Government of **Western Australia**
School Curriculum and Standards Authority

BIOLOGY

ATAR course examination 2021

Marking key

Marking keys are an explicit statement about what the examining panel expect of candidates when they respond to particular examination items. They help ensure a consistent interpretation of the criteria that guide the awarding of marks.

2021/66857

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

Question	Answer
1	b
2	a
3	c
4	b
5	d
6	d
7	a
8	a
9	c
10	a
11	c
12	d
13	b
14	d
15	a
16	c
17	a
18	d
19	b
20	a
21	c
22	b
23	d
24	c
25	a
26	b
27	d
28	d
29	c
30	a

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

Question 31 **(21 marks)**

(a) Microevolution occurs through changes in the allele frequencies in a population. Name the **four** factors (microevolutionary forces) that can change allele frequencies. (4 marks)

Description	Marks
(natural, sexual or artificial) selection	1
genetic drift	1
gene flow	1
mutation	1
Total	**4**

(b) The World Canine Association recognises 360 breeds of domestic dog, ranging in size from Chihuahuas to Great Danes. They all belong to one species, *Canis familiaris*. They were first domesticated about 14 000 to 17 000 years ago but most breeds have been developed in the last several hundred years. Explain how such a range of variation has arisen within domestic dogs. (5 marks)

Description	Marks
artificial selection or selective breeding by humans	1
(ancestral) dogs with a desirable trait/s were selectively breed or only dogs with desirable trait/s were allowed breed/pass on genes	1
this process was repeated over many generations	1
this resulted in a group/breed of dogs showing the desired trait/s or only having genes/alleles for the desired trait/s	1
this happened independently for different traits resulting in breeds with different traits **or** cumulative effect of breeding different variants/traits in different lines **or** dogs were bred for different purposes	1
Total	**5**

Question 31 (continued)

(c) The figure below shows the number of species for three groups of dog-like animals within the family Canidae over evolutionary time.

According to the figure:

(i) When did the Hesperocyoninae become extinct? (1 mark)

Description	Marks
Accept anywhere between 15 and 16 million years	1
Total	**1**

(ii) Which of the three groups evolved first? (1 mark)

Description	Marks
Hesperocyoninae	1
Total	**1**

(iii) Which group has persisted for the longest period of time? (1 mark)

Description	Marks
Caninae	1
Total	**1**

(iv) When did most species across all three groups of the family Canidae occur? (1 mark)

Description	Marks
Accept anywhere between 29 and 31 million years	1
Total	**1**

(d) Explain the type of evidence biologists would have used to determine the number of species for the three groups of the family Canidae over evolutionary time. (4 marks)

Description	Marks
fossil evidence **or** preserved remains **or** preserved/fossilised hard parts	1
different species/families recognised via differences in morphology of fossils	1
count number of different species for each time period	1
use isotope data **or** index fossils **or** sediment layers to determine age	1
Total	**4**

(e) The red wolf is the most endangered canid species on Earth. Fewer than 200 individuals remain in the wild. Explain **one** reason why small populations are at risk of extinction. (4 marks)

Description	Marks
Either (genetic reason)	
small populations lose genetic diversity faster than large population **or** small populations have lower genetic diversity than large populations	1
due to genetic drift **or** random/chance loss of genetic variation	1
(under genetic drift) advantageous alleles can become rare/lost **or** disadvantageous alleles can become common/fixed	1
not enough variation to resist disease **or** to adapt to environment/ environmental change	1
Or (ecological reason)	
individuals may not be able to find a suitable mate because of unequal sex ratio or low population density	1
this may also change/stop important social behaviour/s	1
amount of inbreeding may increase resulting in reduced fitness/increased inbreeding depression	1
susceptible to environmental fluctuations as may lose all/most individuals in a poor year.	1
Total	**4**

Question 32 **(20 marks)**

(a) (i) What name is used to describe plants adapted to arid environments? (1 mark)

Description	Marks
xerophyte	1
Total	**1**

(ii) Describe how these plants lose water to the environment. (2 marks)

Description	Marks
as water vapour **or** via evaporation of water **or** via transpiration	1
from (open) stomata (in the leaves)	1
Total	**2**

