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TOTAL MARKS

NATIONAL SENIOR CERTIFICATE EXAMINATION
NOVEMBER 2021

LIFE SCIENCES: PAPER I

EXAMINATION NUMBER

ANSWER BOOKLET

There are (xvi) pages in the Answer Booklet. Please write your examination number in the blocks above.

QUESTION 1

1.1 Select the term in Column B that best matches the description in Column A. Write the letter of the term in the space provided between the brackets. Each letter may only be used once.

	COLUMN A		COLUMN B
[ ]	Improved features in an organism as a result of cross breeding	A	Sex-linked trait
[ ]	A characteristic that is influenced by genes on a gonosome	B	Heterozygous
[ ]	A section of DNA that codes for a protein	C	Mutation
[ ]	Having two different alleles for a particular gene	D	Locus
[ ]	An organism whose DNA has been altered using genetic engineering techniques	E	Gene
[ ]	Diagram to show the relatedness between individuals over generations	F	Polyploidy
[ ]	The exchange of genes between homologous chromosomes	G	Diploid
[ ]	A random change in the structure of a gene	H	Hybrid vigour
[ ]	The physical site of a specific gene on a chromosome	I	Family pedigree
[ ]	The condition in which a cell has more than two copies of each chromosome	J	Genetically Modified Organism
		K	Crossing over

(10)

1.2 Seven multiple-choice questions are asked below. Choose the most correct answer to each question and write the letter of your choice in the table below.

Question	1.2.1	1.2.2	1.2.3	1.2.4	1.2.5	1.2.6	1.2.7
Answer							

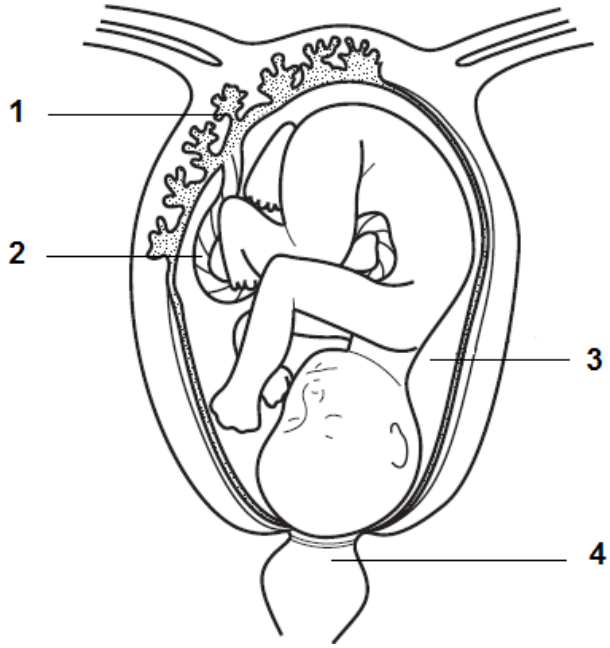
1.2.1 When a woman undergoes *in vitro fertilisation* (IVF) she is given a hormone to stimulate ovum development. What is this hormone?

A LH
B FSH
C Oestrogen
D Progesterone

(1)

1.2.2 Figure 1.1 shows a foetus in the uterus.

Figure 1.1: A developing foetus in the uterus



[Adapted from: <https://www.tutopiya.com>]

Which numbered area cushions and protects the foetus against physical injury?

A 1
B 2
C 3
D 4

(1)

1.2.3 What is the main reason for the establishment of a seed bank?

A Educate societies on the importance of seeds as a food source.
B Sell seeds to agricultural companies for profit.
C Conduct hybridisation and genetic modification experiments.
D Store and preserve the genetic diversity of plant species.

(1)

1.2.4 Plant growth hormones promote growth and specialisation of cells. Why would farmers use these growth hormones?

A Limit the elongation and branching of stems.
B Reduce seed formation.
C Increase the number of flowers and fruit on plants.
D Delay the ripening of fruits in their fields.

