

**Marking Guide**

**BIOLOGY UNITS 3 & 4**

**2022**

**Section One: Multiple-choice 30% (30 Marks)**

|  |  |
| --- | --- |
| **Question** | **Answer** |
| **1** | B |
| **2** | A |
| **3** | D |
| **4** | C |
| **5** | D |
| **6** | B |
| **7** | B |
| **8** | A |
| **9** | A |
| **10** | D |
| **11** | A |
| **12** | D |
| **13** | A |
| **14** | D |
| **15** | D |
| **16** | B |
| **17** | C |
| **18** | B |
| **19** | C |
| **20** | B |
| **21** | A |
| **22** | C |
| **23** | A |
| **24** | C |
| **25** | C |
| **26** | D |
| **27** | D |
| **28** | A |
| **29** | D |
| **30** | B |

**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.

**Question 31 (15 marks)**

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

|  |  |
| --- | --- |
| **Description** | **Marks** |
| * Gradual change in genetic code/characteristics of a species over successive generations
 | 1 |
| **Total** | **1** |

1. Explain how fossils provide evidence for the theory of evolution. (3 marks)

|  |  |
| --- | --- |
| **Description** | **Marks** |
| * Shows forms (bones/tissues/traces) of extinct species
* show changes in a traits/organisms/species over time
* show ancestral forms and how they have changed over time (evolution)
 | 1 - 3 |
| **Total** | **3** |

1. Explain why the fossil record is incomplete. (3 marks)

|  |  |
| --- | --- |
| **Description** | **Marks** |
| The fossil record is incomplete* not every organism died in the correct environmental conditions to be fossilised **or s**pecific conditions must be met for fossils to form
* not every fossil has been found/some fossils are yet to be found
* fossils have been destroyed by weathering/as part of the rock cycle
* fossils that may have been found have not been identified as fossils
 | 1 - 3 |
| **Total** | **3** |

1. Explain how vestigial structures provide evidence for the theory of evolution. (3 marks)

|  |  |
| --- | --- |
| **Description** | **Marks** |
| * structure that is no longer functional/reduced in size
* can be traced to functional structure in other organisms
* shows evidence of relationships among organisms
 | 1 - 3 |
| **Total** | **3** |

1. Explain how comparative embryology provides evidence for the theory of evolution.

 (3 marks)

|  |  |
| --- | --- |
| **Description** | **Marks** |
| * embryo structure is common to vertebrate groups
 | 1 |
| **Any 1 of:** |
| * some vertebrates have traits that were present in embryos but are not present in their later stages of development/in adulthood.
* in different groups/species, pharyngeal gill slits are present, reduced, or absent
* in different groups/species, tails are present, reduced, or absent
* in different groups/species, limb buds are present, reduced, or absent
 | 1 |
| Any 1 of: |
| * these traits are present in the embryos as they were present and functional in their ancestors.
* thus, suggesting a common ancestor
 | 1 |
| **Total** | **3** |

1. Using an example, explain how comparison of pentadactyl limb structures, between species, has provided evidence for the theory of evolution. (5 marks)

|  |  |
| --- | --- |
| **Description** | **Marks** |
| * pentadactyl limb structure is common to many animal/vertebrate groups
* thus, it suggests a common ancestor
* in different groups/species, different bones in the pentadactyl limb have been modified **or** structures developed from the same plan/, but they have different functions in different species
* the structures have been modified to suit the organism’s environment
* any suitable example, such as
	+ - * whales have reduced bones in the hind pentadactyl limbs, to the point of being present but non-functional
			* horses have reduced toe (phalanges) bones and fused toe (phalanges) bones
 | 1 - 5 |
| **Total** | **5** |

**Question 32 (20 marks)**

Both bacteria and fungi can be responsible for infectious diseases.