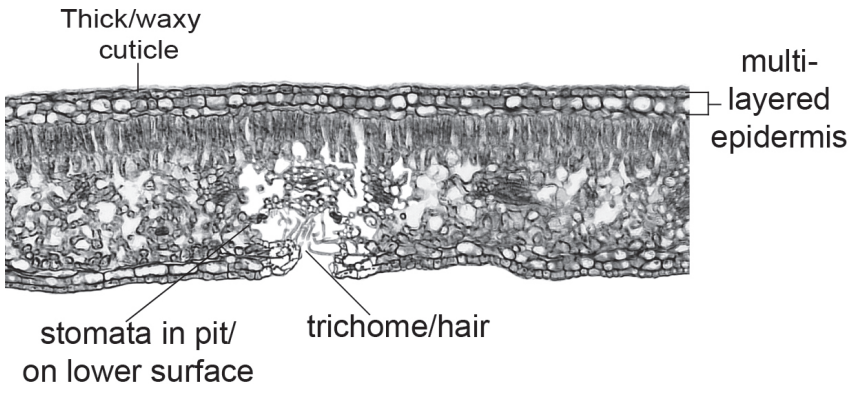
(b) The figures below show cross sections through the leaves of two plants. One of these plants occurs in an arid environment.

(i) On the basis of the features visible in each cross-section, indicate which plant (A or B) occurs in an arid environment. (1 mark)

Description	Marks
(plant) A	1
Total	**1**

(ii) On the relevant cross section, label **four** features that indicate one of the plants is from an arid environment. (4 marks)

Description	Marks
• thick/waxy cuticle • multi-layered epidermis • hairs/trichomes • stomata on lower surface/pit/sunken	1–4
Total	**4**



(c) The seeds of some plants that live in arid environments can germinate after many years in the soil. Explain how this characteristic can help these plants to survive in these environments. (4 marks)

Description	Marks
seeds are dormant so do not need water	1
plants are growing and need water	1
seeds only germinate after rain/when water is available	1
thus active plant growth occurs at times when water is available	1
Total	**4**

(d) Apart from drinking, outline **two** ways in which animals obtain water in arid environments. (4 marks)

Description	Marks
• diet • gain water from plants/animals that they consume	1–2
Subtotal	**2**
• fat/fat stores/carbohydrates • metabolism/respiration/breakdown of fat/carbohydrate generates water	1–2
Subtotal	**2**
Total	**4**

(e) Some species of fish inhabit bodies of water in arid regions in Australia. The salinity (salt content) of these bodies of water is usually higher than that of seawater but can fall below that of seawater after large amounts of rainfall. Explain the challenges that a fish faces in maintaining salt-water balance in these bodies of water. (4 marks)

Description	Marks
High salinity	
salt content of fish is (usually) less/hypotonic to water **or** salt content of water is (usually) higher/hypertonic to fish	1
water will tend to flow from fish to water **and/or** salt will tend to accumulate in fish	1
water loss/salt accumulation will occur at fast rate because the salt content of the water is much higher than that of fish **or** because the salt content of fish is much lower than that of water	1
Variability	
if/when salt content of water drops below that of fish (when there is a lot of rain), the fish will have the reverse problem **or** will tend to accumulate water and lose salts **or** will have to change the direction of osmoregulation	1
Total	**4**

