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Learner Note: It is important that you understand the difference between sexual and asexual reproduction. You must know the definition of both forms of 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 fertilization 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 angiosperms especially as a food source. You need to understand the processes of genetically modified crops, the advantages and disadvantages, as this is regularly questioned in exam papers.

SECTION A: TYPICAL EXAM QUESTIONS – 40 minutes for questions

QUESTION 1: – 8 Minutes

Study the table below. Match each word with the correct statement in the right-hand column. Write the letter of the statement next to the word. (**Read the words first and then read the statements. As you match the word to a statement, write the letter next to the word and cross out the statement once it has been allocated to a word. This way, you will save time because you will not have to read all the statements each time.**)

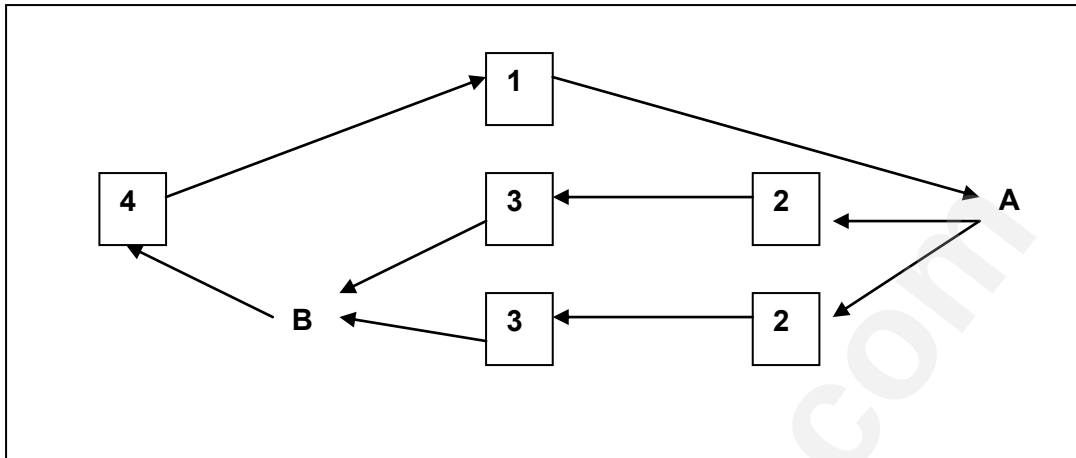
Words	Statements
Pollen	a. Word used to describe development of pollen on stigma
Seed	b. The structure that contains the female gamete
Fertilization	c. The structure that protects the bud before it opens
Petals	d. The process by which the male and female gametes fuse.
Sepals	e. The structure that contains the male gamete
Zygote	f. Brightly coloured structures
Anther	g. Structure that contains ovules
Germination	h. The structure that is formed when a male gamete and female gamete fuse
Ovule	i. Structure that contains pollen grains
Ovary	j. Ovule becomes this after fertilization

(10)

QUESTION 2: MULTICHOICE – 10 minutes. (Cover up the answers, read the question, think of the correct answer and then see if which option is the answer that you thought of or the answer that is the closest. Beware of wasting time with Multichoice questions. If you do not know the answer, mark the question clearly and move to the next question.)

- 2.1. The testa of the seeds of Angiosperm develops from the...
- A. placenta
 - B. integument
 - C. ovary wall
 - D. endosperm
- 2.2. Fertilization in Angiosperms is known as 'double fertilization' because:
- A. pollination of the stigma as well as fertilization of the ovum occurs
 - B. two male gametes are found in the pollen tube
 - C. the ovum and one of the antipodal cells are fertilized
 - D. the ovum and the primary endosperm cells are fertilized
- 2.3. The endosperm of the Angiosperms is the...
- A. haploid tissue of the embryo sac
 - B. diploid product of fertilization
 - C. diploid tissue of the ovary
 - D. nutritional tissue for the embryo
- 2.4. The chromosome number of the nuclei in the endosperm of the seed of a flowering plant is..
- A. n
 - B. $2n$
 - C. $3n$
 - D. $4n$
- 2.5. 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 2.6 to 2.9 refer to the schematic representation in the life cycle of an angiosperm. **(Remember that if there is a diagram, always first write the labels on the diagram before you move onto the questions).**



