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

BIOLOGY

ATAR course examination 2020

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.

2020/65254

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

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

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

Question 31 **(20 marks)**

(a) (i) List **two** structural features of protists that are **not** found in bacteria. (2 marks)

Description	Marks
Any **two** of:	
• protists are eukaryotes/have a nucleus • protists have membrane-bound organelles/mitochondria • cell walls of protists are made of cellulose (not peptidoglycan)	1–2
Total	**2**

(ii) List **two** structural features of protists that are **not** found in fungi. (2 marks)

Description	Marks
Any **two** of:	
• protists are (usually) unicellular • protists (often) have flagella (except in Chytrid zoospores)/cilia • cell walls of protists (when present) are made of cellulose (not chitin)	1–2
Total	**2**

(b) Explain how this can prevent the spread of jarrah dieback. (4 marks)

Description	Marks
disease is spread (from plant to plant) by spores/zoospores	1
spores/zoospores are more active when it is wet	1
vehicles pick up more (contaminated) soil when it is wet; (therefore) risk of transmission/spread is greater when the soil is wet	1
vehicles can spread disease/spores/zoospores over a large area	1
Total	**4**

Question 31 (continued)

(c) (i) Describe how the tuberculosis pathogen is transmitted to a new host. (2 marks)

Description	Marks
pathogen is in air/airborne **or** affected individuals breathe out pathogen/droplet	1
new host breathes in/inhales pathogen	1
Total	**2**

(ii) Describe the impact that the tuberculosis pathogen has on the host. (2 marks)

Description	Marks
Any **two** of:	
• infects lungs/respiratory system • causes coughing/lung irritation/breathing problems/tuberculosis • sometimes does not cause symptoms **or** takes time for symptoms to develop **or** can infect brain/nervous system/tissue other than the lungs	1–2
Total	**2**

(d) Explain how vaccination helps to control the spread of tuberculosis. (4 marks)

Description	Marks
Any **four** of:	
• vaccination introduces weakened/harmless version of a pathogen into body • this stimulates production of antibodies/stimulates an immune response • vaccinated individuals become immune **or** do not catch the disease • higher the proportion of the population that is immune, the greater the protection **or** the converse • because infected individuals do not/rarely come into contact with susceptible individuals **or** the converse • herd immunity/high immunity protects susceptible individuals	1–4
Total	**4**

(e) When travellers enter Australia from overseas, they are required to declare all plant and animal matter that they have brought with them. Explain why. (4 marks)

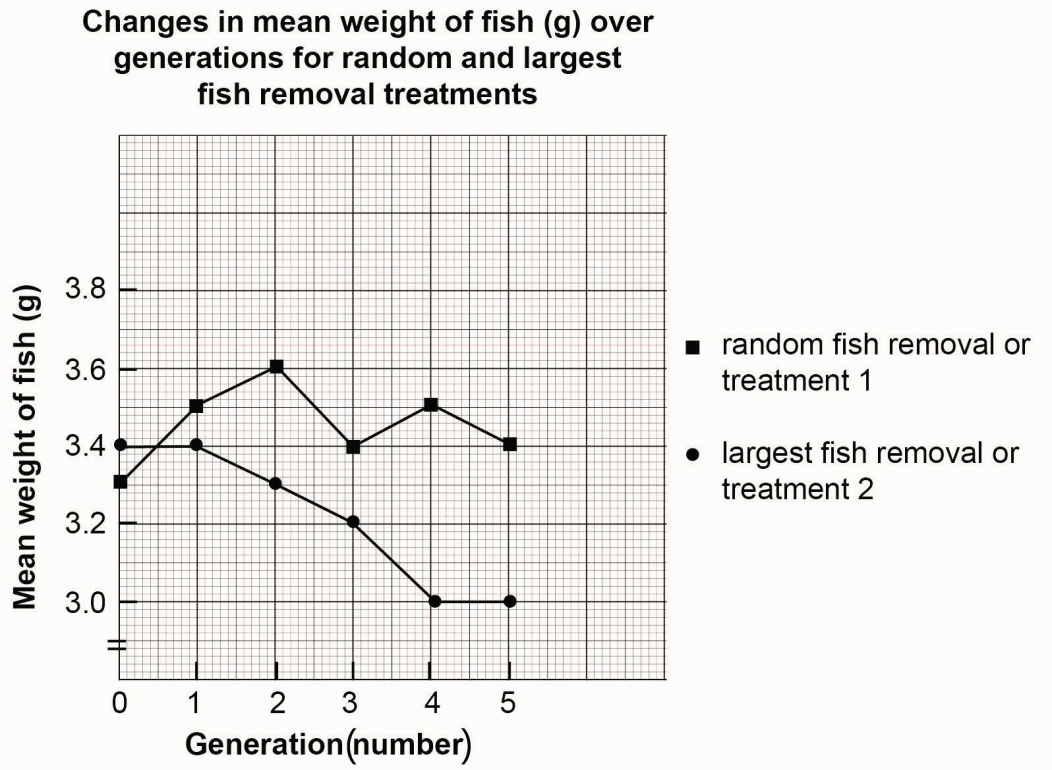
Description	Marks
Any **four** of:	
• quarantine/biosecurity measure • protects agricultural industry/the environment **or** stops spread of disease • stops the introduction of exotic pests/diseases/weeds found in other countries (but not in Australia) • plant and animal matter/declared items may carry pests/diseases • plant and animal matter found to be infected will either be treated with pesticides/insecticides **or** destroyed	1–4
Total	**4**