* 1. State one structural similarity and two structural differences between bacteria and fungi. (3 marks)

|  |  |
| --- | --- |
| **Description** | **Marks** |
| Any two of: |
| *Note: Must show comparison to gain mark*Differences* bacteria have a cell wall made of peptidoglycans and fungi have a cell wall made of chitin.
* bacteria have genetic material localised in a nucleoid and fungi have genetic material in a nucleus.
* bacterial genetic material is circular, whilst fungi have linear chromosomes
* bacteria are single celled, and fungi is (mostly) multicellular.
* bacteria do not contain membrane bound organelles whereas fungi do contain membrane bound organelles.
* bacteria contain plasmids while fungi do not.
* bacteria are smaller (0.5-5.0 µm) in size than fungal cells (2-10 µm)

*Do not accept bacteria are prokaryotic and fungi are eukaryotic as the question specifically asks for structural differences.* | 1 - 2 |
| Any one of: |
| Similarities* both bacteria and fungi have genetic material
* both bacteria and fungi have cell walls.
* both bacteria and fungi have cell membranes
* both bacteria and fungi have ribosomes walls.
 | 1 |
| **Total** | **3** |

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

|  |  |
| --- | --- |
| **Description** | **Marks** |
| *Clostridium tetani*  | 1 |
| **Total** | **1** |

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

|  |  |
| --- | --- |
| **Description** | **Marks** |
| * mode of transmission is direct contact
* spores/bacteria body via wound by contaminated objects **or** animal bites
 | 1 -2 |
| **Total** | **2** |

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

|  |  |
| --- | --- |
| **Description** | **Marks** |
| * Binary fission
 | 1 |
| **Any 3 of:** |
| * chromosome is replicated
* duplicated chromosome moves to opposite end of cell
* cell elongates
* each copy of duplicated chromosome attaches to a different part of the cell membrane
* septum forms
* new cell wall is laid down along the septum
* cell divides into two daughter cells
* each daughter cell is genetically identical to the parent cell
 | 1 -3 |
| **Total** | **4** |

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

|  |  |
| --- | --- |
| **Description** | **Marks** |
| Any two of: |
| * lockjaw
* muscle spasms
* drooling
* excessive sweating
* fever
* difficulty swallowing
* breathing difficulties
* irregular urination and defecation
* facial muscle spasms causing “grin”
* Stiff neck, shoulder and back muscles
* Breathing difficulties
* Convulsions (like seizures)
 | 1 -2 |
| **Total** | **2** |

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

|  |  |
| --- | --- |
| **Description** | **Marks** |
| Any two of: |
| * tetanus vaccine
* cleaning wound with antiseptics
* use protective equipment whilst gardening or working with soil
 | 1 -2 |
| **Total** | **2** |

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.



well for DNA sample

X

* 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)

|  |  |
| --- | --- |
| **Description** | **Marks** |
| * DNA is slightly negative (due to phosphate group in DNA backbone)
* moves to the positive electrode when current is run/ gel electrophoresis occurs
 | 1-2 |
| **Total** | **2** |

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

|  |  |
| --- | --- |
| **Description** | **Marks** |
| six (6) | 1 |
| **Total** | **1** |

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

|  |  |
| --- | --- |
| **Description** | **Marks** |
| 6 bands on gel in diagram | 1 |
| **Total** | **1** |

**Question 33 (25 marks)**

A group of scientists investigated 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. A summary of the results of this investigation are shown in the table below.

|  |  |
| --- | --- |
|  | Average Death Rate of *Clostridium botulinum* (% original population) |
| Antibiotic Concentration(μg/mL) | Antibiotic A | Antibiotic B | Antibiotic C |
| 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 | 95 | 80 | 60 |

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

|  |  |
| --- | --- |
| **Description** | **Marks** |
| title that links both the independent and dependent variables | 1 |
| choose appropriate graph/line graph | 1 |
| scale uses correct intervals and graph size is appropriate for grid size | 1 |
| correct labelling of both axes including units | 1 |
| data points are accurate and accurately joined | 1 |
| legend/key/each line correctly labelled | 1 |
| **Total** | **6** |