- 2.6. If number 1 represents the adult angiosperm and 2 represents the microscopic gametophyte, then A must be the...
- spores
 - gametes
 - seed
 - zygote
- 2.7. If the two number 2s are microscopic gametophytes in the flower then the two 3s are...
- seeds and zygote
 - ova and male gametes
 - spores and pollen
 - two embryos in the seed
- 2.8. B restores the diploid number of chromosomes in the ...
- zygote
 - gametes
 - seed
 - spores
- 2.9. The structure numbered 4, which develops into the adult angiosperm at 1, is the ...
- zygote
 - spore
 - seed
 - endosperm

2.10. 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

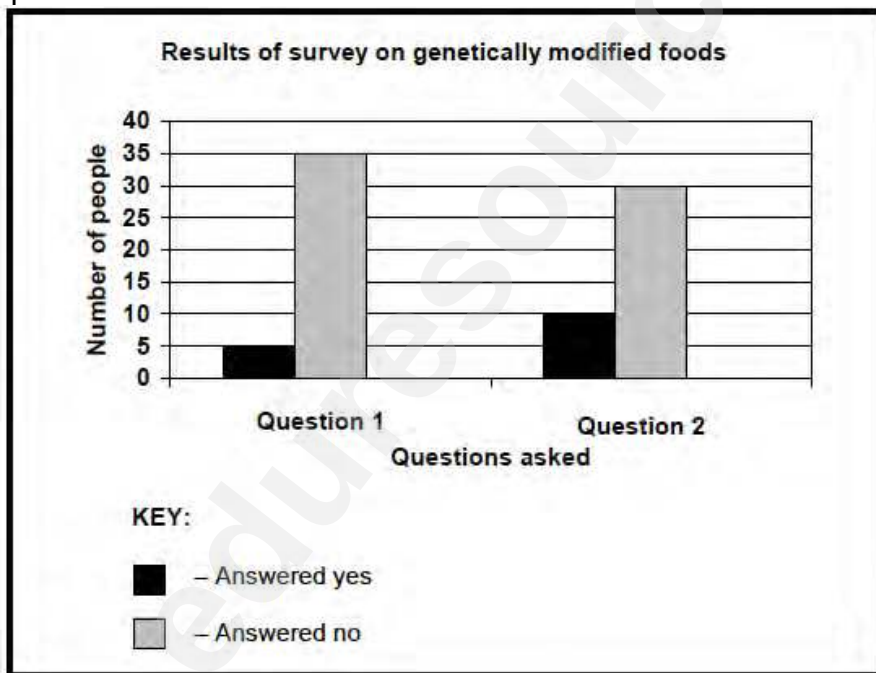
QUESTION 3: - 15 minutes

(Taken from DoE Exemplar 2008)

A group of Grade 12 learners carried out a survey about genetically modified (GM) foods. They used the following two questions in their survey: **(First think about what genetically modified crops are. If you can't remember, refer to the content notes in Section C).**

1. Are GM foods better than normal foods?
2. Are you aware of any dangers in using GM foods?

The results of the survey are shown in the bar graph below. Study the graph and answer the questions that follow.



- 3.1 Explain what GM foods are. (2)
- 3.2 State TWO advantages of genetic modification for food production. (2)
- 3.3 How many people participated in the survey? (1)
- 3.4 Draw a table to show the results of the survey. (6)

(When you have to draw up a table, make sure that you label each column across and down clearly and that

you show what the results are for. Marks are allocated for drawing the table as well as the content that you include into it. Remember to add a heading.)

- 3.5 Suggest TWO ways in which the learners can make sure that the results of the survey are reliable. (4)
- 3.6 State ONE conclusion that can be made from this survey. (1)

