Year 12 Biology

Unit 3 & 4

2016
Marking Key

Multiple Choice Answer Sheet – ANSWER GRID

For each question shade the box to indicate your answer.

Suggested working time for this section is 40 minutes.

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

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Question 31 **(20 marks)**

Negative-feedback mechanisms respond to changes in an animal's internal or external environment to maintain homeostasis. Plants, however, do not contain nervous or endocrine systems to help regulate their internal environment. They must possess specialised adaptations to enable them to survive environmental extremes.

(a) What is the term used to describe plants that are adapted to arid conditions? (1 mark)

Description	Marks
Xerophytes	1
TOTAL	**1**

(b) Identify **two** different adaptations for water-balance in this plant group and explain how these adaptations

Description	Marks
***Two** adaptations with descriptions from the following examples;*	
Hairs on leaves Reflects sun's heat, reducing temperature and evaporation.	1 1
Waxy leaves Prevents water loss from leaf surface.	1 1
Long narrow leaves Reduced surface area exposed to sun.	1 1
Reduced leaf size / leaves as needles or spikes Less surface area exposed to sun and less water loss via evaporation.	1 1
Reduced number of stomata Fewer pores enables plant to retain more water/reduces water loss.	1 1
Sunken/recessed stomata Creates humid micro-environment which reduces water loss from transpiration.	1 1
Stomata on leaf underside Reduces rate of evaporation from upper leaf surface.	1 1
Stomata closure in midday sun Stops water loss when transpiration would be greatest.	1 1
Water storage capabilities storage in leaves/stems Marks	1 1
Extensive/deep root systems - to collect water from limited rainfall	1 1

(c) It has been suggested that an increase in atmospheric CO_2 will significantly improve the growth of all plant life, through stimulating metabolic processes. Explain the accuracy of this theory based on your understanding of gas-exchange mechanisms in Australian plants. (3 marks)

Description	Marks
Many Australian plants close stomata during the heat of the day so an increase in atmospheric CO_2 may not have a significant affect.	1
Other limiting factors such as temperature, light intensity, water and nutrients can affect the way CO_2 is metabolised so significant changes to growth may be seen when these variables are also changed.	1
Not all plants metabolise CO_2 in the same way (different photosynthetic mechanisms - ie C4/Cam) so not all Australian plants would benefit from increased atmospheric CO_2.	1
TOTAL	**3**

(d) Suggest how this theory could be tested experimentally. (2 marks)

Description	Marks
Test a **variety** of different plants with different photosynthetic mechanisms to find those that are most affected by an increase in CO_2.	1
Apply other variables to the increase in CO_2 such as light intensity, temperature, water availability and access to nutrients to see how they affect CO_2 metabolism.	1
TOTAL	**2**

Approximately 1.6 million years ago, Australia was undergoing a period of drying and lush forests retreated to the periphery of the continent. Species that adapted to the changing climate may have phylogenetic links to the flora currently inhabiting Australia's arid environments.

(e) Which biotechnological process could be used to establish the genetic relationship between a fossilised and living plant species? (1 mark)

Description	Marks
DNA hybridisation (old) or DNA sequencing (new method)	1
TOTAL	**1**

(f) Outline the main steps in this process. (6 marks)

Description for Hybridisation	Marks
DNA is extracted from species being compared and cut into short fragments (600 -700 base pairs)	1
DNA fragments are heated until the helix separates into single strands (melting).	1
Temperature of melting is approximately 80 – 90°C.	1
Both species 'melted' DNA is combined and allowed to cool.	1
Single strands of DNA anneal – fragments from each species recombine with each other or hybridise to form new double strands of DNA.	1
Hybridised fragments are reheated to measure the temperature at which melting of new bonds occurs.	1
TOTAL	**6**

Description for Sequencing (Sanger termination)	Marks
DNA is extracted from species being compared and cut into short fragments . May need PCR for limited sample	1
DNA fragments are heated until they separate into single strands (melting).	1
Primers added (to template strand)	1
Primed strands and DNA polymerase added to four reaction 'vessels'	1
Normal dinucleotides and dideoxynucleotides added to the four vessels	1
Each dideoxynucleotide tagged with a fluorescent dye	1
Dideoxys that attach stop the 'build' of the complementary strand at that point	1
Contents of vessels run through a gel tray or more likely a gel capillary tube	1
Lasers will pick up individual dyes at each termination sequence	1
Sequence determined by succession of coloured peaks on computer	1

Marks (six points in sequence) 6

(g) Explain how the genetic relatedness between two different species is measured using the results from this process. (3 marks)

Description (Hybridisation answer)	Marks
A measure of the heat /temperature required to separate new hybrid DNA is a measure of genetic relatedness.	1
The lower the temperature required to dissociate the DNA strands, the fewer the bonds and lower degree of relatedness.	1
The higher the temperature required (closeness to original melting temperature) indicates close genetic relatedness.	1
TOTAL	**3**

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Description (Gene sequencing answer)	Marks
specific sequences can be compared	1
the comparison of the sequences includes analysis of mutations	1
The extinct specimen can then be placed on a phylogenetic tree	1
TOTAL	**3**

Question 32 **(20 marks)**

The way in which pathogens are transmitted from one host to another can significantly impact how easily it can spread.

