James Ruse Agricultural High School

2006 TRIAL HIGHER SCHOOL CERTIFICATE EXAMINATION

BIOLOGY MARKING GUIDELINES

PART A

Multiple Choice: Questions 1-15 (1 mark each)

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

PART B

Total marks: 60 marks

16	Outcomes assessed:		
	Criteria	Marks	Band
	"Current reproductive technologies and genetic engineering have the potential to alter the path of evolution" (4 marks) Discuss this statement. (4 marks) *Discuss: identify issues and provide points for and/or against.* • The theory of organic *evolution* (biological evolution) contends that all living organisms arose in the course of history from earlier forms. Usually, many groups of organisms 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. Modern reproductive technologies: • These include processes such as artificial insemination, artificial pollination and cloning. All these are different to environmental influences since man determines what organisms will breed. These selective breeding processes may reduce the genetic diversity of a species and thus reduce the potential of the species to evolve. • E.g., artificial insemination is a technique involving the artificial injection of sperm-containing semen from a male into a female to cause pregnancy. Artificial insemination is often used in animals to multiply the possible offspring of a *prized animal* and for the breeding of endangered species. Advantages: genetically superior offspring; reduced disease; reduced expenses (feed, facilities, damage, vet, etc.); reduced risk of injury. Disadvantages: acquired skill; management intensive; cost of technician or equipment; less genetic variation due to the artificial selection of traits for breeding. (1): adequate demonstration of the concept of evolution: gradual	1 1 1 1	

	change and common ancestry. (1): statement about the role of one modern reproductive technology in affecting the evolution of species ("reduces the genetic diversity…") (elaboration mark) (1): example supporting modern reproductive technology statement. (1): statement about the role of genetic engineering on the evolution of a species: potential to increase diversity as a result of the inclusion of foreign genes.		
	• Only three of the above given.	3	
	• Only two of the above given.	2	
	• Only one of the above given.	1	

17 (a)	Outcomes assessed:		
	Criteria	Marks	Band
	Describe the experimental method that you would employ to prove that the excretion products of pigeons when mixed with water destroyed the microbes that were present in the water. *Describe: provide characteristics and features.* (1): control: agar plate containing swabs or streaks of the water that does not contain pigeon excretion product. (c) (1): experimental plate: agar plate containing streaks of water containing pigeon droppings. (e) (1): controlling variables: same type of agar plate used, same amounts of water and streaking techniques employed; incubated same temperature. (Of course another control would be an agar plate with no water or droppings added.) Must have two variables controlled or replicates described. (v)	1	
	• Only two of the above given.	2	
	• Only one of the above given.	1	

18	Outcomes assessed:		
	Criteria	Marks	Band
	Describe three different methods for treating water in order to reduce the risk of infection from organisms such as *Giardia* and *Cryptosporidium*. *Describe: provide characteristics and features.* • micro-filter water to remove undissolved solids and cells; • add a flocculating agent to trap small particles and bacteria, filter this away; • add chlorine to water in order to destroy bacteria and any other organism. • boil water.		
	• Only two of the above given.	2	
	• Only one of the above given.	1	

19	Outcomes assessed:		
	Criteria	Marks	Band
	State the name of one infectious disease. (1): malaria, flu, cold, etc State the name of one non-infectious disease. (1): Down's syndrome, cancer, etc Compare infectious diseases with non-infectious diseases. (1): infectious diseases involve the transfer of a pathogen (1): non-infectious diseases involve no pathogen.	1	

20.	Outcomes assessed:		
	Criteria	Marks	Band
	Using a specific example, describe how the theory of evolution is supported by palaeontological studies. • 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): relevant example of a fossil stated. (ex) (1): description of how the fossil record supports the theory of evolution. (d) (1): elaboration of the description. (f)		
	• Only two of the above points given.	2	
	• Only one of the above points given.	1	

