B. commensalism
 - C. mutualism
 - D. parasitism
- 1.11. Which one of the following is possibly the best example of predation?
- A. A bird's nest in a tree
 - B. Ticks on a dog
 - C. A lion catching a zebra
 - D. Bees visiting a flower
- 1.12. A predator....
- A. feeds on dead animal matter
 - B. captures and kills prey because they are in its territory
 - C. competes with prey for food and shelter
 - D. captures and kills prey for food
- 1.13. The most productive ecosystems are those having...
- A. a relatively large autotrophic component
 - B. efficient predator prey relationships
 - C. less autotrophs than heterotrophs
 - D. few decomposers

1.14. This graph shows the number of antelope in an ecosystem



Which of the following events, in the correct sequence, could have caused the particular graph curve?

1. Overgrazing resulting from overpopulation
2. Eradication of predators by people
3. Reduced numbers caused by shortage of food
4. Increase in the number of predators

- A. 4, 3, 2, 1
- B. 2, 3, 4, 1
- C. 2, 1, 3, 4
- D. 1, 4, 2, 3

1.15. Which of the following is not true of predation:

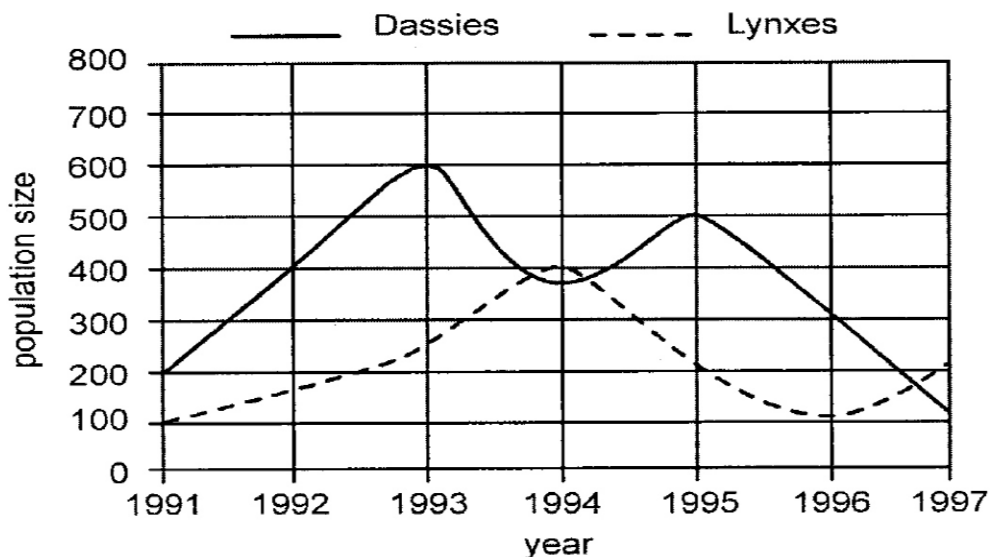
- A. Predator numbers fluctuate slightly out of phase with prey numbers
- B. It is an example of interspecific competition
- C. Predation level is a density-dependent regulator of the prey population
- D. Predators maintain the stability of the prey population

[15]

QUESTION 2: 14 minutes

(Modified from Viva Grade 12 Life Science)

