

Exam Choice

2005 Biology Trial HSC examination.

Marking Guidelines and model Answers.

Section I A Multiple Choice

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

Section I B

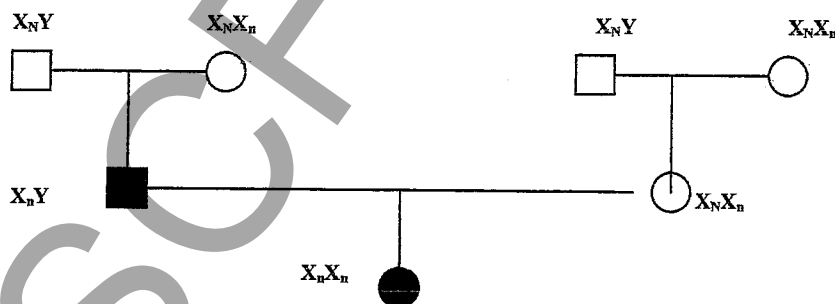
16.

Marking Guidelines	Marks
- Role of water in transmission of pathogens described - Effect of these diseases on the population outlined	3
+ 1 other health implication of unclean water described or – another threat to good health described.	
2 of the above or all 3 poorly done.	2
1 of the above.	1

It is true that water, polluted by human waste plays an important role in the transmission of many pathogens, for example, those responsible for cholera, dysentery and hepatitis A. These diseases and others caused by water borne pathogens are responsible for many deaths and much disease in the third world. Access to clean water would greatly reduce the incidence of these diseases. However, it is debatable whether it is the greatest threat to health. Other diseases such as malaria, and nowadays AIDS have the potential to have a greater effect in the developing world.

17.

Marking Guidelines	Marks
- pedigree diagram drawn using correct symbols or with a key 3 generations correctly represented (at least 7 individuals) - woman and her father shown to be colourblind – her mother not colour blind - explanation of how alleles for colourblindness passed down either in words or through use of genotypes in the pedigree. (explanation must show understanding of sex linkage)	4-5
3 of the above	3
2 of the above	2
1 of the above	1



Both grandmothers are carriers. Her father is colourblind, her mother is a carrier. She inherits allele for colourblindness from mother and father.

18. a

Marking Guidelines	Marks
technology described	2
technology named	1

Pulse oximetry – a beam of light consisting of particular wavelengths that are absorbed by oxyhaemoglobin is shone onto the finger or other extremity. The device measures the extent to which these wavelengths are absorbed and as this is proportional to the amount of HbO present the device can be calibrated to give a measure of oxygen saturation.

18. b

Marking Guidelines	Marks
condition needing blood oxygen monitoring named	2
importance of monitoring assessed	
condition named	1

Premature babies need their blood oxygen levels monitored. It is very important as their lungs are underdeveloped and doctors need to be sure they are receiving sufficient oxygen.

19.

Marking Guidelines	Marks
• Any 3 of Koch's postulates correctly applied to this situation	3
• 2 of Kochs postulates or 3 poorly applied	2
OR	
• another method correctly applying the scientific method	
• 1 of Koch's postulates	1
OR	
• scientific method poorly applied.	

He should isolate the suspected pathogen and grow it in pure culture.

He should then use this culture to infect healthy cows and cause the disease in them.

Then he would need to isolate and culture the suspected pathogen from these experimental cows and show it to be the same type that he isolated from the diseased cows to start with.

20. a

Marking Guidelines	Marks
• osmotic problem outlined	1

It would face an inflow of water by osmosis.

20. b

Marking Guidelines	Marks
• Two mechanisms described and their effect on water balance explained.	3
• One mechanism described or 2 done less well	2
• One mechanism outlined	1

The fish's kidneys would need to start producing copious dilute urine by reabsorbing salts. At the same time it could actively take up salts through its gills. These two measures would remove the excess water entering by osmosis while minimising loss of salts in the urine. Salts lost would be replaced via the gills.

21

Marking Guidelines	Marks
• Method of obtaining a range of values of the independent variable outlined	5-6
• Large sample sizes	
• Variables controlled	
• Method of measuring dependent variable	
• Statistical analysis of data	3-4
• 3 of the above or 4 or 5 less well done	
• 1 or 2 of the above, or more less well done	1-2

A number of towns with different fluoride levels would be selected. Very large groups of people from each town would be sampled to minimise the effect of other variables. The survey could be limited to people of a certain age in order to control this variable. Beyond this the people should be as diverse as possible.