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

|  |  |
| --- | --- |
| **Description** | **Marks** |
| * as the concentration of antibiotic A increases, the death rate of *Clostridium botulinum* increases
* until it has no further effect/no longer kills more bacteria
* maximum death rate is 95 % at concentration of 0.8 ug/mL
 | 1-3 |
| **Total** | **3** |

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

|  |  |
| --- | --- |
| **Description** | **Marks** |
| Any **three** of: |
| * type of antibiotic
* the variable that is manipulated **or** cause/results in a change in the dependent variable
 | 1-2 |
| **Total** | **2** |

* 1. Explain why the scientists cultured the bacteria under the same conditions except for the independent variable. (3 marks)

|  |  |
| --- | --- |
| **Description** | **Marks** |
| * experiment should only have one independent variable/all other variables are controlled

*Note: concentration of antibiotic is kept the same across the different types of antibiotics thus not the independent variable** so that the results (dependent variable) are a result of only the independent variable
* improve validity of experiment **or** can draw valid conclusions **or** valid comparisons
 | 1–3 |
| **Total** | **3** |

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

|  |  |
| --- | --- |
| **Description** | **Marks** |
| * to see which concentration of the antibiotic was the most effective treatment for the swans
 | 1 |
| **Total** | **1** |

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

 (3 marks)

|  |  |
| --- | --- |
| **Description** | **Marks** |
| Any **three** of: |
| * improve reliability **or** can draw more reliable conclusions
* the larger the sample size, the higher the reliability **or** the smaller the sample size, the lower the reliability
* (large sample size) increases chances of representative sampling/reduces chance effects **or** (small sample size) decreases chances of representative sampling/increases chance effects
* (large sample size) reduces influence of outliers **or** (small sample size) increases influence of outliers
* to increase the confidence in the results gained
 | 1–3 |
| **Total** | **3** |

* 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)

|  |  |
| --- | --- |
| **Description** | **Marks** |
| * Antibiotic A
* kills the 95% of the bacterial population
 | 1-2 |
| * at a concentration of 0.80 μg/mL
* it’s the lowest dose/concentration of antibiotic A that results in the highest death rate **or** kills the most bacteria without using excess antibiotic or kills the most bacteria without causing unnecessary side-affects to the swans
 | 1 - 2 |
| **Total** | **4** |

**Question 34 (20 marks)**

Some sharks (cartilaginous fish) are isotonic with their marine environment.

1. Explain what is meant by “isotonic with the environment”. (1 marks)

|  |  |
| --- | --- |
| **Description** | **Marks** |
| there is an equal concentration of solutes (salts) /osmolarity/osmotic pressure within the shark and in the seawater  | 1 |
| **Total** | **1** |

1. Describe one mechanism sharks have for maintaining osmolarity and explain how this mechanism benefit sharks. (2 marks)

|  |  |
| --- | --- |
| **Description** | **Marks** |
| * salt excretion via waste elimination (rectal gland)
* maintains osmolarity as shark ingest salts (in water) when consuming food/absorbing water via skin

OR* water influx through the skin/gills
* maintains required concentration of salts within the sharks body **or** maintains isotonicity with the environment

OR* maintain high level of urea/trimethylamine in blood
* maintains isotonicity with the environment
 | 1 - 2 |
| **Total** | **2** |

A shark swam up a freshwater river.

1. Describe the effects on the shark from being in a freshwater environment. (4 marks)

|  |  |
| --- | --- |
| **Description** | **Marks** |
| * shark in now hypotonic to the environment **or** higher solute concentration within the shark’ internal environment than in the sharks external (ocean) environment **or c**ells hypertonic and the external water is hypotonic
* water will move into the sharks cells by osmosis
* shark cannot regulate water and salt concentrations
* cytolysis of sharks cells /shark bloats/shark dies
 | 1 - 4 |
| **Total** | **4** |

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 comes in contact with the moist surface of the nasal passages.