(a) Identify **two** human behaviours that can decrease the risk of contracting or spreading a contagious disease. (2 marks)

Description	Marks
Two points from the following	
• Not sharing needles when using illicit drugs.	1
• Using appropriate protection during sexual intercourse.	1
• Washing hands after using the toilet and before food preparation.	1
• use of face masks/gloves	1
• Staying 'quarantined' when ill.	1
TOTAL	**2**

(b) Why can a pathogen, showing latent infection, have a high degree of infectivity? (2 marks)

Description	Marks
The pathogen lives within the host for a long period with causing symptoms so the person does not know they are sick/contagious.	1
This allows the pathogen to reach other hosts over a longer period of time and infect a greater number of people.	1
TOTAL	**2**

(c) Differentiate between the terms endemic, epidemic and pandemic. (3 marks)

Description	Marks
An endemic is when a disease occurs within a population at a steady rate.	1
An epidemic occurs when the disease begins to increase in the population above what is considered normal.	1
A pandemic occurs when an epidemic spreads across many countries or continents throughout the world.	1
TOTAL	**3**

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The development of vaccines has enabled highly contagious diseases to be eradicated from the global population.

(d) Describe how immunisation programs have been successful in stopping the spread of virulent pathogens? (2 marks)

Description	Marks
Reducing the rate of infection of virulent pathogens.	1
Eradicating some diseases by completely stopping spread through mass immunisation programs.	1
TOTAL	**2**

(e) Explain the concept of 'herd immunity'. (2 marks)

Description	Marks
When a large proportion of the population are immunised so the few left unimmunised cannot sustain disease spread	1
The chance of an unimmunised person coming into contact with an infected person is very low and the disease cannot spread.	1
TOTAL	**2**

(f) Explain why herd immunity has been compromised in some communities around Australia. (2 marks)

Description	Marks
More people are choosing NOT to have their infants/children immunised due to fear of serious illness from side effects and misinformation.	1
The growing number of non-immunised individuals weakens the 'herd immunity' and certain diseases can be reintroduced into a population.	1
TOTAL	**2**

(g) Identify **two** adaptive characteristics of bacteria and explain how these characteristics increase their chance of survival. (4 marks)

Description	Marks
***Two** adaptations from the following*	
• **Flagellum** – helps to move around increasing spread.	1 – 2
• **Slimy bacterial capsule** – helps bacteria stick to surfaces like cells OR can also increase virulence by impeding immune response.	1 – 2
• **Endospore formation** – make bacteria resistant to extreme conditions allowing increased rate of dispersal.	1 – 2
• **Fast population growth** - some bacteria divide every 20 minutes	1 – 2
• restriction enzymes - protect against viruses	1 - 2
TOTAL	**4**

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(h) Outline **three** different ways in which bacteria cause disease. (3 marks)

Description	Marks
***Three** points from the following*	
• Damaging tissues directly by lysing cells	1
• Production of toxins that disrupt cell function.	1
• Pathogenic parts of bacteria stimulate an overly strong and damaging immune response.	1
• Interfering with the host's immune system, increasing the susceptibility to infection by other pathogens.	1
TOTAL	**3**

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Question 33 **(20 marks)**

A horse breeder sold a healthy young colt to a well-known trainer and jockey for a large sum of money. The colt was the offspring of a Melbourne Cup winner. The trainer received the appropriate paternity papers when the colt was delivered. The trainer was also told that the colt had three 'siblings' fathered by the same horse.

Two months later, the trainer received information that the horse breeder was under investigation for selling horses under false pretences. The paternity of one the colt's 'siblings' was under investigation. Unfortunately, the champion horse had been **shipped overseas** for a race and blood **samples could not be taken**.

(a) Identify **two** types of biological material, other than blood, that could be used to access the father's DNA. (2 marks)

Description	Marks
Saliva - from the mouth bit	1
Horse hair - from the saddle or brush	1
cells from faecal samples	1
frozen semen sample from parent horse	1
TOTAL	**2**

An insufficient amount of DNA was obtained from the alleged father and a genetic profile could not be produced in order to compare his DNA with the DNA of his alleged offspring.

(b) Explain how geneticists overcome issues associated with small DNA samples. (2 marks)

Description	Marks
If the amount of DNA is not enough for experimentation, scientists use a technique called Polymerase Chain Reaction, or PCR.	1
This is used to amplify (make many more copies of) a specific sequence of DNA needed for comparison.	1
TOTAL	**2**

(c) Geneticists use areas within the DNA called **short tandem repeats** (STR's) or **microsatellites** to produce DNA profiles. Define the term **short tandem repeats** and discuss why STR's are useful in this type of research. (5 marks)

Description	Marks
Microsatellites are **non-coding**, short sequences of DNA, repeated over and over, and scattered throughout the genome.	1
Equivalent sequences or microsatellites in different people can vary in the numbers of repeating units.	1
The identification of these variations between people (or animals) can be used for forensic studies.	1
The likelihood of people (or animals) sharing the same microsatellites is about one in a billion.	1
Comparing these repeated DNA areas between people can establish the level of relatedness.	1
TOTAL	**5**

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Genetic samples were obtained and processed for each horse. To establish the genetic relatedness of the horses, the geneticist used gel electrophoresis to visualise the DNA.

