

HSC Trial Examination 2004

Biology

Solutions and marking guidelines

Section I

Part A

Answer and explanation		Syllabus content and course outcomes	
Question 1	D Both the work of Pasteur and Koch established the microbial origin of infectious disease.	9.4.3	H1, H8
Question 2	B From the data provided in the table, the smoking rate declines as educational levels increase.	9.4.6	H4, H14
Question 3	C T and B-cells have an important role in antibody production.	9.4.5	H2, H13
Question 4	A Candidiasis is a fungal disease. Found in the mouth and respiratory tract, it is normally kept in balance by other microorganisms. If the natural balance is disturbed the <i>Candida albicans</i> gains dominance and leads to the disease thrush.	9.4.4	H4, H8
Question 5	A Macrophages (phagocytes) attach to foreign cells and ingest, destroy and present a part of the foreign cell, the antigen, to lymphocytes. This leads to the production of antibodies.	9.4.4	H4, H6
Question 6	D The diagram shows several different vertebrates' forelimbs. Since each demonstrates the pentadactyl limb plan, this is an indication that all have a common ancestor and that each has adapted to suit the needs of the different vertebrates for flying, swimming, running, grasping, etc.	9.3.1	H10
Question 7	B Only by performing a proper test cross with a homozygous recessive can the breeder be sure of the genotype of his new birds. If the new birds are homozygous dominant, the offspring will be all green (dominant), but if the new birds are heterozygous, half of the offspring will be green (dominant) and half of the offspring will be blue (recessive).	9.3.2	H9
Question 8	D The molecule of mRNA uses the naked DNA strand as a template, so the RNA will be complementary to the DNA strand; with the exception that all of the thymine bases (T) will be replaced with uracil bases (U).	9.3.4	H9
Question 9	B From their experimentation with <i>Neurospora</i> , Beadle and Tatum were able to propose that each gene is responsible for the production of a single enzyme, since mutations to single genes they observed in <i>Neurospora</i> led to a lack of production of single enzymes. <i>Note: the amendment of the hypothesis to 'one gene – one polypeptide' didn't occur until later.</i>	9.3.4	H6, H9
Question 10	A The diagram in the question shows the process of meiosis. The outcome of this process is gamete formation, i.e. cell G.	9.3.3	H9
Question 11	D A large surface area exposed to the air will allow increased water loss due to an increased area being presented for evaporation.	9.2.1	H6

Part A (Continued)

Answer and explanation		Syllabus content and course outcomes
Question 12	C The active site of an enzyme is the part of the enzyme molecule which the substrate binds to. Therefore site 3 is the best answer.	9.2.1 H13
Question 13	A Vasodilation near the surface of the skin releases more heat during exercise and gives the skin a red appearance.	9.2.2 H6
Question 14	C Y is a vein and as such its function is to carry blood back to the heart from body tissues where gas, nutrient and waste exchange has occurred.	9.2.3 H14
Question 15	B A higher water level in the blood lowers the solute concentration. This causes the hypothalamus to inhibit the production of ADH by the pituitary gland. The decreasing amount of ADH in the blood causes the kidney collecting tubules to become less permeable to water.	9.2.3 H14

Part B

Sample answer	Syllabus content, course outcomes and marking guide
Question 16 After fertilisation, the zygote will start to differentiate into specific cells that have a specialised function. For example, white blood cells are specialised to protect the body against foreign cells, toxins and infections, thereby maintaining good health.	9.4.1 H4, H6 - Accurate mention of the link between cell differentiation and specialisation with appropriate example..... 3 - Poor link between cell differentiation and specialisation with appropriate example OR - Good link and poor example 2 - Poor link and poor example..... 1
Question 17 1. Non-specific defence, e.g. phagocytosis. Macrophages would encounter any invading pathogens or foreign objects present on the thorn, engulf and destroy it with enzymes within the macrophage. 2. Antibody mediated immunity. T-lymphocytes such as helper T-cells aid B-lymphocytes to produce antibodies that are specific to the antigen or pathogen. The shape of the antibody fits with the shape of the antigen, helping to destroy it upon contact.	9.4.4, 9.4.5 H4, H6 - Two different defence systems named and a detailed description of how they would respond to the pathogen or foreign object 4 - Two different defence systems named and one good description 3 - One defence system named and one good description OR - Two defence systems named and inadequate description 2 - One defence system correctly named ... 1
Question 18 Malaria is caused by the <i>Plasmodium</i> protozoan. The female <i>Anopheles</i> mosquito spreads the parasite to humans. In 1880, Laveran observed the <i>Plasmodium</i> protozoan in the blood of malaria victims, thereby identifying the causative agent. In 1897, Ross showed the mosquito to be a vector. Quinine, extracted from cinchona bark, was known to have anti-malarial properties before the cause of malaria was known. It was used for over 300 years. Once the life-cycle of <i>Plasmodium</i> was understood, synthetic drugs such as Malarone have been used in preventing malaria, some with mixed success. Due to the protozoan developing resistance to many drugs, new drugs are being synthesised but some have unfavourable side effects. From the 1940's, DDT was used to spray mosquitoes, but mosquitoes also developed resistance to this insecticide. In 1987, the first synthetic vaccine was developed against <i>Plasmodium falciparum</i>. Today, however, anti-malarial drugs are still widely used and recommended pre- and post-travel to malaria infested countries.	9.4.3 H5, H8, H10 - Cause of malaria is accurately stated and a good discussion of how malaria is prevented with reference to the table and/or other historical developments such as vaccines 4 - Cause of malaria poorly stated, but prevention well discussed OR - Cause of malaria well stated with prevention adequately discussed 3 - Cause of malaria not stated, but good discussion of prevention OR - Poorly stated cause of malaria and a poor discussion of prevention 2 - Poor cause only or poorly discussed prevention 1