1. Describe and explain one thermoregulation mechanisms used by kangaroo rats. (3 marks)

|  |  |
| --- | --- |
| **Description** | **Marks** |
| Any three of: |
| * nocturnal activity/reduced activity in the day
* less heat gain from the environment/less heat generated by metabolism in the daytime
* thus, animal doesn’t overheat

OR* kangaroo rat burrows
* burrows have a cooler ambient temperature than above ground during the day
* thus, animal doesn’t overheat

OR* evaporative cooling by passing air over the moist surfaces in the nasal passages.
* as water moves from the moist surface of the nasal passages, heat/energy is removed from the blood of the Kangaroo rat.
* as heat is removed the internal temperature of the Kangaroo rat is lowered
 | 1 - 3 |
| **Total** | **3** |

1. What type of nitrogenous waste is excreted by the kangaroo rat? (1 mark)

|  |  |
| --- | --- |
| **Description** | **Marks** |
| Urea (do not accept urine, as it isn’t a nitrogenous waste) | 1 |
| **Total** | **1** |

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

|  |  |
| --- | --- |
| **Description** | **Marks** |
| * water vapour in the air from the lungs
* condenses (body heat) in the warm nasal passages
* water is then reabsorbed in the nasal passages
 | 1 - 3 |
| **Total** | **3** |

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)

|  |  |
| --- | --- |
| **Description** | **Marks** |
| tap root* long/deep to reach moister soil/penetrates into ground water to obtain water **or** anchors plant

spreading roots* shallow roots to obtain water when there is rain
* as surface water evaporates quickly in high (desert temperatures)
 | 1 - 3 |
| **Total** | **3** |

The saguaros cactus spines are highly modified leaves.

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

|  |  |
| --- | --- |
| **Description** | **Marks** |
| Any three of: |
| * spines break up the air flow around the cactus, which can reduce evaporation of water from the plant
* spines trap air around the cactus (insulating layer), creating a humid environment and reducing water loss from the plant
* cactus spines collect dew,/water vapour which will then fall onto the ground near the cactus and be absorbed by the roots
* create shade/shadows, reducing water loss via evaporation
* small surface area, reduce water loss from the spines (modified leaves)
* spines have no stomata, reduced water loss from transpiration
 | 1 - 3 |
| **Total** | **3** |

**Question 35 (20 marks)**

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

1. Define mutation. (1 mark)

|  |  |
| --- | --- |
| **Description** | **Marks** |
| a permanent change in the structure of DNA | 1 |
| **Total** | **1** |

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

|  |  |
| --- | --- |
| **Description** | **Marks** |
| Any 3 of: |
| * mutation must be in the germline/gametes
* to be passed on to offspring/subsequent generations
* if the mutation is not in the germline/mutation is in somatic cells, then then it does not affect the variation of the population or somatic mutations only affect individuals (not populations)
* if mutation is in the germline and not beneficial, and the organism dies before reproducing
 | 1 - 3 |
| **Total** | **3** |

1. (i) Define chemical mutagen. (1 mark)

|  |  |
| --- | --- |
| **Description** | **Marks** |
| a chemical agent capable of inducing changes in DNA/mutations. | 1 |
| **Total** | **1** |

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

|  |  |
| --- | --- |
| **Description** | **Marks** |
| Any one of: |
| * (point mutation) substitution of a base
* (point mutation) addition of a base
* (point mutation) deletion of a base
* change the chemical properties of a base
 | 1 |
| **Total** | **1** |

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

|  |  |
| --- | --- |
| **Description** | **Marks** |
| Any one of: |
| * alcohol
* smoke
* mustard gas
* azides
* benzenes
* any other correct answer
 | 1 |
| **Total** | **1** |

1. Explain how mutations lead to new phenotypes in a population. (5 marks)

|  |  |
| --- | --- |
| **Description** | **Marks** |
| * mutation must occur in an exon/in a gene that codes for a protein
* the change in DNA base sequence changes the code that is used for protein synthesis (DNA and RNA)
* this results in a change in amino acid sequence/number of amino acids/type of amino acids
* resulting in a polypeptide/protein that is different from the original polypeptide/protein
* the altered/new protein produced result in a new phenotype/s
 | 1-5 |
| **Total** | **5** |