(d) Outline the process of gel electrophoresis as a method for DNA profiling. (6 marks)

Description	Marks
DNA extracted from sample (chemicals and enzymes) and amplified if necessary.	1
Positive and negative electrodes are attached at each end of the vessel that contains the agarose gel within a buffer solution.	1
DNA samples are placed into wells of the gel at the negative electrode end.	1
DNA, with a slight negative charge, moves towards positive end. Small DNA fragments move further and faster than heavy DNA fragments.	1
Because DNA is not visible, a fluorescent dye is added to the gel, which binds to the DNA.	1
The completed gel is placed under UV light and DNA bands are visible and can be photographed.	1
TOTAL	**6**

(e) Identify the order of relatedness, from most to least related, of each horse to the alleged father. (2 marks)

Description	Marks
Sibling 3 (most), Sibling 1, Colt, Sibling 2 (least)	1 - 2
TOTAL	**2**

(f) Explain why the horse breeder is guilty of genetic fraud. (3 marks)

Description	Marks
Sibling 2 shows no apparent genetic relatedness on the gel. Not related.	1
Sibling 1 has two matches and **may** be progeny of the champion	1
The Colt shares only one of the five DNA markers. Not a good indication of paternal relatedness	1
TOTAL	**3**

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Question 34 **(20 marks)**

Research scientists, growing new 'skin' for burn victims, discovered a protein that they believe accelerates cell division and growth. The gene that codes for this protein was found in a strain of smallpox previously eradicated from our population. The protein is only effective if the virus gene is integrated into the DNA of the growing skin cells.

(a) Suggest **one** reason why research scientists may have difficulty obtaining ethical permission to carry out trials on humans using these genetically modified cells. (1 mark)

Description	Marks
One point from the following; Cells are being modified using DNA from a deadly virus from a totally eradicated serious disease **or** May be fear that genetically modified cells may infect people with smallpox. **or** may have some other effect such as induce mutation or cancer because of rapid division.	1 1 1
TOTAL	**1**

(b) Suggest **one** possible, positive outcome of this research process. (1 mark)

Description	Marks
One point from the following; **Faster** and cheaper way of producing new skin cells. **or** Burn patients would be able to heal quicker with less scarring. **or** the technique could be eventually used to grow other human tissue faster	1 1 1
TOTAL	**1**

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In order to gain permission from the ethics committee, the researchers had to carry out a series of stringent experiments to prove the effectiveness of the protein on skin growth. Three different 'types' of human skin cells were used in the experiment; skin stem cells, newly differentiated skin cells and mature skin cells. Fifty cell-growth containers, each holding 200mL of nutrient medium, were inoculated with 100 genetically modified cells from each skin type being tested. The cells were cultured in a temperature-controlled room at 37°C for 20 days. Every two days, the number of live cells present on each agar plate was recorded.

(c) Write a hypothesis for this experiment. (1 mark)

Description	Marks
The genetically modified stem cells will reproduce more readily than the other test cells. *Other reasonable hypotheses may be accepted. Must contain independent and dependent variables. No marks allocated for only one variable.*	1
TOTAL	**1**

(d) State the independent and dependent variables of this experiment. (2 marks)

Description	Marks
Independent variable – cell types being modified and tested.	1
Dependent variable – the number of cells produced (over 20 days).	1
TOTAL	**2**

(e) State **two** variables that were controlled in the experiment? (2 marks)

Description	Marks
Culture temperature at 37 C. volume of growth medium. 200ml Number of culture cells at beginning of experiment. 100 per container Number of cell growth containers.	1 - 2
TOTAL	**2**

(f) Construct a graph in the space provided to display the data in Table 1. (6 marks)

Description	Marks
Title	1
Correct axes (variables in correct place) and scale	1
Labelled axes with units	1
Key	1
Correctly plotted points (time vs growth) in a line graph	1
Separate plots for each cell type - straight lines between points	1
TOTAL	**6**