(1)

1.2.5 Which of the following is NOT a use of DNA profiling?

A Increasing the amount of DNA in samples.
B Paternity testing.
C Identifying the origins of illegally traded organisms.
D Analysing DNA samples from crime scenes.

(1)

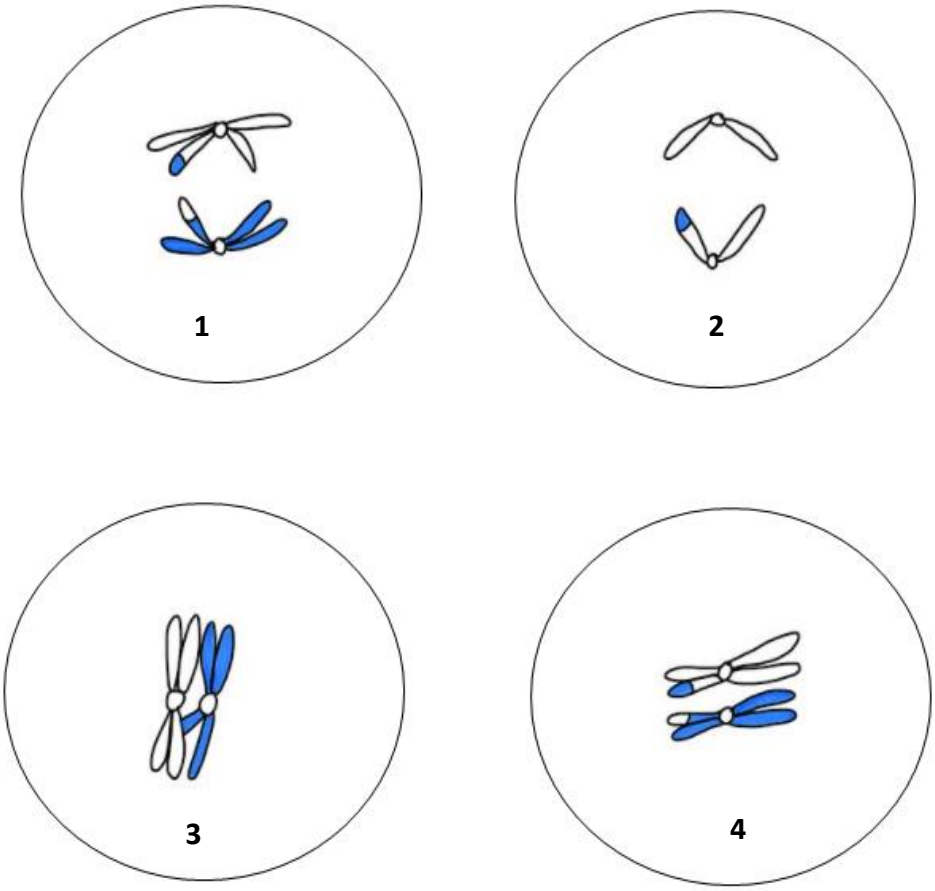
1.2.6 Which technological process can be used to permanently change the genome?

A PCR
B Cloning
C SCNT
D CRISPR

(1)

1.2.7 Figure 1.2 below shows the chromosomes in a cell at various phases of meiosis.

Figure 1.2: A cell shown at various phases of meiosis



[Source: Examiner's own]

Which of the following is the correct sequence of events during meiosis?

A 1 → 2 → 3 → 4
B 3 → 4 → 1 → 2
C 3 → 1 → 4 → 2
D 4 → 1 → 2 → 3

(2)

1.3 Study the following table which consists of TWO items (numbered 1 and 2) in the first column and a term in the second column. Decide which item(s) relate to the term. Write down your choice in the space provided in the "answer" column, making use of the following codes:

A only item 1 relates to the term
B only item 2 relates to the term
C both item 1 and 2 relate to the term
D neither item 1 nor 2 relates to the term

