

**Semester 2, Examination 2022**

**Unit 3 and 4 Biology ATBLY**

**Question/Answer Booklet**

Please insert your student identification label in this box

**Student Number:** In figures

In words

**Please circle your teacher's name:**

**Maccan / Rayner**

**Time allowed for this paper**

Reading time before commencing work: ten minutes

Working time: three hours

**Materials required/recommended for this paper**

***To be provided by the supervisor***

This Question/Answer booklet

Multiple-choice answer sheet

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

Standard items: pens (blue/black preferred), pencils (including coloured), sharpener, correction fluid/tape, eraser, ruler, highlighters, scientific calculator.

Special items: non-programmable calculators approved for use in this examination

**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.

**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 2022*. 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. Do not use erasable or gel pens. 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.

4. 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.

5. Supplementary pages for planning/continuing your answers 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.

**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 a 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, 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.

Suggested working time: 40 minutes.

1. A cross between a yellow flowered plant and a white flowered plant produced 54 yellow flowers and 51 white flowers. If yellow is dominant, then the most likely genotypes of the parent plants are:
2. both heterozygous for yellow and white flowers.
3. a homozygous yellow flower and a homozygous white flower.
4. a heterozygous yellow flower and a homozygous white flower.
5. a heterozygous yellow flower and a heterozygous white flower.
6. If two heterozygous yellow flowers are crossed, the likely ratio of yellow to white flowers is
7. 3 yellow: 1 white
8. 3 white: 1 yellow
9. 1 white: 1 yellow
10. All yellow
11. The different breeds of dogs found today, are a result of
    1. microevolution.
    2. macroevolution.
    3. natural selection.
    4. artificial selection.
12. Which of the following mammalian thermoregulation strategies would return an elevated body temperature to within tolerance limits?
    1. shivering
    2. piloerection of the fur
    3. panting
    4. vasoconstriction of skin capillaries
13. Which of the following comparisons between mitochondrial DNA and chloroplast DNA is correct?

|  |  |  |
| --- | --- | --- |
|  | Mitochondrial DNA | Chloroplast DNA |
| (a) | circular | linear |
| (b) | present in all organisms | present in plants only |
| (c) | single stranded | double stranded |
| (d) | codes for proteins required in respiration | codes for proteins required in photosynthesis |

1. The deformed wing condition in honey bees is caused by a virus. It can be spread by either a bite from a varroa mite or transmission from bee to offspring. These modes of transmission are respectively called
2. Direct and indirect
3. Indirect and direct
4. Both indirect
5. Both direct
6. A disease is considered to be infectious if it is
7. transmissible.
8. caused by a pathogen.
9. can cross species.
10. preventable.
11. A species is a group of organisms that
    1. in nature, can breed to produce fertile offspring.
    2. can breed but produce infertile offspring.
    3. in captivity, can breed to produce fertile offspring.
    4. can breed with other groups of organisms, to produce fertile offspring.
12. Northern elephant seals were hunted almost to extinction, the resulting survivors were small in number. The surviving population
13. is less genetically diverse that the original population.
14. was formed due to natural selection.
15. was a result of gene flow.
16. was formed due to the founder effect.
17. Which of the following in **not** an adaptation to salinity?
18. sequestration of ions into vacuoles
19. exclusion of some particles from the roots
20. succulence
21. low density of stoma

1. Which of the following is **true** of ectotherms?
2. Ectotherms don't use metabolic heat production to maintain a constant body temperature.
3. The blood of an ectotherms is always cold.
4. Mammals and birds are ectotherms.
5. Ectotherms hibernate when the environmental temperature is very low.
6. Antibiotics are used in the treatment of
   1. both viral and bacterial infections.
   2. both bacterial and fungal infections.
   3. viral infections only.
   4. bacterial infections only.
7. Which of the following statements about DNA replication are correct?

I DNA replication is semiconservative.

II A replication fork is a result of ligase unwinding and unzipping the DNA.

III DNA polymerase reads the parent DNA strands in the 3’ to 5’ direction.

IV Free nucleotides are required to build both DNA strands that result from DNA replication.

V DNA is synthesised in the 5’ to 3’ direction.

