**Marking Guide**

**BIOLOGY UNITS 3 & 4**

**2022**

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

|  |  |
| --- | --- |
| **Question** | **Answer** |
| **1** | C |
| **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** | A |
| **17** | D |
| **18** |  B |
| **19** | C |
| **20** | B |
| **21** | A |
| **22** | C |
| **23** | A |
| **24** | C |
| **25** | C |
| **26** | D |
| **27** | D |
| **28** | B |
| **29** | A |
| **30** | B or C  |

**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**

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)

|  |  |
| --- | --- |
| **Description: Must have first 3 points then any two of the next three** | **Mark** |
| All populations contain genetic variation/mutations for resistance exist | 1 |
| Antibiotics present a strong selection pressure | 1 |
| when the infection is treated with an antibiotic, not all individuals are equally susceptible due to natural variation/ those with variation survives | 1 |
| Individuals not susceptible will survive and reproduce due to reduced competition | 1 |
| New population contains more individuals that are resistant | 1 |
| May also mention that resistance can be passed to other bacteria by horizontal gene transfer | 1 |
| **Total** | **5** |

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

|  |  |
| --- | --- |
| **Description** | **Mark** |
| occurs when a population is divided by a geographic barrier, eg river, lava flow, mountain range, expanding desert | 1 |
| gene flow between the two populations is reduced to zero/ reproductive isolation | 1 |
| different selection pressures act on the two populations | 1 |
| genetic drift occurs differently/acts on random alleles within each population | 1 |
| Accumulated micro-evolutionary changes lead to new species that can no longer interbreed and produce fertile offspring | 1 |
| **Total** | **5** |

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)

|  |  |
| --- | --- |
| **Description** | **Mark** |
| Convergent evolution  |  |
| Aquatic habitat/same environmental selection pressures selects for particular characteristics | 1 |
| such as streamlined body shape, fins for stability, muscular tails for propulsion | 1 |
| all these organisms are predators so speed through the water is an advantage | 1 |
| ancestral forms of each type were acted on by selection pressures | 1 |
| giving rise to organisms with similar body shapes | 1 |
| **Total** | **5** |

1. What is the difference between natural selection and sexual selection, and how does the latter impact on the allele frequencies in a population? (3 marks)

|  |  |
| --- | --- |
| **Description** | **Mark** |
| Natural selection selects for traits which provide a survival advantage | 1 |
| Sexual selection selects for traits which increases chances of having sex | 1 |
| Sexual selection increases the allele frequency of traits which are desirable in the opposite sex. | 1 |
| **Total** | **3** |

1. What is meant by the term “genetic drift”? (2 marks)

|  |  |
| --- | --- |
| **Description** | **Mark** |
| Genetic drift is the change in allele frequency caused by random chance | 1 |
| Has a greater impact in small populations because the loss of an allele from a small gene pool cannot be replaced | 1 |
| **Total** | **2** |

**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 (3 marks)

|  |  |
| --- | --- |
| **Description** | **Marks** |
| 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.
 | 1 |
| Any two of: |
| *Note: Must show comparison to gain mark. Points must be comparable*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 |
| **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 replicate (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
* Cleavage furrow develops in 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 (must be more than “list”)** | **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 (20 marks)**

* 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. Describe two aspects of the experimental design that the scientists would need to control to ensure a valid experiment. (3 marks)

|  |  |
| --- | --- |
| **Description** | **Marks** |
| * Temperature of petri dishes
* Same population of bacteria
* Incubation time
* Nutritional agar from the same stock
* Handling of petri dish to prevent cross contamination
* Other reasonable
 | 1–2 |
| **Total** | **2** |

* 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.

 (2 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
 | 1-2 |
| **Total** | **2** |

* 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
* at a concentration of 0.80 μg/mL
* kills the 95% of the bacterial population
* 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 |
| 1 - 2 |
| **Total** | **4** |

**Question 34 (20 marks)**

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

|  |  |
| --- | --- |
| **Description** | **Mark** |
| Any one of: |  |
| * The active regulation of an organism’s water balance
* the maintenance of water balance within organisms and cells via homeostatic mechanisms
* active regulation of an organism’s water content; maintains fluid balance (water gain & loss) & the concentration of solutes to keep internal fluids from becoming too diluted or too concentrated
 | 1 |
| **Total** | **1** |

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

|  |  |
| --- | --- |
| **Description** | **Mark** |
| Osmosis  | 1 |
| is the passive diffusion of water across a membrane in response to a concentration gradient/difference in solutes either side of the membrane | 1 |
| **Total** | **2** |

