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

BIOLOGY

ATAR course examination 2023

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.

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

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

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

Question 31 **(19 marks)**

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

Description	Marks
the process by which the body maintains a relatively constant internal environment	1
Total	**1**

(ii) Define the term 'endothermy'. (1 mark)

Description	Marks
Any one of (1 x 1 mark)	
• maintenance of a relatively constant body temperature (independent of the environment) • system of temperature control using internally generated heat	1
Total	**1**

(iii) Indicate **two** classes of organisms that are endotherms. (2 marks)

Description	Marks
Mammalia/Mammals	1
Aves/Birds	1
Total	**2**

(b) List **four** advantages of endothermy. (4 marks)

Description	Marks
Any four of (4 x 1 mark)	
• metabolic reactions are always at optimum temperature • less susceptibility to environmental variation or can occupy a wider range of ecological niches/live in a wider range of environments (compared to ectotherms) • can sustain high levels of activity • can always respond quickly to stimuli • (consistently) higher body temperatures may deter pathogens	1–4
Total	**4**

(c) Consider an ectotherm and an endotherm that weigh the same amount, live in the same environment and eat the same type of food. Indicate which would need more food and justify your answer. (3 marks)

Description	Marks
endotherm	1
endotherms use metabolic reactions to generate heat or converse	1
metabolic reactions require energy (from food)	1
Total	**3**

Question 31 (continued)

(d) (i) Outline how the wrinkles and creases in the skin assist temperature regulation in African elephants. (2 marks)

Description	Marks
Any two of (2 x 1 mark)	
• increases surface area for evaporation • evaporation can occur over a longer period of time or can retain water for some time after bathing • evaporation of water cools elephant or draws heat energy from elephant	1–2
Total	**2**

(ii) Outline how the sparse distribution of hairs assists temperature regulation in African elephants. (2 marks)

Description	Marks
Any two of (2 x 1 mark)	
• increase heat loss (to the environment) • (sparse hairs) provide no/little insulation • warm air is not trapped close to elephant or thick fur/dense hairs would trap warm layer of air next to elephant	1–2
Total	**2**

(e) Explain why drinking salt water is harmful to land mammals, like the African elephant, but not to marine fish. (4 marks)

Description	Marks
fish can actively remove excess salt via gills	1
fish kidneys can also remove a lot of salt/concentrated urine	1
land mammals do not have a mechanism to remove excess salt or kidneys of land mammals can only remove some of the extra salt	1
the extra salt in land mammals disrupts the salt-water balance of blood/body fluids/cells	1
Total	**4**

Question 32 **(21 marks)**

(a) DNA occurs in **three** organelles in plant cells. Identify these organelles. (3 marks)

Description	Marks
nucleus	1
mitochondrion/mitochondria	1
chloroplast	1
Total	**3**

(b) (i) Identify the process by which bacterial cells reproduce. (1 mark)

Description	Marks
binary fission	1
Total	**1**

(ii) List the **four** main steps in the process in part (b)(i) above. (4 marks)

Description	Marks
DNA/chromosome replicates	1
cell elongates or DNA/chromosome copies attach to a different part of cell membrane	1
DNA/chromosome copies move to different end of cell **or** to different poles	1
cell divides or a new cell wall/cell plate is formed	1
Total	**4**

(c) (i) Distinguish between the three different models of DNA replication. (3 marks)

Description	Marks
conservative: one molecule with original DNA and one with newly synthesised DNA	1
semi-conservative: molecules have one strand of original DNA and one strand of newly synthesised DNA	1
dispersive: individual strands contain a mix of original and newly synthesised DNA	1
Total	**3**

(ii) Ultimately one of the models was shown to be correct. Identify the correct model. (1 mark)

Description	Marks
semi-conservative	1
Total	**1**

Question 32 (continued)

(d) Explain why the number of cytosine bases was the same as the number of guanine bases in the DNA molecule but not in the mRNA molecule. (4 marks)