* 1. I, III and V only
  2. II, and IV only
  3. III and V only
  4. I, III and IV only

Use the diagram below of a piece of RNA, to answer question 14.

Diagram

Description automatically generated

1. Which of the following has the correct labels for the RNA shown above?

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Diagram Labels | | | | | |
| 1 | 2 | 3 | 4 | 5 | 6 |
| (a) | phosphate | guanine | adenine | cytosine | thymine | deoxyribose |
| (b) | cytosine | thymine | uracil | guanine | phosphate | ribose |
| (c) | adenine | uracil | phosphate | guanine | deoxyribose | cytosine |
| (d) | uracil | cytosine | guanine | adenine | ribose | phosphate |

1. The transfer of body heat (from an organism) to the external environment is via
2. conduction and radiation only.
3. convection and radiation only.
4. radiation and evaporative cooling only.
5. radiation, convection and conduction.
6. Which of the following is NOT true of viruses?
7. They are highly host specific
8. They replicate as they circulate in the bloodstream.
9. A virus is not considered to be living because it cannot function outside a host cell.
10. They consist of a core containing nucleic acid, plus a protein coat.
11. Which of the following correctly lists characteristics of fungal cells?
12. They are autotrophic and all are pathogens
13. They have a cell wall made of cellulose and carbohydrate.
14. They contain RNA and circular plasmids.
15. They mainly reproduce asexually by spores but can also reproduce sexually via the fusion of haploid cells
16. Water balance is vital to living organisms. Plants growing in hypersaline soils will be at a disadvantage because
17. The salt competes with other soil nutrients, which cannot be taken up
18. Water will move via osmosis from the plant to the soil
19. Water will move via osmosis from the soil to the plant
20. Plants have no use for salt because they don’t sweat.

Use the table below to answer question 19.

The number of amino acid differences to humans for cytochrome C.

|  |  |
| --- | --- |
| Species | Number of amino acids  differences from humans |
| Chimpanzee | 0 |
| Fruit Fly | 24 |
| Rabbit | 9 |
| Bullfrog | 20 |
| Pigeon | 12 |

1. Which of the following can be inferred from the similarity of amino acids for cytochrome C across different species?
2. The more similar the amino acid sequence, the less closely related the species are.
3. The less similar the amino acid sequence, the more recent the common ancestor.
4. The more similar the amino acid sequence, the more closely related the species are.
5. The less similar the amino acid sequence, the more closely related the species are.
6. *Influenza*, type A, is considered to have high infectivity and high virulence. Which of the following are the most correct definitions for infectivity and virulence?

|  |  |  |
| --- | --- | --- |
|  | Infectivity | Virulence |
| (a) | how the pathogen is transferred from one host to another | the term for virus transmission |
| (b) | the ability of the pathogen to establish an infection | severity of the symptoms |
| (c) | severity of infection | ability of pathogen to cause symptoms |
| (d) | the number of organisms infected per day | the number of deaths per day |

1. In a population of mice, the frequency of the dominant allele for grey fur is 0.6. What is the frequency of the recessive allele for white fur?
2. 0.40
3. 0.12
4. 0.06
5. 0.24

An endogenous retrovirus (ERV) is a stretch of DNA found in chromosomes that got there when an ancestor was infected by a retrovirus. On rare occasions viral genes find their way into sperm or egg cells where they can go on to become a permanent part of a species genome. If two species share a ERV in common, it indicates that the ERV mutation occurred in a common ancestor.

Use the table below, that shows the types of endogenous retroviruses (ERVs) present in different in a number of different species, to answer question 22.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Type of ERVs | Species | | | | |
| Human | Chimpanzee | Gorilla | Colobines | Spider Monkey |
| PtERV 1 |  | ✔ | ✔ |  |  |
| HML 2 | ✔ |  |  |  |  |
| HERVS | ✔ | ✔ | ✔ | ✔ |  |
| HERV-FRD | ✔ | ✔ | ✔ | ✔ | ✔ |