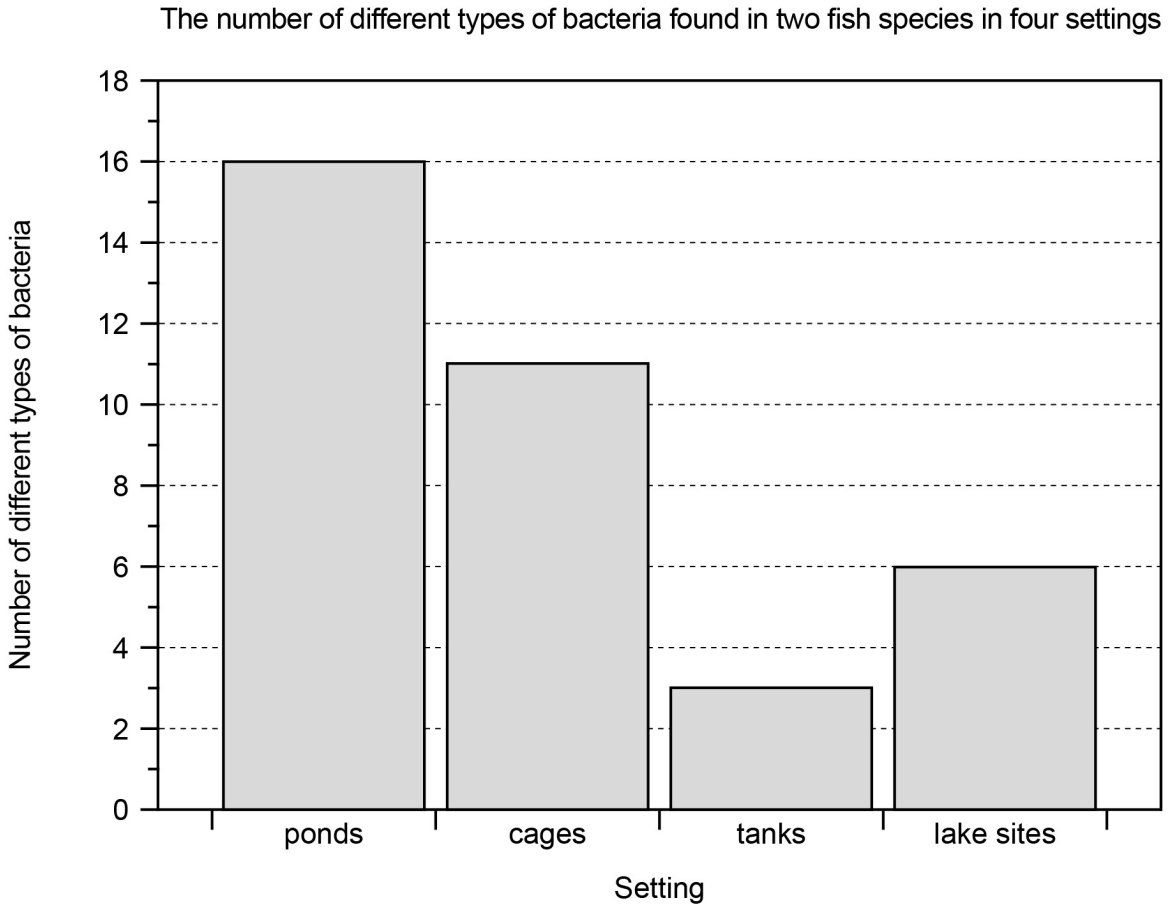
Question 33 **(19 marks)**

Fish farming is the fastest-growing agricultural sector in the world. In this method of farming, fish are grown in ponds, cages, tanks or other types of enclosures, usually for food.

(a) Complete the table by determining the number of different types of bacteria found in fish from cages. (1 mark)

Description	Marks
11	1
Total	**1**

(b) Draw a bar graph to show the number of different types of bacteria found in fish in each of the four settings. (5 marks)



Description	Marks
title - must include both variables	1
appropriate scale	1
y axis label	1
x axis label	1
plotting – data plotted accurately	1
Total	**5**

(c) (i) List the settings in which *Pseudomonas fluorescens* was found. (1 mark)

Description	Marks
ponds, cages and lake/lake sites	1
Total	**1**

(ii) Identify which type of bacteria was found in ponds, cages and tanks but not from lake sites? (1 mark)

Description	Marks
Edwardsiella tarda	1
Total	**1**

(d) A fish farmer reviewed the data and concluded that fish in tanks have fewer different types of bacteria than those in ponds, cages or the lake. Evaluate this conclusion. (4 marks)

Description	Marks
Any **four** of:	
• not correct **or** need more information to be sure • tanks had the lowest number of bacterial types however, (far) fewer tanks were sampled than was the case for other settings • need to correct data according to the number of each setting sampled **or** the number/percentage of bacterial types found per tanks/cages/lake sites sampled was less than that for tanks • the (two) sampled tanks may not have been representative of the number of bacterial types (due to chance) **or** need to sample more tanks (to be sure of the data for tanks) • unclear if other variables/number/types/condition of fish were controlled **or** influenced the results	1–4
Total	**4**

