James Ruse Agricultural High School

2002 TRIAL HIGHER SCHOOL CERTIFICATE EXAMINATION

BIOLOGY MARKING GUIDELINES

SECTION I: PART A

Questions 1-15 (1 mark each)

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

SECTION I: PART B

Questions 16 - 28

16 (a)	Outcomes assessed:		
	Criteria	Marks	Band
	• Oxygen saturation: use an oximeter. This measures the amount of light absorbed by the haemoglobin that is not bound with oxygen. Oximeter attached to finger and does not require invasive techniques. • Carbon dioxide: from blood gas analysis (invasive).	2	4
	• Only one of the above given	1	

16 (b)	Outcomes assessed:		
	Criteria	Marks	Band
	• If carbon dioxide levels get too high the patient's blood too acidic and this affects the functioning of the body. Or, low levels of oxygen may result in damage to the brain.	1	5

17 (b)	Outcomes assessed:		
	Criteria	Marks	Band
	• Depends on the factor given by the student in 17 (a). E.g., if temperature given, then variables that would need to be controlled would be the amount of enzyme used in each test tube, and the amount of substrate provided in each test tube. • If temperature given, then the control condition would be a test tube(s) with no enzyme but containing all other substances (substrate). • Description of how results were determined.	3	5
	• Only two of the above points given.	2	
	• Only one of the above points given.	1	

17 (c)	Outcomes assessed:		
	Criteria	Marks	Band
	Depends on the factor given by the student in 17 (a). E.g., if temperature given: • The enzyme's activity would increase with the temperature. This continues right up to its optimal temperature. • Beyond this temperature the enzyme's activity would decrease as it becomes denatured due to the high temperature affecting its structure.	2	5
	• The enzyme's activity would increase with the temperature. This continues right up to its optimal temperature.	1	

18 (a)	Outcomes assessed:		
	Criteria	Marks	Band
	• Active transport: movement of substances against their concentration gradient via energy-requiring mechanisms. (Must have both points.) • Passive transport: movement of substances down their concentration gradient. Does not require energy. (Must have both points.)	2	5
	• Only one of the above points given.	1	

18 (b)	Outcomes assessed:		
	Criteria	Marks	Band
	• Correct labelling of the ascending loop of Henle for active transport plus stating either Na^+ or Cl^- or NaCl as being actively transported.	1	4

18 (c)	Outcomes assessed:		
	Criteria	Marks	Band
	• Phloem • Translocation may occur via the pressure-flow hypothesis (accounting for the source-to-sink pattern). This means that the sugar of the leaves (the source) attracts water, the pressure of the water consequently causing it to flow to other tissues lacking in sugar (the sink). • This flow of water from source to sink drags sugar molecules.	3	6
	• Only two of the above points given correctly.	2	
	• Only one of the above points given correctly.		

19 (a)	Outcomes assessed:		
	Criteria	Marks	Band
	• Aldosterone is a hormone that acts on the distal tubule cells and causes them to increase their reabsorption of sodium. • Hormone replacement therapy involves replacing, or substituting, the hormones that the adrenal glands are not making. Cortisol is replaced orally with hydrocortisone tablets, a synthetic glucocorticoid, taken once or twice a day. If aldosterone is also deficient, it is replaced with oral doses of a mineralocorticoid, called fludrocortisone acetate (Florinef)), which is taken once a day.	2	5
	• Only one of the above points given.	1	

19 (b)	Outcomes assessed:		
	Criteria	Marks	Band
	• Aldosterone is a hormone that acts on the distal tubule cells and causes them to increase their reabsorption of sodium. Sodium is needed for nerve impulses and correct osmotic potentials.	1	5

20 (a)	Outcomes assessed:		
	Criteria	Marks	Band
	• At high oxygen pressures, such as in the lungs, haemoglobin becomes fully saturated with oxygen. • At low oxygen pressures, such as in the tissues, haemoglobin loses some of its oxygen, which the cells use in respiration. (This allows some of the CO_2 produced from respiration to be carried on the haemoglobin in the form of carbaminohaemoglobin.)	2	6
	• Only one of the above points given.	1	