Description	Marks
DNA molecule is double stranded	1
because cytosine/C on one strand pairs with guanine/G on other strand, the number of each of these must be the same	1
mRNA is single stranded	1
can get a different number of C/G bases because there is no base pairing	1
Total	**4**

(e) Explain the reasons for this difference in colouring. (5 marks)

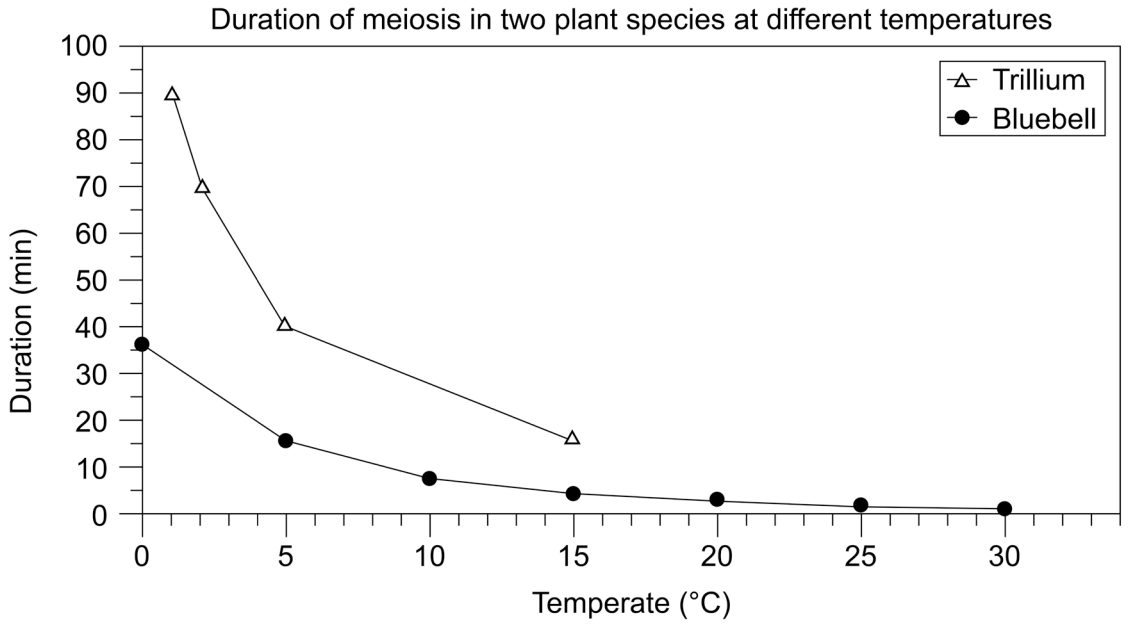
Description	Marks
Any five of (5 x 1 mark)	
• phenotypic expression of genes depends on interactions of genes with the environment or expression of gene that determines Himalayan pattern is temperature dependent • white colour occurs in the absence of black or black covers white colour or gene involved produces black fur • gene/allele/gene product that produces black is only active at low/lower temperatures • extremities are black because temperature is low/lower (hence gene/allele/gene product is active) • body is white because temperature is high/higher (hence gene/allele/gene product is active)	1–5
Total	**5**
Accept other relevant answers that identify that the pattern arises via a temperature dependent enzyme.	

Question 33 **(21 marks)**

(a) Graph the duration of meiosis against environmental temperature for both species. (6 marks)

Description	Marks
Title, must include both variables	1
Data plotted separately for each species, with legend/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**

Sample graph



(b) (i) Using your graph, estimate the duration of meiosis in the common bluebell at 2 °C. (1 mark)

Description	Marks
29 min (accept 28 to 30, must include units)	1
Total	**1**

(ii) Using your graph, estimate the duration of meiosis in red trillium at 20 °C. (1 mark)

Description	Marks
4 min (accept 3 to 5, must include units)	1
Total	**1**

(iii) State which estimate you have the most confidence in. Justify your response. (2 marks)

Description	Marks
29 min or (i) or bluebell	1
interpolation/within the range of data for the bluebell or converse	1
Total	**2**

Question 33 (continued)

(c) (i) List **two** similarities between meiosis and mitosis. (2 marks)

Description	Marks
Any two of (2 x 1 mark)	
• types of cell/nuclear division • have same stages or have prophase, metaphase, anaphase, telophase • DNA replication is not part of the process/occurs beforehand • spindle forms or spindle is used to divide chromosomes	1–2
Total	**2**
Accept other relevant answers.	