1. The data in the table suggests that
2. gorillas are more closely related to colobines than chimpanzees.
3. humans, chimpanzees and gorillas share a common ancestor that is not a common ancestor for colobines and spider monkeys.
4. humans, chimpanzees, gorillas, colobines and spider monkeys share a common ancestor.
5. spider monkeys are more closely related to gorillas than colobines.
6. Some mammals use evaporative cooling as a mechanism to lose heat from their bodies. Evaporative cooling requires
7. the activation of sweat glands, mostly bare skin, vasodilation of blood vessels under the skin and a terrestrial environment.
8. the activation of salivary glands, vasoconstriction of blood vessels in the mouth and tongue and a terrestrial environment.
9. the activation of sweat glands, skin mostly covered in fur, vasodilation of blood vessels under the skin and an aquatic environment
10. the activation of sweat glands, vasodilation of blood vessels to the major organs and a terrestrial environment.
11. Which of the following comparisons, between saltwater fish and freshwater fish, is correct?

|  |  |  |
| --- | --- | --- |
|  | Freshwater Bony Fish | Saltwater Bony Fish |
| (a) | Due to osmoregulation the fish drinks water. | Due to osmoregulation concentrated urine is produced. |
| (b) | As a result of being hypertonic to the environment, salt is absorbed across the gills via osmosis. | Due to osmoregulation dilute urine is produced. |
| (c) | As a result of being hypertonic to the environment, water is absorbed across the gills via osmosis. | As a result of being hypotonic to the environment, water is lost across the gills via osmosis. |
| (d) | Due to osmoregulation concentrated urine is produced. | As a result of being hypertonic to the environment, salt is absorbed across the gills via osmosis. |

1. Which of the following adaptations by ectotherms, is a response to a decrease in environmental temperature?
2. vasodilatation of blood vessels near the surface of the skin
3. sweating
4. sunbaking
5. redirection of blood to the extremities
6. Which of the following adaptations could be utilised by plants living in a hot dry environment?

I decreased number or stomata on the surface of leaves

II stomal pits with hairs (trichomes)

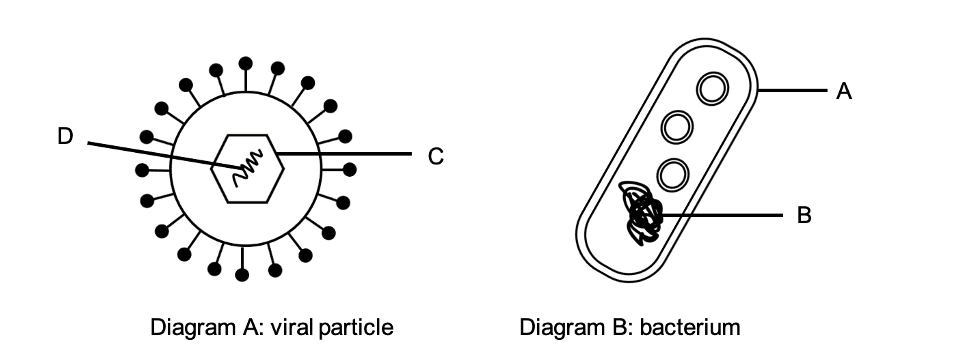
III partitioning of solutes

IV opening of stomata during the day

V an extensive shallow root system

1. I, III and IV only
2. II, III and V only
3. II, IV and V only
4. I, II and V only

Use the information below to answer question 27.

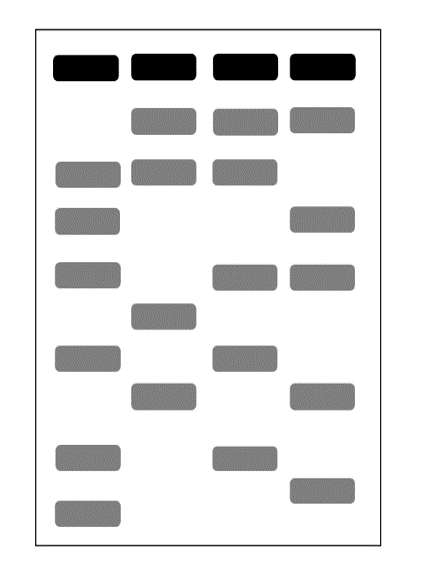


1. Which of the following correctly identifies the structures labelled in the diagram?

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | A | B | C | D |
| (a) | capsid | plasmid | envelope | DNA |
| (b) | cell membrane | genetic material | capsid | RNA |
| (c) | capsid | RNA | cell wall | genetic material |
| (d) | cell wall | nucleoid | capsid | genome |

Use the information below to answer question 28

The DNA from four different species was compared via gel electrophoresis. The results are shown below.