21	Outcomes assessed:		
	Criteria	Marks	Band
	Assess the impact advances in technology have made on our understanding of evolutionary relationships. *Assess: make a judgement of value, quality, outcomes, results or size.* • Humans and apes. • Fossil-based evidence of apes suggested gorillas and chimpanzees being more closely related than humans, who split from the ape lines about 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 evidence shows that humans split from the ape lines about 5 million years ago. • Amino acid sequences of universal proteins such as cytochrome 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. (1): technique described: "DNA sequencing" amino acid sequencing" (t) (1): organisms involved: e.g., humans and apes. (o) (1): relationship: "more similar the sequences…" (r) (1): difference: "changed…than previously thought" (I = impact mark)		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	

22	Outcomes assessed:		
	Criteria	Marks	Band
	State the name of one mutagen and describe evidence for the mutagenic nature of this mutagen. • UV light/radiation • associated with skin cancer/ flies radiated developed variations	1	3
	• Only one of the above points given.	1	

23 (a)	Outcomes assessed:		
	Criteria	Marks	Band
	State the name of the cell division process by which the bacterium replicates in both types of environments. • mitosis	1	
23 (b)	Explain the appearance of the black-coloured bacterial *E. coli* strain in the normal environment. • mutation		

23 (c)	Outcomes assessed:		
	Criteria	Marks	Band
	Compare the effects of the two environments on the bacterium. *Compare: show how things are similar or different.* • In normal environment, two strains of the bacterium exist. (1) The number of the black strain is low compared to the number of white strain bacteria. (1) • In the streptomycin environment, the number of white strain bacteria is low (dies out) whereas the black strain numbers have increased, surviving the effects of the antibiotic. (1)	1 1 1	5
	• Only two of the above points given.	2	
	• Only one of the above points given.	1	

23 (d)	Outcomes assessed:		
	Criteria	Marks	Band
	Explain how these results support Darwin and Wallace's theory of evolution. • In normal environment, two strains represent variation in a bacterial population. (1) • Addition of streptomycin favours the strain that has adaptations enabling it to survive the environment. (1) • The surviving strain replicates. (1)	1 1 1	5
	• Only two of the above points given.	2	
	• Only one of the above points given.	1	

23 (e)	Outcomes assessed:		
	Criteria	Marks	Band
	Is the above diagram representative of Darwin's theory of gradual evolutionary processes or does it represent punctuated equilibrium evolutionary processes? Explain your answer. • Punctuated equilibrium evolution. (1) • It could be argued that the sudden dying out of the white bacterial strain is an abrupt dying out of the bacterium; the sudden		5

	domination by the black strain represents the sudden appearance of a new bacterial strain. (1)		
	• Only one of the above points given.	1	

24	Outcomes assessed:		
	Criteria	Marks	Band
	Compare the effects of the two environments on the bacterium. *Compare: show how things are similar or different.* • Pedigree: correct offspring shown. (1); correct symbols used. (1) State the type of genetic inheritance for left-handedness in the family. • sex-linked recessive. (1)	1 1 1	5
	• Only two of the above points given.	2	
	• Only one of the above points given.	1	

25 (a)	Outcomes assessed:		
	Criteria	Marks	Band
	Compare artificial blood with normal blood in terms of the adaptive advantage of the substances used to transport oxygen. *Compare: show how things are different or similar.* • perfluorocarbons can bind more oxygen in blood plasma (outside red blood cells) than haemoglobin, which is confined to red blood cells. (1) • haemoglobin can pick up oxygen in areas which are high in oxygen; it offloads oxygen in areas that are low in oxygen. (1)	1	5
	• Only one of the above points given.	1	

25 (b)	Outcomes assessed:		
	Criteria	Marks	Band
	Justify why research is being conducted on artificial blood. *Justify: support an argument or conclusion.* • perfluorocarbon solutions are free of blood-borne diseases like HIV. (1) • artificial blood may be stored for a long period of time and transported for use at accidents. (1)	1 1	5
	• Only one of the above points given.	1	

26 (a)	Outcomes assessed:		
	Criteria	Marks	Band
	Draw labelled, longitudinal sections to distinguish between the mature phloem and xylem tissues of plants. • Xylem: thick walls (lignified) or pits shown + one labelled feature (1) • Phloem: companion cell, sieve plates + one labelled feature (1)		
	• Only one of the above points given.	1	

