NSW INDEPENDENT TRIAL EXAMS – 2003

BIOLOGY - SUGGESTED ANSWERS

SECTION I - PART A

1	B	2	B	3	A	4	D	5	B	6	A	7	C	8	D
9	B	10	D	11	D	12	D	13	A	14	B	15	C		

SECTION I - PART B

16. (a) Only those exposed to stresses in the environment are likely to develop the illness **1**
    (b) e.g. PKU and phenylalanine or alcoholism etc **2**

17. (a) Hibernation, inactivity, bury themselves to escape the cold and snow. **1**
    This response assists the animal to maintain a temperature above the freezing point. **1**
    (b) Name an animal, must be an endotherm (no marks)
    (Each response 1 mark) eg: Kangaroo. Seeks shade in cave, under tree etc. stops activity/rests, licks wrists, etc. **2**

18. (a) Recessive. There are individuals in F1 who lack the trait **2**
    (b) To track the inheritance of unfavourable (or favourable) characteristics so that they can be bred in OR out of the progeny. **2**

19. **4**

Criteria	Marks
▪ (a) Identifies example of defence barrier and describes the effect on pathogen	2
▪ Any one of above	1
▪ (b) Example of the action of B lymphocytes and one similarity or difference between this action and how the barrier works.	2
▪ Any one of above	1

Answer could include:
(a) Saliva, nasal secretions and tears produced by mucous membranes contain the chemical lysozyme, which breaks down bacterial cell walls and so inhibits this kind of pathogen. Defence adaptations such as above are barriers to the entry of pathogens.
(b) Production of antibodies by B-lymphocytes is a specific response to pathogens, which have breached these barriers.

20. **7**

Criteria	Marks
(a) - three steps	3
- two steps	2
- one step	1
(b) Independent and dependent variables identified	2
One variable	1
(c) One safety risk identified	1
(d) One matched safe work practice identified	1

Answers could include:
(a) 1. Prepare sterile Petri dishes containing nutrient medium.
2. Using aseptic techniques inoculate the plate with a food or water sample.
3. Incubate at around 30ºC
4. Observe for evidence of microbial growth.
(b) Independent variable - the food or water sample used to inoculate the plate.
Dependent variable – microbial growth
(c) example: infection by a human pathogen grown on the nutrient medium.
(d) once inoculated seal labelled plates and do not open again.

21. (a) Long intervals in which nothing changes ("equilibrium"), "punctuated" by short, revolutionary transitions, in which species became extinct and replaced by wholly new forms. **2**
    (b) Darwin- long, (gradual) process over millions of years compared to part (a) **2**

22. **4**

Criteria	Marks
▪ Identifies the nature of antibiotics. Describes the function of antibiotics in bacterial disease prevention and control, or diseases against which they are ineffective. Makes a judgement about the effectiveness of antibiotics.	4
▪ Identification and brief description and judgement	3
▪ Any two of above	2
▪ Any one of above	1

Answers could include:
Antibiotics are chemicals that destroy bacteria by damaging the cell wall. They are very effective in treating bacterial diseases reducing the number of people with symptoms and so reducing transmission. Antibiotics are ineffective against other forms of infectious and all non-infectious diseases. Despite understanding their specific nature, antibiotics have been widely overused producing many resistant strains of bacteria. Antibiotics are very effective against specific diseases but overuse has, and continues to reduce effectiveness.

23. 4

Arteries	Veins
Have thick muscular walls	Walls are thinner than the arteries walls
Have no valves	Have valves that prevent blood flowing backwards

Note: 1 mark for table.1 mark for each comparison thick/thin walls, valves/no valves.
NO marks given for function eg: carry blood towards the heart, carry oxygenated blood etc.

24 (a) Transpiration pull. As water evaporates from the leaves, cohesive forces tend to pull water molecules upwards. Capillarity also helps. Root pressure. The force of water moving into the roots tends to force the water upwards in front of it. 2

(b) Pressure flow mechanism where sugars move from an area of high concentration in the leaves to an area of lower concentration in other parts of the plant. 2

25. (a) Name the species of plant or animal.
Identify issues and provide points for and against
Points should relate to the fact that genetically altered organisms are very similar and mass-produced thereby reducing the genetic diversity. 2
This could have major implications for viability of the species and lack of hybrid vigour. 2

(b) This reduction in genetic variability reduces the evolutionary "fitness" of a species since diversity is necessary for natural selection to operate. 2

26. *Reduction in leaf size, eg. Needle shaped leaves. 1 mk each – any three3
*Shiny surface on leaf. eg. Hakea leaves have a thick waxy cuticle.
*Aspect of leaves. eg. Eucalyptus leaves hang down.
*Fewer stomates. eg. many Australian plant species have few stomates on their upper surface.
*Leaves roll up during dry conditions. eg. Spinifex grass will roll its leaves during draught.
*Having hairy leaves.
*Any other description of structural, physiological or behavioural adaptation to control loss of water.