Species A

Species B

Species C

Species D

1. Which two species are the most closely related?
2. species A and species B
3. species A and species C
4. species C and species D
5. species C and species B
6. Which of the following statements is the best example of an observation?
7. Kangaroos gather at a waterhole at the same time each day.
8. The bilby burrowed to get away from the heat.
9. Female spiders eat their mates to reduce competition for food.
10. The dolphins at Monkey Mia must like people because they come close to the shoreline.
11. Which of the following lists the correct sequence of steps in a scientific investigation?
12. hypothesis, prediction, question, observation, experiment, conclusion
13. question, hypothesis, prediction, experiment, observation, conclusion
14. observation, question, prediction, hypothesis, experiment, conclusion
15. question, observation, hypothesis, prediction, experiment, conclusion

**End of Section One**

**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 answers 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)**

1. Many pathogenic bacteria have evolved a resistance to the antibiotics that have been used in the past to treat infections. These resistant forms cause significant problems for people or animals that become infected with them. Describe how such resistance develops in bacterial groups. (5 marks)

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1. Explain the process of allopatric speciation. (5 marks)

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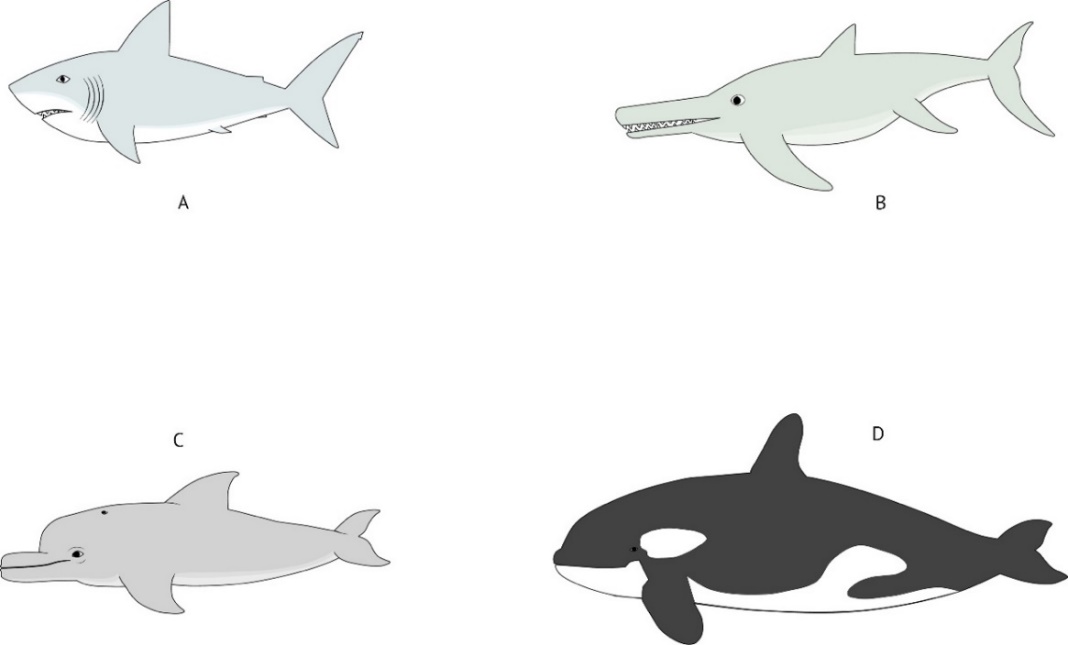
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1. The organisms below are all marine and represent 3 different Classes of vertebrates. Species A is a shark, B is an extinct ichthyosaur, C is a dolphin and D is a killer whale.



Despite not having a common ancestor for approximately 450 million years, these organisms have very similar body shapes and diets.