Question 32 **(20 marks)**

(a) Graph the mean weight of fish for both the random fish removal treatment and the large fish removal treatment against generation. (6 marks)

Description	Marks
title must include both variables	1
data plotted separately for treatments 1 and 2 including key	1
correct axes (X and Y)	1
appropriate scale	1
labelling – accurate labelling on both axes including units	1
plotting – data plotted accurately and joined (line graph)	1
Total	**6**

Note: 'mean' is required in Y axis label



(b) (i) Identify the dependent variable in the experiment. Give a reason for your answer. (2 marks)

Description	Marks
mean weight/size of fish left in tank	1
this is the variable that was measured/depends on the independent variable	1
Total	**2**

(ii) Would conducting the experiment for more generations improve the reliability or validity of the experiment? Give a reason for your answer. (2 marks)

Description	Marks
validity	1
this would improve accuracy of experiment **or** the ability to determine whether removing largest fish had an effect	1
Total	**2**

Question 32(b) (continued)

(b) (iii) Why did the biologists remove fish at random from the two tanks in Treatment 1. (2 marks)

Description	Marks
control	1
so the only difference between treatments was the size of the fish that were removed **or** to determine what would happen if fish were removed from tank regardless of weight/size	1
Total	**2**

(c) Explain why the mean weight of the fish declined over generations in Treatment 2. (4 marks)

Description	Marks
natural selection **or** selection **or** environment favours small fish	1
only the smallest/lightest fish were left to breed **or** larger/heavier fish did not breed	1
smaller/lighter fish passed alleles/trait for small size/weight to offspring **or** larger/heavier fish did not pass on alleles/traits for large size/weight to offspring	1
the frequency of alleles for small size/weight (progressively) increased over generations (hence mean weight declined)	1
Total	**4**

(d) Predict what would have happened if the biologists had removed the largest fish until 50% (rather than 10%) of the fish remained. Explain your answer. (4 marks)

Description	Marks
Either • mean size/weight of fish would (still) decline • but at a slower rate • (natural) selection would still favour smaller/lighter fish • but the strength of selection would be less **or** the remaining/breeding fish would be larger compared to experiment **or** less alleles for smaller size/weight **or** more alleles for larger size/weight **or** • might not have detected an effect **or** a reduction in size/weight • because rate of increase of alleles favouring small size/weight would be slower • but (natural) selection would still be favouring smaller/lighter fish • would expect to see an effect if experiment was conducted for more generations/a longer period of time	1–4
Total	**4**

Question 33 **(20 marks)**

(a) The following terms are relevant to developing conservation plans for the malleefowl. Define each term.