27. Temperature affects the rate of enzyme activity. High temps cause the enzyme to denature and activity slows or stops. Low temps also slow down enzyme activity. 2

28. Gametes result from meiotic cell division.(give explanation) 2
This results in variability in the sex cells 1
Sexual reproduction results from the union of two haploid cells (give explanation) 2
therefore resulting in further variation 1

29. Name the disease. No marks
Occurrence-prevalence in sex, age group socio-economic background race etc 1
Symptoms- give at least two 1
Cause- outline the main cause of the disease 1
Treatment and management- both for the individual and the community eg: education/lifestyle changes 2

SECTION II - OPTIONS

Q.30 – Communication

(a) Outcomes assessed: H14 Bands 3-4

	Criteria	Marks
(i)	retina	1
(ii)	▪ ONE DIFFERENCE between the two locations, with the distinction (specific details) CLEARLY OUTLINED ▪ ONE SIMILARITY AND ONE DIFFERENCE listed (where difference listed DOES OR DOES NOT give any detail pertaining to the two locations)	2
	▪ Identifies ONE SIMILARITY between both locations. ▪ Makes simple statement of ONE DIFFERENCE without giving any detail.	1
	<u>Similarities</u>: Both locations contain receptor cells that respond to light as stimulus. Three different kinds of cones - red, green & blue – at each location. <u>Differences</u>: Location 1 - both rods AND cones as receptor cells present; many rods and cones connect to one optic nerve cell. Location 2 (fovea) – receptor cells are 100% cones; each cone cell connects to one nerve cell.	
(iii)	ANY TWO structures named and a correct function given (1 mark each) Some examples are: Conjunctiva – protects front part of eye Cornea – transparent window; acts as refractive medium Iris – control amount of light entering eye, etc.	2

(b) Outcome assessed: H13, H14 Band 4

	Criteria	Marks
(i)	Clearly defines both terms & gives clear explanation of mechanism by which refractive power of lens is increased.	3
	Defines BOTH terms adequately BUT fails to give adequate explanation of how refractive power of lens is increased <u>OR</u> only gives adequate definition for ONE term along with suitable explanation of how refractive power of lens is increased	2
	Defines only ONE TERM adequately OR only gives suitable explanation of how the lens' refractive power is increased. **<u>sample answer</u>**: "Refraction" – bending of light as it passes obliquely from a medium of one refractive index into a medium of different refractive index. "Accommodation" – focusing on objects at different distances by altering the refractive power of the lens to ensure that rays of light coming from the object are focused on the retina. During accommodation the refractive power of the lens is increased by the ciliary muscles contracting and tightening inwards, causing the lens to bulge thus resulting in an increase in curvature of the lens and greater refraction of light.	1

(b) continued

	Criteria	Marks
(ii)	Correctly identifies that myopia involves the ability to focus on near, but not far, objects; correctly identifies that hyperopia involves ability to focus on far, but not near, objects AND correctly identifies type of lens needed to correct these defects (diverging for myopia and converging lens for hyperopia) OR identifies advanced optical techniques such as contact lenses and radial keratotomy	3
	Only TWO of the above adequately explained	2
	Just ONE term OR one correction technique adequately explained.	1

(c) Outcomes assessed: H13, H14 Bands 4-5

	Criteria	Marks
(i)	Naming correct and relevant structural detail pertaining to EACH organ Relating structural detail to production or detection of sounds. **Larynx:** ▪ Vocal folds (chords) on either side which vibrate as air moving up from trachea passes over them thus creating sound. ▪ Associated structures such as cheeks, nasal passages and lips shape sound **Organ of Corti:** ▪ Oval & round windows for introduction and release of pressure ▪ Basilar membrane narrowest & stiffest at base and widest & most flexible at apex. ▪ outer hair cell length on basilar membrane varies along its length with shortest hair cells near base detecting highest frequency sounds & longest hair cells near apex detecting the lowest frequency sounds.	4 (1 for each correct)
(ii)	Speech – (A) (Broca's Area): outgoing; (B) (Wernicke's Area): incoming	1
(iii)	Hearing – part VI Vision – part V	1 1

(d) Outcomes assessed: H12, H14 Band 6

	Criteria	Marks
	▪ Discusses at least TWO different methods of communication employed by animals ▪ Outlining different ways in which the same type of communication signal eg. sound or colour , can be either produced or utilised by different animals ▪ Outlining how different animals use different methods of detecting a communication signal such as sound, or light. ▪ Using quantitative measures to provide a clear explanation of at least one difference in the capabilities of organisms to transmit/detect information using different intensities or frequencies of energy ▪ Explaining clearly what a "threshold level" for a signal refers to ▪ Identifying that an "action potential" is an electrochemical change in the membrane of a neurone. ▪ Explaining why some stimuli do not generate an action potential (insufficient energy to cause depolarisation of nerve cell)	7 (1 for each correct)

Q.30 (d) continued - Sample answer

Components of a good answer will include discussion of some of the following:

Signal Types Electromagnetic radiation (particularly light); sound; chemicals; touch; pressure

Signal Production Stridulation; vocal folds; resonance chambers; air sacs in head of dolphins; bioluminescence; etc.