Describe the mechanisms that have led to these animals looking so similar. (5 marks)

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1. Describe the difference between natural selection and sexual selection, and explain how the latter impacts on the allele frequencies in a population? (3 marks)

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1. Define the term “genetic drift”? (2 marks)

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**Question 32 (20 marks)**

* 1. Both bacteria and fungi can be responsible for infectious diseases.
     + - 1. State one (1) structural similarity between bacteria and fungi. (1 mark)

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* + - * 1. State two (2) structural differences between bacteria and fungi (2 marks)

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* 1. Name the bacterial pathogen that causes tetanus. (1 mark)

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* 1. Name the mode of transmission for the tetanus pathogen and describe how the pathogen infects a host. (2 marks)

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* 1. Name and describe the primary method used by the tetanus pathogen to reproduce. (4 marks)

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* 1. Describe two impacts on the host, once infected by the tetanus pathogen. (2 marks)

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* 1. Describe two different ways to prevent the contraction of tetanus. (2 marks)

One: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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A plasmid was extracted from a tetanus causing bacterium and broken into fragments using the restriction enzyme Bam H1. The DNA was then run through a flat gel bed using gel electrophoresis. The results are shown in the diagram below.

Icon

Description automatically generated

well for DNA sample

* 1. Add the following to the diagram above.
     1. Draw an arrow to show the direction in which the fragments move during electrophoresis. (1 mark)
     2. Label the largest DNA fragment with an X. (1 mark)
  2. Explain why the DNA fragments move in the direction you indicated in part (g) (i). (2 marks)

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* 1. How many times does the sequence of bases recognised by Bam H1, occur in the bacterial plasmid? (1 mark)

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* 1. Explain how you arrived at your answer in part (i). (1 mark)

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**Question 33 (20 marks)**

A group of scientists investigated an outbreak of botulism in the swan population at Herdsman Lake. Botulism is caused by the bacterium *Clostridium botulinum.* The scientists wanted to determine the best antibiotic to use to treat infected swans. *Clostridium botulinum* was cultured in Petri dishes, on an agar containing nutrients and the antibiotic, and incubated at 40°C. Three different antibiotics were tested at varying concentrations. For each antibiotic, at each concentration, there were ten replicates. The death rate was recorded as a percentage of the original population remaining after treatment. A summary of the results for this investigation are shown in the table below.

|  |  |  |  |
| --- | --- | --- | --- |
| Antibiotic Concentration  (μg/mL) | Average Death Rate of *Clostridium botulinum*  (% original population) | | |
| Antibiotic A | Antibiotic B | Antibiotic C |
| 0.0 | 0 | 0 | 0 |
| 0.2 | 40 | 15 | 35 |
| 0.4 | 65 | 25 | 50 |
| 0.6 | 80 | 50 | 60 |
| 0.8 | 95 | 75 | 60 |
| 1.0 | 95 | 80 | 60 |

* 1. Construct a graph of the data in the table on the grid below. (6 marks)

A picture containing chart

Description automatically generated

A spare grid is provided at the end of this Question/Answer booklet. If you need to use it, cross out this attempt and indicate that you have redrawn it on the spare grid

* 1. Using data, describe the effect that antibiotic A has on the population of *Clostridium botulinum*. (3 marks)

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* 1. What is the independent variable in this study? Give a reason for your answer. (2 marks)

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* 1. Describe two aspects of the experimental design that the scientists would need to control to ensure a valid experiment (2 marks)

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* 1. Explain why the scientists tested each antibiotic at different concentrations. (1 mark)

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* 1. Explain why the scientists used 10 replicates of each antibiotic, at each concentration.

(2 marks)

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* 1. Which antibiotic and what concentration would be the best choice for treating the outbreak of botulism in the swan population at Herdsman Lake? Justify your answer. (4 marks)

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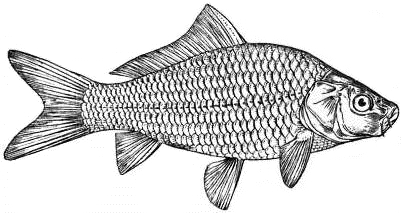
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**Question 34 (20 marks)**

1. Define the term “osmoregulation” (1 marks)

1. Name and describe the process by which water moves in and out of cells. ` (2 mark)

1. The fish below is a carp, which lives in a fresh water habitat. Briefly describe how each of the labelled parts contributes to the maintenance of water balance in this fish in its freshwater environment.   
    (4 marks)



Gills

Kidneys

Scales

Mouth

1. Scales: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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1. Kidneys: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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1. Gills: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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iv) Mouth: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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Kangaroo rats (*Dipodomys ordii*) are small rodents that live in the deserts of North America. They forage and collect seeds at night, storing seeds in their cheek pouches. Extra seeds are stored in their burrows. They have kidneys that reduce and concentrate their urine to almost a crystal-like consistency and when the animal exhales air from lungs it comes in contact with the moist surface of the nasal passages.

