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

WACE
Western Australian Certificate of Education

BIOLOGY

WACE Sample Examination 2016

Marking Key

Marking keys are an explicit statement about what the examiner expects of candidates when they respond to a question. They are essential to fair assessment because their proper construction underpins reliability and validity.

 2014/10546

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

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

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

Question 31 **(20 marks)**

(a) (i) List the characteristics for which the male parent is heterozygous. (2 marks)

Description	Marks
• Ear shape and eye size	1–2
• Correct phenotype (Rounded ear, large eye)	
Total	**2**

(ii) List the characteristics for which the female parent is homozygous. (2 marks)

Description	Marks
• Ear shape and coat colour	1–2
• Correct phenotype (Pointed ear, light grey coat)	
Total	**2**

(b) Give the probability of an offspring of this pair having pointed ears. Explain your answer, showing your working. (4 marks)

Description	Marks
0.5/50%/$\frac{1}{2}$	1
Correct punnet square or other clear working	1
Genotype of each parent clearly included in working	1–2
Total	**4**

NB: any letters OK for the working **except** X or Y

(c) (i) Describe the phenotype of the male parent for all characteristics. (2 marks)

Description	Marks
All features needed. One mark off for each wrong or omitted feature	1–2
Rounded ear, dark coat, large eyes	
Total	**2**

(i) Describe the phenotype of the female parent for all characteristics. (2 marks)

Description	Marks
All features needed. One mark off for each wrong or omitted feature	1–2
Pointed ear, light coat, large eyes	
Total	**2**

(d) Is it possible that the male parent's mother had a light-grey coat? Explain your answer, showing your working. (4 marks)

Description	Marks
No	1
Clear punnet square or other working	1
Any two of: • His parents must be DD or Dd/homozygous dominant or heterozygous (i.e. with dark coat phenotype) • Must receive D from mother and D from father • Mother would have to be dd to have a light coat	1–2
Total	**4**

(e) What is the probability that the first offspring of this pair is a female with rounded ears and a dark coat? Show your working. (4 marks)

Description	Marks
0.25/25%/$\frac{1}{4}$	1
Clear punnet square or other working	1
Any two of: • Indicate that 0.5 chance of being female • Indicate 0.5 chance of rounded ears • Indicate 1.0 probability of dark coat	1–2
Total	**4**

Question 32 **(20 marks)**

(a) Explain **two** ways in which periods of inactivity help the bat's survival. (2 marks)

Description	Marks
Inactivity means less demand for energy as metabolic rate is lower **and** therefore less demand for food	1
Less temperature difference with the environment **and** therefore a decrease in heat loss to the environment	1
Total	**2**

(b) (i) Explain why these bats, like all other mammals, are considered to be endothermic despite their low resting body temperature while inactive. (2 marks)

Description	Marks
A bat, which is an endothermic mammal, has the ability to control and regulate its internal core temperature at a different level to the ambient temperature. While the body temperature may fall it will be still higher than the environment	1
It changes its metabolic rate as required, such as entering a state of torpor to make heat gain = heat loss and therefore conserving energy production	1
Total	**2**

(ii) Why are bats **not** considered to be ectothermic? (2 marks)

Description	Marks
An ectotherm is an organism which follows or mimics that of the ambient temperature	1
Its metabolic rate is determined by energy gained from the environment/Bats are able to raise their body temperature by muscle activity	1
Total	**2**

(c) In some species of bats, period of inactivity can last for several months. During a period of inactivity, they must waken occasionally to drink water and urinate. Reptiles in the same environment do not wake at all. Explain how differences in the excretion of nitrogenous waste between mammals and reptiles might help to account for these observations. (4 marks)

Description	Marks
Mammals produce urea as their nitrogenous waste	1
Urea is slightly toxic and requires some water to remove this from the body.	1
The reptile produces uric acid as a nitrogenous waste product	1
Uric acid is very low in toxicity and does not require water for removal	1
Total	**4**

(d) While they are inactive and beginning to warm up, the bats' wings are folded against their bodies. Explain **two** reasons why this is an advantage for the bats. (4 marks)

Description	Marks
The surface area exposed to the environment is reduced	1–2
Heat loss via conduction and radiation is reduced	
A layer of air is trapped between the body and the wings	1–2
Air acts as an insulation layer reducing the heat loss to the environment	
Total	**4**

(e) During awakening, the bats' metabolic rates increase to above normal levels. In terms of the stimulus response feedback model of temperature regulation, explain why their body temperature does **not** rise above normal levels. (4 marks)