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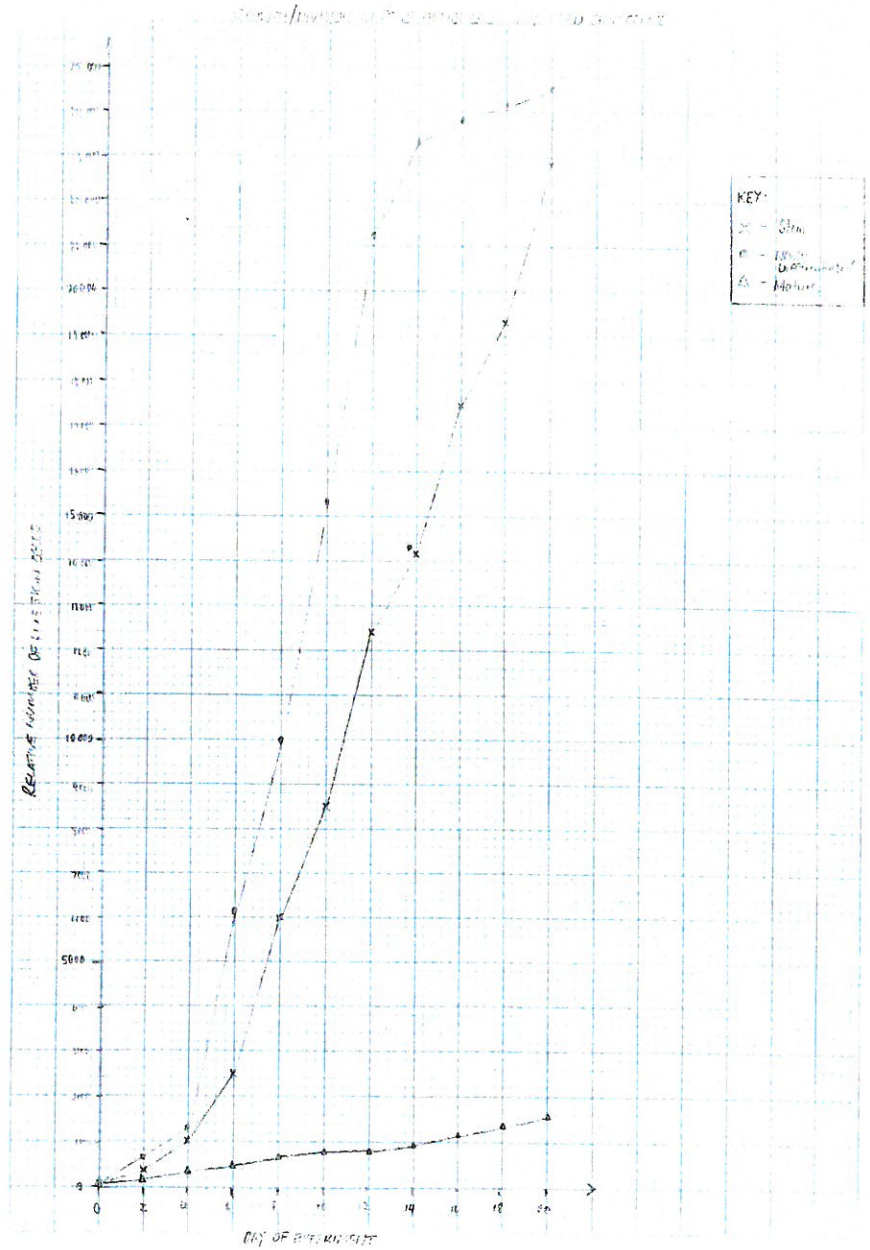
See the following graph as an example.



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(g) What can you conclude from the data presented in your graph? (3 marks)

Description	Marks
*Response must include **3 of the following points**. Allocate one mark each.*	
Stem cells and differentiated cells shown a similar pattern of division over time.	1
Newly differentiated cells appear to reproduce faster than the other cells.	1
Mature cells were significantly slower at reproducing than the ND or stem cells.	1
ND cell division/cell numbers slowed down quite a lot towards the end of the experiment.	1
The cell division of stem cells appeared to increase towards the end of the experiment and almost catch up to ND cells.	1
TOTAL	**3**

The ethics committee was presented with a report from the skin cell experiment. To their horror, the researchers were not given permission to proceed with their human trials because the committee decided that their data was invalid. They would have to start their research over with an improved experimental design.

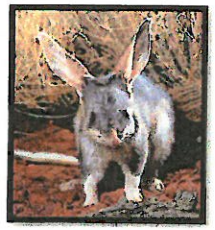
(h) Identify **two** errors in the experimental design and make suggestions as to how these could be resolved. (4 marks)

Description	Marks
One mark for an error and one mark for resolution. Examples include	
Error - No control cell group	1
Resolution - Need to include a control cell group for each test cell type in future experiments.	1
Error - Length of experiment not sufficient.	1
Resolution - Must run for a longer time to get more accurate picture of long-term effectiveness of the GM cells.	1
Error – Use of mature skin cells. They will not be able to reproduce as readily as the other cell types, regardless of modification, and donor issues may arise with mismatched tissue types.	1
Resolution – Do not include them in the new trials.	1
Error – Using donor cells.	1
Resolution - Use patient's own cells to avoid ethical issues and to obtain specific results for each patient.	1
TOTAL	**4**

Question 35 **(20 marks)**

Consider the images of Australian animals shown below.