(i) Gene pool (1 mark)

Description	Marks
all of the genes/alleles/genetic diversity/genetic information in a population/species	1
Total	**1**

(ii) Population dynamics (1 mark)

Description	Marks
study of changes in population size **or** of how and why populations change size **or** of size and age composition of populations	1
Total	**1**

(iii) Biogeography (1 mark)

Description	Marks
study of the geographical distribution of organisms/species/ communities	1
Total	**1**

(iv) Reproductive behaviour (1 mark)

Description	Marks
behaviour associated with mating **or** rearing young	1
Total	**1**

(b) To investigate genetic diversity, biologists produced DNA profiles for malleefowl. List the main steps involved in producing a DNA profile. (4 marks)

Description	Marks
extract/isolate/obtain DNA (from the malleefowl)	1
(PCR) amplify DNA/make large amounts of DNA/clone DNA	1
use electrophoresis to separate DNA fragments/pieces **or** to visualise DNA	1
record DNA sequence **or** number of short tandem repeats/STRs **or** restriction enzyme fragments	1
Total	**4**

Question 33 (continued)

(c) Biologists are breeding malleefowl in captivity to assist in the recovery of wild populations. Describe **two** ways in which captive breeding can assist in the recovery of wild populations. (4 marks)

Description	Marks
• release genetically diverse individuals to • boost/maintain genetic diversity (of wild populations)	1–2
Subtotal	**2**
• release additional/large numbers of individuals to • boost population size	1–2
Subtotal	**2**
Total	**4**

(d) Explain how a consideration of population dynamics can assist conservation planning to maintain viable gene pools in a vulnerable species, such as the malleefowl. (4 marks)

Description	Marks
can identify trends in population size **or** when populations will grow/decline	1
smallest population sizes pose the most risk to gene pool **or** population will lose genetic diversity when small	1
(therefore) conservation planning should be based around smallest population size **or** should allow for times when population numbers will drop **or** should consider small sizes in the past	1
can identify and potentially correct factors that cause numbers to drop	1
Total	**4**

(e) Habitat destruction has reduced the opportunity for gene flow between malleefowl populations. Explain how gene flow affects the gene pool of a population. (4 marks)

Description	Marks
Any **four** of:	
• gene flow is the exchange of genetic material/alleles between populations • gene flow/migrants/immigrants can bring new alleles into the gene pool/population • because they come from populations with different alleles • gene flow/migrants/immigrants can change allele frequencies in the allele in the gene pool/population • because they come from populations with different allele frequencies • gene flow/migrants/immigrants reduce differences between the gene pool of the source and recipient populations	1–4
Total	**4**

Question 34 **(20 marks)**

(a) (i) Thermoregulation in the greater bilby is an example of homeostasis. Define homeostasis. (1 mark)

Description	Marks
process organisms use to maintain stable internal conditions/constant internal environment	1
Total	**1**

(ii) The greater bilby uses a negative feedback mechanism to thermoregulate. State the defining feature of a negative feedback mechanism. (1 mark)

Description	Marks
response counteracts the change **or** response reduces stimulus	1
Total	**1**

(iii) Indicate whether a rise in the body temperature above 37 °C would be a stimulus or a response in a negative feedback mechanism. Give a reason for your answer. (2 marks)

Description	Marks
stimulus	1
it is a disruption of homeostasis **or** it is the change that brings about the response	1
Total	**2**

(b) Explain how a greater bilby's ears could help it to thermoregulate. (4 marks)

Description	Marks
Any **four** of:	
• blood/ blood vessels bring heat (from the core of the body) to the ears • heat is exchanged (with the environment) via the ears **or** heat is lost through the ears • can increase blood supply to increase heat loss **or** decrease blood supply to reduce heat loss • large size/high surface area to volume ratio allows for a lot of heat exchange **or** a for large area for heat exchange • hairless ears make heat loss more efficient **or** there is no insulation (to trap air close to the body) **or** the surface of the ears is in direct contact with the air	1–4
Total	**4**

Question 34 (continued)

(c) (i) State the relationship between environmental temperature and mean rate of oxygen consumption in thorny lizards at rest. (1 mark)

Description	Marks
as environmental temperature increases so does oxygen consumption **or** as environmental temperature decreases so does oxygen consumption **or** environmental temperature and oxygen consumption are positively correlated	1
Total	**1**

(ii) Explain the reason for the relationship described in part (c)(i). (3 marks)

Description	Marks
oxygen consumption is a measure of the metabolic rate	1
the metabolic rate of the lizard depends on the body temperature **or** the metabolic rate is higher at higher temperatures **or** the metabolic rate is lower at lower temperatures	1
because the lizard is an ectotherm **or** because the body temperature of the lizard varies with the environment	1
Total	**3**

(d) The colour of the scales on a thorny lizard changes from pale during warmer months to darker during cooler months. Explain how this helps the lizard to thermoregulate. (4 marks)