Description	Marks
The receptors in the body detect this rise in core temperature	1
This message is passed to modulator which determines the response and sends a signal to the effectors to bring about the response	1
Blood vessels at the skin surface vasodilate to increase heat loss and heat production by internal organs decrease	1
This is the negative feedback where the response alters the stimulus by reducing body temperature	1
Total	**4**

Question 33 **(20 marks)**

(a) (i) Name the organism that causes this disease. (1 mark)

Description	Mark
Phytophthora cinnamomi	1
Total	**1**

(ii) Describe how this organism is transmitted naturally through an ecosystem. (1 mark)

Description	Mark
This organism is transmitted by spores through soil and water	1
Total	**1**

(iii) List **two** ways in which humans transmit this organism into ecosystems. (2 marks)

Description	Mark
On the bottom of shoes	1
On tyres of vehicles and machinery	1
Total	**2**

(b) (i) Describe how plants that are located in a jarrah dieback area are treated to assist their survival. (2 marks)

Description	Mark
Sprayed or injected	1
Use Phosphite (phosphonate)	1
Total	**2**

(ii) Name and describe **two** human management practices that are carried out to prevent the spread of jarrah dieback. (4 marks)

Description	Mark
One for naming and one for description of any two:	1–2
Hygienic practices: • Removing soil from shoes and vehicles	
Prevent relocation of soil: • Soil from infected areas may carry the disease and so it should be left in that area and not transported to non-infected areas.	1–2
Controlling access: • Areas that have not been infected in National parks become restricted in terms of access to prevent infection	1-2
Drainage: • Developing better drainage to prevent moisture build up in the soil	1–2
Total	**4**

(c) Using the graph, explain the effect of rainfall on jarrah dieback in the Dandaragan woodlands. (3 marks)

Description	Mark
Phytophthora cinnamomi requires a moist environment to grow and gain access to other plants	1
As the rainfall decreases the soil becomes drier	1
The pathogenic agent is less likely to survive due to its requirement for moisture and infection numbers decrease	1
Total	**3**

(d) (i) Name the organism that causes this infection. (1 mark)

Description	Mark
Various bacteria of the genus *Agrobacterium*	1
Total	**1**

(i) Describe how this organism is different from the type of organism that causes jarrah dieback. (2 marks)

Description	Mark
Any two of:	1–2
• Jarrah dieback is caused by a protist • Crown gall is a bacteria • Crown gall does not have a defined nucleus or membrane bound organelles	
Total	**2**

(e) Explain the method used by this pathogen to invade the host plant and the impact of the pathogen on the plant. (4 marks)

Description	Mark
Agrobacterium tumefaciens enters the plant through a break in the tissues	1
Once inside the bacteria will multiply into the intercellular spaces.	1
This growth produces a large amount of auxins; which further stimulate abnormal cell growth	1
This becomes a tumour which provides a large amount of nutrients for the bacteria but limits normal cell growth	1
Total	**4**

Question 34 **(20 marks)**

(a) Describe each of these processes and explain briefly how they produce genetic variation.

Crossing over

Description	Marks
Involves exchange of DNA segments/alleles/sections of chromatid between homologous chromosomes	1
Each chromosome can be a blend of maternal and paternal DNA/creates new combinations of alleles	1
Total	**2**

Independent assortment

Description	Marks
Any one of: • Random combinations of maternal and paternal chromosomes • Chromosomes align randomly • Independently on each side of equator	1
Produces a very large range of variation in gametes	1
Total	**2**

(b) Humans have used artificial selection (selective breeding) to modify the characteristics of plants and animals for many years. Outline how artificial selection can be used to increase drought resistance in rice. (4 marks)

Description	Marks
Any four of: • Genetic variation exists in rice population • Expose rice to drier conditions • Select/breed with those that survive the longest • Their favourable genes are passed to the next generation • Repeat the process for several generations to produce drought tolerant strain	1–4
Total	**4**

(c) Humans are now using recombinant DNA technology to modify the characteristics of plants and animals. Outline how recombinant DNA technology can be used to increase drought resistance in rice. (4 marks)

Description	Marks
Any four of: • Identify drought tolerant genes in other species • Genes are extracted • These genes are cloned in bacteria • Insert drought tolerant genes into the chromosomes of rice plants	1–4
Total	**4**

(d) Describe **two** advantages and **two** disadvantages of using recombinant DNA technology to modify the characteristics of plants and animals. (4 marks)