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

|  |  |
| --- | --- |
| **Description** | **Marks** |
| * independent assortment
* homologous chromosomes from both parents align on the equator of the cell and move to the poles independently of whether they are maternal or paternal chromosomes
* results in genetic variation in the gametes **or** gamete has a mix of maternal and paternal chromosomes in the gamete

OR* crossing over
* genetic material between the homologous chromosomes is exchanged
* mixture of both the paternal and maternal DNA in one chromosome thus increasing variation

OR* non-disjunction
* chromosomes are not evenly distributed between daughter cells
* increasing variation
 | 1-3 |
| **Total** | **3** |

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

 (5 marks)

|  |  |
| --- | --- |
| **Description** | **Marks** |
| * different phenotypes/variation within the population/offspring/genetic variation
* some/one of the variations will have a selective advantage to changing environmental pressures
* individuals with the selective advantage survive to reproduce/to reproductive age
* these individuals pass on their (advantageous) alleles/genes to the successive generation
* resulting in the increase advantageous alleles in the species/population
 | 1 - 5 |
| **Total** | **5** |

**End of Section Two**

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

**Question 36**

1. Explain how transgenic crops have been engineered for desirable traits. (10 marks)

There are 2 main ways that transgenic crops have been engineered for desirable traits are using *Agrobacterium tumefaciens* **or** a gene gun for the gene transfer. An answer for each method is given below.

|  |  |
| --- | --- |
| **Description** | **Marks** |
| **Gene Transfer via *Agrobacterium*** | **Gene Transfer via a Gene Gun** |  |
| Any 2 of: | Any 2 of: |
| Isolate the gene of interest* Identify and isolate the gene (DNA) of interest for the desired trait
* Cut the gene at the recognition sites with restriction enzymes
* Leaving sticky ends
 | Isolate the gene of interest* Identify and isolate the gene (DNA) of interest for the desired trait
* Cut the gene at the recognition sites with restriction enzymes
* Leaving sticky ends
 | 1 - 2 |
| Any 4 of: | Any 4 of: |
| Insert gene of interest into vector* Use a vector carry the gene
* Bacterial plasmid (*Agrobacterium tumefaciens*, Ti plasmid)
* Additionally insert antibiotic resistance gene into plasmid
* Cut the plasmid with the same restriction enzyme used to cut out the gene of interest to ensure matching sticky ends
* Use DNA ligase to anneal/join the two pieces of DNA (plasmid and gene of interest, sticky ends match)/
* Heat shock bacteria to take up plasmid
 | Insert gene of interest into vector* Use a vector carry the gene
* Bacterial plasmid (*Agrobacterium tumefaciens*, Ti plasmid)
* Additionally insert antibiotic resistance gene into plasmid
* Cut the plasmid with the same restriction enzyme used to cut out the gene of interest to ensure matching sticky ends
* Use DNA ligase to join the two pieces of DNA (plasmid and gene of interest, sticky ends match)
* Heat shock bacteria to take up plasmid
* Bacteria replicate via binary fission
 | 1 - 4 |
| Any 2 of: | Any 2 of: |
| Culture the bacteria* Bacteria are cultured with plants cells (that are to be transformed)
* Bacteria replicate via binary fission
* *Agrobacterium tumefaciens* naturally inserts the gene of interest into the plant cells DNA
 | Gene gun * Isolated gene is added to the surface of metal/gold particles
* Metal particles punch holes in the cell walls of the plant cells and into the cell cytosol/cytoplasm.
* Desired gene is incorporated into the plant cell’s DNA
 | 1 - 2 |
| Any 2 of: | Any 2 of: |
| Culture the plant cells* Plants cells transferred to a growing medium
* medium contains the antibiotic the same antibiotics that is encoded for by the antibiotic resistance gene in the transgenic bacterial plasmid
* Only the transgenic plants which contain the antibiotic resistance gene survive
 | Culture the plant cells* Plants cells transferred to a growing medium
* medium contains the antibiotic the same antibiotics that is encoded for by the antibiotic resistance gene in the transgenic bacterial plasmid
* Only the transgenic plants which contain the antibiotic resistance gene survive
 | 1 - 2 |
| **Total** | **10** |