Signal detection Ear (particularly ear drum & organ of Corti); Tympanic organs; Lower jaw of cetaceans; Lateral line system of fish; Eye (retina); Ocelli , Compound eyes of insects; electroreception

Social signals conveyed by colour in animals with colour vision

Hearing ranges and threshold frequencies of sounds for different animals or wavelengths ranges in visible light region that organisms are most sensitive to.

Q.31 BIOTECHNOLOGY

Outcomes assessed: H1, H3, H7,

(a)

	Criteria	Marks
(i)	Correct statement about the use of vectors to add new genes to nuclear DNA	1
(ii)	Explanation that microinjection is using a micropipette to inject DNA into nuclear DNA	1
(iii)	Explanation of a named vector (such as a bacterium or virus) containing recombinant DNA being used with a named transgenic organism	3
	An explanation that includes only two of the above components	2
	Naming the sort of organism that can be used as a vector	1

(b)

	Criteria	Marks
(i)	Naming the material used, describing the removal of proteins, removing starch and extracting DNA from the ethanol/ DNA interface	4
	Any 3 of the above 4 stages	3
	Any two of the above stages	2
	Minimal understanding of the process	1
(ii)	Good explanation of such things as the opposition to 'interfering with nature', concerns about genes getting into related species and opposition to interfering with the human germ line	2
	Weak explanation	1

Q.31 continued

(c)

	Criteria	Marks
(i)	Names a species that has been changed as the result of long term breeding practices. Description of the original organism, some intermediate stages and the present day organism, including the features that have been selected for.	4
	Explanation including two of the above factors	3
	Explanation of the change from the original organism to the present day one.	2
	Weak understanding of the effects of controlled breeding	1
(ii)	Description of one Aust. aboriginal use of biotechnology	1
(iii)	Definition of biotechnology and an explanation of how this applies to animal breeding practices	2
	Weak explanation	1

(d)

	Criteria	Marks
	Refers to early biotechnology, indicates important steps in the history of biotechnology including the technology used to increase the understanding of microorganisms and genetics and shows how these steps have led to present day applications	7-6
	As above but with less detailed explanation of the development of understanding of microorganisms and genetics	5-4
	Weak explanation of changes in technological and scientific knowledge	3-2
	Some indication of changing complexity in biotechnology	1

Q.32 – Genetics: The Code Broken

(a) Outcome assessed: H4, H13

	Criteria	Marks
(i)	Multiple allelic characteristics occur because more than two alleles exist at the same locus in a population but only two are present in each individual. The fur colour of rabbits, full colour (C^+) is dominant to chinchilla (C^{ch}), chinchilla is dominant to Himalayan albinism (C^h), Himalayan is dominant to albino (c). If a rabbit has a genotype of C^+C^{ch}, it will still have full colour	1
(ii)	The male has genotype I_Ai, the female has genotype I_Bi. The genes segregate during gamete formation. On fertilization of I_A with I_B, blood group AB results, I_A with i, group A results, i with I_B, group B results, i with i, group O results.	2
(iii)	ABO blood grouping involves three alleles, namely I_A, I_B and i. The Rh system contains at least eight different genes involved but only three dominant genes – C, D and E. The gene that cause problems in blood transfusions is D; the homozygous dominant DD and the heterozygous Dd both produce individuals who are Rh positive, whereas the double recessive dd produces those who are Rh negative. The inheritance of both ABO system and Rh system still follow the Mendelian inheritance.	2

(b) Outcomes assessed: H4, H5, H6, H11, H13

	Criteria	Marks
(i)	Use radioactive probes to carry out DNA hybridization Perform autoradiography to produce photographic film that can be compared	4
(ii)	▪ As each person has a unique pattern of nucleotide bases in the intron or non-coding area. DNA can be used in paternity investigations to prove family relationships as close family members have very similar intron sequences, for example a child has the same number of short tandem repeats as either the mother or father at each of the sites tested. ▪ However the DNA of identical twins are the same. This technology cannot be use to find out which one of the two brothers are the father of a child ▪ Furthermore, there are ethical issues concerning the collection and storage of DNA information in databases due to problems of privacy and misuse of the personal information.	2