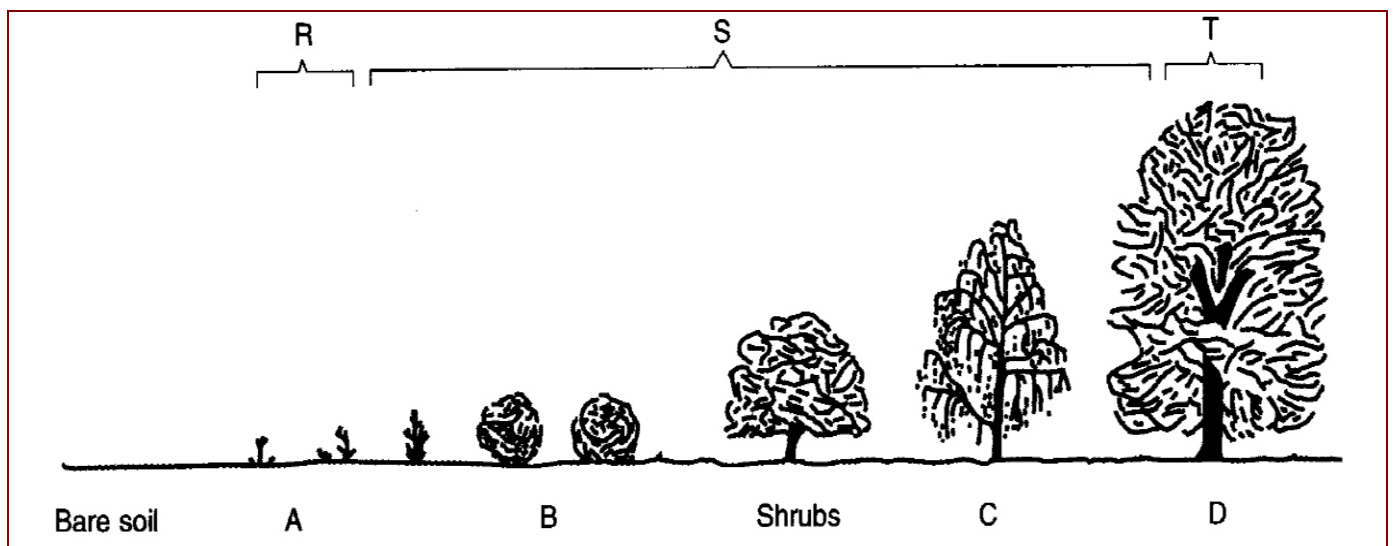
Study the graph below and answer the questions that follow:



- 2.1. How many dassies and lynxes were there in 1995? (2)
 - 2.2. In what year was the population of dassies the highest? (1)
 - 2.3. In what year was the population of lynxes the highest? (1)
 - 2.4. In which year did the population of dassies start decreasing? Give a reason for your answer. (2)
 - 2.5. In which year did the population of lynxes start decreasing? Give a reason for your answer. (3)
 - 2.6. Study the graph and explain the relationship between the population of the dassies and the lynxes as a survival strategy. (5)
- [14]

QUESTION 3: 26 minutes*(Modified from Study and Master Grade 10 old syllabus)*

The diagram below illustrates succession in a plant community. Study the diagram and answer the questions that follow.



- 3.1. What is meant by the term succession? (4)
 - 3.2. Which marked part R, S or T represents:
 - a) Succession (1)
 - b) A climax community (1)
 - c) Colonisation? (1)
 - 3.3. What are the various stages of succession called? (1)
 - 3.4. Which part marked A, B, C or D represents small bushes? (1)
 - 3.5. Distinguish between autogenic and allogenic succession. (3)
 - 3.6. Tabulate the difference between primary and secondary succession. (7)
 - 3.7. Explain the difference between R-strategy and K-strategy organisms. (6)
 - 3.8.
 - a) What is the plant community in the first stage of succession called? (1)
 - b) Which part marked A, B, C or D represents the community mentioned in QUESTION 3.8 (a)? (1)
 - c) Name three different types of animals that may be found in the part mentioned in QUESTION 3.8 (b)? (3)
- [30]

SECTION B: ADDITIONAL CONTENT NOTES**PREDATION:**

Predators play a very important role in an ecosystem. Predation is an **interaction** between the predator and the prey in a **specific territory**. Predators are carnivores that hunt, kill and eat prey. The prey is generally herbivores meaning that **no competition** exists between predators and prey. Predators assist with the survival of the fittest by **regulating populations naturally**. The weakest of the prey are caught and eaten.

The survival of the predator depends directly on the number of prey that is available, as numbers will **change constantly**.

Large prey population → carrying capacity is raised for the predator → increase of the predator population. Now: prey population decreases = predator population decreases because **less food** available → carrying capacity of the environment decreases. Predators either **starve** or **emigrate**. Predators keep the population of the prey close to carrying capacity in a **cyclic fluctuation** (a cycle that changes). When the prey population increases and decreases in a cycle, the predator population responds. A healthy, **stable population** results for both the predator and the prey called **self-regulation** within an ecosystem.