(e) Florfenicol is a type of antibiotic that is widely used to manage outbreaks of bacterial diseases in fish farming. It acts by inhibiting translation in bacterial cells. Explain how florfenicol can help to manage outbreaks of bacterial diseases in fish farming. (3 marks)

Description	Marks
Any **three** of:	
• translation is where mRNA is converted to a protein/polypeptide/ sequence of amino acids • florfenicol stops bacteria producing proteins • (without proteins) bacterial cells cannot survive/reproduce • fewer bacteria are present to cause disease/infect fish	1–3
Total	**3**

Question 33 (continued)

(f) DNA technology has been used to produce a line of fish with increased resistance to infection by certain bacteria. Outline the four main steps required to produce a line transgenic fish with increased resistance to infection by certain bacteria. (4 marks)

Description	Marks
Step 1: identify gene from another organism that will confer resistance to bacterial infection	1
Step 2: isolate target gene **or** make gene construct (based on that gene) **or** make copies of target gene	1
Step 3: insert target gene into fish	1
Step 4: verify that fish is expressing gene **or** propagate modified/transgenic fish	1
Total	**4**

Question 34 **(20 marks)**

Honey bees suffer from a range of viral diseases.

(a) (i) List the **two** main structural features of a virus. (2 marks)

Description	Marks
has a protein coat/protein layer/capsid	1
Any one of the following: • nucleic acid • RNA • DNA	1
Total	**2**

Many biologists do not regard a virus as a living organism.

(ii) List **two** characteristics of a virus that suggest it is not a living organism. (2 marks)

Description	Marks
Any **two** of:	
• cannot reproduce without a host **or** requires host structures to reproduce • does not have a cellular structure/cell organelles • does not produce own energy/does not respire • does not grow	1–2
Total	**2**

(b) (i) Is deformed wing in honey bees an infectious disease? Give reasons for your answer. (3 marks)

Description	Marks
Yes (must be a clear yes)	1
because it is caused by a pathogen (must say pathogen, not just virus)	1
and can be transmitted (from one host to another)	1
Total	**3**

(ii) State what is a disease vector. (2 marks)

Description	Marks
an organism/agent that transmits a pathogen	1
into another species/type of organism (e.g. mite to bee)	1
Total	**2**

Question 34 (continued)

(c) The *Varroa* mite is common in many countries but there is no established infestation in Australia. However, this mite has been detected in a bee colony in Queensland. Outline **two** measures that could be used to reduce the chances of this mite becoming established in Australia. (4 marks)

Description	Marks
Any **two** options (2 x 2 marks):	
Option one • check/prohibit import of bees/bee products (contaminated with mite) • stop mite entering Australia	1–2
Subtotal	**2**
Option two • monitor bees/bee colonies in Australia for mite infestation • destroy/treat infested bees/bee colonies (before mite can spread further)	1–2
Subtotal	**2**
Option three • limit movement of bees/bee colonies/bee products within Australia • infestations will remain localised	1–2
Subtotal	**2**
Option four • educate beekeepers **or** general public about mites • increase the chances of detecting mite **or** of people following/supporting biosecurity measures	1–2
Subtotal	**2**
Total	**4**

(d) The deformed wing virus is an RNA virus. Its genome is 10,140 nucleotides in length. One part of the genome, which is 450 nucleotides in length, codes for the VP1 protein. On this basis, how many amino acids are there in the VP1 protein? Justify your answer. (3 marks)

Description	Marks
150 **or** approximately 150 if there are start and stop codons	1
each amino acid is coded for by a codon **or** 3 nucleotides	1
therefore the number of amino acids is the number nucleotides divided by 3	1
Total	**3**

(e) The diploid number of chromosomes in honey bees is 32. Queen bees are diploid and produce eggs by meiosis. Female worker bees hatch from fertilised eggs, whereas male bees hatch from unfertilised eggs. How many chromosomes will occur in male bees? Explain your answer. (4 marks)