**Question 36**

1. Explain how some insects that eat and live on crops, have evolved pesticide resistance.
2. marks)

|  |  |
| --- | --- |
| **Description** | **Marks** |
| Any 10 of: |
| there is genetic variation in the population due to mutations | 1-10 |
| pesticide resistance in the insect population evolves via natural selection |
| this is an example of microevolution |
| pesticides kill most insects and insects with resistance survive **or** insects with the allele for pesticide resistance survive |
| the environmental selection pressure is the presence of the pesticide |
| through mutation some insects became resistant to the pesticide (those insects that survived the pesticide)  |
| resistant insects have a selective advantage and do not die in the presence of the pesticide/survive in the presence of the pesticide |
| the offspring/some offspring will inherit the advantageous allele, or the advantageous allele will be passed from parents to (some) offspring |
| occurs over many generations  |
| therefore, the pesticide resistant insects are becoming more common in the population |
| natural selection favoured the pesticide resistant insects or the insects that are not pesticide resistant were selected against |
| the advantageous allele (for pesticide resistance) will spread through the population/the allele frequency of the pesticide resistance will increase in the population |
| there is genetic variation in the population, or some individuals will have the new/advantageous allele, and some will have the old/disadvantageous allele  |
| individuals with the advantageous allele have an advantage/higher fitness (compared to those without the allele)  |
| individuals with the advantageous allele will leave more offspring (than those without the allele)  |
| the offspring/some offspring will inherit the advantageous allele, or the advantageous allele will be passed from parents to (some) offspring |
| **Total** | **10** |

**Question 37**

1. Explain how DNA-DNA hybridisation can be used in the development of phylogenetic trees.

 (10 marks)

|  |  |
| --- | --- |
| **Description** | **Marks** |
| Any 2 of: |
| DNA–DNA hybridization * technique that measures the degree of genetic similarity between DNA sequences
* used to determine the genetic distance/similarity between two organisms/groups/species
* this determines the relatedness between the two organisms/groups/species
 | 1 - 2 |
| When several species are compared using DNA-DNA hybridisation the similarity of DNA between species can be arranged in a phylogenetic tree | 1 |
| Any of: |
| *No more than 2 marks from anyone heading, to a maximum of six:* * Create hybrid DNA using a thermocycler

Denature DNA* using a thermocycler
* heat the DNA of each species to denature/separate the DNA strands
* temperature to denature is approximately 90 ºC – 95 ºC
* one piece of double stranded DNA becomes two single strands DNA

Anneal DNA* a single stranded DNA from each species is annealed together
* temperature to anneal is approximately 65 ºC
* not all bases will complementary base pair
* as different species have different DNA base sequences

Denaturing hybrid DNA* increase the heat the hybrid DNA is exposed to
* the higher the temperature required to denature/separate the DNA stands, the more closely related the species are
* as more bases that have formed complementary base pairs (between the two species DNA), thus more heat is required to break the hydrogen bonds

**OR*** increase the heat the hybrid DNA is exposed to
* the lower the temperature required to separate the DNA, the less closely related the species are
* as less bases have formed complementary base pairs (between the two species DNA), thus less heat is required to break the hydrogen bonds
 | 1 - 7 |
| **Total** | **10** |

**Question 37**

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)

|  |  |
| --- | --- |
| **Description** | **Marks** |
| **Similarities** |
| Any three of: |
| * generational effects/occur over multiple generations
* can cause the disappearance of alleles/allele fixation
* can see an increase or decrease in the frequency of alleles
* affected by the introduction of mutations
* in both cases, only germline mutations can influence allele frequency in gene pools over time
* allele frequency may change more quickly in the event of significant and rapid environmental change (such as a natural disaster)
* can cause loss of genetic diversity/allele loss form population

