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**ROSSMOYNE SENIOR HIGH SCHOOL**

**Science**

**Semester 1, Examination 2019**

**Unit 3 Biology ATBLY**

**Question/Answer Booklet**

**Student Number:** In figures

In words

#### Time allowed for this paper

Reading time before commencing work: ten minutes

Working time for paper: three hours

**Materials required/recommended for this paper**

To be provided by the supervisor

This Question/Answer Booklet

***To be provided by the candidate***

Standard items: pens, pencils, eraser, correction fluid, ruler, highlighters

Special items: nil

**Important note to candidates**

No other items may be taken into the examination room. It is your responsibility to ensure that you do not have any unauthorised material. If you have any unauthorised material with you, hand it to the supervisor before reading any further.

**Circle your Teacher’s name: Ballantyne Rayner**

Structure of this paper

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Section | Number of questions available | Number of questions to be answered | Suggested working time (minutes) | Marks available | Percentage of examination |
| Section One Multiple-choice | 30 | 30 | 40 | 30 | 30 |
| Section Two Short answer | 5 | 5 | 90 | 100 | 50 |
| Section Three Extended answer  Part A | 2 | 1 | 50 | 40 | 20 |
| Part B | 2 | 1 |
|  |  |  |  | **Total** | 100 |

Instructions to candidates

1. The rules for the conduct of the Western Australian external examinations are detailed in the *Year 12 Information Handbook 2019*. Sitting this examination implies that you agree to abide by these rules.
2. Write your answers in this Question/Answer booklet preferably using a blue/black pen. Do not use erasable or gel pens.
3. Answer the questions according to the following instructions.

Section One: Answer all questions on the separate Multiple-choice answer sheet provided. For each question, shade the box to indicate your answer. Use only a blue or black pen to shade the boxes. If you make a mistake, place a cross through that square, then shade your new answer. Do not erase or use correction fluid/tape. Marks will not be deducted for incorrect answers. No marks will be given if more than one answer is completed for any question.

Section Two: Write your answers in this Question/Answer booklet. Wherever possible, confine your answers to the line spaces provided.

Section Three: Consists of two parts each with two questions. You must answer one question from each part. Tick the box next to the question you are answering. Write your answers in this Question/Answer booklet.

1. You must be careful to confine your answers to the specific questions asked and to follow any instructions that are specific to a particular question.
2. Supplementary pages for the use of planning/continuing your answer to a question have been provided at the end of this Question/Answer booklet. If you use these pages to continue an answer, indicate at the original answer where the answer is continued, i.e. give the page number.

|  |  |
| --- | --- |
| Section One: Multiple–choice | 30% (30 Marks) |

This section has **30** questions. Answer **all** questions on the separate Multiple-choice Answer Sheet provided. For each question shade the box to indicate your answer. Use only a blue or black pen to shade the boxes. Do not use erasable or gel pens. If you make a mistake, place a cross through that square, do not erase or use correction fluid, and shade your new answer. Marks will not be deducted for incorrect answers. No marks will be given if more than one answer is completed for any question.

Suggested working time: 40 minutes.

1. Which of the following statements is **true** for meiosis? Meiosis

(a) occurs in the somatic cells of multicellular organisms.

(b) produces two daughter cells from every parent cell.

(c) produces four daughter cells after one division of the parent cell.

(d) produces gametes with half the chromosome number of the parent cell.

1. In 1953, scientists Watson and Crick formulated the detailed structure of DNA. The structure of DNA is comprised of

(a) amino acids linked by hydrogen bonding.

(b) repeating units called nucleotides.

(c) ribose sugar, an organic base and phosphate.

(d) a double strand of polypeptide chains.

3. Which of the following is an example of a homologous structure?

(a) the paired wings of insects and birds

(b) the amniotic eggs of birds and reptiles

(c) the pentadactyl limb of bats and birds

(d) the fin of sharks and the dolphin flipper

4. Many people believe that evolution is a false theory, based on the idea that humans 'evolved from apes'. If humans have large brains, extensive problem-solving abilities and the power of speech, then why don't these primate 'ancestors'? Which of the following statements best supports the theory of evolution in response to this idea?

(a) Adaptations result in a compromise to another advantageous trait.

(b) Evolution is limited by phylogenetic constraints.

(c) The evolution of advantageous traits is dependent upon environmental factors.

(d) Advantageous traits do not appear within a population's gene pool on command.