When predators are removed from an area, the prey population **explodes**, because there is no longer a natural **stabilising factor**. Overgrazing and severe damage to the habitat will result in **environmental resistance** and a decrease in the **carrying capacity** = starvation, disease and death.

COMPETITION

Interactions occur between the various species that inhabit an ecosystem. There are two types of competition that exist within an ecosystem:

- **Intraspecific competition** occurs within the **same species** for food, water, mates, living and breeding space. It ensures that the strongest win the territory, therefore, the best genes are passed on to the next generation (natural selection).
- **Interspecific competition** occurs between **different species** for light, food, water and space. In a given area, for example, a lion and a cheetah will compete for the same prey and different buck species will compete for the grass.

Competitive exclusion:

If there are enough natural resources, the different species may **co-habit** and an **equilibrium** will exist for a period. One species is always more **dominant**, forcing the other species to adapt to a different ecological niche or to die (become extinct). This will minimise the competition. Example: where two types of algae inhabit the same pond, the more adapted species will survive. There will be a decline in the numbers of the weaker species, to the point of extinction. Competition within and between species will result in natural selection.

Resource partitioning: is the specialisation that occurs in **different species** to use **different resources** that are available in an ecosystem. This leads to less competition and a more stable community structure and is a mechanism for survival.

Resource partitioning among plants:

- In the African savannas, grasses have shallow root systems while shrubs and trees have deeper root systems to reach nutrients further down.
- A forest is made up of different plant layers or storeys, for example, tall trees grow next to shade-loving shrubs and climbers. These plants are able to live together because they need different amounts of light to survive.
- Where carnivorous plants, like the pitcher plant, and non-carnivorous plants grow together, there is little competition for soil nutrients.

Resource partitioning among animals:

- Birds have beaks that are **modified** for eating insects, picking up seeds, tearing flesh, drilling holes in bark or cracking the hard shells of nuts. In a forest, **vertical separation** ensures that canopy dwellers and forest-floor dwellers do not compete for the same resources.
- Lions and leopards are predators that **co-exist** in the same areas. Lions feed on larger buck because the females in the pride hunt together and are able to pull down a large animal. Leopards and cheetahs are solitary hunters and hunt smaller prey so there is stable **co-existence** between these two predator types. When food is scarce, lions often steal a kill from a leopard or cheetah. To prevent this, leopards and cheetahs pull the kill up into a tree and eat it there. Lions do not climb trees.

PARASITISM

Parasitism is a relationship between two organisms of different species where one organism **benefits (the parasite)** and the other is **harmed (the host)**. The host provides food and a protected habitat for the parasite. The parasite needs to keep the host alive, so parasites hardly ever kill their host. Parasites can be divided into two main groups:

- **Ectoparasites:** Parasites that live on the **outside** of the host's body, for example arthropods like ticks, fleas and lice.
- **Endoparasites:** Parasites that live **inside** the host's body, for example tapeworms (alimentary canal), bilharzia (blood, liver and kidneys) and malaria parasite (blood).

Know examples of life cycles of the flea, tapeworm, malaria, bilharzia, symptoms and prevention etc.

MUTUALISM

Mutualism is a relationship between two organisms of different species where **both organisms benefit**. Know examples of mutualism.

COMMENSALISM

Commensalism is a relationship between two organisms of different species where one organism **benefits** and the other is **not harmed or does not benefit**. Know examples of mutualism.

ECOTOURISM, HUNTING AND CULLING

In reserves and on game farms, there is often a lack of **natural predators** to keep populations of animals within limits. At certain times of the year, the excess animals must be **culled** to ensure that the population stays within the number that the reserve can hold naturally. If the animals are not culled, the natural habitat is destroyed and the animals all suffer from starvation as environmental resistance increases. This will lower the carrying capacity of the area. The National Parks Board and the Department of Nature Conservation ensure that hunting is allowed during specific seasons only. Game hunters from all over the world visit South Africa during hunting season. They pay large amounts of money to be taken into the hunting areas to shoot buck and other game. The money that is

paid for game hunting contributes to the economy of our country. Regulated hunting keeps the game populations within the carrying capacity of the specific ecosystem.