(i) (ii) (iii)



(a) Identify an adaptation for each animal that assists thermoregulation and state whether it is structural, physiological or behavioural (or a combination). (3 marks)

vague answers score poorly

Description - others may be acceptable	Marks
(i) Large, thin, vascular ears – structural.	1
(ii) Slim forearms that are licked and covered with saliva – structural and behavioural.	1
(iii) Thick layer of fur, two types – structural.	1
TOTAL	**3**

(b) Describe how these adaptations enable each animal to maintain its core body temperature.d (6 marks)

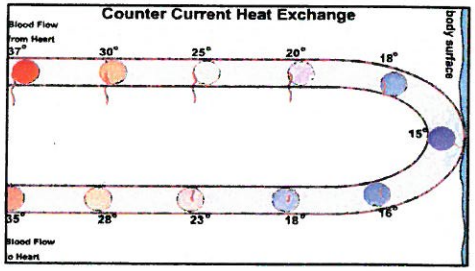
vague answers score poorly

Description	Marks
• Highly vascular, thin ears allow excess heat to be removed readily from the body (vasodilation).	1
• Blood supply can also be restricted (vasoconstriction) to maintain warm blood with the animal's core.	1
• Kangaroos are known to lick their thin forearms, which have blood vessels very close to the skin surface.	1
• As air passes over the wet surface it cools the skin and blood, which is circulated around the body.	1
• Thick fur	1
• Fur acts as an insulator against the cold and the waterproofing prevents the animal getting wet fur and cold skin.	1
TOTAL	**6**

Counter-current heat exchange is a structural and physiological adaptation found in animals that inhabit extremely cold environments.

(c) Draw a labelled diagram representing a counter-current heat exchange loop. (3 marks)

Description	Marks
*Diagram **must include**;* • Arterial – venous loop labelled • Temperatures indicated showing gradient • Labels for arterial/warm blood & venous/cool blood • ***See diagram below for example***.	 1 1 1
TOTAL	**3**



(d) Identify an animal in which this adaptation is found and the location in its body. (2 marks)
must have animal and part matched. Just an animal - not awarded marks

Description	Marks
***One** point from the following examples. Other correct organisms can be accepted.* • Penguin – feet • Dolphin – pectoral fins • Seal – pectoral fins • wolves - feet • some indigenous human groups - legs	 1 – 2 1 – 2 1 – 2
TOTAL	**2**

(e) Explain the process of counter-current heat exchange. (4 mark)

Description	Marks
Arteries and veins lie adjacent and close to one another in the animal's appendage.	1
Warm blood from the body's core/heart is pumped to skin's surface that is in contact with cold surface.	1
Blood loses heat/is cooled and flows back toward heart through vein.	1
Warmer 'core' blood flowing into appendage transfers heat down a gradient to the cooled blood returning from the skin's surface.	1
TOTAL	**4**

(f) Outline **two** reasons why this adaptation is so important to the survival of Antarctic or Artic animals. (2 marks)

Description	Marks
Helps to maintain core temperature without **excessive energy use.**	1
Keeps the appendages/skin warm and reduces damage (from frostbite).	1
TOTAL	**2**

Section Three – Extended Answer **40 marks (20%)**

The points made for each question are a guide to the type of responses expected. Alterations to these guides can be made to suit specific topics covered in class.

Unit 3 – Complete either **Question 36** or **Question 37**

Question 36 **(20 marks)**

Sexual reproduction initiated the rapid evolution of millions of new species throughout geographical time.

(a) Describe how the process of meiosis and fertilisation contributes to genetic variation within a gene pool. ***(10 marks)***

- Meiosis is a form of cell division in which the four resultant daughter cells contain only half the genetic information of the parent cell (haploid). (1)
- Meiosis has extra metaphase, anaphase and telophase and partial prophase. (1)
- These daughter cells then develop into gametes or sperm and ova. (1)
- At the time of fertilisation, gametes combine their genetic material to become diploid. (1)
- Meiosis can increase the genetic variation of a gene pool. Each daughter cell is **not identical** as in mitosis. (1)
- This is due to the occurrence of crossing over and independent assortment. (1)
- Crossing over occurs during the 1st prophase of meiosis. Once the chromosomes have been duplicated and are starting to move into metaphase, small sections of DNA from the same region on an adjacent chromatid swap places. The alleles of genes can swap chromatids. (1)
- Swapping alleles of gene pairs between chromatids results in the formation of many different combinations of gametes during meiosis. (1)
- This is known as **independent assortment** because crossing over occurs spontaneously and the alleles are redistributed independently of each other into separate cells. (1)
- When fertilisation occurs, two random gametes combine to form a new genome. This will develop into a new and genetically unique individual. Fertilisation therefore increases variation of genotypes and phenotypes even further. (1)

(b) Explain how a reproductively isolated species can evolve as a result of permanent changes to gamete DNA. ***(10 marks)***

- Variation in meiosis and fertilisation is not sufficient to support evolution. Significant changes can sometimes appear in a species as a result of actual changes to the DNA. (1)
- Permanent change to the DNA of gametes is called germ-line mutation (affects all cells in the body). (1)
- Mutations in gametes are passed on to offspring. (1)