1. A pea seed packet contains roughly equal numbers of yellow seeds and green seeds. To investigate how the seed colours were inherited 100 green seeds were planted in a separate container and the F1 seeds were collected.

Which of the following results would indicate that green colour is inherited as a recessive, autosomal allele?

(a) approximately 75% of the F1 are green

(b) approximately 25% of the F1 are green

(c) all of the F2 would be yellow

(d)all the F1 are green

6. A dihybrid cross is a useful tool to help geneticists analyse

(a) independent assortment in gametes.

(b) the frequency of heterozygotic inheritance.

(c) inheritance of unlinked autosomal genes.

(d) the occurrence of self-pollination in flowering plants.

*The information below relates to question 7.*

Birds of Paradise have some amazing courtship rituals coupled with stunning plumage. The 'King of Saxony' Bird of Paradise (*Pteridophora alberti*) has exceptionally long, ornamental brow feathers that can reach up to 50 centimetres. During courtship, the male birds sing and flourish their brow feathers around in an elaborate performance.

A biologist wanted to investigate whether the length of the brow feathers influenced the female birds' choice of mate. To prove her theory, the biologist had to monitor the courtship rituals and mating success of several male King of Saxony birds, over a period of two months.

7. Which of the following hypotheses best reflects the aim of this investigation?

(a) Male birds with short brow feathers will be more reproductively successful.

(b) Female birds will prefer long brow feathers to short brow feathers.

(c) The longer the brow feathers, the greater the chance of mating success.

(d) Female birds will be less attracted to male birds with short brow feathers.

1. During protein synthesis, a messenger RNA molecule is

(a) transcribed from DNA.

(b) translated into DNA.

(c) transcribed into protein.

(d) translated into protein.

1. In fruit flies, the allele for red eyes is dominant to the allele for white eyes. If two heterozgous parents were crossed, what percentage of the F1 generation would be white eyed?

(a) 25%

(b) 100%

(c) 50%

(d) 75%

10. Natural selection occurs through the ‘survival of the fittest’ and

(a) selects for those indivduals that survive the longest.

(b) increases genetic variation within a population.

(c) leads to a population having an optimal set of traits due to random chance.

(d) selects phenotypic suitability in the prevailing environment.

1. Genetic variety in the continuity of life requires the replication of genetic material and its transfer onto the next generation through fundamental processes, including

(a) binary fission.

(b) mitosis.

(c) meiosis and fertilisation.

(d) protein synthesis.

1. Some cattle may be horned or hornless. The allele for the hornless trait (H) is dominant over the allele for horned (h). Hornless cattle and horned cattle were mated and have the following offspring:

Hornless Horned

24 22

Which of the following parental genotypes is most likely to be correct?

(a) HH x Hh.

(b) Hh x Hh.

(c) Hh x hh.

(d) HH x hh.

1. In the Japanese four o’clock plant, pink flowers are produced when red flowers are crossed with white flowers. This is an example of

(a) sex-linkage.

(b) autosomal dominance.

(c)incomplete dominance.

(d) codominance.

1. Which of the following would indicate an autosomal recessive pattern in a given pedigree chart?

(a) An individual with the trait can have both parents without the trait.

(b) If both parents show the trait, then none of their offspring will show the trait.

(c) Every individual showing the trait has at least one parent showing the trait.

(d) Individuals without the trait cannot pass the trait to their offspring.

1. The new strands of DNA are said to be semi-conservative because

(a) they are comprised of a leading strand and a lagging strand.

(b) the genetic information has not been conserved.

(c) they are comprised of a parent strand and a newly synthesised strand.

(d) they are made from bonded segments of Okazaki fragments

1. A rare coat colour in a group of rodents is a sex-linked (X-linked) dominant condition. In a cross between a heterozygous female and an unaffected male, what is the probability that their first offspring is an affected male?

(a) 0

(b) 0.125 (1/8)

(c)0.25 (1/4)

(d) 0.5 (1/2)

1. A cross between a donkey (n = 32) and a horse (n = 31) will produce a sterile hybrid, known as a mule. How many chromosomes would there be in the body cells of a mule?

(a) 31

(b) 32

(c)63

(d) 16

18. In the males of some species of deer a larger antler size increases the males chances of mating. The large antlers of the male deer are likely to have evolved through

(a)natural selection, where males compete with other males for mates.

(b) sexual selection, where males compete with other males for mates.

(c) sexual selection, where females compete with each other for mates.

(d) natural selection, where males compete with other closely related species for mates.