Item	**Term**	**Answer**
1. Organisms that look similar 2. Organisms able to breed with each other and produce fertile offspring	Species	
1. Distribution of similar species on different continents 2. Sympatric speciation	Biogeography	
1. Inheritance of acquired characteristics 2. Law of use and disuse of body structures	Darwin	
1. Limited gene flow 2. Geographic isolation of a small group of individuals	Founder effect	
1. Inbreeding 2. Share a common ancestor	Divergent evolution	

(5)

1.4 Study the information below and use the information and your own knowledge to answer the questions that follow.

A UN report of worldwide contraceptive use showed that **65%** of women relied on some form of contraception, while **35%** of women do not use any form of contraception.

Table 1: Worldwide use and effectiveness of contraceptive methods.

Choice of contraception	Worldwide use (%)	Effectiveness (%)
IUD	20	99
Oral Contraceptive Pill (OCP)	15	93
Male condom	15	87
Various other methods	15	77

[Adapted: <https://onlinedoctor.superdrug.com>]

1.4.1 According to the table, which method is the most popular?

_____

(1)

1.4.2 Give TWO reasons why women may choose an IUD over the OCP as a means of birth control.

_____

_____

_____

(2)

1.4.3 Male condom use in South Africa is 60%. Suggest why it is much higher than worldwide use.

_____

_____

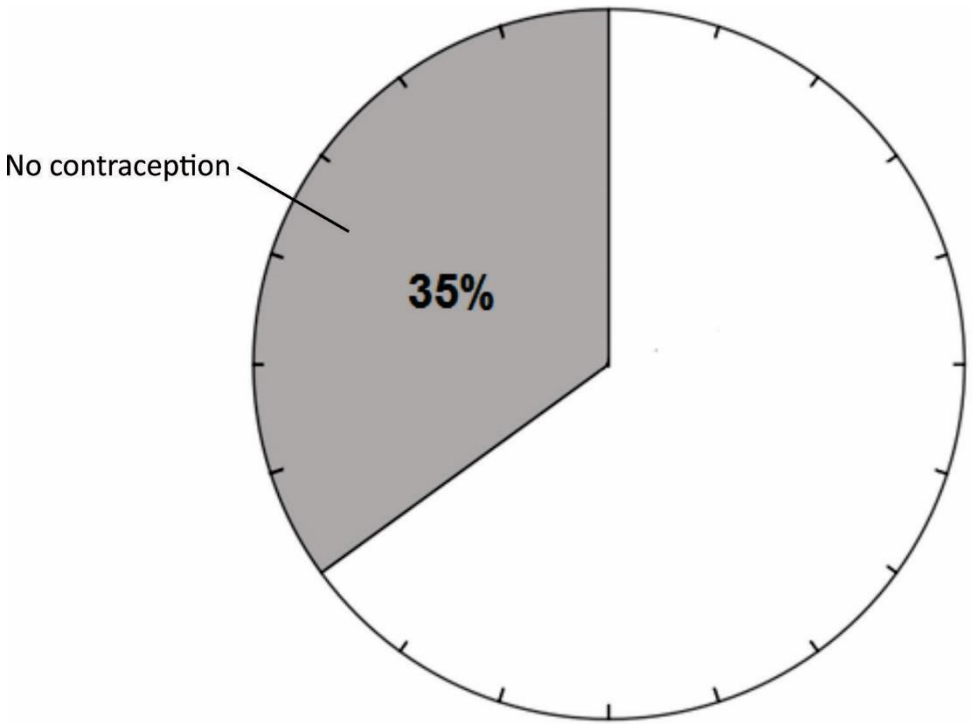
(2)

1.4.4 Name ONE contraceptive method that would fall in the "various other methods" category listed in the table.

_____

(1)