1. Explain how kangaroo rats exhaling air, via the nasal passages, can assist thermoregulation from the animal. (3 marks)

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1. State the primary type of nitrogenous waste that is excreted by the kangaroo rat. (1 mark)

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1. Describe one adaptation that allows the kangaroo rat and other desert adapted mammals to reabsorb more water and produce such a concentrated urine. (3 marks)

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Many types of cacti are found in the deserts of North America. The saguaros cactus (*Carnegiea gigantea)* is a large, tree-like columnar cacti that has branches (or arms) that bend upward. Saguaros are covered with protective spines. The root system consists of spreading roots that are 10 -15 cm below the grounds surface and radiate out from the cactus for some distance. The saguaros cactus also has one tap root that penetrates over 1.5 m into the ground.

1. Explain why the saguaros cactus has both a tap root and spreading roots. (3 marks)

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Cactus spines are highly modified leaves.

1. Explain how cactus spines aid the cactus in conserving and gaining water. (3 marks)

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**Question 35 (20 marks)**

Mutation is one mechanism that may introduce genetic variation into a population, however, not all mutations do.

1. Define the term ‘mutation’. (1 mark)

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1. Explain why some mutations introduce genetic variation into a population and others do not. (3 marks)

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1. (i) Define the term ‘chemical mutagen’. (1 mark)

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1. State one type of mutation than can result from a chemical mutagen? (1 mark)

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1. Give an example of a chemical mutagen. (1 mark)

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1. In relation to protein synthesis, explain how a mutation could lead to a new phenotype in an individual (5 marks)

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1. Explain one way that meiosis can increase genetic variation. (3 marks)

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1. Explain how genetic variation in a species, is an advantage in a changing environment.

(5 marks)

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**End of Section Two**

**Section Three: Extended answer 20% (40 marks)**

Section Three consists of **four** questions.

Questions 36 and 37 are from Unit 3. Questions 38 and 39 are from Unit 4.Answer **one** question from Unit 3 and **one** question from Unit 4.

Use black or blue pen for this section. Do not use erasable or gel pens. 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 to continue an answer, indicate at the original answer where the answer is continued, i.e. give the page number.

Suggested working time: 50 minutes

**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 27-31. When you have answered your first question, turn to page 32 and indicate on that page the second question you will answer.

**Question 36 (20 marks)**

1. Explain how transgenic crops have been engineered for desirable traits. (10 marks)
2. Explain how some insects that eat and live on crops, have evolved pesticide resistance.

(10 marks)

**OR**

**Question 37 (20 marks)**

1. During mitosis and meiosis, it is important that the cells duplicate the DNA genetic material exactly to ensure that the genetic material is correctly passed onto the daughter cells.

Describe the semi-conservative process of DNA replication. (10 marks)

1. Compare the mechanisms of natural selection and random genetic drift and the potential effects of these mechanisms on gene pools of populations. (10 marks)

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**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.

**Question 38 (20 marks)**

1. Explain why the type of nitrogenous waste produced by different vertebrate groups is related to the toxicity of the waste and the environment in which the organism lives. (10 marks)
2. Discuss the biology, transmission and treatment of Tuberculosis (TB). In your response, explain why cases of TB in Australia are rare. (10 marks)

**OR**

**Question 39 (20 marks)**

1. Discuss the purpose of homeostasis and how negative feedback loops are used to maintain an organisms’ internal environment. (10 marks)
2. Viral diseases include influenza, Ross River virus and the bat lyssavirus.

Describe the structure of viruses in general, then chose one of these and discuss the mode of transmission, impact on the affected individual and what treatments are available.

(10 marks)

**End of questions**

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Spare grid

A picture containing chart

Description automatically generated