19. Pesticides have been used in pest control and to increase crop yield. However, many pest species have evolved resistance to specific pesticides. Which of the following statements best explains the development of pesticide resistance?

(a) Individual resistance increases as spraying increases.

(b) Some pests survive and reproduce.

(c) Individual pests were becoming more resistant during their lives.

(d) Some pests develop resistance during their lives.

20. Which of the following statements best defines the evolutionary process?

(a) Progressive change that produces new allele combinations.

(b) Gradual change that produces variation in a species.

(c) Progressive change that produces different species from a common ancestor.

(d) Progressive change where allele combinations remain constant.

21. Random changes in allele frequency can alter the genetic structure of a population. This is best known as

(a) genetic recombination.

(b) genetic drift.

(c) gene flow.

(d) natural selection.

22. Which one of the following sources of genetic variation could occur in both sexually and asexually reproducing organisms?

(a) Crossing over.

(b) Fertilization.

(c)Mutation.

(d) Random assortment.

23. A growing root tip contains a large number of cells undergoing mitosis. The plant, an onion, has a diploid number of 16. Each cell division by mitosis will produce

(a) Four new haploid cells.

(b) Two cells identical to the original cell.

(c) Two new diploid cells.

(d) Four cells, each containing some small, genetic variations.

24. How many chromosomes would there be in a gamete from the onion plant?

(a) 16

(b) 32

(c) 8

(d) 4

25. If 40% of the nucleotides in a DNA fragment contain cytosine, what percentage will be adenosine?

(a) 10

(b) 20

(c) 40

(d) 60

26. A section of DNA used in the synthesis of mRNA is known as a

(a) codon.

(b) coding region.

(c) promoter.

(d) enhancer.

27. DNA fragments are produced through the action of

(a) restriction enzymes

(b) ligase.

(c) lipase.

(d) primase.

**Question 28 refers to the diagram below.**

Cutting site

DNA

220 kbp 120 kbp

28. Which of the following profiles would be produced by the DNA cut as shown above?

(a) (b) (c) (d)

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| 120 |  | 220 |  | 340 |  | 340 |  |  |
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|  |  |  |  |  |  | 220 |  |  |
| 220 |  | 120 |  |  |  |  |  |  |
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|  |  |  |  |  |  | 120 |  |  |
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Loading wells

29. Three amino acids and their triplet codes are listed below.

Valine **GUU GUC GUA GUC**

Alanine **GCU GCC GCA GCG**

Cysteine **UGU UGC**

The correct order of amino acids for the DNA sequence **UGUGCCGUCUGUGUA** would be

(a) Cysteine, Cysteine, Valine, Alanine, Valine.

(b) Cysteine, Alanine, Alanine, Cysteine, Valine.

(c) Cysteine, Alanine, Valine, Cysteine, Valine.

(d) Cysteine, Cysteine, Valine. Alanine, Valine.

30. DNA profiles of three pedigree bulls, a calf and the mother at four loci are shown below.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **locus** | **Bull A** | **Bull B** | **Bull C** | **Calf** | **Mother** |
| w | 14, 20 | 12, 14 | 12, 14 | 14, 18 | 12, 18 |
| x | 24, 30 | 28, 28 | 26, 30 | 26, 28 | 26, 26 |
| y | 13, 16 | 12, 12 | 12, 15 | 12, 15 | 15, 17 |
| z | 32, 36 | 30, 32 | 30, 32 | 30, 30 | 30, 36 |

Based on the above information, which of the following statements is correct?

(a) Bull A is the father of the calf.

(b) Bull B is the father of the calf.

(c) Bull C is the father of the calf.

(d) None of the pedigree bulls could be the father.

**End of Section One**

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| **Section Two: Short answer** | **50% (100 Marks)** |

This section has **five** questions. Answer **all** questions. Write your answers in the spaces provided.

Supplementary pages for planning/continuing your answer to questions are provided at the end of this Question/Answer booklet. If you use these pages to continue an answer, indicate at the original answer where the answer is continued, i.e. give the page number.

Suggested working time: 90 minutes.

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| **Question 31** | **(20 marks)** |

The domestication of livestock dates back over 10,000 years. Selective breeding, also known as artificial selection, has produced most of todays domesticated breeds.

1. Briefly explain the purpose of selective breeding with reference to the domestication of plants and livestock. (2 marks)

Selective breeding has increased the efﬁciency of domesticated plants and animals; however, there are some disadvantages.