Description	Marks
16	1
haploid number of chromosomes **or** half the number of diploid chromosomes **or** meiosis halves the (diploid) chromosome number	1
same number of chromosomes as unfertilised egg	1
the male parent does not contribute any chromosomes **or** only the female parent contributes chromosomes	1
Total	**4**

Question 35 **(20 marks)**

(a) Some botanic gardens provide advice to the general public about how to detect certain diseases in their garden plants. Provide advice to the general public about how they could detect crown gall disease in their garden plants. (3 marks)

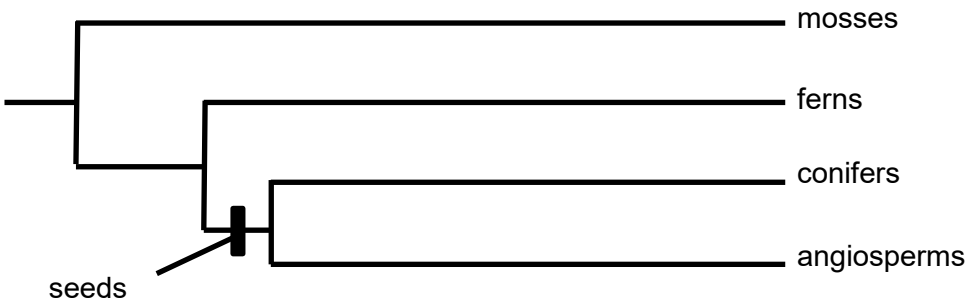
Description	Marks
look for tumours/lumpy growths/galls	1
(especially) near the base of the plant **or** just above the soil **or** crown	1
(especially) on plants that are stunted/unproductive **or** on fruit trees/grapes/olives/ornamental plants (which are common hosts)	1
Total	**3**

(b) Other than providing education, outline **two** ways in which botanic gardens can contribute to plant conservation. (4 marks)

Description	Marks
Any **two** options (2 x 2 marks):	
Option one • selective breeding/cultivate/genetically modify/seed banks endangered/vulnerable/threatened species • can release individuals to supplement/restore wild population **or** so some individuals will remain even if species goes extinct in the wild	1–2
Subtotal	**2**
Option two • keep seed banks/gene banks/genetic resources • use to replenish genetic diversity of wild populations	1–2
Subtotal	**2**
Option three • archive data on/research the biology/ecology/taxonomy/genetics of species • improve understanding of how species will respond to environmental change **or** factors that might improve species' recovery	1–2
Subtotal	**2**
Total	**4**

Question 35 (continued)

(c) Draw a phylogenetic tree showing the evolutionary relationships among the four types of plant based on the characters in the table. Show the point on the tree where seeds evolved. (5 marks)



Description	Marks
tree shows mosses in correct position	1
tree shows ferns in correct position	1
tree shows conifers in correct position	1
tree shows angiosperms in correct position	1
tree shows evolution of seeds in correct position	1
Total	**5**

(d) Explain comparative genomics and how it can lead to an in-depth understanding of plant evolution. (4 marks)

Description	Marks
comparison of the entire genomes of different species/groups	1
used to identify all similarities/differences between different species/groups	1
and genes/DNA sequences that are unique particular groups **or** that control particular traits	1
(can use the information to) deduce evolutionary relationships **or** when traits evolved **or** how traits have changed over time	1
Total	**4**

(e) Explain bioinformatics and why it is important to the field of comparative genomics. (4 marks)

Description	Marks
Bioinformatics	
Any **two** of:	
• science of analysing large/complex data sets in biology • multidisciplinary **or** applies computers/mathematics/statistics to the study of problems in (molecular) biology • involves the development of software **or** storage/analysis of biological/molecular data	1–2
Subtotal	**2**
Importance to comparative genomics	
comparative genomics produces very large data sets	1
specialised computing/analyses provided by bioinformatics is needed to store/analyse such large data sets **or** traditional methods for analysing genetic data are not capable of storing/analysing such large data sets	1
Subtotal	**2**
Total	**4**