20 (b)	Outcomes assessed:		
	Criteria	Marks	Band
	• At high altitudes the oxygen partial pressure is low thus causing less haemoglobin to be saturated with oxygen. This causes a lower oxygen pressure in the blood. • The lower oxygen pressure in the blood is detected by chemoreceptors (carotid bodies and aortic bodies), which stimulate an increase in the rate and depth of breathing and cause an increase in heart rate.	2	6
	• Only one of the above points given.	1	

21 (a)	Outcomes assessed:		
	Criteria	Marks	Band
	• The theory of evolution contends that all living organisms arose in the course of history from earlier forms. Usually, many groups of organisms such as the vertebrates have a common ancestor. As the earth's environments altered over a long period of time, organisms gradually change, or evolved, into other types of organisms, such as the vertebrates.	1	6

21 (b)	Outcomes assessed:		
	Criteria	Marks	Band
	• Palaeontological evidence refers to the fossil record and this provides support for the theory of evolution. For example, the modern horse, Equus, has had several ancestors, as found in the fossil record. These horse fossils show gradual changes over the course of some 65 million years. The earliest horse fossil for instance, Hyracotherium, had a three-toe foot structure whilst the younger horse fossil, Miohippus, had evolved to have mainly a single-toe foot with two side bones; the Equus has a single toe foot. These changes are thought to be the result of the horse evolving in an environment that was changing from marsh-like to one that was dry and of hard ground.	1	4

	Outcomes assessed:		
	Criteria	Marks	Band
	• Darwin/Wallace contend that evolution is due to the natural variation that occurs in a population being acted upon by the environment. Those organisms that had favourable characteristics for survival in a particular environment will survive and reproduce offspring that will inherit the favourable traits for survival and so on. As the environment changed so did the types of organisms that existed. They therefore contributed the theory of Natural Selection as a mechanism for how evolution may occur.	1	3

22 (a)	Outcomes assessed:		
	Criteria	Marks	Band
	• Biodiversity refers to the amount of genetic variation in the gene pool of a species. (Or, the number of different species in an ecosystem or number of different types of ecosystems.) • Having a greater genetic variation means there is more chance of a species surviving changing environmental conditions including disease-causing organisms. More genetic variation leads to different phenotypes and thus more chance of surviving.	2	4
	• Only one of the above points given.	1	

22 (b)	Outcomes assessed:		
	Criteria	Marks	Band
	• Koala numbers are dropping and this may lead to inbreeding depression. • By measuring the genetic diversity of koalas, conservationalists can develop breeding programs that will lead to more vigorous koala populations. This is achieved by mixing koalas that have enough genetic diversity.	2	5
	• Only one of the above points given.	1	

23	Outcomes assessed:		
	Criteria	Marks	Band
	• Humans and apes. • Fossil-based evidence of apes pointed to gorillas and chimpanzees being more closely related than humans; they evolved much later than humans, who split from the ape lines some 15 million years ago. • However, DNA and protein studies show that humans are more closely related to chimpanzees and gorillas than that proposed by the fossil evidence. This shows that humans split from the ape lines some 5 million years ago. • Amino acid sequences of universal proteins such as cytochome C and haemoglobin are analysed and compared between different groups of organisms. The number of different amino acids between organisms is related to the time since separation of the groups during their evolutionary history.	4	5
	• Only three of the above points given.	3	
	• Only two of the above points given.	2	
	• Only one of the above points given.	1	

① technique: "DNA sequencing" "amino acid sequencing"

① organisms involved: humans and apes.

① relationship: "more similar the sequences..." "more closely related."

① difference: "changed... than previously thought"