ECOLOGICAL SUCCESSION

Ecological succession is the **orderly change** in the structure of a community. All communities change in response to **internal** (autogenic) and **external** (allogenic) factors. If the abiotic factors remain relatively constant, the biotic community will develop over time, from a bare rock or open water to a **climax community**. A climax community is one that is complex, diverse, productive and stable. When a fire, deforestation, flood or a volcanic eruption destroys a climax community, a new sequence of **rapid changes** will take place.

Organisms modify their environment through the process of **succession**. Individual successions are called **seres** and the developmental phases are called **seral stages**. The process begins with **autotrophs**, with detrital feeders (organisms like earthworms, woodlice, millipedes that live on dead organic matter) and decomposers. As new plant species are added, herbivores and secondary consumers follow to complete the food web, forming a **complex biotic community** within an ecosystem. The tropical rainforest communities are very well established. They are an example of a rich, diverse and extremely complex biotic community. **Succession principles** can be applied when addressing the impact of humans on the environment. In this way, mine dumps, motorway verges, landfills and reclaimed land from the sea can be assisted to become stabilised biotic communities.

TYPES OF SUCCESSION

Autogenic succession

This is when the stimulus for change is **internal** and caused by organisms in the biotic communities (*auto* = by itself). The following are examples of autogenic succession:

- A change in the pH or fertility of the soil caused by the organisms that presently inhabit an ecosystem, will cause a change in the new plants that grow in that soil. This will, in turn, affect and change the animal species that eat the plants. Different plants will lead to different animals inhabiting this ecosystem.
- When trees mature, growing big and tall in a forest, they produce a lot more shade than when they were smaller with fewer leaves. Shrub type plants grow around the bottom of the stems, but need more sunlight than they are able to get because of the shade of the large trees. These shrubs die while shade-tolerant species take over because they grow well on the shaded forest floor.

Allogenic successions

This is when the stimulus for change is **external** to the biotic communities. The following are examples of allogenic succession:

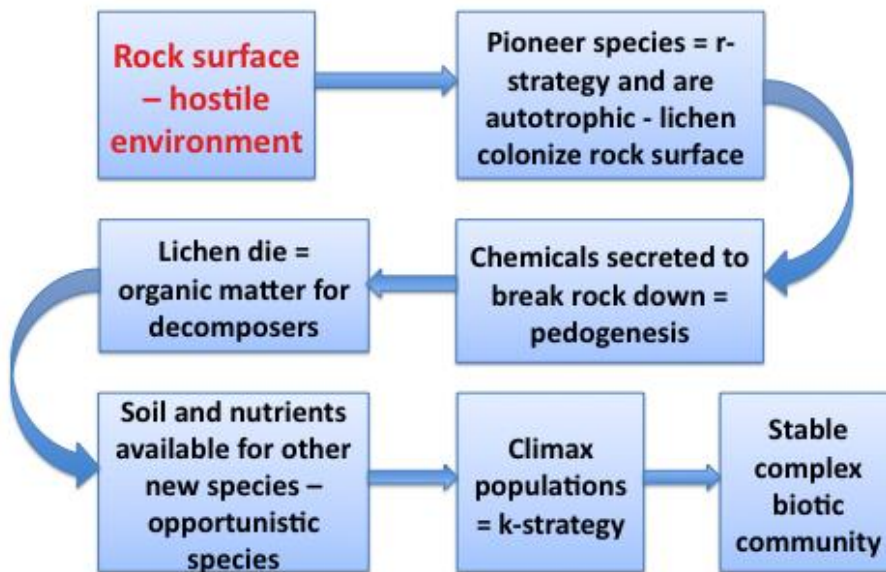
- Changes in the soil composition by erosion, silt deposits after a flood, leaching, mine dumps and chemical deposits (pesticides, insecticides and pollution).
- Climatic changes in temperature and rainfall occurring over a long period of time, like after the ice age, and presently due to global warming.
- Catastrophes like volcanic eruptions, earthquakes, floods, hurricanes and fires.