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

Unit 3

Question 36 **(20 marks)**

(a) Outline the **four** main steps involved in gene expression. Explain, using examples, how the phenotypic expression of a gene can depend on interactions with environment.
(10 marks)

Description	Marks
Main steps in gene expression	
DNA is transcribed into mRNA or a mRNA molecule that is complementary to the DNA template is produced	1
introns are removed from mRNA so that only exons/coding sequence remains	1
mRNA moves to cytoplasm **or** moves to ribosome	1
mRNA interacts with tRNA to translate genetic code or to add correct amino acid to growing protein/polypeptide chain	1
Subtotal	**4**
Any **six** of:	
Effects of environment External environment • expression of some genes varies with external environment • temperature/availability of food/light exposure can determine whether or not a gene is expressed **or** expression of genes that determine sex in reptiles is affected by temperature **or** other specific example of how gene expression can vary with external environment Body condition • expression of some genes varies with body conditions/internal environment/hormones • hormones regulate expression of genes that are expressed only in one sex **or** more strongly in one sex **or** genes needed for lactation are expressed only in female mammals **or** other specific example of how gene expression can vary with body condition/hormones Environmental influence on gene products • gene products/proteins/enzymes of some genes are affected by external environment **or** environment may prevent some gene products/proteins/enzymes from functioning • enzymes may not function at high/low temperatures/pHs **or** Himalayan rabbits are white except for black extremities because the enzyme needed to produce black fur only functions at low temperatures **or** other specific example of how environment can determine whether or not a gene product can function Chemical changes to DNA • environment can result in chemical changes to DNA that affect gene expression (called epigenetics) • e.g. methylation of DNA (usually results in gene silencing) **or** acetylation of (histone) proteins (usually results in gene expression)	1–6
Subtotal	**6**
Total	**10**

Question 36 (continued)

(b) Explain sexual selection and how it is similar to, and different from, natural selection. Include a specific example of a trait that evolved by sexual selection in your answer.

(10 marks)

Description	Marks
Sexual selection	
sexual selection acts on an organism's ability to find a mate **or** results in the evolution of traits that help an organism to find a mate	1
it can occur when males compete with each other to mate with females	1
it can occur when females choose a male to mate with	1
(large) antlers in stags/male deer **or** courtship display/vocalisation in male frogs **or** large/colourful/ornamental feathers in peacock **or** red patches in male marine iguana **or** other specific example (must include trait, sex, type of organism)	1
Subtotal	**4**
Any **three** of:	
Similarities • both apply to inherited traits • sexual selection is a special type/case of natural selection • both select for traits that increase an organism's chance of having offspring **or** in both cases individuals with favoured traits will leave more offspring • both increase the frequency of favoured alleles • both require variation to exist in population	1–3
Subtotal	**3**
Differences • natural selection favours traits that help an organism to survive **or** (rather than to find a mate) • sexual selection can result in the evolution of traits that reduce an organism's chances of survival • because traits that attract a mate can also attract a predator **or** can take a lot of energy to produce/maintain **or** because male-male competition can injure/damage an individual	1–3
Subtotal	**3**
Total	**10**

Question 37 **(20 marks)**

(a) Using your knowledge of microevolutionary forces and the data provided, explain how the soapberry bugs feeding on the fruits of the golden rain tree came to have much shorter beaks than the soapberry bugs feeding on the fruit of the balloon vine. (10 marks)

Description	Marks
Any **eight** of:	
• prior to the introduction of the Golden Rain Tree, natural selection favoured bugs with long beaks • because bugs only had balloon vine fruit to feed on **or** long beaks are suitable for feeding on balloon vine fruit (because the fruit is larger) • (once the Golden Rain Tree was introduced) some bugs started to feed on the fruit of the Golden Rain tree • smaller beaks were suitable for feeding on the Golden Rain tree fruit (because the fruit are smaller) • shorter beaks may have arisen by mutation **or** there was variation in beak length in the population • bugs with shorter beaks feeding on Golden Rain tree fruit are favoured by natural selection/fitter/leave more offspring • pass alleles for shorter beak length to offspring • over time/generations alleles for shorter beaks became increasingly common in bugs feeding on Golden Rain tree fruit • absence of gene flow keeps gene pools of bugs with different beak lengths/feeding on different fruits separate	1–8
Subtotal	**8**
Accurate quote of the data • quote relevant to beak length • quote relevant to fruit size	1–2
Subtotal	**2**
Total	**10**