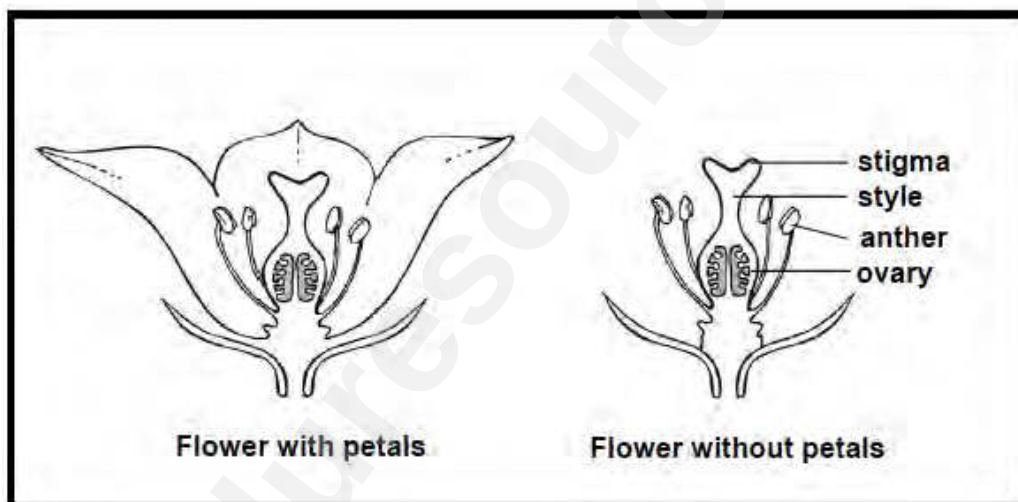
QUESTION 4: 7 minutes

(Taken from DoE 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 fertilization 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 fertilization 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

- 4.1. Give an explanation for the presence of more pollen on the stigmas of the flowers with petals than on the flowers without petals. (**Think about the requirements for cross-pollination**)

(2)

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- 4.2. Explain why there are more pollen tubes present in the styles of both types of flowers than the number of ovules fertilized. (2)
- 4.3. State THREE ways in which this investigation could be improved. (3)
(Think about what would make the results better and more reliable. Reread the first part of the question before completing this question)

SECTION B: SOLUTIONS and HINTS

1.

Pollen - e
Seed - j
Fertilization - d
Petals - f
Sepals - c
Zygote - h
Anther - i
Germination - a
Ovule - b
Ovary - g

2. MULTICHOICE:

1. B
2. D
3. D
4. C
5. A
6. A
7. B
8. A
9. C
10. B

3.1 When the genetic code of food is changed ✓ by introducing a foreign/new gene ✓ into food (2)

3.2 To enable an organism to become resistant to a disease ✓ /pathogen/weed killers. In order to produce a

very high yield of a particular food type ✓ (2) **(Mark first TWO only)**

3.3 40 ✓(1)

3.4 Table showing the results of the survey on GM food

Header ✓
 Labelled columns correctly ✓
 Labelled rows correctly ✓
 Data in table: 3 or 4 correct ✓✓
 1 or 2 correct ✓
 Draw table ✓ (6)

	Number of people	
	Yes	No
Question 1	5	35
Question 2	10	30

- 3.5 - Increase ✓ the number of people ✓ participating in the survey
 - The people ✓ in the survey must be randomly ✓ selected
 - Ensure that people are selected ✓ from all sections of society ✓ any 2 x 2 (4)
(Mark first TWO only)
- 3.6 - Most of the people sampled do not consider GM food to be better than normal food ✓
 - Most of the people sampled are not aware of the dangers in using GM food ✓
 - Even though most people sampled are not aware of the dangers of GM foods, the majority of them do not consider GM food to be better than normal food ✓ any (1)

- 4.1. The flowers with petals attracted more insects ✓ for pollination ✓ than the flowers without petals/ attracts pollinating ✓ agents ✓ /pollinators ✓ ✓

OR

The flowers without petals may not have attracted insects ✓ for pollination ✓ /pollinating ✓ agents ✓ /pollinators ✓ ✓

OR

The presence of petals prevents ✓ wind from blowing most of the pollen away ✓

OR

The absence of petals will allow ✓ wind to blow most of the pollen away ✓

(2)

- 4.2 Some of the pollen tubes that developed were from the same flower ✓ /self-pollination occurred and only make little growth into the style ✓ /not all pollen tubes reach the ovary /does not fertilise the ovum /ovule

OR

The contents of some pollen tubes ✓ may be non-functional ✓

(2)