24	Outcomes assessed:		
	Criteria	Marks	Band
	• A transgenic species is one that has integrated into its own DNA a foreign gene or genes (1). • Advantages (3): Transgenic animals have been used for simulating diseases and testing new therapies. E.g., cardiovascular and neurodegenerative diseases. Animal models provide an opportunity to test methods for the prevention or delay of disease in humans. Genetic research; to produce drugs (pharming); organ donation (neutralise antigenic proteins on animal organs so they can be suitable human transplants). • In agriculture, transgenesis may: increase the yield of crops; increase the quality of crops; for pest and disease resistance; to produce drugs (pharming). • Transgenesis may reduce or even replace the large-scale use of pesticides and long-lasting herbicides used in agriculture. When fully developed, it may offer a number of advantages over traditional methods of breeding. Compared with traditional methods, transgenic breeding is: More specific: scientists can choose with greater accuracy the trait they want to establish. The number of additional unwanted traits can be kept to a minimum. Faster: establishing the trait takes only one generation compared with the many generations often needed for traditional selective breeding, where much is left to chance. More flexible: traits that would otherwise be unavailable in some animals or plants may be achievable using transgenic methods. Less costly: much of the cost and labour involved in administering feed supplements and chemical treatments to animals and crops could be avoided. • Disadvantages (3): Difficult to estimate the effect of transgenesis on a species; it may be advantageous and it may not. New diseases may be created as a result of modifying viral and bacterial genes. May lead to loss of biodiversity since the same type of organism is being used, with only one gene modified. • Ethical issues (1): Companies that have the patent for the transgenesis of a species may have a monopoly on the market; who decides what genes can be incorporated?; who decides what should be transgenetic?	8	6
	• Only one – seven of the above points given.	1-7	

25 (a)	Outcomes assessed:		
	Criteria	Marks	Band
	• Immune system required when a pathogen or modified pathogen (as in a vaccine) has entered the bloodstream of the body.	1	4

25 (b) (i)	Outcomes assessed:		
	Criteria	Marks	Band
	• T lymphocytes: There are three types of T cells (any one of these is adequate): (i) The cytotoxic (killer) T lymphocytes recognise infected cells or cells with antigens on their membrane and then may combine with the cell thus immobilising it and at the same time producing a chemical called lymphokine which attracts macrophages for phagocytosis. Alternatively, killer T cells may produce cytotoxins that are chemicals that directly destroy the cell. (ii) Helper T lymphocytes activate other types of T cells as well as B lymphocytes in responding to antigens. (iii) Suppressor T lymphocytes inhibit the immune response by suppressing B cell and T cells. They only live a short time. • B lymphocytes: When a B cell comes into contact with the specific antigen to which it is targeted, it divides rapidly to form a clone of identical cells. Most of these B cells differentiate into plasma cells. Plasma cells continue to divide and to produce antibodies.	2	4
	• Only one of the above points given.	1	

25 (b) (ii)	Outcomes assessed:		
	Criteria	Marks	Band
	• Once activated by foreign antigen on the surface of a specialised antigen-presenting cell, an appropriate helper T cell can help activate a B cell by binding to the same foreign antigen on the B cell surface. (The helper T cell recognises the same antigen-MHC complexes on the B cell it helps as on the antigen-presenting cell that initially activated the T cell.) • The specific contact between a helper T cell and a B cell initiates an internal rearrangement of the helper cell cytoplasm toward the target B cell. This enables the helper T cell to direct the secretion of interleukins onto the B cell surface. These interleukins include IL-4, which helps initiate B cell activation, IL-5, which stimulates activated B cells to proliferate, and IL-6, which induces activated B cells to mature into antibody-secreting cells.	2	6
	• Only one of the above points given.	1	

25 (c)	Outcomes assessed:		
	Criteria	Marks	Band
	• It has been shown that the T cells are directed against certain cell-surface glycoproteins (a carbohydrate and protein complex) known as the major histocompatibility complex, or MHC. These antigens are coded for by at least 20 different genes, and each of these genes has as many as 8 to 100 alleles; so the total number of different combinations is enormous. Hence, it is predicted that no two persons will ever be found to have the same MNC; it is a fingerprint. Therefore, these antigens exist on the tissues associated with an organ being transplanted. • The cells that infiltrate the graft are mainly lymphocytes and macrophages, and it is the T cells that are responsible for the graft rejection. Transplant patients are given drugs to suppress the immune response, however, this has the problem of causing infections in patients.	2	4
	• Only one of the above points given.	1	

26	Outcomes assessed:		
	Criteria	Marks	Band
	• Australia is BSE-free due to strict quarantine measures. • Quarantine measures such as prevention of importation of cattle from BSE infected countries have thus been effective. • The potential importation of exotic diseases and species via illegal boats, for example, could have potentially devastating quarantine consequences for Australia's $13.5 billion agricultural industry. • Australia has a large and isolated coastline and this is difficult to monitor. Thus quarantine is not effective against illegal migration. • Australian Quarantine's early warning system has again demonstrated its effectiveness by delivering a timely warning of the presence of Japanese encephalitis (JE). Blood samples, which are collected from the pigs each week during the wet season and airfreighted to CSIRO's Australian Animal Health Laboratory in Geelong and the Queensland Health laboratory for testing, last week tested positive for the JE virus. • As there is no way to stop JE coming into Australia annually, early warning remains our best protection against this disease. Early detection of JE this wet season again underscores the importance of Quarantine's monitoring and surveillance program in northern Australia, which plays a vital role in our defence against exotic pests and disease.	4	
	• Only three of the above points given.	3	
	• Only two of the above points given.	2	
	• Only one of the above points given.	1	