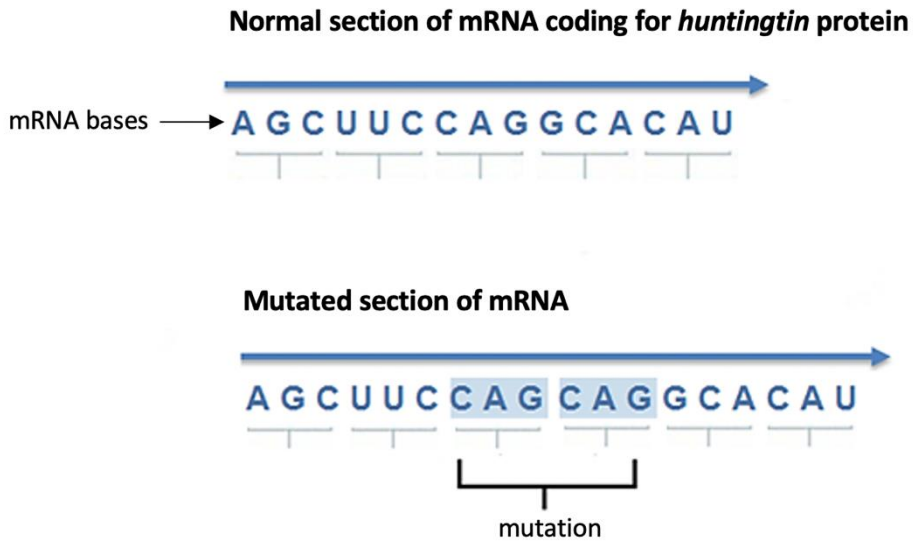
1.4.5 Refer to Table 1 on Page vi. Complete the pie chart below to show the worldwide use for each contraceptive.



(5)

1.5 Read the following information to answer the questions that follow.

Huntington's Disease is caused by the presence of an autosomal dominant allele which codes for an abnormal form of the *huntingtin* protein. The mutation in the allele involves the CAG sequence of DNA being repeated (see diagram below). If this sequence is repeated in the gene, then Huntington's disease will be present, which causes degeneration (break down) of nerve cells in the brain. Symptoms include involuntary movement and mental difficulties.



[Adapted: <https://medlineplus.gov>]

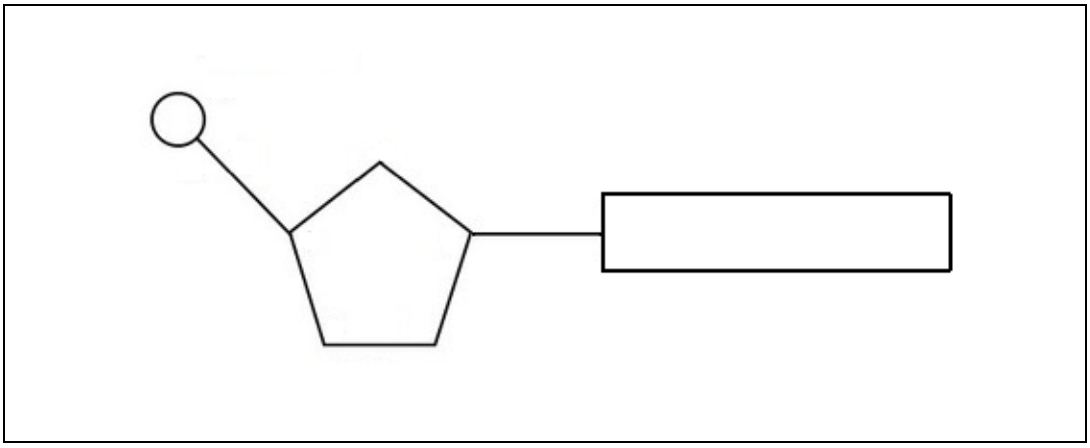
1.5.1 Explain what is meant by the term *dominant allele*.

_____

_____

(2)

1.5.2 Label the nucleotide below. (No heading required).



(3)

1.5.3 Which nitrogenous base is only found in RNA?

(1)

1.5.4 Table 2 below illustrates the corresponding amino acids coded for by mRNA.

Using Table 2, determine how the amino acids would be different in the mutated section of mRNA compared to the normal section of mRNA.