OR

More pollen tubes to increase ✓ chances of fertilisation ✓

- 4.3 Repeat the investigation and use the average✓
 Increasing the size of the sample✓
 Use the same size flowers✓
 Use the same colour flowers✓
 Use the flowers of the same apple tree✓
 Ensure that all the flowers are pollen-free at the beginning of the investigation✓
 The number of flowers with or without petals must be the same✓
 Allow the same number of days for pollination✓/prevention of pollination/ fertilisation to take place
 Keep all environmental factors constant✓
 Increase the period of the investigation✓ (3)
(Mark first THREE only)

SECTION C: ADDITIONAL CONTENT NOTES

1. Introduction

Most of the food humans and animals eat, is produced by **angiosperm plants**. Some angiosperms do not have colourful flowers, for example: wheat, maize and rice. Flower structures are produced and **seeds** result. Angiosperms are able to reproduce sexually and asexually.

Sexual reproduction is the formation of **haploid gametes** in the male and female structures of the flowers. After fertilization, fruits and seeds result. The offspring of sexual reproduction have **genetic variation**, because of the recombination of the chromosomes during **meiosis** and the fusion during **fertilization**.

Asexual reproduction - vegetative structures grow from the parent plant and form a new plant. The offspring is formed by **mitosis** and will be **identical** to the parent plant. Asexual reproduction is used to produce large numbers of **identical offspring** with desirable genetic characteristics, using one selected parent plant.

2. Asexual reproduction in flowering plants

Horticulturalists (grower of plants) and farmers use asexual reproduction methods to produce plants **quickly**, as it is not necessary to wait for seeds to be formed, germinate and grow. The resulting plant is genetically identical to the parent plant. Angiosperms have many methods of reproducing asexually using the stems, leaves and roots of the plant.

• Stems

- **Rhizome** : an **underground stem** from which a new plant will grow. Grasses are examples of rhizome propagation. Grass is a food source for herbivores like cows, goats, sheep and buck.
 - **Tubers: underground stems** that stores food. The potato plant produces tubers. Lateral buds called 'eyes' develop on the tubers. A new plant will grow from each lateral bud. If lateral buds are cut with pieces of potato and planted, a new potato plant will grow from each piece.
 - **Bulbs**: shortened **underground stem** with fleshy storage leaves, for example the onion. Small daughter bulbs develop from the mother bulb. The daughter bulb separates from the mother bulb and develops into a new plant.
 - **Stolon** (also called a runner) is a horizontal stem with long internodes that lie above the ground. Adventitious buds develop at the nodes of the stolon. Each bud will grow into a new plant, for example the strawberry plant
- **Leaves**: some plants make plantlets along their leaf margins, e.g.: the **kalanchoe**. The little plants develop from the meristematic tissue in the leaf. When the plantlets are a certain size, they drop off the leaf, onto the ground and grow into adult plants.
 - **Roots**: some roots produce **suckers** that are above the ground stems. Suckers develop from **adventitious buds** on the roots. Each sucker grows roots at the base of the stem and a new plant develops. It is possible to separate the sucker from the parent plant. Examples of this type of asexual reproduction are apple trees, cherry trees, raspberry plants and blackberry plants. Some weeds reproduce in this way. When the weed plant is pulled from the soil, some of the roots stay behind to produce adventitious buds and therefore many more weeds will grow.

3. Sexual reproduction in flowering plants

The angiosperms are highly developed plants. The organ of sexual reproduction is the flower. The flower contains the sepals and petals for protection of the reproductive parts. Colourful petals attract insects for pollination. The flower contains the **stamens** (male parts called the androecium) and the **carpels** (the female parts called the gynoecium). A flower that contains both the stamens and carpels is said to be **perfect and complete**. If one of these whorls is missing, the flower is said to be incomplete and imperfect.