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)

|  |  |
| --- | --- |
| **Description** | **Mark** |
| **Scales:** physically block the movement of water from the water into the fish | 1 |
| **Kidneys:** (many glomeruli) retain salts and excrete copious volumes of dilute urine | 1 |
| **Gills:** actively absorb salts from the water | 1 |
| **Mouth**: minimises drinking to reduce the amount of water ingested / consumption of food containing salts | 1 |
| **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. Explain how kangaroo rats exhaling air, via the nasal passages, can assist thermoregulation from the animal. (3 marks)

|  |  |
| --- | --- |
| **Description** | **Marks** |
| Any three of: |
| * Evaporative cooling
* Evaporation of moisture causes cooling of the nasal surface
* Therefore cooling the blood vessels near the surface.
 | 1 - 3 |
| **Total** | **3** |

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

|  |  |
| --- | --- |
| **Description** | **Marks** |
| * Long loop of Henle
* In Nephron
* Increases the surface area for reabsorption of water into the bloodstream
 | 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
* Accepted “deletion”
* Did not accept nonsense (is this a type or effect?)
 | 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 an individual (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** |
| * Variation in a population increases the likelihood that some individuals can survive most changes/selection pressures
 | **1** |
| * 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 – 4  |
| **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/recombinant plasmids added to a bacterial culture & some are taken up by bacteria (transformation)
 | 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 Students who choose this method did not include any detail* 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: |
| 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

**NOTE: These last 2 points can be performed after inserting the plasmid with the antibiotic resistance gene into the bacteria to check if the agrobacterium has been transformed and does in fact contain the gene of interest** | 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. **NOTE: the mutation does not arise due to repeated use of the insecticide** | 1-10 |
| there is genetic variation in the population, or some individuals will have the new/advantageous allele, and some will have the old/disadvantageous allele |
| 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 |
| 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** |

**Needed to relate the principals of natural selection to the evolution of pesticide resistance**

**Question 37**

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

|  |  |
| --- | --- |
| **Description** | **Marks** |
| * Semi conservative as new DNA molecule has one new strand and one from parent molecule; MUST STATE THIS FOR MARK
* helicase uncoils/unwinds/unzips DNA; (DID NOT AWARD UNZIPS IF STATED NEXT POINT BELOW)
* helicase separates the two strands by breaking hydrogen bonds between (bases);
* RNA primase adds primer / primase adds (short) length of RNA;
* DNA polymerase (III) binds to strands/starts at (RNA) primer/extends primer
* DNA polymerase (III) adds nucleotides/bases in a 5’ → 3’ direction;
* bases according to complementary base pairing / A–T and C–G; (didn’t award this mark is did not state nucleotides added first)
* (leading strand) built up continuously (towards the replication fork);
* (lagging strand) built up in pieces/short lengths/Okazaki fragments;
* DNA polymerase (I) removes RNA/primers and replaces them with DNA;
* ligase seals gaps between nucleotides/fragments/makes sugar-phosphate bonds; (ligase joins fragments)
 |          1-10  |
| **Total** | **10** |

Notes: Many students are not wording the definition of ‘semi-conservative’ correctly. The incorrect wording makes it sounds like of the 2 strands of DNA, one strand is half parent and half new

**Question 37**

(b) 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/both result in changes to allele frequency
* 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)/allele frequecy change more quickly in a changing environment
* can cause loss of genetic diversity/allele loss form population
 | 1-3 |
| **Differences** |
| Any seven of:  |
| **Natural Selection** | **Random Genetic Drift** |
| acts on phenotype | affects genotype | **1 mark** **per comparison 1 – 7 Marks Total**1-7 |
| variation is more important | variation is less important |
| selective pressures cause this mechanism/environmental selection pressures | 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/increase in alleles conferring a survival advantage | does not produce a directional change/change occurs in a random direction/random/random loss of alleles |
| 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 changeEffects are greatest in a smaller population |
| doesn’t/less likely to result in extinction | may/more likely to result in extinction |
| Resulting population gene pool representative of old population | Resulting population gene pool may not be representative of old population |
| 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**