26 (b)	Outcomes assessed:		
	Criteria	Marks	Band
	State the name of one theory that accounts for the movement of water in the xylem tissue of plants. Describe this theory. • Evaporation (transpiration)-cohesion-tension theory accounts for the movement of water, and thus ions, in the xylem. Water molecules attract each other and are also attracted to the walls of the xylem. As water evaporates from the leaf, each molecule of water drags another upwards. This stream carries ions as well. (1): Evaporation (transpiration)-cohesion-tension theory (1): water attracts water. (1): water movement occurs a result of the evaporation of water from the leaf or other thus tugging the solution to other parts of the plant.		
	• Only two of the above points given.	2	
	• Only one of the above points given.	1	

27 (a)	Outcomes assessed:		
	Criteria	Marks	Band
	Describe the pH results you obtained when investigating the effect of adding carbon dioxide to water. • pH decreases. (1)		

27 (b)	Outcomes assessed:		
	Criteria	Marks	Band
	Carbon dioxide affects the pH of water. Explain the implications this effect has for the transportation of carbon dioxide in human blood. • majority of CO_2 transport in blood is in the form of the bicarbonate ion HCO_3^{2-}. (1) • bicarbonate is a result of carbon dioxide reacting the water in blood plasma. • CO_2 must be removed from blood (at lungs) otherwise blood becomes too acidic. (1)		

	• Only one of the above points given.	1	

28	Outcomes assessed:		
	Criteria	Marks	Band
	Describe one method used to produce a transgenic animal. Animals: • This method involves the direct microinjection of a chosen gene construct (a single gene or a combination of genes) from another member of the same species or from a different species, into the pronucleus of a fertilized ovum. (m) • The DNA construct (usually about 100 to 200 copies in 2 pl of buffer) is introduced by microinjection through a fine glass needle into the male pronucleus - the nucleus provided by the sperm before fusion with the nucleus of the egg. The diameter of the egg is 70 µm and that of the glass needle is 0.75 µm; the experimenter performs the manipulations with a binocular microscope at a magnification of 200x. (p) (f) • The insertion of DNA is, however, a random process, and there is a high probability that the introduced gene will not insert itself into a site on the host DNA that will permit its expression. The manipulated fertilized ovum is transferred into the oviduct of a recipient female, or foster mother that has been induced to act as a recipient by mating with a vasectomized male.	1 1 1	6
	• Only two of the above points given correctly.	2	
	• Only one of the above points given correctly.	1	

29	Outcomes assessed:		
	Criteria	Marks	Band
	Compare the processes used by marine fish with those used by freshwater fish in regulating water balance. • salt water fish: drink copious amounts of water (d); chloride-secreting cells in gills excrete salt (s); urine is concentrated (U). • fresh water fish: drink small amounts of water; cells absorb salt in gills; urine is dilute. (1): for each difference.	1 1 1	6

30	Outcomes assessed:		
	Criteria	Marks	Band
	Two important regulatory processes used by a variety of organisms are homeostasis and enantiostasis. Compare the features of these two regulatory processes using appropriate examples. Homeostasis refers to the maintenance of a relatively stable internal environment (HD). When there are deviations from the normal levels, mechanisms are implemented to restore values to normal levels. For example, mammals regulate body temperature by		

	feedback mechanism. If the core body temperature of humans goes higher than 37^{o}C, this is detected by receptors in the hypothalamus (HM) which send nerve signals to the sweat glands to excrete sweat. This results in evaporation of sweat and removal of heat from the blood vessels at the skin (HE). If the core body temperature is lower than 37^{o}C, receptors in the hypothalamus which send nerve signals to the muscles producing shivering. This process generates heat. Enantiostasis means the adjustment of the internal environment to optimise functional capacity in the face of external alterations (ED). For example, some crustaceans (e.g., crabs) (EE) use intracellular osmotic regulation, moving free amino acids in and out of cells (EM) to equalise osmotic concentration in order to survive an estuarine environment. Sharks can do the same. These adjustments to the levels of the amino acids or salts in the cells enables the organism to obtain the appropriate water balance in the varying salt water environment of an estuary. (1): statement about maintenance of a relatively stable internal environment (homeostasis mark) (1): homeostasis example-temperature too high (high mark) (1): homeostasis example-temperature too low (low mark) (1): statement about adjustment of the internal environment to changes in the environment (enantiostasis mark) (1): enantiostasis example- mechanism (1): enantiostasis example- how mechanism helps organism survive the change to the environment. (1): any other type of similarity (e.g., both processes enable organism to survive) or difference given (S).		
	• 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	