- **The androecium (male parts):** It consists of three or more stamens. Each stamen has a **filament** and an **anther lobe**. Each anther lobe consists of four pollen sacs in which diploid mother cells are formed. The diploid mother cells divide by meiosis to form **haploid pollen grains** (microspores).
- **The gynoecium (female parts):** The pistil consists of three parts: **stigma, style and ovary**. The ovary is divided into locules, which contain the ovules. Each ovule consists of a nucellus, which contains a diploid megaspore mother cell. Two integuments surround the nucellus with a small hole at one end called the **micropyle**. The megaspore mother cell undergoes meiosis to form four haploid megaspores. One megaspore develops into an embryo sac while the other three disintegrate. The haploid nucleus in the embryo sac divides by mitosis to result in eight nuclei: three form antipodal cells, two form polar cells, two form synergids and one develops into the egg cell.
- **Pollination:** Before fertilization, 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.
- **Fertilization:** When the ripe pollen falls on the **receptive stigma**, the pollen grain **germinates** forming a pollen tube. The generative nucleus divides by mitosis to form **two male gametes**. The pollen tube grows down the style and in through the micropyle of the ovule to the embryo sac. The tip of the pollen tube disintegrates and both male gametes are released into the embryo sac. One male gamete fuses with the egg cell to form a **diploid zygote**. The second male gamete fuses with the two polar nuclei to form a **triploid endosperm nucleus**, which will become food for the zygote. This is called **double fertilization**. The zygote forms the seed while the ovary wall grows into the fruit. Fruit is therefore a mature, ripe ovary.

4. Importance of angiosperms

- Producers and a source of food because they are autotrophic and photosynthesize. Roots, stems, leaves and fruit provide food for consumers like animals, birds and insects.
- Flowers produce nectar, collected by bees and converted into honey.
- The process of photosynthesis allows the conversion of carbon dioxide into oxygen.
- Many angiosperms are used for medicinal purposes.

5. Genetically Modified crops

Scientists use plant biotechnology to genetically modify plants to:

- yield larger crops,
- withstand unfavourable environmental conditions and
- be more resistant to pests and diseases.

The process starts with artificial selection of characteristics that are regarded as good. Selected plants are crossed with others to improve characteristics and ensure that the new species that is developed, is superior to the previous one.

SECTION D: HOMEWORK

HOMEWORK QUESTION : - 20 minutes

(Taken from DoE November 2009)

(Remember, when you write a short essay type question, that you will be given marks for writing the facts in a logical order. Briefly plan what you are going to write and the order in which you will give the facts. Make sure that you punctuate properly and that you check your spelling. Do not use bullet points. The following table shows how marks for the synthesis component are given. This will be the same for each essay type question.)

Marks	Descriptions
3	Well structured – demonstrates understanding of question
2	Minor gaps in the answer
1	Attempted but with significant gaps in the answer
0	Not attempted/nothing written/nothing correct other than question number

Using genetically modified organisms as a source of food is supported by some people and rejected by others.

Explain SIX advantages of using genetically modified organisms as a source of food. (12)

Synthesis: (3)

(15)

NOTE: NO marks will be awarded for answers in the form of flow charts or diagrams.

(Make sure that you know what genetically modified crops are as well as examples. The chances are that you will be asked a question on genetically modified crops or livestock in an exam. You will need to know the advantages and also the disadvantages. In this question they have asked ONLY for the advantages so do not give the disadvantages as well if you are not asked for this. It is important because this is an example of **SELECTIVE BREEDING** and **ARTIFICIAL SELECTION** that will be studied in Module 4 and benefits humans greatly.)

SECTION E: SOLUTIONS TO SESSION 7

Exercise 1 Answer:

Accept any 1 ethical use (1x2 marks) **AND** any 1 unethical use (1x2 marks)
OR
 Accept any 2 unethical uses (2x2 = 4 marks)

Ethical uses of the 'spare embryos'

- Could be available to people that cannot have children ✓
- Could be used to enhance research in embryology ✓ /genetic engineering to improve health/ensure survival of people ✓
- Could be stored and used later by the people ✓ – if *in vitro* fertilisation fails the first time or if the people want to have more children ✓
- To produce human parts ✓ to save lives ✓

Unethical uses of the 'spare' embryos

- Could be sold to people that cannot have children ✓ /to anybody that can pay for it – lead to exploitation ✓
- Could be used to do research in embryology/genetic engineering ✓ that may be unacceptable ✓
- Could be stored ✓ and misused later ✓
- To produce human parts ✓ to sell on illegal market ✓ /rest of organism discarded
- Religiously unacceptable ✓ /objection due to lack of respect for life ✓

Accept any 1 advantage (1x2 marks) **AND** any 1 disadvantage (1x2 marks)
OR
 Accept any 2 disadvantages (2x2 = 4 marks)