(b) Discuss **two** long-term disadvantages to a plant species, as caused by selective breeding, that need to be considered. (2 marks)

(c) How might these disadvantages be reduced or prevented? (2 marks)

**Question 31** (continued)

(d) From your knowledge of genetics and using a named example, brieﬂy describe how the process of artificial selection operates. (2 marks)

(e) Biotechnology applications include recombinant DNA technology and DNA hybridization.

1. What is recombinant DNA and what is this technology used to produce? (2 marks)

1. Briefly describe how recombinant DNA is produced? (4 marks)

1. Briefly explain how DNA hybridization can indicate genetic relationships between species. (2 marks)

The percentage similarity in the DNA sequence among four species are shown in the table below.

|  |  |
| --- | --- |
| **Species** | **Percentage similarity with species 1** |
| 1 | - |
| 2 | 90 |
| 3 | 95 |
| 4 | 80 |
|  |  |

(f) Use the information from the table above to create a phylogenetic tree in the space below.

(4 marks)

|  |  |
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| **Question 32** | **(20 marks)** |

The pattern of inheritance for albinism in rabbits produces white hair and pink eyes.

1. In a cross between two non-albino rabbits the offspring included some albino and some non-albino kittens. Explain how the non-albino parents could produce albino offspring. (2 marks)

Use the symbols 'A' for the dominant allele and 'a’ for the recessive allele to answer the questions for part (b) and part (c). Draw a punnett square to show your working.

1. A non-albino female, whose mother was albino, was bred with an albino male and their first two offspring were albino males. What is the probability that their third offspring will also be an albino male? (3 marks)

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1. A breeder crossed two rabbits which were heterozygous for albinism. In what ratio would you expect normal and albino rabbits in the offspring? Indicate clearly the genotypes and phenotypes of the offspring. (4 marks)

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(d) Explain why, albino rabbits are quite common in domestic populations but rare in natural populations. (3 marks)

The Andalusian fowl has three varieties of feather colour: blue, black or splashed white.

Using appropriate symbols to represent the alleles that produce feather colour, answer questions (e) and (f) below

(e) In a cross between a blue chicken and a splashed white rooster the offspring of F1 were either blue or black in the ratio of 1:1. Show all working of this cross below and explain the pattern of inheritance that would produce this ratio (6 marks)

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(f) Of the three varieties of feather colour shown in Andalusian fowl, which one(s) would be heterozygous and which one(s) would be homozygous? (2 marks)

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| **Question 33** | **(20 marks)** |

Grasses form a major part of agricultural pastures around the world. In drier parts of the world these grasses are annuals, meaning that they complete their life cycle in one season, produce seeds and die. The seeds germinate in wet seasons of following years to renew the pasture. Some seeds germinate the very next year but others remain dormant for up to several years before germinating.

A scientist investigated the dormancy rates for seeds of three different species of annual grass. Two grams (2 g) of seed of each species were planted in separate square meter plots. No other plant species was present in the plots. Each year for six years the number of seed that germinated in each plot was counted. The seedlings were then removed so that no new seeds were produced in the plots.

The results of this experiment are shown in the table below.

Examine the data presented below and answer the questions that follow.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Grass species** | **Time (years)** | | | | | |
| Number of seeds germinated (No. per sq m) | 1 | 2 | 3 | 4 | 5 | 6 |
| A | 610 | 320 | no reading | 140 | 20 | 5 |
| B | 415 | 35 | 0 | 0 | 0 | 0 |
| C | 380 | 100 | 35 | 15 | 10 | no reading |

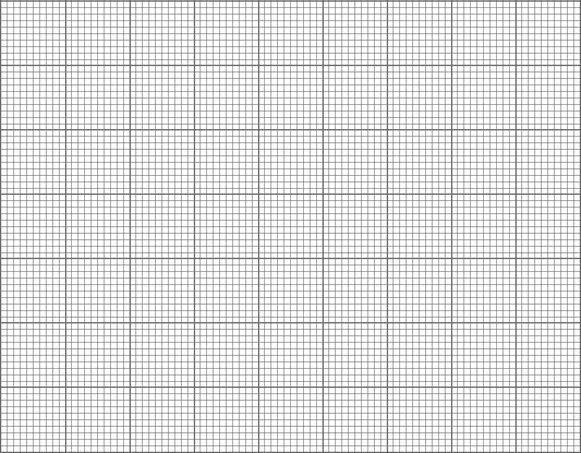
(a) For the experiment described, name

the dependent variable. (1 mark)

the independent variable. (1 mark)

(ii) **two** variables that would have to be controlled to ensure the differences observed were only due to seed dormancy. (2 marks)

1. On the grid provided, draw a line graph for the data obtained for each of the 3 grass species. (6 marks)



**A spare grid is provided on page 30 of this Question/Answer booklet. If you need to use it, cross out this attempt.**

For species ‘A’ in year 3 and species ‘C’ in year 6 valid measurements were not available.