(2)

Table 2: mRNA codons.

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

[Source: <http://www.vce.bioninja.com.au>]

1.5.5 How would the changed amino acid sequence affect the *Huntingtin* protein?

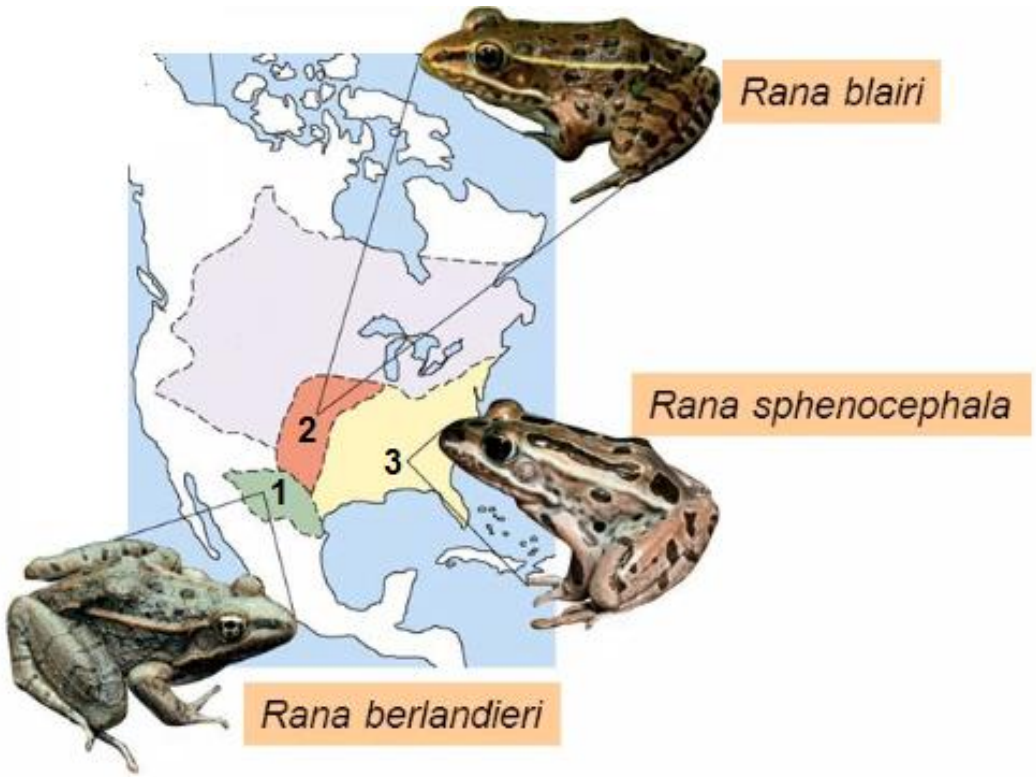
(1)

1.5.6 Construct a flow diagram to show how mRNA is formed from chromosomal DNA.

(6)

1.6 The breeding of three species of distantly related leopard frog (*Rana spp.*) was studied. The different populations of frog species are geographically isolated from each other and have different ecological niches as shown in Figure 1.3 below. The graph in Figure 1.3 shows the number of times researchers observed frogs mating during field trips.

Figure 1.3: Three populations of leopard frog species



Graph showing the number of times the frog species were observed mating in one year.

Populations	MONTH J F M A M J J A S O N D
Rana berlandieri	
Rana blairi	
Rana sphenocephala	

Key: Observations of mating events
- < 3
- 3 – 5
- 6 – 10
- > 10

[Adapted: <https://www.ets.org/s/gre/pdf/practice_book_biology.pdf> ; <https://slideplayer.com>]

1.6.1 The four statements in the table below refer to the information on Page xi. For each statement decide whether:

A the statement is supported by the information
B the statement is contradicted by the information
C the statement is neither supported nor contradicted by the information

	Statement	**A, B or C**
(a)	*Rana berlandieri* is observed to breed all year round.	
(b)	All three species of leopard frog live in the same ecological niche.	
(c)	Over 20 mating events were observed for *Rana blairi.*	
(d)	*Rana sphenocephala* only mates from January to March every year.	