Description	Marks
external temperature is higher than optimal body temperature during warmer months **or** lower than optimal body temperature during cooler months	1
pale scales reflect more (radiant) heat	1
dark scales absorb more (radiant) heat	1
reduce heating in warmer months **or** increase heating during cooler months	1
Total	**4**

(e) There are approximately 55 species of true sea snakes. These snakes are common in warm tropical waters but do not occur in colder waters. Provide a plausible explanation for this distribution. (4 marks)

Description	Marks
Any **four** of:	
• sea snakes are ectotherms **or** the body temperature of the sea snakes varies with the environment • need to retain/gain body heat in order to function • heat will be lost to water by conduction • the rate of heat loss is determined by the temperature difference between the sea snakes and the water • (therefore) heat loss will be less in warm water **or** greater in colder water **or** more opportunity to gain heat in warm water **or** less opportunity to gain heat in colder water • heat loss/conduction is higher in water than land (so the problem is acute for sea snakes) • sea snakes are relatively small/have a high surface area to volume ratio (and therefore experience relatively high rates of heat loss)	1–4
Total	**4**

Question 35 **(20 marks)**

(a) (i) Define the term 'fossil'. (1 mark)

Description	Marks
preserved remains/impression/traces of an old/ancient/extinct organism	1
Total	**1**

(ii) Outline how fossils can provide evidence for evolution. (3 marks)

Description	Marks
show past life/extinct organisms	1
show that life has changed over time **or** that life on earth has a long history	1
show how one type of organism/structure has transitioned to another	1
Total	**3**

(b) List **four** reasons why the fossil record is incomplete. (4 marks)

Description	Marks
Any **four** of:	
• only hard parts are likely to form fossils **or** soft parts are unlikely to form fossils • only organisms that avoid decomposition/scavengers/predators form fossils **or** fossils only form in areas with no oxygen/bacteria • only organisms that are buried in sediment/mineral rich water form fossils **or** rapid burial • not all fossils have been found yet • some fossils have been destroyed (by volcanic eruptions/human activities/earthquakes)	1–4
Total	**4**

(c) (i) Approximately when did life first evolve on Earth? (1 mark)

Description	Marks
3.5 billion years ago (accept any answer between 3 and 4 billion) **or** Archaean **or** Palaeozoic	1
Total	**1**

(ii) Describe the first life forms on Earth. (3 marks)

Description	Marks
Any **three** of:	
• microbes/single cell • simple cells/prokaryotes • bacteria/bacteria-like/archaea • aquatic/anaerobes/marine	1–3
Total	**3**

(d) Use these data to describe the evolutionary relationships of these monkeys. (4 marks)

Description	Marks
saki and woolly are closely related/most closely related	1
colobus and macaque are closely related/next most closely related	1
squirrel, saki and woolly form a related group **or** colobus and macaque are distantly related to others **or** form a distinctive group	1
any accurate quote of data (must give names of monkeys and number of amino acid substitutions)	1
Total	**4**

(e) Explain how differences in the amino acid sequence of a protein can provide evidence of evolutionary relationships between organisms. (4 marks)

Description	Marks
Any **four** of:	
Either • sequence of amino acids in a protein is determined by a DNA sequence • the more similar the amino acids, the more similar the DNA sequence • organisms with similar DNA/amino acid sequences are closely related • because they diverged more recently • less time to accumulate mutations/differences **or** • sequence of amino acids in a protein is determined by a DNA sequence • the more different the amino acids, the more different the DNA sequence • organisms with different DNA/amino acid sequences are not closely related • because they diverge a long time ago • more time to accumulate mutations/differences	1–4
Total	**4**

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

Unit 3

Question 36 **(20 marks)**

(a) Describe the structure of a double-stranded DNA molecule and explain how the structural properties allow for replication. (10 marks)

Description	Marks
Any **six** of:	
Structure of DNA • arranged as a double-helix • antiparallel strands **or** two strands that run in opposite directions • each strand consists of a chain of nucleotides • nucleotides consist of a sugar (deoxyribose), phosphate group and a nitrogenous base • nitrogenous bases on opposite strands are complementary **or** pair with a base on the other strand **or** there is complementary base pairing • adenine pairs with thymine and cytosine pairs with guanine **or** A pairs with T and C pairs with G • complementary bases/two strands are held together by hydrogen bonds	1–6
Subtotal	**6**
Explains how structural properties allow for replication	
• the hydrogen bonds are weak **or** can be easily broken • allows the two strands to separate (which is needed for replication to occur) • the complementary base pairing • means each strand can be synthesised from its complementary strand **or** each strand can be used as a template to synthesise the complementary strand (semiconservative replication)	1–4
Subtotal	**4**
Total	**10**