*Any other reasonable answer* | 1-3 |
| **Differences** |
| Any seven of:  |
| **Natural Selection** | **Random Genetic Drift** |
| acts on phenotype | affects genotype | **1 mark** **per comparison**1-7 |
| variation is more important | variation is less important |
| selective pressures cause this mechanism | this mechanism occurs at random/change event |
| a gradual change in phenotype over time | can be a rapid or gradual change in phenotype |
| involves adaptations to the environment | does not involved adaptations |
| produces a directional change/change occurs in a specific direction | does not produce a directional change/change occurs in a random direction |
| must have more offspring than can be supported | the number of offspring is less important/relevant |
| competition must exist between individuals | competition does not exist between individuals |
| one allele is favoured over another | no allele is “favoured” |
| can cause speciation | cannot/is very unlikely to cause speciation |
| dominant traits produce a more rapid change than recessive traits | dominance is irrelevant to rate of change |
| population size is less likely to affect speed of change **or** significance of selective pressure is more likely to show rapid/significant change  | a smaller population will show drift more rapidly/is more likely to show significant change |
| doesn’t/less likely to result in extinction | may/more likely to result in extinction |
| *Any other reasonable difference* |
| Total | **/10** |

**Question 38**

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)

|  |  |
| --- | --- |
| **Description** | **Marks** |
| Any 4 of: |
| Nitrogenous waste 🡪 ammonia* is highly toxic to the organism
* must be excreted with or into large amounts of water to dilute its toxicity
* excreted from the organism immediately/shortly after being produced
* the ammonia is highly soluble in water, so can be released into an aquatic environment to be diluted
* produced by aquatic organisms
 | 1 - 4 |
| Any 3 of: |
| Nitrogenous waste 🡪 urea* has medium toxicity to the organism
* must be excreted with some water to dilute the toxicity **or** dissolves in water so is diluted when stored within the organism
* therefore, there must be some water available in the environment
* generally produced by terrestrial organisms
 | 1 - 3 |
| Any 3 of: |
| Nitrogenous waste 🡪 uric acid* has very low toxicity to the organism
* very little water required to excrete uric acid
* environment can have very low water availability **or** produced by terrestrial organisms in very dry environments (generally)
* due to very low toxicity and insolubility, it can be produced in eggs without harming the embryo
 | 1-3 |
| *Any other correct response**(that links toxicity of waste the environment in which the organism lives)* |
| **Total** | **10** |

**Question 38**

1. Explain how *Influenza* evolves, and why this results in it being difficult to control its spread.

|  |  |
| --- | --- |
| **Description** | **Marks** |
| Any 3 of: |
| Rapid evolution of the *Influenza* virus due to* mutation of viral genetic material
* viruses have a high mutation rate
* mutation usually occurs when the host cell copies the viral genetic material
* (usually) mutation results in high infectivity for influenza
* heritable traits that help a virus “reproduce” become more common in the virus population over time
 | 1 - 3 |
| Any 7 of: |
| No more than 2 marks from anyone heading, to a maximum of seven: The difficulty in controlling the spread of influenza is due to Explains the role of *Influenza* transmission * transmitted from human to human/by inhaling droplets (from infected individuals)/close contact
* infected individuals usually survive long enough to spread the virus (so more opportunity to transmit disease)
* increased contact between infected and uninfected individuals will spread the virus/disease
* increased host density will increase the spread of the virus/disease
* increased hygiene will decrease the spread of the virus/disease

*Influenza* being a virus* viral populations are large
* therefore, a higher mutation rate on which natural selection can act.
* Virus has short lifecycle **or** viruses reproduce rapidly
* Virus evolves faster than their host

Explains the role of globalisation/urbanisation* humans are very mobile/travel long distances/across regions or across the globe
* this can introduce disease/strains of Influenza into regions where does not usually occur
* people may live in urban areas/areas with high population density/in unhygienic conditions

