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GR.12 LIFE SCIENCES
PRELIMINARY EXAM
PAPER 2
MEMORANDUM

QUESTION 1

1.1 Provide the **correct biological term** for the following phrases from the given sources:

(4)

1.1.1 "Chemicals to attract the right type of mate."	Pheromones ✓
1.1.2 "Penis-like organ inserted into the modified lip of the flower"	Copulation ✓
1.1.3 "Factor that distributes the pollen"	Pollinator ✓
1.1.4 " <i>Disa forficaria</i> was last seen in 1966 and only 11 of these plants have been found in the last 200 years"	Critically endangered ✓

1.2 The Red Disa (*Disa uniflora*) and *Disa forficaria* employ different reproductive strategies to ensure pollination and reproduction.

a) Explain the terms pollination and reproduction. (2)

Pollination: the transfer of pollen the anther to stigma, to enable fertilization and reproduction. ✓

Sexual reproduction is the joining is the joining of two haploid gametes to produce a new generation of offspring from an existing generation. ✓

b) Define the term "reproductive strategy". (2)

Genetic determined behavior of a species to produce the maximum amount of surviving offspring ✓ while using the least amount of energy. ✓

- c) Differentiate how the Red Disa (*Disa uniflora*) and *Disa forficaria* employ different reproductive strategies to ensure pollination and reproduction. (4)

The Red Disa primarily relies on the Mountain Pride butterfly for pollination. ✓

The flowers are brightly coloured (mostly red or pinkish), attracting the butterfly which acts as the sole pollinator due to its specific adaptations to mountainous habitats. ✓

Disa forficaria employs a unique strategy of sexual deception involving male beetles. ✓

The orchid mimics the appearance and chemical signals of female beetles, attracting males that inadvertently pollinate the flowers during mating attempts. ✓

- 1.3 “During their experiment with the synthesised molecules, they discovered that some of the beetles were carrying pollen (confirmed by genetic barcoding) from at least two other individuals of this *Disa*, proving the plant is not extinct. Using pollinators to see if an endangered plant is present in the area is a world-first,” said Cohen in Source B.

- a) What is the aim of this experiment? (2)

To investigate if there are more individuals of the *Disa forficaria* species ✓
left in the wild by utilising the pollen carried on the male beetles. ✓

- b) This investigation on *Disa forficaria*, described in Source B, can possibly contribute significantly to the conservation of this orchid species through innovative techniques.

Evaluate whether this investigation can be seen as a fair test. (4)

Testing is fair if:

- the question being dealt with must be answerable through experiment;
- the experiment must deal with the question being studied;
- all the variables in an experiment must be considered and controlled;

- only one variable may be altered at a time;
- the experiment must be able to be replicated

Must argue both the yes and no side.

Yes – two valid scientific facts supporting the above-mentioned bullets

No – two valid scientific facts contradicting the above-mentioned bullets.

- 1.4 Source B states that *Disa forficaria* – a relative of the iconic Red Disa – was last seen in 1966 and only 11 of these plants have been found in the last 200 years, making it one of the rarest plants in the world.

- a) Why is *Disa forficaria* called a relative of the iconic Red Disa? (1)

The belong to the same genus. ✓

- b) Provide TWO possible reasons why *Disa forficaria* became one of the rarest plants in the world. Provide phrases from the given sources to support your answers. (4)

1 – over exploitation ✓ (due to the actions of an overzealous orchid collector) ✓ OR

2 – Favourable food source ✓ (the work of a porcupine) ✓ OR

3 – Slow reproductive cycle ✓ (produces one flower at a time; and when Cohen first saw it, the flower had withered. But he persisted, visiting a further four times until another flower bud slowly ripened) ✓

ANY TWO ANSWERS WITH PHRASES

- 1.5 Evaluate the importance of seed banks, such as the Millennium Seed Bank Partnership mentioned in Source C, in conserving plant biodiversity.