SEQUENCE OF THE SUCCESSION PROCESS

Primary succession

A succession that develops in a **new, uncolonised habitat** is called **primary succession**. This implies that there is a lack of soil, for example when land or lakes emerge after a glacier retreat or volcanic eruption. **Pioneer species** will begin to develop, like algae, mosses, lichen and fungi. Generally, pioneer species form part of the **r-strategy**. These populations have a very **high production** of offspring, but a **low survival rate**. This will then result in opportunistic species developing, followed by **climax species (K-strategy species)** with few offspring but a high survival rate. The succession process results in a **complex biotic community** within the ecosystem.

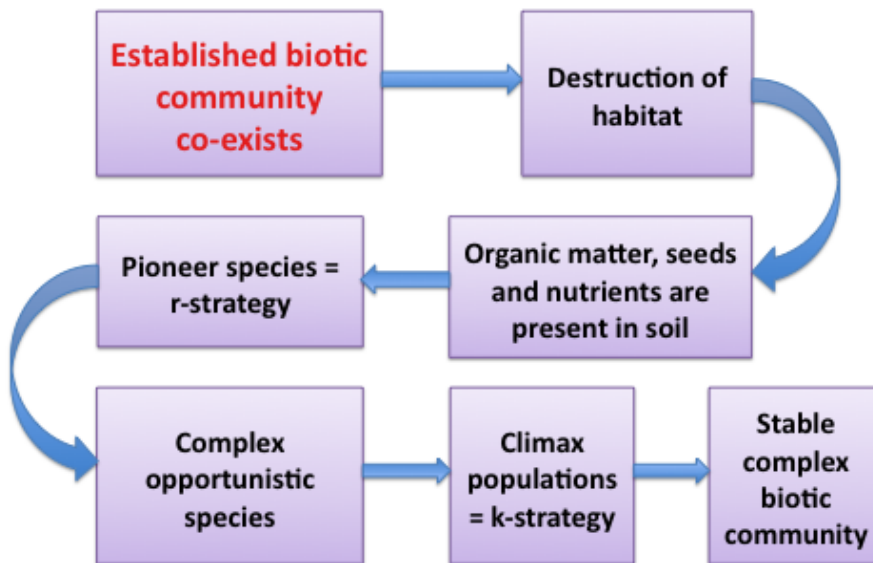
The process of Primary Succession:



Secondary succession

A succession that develops **after** an established biotic community has been destroyed, is called **secondary succession**. The established community could have been destroyed by a fire, a natural catastrophe like a hurricane or tornado, deforestation, or after the harvesting of a crop. This would mean that a community **coexisted** successfully within an ecosystem before, but that it has been **destroyed**.

The process of Secondary Succession:



SECTION C: HOMEWORK

QUESTION 1: 20 minutes *(Modified from Viva Grade 12 Life Science)*

Species A is a consumer found in the grasslands habitat. The data below shows the number of individuals in a population of species A over a 14-week period.

Time (weeks)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Number of individuals	0	6	8	16	26	40	70	96	110	118	120	120	120	110	70

- 1.1. Draw a line graph to illustrate the growth curve of the population of species A. Label the axes and provide a heading for the graph. (9)
 - 1.2. Interpret and explain each phase as indicated by the results shown in the graph. (10)
 - 1.3. What kind of competition occurs among the individuals of the population? State a reason for your answer. (2)
 - 1.4. What is the carrying capacity of the habitat? Provide a reason for your answer. (2)
 - 1.5. What impact will the introduction of a predator have on the population of species A? (2)
- [25]

QUESTION 2: 17 minutes*(Taken from Bios Best 2007)*

Read the passage and answer the questions that follow.