Question 36 (continued)

(b) Compare artificial selection and transgenesis. (10 marks)

Description	Marks
Any **two** of:	
Similarities • both alter the genetic composition of individuals (to produce the traits) • both reduce the genetic diversity in the selected/modified organisms • both involve human intervention	1–2
Subtotal	**2**
Artificial selection methods • artificial selection uses selective breeding **or** selects individuals with desirable trait to breed • results in gradual/progressive changes in frequency of alleles (across generations)	1–2
Subtotal	**2**
Transgenesis methods • artificial production of a genetically modified organism • involves cloning/biotechnology/DNA recombinant technology	1–2
Subtotal	**2**
Any **four** of:	
Differences • artificial selection can be slow whereas transgenesis can be fast • artificial selection does not require specialist equipment whereas production of transgenics requires specialist equipment • artificial selection affects all/most of genome whereas transgenesis affects one gene • artificial selection (usually) changes alleles/genes normally found in target organism whereas transgenesis may involve transfer of gene from different species • artificial selection is viewed as natural/environmental friendly whereas transgenesis is viewed as more controversial/artificial/environmental threat	1–4
Subtotal	**4**
Total	**10**

Question 37 **(20 marks)**

(a) Explain why there are so many species of rock wallaby. (10 marks)

Description	Marks
Any **ten** of:	
• due to high rates of speciation/allopatric speciation **or** repeated speciation • common ancestor colonised different rock outcrops • populations (on different outcrops) experienced different environmental conditions **or** different selection pressures • these populations evolved different adaptations **or** genetic differences evolved by natural selection • genetic drift/bottlenecks/founder effects resulted in random genetic changes/differences among populations • effects of genetic drift are likely to be large because of small size **or** number of founders was small • populations (on different outcrops) had different mutations **or** mutation introduce new/different alleles into populations • gene flow/migration/dispersal between populations (on different outcrops) was non-existent/rare **or** populations (on different outcrops) were isolated from each other • (therefore) populations on different outcrops became genetically different **or** evolved genetic differences **or** different gene pools • over time populations (on different outcrops) became increasingly different • eventually individuals on different outcrops were no longer able to interbreed/became new species	1–10
Total	**10**

(b) Compare mitosis and meiosis. (10 marks)

<table>
<tr><th colspan="2">Description</th><th>Marks</th></tr>
<tr><td colspan="2">Similarities</td><td></td></tr>
<tr><td colspan="2">Any four of:</td><td></td></tr>
<tr><td colspan="2">• both are types of cell/nuclear division
• both start with a diploid cell
• both have same/similar substages or prophase, metaphase, anaphase, telophase
• DNA replication occurs before mitosis/meiosis starts/during interphase or both produce daughter cells with less DNA (i.e. compared to the amount of DNA in the parent cell at the start of mitosis/meiosis)
• sister chromatids separate (to different poles) in mitosis and meiosis II</td><td>1–4</td></tr>
<tr><td colspan="2">Subtotal</td><td>4</td></tr>
<tr><td colspan="2">Differences</td><td></td></tr>
<tr><td colspan="2">Any six of:</td><td></td></tr>
<tr><td>Mitosis</td><td>Meiosis</td><td rowspan="8">1–6</td></tr>
<tr><td>daughter cells identical or type of asexual reproduction</td><td>daughter cells not identical or involved in sexual reproduction</td></tr>
<tr><td>one division</td><td>two divisions</td></tr>
<tr><td>results in two daughter cells</td><td>results in four daughter cells</td></tr>
<tr><td>daughter cells diploid</td><td>daughter cells haploid</td></tr>
<tr><td>produces somatic/general body cells or occurs in somatic/general body cells</td><td>produces gametes/sex cells or occurs in gonads/germ-line cells</td></tr>
<tr><td>homologous chromosomes do not pair</td><td>homologous chromosomes pair (in meiosis I)</td></tr>
<tr><td>no crossing-over and/or independent assortment</td><td>crossing-over and/or independent assortment occur (in meiosis I)</td></tr>
<tr><td colspan="2">Subtotal</td><td>6</td></tr>
<tr><td colspan="2">Total</td><td>10</td></tr>
</table>