- If the mutation is beneficial and does not have detrimental effects on the resultant offspring, it can enter the gene pool, be passed on to future generations, thereby introducing new alleles into the population. (1)
- Mutations occur during meiosis when DNA is replicating. (1)
- They can be spontaneous or caused by exposure to a mutagen like UV radiation, chemicals, medication and X-rays. (1)
- Many mutations do not have an effect but those that do cause changes in the DNA within a gene so that the protein it codes for cannot be made. (1)
- Mutations can result in chromosome rearrangement that increases the variation on genotypes (and phenotypes in the population). (1)
- Large genetic variation within a population allows stability during difficult environmental conditions. (1)
- The evolution of new species is also possible through selection pressures if some individuals exhibit favourable traits as a result of genetic variation and mutation in meiosis. (1)

Question 37(a) **(20 marks)**

Evolution can be regressive, where a characteristic that is no longer required is lost and the energy saved is diverted to other functions. Fish in the genus *Astyanax* provide an excellent example of regressive evolution. Some of the fish in this genus possess eyes and live in surface streams, whereas others live deep in underground caves and have degenerative eyes (called eyeless). The cave-dwelling fish however, have other improved sensory systems. For example, the number of taste buds in the cave-dwelling fish is much greater than in the surface-dwelling fish.

Explain how the evolutionary process has resulted in the cave-dwelling forms of *Astyanax* becoming eyeless.

Description	Marks
Any ten of:	
• Genetic variation exists within a species • Variation is due to gene mutation • Variation is due to reproductive processes/ non disjunction/ crossing over/ independent assortment • There is an excessive amount of reproduction with each new generation • Fish isolated in caves • Selection pressure now exists • Those with the best genetic adaptations are most likely to survive and reproduce • Establish the link between reduction in vision and increase in other senses as being advantageous in dark/cave environment • More energy available for other senses • Their offspring will inherit the favourable genes • Gene frequency of favourable genes will increase • If a population is reproductively isolated, speciation can occur • After many generations/a lot of time all/most members of the species are eyeless • Eyeless population may no longer be able to interbreed with surface population	1–10
	Total 10

Question 37(b)

The Noisy Scrub-bird is a small, insect-eating bird. It can only fly short distances, but is very agile in flight and on the ground, where it can run quickly. It prefers low, dense, long-unburnt vegetation on the boundaries between swamp and forest. It feeds on or near the ground. It builds nests within 20 cm of the ground in low vegetation. There is usually only one chick per clutch. The Noisy Scrub-bird is found only in a small area on the south coast of Western Australia, although it was more widely distributed in the past.

Considering the Noisy Scrub-bird's biology, describe two distinctly different strategies that could be used to conserve the Noisy Scrub-bird and, in each case, explain why the strategy would be effective.

Description	Marks
Any two combinations: (up to 5 marks each) If more than two strategies are given, mark the first two only.	
Strategy 1 (Predator Control) (up to 5 marks) • control predator numbers/Reduce impact of introduced predators/cats/foxes/dogs • control cats/foxes/dogs number using baiting, trapping, shooting, biological control • fence habitat to keep out predators • measures must have minimal impact on bird/ecosystem	1–3
Effective because bird is probably susceptible to introduced predators/cats/foxes/dogs because it lives in close association with ground	1
Evolved in an environment without large predators/large predators (and so does not have natural defenses)	1
and/or	
Strategy 2 (Habitat Restoration/Fire Control/Habitat Management) (up to 5 marks) • plant suitable vegetation/Restore Habitat • adopt suitable fire management regime • habitat is essential for food, shelter from predators, nesting sites • potential to allow the bird to be reintroduced into areas from which it has been lost and so expand the range of the bird/increase the number of populations	1–3
Effective because bird's habitat requirements are quite specific (which make it very vulnerable to landscape change)	1
Also other conservation strategies will fail if there is no suitable habitat	1
and/or	
Strategy 3 (Human Intervention/Captive Breeding and Translocation) (up to 5 marks)	
Use captive breeding programs to build up numbers	1
Individuals can then be released into the wild	1
Could translocate birds to different sites	1
• effective because bird has low fecundity (will take a long time to build up numbers naturally) • effective because bird has a limited capacity for dispersal (limited ability to increase range/move between areas of habitat) • will be captive populations even if bird goes extinct in the wild	1–2
and/or	

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Description	Marks
Strategy 4 (National Parks/Reserves/Conservation Areas) (up to 5 marks)	
Include bird habitat in national park/conservation areas/reserves	1
(Such areas) Have special rules that regulate human/human-related impacts and so increase protection for all species in the area	1
(Also) Easier for managers to control other threats (e.g. fires, introduced predators) in these areas as well because they have legal control of the areas	1
Effective because it will conserve the whole ecosystem that bird is a part of	1
Strategies that address a single issue may not be successful if other problems/threats remain	1
and/or	
Strategy 5 (Legislation) (up to 5 marks)	
Give the bird special legal/conservation status (e.g. critically endangered)	1
This gives the bird additional protection/will limit human activities that might impact on the bird/bird habitat but would be allowed if the species did not have special status	1
Potentially limits all sorts of activity, even if it is economically important (e.g. agriculture, mining, urbanisation)	1
• effective because there are penalties for non-compliance • plans to conduct activities will not be approved if they do not include measure to mitigate impact on the bird/bird habitat • general population tends to notice species with special status and may develop grass roots conservation initiatives for the bird/there can be community backlash if activities are perceived as impacting on such species	1–2
Total	**10**