Description	Marks
Any two advantages: • Much faster result/artificial selection may take decades/centuries/don't have to wait for natural mutations to occur • Allows the retention of other desirable characteristics of the best varieties of the species • Able to use the best genes available/genes from other species- not just the best in the species	1–2
Any two disadvantages: • May become a weed due to success in dry conditions • May upset natural food webs by suddenly becoming a food source for native animals • May crossbreed with nearby non-recombinant crops/related native species to contaminate them • Complicated/specialised process/expensive • Not always successful • Effects/consequences not fully understood/ethical issues/ allergic reactions	1–2
Total	**4**

(e) (i) On the basis of the information contained in the phylogenetic tree, is Asian rice related more closely to *O. australiensis* or *O. officinalis*? Explain your answer. (2 marks)

Description	Marks
O. officinalis	1
The *O. officinalis* branch is closer to *O. sativa* than the *O. australiensis* branch/ share a more recent common ancestor	1
Total	**2**

(ii) Some scientists have argued that *Portensia coarctata* should be regarded as a member of the *Oryza* rather than as a separate genus. Does the phylogenetic tree support this argument? Explain your answer. (2 marks)

Description	Marks
Yes/Supports the argument	1
The *Portensia* branch is in the middle of a number of *Oryza* branches instead of outside them.	1
Total	**2**

Question 35 **(20 marks)**

(a) Propose a hypothesis for this investigation. (2 marks)

Description	Marks
Correct variables matched eg independent variable (amount of food / type of barramundi) with dependent variable (increase in mass / growth)	1
Written in the form of a hypothesis	1
Total	**2**

(b) (i) State the independent variable. (1 mark)

Description	Marks
Amount of fish food/type of fish	1
Total	**1**

(ii) State the dependent variable. (1 mark)

Description	Marks
Mass of fish Note: Per cent increase in weight not permitted as not measured but calculated	1
Total	**1**

(iii) Apart from those mentioned above, name **two** variables that would need to be controlled to ensure the experiment was reliable (2 marks)

Description	Marks
Any two of: • Type of feed • Water temperature • Stock levels • Currents	1–2
Total	**2**

(c) (i) What conclusion could be drawn from the data? (2 marks)

Description	Marks
At low levels of feed barramundi gain mass more efficiently	1
At higher levels there is no difference	1
Total	**2**

(ii) Explain whether the sample size was appropriate for this investigation. (2 marks)

Description	Marks
Large sample size	1
Yes as it is large enough to overcome individual variation and outliers can be removed from the data	1
Total	**2**

(d) Explain **two** ways in which the data collected in this investigation could be made more reliable. (4 marks)

Description	Marks
Replication	1
Conduct multiple trials using the same sea cages	1
Increase the sample size	1
Have more cages or more fish in each cage	1
Total	**4**

(e) What was the percentage change in the mass of the fish in Sea Cage C? Show your workings clearly. (2 marks)

Description	Marks
Working – note there are a number of ways of mathematically calculating the answer. Students working should demonstrate that the answer has been determined mathematically. eg Cage C Before 1.65 After 2.20 ((2.2-1.65)/1.65) × 100	1
33% increase	1
Total	**2**

(f) The Port Stephens barramundi stock showed an average increase in mass when fed 10 grams/fish/day in the Kimberley, but lost mass in the Port Stephens trials. Explain **two** possible reasons for this difference. (4 marks)

Description	Marks
Any two well explained – explanation must give a reason why the factor chosen could have influenced the difference in mass gain/loss	1–4
• Biological variation/Genetic differences – In a sample size of 100, by chance there may not have been an even spread of genetic diversity	
• Differences in food quality – there may have been differences in the nutrient concentration in the pellets, some may have contained more or less protein/carbohydrate	
• Water temperature – the colder water could result in a lower metabolic rate and therefore a slower growth rate	
• Metabolic rate – due to the warmer water they their metabolic rate was higher and this enabled them to grow faster	
• Oxygen availability – colder water has a higher oxygen concentration and this would affect metabolism and growth rate	
• Presence of pathogens in water – pathogens or parasites in the water of one area may differ to those in another and effect the fishes health and therefore growth rate	
• Change in salinity concentration – differences in salinity concentration may affect osmotic balance and fluid levels within the fish	
Total	**4**

End of Section Two

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

Part A

Question 36 **(20 marks)**

(a) Describe the process that could lead to a few initial super weeds potentially becoming the dominant type of weed in the wheatbelt. (10 marks)