Advantages in being allowed to choose the sex of a child

- Planning a family ✓ so that one does not have too many children ✓ /does not have to continue having children until one gets ones preferred gender ✓
- Planning to have a child of a particular sex ✓ for various reasons like prevention of sex-linked diseases ✓ /cultural reasons
- Some people may specifically want a son ✓ to continue the family name ✓ /as an heir
- Prevent the killing ✓ of unwanted newly-born babies ✓

Disadvantages in being able to choose sex of ones child

- Due to political/cultural reasons ✓, there might be a preference for a particular gender ✓
- Imbalances in ratio between males and females ✓ – difficulty in finding partners ✓
- Determining the sex of the embryo is an expensive process ✓ – only the rich could afford

this privilege ✓

- Religious objection to the procedure ✓ / playing God- every child is a gift ✓
- Increased abortion of unwanted fetuses ✓ if it was not of the preferred gender/if carrying diseases ✓

Views in support of use of contraceptives

- Could plan ✓ how many children they can afford to have ✓ /prevents unplanned or unwanted babies /regulate population size
- Couples plan ✓ - when ✓ they want to have children
- Some contraceptives/condoms ✓ assist in preventing STDs transmission ✓

Accept any 1 view in support (1x2 marks) **AND** any 1 view against (1x2 marks)
OR
 Accept any 2 views against (2x2 = 4 marks)

Views against the use of contraceptives

- Some religions/cultures ✓ do not allow the use of contraceptives ✓
- Claims that the use of contraceptives encourages illicit sex ✓ since pregnancy is not a consequence ✓
- Not 100% safe ✓ so pregnancy may still result ✓
- Side effects of contraceptive use ✓ may cause pain ✓ /discomfort/decrease sexual pleasure.

Maximum (12)

Synthesis

Description	Marks
Not attempted/ No relevant information provided	0
ONE or TWO issues explained with some irrelevant information	1
TWO issues explained with no irrelevant information/ All THREE issues explained with some irrelevant information	2
All THREE issues explained with no irrelevant information	3

Exercise 2 Answer:

- 2.1. Results of the study to show effectiveness ✓ of a range of contraception methods ✓ (2)
- 2.2. Method of contraception ✓ (1)
- 2.3. Bar graph ✓
- The independent variable is discontinuous ✓
 - Each method's results cannot be correlated with one another ✓ (3)
- 2.4.
- Age of the participants ✓ – fertility varies with age ✓
 - Socio-economic status / education level of the participants ✓ – will effect ability to comply ✓ (4)
- 2.5. Vaginal sponge ✓ (1)
- 2.6. Hormone implant – 3 per 1000 users ✓. The hormone prevents ovulation and is implanted into the body ✓ – so very little chance of the method not being effective (2) / Intra-uterine device – 3 per 1000 users ✓. The IUD is implanted into the uterus ✓ – so it is effective all the time it is in the uterus.
- 2.7. Condoms are effective in preventing the spread of HIV infection ✓. They might not prevent an unwanted pregnancy, but they will prevent the partner from cross infecting each other with the virus ✓. Condoms are very inexpensive/cheap ✓. Condoms are easily available ✓. (2 marks - any 2 relevant answers)
-

Exercise 3 Answer:

3.1. Fertilization ✓ (1)

3.2. Couple could not conceive normally due to any of the following:

- Man has a low sperm count / infertile ✓
- Blocked Fallopian tubes ✓
- Irregular menstrual cycle ✓
- Imbalance of the hormones concerned with ovulation ✓
- Sexually transmitted diseases ✓

(Mark only the first two = 2)

3.3. (a) Ethical since it allows couples to have children if one of them is infertile ✓

OR

Unethical since only those that are rich would be able to take advantage of this opportunity ✓

(any 1 x 2 = 2)

(b) Ethical since it can be used to develop treatment for defects in foetuses ✓

OR

Unethical since this is experimentation with human life ✓ (any 1 x 2 = 2)

3.4. IVF involves fusion of 2 haploid nuclei / gametes ✓

whereas in cloning no fusion takes place / diploid nucleus of somatic cell used ✓

OR

IVF can lead to variation in offspring whereas cloning produces identical offspring ✓

OR

IVF 'mimics' natural sexual reproduction whereas with cloning there is no sexual reproduction ✓

(Mark first comparison only = 2)