(b) Discuss the biology, transmission of and treatment for Tuberculosis (TB). In your response, explain why cases of TB in Australia are rare. (10 marks)

|  |  |
| --- | --- |
| **Description** | **Marks** |
| TB is caused by bacterial infection (*Mycobacterium tuberculosis*) | 1 |
| bacteria can remain dormant for long periods of time (8 months) and become active in suitable conditions | 1 |
| (highly infectious)- pathogen/bacteria transmitted via airborne droplets in saliva/mucous/cough/sneezes and inhaled by host | 1 |
| bacteria can infect lungs/respiratory system causing breathing problems/coughing/irritation | 1 |
| infection can occur in/spread to other areas including brain and nervous system (usually fatal) | 1 |
| incubation period can be long/host can be asymptomatic | 1 |
| TB treated with antibiotics for and extensive period (6 months) | 1 |
| vaccine for TB is available (not part of Australian immunisation program) which prevents infection | 1 |
| Tuberculosis in Australia |
| Any **two** of: |
| * effective border control - quarantine measures are used in suspected/diagnosed cases
* quality healthcare provides vaccines and appropriate treatments
* appropriate sanitation in Australia reduces risk of infection and transmission
* healthcare/frontline workers are all vaccinated for TB
 | 1 - 2 |
| **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)

NOTE: negative feedback needs to discussed in general terms

|  |  |
| --- | --- |
| **Description** | **Marks** |
| **Homeostasis** * Definition: is the ability of an organism (or cell) to maintain a constant internal environment (steady state) within set tolerance limits/range, despite fluctuations in the external environment
* Purpose : to allow optimal functional of cellular processes/metabolic processes/activity
 | 1 - 2 |
| Negative feedback* is activated/triggered when a parameter/factor is above or below/outside the set point/tolerance limit/normal optimal value

It is negative feedback loop as* Always reduces the stimulus

How negative feedback maintains homeostasis* the effector ceases to generate a response when the parameter returns to “equilibrium/normal”/effector stops generating the response once factor within tolerance limit/Once factor is within set point/tolerance limit/normal optimal values and homeostasis maintained the effector stops the response/once the stimulus is reduced, the effector ceases to generate a response
 | 1 - 3 |
| **Below are marks for defining each part of the negative feedback loop that operates to return internal environment to set point MAX 5 marks** |  |
| a stimulus is a change in the internal or external environment detected by receptor Only have to state ‘detected by receptor ‘if not stated for receptor | 1 |
| the receptor detects the stimulus (a change in the environment) & sends message to the modulator/co-ordinating centre | 1 |
| the processing centre/control centre/modulator receives message from receptor & coordinates a response by sending message to effector | 1 |
| the effector is a muscle or gland carries out the response (using hormonal or neural mechanisms) | 1 |
| the response counteracts the change/reduces stimulus | 1 |
| **Total** | **10** |

**Question 39**

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)

|  |  |
| --- | --- |
| **Description: general description of virus structure**  | **MAX 4 Marks** |
| Viruses consist of a protein coat (capsid)  | 1 |
| the nucleic acid can be DNA or RNA but not both | 1 |
| No membrane bound organelles/no cell organelles | 1 |
| Some virus are enveloped and have a phospholipid bilayer (NOT ALL VIRUSES HAVE THIS) | 1 |
| Viruses are smaller than other pathogens/bacteria (up to 300 nm in length) | 1 |
| Influenza | Ross River virus | Bat lyssavirus |  MAX 6 marks |
| **MODE OF TRANSMISSION any of the 2 below – must state the MODE OF TRANSMISSION** |  |
| **Direct transmission**, close contact via airborne droplets when infected persons coughs/sneezes (1)**indirect transmission** via fomites. (1) | **Indirect transmission (1)**by bite from a (pregnant) female mosquitos. Or detail how mosquito spreads virus via a blood feed (1) | **Direct transmitted (1)**by direct contact with infected bats bodily fluids, through bite or scratch (1) | 1 – 2 |
| **IMPACT ON HOST 2 marks max – any 2 below** |  |
| Infected individuals suffer general aches & pains/fatigue, fever, coughs, over-active nasal secretions/runny nose | Infected individuals develop a rash and joint pain/muscle aches  | Infected individuals have their nervous system attacked leading to paralysis, delirium, convulsions and sometimes death | 1 |
| Some strains may be fatal, especially in elderly people/can cause death in susceptible hosts | The effects can be long term/symptoms can last long time/many months | the effects can be fatal | 1 |
| **Treatments available 2 marks – any 2 below** |  |
| Fluids, rest, hospitalisation used to treat influenza | Medical treatment can reduce joint pain & swelling |  | 1 |
| Prevention is more effective than treatments, so reducing contact with infected people (influenza),  | Prevention is more effective as there is no treatment, so reducing contact with mosquitos (RRV) | No treatment so prevention more effective, so reducing contact with bats/do not touch bats (lyssavirus) will help reduce the spread. | 1 |
| Influenza vaccinations = preventative treatment |  | Rabies vaccination = preventative treatment | 1 |
| Treatment with anti-viral medication is available to minimises symptoms for influenza |  |  | 1 |
| **Total** | **10** |