Description	Marks
Variation • In any population due to mutations and or sexual reproduction there is genetic variation. • Variation has been introduced by the introduction of a herbicide resistant gene.	1
Overpopulation • In most populations the number of individuals exceeds the capacity of the environment to support them. • Not all individuals can survive. • The phenotype that provides the best chance of surviving will become more predominant in the population.	1–2
Selection pressure • If a factor in the natural environment is altered so that one phenotype is favoured over another. • Selection pressure is the use of the herbicide.	1–2
Competition • Individuals with characteristics best suited to the 'new' environment will survive eg survival of the fittest. • The ‘super weeds’ will not be killed by the herbicide.	1–2
Reproduction • Those individuals that survive will reproduce. • They will pass the alleles (genotype) responsible for the advantageous phenotype onto their offspring. • The ‘super weeds’ will increase in number. • Non-resistant weeds would have been killed.	1–2
Gradual change • Over a number of generations the favourable alleles/genotype/ phenotype will become more predominant in the population. • Less favourable alleles genotypes/phenotypes will become less predominant. • The ‘super weeds’ will become the dominant population of weeds.	1
Total	**10**

(b) Explain the consequences of the establishment of super weeds for organisms living in the natural ecosystem. (10 marks)

Description	Marks
Competition • competition with native plants • competition for space/ light/ nutrients/ water • super weeds occupy a niche similar to herbaceous plants • native herbaceous plants are flowering plants	1–2
Food source • native mammals may lose their food source • super weeds may encourage other animal species • feral species may be favoured	1–2
Loss of small animals • loss of shelter for small animals/microhabitats disturbed • smaller organisms (insects, soil organisms)that provide food for higher order consumers may no longer be there • single species encourage pests (locusts/disease)	1–2
Pollination • grasses are wind pollinated • less flowering plants for specialised insects	1–2
Biodiversity • super weeds replace a variety of native herbaceous plants • loss of biodiversity ensues	1–2
Total	**10**

Question 37 **(20 marks)**

(a) Explain the processes which could be performed on the hair sample to determine whether an animal would be genetically useful. (10 marks)

Description	Marks
Extraction/Isolation of DNA • Separate suitable cells from hair samples • Break the cells open / lysis - physcial • Remove membrane lipids - detergent or surfactants • Purify DNA – precipitation by alcohol	1–3
DNA profiling using PCR • Targets microalleles/STR – noncoding units of DNA • STR – number of repeats varying between individuals • Specific primers are produced from adjacent regions of STR • Primers are used to make large quantities of the STR and adjacent region	1–3
DNA identification (probes/chips) • Different dyes are used for different DNA segments • During PCR, fluorescent dyes are attached to PCR	1–2
Gel electrophoresis • Fragments of DNA are separated by size • Negative DNA travels towards positive terminal • Shorter fragments travel faster/further than longer ones • Banding pattern used to compare individuals	1–2
Total	**10**

(b) Explain the characteristics of a viable population and the role of biogeography, reproductive behaviour and population dynamics in maintaining a viable gene population in an artificially-selected area. (10 marks)

Description	Marks
Characteristics of a viable population • range of genetic diversity/alleles • large enough numbers of breeding individuals to cope with random genetic drift • appropriate number of males and females	1–2
Biogeography (role in maintaining a viable gene population in an artificially selected area) • definition–presence, absence and distribution of organisms in an area • solitary or herd/group affects the size of the territory required, or reproductive success • size of the territory–minimum habitat required for general group size	1–2
Reproductive behaviour (role in maintaining a viable gene population in an artificially selected area) • includes all the events and actions that are directly involved in the process by which an organism generates at least one replacement of itself • small population size –inbreeding reduces genetic variation • breeding season optimises survival of offspring • mate selection/polygamy versus monogamy affects genetic diversity • visual, auditory and/or olfactory clues increases efficiency of two individuals finding each other • courtship reduces hostility between partners/selection of partners with advantageous characteristics • degree of parental care affects survival of offspring to maturity	1–3
Population dynamics (role in maintaining a viable gene population in an artificially selected area) • definition–study of changes in population size, density and dispersal • availability of prey/abundance of food • abundance of predators/predator control • exposure to disease • competition with other species/occupying the same niche • variation in the physical parameters of the environment –dispersal • consideration of territories/home ranges for population size • expected population growth–carrying capacity of the area	1–3
Total	**10**

PART B

Question 38 **(20 marks)**

(a) Describe malaria and Ross River fever with reference to the type of organism that causes the disease, the intermediate host, mode of transmission and impact on the host.