- a) What is a seed bank? (1)

A seed bank is a facility used to store seeds of various wild plants in an effort to maintain biodiversity. ✓

- b) Considering the challenges that the world faces, in your opinion, are seedbanks really necessary? Motivate your answer. (2)

Yes OR No and any appropriate reasons supporting the decision. ✓✓

c) Suggest TWO ways in which a seed bank can possibly assist with the conservation of Disa species in the Western Cape. (4)

- **Collection and Preservation of Genetic Diversity:** Seed banks collect seeds from various populations of Disa species across their range. This helps in preserving the genetic diversity present within the species, which is essential for their long-term survival and adaptation to changing environmental conditions. ✓✓ **OR**
- **Propagation and Research:** Seeds stored in seed banks can be used for research purposes and for propagating plants outside their natural habitat. This is particularly useful for species that are rare or threatened in the wild, as it provides a safeguard against extinction. ✓✓ **OR**
- **Reintroduction Programs:** Seeds from the seed bank can be used to reintroduce Disa species into their natural habitats where they have become locally extinct or are in decline. This can help restore populations and improve genetic diversity in these areas. ✓✓ **ANY TWO WAYS**

TOTAL QUESTION 1: 30

QUESTION 2

2.1 What are female gonads referred to? (1)

Ovaries ✓

2.2 "... it became clear that this model was too simplistic". Do you agree with this statement? Motivate your answer. (2)

Yes, gender determination is complex, it relies on genes, gonads, hormones, and internal reproductive structures. ✓ Mutations on the SRY gene can result in variations in sex development. ✓

2.3 Discuss your opinion on the potential impact of changing names of conditions such as "hermaphrodite", to "disorders of sex development". (2)

Students' own opinion. Potential discussion points:

- More inclusive.
- Destigmatizes intersex individuals.
- Might be met with resistance from certain groups (religious/ conservatives).
- Potentially result in confusion when using new terminology amongst certain groups.

2.4 Predict a possible long-term effect that AIS could have on affected males. Explain your reasoning. (2)

Result in potential sterility/ infertility, due to male genitals not developing as it should ✓, leading to low testosterone levels, thus preventing sperm production/ maturation. ✓

2.5 Making use of the information provided in Source B, use ONLY the letters provided below to indicate whether the statements in the table are: (3)

A- Supported by the text

B- Contradicted by the text

C- Neither supported, nor contradicted by the text

STATEMENT	LETTER
Individuals affected by AIS do not produce testosterone.	A ✓
Every male affected by AIS develop breasts.	C ✓
AIS is a result of an X-linked mutation.	C ✓

Higher likelihood of fertilization, as both reproductive structures occur on the same plant/
can self-pollinate. ✓

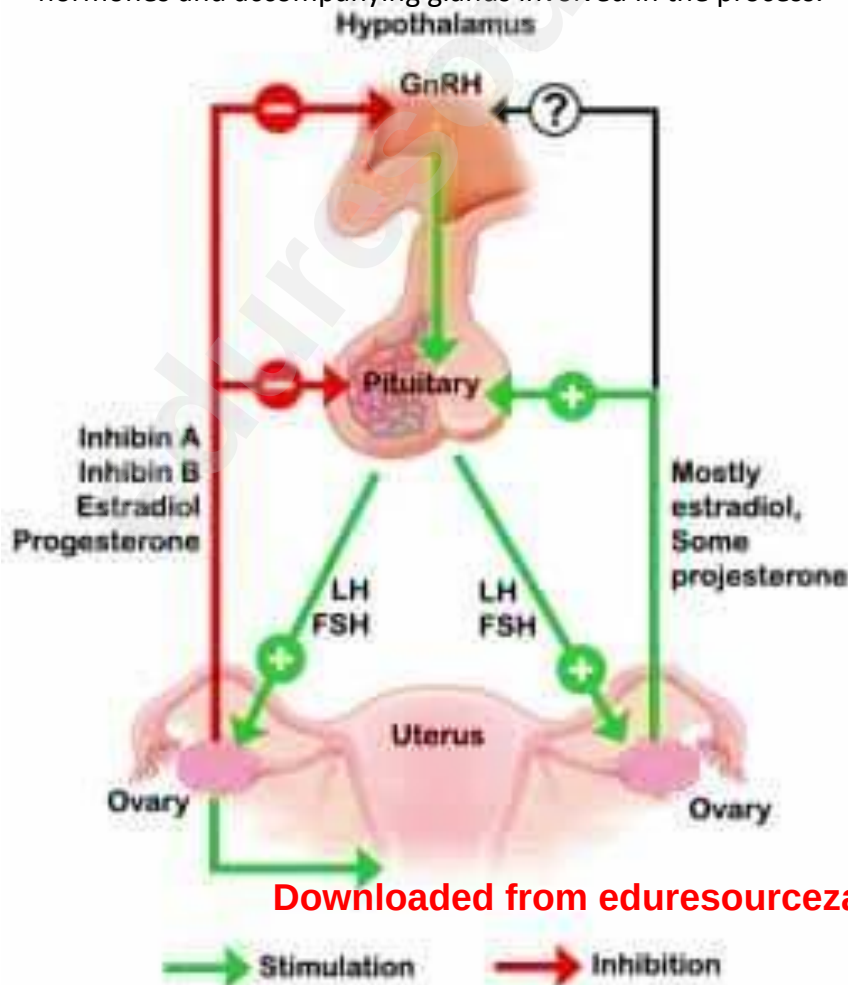
Students' own reasoning. Must mention risks to achieve 2 marks.