(ii) Outline **one** difference between meiosis I and meiosis II. (2 marks)

Description	Marks
Either • independent assortment of homologous chromosomes/homologous chromosomes separate in meiosis I • sister chromatids separate in meiosis II or • meiosis I reduces the number of chromosomes • meiosis II keeps the number of chromosomes the same	1–2
Total	**2**
Accept other relevant answers.	

(d) The haploid number of chromosomes in the Musk ox is 24. Indicate how many chromosomes will occur in a skin cell of a Musk ox. Justify your response. (3 marks)

Description	Marks
48	1
skin cell is diploid or haploid is number of chromosomes in gamete	1
skin cells have 2X haploid number of chromosomes	1
Total	**3**

(e) Most *Banksia* plants have a chromosome number of 2n = 28. Explain how an error in meiosis could generate an individual with 29 chromosomes. (4 marks)

Description	Marks
Any four of (4 x 1 mark)	
• error during random/independent assortment or an error in disjunction or non-disjunction • both members of a homologous pair should move to poles/daughter cells/gametes • both chromatids of a chromosome/sister chromatids should move to different poles/daughter cells/gametes • if both move to the same pole/daughter cell/gamete, then pole/daughter cell/gamete will have an extra/15/n+1 chromosome • gametes with 15 chromosomes fuses with gamete of 14 chromosomes (to give an individual with 29 chromosomes)	1–4
Total	**4**

Question 34 **(19 marks)**

(a) Identify the **four** main groups of organisms that cause infectious diseases. (4 marks)

Description	Marks
bacterium/bacteria	1
protist	1
fungus/fungi	1
virus	1
Total	**4**

(b) State whether polycystic kidney is an infectious disease. Justify your response. (3 marks)

Description	Marks
no/not an infectious disease (must be a clear no)	1
the disease is not caused by a pathogen	1
the disease is not transmitted from one host to another	1
Total	**3**

(c) Define the term 'zoonosis'. (1 mark)

Description	Marks
infectious disease that can be transmitted between vertebrate species	1
Total	**1**

(d) Outline how tuberculosis is transmitted. (2 marks)

Description	Marks
Any two of (2 x 1 mark)	
• airborne or spread through air • pathogen is release into air when infected people breath/cough/speak • (pathogen) is inhaled by new host	1–2
Total	**2**

(e) Explain why antibiotics are used to treat tuberculosis, but not influenza. (4 marks)

Description	Marks
Any four of (4 x 1 mark)	
• tuberculosis is caused by a bacterium • influenza is caused by a virus • antibiotics affect bacteria but not viruses • antibiotics affect cell structures/ribosomes/cell walls/DNA replication that occur in bacteria/that do not occur in viruses • influenza is treated with antiviral medication rather than antibiotics	1–4
Total	**4**

Question 34 (continued)

(f) Explain how these resistant strains have arisen. (5 marks)

Description	Marks
Any five of (5 x 1 mark)	
• natural selection/selection pressure/mutation generates resistance • some bacteria are resistant to antibiotics • these bacteria survive/reproduce or susceptible bacteria do not survive reproduce • number of resistant bacteria increases or frequency of resistant allele increases through time • bacteria have a short generation time, so resistance will evolve over a short period of time • long treatment increases chances people will not complete treatment or fail to complete antibiotic course, increases chances some resistant bacterial cells will survive	1–5
Total	**5**

Question 35 **(20 marks)**

(a) Use the information in the phylogenetic tree to answer the following questions.