Question 33 Genetics – The Code is Broken? (25 marks)

33 (a)	Outcomes assessed:		
	Criteria	Marks	Band
	• Labelled diagrams of: - eucaryotic DNA segment <u>including enhancer (1) and promoter regions and genes</u> coding for polypeptides/proteins (1);		5

	- transcription factors (or regulatory proteins) binding to enhancer and promoter regions (1); - RNA polymerase transcribes gene thus causing the gene to be expressed (1); - If a negative transcription factor binds then the gene is not expressed. Or, the gene is not expressed if no transcription factor binds (1). 3 structural components provided in a labelled diagram: enhancer, promoter, transcription factor, cap, mRNA, introns and exons, histone, DNA coil, methyl groups. (S1, S2, S3) 1 gene "on" component. (go) 1 gene "off" component. (gf) Max 2 marks if operon theory presented (prokaryotes), if polypeptide synthesis presented, if no diagram provided.		

33 (b)	Outcomes assessed:		
	Criteria	Marks	Band
	Describe how scientists can verify that an animal produced is a clone. • Use DNA fingerprinting to compare the types of minisatellites in the animal and its clone. (1) • The DNA *pattern* should be the same. (1)		
	• Only one of the above points given.	1	

33 (c)	Outcomes assessed:		
	Criteria	Marks	Band
	Assess the impact of transposable genetic elements on the evolution of bacteria. • Transposable genetic elements are pieces of DNA that can move from one location in the genome to another. In bacteria, transposons may move from bacterial cell to another. In bacteria transposons may contain genes that confer resistance to antibiotics. Thus, transposons may influence the evolution of bacteria by causing the movement of genes from one bacterial cell to another and this may increase genetic and phenotypic (survival to antibiotics) variation. (1): judgement mark (does it impact on evolution or not?) (j) (1): definition of a transposon. (d) (1): description of a process in which transposons may influence the variation of bacteria (e.g., conferring antibiotic resistance). (p)		
	• Only two of the above points given.	2	
	• Only one of the above points given.	1	

33 (d)	Outcomes assessed:		
	Criteria	Marks	Band
	Discuss the roles of gene cascades, gene homologues and the timing of gene expression in the development of mammal embryos. • 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. (2) • 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. (2) • 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 Timing comments (2)	4	

33 (e) (i) and (ii)	Outcomes assessed:		
	Criteria	Marks	Band
	(i) Name a disease that may be treated by gene therapy. (ii) Describe how gene therapy may be used to treat the disease you named in (i). • 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 patient's nose, leading directly into the lungs.	2	
	• Only one of the above points given.	1	

33 (f) (i)	Outcomes assessed:		
	Criteria	Marks	Band
	Give one example of a mutation that is a result of chromosomal rearrangements. • Down's syndrome.	1	

33 (f) (ii)	Outcomes assessed:		
	Criteria	Marks	Band
	Explain how this mutation may occur. • Non-disjunction in meiosis results in a trisomy at position 21.	2	

33 (g) (i) and (ii)	Outcomes assessed:		
	Criteria	Marks	Band
	(i) State the name of this type of cross, which was designed to show the relative positions of genes along a particular chromosome. • test cross (1) (ii) Explain how the outcomes of the cross indicate the two genes involved are linked. • The frequencies of the two types of recombinants (1) are similar and higher than the parental frequencies (1). (iii) Describe how these results may be used to calculate the map distance between the two genes. • The total of the frequencies of the two types of recombinants is divided by the total number of offspring. (1)	2	