- ### Risks:

- Gender dysphoria when the child reaches puberty.
- Social isolation due to being different.
- Psychological impact: suicide/ self-harm, etc.

(Will have to refer to final printed version.)

2.9 Construct a flow diagram to illustrate the negative feedback mechanism of FSH and AMH (cells in ovarian follicle secretes AMH). In your diagram include the hormones and accompanying glands involved in the process. (6)



2.10 Identify two other ovarian hormones, and mention the role it plays during the menstrual cycle. (4)

Oestrogen✓: released by Graafian follicle, initiates thickening of endometrium lining, triggers release of LH from pituitary.✓

Progesterone✓: released by Corpus luteum, thickens and maintains endometrium lining, inhibits the release of FSH and LH.✓

Use Source E to answer the following questions:

2.11 Identify the function of the cells represented by A. (1)

Cells of Leydig releases testosterone.✓

2.12 Identify the process represented by B. (1)

Spermatogenesis.✓

2.13 Mention one significant difference between male and female gametogenesis. (1)

Spermatogenesis is continuous, whilst Oogenesis completes if fertilisation occurs✓ / spermatogenesis produces 4 haploid gametes, oogenesis produces 1 haploid ovum.✓

QUESTION 3

Artificial breeding of brachycephalic dogs should be banned.

Stance for argument	Counter argument
SOURCE A	
Brachycephalic dogs, are often unable to breed or give birth naturally due to their extreme anatomy, meaning breeders turn to artificial insemination (AI) – costly procedures	AI is now used for many breeds and can bring genetic benefits
Caesarean sections are often necessary – this costs money for owners	Non-vets can be very skilled in aspects of canine fertility that can be practised without veterinary qualifications
Breathing difficulties makes it difficult for them to mate – should have gone extinct without human intervention	Professional support can help inexperienced breeders ensure safety and good conditions of dogs – some layman professionals might have more experience than vets
Because of the rise in AI some of the canine fertility clinics seem to not have licensed veterinarians performing the procedures – this might cause dogs to die	Legal forms of AI are allowed and is important for breeding – vets should just be involved in their usage
Banned forms of AI are being used – illegal activities are being encouraged and this whole movement should be stopped	If dogs with brachycephalic obstructive airway syndrome are neutered there should not be a problem in continuing AI on healthy dogs
Canine AI and ultrasound scans do not require a licence to operate – these facilities are not being regulated to the extent that they should be	The clamour for such dogs has been huge with registrations of French bulldogs alone rising from 1 521 in 2009 to 36 785 in 2018 in the UK – people love these dogs and find companionship from them
Breeding is unlawful if it harms the health or welfare of the parent or offspring	
AI is not suitable for all dogs – including those who cannot mate or give birth naturally	
AI could allow dogs with inherited diseases and conditions, for example brachycephalic obstructive airway syndrome in flat-faced dogs, to be used for breeding	
SOURCE B	
Some vets consider brachycephalic dogs as having health and welfare too compromised to continue breeding	93% of owners of brachycephalic dogs would choose to own their current breed again in the future, and two-thirds would

	recommend their current breed to a potential first-time dog owner – very good companion dogs
Owners of pets with chronic illnesses report greater psychological distress and a lower quality of life	Brachycephalic dogs have <u>positive behavioural attributes</u> as companion dogs, they are <u>suitable for a sedentary lifestyle</u> with <u>limited space</u> , and <u>suitable for households with children</u>
Owners recommended against their breed due to the <u>high prevalence of health problems</u> , <u>expense</u> of ownership, <u>ethical and welfare issues</u> associated with breeding brachycephalic dogs, <u>negative effects upon owner lifestyle</u> and <u>negative behavioural attributes</u>	Owners are becoming hooked on the loving personalities of these sweet dogs
Owners are accepting and normalising these dogs' shocking health issues	
SOURCE C	
Symptoms of brachycephalic obstructive airway syndrome: • Coughing - constricted airways • Exercise intolerance - physical abnormalities to get enough oxygen to their lungs • Breathing difficulties – narrower airways • Vomiting – swallows too much air when eating or drinking accumulating in their stomachs • Weight loss – lack of oxygen causes rapid breakdown of fats	
SOURCE D	
Brachycephalic phenotype was likely originally selected as a potential advantage in fighting – these dogs are not being used for this reason and are thus not needed for their designed purpose	Brachycephalic breeds are selected as companion dogs with appealing looks
	Distinctive physical facial characteristics resemble infantile facial features and trigger the same attraction, nurture response and positive emotions in adults that are aroused by a human baby
SOURCE E	
Possible brachycephalic shortcomings: • Cranial arthritis	BIBs may not exist for much longer and should be protected through AI