27 (a)	Outcomes assessed:		
	Criteria	Marks	Band
	• Malaria is caused by a protozoan, *Plasmodium vivax*.	1	

27 (b)	Outcomes assessed:		
	Criteria	Marks	Band
	• Transmission: via the female *Anopheles* mosquito, which has bitten an infected human.	1	

27 (c)	Outcomes assessed:		
	Criteria	Marks	Band
	• Host response: some antibodies are made in response to the *Plasmodium*. Shivering and periodic bouts of high temperature (fever) associated with malaria are designed to fight the *Plasmodium* forms.	1	

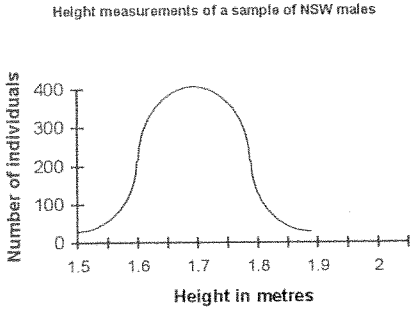
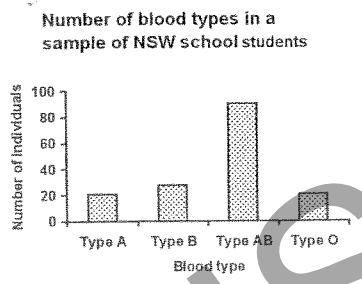
27 (d)	Outcomes assessed:		
	Criteria	Marks	Band
	• Treatment: chloroquine given orally	1	

27 (e)	Outcomes assessed:		
	Criteria	Marks	Band
	• Disease control: prevention of mosquitoes.	1	

28	Outcomes assessed:		
	Criteria	Marks	Band
	[illegible]	4	
	• Only three of the above points given.	3	
	• Only two of the above points given.	2	
	• Only one of the above points given.	1	

SECTION II: Question 31 Genetics – The Code is Broken? (25 marks)

31 (a)	Outcomes assessed:		
	Criteria	Marks	Band
	• alanine-glutamic acid-cysteine	1	

31 (b) (i)	Outcomes assessed:		
	Criteria	Marks	Band
	• Polygenic inheritance shows continuous variation:  • Multiple alleles inheritance shows discontinuous variation:  	2	
	• Only one of the above graphs given.	1	

31 (b) (ii)	Outcomes assessed:		
	Criteria	Marks	Band
	• Polygenic inheritance is due to the effects of more than one gene. A trait affected by numerous genes does not have clear-cut differences between groups of individuals because of the differences in gene expression between individual genes within an individual and between individuals. • Multiple alleles: more than two alleles have been identified for the same gene locus (that is location on a chromosome). Thus there are a limited number of clearly distinguishable phenotypes since only a small number of allele combinations can arise.	2	
	• Only one of the above points given.	1	

31 (c)	Outcomes assessed:		
	Criteria	Marks	Band
	• DNA fingerprinting involves the sequencing of short highly repeatable DNA sequences called minisatellites or Variable Number Tandem Repeats (VNTRs). DNA fingerprinting can be used to determine the pedigree of breeding dogs. By analysing the DNA fingerprints of one dog with another dog, the degree of closeness between DNA fingerprints will be a measure of closeness between the breeding pair. • DNA fingerprinting can be used to establish the identity of the father of a child by comparing the minisatellites of the Y chromosome or other chromosomes of the child's with the suspected father's. The more similar the patterns the more chance the suspect is the father of the child.	2	
	• Only one of the above points given.	1	