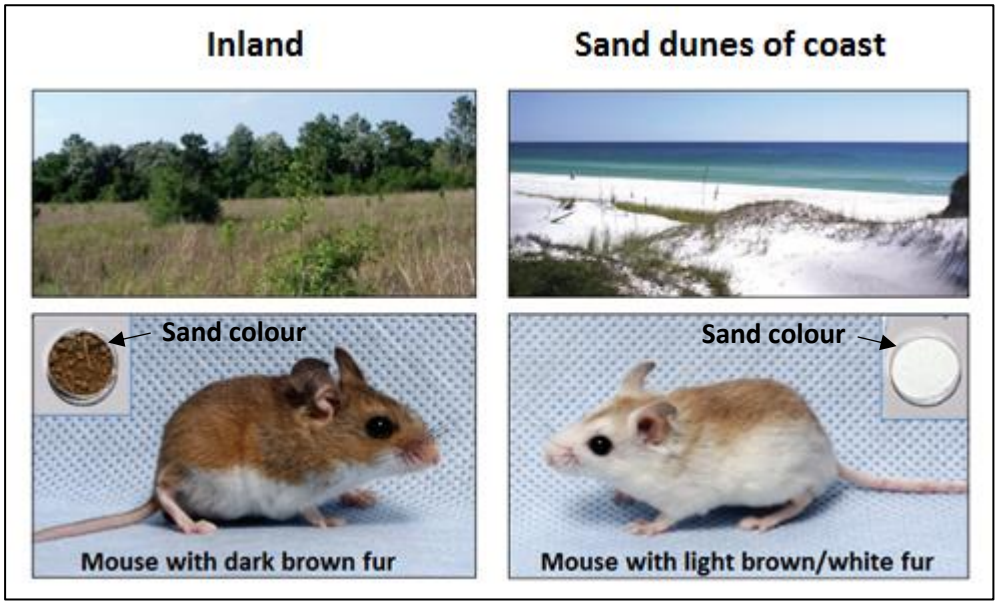
(4)

1.6.2 Did the three species of leopard frog originate by allopatric or sympatric speciation? Give a reason for your answer.

(2)

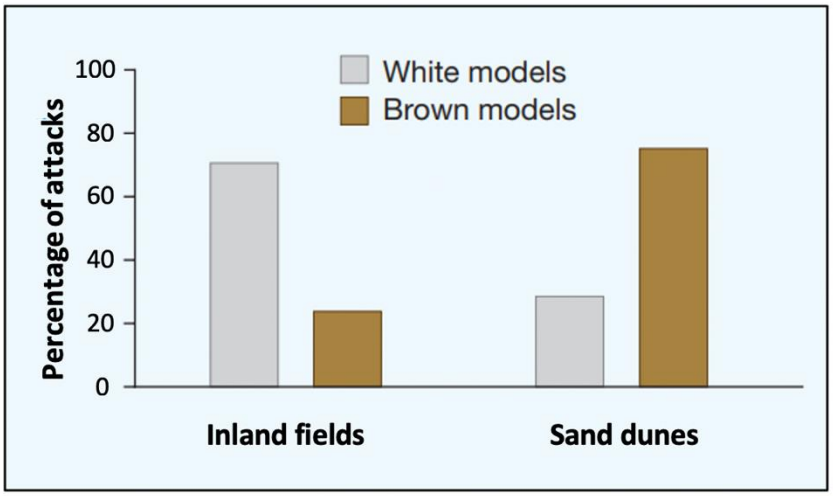
1.7 Read the following information on natural selection in mice and answer the questions that follow.