(c) Use the graph that you have drawn to predict likely values for these readings had it been possible to measure them.

1. Species ‘A’ year 3 (1 mark)

1. Species ‘C’ year 6 (1 mark)

In which prediction do you have the greatest confidence? Explain why. (2 marks)

**Question 33** (continued)

All plots were planted with equal amounts of seed (2 g per m2), yet very different numbers of plants grew in each plot.

1. Give **two** possible reasons to explain this. (2 marks)

In severe drought years grass seeds germinate when it rains but fail to mature, dying before they produce seed. In the year following a severe drought year pasture growth depends largely on dormant seeds in the soil that are at least two years old.

1. (i) In a period of extended drought (two or more years) which of the three

species of grass would suffer the greatest reduction? (1 mark)

(ii) Give an explanation for your answer above. (1 mark)

1. Suggest **two** ways in which the experiment could be improved. (2 marks)

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| **Question 34** | **(20 marks)** |

Charles Darwin (1809-1882) suggested that all organisms on Earth arose through a process called natural selection. This is the basis of the theory of evolution. Evidence supporting Darwin's theory has been substantial.

1. Briefly explain Darwin’s Theory of Evolution. (4 marks)

1. Explain how the following areas of study provide evidence for the theory of evolution.
2. Fossils and the fossil record (4 mark)

1. Homologous structures (3 marks)

1. Embryology (4 marks)

**Question 34** (continued)

1. Give an example of a selective pressure in nature and briefly explain how selective pressures may contribute to evolutionary change. (3 marks)

1. The percentage difference between Human and Chimpanzee DNA and Human and Gibbon DNA is 2% and 5%, respectively. What can be inferred from these results? (2 marks)

**Question 35 (20 marks)**

Molecular biologists were investigating the presence of a genetic mutation in two species of frog, *Limnodynastes dorsalis* (Pobblebonk frog) and *Crinia glauerti* (Glauert's froglet). This mutation is thought to provide natural resistance to a virus affecting frog populations worldwide. In 'normal' frogs, a protein found on the external surface of cell membranes allows the virus to attach to and enter the cell, resulting in infection and subsequent death. In frogs carrying the mutation, the virus is unable to enter their cells and cause illness.

40 individuals from each species were used in the investigation. Approximately half of the frogs showed symptoms of the virus (normal gene) and half were thought to be resistant (mutated gene). Genomic DNA was extracted from each frog and the region of DNA under investigation isolated.

(a) Identify the type of enzyme used to remove or 'cut' segments of DNA from a chromosome and explain how it works. (3 marks)

In a normal frog, the cell membrane protein is coded for by the gene VPCM. In frogs carrying the mutation, the end of this gene sequence has been deleted.

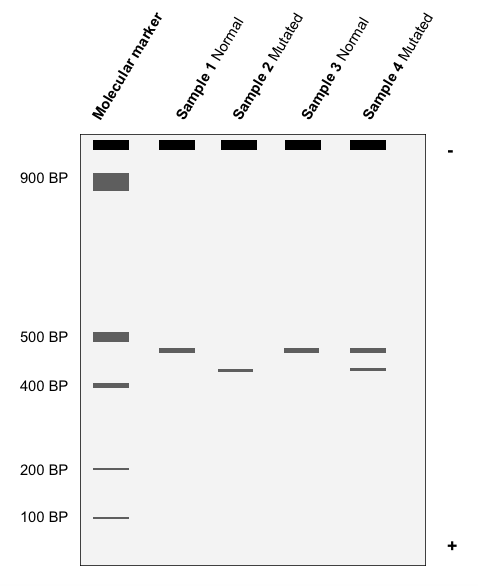
(b) Suggest why this mutation prevents the virus from entering the frog's cells. (2 marks)

Multiple copies of the frog's DNA, required to carry out further analysis, were synthesised using PCR (Polymerase Chain Reaction). Two different DNA primers were added to the PCR so the correct gene sequence would be copied from the mutated and non-mutated DNA.

(c) Explain the function of a DNA primer and their importance in the PCR process.