All the people to be sampled should be examined by dentists and the number of cavities recorded.

Then the average number of cavities for each group would be calculated and plotted against fluoride level to see whether there was a relationship between fluoride level and number of cavities.

22. a

Marking Guidelines	Marks
• The problem raised by each point explained	3
• 2 points explained	2
• 1 point explained	1

- only one specimen – any future cloned population would all be genetically identical – too little genetic diversity to be viable
- nuclear membranes broken down – present whole animal cloning technique involves placing a nucleus from the animal to be cloned into an enucleated egg cell – not possible if no distinct nuclei are available.
- No thylacines, only close relative Tas devil – What will be surrogate mother? – Tas devil may be too small and unsuitable for development of young thylacine.

22.b

Marking Guidelines	Marks
• 2 ethical issues described and related to this case	3-4
• 1 ethical issue described or two named	2
• 1 ethical issue named	1

Humans are responsible for the extinction of the thylacine, therefore we have an obligation to try to bring it back if possible. We have abused the 'rights' of this species and ethically we should make amends.

On the other hand, this would be a very expensive project with limited chance of success. If we accept that we have an ethical duty to protect the environment, the money would be better spent on protecting habitat and saving other species from extinction.

23.

Marking Guidelines	Marks
2 social and/or political influences described and their influence on the development of the theory explained.	4-5
1 social and/or political influence described and its influence on the development of the theory explained. OR 2 explained less well	2-3
1 influence named OR - Darwins Theory of Natural Selection outlined.	1

In 1858 Darwin and Wallace jointly presented the Theory of evolution by Natural Selection. Essentially it states that individuals with favourable characteristics will survive and reproduce more successfully than others and hence these characteristics will become more frequent in the population.

Political factor – Britain was a very powerful country in the C19 – it effectively controlled the seas. A consequence of this was its policy of sending voyages of exploration all over the world. Darwin sailed as ship's naturalist on the Beagle in one of these voyages. Without this opportunity Darwin would not have made the observations which led him to his theory.

Social factor – At this time the biblical version of creation was accepted by the vast majority of the population and reinforced by influential church authorities. Darwin knew his ideas would invite a powerful reaction and for this reason he spent nearly 20 years 'building his case' before he went public.

24.

Marking Guidelines	Marks
- Hypothesis correctly stated - Reasonable equipment list - Step by step method - Method of measuring independent and dependent variable given - Other variables controlled - A large number of tests done or experiment repeated - One safety measure outlined - Result given	8
1-7 of the above	1-7

Hypothesis – The greater the amount of CO₂ dissolved in water the lower its pH will be.

Equipment: marble chips, 1M HCl, test tubes, delivery tube, data logger with pH probe. Stop watch

- The reaction of marble chips with HCl will be used to generate CO₂ and the assumption will be made that it generates CO₂ at a uniform rate. This will allow the amount of CO₂ to be measured as the time in seconds that the reaction has been progressing (measured with the stop watch)
- Place 15 mL of distilled water in a test tube. Measure its pH using the pH probe.
- Place 5g of marble chips in the test tube. Add 10 mL of HCl and use the delivery tube to bubble the gas produced through the distilled water for 5 seconds. Measure pH using the probe.
- Repeat this procedure for 10, 15, 20, 25 & 30 seconds. Ensuring fresh marble chips, HCl and distilled water each time. Also ensure the same amount of each, each time to control these important variables.
- The whole experiment is repeated twice more and the results for each value of CO₂ are averaged to ensure results are reliable.

Safety measure – wear glasses to protect eyes from possible acid splashes

Result – pH was found to decrease from about 7.5 to around 4.0, supporting the hypothesis.

25.

Marking Guidelines	Marks
Role of T4 lymphocytes explained	3-4
Reduction in numbers of T4 s linked to symptoms of AIDS	2
One of the above or both less well done	1

Helper T cells have the role of 'sensitising' B lymphocytes and Killer T lymphocytes. I.e – they facilitate the process whereby those cells are 'programmed' to combat a particular antigen.

AIDS patients experience a drop in numbers of helper T cells. This impairs their ability to sensitise B cells and Killer T cells and consequently they are less able to combat infection.

26.