(i) Identify the lineages that make up the Marginocephalia. (1 mark)

Description	Marks
Pachycephalosauria and Ceratopia	1
Total	**1**

(ii) Identify the lineage that is most closely related to the Stegosauria. (1 mark)

Description	Marks
Ankylosauria	1
Total	**1**

(iii) State when the Jurassic period started and finished. (1 mark)

Description	Marks
208 to 145 million years ago/MYA (must have units)	1
Total	**1**

(iv) State when the Sauropoda became extinct. (1 mark)

Description	Marks
65 million years ago/MYA or end of Cretaceous	1
Total	**1**

(b) Outline what the phylogenetic tree suggests about the evolution of birds. (2 marks)

Description	Marks
Either • evolved from a type of theropod dinosaur • during the late Jurassic period or about 150 million years ago or • evolve from Maniraptora/shares a common ancestor with Deinonychosauria • during the Early Jurassic period or 175 million years ago	1–2
Total	**2**

(c) State whether the phylogenetic tree on page 22 supports this view. Justify your answer. (2 marks)

Description	Marks
no	1
tree suggests that birds are a type of dinosaur, not separate or tree includes the birds with the dinosaurs	1
Total	**2**

Question 35 (continued)

(d) (i) Outline why vertebrates are relatively common in the fossil record. (2 marks)

Description	Marks
Either • vertebrates have hard parts/bones • these are hard to destroy or are likely to persist long enough to fossilise or • vertebrates evolved recently • less time for fossils to be destroyed	1–2
Total	**2**
Accept other relevant answers.	

(ii) Outline why burrowing organisms are relatively common in the fossil record. (2 marks)

Description	Marks
Either • burrowing organisms live in sediment or are more likely to be buried in sediment • burial in sediment reduces the chances of predators/scavengers destroying the remains or • burrowing organisms live in low oxygen environment • slows down decay by bacteria	1–2
Total	**2**
Accept other relevant answers.	

(e) Explain how comparative embryology provides evidence for evolution. Include a specific example in your answer. (4 marks)

Description	Marks
embryos of different organisms may be similar or show similarities	1
even though the adults may be different or not show the similarities	1
similarities are evidence that the different organisms evolved from a common ancestor or are closely related or converse	1
embryos of all vertebrates have gill slits or embryos have a similar sequence of development or other relevant example	1
Total	**4**

(f) (i) Outline why geographic isolation is important in allopatric speciation. (2 marks)

Description	Marks
prevents gene flow/gene exchange between populations	1
so genetic differences can build over time	1
Total	**2**

(ii) Outline why natural selection is important in allopatric speciation. (2 marks)

Description	Marks
speciation depends on populations evolving genetic differences/reproductive isolation	1
differing selection pressures can cause the evolution of genetic differences/reproductive isolation	1
Total	**2**

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

Unit 3

Question 36 **(20 marks)**

(a) Describe how recombinant DNA technology is used to genetically modify bacteria to digest oil and discuss **two** advantages and **two** disadvantages of using a genetically-modified microorganism for environmental conservation. (10 marks)

Description	Marks
Description of recombinant DNA technology used to genetically modify bacteria: any six of (6 x 1 mark)	
• identify/isolate a suitable gene • must be a gene that produces enzyme that digests oil • choose a suitable bacterium for genetic modification (one that can survive in aquatic environments) • use same restriction enzyme to remove gene from host and insert in plasmid • amplify target gene (in plasmid or by polymerase chain reaction (PCR)) • insert gene into bacteria/target organism • transform bacteria using heat shock or other relevant method • check ability of bacteria to reproduce/produce gene product	1-6
Subtotal	**6**
Advantages of use: any two of (2 x 1 mark)	
• can use genes from other species or can achieve outcomes not possible via natural processes • (after development) easy/fast to produce/supply transgenics in large quantities • microorganisms are easy to transport/handle/store	1–2
Subtotal	**2**
Disadvantages of use: any two of (2 x 1 mark)	
• transgenic organisms could have negative impact on other organisms/the environment or oil-digesting bacteria could take over/displace natural bacteria • gene transfer to other organisms • fairly new technology, may be unknown effects or may not be effective or development can be very expensive	1–2
Subtotal	**2**
Total	**10**