Unit 4 – Answer **Question 38** or **Question 39.**

Question 38 **(20 marks)**

Water is essential for life. All living organisms must continually regulate their water and solute concentrations. Most organisms have specialised adaptations in order to maintain a constant internal environment and osmotic gradients.

(a) ***Discuss and compare the mechanisms involved in the regulation of water balance for osmoregulators and osmoconformers in both freshwater and marine ecosystems.***
(10 marks)

- In the aquatic environment, organisms can be either osmoregulators or osmoconformers. Osmoconformers are only found in marine ecosystems while osmoregulators are found in both marine and freshwater. (1)
- Osmoconformers are mainly marine invertebrates with highly permeable skin surfaces. E.g., sea stars. They do not use any energy maintaining water balance. (1)
- Body fluids of osmoconformers are isotonic with the seawater so they gain and lose water at similar rates. They have a very narrow tolerance range of solute concentration at which they can function normally. (1)
- Osmoregulators make up the remaining aquatic organisms in marine ecosystems and freshwater ecosystems. They maintain osmolarity by physiological means. (1)
- Osmoregulation is achieved through the use of excretory organs such as kidneys, salt glands and specialised secretory cells in gills. (1)

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- Marine organisms are hypotonic to their external environment – their body fluids are slightly less saline than the seawater. Marine osmoregulators constantly drink water that contains salts and lose large amounts of water through their gills. (1)
- Many organisms overcome the problem of excess salt by the active removal (requiring energy) of salt from cells in their gills. They also produce very concentrated urine which helps reduce water loss. (1)
- Freshwater organisms are hypertonic to their external environment – their body fluids are slightly more saline than the freshwater in which they live. Freshwater osmoregulators drink very little water. They tend to gain water through osmosis and lose salt. (1)
- Freshwater osmoregulators actively absorb salts via cells in their gills. Their kidneys produce and excrete large amounts of dilute urine due to presence of large number of glomeruli. (1)
- Some marine animals like shark and rays have high urea levels in their body tissues to help reduce water loss. The internal solute concentration becomes hypertonic to the surrounding seawater. Consequently, water moves in via osmosis but is easily removed by the kidneys in urine. (1)

NB – A well-presented and annotated diagram is acceptable to explain some aspects of this extended answer.

(b) Discuss how some specialised plants are adapted to overcome excess salt in their tissues and maintain osmotic potential. (10 marks)

- Halophytes are plants that are adapted to living in saline soils, and occur naturally in environments such as marine estuaries and inland salt lakes in arid zones. (1)
- Halophytes usually have a higher osmotic pressure in their cytoplasm compared to other species. Cells must maintain turgidity for growth and metabolic processes. (1 – 2)
- Halophytes survive saline conditions by regulating the concentration of salt in their shoots that has been delivered from the roots by transpiration. (1)
- Mechanisms for salt regulation are found in the shoots/leaves and involve: (1 – 5)
    1. Diluting the incoming salt by increasing growth rate.
    2. Excluding salt from entering the leaves.
    3. Shedding leaves that contain a high concentration of salt.
    4. Returning the salt from transpiration back to the roots.
    5. Storing excess salt in the vacuole to maintain turgor.
    6. Excreting salt from 'bladders' on the leaf hairs. Show up on the leaves as crystals of salt. Also function to reflect sunlight.
- Some salt-tolerant species use C4 or CAM Photosynthesis to reduce water usage. If stomata are closed it will reduce transpiration and the exchange of gases crucial for metabolic processes. (1)

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Question 39

For thousands of years, Malaria has caused the death of millions of people worldwide. The nature of the Malarial pathogen has made the development of effective treatments both difficult and time consuming.

(a) Describe the structure of the Malarial pathogen and its method of reproduction. Including a simple, labelled diagram to show the reproductive process.