Researchers have studied aspects of natural selection in fur colour variation in populations of mice of the same species where they occur on the coast and adjacent inland areas. Over the last 60 years, they have noted a change in fur coat colour in the mice populations. Most of the mice living inland have brown fur, while the mice living on the sand dunes of coastal regions have lighter brown or white fur.



Researchers tested a hypothesis that predators drove the natural selection of mouse fur colour. They made plasticine models of white and brown mice. They placed the mice models in fields inland and on sand dunes at the coast. They recorded the percentage of the models that were attacked by predators. The results are shown in Figure 1.4 below.

Figure 1.4: Graph showing percentage of attacks on mouse models inland and on sand dunes on the coast



[Source: Vignieri, S.N., J.G. Larson, and H. E. Hoekstra. 2010 Evolution 64: 2153–2158; <https://www.pearson.com>]

[Adapted: <https://nescent.org>]

1.7.1 Refer to Figure 1.4.

(a) Identify the dependent variable in the investigation.

(1)

(b) What percentage of white mice models were attacked in the sand dunes?

(1)

(c) Explain how the results support the researchers' hypothesis that predation drove the natural selection of mouse fur colour.

(4)

1.7.2 Refer to Darwin's theory of natural selection to explain how the population of mice on the coast evolved white fur.

(5)

1.7.3 Why is the change in fur colour NOT an example of macroevolution?

_____

_____

(2)

1.7.4 Complete the table below by selecting the words listed in bold and writing them in the corresponding block in the table.

Slow **Fast** **Human**

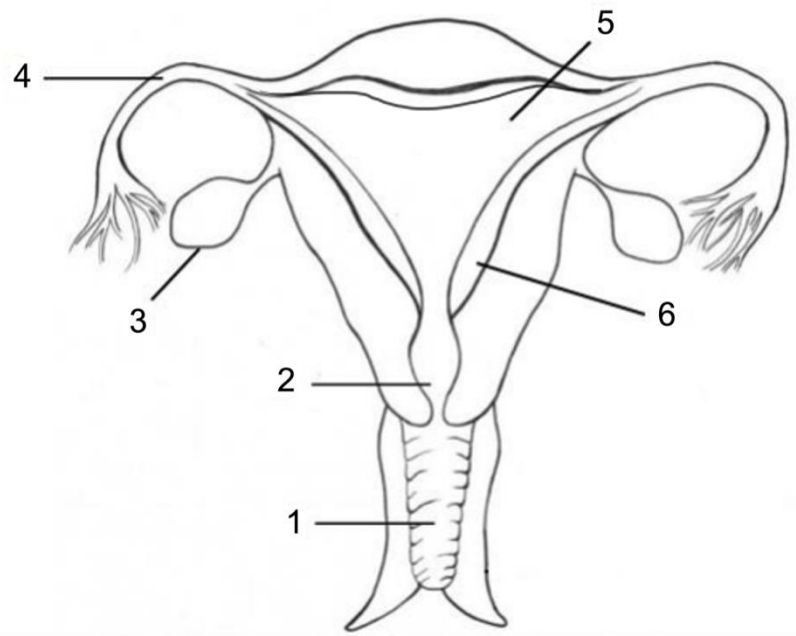
Environment **Decrease in variation** **Increase in variation**

	Natural selection	Artificial selection
1. Cause of change		
2. Rate of change		
3. Variation		

(6)

1.8 The diagram below shows the female reproductive system.

Figure 1.5: The female reproductive system



[Adapted: <https://o.quizlet.com>]

1.8.1 Choose the number in Figure 1.5 which corresponds with the statement in the table below and write the correct number in the space provided in the answer column.

Statement	**Answer**
Non-permanent layer richly supplied with blood vessels.	
Muscle action and cilia move developing zygote to uterus.	
Place where sperm is deposited during sexual intercourse.	
Cavity where the foetus grows and develops during gestation.	

(4)

1.8.2 On the diagram above, indicate any ONE place where the following occur:

(a) place an "X" where ovulation takes place.

(1)

(b) place an "M" where implantation would occur in a healthy pregnancy.

(1)
[80]