Marking Guidelines	Marks
Homeostatic mechanism outlined	3-4
Importance of mechanism linked to metabolic efficiency	2
One of the above or both done less well	1
OR Homeostasis defined	

One example of a homeostatic mechanism in humans is the maintenance of body temperature. The hypothalamus monitors blood temperature and when it detects variations above or below 37°C prompts the brain to trigger various responses which will return the temp to 37°C.

This is essential for metabolic efficiency as metabolism is controlled by enzymes. Enzymes are highly temperature specific.

27.

Marking Guidelines	Marks
• Explanation incorporating variation, differential survival or reproduction and change in the population. – related to the example given	3
• The above points made but not related to the example.	2
OR	
• 2 of the points related.	1
• 1 point related.	1

The rainbowfish showed natural variation in their tolerance of copper. Some were able to survive the increased levels and they survived and reproduced more successfully than others, passing this copper tolerance on to their offspring. Over subsequent generations the ability to tolerate copper became much more common in the population.

28.

Marking Guidelines	Marks
• description of role of microflora	3-4
• explanation of causes and consequences of imbalance related to an example	
• 1 of the above or both less well done.	2
• 1 of the above poorly done	1
OR	
• A disease resulting from an imbalance named.	

Humans have a large population of mutualistic bacteria living in the digestive tract, on the skin, inside the vagina and elsewhere. One of their useful functions is to exclude pathogens by out competing them for the resources present.

This balance can be disturbed in a number of ways – one of these is through over use of antibiotics which kills a large proportion of the bacteria. Pathogens are then able to establish themselves – for example the fungus *Candida* which causes thrush.

Section II Options.

29. Communication

a i

Marking Guidelines	Marks
• Receptor named	1

Photoreceptor cell of eye.

ii

Marking Guidelines	Marks
• Structural features of larynx described	2-3
• Role of features in prodn. of sound explained	
• One of the above.	1

The larynx is the top part of the trachea. It has vocal chords made of elastic fibres which extend across the opening of the trachea. Movement of air across them causes them to vibrate and produce sound waves which can travel through the air.

b i

Marking Guidelines	Marks
• Full explanation including mention of ion movement	2
• Poorer explanation	1

The threshold potential is the point at which movement of sodium ions raises the membrane potential to a critical level above the resting potential. At this point the action potential is triggered – an all or nothing response.

ii

Marking Guidelines	Marks
• Explanation in terms of ion movement and changes in potential	3-4
• Answer related to graph	
• Poorer explanation	1-2

Resting nerve fibre has higher $[Na^+]$ outside than in. $[K^+]$ is lower outside than in. At rest, membrane potential is -70 mV (see graph). The membrane is impermeable to Na^+ .

Stimulus causes membrane to become more permeable to Na^+ ions – they move into nerve cell causing polarity to be reversed (spike in graph).

Polarity can only be reversed at nodes of Ranvier. Na^+ ions move from one to the next triggering the next action potential there – causing the 'message' to move along the axon. The action potential is quickly reversed by the $Na^+ - K^+$ pump restoring the membrane potential to its resting state as shown in the graph.

iii.

Marking Guidelines	Marks
• Nerve and neuron described and distinguished between	2
• One described	1

A neuron is a single nerve cell. It transmits in one direction only. A nerve consists of a bundle of neurons. A nerve will normally contain both motor neurons and sensory neurons, meaning that it transmits in both directions.

c.

Marking Guidelines	Marks
• Two technologies outlined • Ways in which each operate explained • Assessment of potential of each to help people with hearing disabilities given	5-7
• Two of the above OR • All three less well done.	3-4
• One of the above OR • Two less well done.	1-2

Hearing aids are digital electronic devices which fit in the ear canal. They act by amplifying the sound received and have great potential to improve the hearing of someone whose disability is due to eardrum or ossicle problems. The hearing aid essentially takes over the amplifying functions of these structures, ensuring that a high enough intensity stimulus reaches the cochlea. Hearing aids are of no use to people with inner ear damage.

Cochlear implants are a more modern development. They have great potential to improve the hearing of people with inner ear damage such as degeneration of the nerve endings in the cochlea. They have an external component which receives the sound, converts it into electric impulses and stimulates the auditory nerve, which transmits the message to the brain where it is interpreted as sound.

d i

Marking Guidelines	Marks
• At least 2 refractory media identified and their effect outlined	2
• One refractory medium identified and its effect outlined OR • 2 refractory media identified.	1

The aqueous humour behind the cornea is a liquid medium which is much denser than air. It causes light to refract (ie bend towards the normal) and performs most of the function of focussing light onto the retina.