(10 marks)

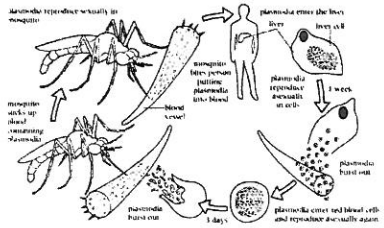
Pathogen: (5 marks)

- Protozoan
- called a plasmodium. various forms exist
- Plasmodium falciparum is the most lethal malarial parasite
- Plasmodia have intermediate forms adapted to specific sites during the life cycle
- The parasite always has two hosts in its life cycle: a mosquito host and a vertebrate, human host. Sexual reproduction always occurs in the mosquito, asexual in the human

Life cycle (5 marks)

- When the mosquito bites a vertebrate host, plasmodia (sporozoites) are injected into the human with the saliva.
- From there, the sporozoites enter the bloodstream and are transported to the liver, where they invade and replicate within liver cells.
- At this point, some species of *Plasmodium* can form a long-lived dormant stage which can remain in the liver for many years.
- The parasites that emerge from infected liver cells travel to the blood to infect red blood cells.
- The infected red blood cell eventually bursts, allowing the plasmodia to travel within the bloodstream to infect new red blood cells.
- Some plasmodia differentiate into male or female sexual forms called gametocytes.
- These gametocytes circulate in the blood until they are taken up when a mosquito feeds on the infected vertebrate host, taking up blood which includes the gametocytes.
- In the mosquito, the gametocytes fertilize each other, forming a zygote.
- These zygotes form sporozoites which migrate to the salivary glands of the mosquito where they can be injected into the blood of the next host the mosquito bites, repeating the cycle.

OR Diagram - Annotated, must show cycle in human and cycle in mosquito
Similar to below - does not indicate intermediate forms



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(b) Explain how Malaria is transmitted to humans. Outline the signs of infection, possible treatments and preventative measures currently used in affected areas.

(10 marks)

Transmission:

- The parasite is transmitted to humans by the **female mosquito** (must indicate) 1 mark
- The mosquito feeds on blood to grow her fertilised eggs 1 mark

Signs of infection:

- headache, fever, shivering, convulsions. (any two) 2 marks

Possible treatments: (any two) 2 marks

- antimalarial drugs - for the parasite in the blood and
- different drugs for the parasite in the liver
- drug combinations are common and special care must be taken with women who are pregnant

Preventative measures: (any four)

- prophylactic drugs taken when in malarial prone areas
- vector control programs - insecticides, drainage of wetlands (unpopular) control of still water around homes
- personal protection - nets over beds, repellents, appropriate clothing, window screens
- avoidance of outside activities when mosquitos most active
- massive research on vaccine development is taking place

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Essay questions: some observations and points.

36(a)
Quite a few students missed the point of Meiosis and in the first instance did not even mention what Meiosis is for, that it is to create Gametes that are Haploid. This in itself is the precursor to variation, producing daughter cells that are non identical to each other.
Some students launched into Meiosis giving detailed descriptions, complete with diagrams, of each stage of the process. This was unnecessary.

Although there was no correct sequence required by the question, it would have been beneficial to construct your answer answer by placing events in the sequence in which they occur.

Many students just started their essay with crossing over, some got the right time i.e. Prophase 1 while others got this wrong or failed to mention it at all.
A few students failed to indicate the importance of independent assortment, which begins in Metaphase 1 and completes its function in Anaphase 1. Some didn't know how to explain it.
It is random distribution of homologous chromosomes.

Most students described fertilization as a source of variation, which is correct, and some even described choosing a mate is also a means. Although this is correct it is not part of the Meiosis process. So be careful.
I also gave a mark for stating mutation as a source of variation in meiosis, which indeed it is.

36(b)
This was a tricky question. In the first instance many students missed the whole point, that being that meiosis and fertilization are not enough to support evolution and that mutations in the germ line are required.

While the answer key paid a lot of attention to mutations it did not elaborate on the evolution aspect of the answer.
While it was really important to address the mutation aspect, and many students didn't, but answered well in the evolution aspect.
I gave marks for: stating mutations in the germ line, these increase variation, better chance to pass on, thus allele frequency advantageous, individuals with favoured traits will reproduce, this is called natural selection, change in allele frequency can now lead to speciation.
The underlying point though is of the importance of mutations when addressing this question and a discussion on mutations is required.

37(a)

Question done reasonably well by all who did it.
Again though there was a lack of discussion about the importance on mutation in the first instance. Some students however described in detail all the types of mutations, which is unnecessary.
Also requires a discussion about the selection of useful/favourable genes and reproductive isolation.
Speciation must also be discussed.
Overall most students had reasonable ideas.

37(b)
Question done quite well. All students who did this came up with two strategies.

38(a)

Those who completed this needed to start with good definitions of both types and why there is a need to carry out Osmoregulation and what was used to do this. This was missing in many essays. These students just launched straight in.

The marks here were in the explanations and then the detail. Students also failed to expand and draw out the concepts. Its all very well describing osmoregulation in marine organisms, but detailed explanations of the processes and organs involved are required.

38(b)

This was badly answered and students need to priortise this in their revision.

39(a)

Many students described the Plasmodium as a virus or a bacteria. None identified it as a Protozoan- not one and there was a mark paid for that!!!
Not many described Plasmodium as having intermediate forms and few discussed hosts and vectors.

The life cycle was described well by some and jumbled by others. If you are to attempt this question you must describe the cycle in full and correctly.
Overall this was done quite well.

39(b)
This was done reasonably well although all students need to be aware of Possible Treatments and respond to this correctl.
See the answer key.