Question 37 (continued)

(b) Explain, including examples, how chemical factors in the environment can cause mutations and discuss the consequences of a mutation occurring in a germline cell and in a somatic cell. (10 marks)

Description	Marks
Chemical factors (any two of the following) • mutagens are chemicals in the environment that react with DNA • a mutation is a permanent change to DNA or the genome • they can substitute/change chemistry of bases or inhibit DNA repair/replication/mitosis/meiosis	1–2
Specific examples (any two of the following) • names chemical mutagen, • describes the specific effect on DNA structure Answers could include • nitric acid/deaminating agent - changes one nitrogenous base into another • colchicine - prevents spindle formation so chromosomes cannot segregate **or** doubles chromosome number **or** interferes with mitosis/meiosis • ethidium bromide/intercalating agents - are inserted into DNA and distort DNA helix **or** cause problems with DNA replication/repair • mustard gas/alkylating agent - causes base-pair mismatches **or** cross-link guanine bases **or** prevents DNA molecule from unwinding • other specific example that states type of chemical and its specific effect	1–2
Subtotal	**4**
Any **six** of:	
Consequences • germline cell is a gamete **or** a cell that undergoes meiosis (to produce gametes) • germline mutations usually do not affect the health/viability of the individual that underwent the mutation because the mutation is limited to the germline/germ cells • germline mutations can be passed to offspring because they occur in the gametes • the health/viability/fertility of these offspring can be (badly) affected because all of their cells will carry the mutation • somatic cell is a general body cell • a mutation that occurs in a somatic cell usually does not affect the health/viability/fertility of the individual because it is limited to a particular cell line • however, the health/viability of an individual can be affected if the mutation causes cancer **or** if the mutation affected occurs early in embryonic development (because most cells will have the mutation) • somatic cell mutations cannot be inherited because they do not occur in the gametes	1–6
Subtotal	**6**
Total	**10**

Unit 4

Question 38 **(20 marks)**

(a) Explain how each of the above features helps whales to thermoregulate in cold water. (10 marks)

Description	Marks
General • heat will be lost to the environment because the water is colder than core body temperature **or** because the core body temperature is warmer than water	1
Subtotal	**1**
Any **three** of:	
Large size • heat is lost to environment/water via the surface of whale/body parts in contact with water • large size means low surface area to volume ratio • less surface area per unit volume in contact with the water to lose heat • large size also allows for more insulating blubber	1–3
Subtotal	**3**
Lower core temperature	
the rate of heat loss to the environment depends on temperature difference between whale and water	1
reduced core temperature reduces the amount of the difference between the body temperature and water/environment	1
hence heat is lost at a reduced rate (must say rate)	1
Subtotal	**3**
Any **three** of:	
Blubber • blubber is an insulator **or** a poor conductor of heat **or** stops the transfer of heat • provides a barrier between the (warm) core of the body and surface of the whale **or** separates the (warm) core of the body from the (cold) water • heat is trapped in the core of the body **or** ensures that the surface/part of the whale in contact with the water is cooler than body core • can constrict blood vessels/limit blood flow in blubber to reduce amount of warm blood flowing to surface of whale (where the heat could be lost)	1–3
Subtotal	**3**
Total	**10**

Question 38 (continued)

(b) Discuss the effects of global climate change on the distributions of human diseases by direct and by indirect transmission. Include a specific example in your answer of a disease, the distribution of which is likely to be affected by global climate change.