The lens is a more solid structure which is more dense than the aqueous humour. It performs the fine focussing function.

ii.

Marking Guidelines	Marks
• Explanation in terms of changing shape and differential refractive rates of different shaped lenses	2
• Poorer explanation	1

To view a distant object the muscles of the eye cause the lens to flatten and adopt a 'thin' profile. This gives it its lowest focal power which is suitable for the virtually parallel rays of light coming from a distant object.

To view a close object the muscles cause the lens to thicken and adopt a 'fat' profile. This gives it its highest focal power and allows it to focus the diverging rays from a close object.

iii.

Marking Guidelines	Marks
• Explanation in terms of stereoscopic vision and the role of the brain	2
• Poorer explanation	1

Humans have 2 eyes which each form a slightly different image of a given scene because of their different positions. This is called stereoscopic vision. These two images allow the brain to build a 3D image of the scene, allowing depth perception.

Question 30 — Biotechnology.

a i

Marking Guidelines	Marks
• Food product named	1

Wine

ii

Marking Guidelines	Marks
• Changes to two characteristics of a named species described	3
• Two changes named OR • One change described	2
• One change named	1

Modern chickens have been developed by artificial selection from wild jungle fowl of Asia. They have been selected for increased egg weight and earlier laying. They have also been selected for increased meat production.

b i

Marking Guidelines	Marks
- Outline of process of removal of gene from original species - Outline of process of insertion of gene into plasmid - Role of restriction enzymes and ligases outlined.	3
- Two of the above OR - All three done less well	2
one of the above	1

Restriction enzymes target a particular base sequence in a DNA molecule and cut the molecule at that point. They leave a 'sticky end' at that point (ie not a straight cut). Ligases are enzymes which join sticky ends with complementary base sequences together. Both types of enzymes are essential in the process of making recombinant DNA.

The DNA of the 'donor' species is extracted and restriction enzymes are used to cut out the desired gene. The bacterial plasmids are then treated with the same restriction enzymes to ensure complementary sticky ends. The genes to be inserted are then added and ligase enzymes join them into the plasmids.

ii

Marking Guidelines	Marks
Description of two methods	3
One method described, one named	2
- One described OR - Two named	1

A viral vector can be used to introduce the gene. The gene is inserted into the viral DNA and the organism is then exposed to the virus. The virus inserts its DNA, including the gene, into the DNA of the organism.

Electroporation can be used. This involves mixing cells with the DNA to be incorporated and treating them with high voltage.

iii

Marking Guidelines	Marks
- Outline of application of process - Description of process	2
One of the above	1

The PCR can be used to synthesise large quantities of a DNA fragment without cloning it. It is used when only a small fragment of DNA is available, -eg at a crime scene.

This section of DNA is mixed with a selection of nucleotides and DNA polymerase from a heat tolerant bacterium. The mixture is heated, causing it to unzip and act as a template for the production of identical copies.

c

Marking Guidelines	Marks
- Two named biotechnologies described - Application of each to human health described - Potential of each assessed	5-7
Two biotechnologies described but potential not assessed	3-4
- One biotechnology described OR - Two named	1-2

Recombinant DNA technology is used to make synthetic proteins such as the hormone insulin. The human insulin gene has been identified, 'cut' from human DNA and spliced into a bacterial plasmid. The bacteria are then cultured and the insulin they produce collected. This insulin can then be used to treat diabetics who don't make enough of their own. This has great positive implications for human health. Previously diabetics received animal insulin which is chemically slightly different and therefore less effective. Also, with any transfer of animal tissue there is a risk of transferring a virus as well.

The delivery of gene therapy through the use of nasal sprays is another significant development. It has great positive implications for human health. Sufferers from cystic fibrosis lack an allele which allows normal function of the lungs. By using nasal sprays to introduce viral vectors which carry the missing allele, these people can hopefully be treated. The missing gene will be taken up by some cells in the lungs of the sufferer causing them to function correctly and relieving the symptoms of the disease.

d i

Marking Guidelines	Marks
- Outline of process - Product and microorganism named	3
The above done less well	1-2

Citric acid is a product of industrial fermentation using the fungus *Aspergillus niger*. Fungal cells are maintained in a submerged culture in a stirred tank, provided with the necessary raw materials and citric acid is produced.