(3 marks)

Following the PCR process, the copied segments of DNA from each frog species were visualised via gel electrophoresis. The final 'gel' is shown below.



(d) Estimate the base-pair lengths for the gene segments of each test sample. (5 marks)

**Sample 1**

*L.* *dorsalis* (normal)

**Sample 2**

*L.* *dorsalis* (mutated)

**Sample 3**

*C. glauerti* (normal)

**Sample 4**

*C. glauerti* (mutated)

(e) Suggest a reason for the anomaly in the data for Sample 4. (1 mark)

The scientists repeated the experiment several times, only using the DNA from the frogs that were obviously healthy but had been exposed to the virus. To their surprise, they got the same results; two bands in Sample 4. After further analysis, a second mutation for the protein

was discovered in the gene from *C. glauerti*. It was later identified as a substitution mutation which did not change the length of the gene. While this mutation still allowed for protein production, the frogs carrying this gene were resistant to viral infection.

(f) Explain how this substitution mutation could allow the synthesis of the protein while offering resistance to the virus. (4 marks)

(g) Propose how these findings could be used in the future conservation of frogs.

(2 marks)

**END OF SECTION TWO**

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| **Section Three: Extended answer** | **20% (40 Marks)** |

Section Three consists of **four** questions

Answer **one** question from Part A and **one** question from Part B

Use black or blue pen for this section. Only graphs and diagrams may be drawn in pencil.

Responses can include: labelled diagrams with explanatory notes; lists of points with linking sentences; labelled tables and/or graphs; and/or annotated flow diagrams with introductory notes.

Supplementary pages for planning/continuing your answers to questions are provided at the end of this Question/Answer booklet. If you use these pages, indicate at the original answer where the answer is continued, i.e. give the page number.

Suggested working time: 50 minutes.

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**PART A**

Choose **either** Question 36 **or** Question 37.

Indicate the question you will answer by ticking the box next to the question. Write your answer on pages 22 - 26. When you have answered your first question, turn to page 26 and indicate on that page the second question you will answer.

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**Question 36 (20 marks)**

1. Meiosis is a process known to produce genetic variation in offspring produced by sexual reproduction. Describe the process of meiosis and explain how this process produces genetic variation. (10 marks)
2. Recombinant DNA technology is used to produce transgenic organisms that have been genetically modified for a specific purpose. The process has been applied to agriculture and environmental conservation. Using specific examples, briefly discuss the advantages and disadvantages for introducing transgenic organisms. (10 marks)

**Question 37 (20 marks)**

1. “PCR and DNA Profiling are an ecologist’s best friend”

Justify this statement in relation to conservation ecology. Describe how PCR and DNA profiling can be used in studying genetic diversity of a single species over a broad range of geographic and environmental conditions (10 marks)

1. Protein synthesis involves two stages, transcription and translation. Describe the main steps in each of these processes. (10 marks)

**Question**

**Part B**

Choose **either** Question 38 **or** Question 39.

Indicate the question you will answer by ticking the box next to the question. Write your answer on the pages provided.

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**Question 38 (20 marks)**

1. Evolution occurs over a time frame that makes it difficult to observe, however examples of natural selection in action can be found.

Using an example of natural selection in action, such as industrial melanism in peppered moths (*Biston betularia*) or bacterial resistance to antibiotics, explain how selective forces in the environment contribute to evolutionary change at the species level. (10 marks)

* + - * 1. Many plant and animal species are under threat of extinction. Briefly describe examples of external factors and factors within a species that are likely to increase its chances of extinction. (10 marks)

**Question 39 (20 marks)**

(10 marks)

1. Several unrelated mammals, such as the giant anteater and the aardvark, have a specialized diet of ants and termites. Giant Anteaters (*Myrmecophaga tridactyla*) are found in Central and South America. The aardvark (*Orycteropus afer*) shares many features with the giant anteater but is found only in Africa.



These two mammals which are unrelated, yet share similar structures with similar functions is an example of an analogous structure or convergent evolution, showing the evolution of similar structures without any common ancestry.

Explain how these unrelated mammals have evolved to have similar structural specialisations for obtaining food and give examples of the common structures they share. (10 marks)

1. Over several generations, natural selection and genetic drift may act to bring a change in the allele frequencies of a gene pool. Explain how genetic drift may result in changes in allele frequency in a population and how this differs from changes in allele frequency as a result of natural selection. (10 marks)

**End of question**

**Question**

**Additional Working Space**

**Additional Working Space**

**Spare grid**