(10 marks)

Description			**Marks**
	Malaria	Ross River Fever	
Pathogenic organism	protist	virus	1–2
Intermediate host	humans	possums, bandicoots	1–2
Mode of transmission	bitten by mosquito	bitten by mosquito	1–2
Impact on host	• fever, which may come and go, or may be constant • chills • profuse sweating • feeling unwell • muscle and joint pain • headache, confusion • nausea, loss of appetite, diarrhoea • abdominal pain • cough	• fever • chills • muscle aches • rash • fatigue • aching tendons • swollen lymph nodes. • headache, especially behind the eyes • joint pain, swelling and stiffness	1–4
		Total	**10**

(b) Explain this statement with reference to changes in the spread of these infectious diseases. (10 marks)

Description	Marks
Mosquitoes are the vectors for both these diseases Since mosquito-borne diseases are weather sensitive, and are located more in tropical regions If the temperature and rainfall patterns change these diseases will move into new areas.	1–2
Geographic and Temporal Distribution: By moving into new areas the mosquito vector will come in contact with populations that have not been exposed to the disease. Also with changes in lengths of seasons the mosquitos will exist for a longer period of time in the ecosystem.	1–2
Population Density: With the change in temperature and longer warmer periods the mosquito could increase in density. This could be due to changes in the life cycle for example shorter larval stages, or increase in length of adult life span due to increase in humidity.	1–2
Prevalence of Infection by Zoonotic Pathogens: As more humans become infected there will be an increase in the zoonotic pathogen which means increased chance of the mosquito to come in contact with the pathogen when biting humans.	1–2
Pathogen Load: With the possible climate changes the pathogen may increase its rate of reproduction, replication, and development in the mosquito. The temperature rise can also result in faster maturation rates . Overall this will increase the efficiency of transmission.	1
When considering the disease and increased temperatures in areas the overall result could be increased epidemics and possible long term changes in the disease trends. It is important to also consider that human activities and Socioeconomic factors will impact the disease and either encourage or interrupt the lifecycle.	1
Total	**10**

Question 39 **(20 marks)**

(a) Explain **five** features that plants adapted to this environment may possess. (10 marks)

Description	Marks
Any five of the following:	1–2
• Reduced leaf surface area: Reduces the area of transpiration therefore reduce water loss	
• Extensive shallow root system Allows for maximum water absorption when it rains	1–2
• Sunken stomata: Prevents water loss by increasing the relative humidity in the vicinity of each stoma. Creates a micro climate	1–2
• The hypodermis: Composed of thick-walled cells that are compactly arranged beneath the epidermal layer These cells hinder the passage of water into the epidermal layer	1–2
• Thick waxy cuticle: The composition of this layer prevents water loss from the plant while still allowing the transmission of light It is also shiny which reflects light and reduces heat	1–2
• Leaf rolled with stomata inside: The inner surface is covered in hairs The rolled leaf and hairs both serve to trap moist air so reducing transpiration, creating a humid micro climate In addition, a smaller surface area of leaf is exposed to the drying effects of the wind	1–2
Total	**10**

(b) Describe the problems these vertebrates face in maintaining water balance and how they overcome these problems in each water environment. (10 marks)

Description	Marks
Freshwater problems • lower salt concentration/higher water concentration in surroundings than cells • surroundings hypotonic to cells/cells hypertonic to surroundings • osmosis occurs • water movement into cells/fish	1–2
Marine problems • higher salt concentration/lower water concentration in cells than in surroundings • surroundings hypertonic to cells/cells hypotonic to surroundings • osmosis occurs • water movement out of cells/fish	1–2
Adaptations – freshwater • large amounts/dilute urine/high filtration rate in kidneys/large number of glomeruli (fish) • selective reabsorption of salts/ions in kidneys by active transport • active uptake of salts through the gills of fish • cells can also maintain osmotic balance by actively pumping ions/salts into the cells • preventing water entering the cells so the water only enters the blood and is then excreted • scales/mucus layer to reduce surface area exposed to water	1–3
Adaptations – marine • drinking sea water • secretory cells in the gut of fish actively absorb salts and transfer them to the blood • salts are actively excreted by special glands/chloride secretory glands in the gills • small amounts/highly concentrated urine/slow filtration rate in kidneys/small number of glomeruli (fish) • excretory products used which require less water to remove (e.g. trimethaylamine instead of ammonia) • retaining a higher level of urea in body (cartilaginous fish) • survive on metabolic water by highly efficient reabsorbtion of water from the rectum (mammals)	1–3
Total	**10**

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