(b) Describe how mutation and genetic drift change the frequency of alleles in a population and explain the significance of these changes. (10 marks)

Description	Marks
Mutation: any two of (2 x 1 mark)	
• permanent change to DNA or change in DNA structure • changes one allele to another or creates new alleles • occurs at random	1–2
Subtotal	**2**
Significance of changes made by mutation: any three of (3 x 1 mark)	
• can have deleterious effects on individuals or can result in the death of individuals or can have neutral, advantageous or disadvantageous effects (depending on the mutation) • limited effect on allele frequencies (because rate of mutation is low) • source of all genetic variation/alleles/biological diversity • other evolutionary processes are dependent on this variation or populations cannot evolve without genetic variation	1–3
Subtotal	**3**
Genetic drift: any two of (2 x 1 mark)	
• random death of individuals or selection of gametes or founder effect • random/chance changes in allele frequencies • has the biggest effect in small populations	1–2
Subtotal	**2**
Significance of changes made by genetic drift: any three of (3 x 1 mark)	
• leads to loss of diversity/alleles or can result in loss of advantageous alleles • places populations at risk of extinction • due to increased inbreeding or inability to adapt or susceptibility to pathogens	1–3
Subtotal	**3**
Total	**10**

Question 37 **(20 marks)**

(a) Explain how the genetic code converts the information in a gene into a specific protein. (10 marks)

Description	Marks
Any 10 of (10 x 1 mark)	
• gene/DNA consists of a sequence of nucleotides • gene/DNA sequence is copied into mRNA • nucleotides are organised into groups of three • three nucleotides are called a codon • each codon codes for a specific amino acid (or stop signal) • some codons code for the same amino acid or there are 64 different codons that specify 21 amino acids • tRNA molecules carry specific amino acids or different tRNA molecules carry different amino acids • tRNA molecules (carrying specific amino acids) bind to mRNA • tRNA molecules bind at a position determined by anticodon/three nucleotides that are complementary to codon in mRNA • different tRNAs bind at different positions on the mRNA • they add their amino acid to protein chain at this position • this determines the sequence of amino acids in a protein • type of protein is determined by sequence of amino acids	1–10
Total	**10**

(b) Explain how DNA profiling and a consideration of population dynamics can help to ensure that the gene pool of the woylies translocated to the sanctuary in the Northern Territory is viable. (10 marks)

Description	Marks
DNA profiling: any three of (3 x 1 mark)	
• estimate relatedness/diversity/genetic background of woylies (before translocation) • translocate unrelated/genetically different individual woylies or converse • to stop inbreeding/ensure gene pool has diversity/range of alleles • identify/do not transfer individual woylies carrying a genetic disease or transfer individuals with adaptations/alleles that will favour survival in new location	1–3
Subtotal	**3**
Population dynamics: any five of (5 x 1 mark)	
• consider number of individuals needed to maintain diversity or stop loss of diversity or ensure individuals can find a mate (in new location) • consider the age of individuals (to be translocated) • need individuals that can survive in the long-term or survive/reproduce • consider birth rate/fecundity of individuals • to ensure enough individual woylies in next generation or population can grow/persist • consider sex ratio • ensure ratio of males and females (to be translocated) will maximise the chances of most/all individuals reproducing/contributing to next generation • consider migration/immigration/emigration • can/will woylies leave the sanctuary (thereby reducing population size) or no possibility that migration/immigration will improve numbers/genetic diversity in new location (because woylie was extinct in NT)	1–5
Subtotal	**5**
Meaning of viability	
gene pool needs diversity to be viable or populations with reduced diversity face an increased risk of extinction	1
large number of woylies/large population size is needed (to avoid genetic drift/loss of diversity)	1
Subtotal	**2**
Total	**10**

Unit 4

Question 38 **(20 marks)**

All animals produce nitrogenous waste, which must be excreted.