Prior to 1907, there were about 4 000 springbuck and their predators in the Kalahari. It was estimated that this area could have supported 30 000 buck at this time. In 1907 this region was declared a nature reserve and all predators such as lions and cheetahs were eradicated. By 1925 the buck population had increased to 100 000... and everything in reach, grass, tree seedlings and shrubs were eaten. The area had become overgrazed and over-browsed. In the following two winters 40% of the buck starved to death. The buck population continued to decrease to about 10 000 individuals. The area continued to be depleted and the damage to the plant productivity would be evident for a long time.

- 2.1. List TWO density-dependent factors, which could have caused a decrease in the population. (2)
 - 2.2. List ONE density-independent factor, which could have caused a decrease in the population. (1)
 - 2.3. Name the type of competition that occurred in the buck population. Provide a reason for your answer. (3)
 - 2.4. Are springbuck K-strategy or r-strategy species? Provide a reason for your answer. (2)
 - 2.5. What was the original carrying capacity of the area? (1)
 - 2.6. What is likely to have been the cause of most of the damage to the plant vegetation? (1)
 - 2.7. Suggest TWO ways in which the habitat could be restored to its former state? (2)
 - 2.8. What would the function of the predators have been ecologically, if they had been left in the nature reserve. (2)
 - 2.9. What type of process of succession will occur in the area mentioned in the passage, should the buck be removed for a period of time? (2)
- [16]

SECTION D: SOLUTIONS AND HINTS TO SECTION A

QUESTION 1

- | | | | |
|--------|---|-------|---|
| 1.1. | | 1.10. | B |
| 1.2. A | | 1.11. | B |
| 1.3. | B | 1.12. | C |
| 1.4. | B | 1.13. | D |
| 1.5. | D | 1.14. | A |
| 1.6. | D | 1.15. | C |
| 1.7. | A | 1.16. | B |
| 1.8. | D | | |
| 1.9. | A | | |

(15 x 1) [15]

QUESTION 2

- 2.1. Dassies – 500 ✓, Lynxes – 200 ✓ (2)
- 2.2. 1993 ✓ (1)
- 2.3. 1994 ✓ (1)
- 2.4. 1993 ✓ – The number of predators in the area had increased. ✓ (2)
- 2.5. 1994 ✓ – The number of dassies in the area had decreased ✓, therefore, the amount of food for the predators had decreased. ✓ (3)
- 2.6. As the population of the dassies increases, ✓ the lynx population increases. ✓
Lynxes prey on the dassies ✓ reducing / regulating the dassie population. ✓
When the population of the dassies decreases, the lynx population decreases. ✓ (5)
- [14]**

QUESTION 3

- 3.1. It is the orderly ✓ and gradual change ✓ where one plant or animal community is replaced by another ✓ in a given area over a period of time. ✓ (4)
- 3.2. a) S ✓ b) T ✓ c) R ✓ (3)
- 3.3. Seral stages ✓ (1)
- 3.4. B ✓ (1)
- 3.5. **Autogenic:** When the stimulus for change is **internal** ✓ and caused by organisms in the biotic communities. ✓
Allogenic: when the stimulus for change is **external** to the biotic communities. ✓ (3)
- 3.6

Primary Succession	Secondary Succession
Develops in a new, uncolonised habitat ✓	Develops after an established biotic community has been destroyed ✓
Occurs when land or lakes emerge after a glacier retreat /or volcanic eruption ✓	Communities are destroyed by a natural catastrophe / like hurricanes, / tornados, /deforestation or /after crop harvesting ✓
Lack of soil so pedogenesis must first take place ✓	Fertile soil is already present ✓

Plus 1 mark for drawing a table and headings are correct. ✓)

(Total = 7)

- 3.7. **R-strategy:** pioneer populations ✓ = very **high production** of offspring ✓, but a **low survival rate** ✓ (3)
- K-strategy:** climax populations ✓ = produce **few offspring** ✓, but have a **high survival rate** ✓ with good parental care ✓ (Any 3) (3)
- 3.8. a) Pioneer plants/pioneers ✓ (1)
- b) A ✓ (1)
- c) ants/ termites/ grasshoppers/ locusts/ mice ✓ (Any 3) (3)
- [30]**