Explains the role of disease management* (infected) individuals are not usually treated for the *Influenza* virus (only symptoms treated or managed)
* many individuals are not immunised (flu vaccine)
* hence no herd immunity **or** large numbers of susceptible people (so the disease spreads)
 | 1 - 7 |
| **Total** | **10** |

**Question 39**

(a) Discuss the purpose of homeostasis and how negative feedback loops are used to maintain an organisms internal environment. (10 marks)

|  |  |
| --- | --- |
| **Description** | **Marks** |
| Homeostasis * is the ability of an organism (or cell) to maintain a constant internal environment (steady state) within set tolerance limits, despite fluctuations in the external environment
* to allow optimal functional of cellular processes
 | 1 - 2 |
| * Negative feedback is activated when a parameter is above or below the set point

It is negative feedback loop as* the effector ceases to generate a response when the parameter returns to “equilibrium/normal”
* and the response counteracts the change **or** response reduces stimulus
 | 1 - 3 |
| a stimulus is a change in the internal environment that triggers a response/can be detected by the receptor | 1 |
| the receptor detects a change outside of the tolerance limits (around the set point) and produces a signal (chemical or nervous) | 1 |
| the processing centre/control centre/modulator processes the signal, coordinates the response and sends a message to the effector | 1 |
| the effector carries out the response (using hormonal or neural mechanisms) | 1 |
| the response counteracts the change/reduces stimulus | 1 |
| **Total** | **10** |

**Question 39**

(b) Using the life cycle of *Phytophthora*, explain how it invades new hosts, its impact on theses hosts and factors that affect its spread in West Australian forests. (10 marks)

|  |  |
| --- | --- |
| **Description** | **Marks** |
| Any 2 of: |
| Life Cycle of *Phytophthora** zoospores are produced by sporangium (asexual)
* when on a suitable infection site, the zoospores drop stop swimming/drop their flagellum and develop a cyst
* cysts germinate to form hyphae/mycelium
* hyphae/mycelium produce sexual reproductive organs (oogonium)
* sexual reproductive organs (oogonium) produce oospores
* hyphae/mycelium also asexually produce chlamydospores in unfavourable conditions
* chlamydospores can lie dormant for extended periods of time
* in favourable conditions chlamydospores germinate to form sporangia

**NOTE:** This section is only 2 marks as much of the life cycle will be explained in the following parts of the question | 1 - 2 |
| Diagram **not** required. Students may choose to answer the question by drawing the diagram and annotating with points to answer the questionDiagram  Description automatically generated |
| Method of Invading the host* zoospores attach to the root/root tip of plant and cause cysts
* the cysts form hyphae/mycelium which allow pathogen to invade the root and allow the pathogen to infect plant cells
* can be indirect (through spores) or direct (root to root contact) transmission
 | 1 - 2 |

|  |  |
| --- | --- |
| Impacts on host plants* limited uptake of water and nutrient through roots as they are destroyed
* root rot (causing necrosis) **or** roots and crowns are black from rot
* leaves and branches die and drop off
* eventual death of the plant
 | 1 - 2 |
| Any 4 of: |
| No more than 2 marks from anyone heading, to a maximum of four: Factors affecting the spread of *Phytophthora* in West Australian forests*Phytophthora* spreads in ideal temperature and soil moisture* warm and wet
* providing ideal conditions for sporulation (for spore production)
* Movement of zoospores which may swim to new hosts/disperse over large distances/ Zoospores likely to swim downhill / with the flow of water

*Phytophthora* produces spores in unfavourable conditions* they survive for long periods of time
* chlamydospores (asexual)
* oospores (sexual)
* “germinate” when conditions are favourable

*Phytophthora* spread through any movement in soil, water or plant material * contains oospores and zoospores spread
* human activity
* such as bushwalking/vehicle use/road building/mining
* spreads rapidly during rainfall and warm, humid temperatures

Growth and density of *Phytophthora** increased density/population results in increased spread of *Phytophthora*
 | 1 - 4 |
| **Total** | **10** |

**End of Section Three**