(a) Distinguish between how bony fishes and land vertebrates excrete nitrogenous waste. (10 marks)

Description	Marks
Bony fish: any five of (5 x 1 mark)	
• (mainly) excrete ammonia or via gills • ammonia is a by-product of metabolism or ammonia requires no/little energy to produce • it is toxic • fish can continuously excrete ammonia or do not need to store ammonia • because they live surrounded by water or in an aquatic environment • some marine fish excrete urea (due to need to conserve freshwater)	1–5
Subtotal	**5**
Land vertebrates: any five of (5 x 1 mark)	
• excrete either urea or uric acid (depending on vertebrate) or excrete via kidneys • ammonia is converted to urea/uric acid • conversion takes energy • urea/uric acid is less toxic than ammonia (and so can be stored for longer) • urea/uric acid needs less water to expel or reduces water needs or is more suitable for land where water is limited • comparison of uric acid and urea, e.g. excretion of uric acid requires less water than urea or other valid comparison	1–5
Subtotal	**5**
Total	**10**

(b) Discuss the impact that chytridiomycosis has on the host amphibian. (10 marks)

Description	Marks
Any 10 of (10 x 1 mark)	
• disrupts skin function or disrupts breathing/respiration and osmoregulation/water exchange • because pathogen infects/damages skin/outer layer of skin/keratin layer or causes skin lesions/skin discolouration or causes skin to thicken/slough • breathing/respiration is disrupted because amphibians exchange gas or CO_2/O_2 through skin • osmoregulation/water exchange is disrupted because ions are transported across skin or hosts lose ions/sodium/potassium through skin • disrupted ion balance can cause heart failure • neurological effects such as lethargy/loss of balance/abnormal posture/loss of flight response • neurological problems can reduce foraging efficiency or susceptible to predators • often fatal • amphibians susceptible to skin disease because of the importance of skin in maintaining homeostasis • effects vary among individuals of a species or effects vary between species or some species are more susceptible/resistant/tolerant • a lot is unknown about impact/emerging disease/more research required (e.g. why susceptibility varies/pain/cytology of disease) • huge impact on amphibian biodiversity/populations or has caused local extinctions	1–10
Total	**10**

Question 39 **(20 marks)**

Ross River disease is the most significant mosquito-borne disease in Australia.

(a) Discuss the management strategies available for the control of Ross River disease. (10 marks)

Description	Marks
Management strategies to control Ross River disease	
disrupt life cycle of pathogen	1
reduce chance of being bitten by mosquito	1
Subtotal	2
Mosquito control: any three of (3 x 1 mark)	
• control mosquito populations • remove breeding sites or reduce amount of standing water • use insecticide or biological control agent • discussion point – e.g. cannot remove all standing water or health/environmental concerns about applying insecticides or other relevant point	1–3
Subtotal	**3**
Avoid mosquito bites: any three of (3 x 1 mark)	
• alter behaviour to avoid mosquitoes or do not go outside at dawn/dusk/peak mosquito activity • wear protective clothing or use insect repellent when outdoors • use screens on windows/doors or use mosquito nets • discussion point – e.g. will be most effective if used in combination with mosquito control or other relevant point	1–3
Subtotal	**3**
Other (2 x 1 mark)	
• educate people about disease and management strategies • people more likely to support strategies if aware of them/disease	1–2
Subtotal	**2**
Total	**10**

(b) Explain why high salinity in the soil is harmful to many plants and how halophytic plants overcome the problems caused by high salinity. (10 marks)

Description	Marks
Why high salinity is harmful	
normally water enters plants via the roots	1
because concentration of solutes/salts is higher in the roots	1
if concentration of salts is higher in soil, then water will leave the roots	1
plant will dehydrate/dies/increased concentration of salts can be toxic	1
water moves in and out of roots by process of osmosis	1
Subtotal	**5**
How halophytes overcome problem	
secrete excess salt through salt glands	1
concentrate salt in old leaves (which are shed)	1
sequester excess salt in vacuoles	1
tolerate high internal salt concentration	1
keep salt concentration in roots about that in soil (so water will flow in)/ultrafiltration in roots prevents uptake of salt	1
Subtotal	**5**
Total	**10**

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