• Too much body fat – 94,5% • Paws are bunions – causing pain to dogs • Nasal passages open directly to the brain • Plugged ears – causing hearing problems • Folds of skin eventually smother the dog	
Bulldogs and pugs are breathing-impaired breeds (BIB) who, according to experts, may not exist for much longer	
Genetic diseases prevalent in BIBs will likely reach a point where their health is so poor that they'll be unable to survive	
constantly declining and already cruelly compromised quality of life, it would be best if these dogs no longer existed—and they shouldn't have been bred into existence in the first place	
Owners state - "I wish no more dogs would have to go through this"	
Going for a walk, chasing a ball, running, and playing—the things that make dogs' lives joyful and fulfilling—are impossible for many breathing-impaired dogs – unethical to keep them alive for our own pleasure	
Breeding of BIBs is already restricted in many countries like Norway and the Netherlands because they're so prone to suffering that their existence was deemed cruel and in violation of animal welfare laws	
Breeders breed too many dogs in the hope of having a prizewinning dog they can then profit from by breeding and selling the dog's puppies - greedy breeders will continue to produce more—regardless of how much they cause dogs to suffer in the process	
All "purebreds" (flat-faced or not) suffer from congenital and often painful conditions. If you have the time, money, patience, and love to care for an animal for life (which could be for more than 15 years), please adopt one from a shelter	
SOURCE F	
Because of their flat faces and their resulting occasional breathing problems, they do best in	Pugs: • affectionate lapdogs

moderate climates and would rather lounge on the couch than head on a hike – cannot be kept in all locations	• mischievous, charming, and often have startlingly human-like expressions that make bonding with them a breeze • ideal modern-day pals for families with kids, singletons, the elderly, and everyone in between
Bulldogs and Boston terriers were originally bred to be violent fighters – might resort to this state again and harm owners	Bulldogs: • Dignified. Friendly. Chill • loyalty, and adaptability (they can live in cities or more rural areas) • loves to relax but also enjoys a brisk walk
Bulldogs should never be left alone around stairs or water – this is not always possible for owners and dogs might fall down stairs or drown	Boston terrier: • small in size and they are big in personality – good for living in smaller apartments • friendly and lively dispositions • make fabulous city dogs and are always up for a walk • Good manners and looks
SOURCE G	
27% of South Africa's cats and dogs don't have homes – 4.1 million homeless animals	
1.7 million street or stray dogs & many in shelters – people should either adopt dogs in shelters or on the streets than spending money on AI to breed new dogs that need homes	
OWN	
Money spent on continuing these dog breeds could have been spent on humans that do not have basic human needs like food and shelter.	If proper genetic testing is done to prevent dogs with inherent diseases from continuing to breed artificial insemination should be allowed to continue the species
Some dogs have died from artificial insemination procedures that have not been done by professionals or that have gone wrong – very unethical	Dogs are often not only pets to their owners but can offer therapeutic benefits to people with mental health issues
Proper genetic checks might not be done on the dogs being bred causing diseases to continue over generations and even become worse	Because these dogs cannot exercise as much, they are perfect companion dogs for older people that might have lost loved ones

Keeping these dogs alive is unethical because of their health issues causing them to suffer.	If owners have pet insurance, it should not cost them too much money if their pets do get sick
Brachycephalic obstructive airway syndrome reduces air flow to the lungs causing dogs to have less respiration occurring at cellular level lowering their energy available	If owners live in areas with moderate climates these breeds of dogs should not be as affected with regards to breathing
The unusual sounds that these dogs make could cause a lot of noise in apartment complexes	
People with these dogs breeds need to take out pet insurance because of their many health issues	
These dog breeds need extra time from their owners to properly clean in between their facial folds to prevent infections	
Breeders only keep breeding because of money and not animal welfare	