31 (d) (ii)	Outcomes assessed:		
	Criteria	Marks	Band
	• Cystic fibrosis is a result of a defective cell membrane protein in the some lung tissues. This is a result of a mutated or a missing gene for the membrane protein. To treat this condition via gene therapy, the normal gene for the membrane protein is inserted into a viral vector. • This viral vector is inserted into the lung tissue via a tube inserted in the patients nose, leading directly into the lungs.	2	
	• Only one of the above points given.	1	

Translocation Down's Syndrome

31 (e) (i)	Outcomes assessed: Cri-du-Chat		
	Criteria	Marks	Band
	• E.g., Down's syndrome. • A non-disjunction occurs at pair 21 during meiosis in one parent. • The gamete that contains the two chromosomes, instead of the usual single chromosome, may then be fertilised to form a zygote that has a trisomy at pair 21	3	
	• Only two of the above points given.	2	
	• Only one of the above points given.	1	

33 (e) (ii)	Outcomes assessed:		
	Criteria	Marks	Band
	• Chromosomal rearrangements and base substitutions may be inheritable if they occur in the germ line cells that are contained in the sex organs. These cells undergo meiosis to form into gametes. If the same non-disjunction described above occurs during meiosis of the person who has Down's syndrome, then the child may also have Down's syndrome.	1	

33 (f)	Outcomes assessed:		
	Criteria	Marks	Band
	• Embryonic development in many organisms depends on several types of genes, or genes that have similar roles: maternal effect genes, segmentation genes and pattern formation genes. • Maternal effect genes cause the egg to have concentration gradients of proteins that may act as gene regulatory proteins (transcription factors). The amount of these proteins received by embryonic cells influences what genes are switched on or off. Gene expression in, and the developmental fate of, cells in the early embryo are influenced by these local differences in the distribution of cytoplasmic determinants. • Pattern formation genes mainly depend on the expression of the homeotic genes that contain the homeobox sequence of DNA (found in many types of organisms). • The proteins expressed by these genes are transcription factors that turn on or off other genes in the embryo cells. For example, mutations occurring in the homeobox genes are responsible for many limb defects in vertebrates. • Gene cascades also play a role in the development of the embryo. If one of the transcription factor proteins switches on another gene that also is a transcription factor, the latter may switch on another gene(s), which may also be responsible for transcription. In this fashion a cascade of gene expression is built up (a type of amplification), producing proteins along the way that may influence what the embryonic cells differentiate into. • The spatial location of the limb formation cells also influences the orientation of the cells and thus determines features such as left and right, front and back. Pattern formation is controlled by positional information, which is a set of molecular cues that indicate a cell's location relative to other cells in an embryonic structure and that help to determine how the cell and its descendants respond to future molecular signals. Gradients in the concentration of these signaling factors along the three orientation axis provide cells with positional information	5	
	• Only five of the above points given.	5	
	• Only four of the above points given.	4	
	• Only three of the above points given.	3	
	• Only two of the above points given.	2	
	• Only one of the above points given.	1	

33 (g)	Outcomes assessed:		
	Criteria	Marks	Band
	• **Eucaryotic** DNA segment including enhancer and promoter regions and genes coding for polypeptides/proteins. • Transcription factors (or regulatory proteins) binding to enhancer and promoter regions. RNA polymerase transcribes the operon when transcription factors bind to enhancer and promoter regions. Either mRNA or polypeptides/proteins produced from the genes being read by RNA polymerase. Absence of transcription factors (or regulatory proteins) results in no transcription. • **Eucaryotic** regulation of mRNA (mRNA splicing): introns are excised before the mRNA leaves the nucleus. • The exons are then spliced. Regulatory proteins control the splicing and cause different splicing events to occur thus leading to different polypeptides made. (Or, DNA unpacking: genes switched off due to the tightness of the packing of DNA wrapped around histones. Or, ends of transcribed RNA are capped. Removal of these protective caps allows mRNA to be degraded and hence shorten the life of the mRNA.) • **Procaryotic:** DNA segment includes promoter, operator and operon (genes coding for proteins/polypeptides). • Repressor bound to operator hence switching 'off' the operon. • Repressor bound to an inducer thus preventing it from binding to the operon.	7	
	• Only six of the above points given.	6	
	• Only five of the above points given.	5	
	• Only four of the above points given.	4	
	• Only three of the above points given.	3	
	• Only two of the above points given.	2	
	• Only one of the above points given.	1	