Unit 4

Question 38 **(20 marks)**

(a) Describe the impact that the crown gall pathogen has on the host and discuss the best strategy for managing this disease. (10 marks)

Description	Marks
Impact on host	
Any **five** of:	
• causes galls/growths/tumours • (usually) on roots **or** at ground level **or** on roots and stems • (galls/growths/tumours) can prevent the uptake/movement of water **or** nutrients • slows plant growth **or** plants become stunted/unproductive/unhealthy **or** plants can die • *Agrobacterium*/pathogen genes are expressed (in the plant) • some chemicals/hormones cause the galls/growths/tumours **or** changes expression of (some) plant genes	1–5
Subtotal	**5**
Management strategy	
• best strategy is disruption of pathogen life cycle/disease prevention (because there is no cure)	1
Any **four** of:	
• plants should be monitored for signs of disease • affected plants should be destroyed/isolated • soil around affected plants should be removed/heated/treated (because the disease is caused by soil-borne bacterium) • (garden) tools should be disinfected (because the bacterium can be spread via these tools) • treat plants with biological control agent to prevent infection	1–4
Subtotal	**5**
Total	**10**

(b) Explain the physiological challenges that fish, such as salmon, face when living in freshwater and in seawater. How have they overcome these challenges? (10 marks)

Description	Marks
Freshwater	
• salt concentration is higher/hypertonic in fish compared to freshwater **or** lower/hypotonic in freshwater compared to fish • fish tends to gain water and/or lose salt • kidneys produce large volumes of dilute urine to remove excess water • actively gain salt from water through gills • do not drink water	1–5
Subtotal	**5**
Seawater	
• salt concentration is lower/hypotonic in fish compared to seawater **or** higher/hypertonic in seawater compared to fish • fish tends to lose water and/or gain salt • fish drinks seawater to gain water • actively expel excess salt through gills • produce concentrate urine to reduce water loss	1–5
Subtotal	**5**
Total	**10**

Question 39 **(20 marks)**

(a) Explain how halophytes obtain water and exclude and remove salt. (10 marks)

Description	Marks
Obtain water • accumulate salt/NaCl/solutes (proline, glycine betaine) in roots • concentration of salt/NaCl/solutes is higher in roots/root cells than in soil/external environment • water therefore flows from soil/external environment into roots by osmosis **or** water flows from high salt to low salt solution • uptake water during periods when salt concentration in soil/external environment is reduced (and store water for later use)	1–4
Subtotal	**4**
Exclude salt • root cells that impermeable to (some) salts **or** roots that filter salt out of water • accumulate salt in vacuoles/tissues/glands/bladders so salt is excluded from other parts of cell/plant	1–2
Subtotal	**2**
Remove salt • accumulate salt in leaves/tissue • leaves/tissue detach from plant (removing salt) • (salt) glands/bladders that accumulate and then expel salt • root cells actively pump salt into soil	1–4
Subtotal	**4**
Total	**10**

(b) Assess the biological factors that make malaria a difficult disease to control. (10 marks)

Description	Marks
Overall • the lifecycle of the pathogen is complex **or** the lifecycle of the pathogen involves a (mosquito) vector and a (human) host • (therefore) difficult to disrupt life-cycle of pathogen	1–2
Subtotal	**2**
Any **three** of:	
Mosquito/vector • mosquitoes evolve resistance to insecticides/pesticides/chemicals • mosquitoes can breed quickly **or** build up population numbers quickly • mosquitoes can breed in small/inaccessible places **or** often difficult to remove/treat mosquito breeding grounds • mosquito has a wide range **or** range of mosquito is increasing with climate change • Mosquitoes are asymptomatic therefore presence in new areas will not be obvious until host display symptoms	1–3
Subtotal	**3**
Any **three** of:	
Plasmodium/protist/pathogen • plasmodium/protist/pathogen evolve drug resistance or anti-malarial drugs are not always effective • no vaccine/difficult to develop a vaccine • multiple strains of plasmodium/protist/pathogen make it harder to develop vaccine/effective drug • long incubation/pathogen can be dormant/affected individuals can be symptomless • multiple phases/stages that reproduce/increase the number of infectious particles	1–3
Subtotal	**3**
Human factors/host • common in areas with limited healthcare/equipment/resources to buy medicine/supplies to reduce mosquito bites • hard to prevent mosquito bites	1–2
Subtotal	**2**
Total	**10**

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