(10 marks)

Description	Marks
Any **eight** of:	
Climate change • climate change could allow the emergence of new (zoonotic) diseases by changing interactions between humans and animals (direct) • for a newly emerged disease, global travel will impact the distribution of this disease • if the distribution of the vector is affected by global climate change, then it is likely that the distribution of the disease will also be impacted (indirect) Direct transmission • disease/pathogen is transferred directly from one human to another • distribution tends to match the distribution of humans and has the potential to reflect distribution of humans • humans are already distributed across globe and global climate change is unlikely to affect this distribution or distribution of disease with direct transmission Indirect transmission • disease is transmitted to humans via a vector • distribution of disease is influenced by distribution of vector **or** cannot spread to regions where vector does not occur Others • standard of health care/degree of urbanisation/quality of environment is important in determining distribution of some diseases (irrespective of mode of transmission or climate) • ease of transmission of disease/degree of resistance in human population will impact on how widespread a disease is (irrespective of mode of transmission or climate)	1–8
Subtotal	**8**
Specific example	
• specific example that includes disease and mode of transmission (e.g. malaria has indirect transmission) • illustrates how the distribution of the disease is or is not changing (e.g. in Africa malaria is now extending to higher altitudes, along with the distribution of the (*Anopheles*) mosquito vector)	1–2
Subtotal	**2**
Total	**10**

Question 39 **(20 marks)**

(a) Discuss how the types of nitrogenous waste produced by different vertebrates are related to the availability of water in the environment and the ancestry (evolutionary history) of the vertebrate. (10 marks)

Description	Marks
ammonia is only suitable for vertebrates living in an aquatic environment	1
because it is very toxic and requires large amounts of water to excrete	1
uric acid is suitable for terrestrial environment **or** a dry/arid environment or for a vertebrate with (non-aquatic) eggs	1
because it is not toxic/has low toxicity/is not soluble in water and requires no negligible water to excrete	1
all birds and reptiles excrete uric acid	1
urea has medium toxicity and requires some water for excretion but not large amounts	1
suitable for terrestrial environments **or** can be suitable for arid environments if urine is highly concentrated	1
all mammals excrete urea	1
Subtotal	**8**
Any **two** of:	
• type of nitrous waste depends on type of vertebrate • amphibians can excrete a range of types **or** amphibians can excrete urea or uric acid or ammonia • type excreted by amphibians largely depends on water availability of environment **or** aquatic tadpoles excrete urea whereas the terrestrial/desert frogs excrete urea/uric acid • any example that shows that the waste excreted may not be ideal in environment because of ancestry e.g. dolphin excretes urea desert mammal excretes urea	1–2
Subtotal	**2**
Total	**10**

Question 39 (continued)

(b) Discuss the reasons why it is difficult to control the spread of *Phytophthora* dieback in Australia. (10 marks)

Description	Marks
Any **five** of:	
Cure/treatment • no cure/treatment/method for killing pathogen • multiple means of transmission • phosphite can limit impact/growth of pathogen in an infected plant • but phosphite does not stop plant from getting infection in first place **or** does not eliminate the pathogen **or** may only have a temporary effect **or** symptoms are often overlooked in the early stages (so treatment is delayed) • unrealistic to treat all infected plants in wild/natural environment • spreads by (mobile) microscopic spores/remains dormant in soil	1–5
Subtotal	**5**
Any **five** of:	
Managing spread In natural environment • *Phytophthora* pathogen is introduced/not native • native plants do not have resistance **or** have not had enough time to evolve resistance **or** *Phytophthora* does not have its own pathogens/diseases/biological controls • affects many native (plant) species so easy to find new host • *Phytophthora*/dieback is widespread **or** was already widely spread before attempts to control it were started • can be spread over (large) distance by water **or** animals **or** human activities **or** plant to plant • common in areas frequented by humans • humans may be unaware of/unwilling to follow protocols for preventing spread For cultivated/garden plants • can treat soil **or** remove affected plants or buy plants from reputable nursery • but labour intensive **or** is only effective on local scales **or** unrealistic strategy for natural environment	1–5
Subtotal	**5**
Total	**10**

ACKNOWLEDGEMENTS

Question 32(b) Adapted from: Berkshire Community College Bioscience Image Library. (2017). *Xerophyte leaf x mesophyte leaf* (34810763066). Retrieved May, 2021, from https://commons.wikimedia.org/wiki/File:Xerophyte_leaf_x_Mesophyte_leaf_(34810763066).jpg

Published by the School Curriculum and Standards Authority of Western Australia
303 Sevenoaks Street
CANNINGTON WA 6107