(c) Outcomes assessed: H4, H7, H11, H12, H13, H14

	Criteria	Marks
(i)	▪ The development of parts of the body, such as the arms and legs is not controlled by a single gene. Many genes must be switched on or off in the appropriate sequence to form muscles, blood vessels, nerves and various tissues in the correct arrangement of the limb. ▪ During limb development from limb buds, a sequence of genesis isturned on, one after the other. As each gene is turned on substances that turn on the next gene are produced. The molecules affecting the sequence may be produced in nearby cells or within the same cell. ▪ The process is repeated as a series of genes are turned on one after the other. This process of genes being switched on in turn, where the action of each gene causes the next gene to be turned on is called a gene cascade. ▪ The developmental genes that control the anterior to posterior regions are called the homeobox genes and they control development from just behind the brain to the tail. Homeobox genes are located on one chromosome in Drosophila. Homeobox genes are numbered 1 to 9. Hox-1 specifies the anterior region and Hox-9 specifies the posterior region. Hox-1 is expressed before Hox-2. Hox-2 is expressed before Hox-3 and so on	4
(ii)	Recent studies have uncovered DNA sequences that are similar in many organisms. The similar DNA sequences are called homologue genes or homeotic genes. Similar homologue genes have been found in every eucaryote studied including : invertebrates (e.g. Drosophila), vertebrates (eg chickens and humans), yeasts and plant. This suggests a common ancestry of all eucaryotic organisms. It seems that the formation of limbs in organisms as different as flies, mice, chickens and humans is controlled by a similar gene.	1

(c) continued

	Criteria	Marks
(iii)	DNA sequencing has indicated a stepwise evolutionary change in the DNA sequence of some genes, eg the genes coding for haemoglobin proteins. Studies of DNA sequences indicate that a series of changes to the DNA sequences that code for globin proteins has produced the variety of haemoglobin present in humans today. These studies suggest an evolutionary sequence for the origin of different globin genes.	2

(d)

	Criteria	Marks
	In July 5, 1996, Dr Ian Wilmut and his team from the Roslin Institute, Scotland created a lamb named Dolly. A whole nucleus containing an entire set of chromosomes was taken from a mammary cell in an adult ewe and injected into an egg of another sheep whose own nucleus has been removed. The egg, now with a full complement of genes begins dividing and is placed into the uterus of a surrogate mother. The embryo develops into a complete new organism genetically identical to the organism from which the original nucleus is taken. In whole organism cloning, the product is a complete new organism genetically identical to the organism from which the original nucleus is taken. DNA fingerprinting can be used to verify that the animal produced was a clone. As each individual has a unique pattern of nucleotide bases in the intron or non-coding area. DNA can be used in paternity or maternity investigations to prove family relationships as close family members have very similar intron sequences, for example an offspring has the same number of short tandem repeats as either the mother or father at each of the sites tested. Unfortunately Dolly has not been proved that it was a clone from her 'udder mum' as the 'udder mum' was dead by the time Dolly was born.	7

Q.33 - The Human Story

(a)

	Criteria	Marks
(i)	Living hominids belong to the genera *Pongo, Pan, Gorilla* and *Homo*. Any THREE of these animals (biological or common names).	1
(ii)	Living hominins belong to the genus Homo. Any TWO of: upright stance, bipedal gait, large brain (larger than other hominids), smaller canine teeth than other hominids. OAP	2
(iii)	Any TWO of: organisms that interbreed and produce fertile offspring; organisms that share a gene pool; organisms with many features in common	2

(b)

	Criteria	Marks
(i)	For each idea: definition (1), example (1) Genetic Polymorphism: when there is more than one form (allele) of a gene present in a population; eg: human ABO blood groups Clinal gradation: a gradual change in a characteristic (or the frequencies of alleles) in a species across its geographic range; eg: change in ABO blood groups in Australian Aborigines from north to south	4
(ii)	increase in interbreeding/genetic mixing between previously separate human populations (1), leading to reduction of clinal gradations, etc. (1)	2

(c)

	Criteria	Marks
(i)	Correct description of one identified feature in one fossil hominid species = 1 mark Correct comparison of one identified feature between two fossil hominids = 2 marks Correct comparison plus statement of evolutionary significance = 3 marks [Example: *Australopithecus afarensis* had a cranial capacity of about 500 mL, while *Homo habilis* had a cranial capacity of about 700 mL. This indicates an increase of hominid cranial capacity over time.]	3
(ii)	In sexual reproduction, mitochondria are inherited in the egg cell from the mother. The sperm from the father contributes genetic material, but not other cell contents	1
(iii)	It is assumed that mitochondrial DNA mutates at steady, predictable rates, which provides a regular "clock" that can be used to date evolutionary events (1). By applying this clock to differences in DNA between primate groups, it can be determined when the groups diverged (1). By this method, it is estimated that humans and chimpanzees diverged from a common ancestor about 5 million years ago (1).	3