Part B (Continued)

Sample answer	Syllabus content, course outcomes and marking guide
Question 19 Quarantine is used to isolate infected people, people suspected of carrying the disease or people travelling from a known infected area with SARS. They are tested to ensure that those infected with the disease are treated before contact is made with other individuals. This is done to minimise the chance that the SARS virus will spread amongst the population. With some diseases, treatment is difficult because: • of a lack of an appropriate serum or vaccine or antibiotic; • no treatment has been successfully developed; • treatments are very expensive; • the disease spreads very quickly and resources cannot cope with the spread. Therefore, control of the disease becomes difficult when treatment cannot halt the spread of the disease. As a result, quarantine is used to minimise the contact of infected individuals, helping to prevent the spread of disease. This is important for those diseases that are difficult to treat and those that rapidly spread.	9.4.7 H4, H5, H8, H16 • A good discussion of the role of quarantine. • A good discussion of the changing emphasis from treatment and control to management and prevention 7–8 • A reasonable discussion of quarantine and the changing emphasis from treatment and control to management and prevention OR • A reasonable discussion of the role of quarantine and the changing emphasis from treatment and control to management and prevention 5–6 • A satisfactory discussion of quarantine and the changing emphasis from treatment and control to management and prevention OR • A good discussion of quarantine but a poor discussion of the changing emphasis from treatment and control to management and prevention 3–4 • Poor discussion of the above 2–3 • Limited and lacking in many areas ... 1–2
Question 20 (a) Peppered moth. (b) The peppered moth population was originally mostly light in colour. With the advent of industrialisation near its habitat, trees changed from light-coloured to dark-coloured. As a consequence, light-coloured moths were no longer camouflaged while the previously rare dark-coloured moths now gained an advantage by being camouflaged on the darker tree trunks. The population phenotype shifted from being mostly light to being mostly dark.	9.3.1 H10 • Correctly names a species that can be used as an appropriate example 1 9.3.1 H10, H8 • Clear explanation linking the changes in the named species to changes in its environment 2 • Minimal explanation given OR • Minimal link between changes in the environment and changes in the species 1

Part B (Continued)

Sample answer	Syllabus content, course outcomes and marking guide
Question 21	
(a) adenine, uracil, cytosine, guanine	9.3.4 H10 Correctly names all four bases of mRNA 1
(b) The existence of multiple codons for each amino acid ensures that point mutations in the nucleic acid will not adversely affect the production of the desired polypeptide. If only one base is altered in the codon sequence, the change will often have no effect on the amino acid that is coded for (e.g. UUA changed to UUG by mutation – still codes for leucine). Therefore, the organism can continue to function normally in spite of random point mutations in its nucleic acids.	9.3.4 H10 - Clearly describes how multiple codons are a built-in redundancy to compensate for occasional point mutations. 2 - Limited explanation of significance of multiple codons for point mutations 1
Question 22	
Although Mendel and Darwin published their work within years of one another, the reception of their work couldn't have been more different. While Darwin's evolutionary theories became the focal point of heated debates and social upheaval and he sold many copies of his book, Mendel's work was published in an obscure journal and was forgotten about until after it was rediscovered after 1900. Darwin's work was given immediate attention most likely because it appeared to challenge the authority of the church, which at the time was fighting to keep its dwindling control over society. Also, Darwin was a part of the established scientific aristocracy and his opinions were given an immediate hearing. On the other hand, Mendel's work was overlooked for decades for several reasons: being a monk, he was not part of the inner circle of the scientific elite and did not receive a fair hearing of his findings; his work was published in an obscure journal which did not gain a wide audience; but most importantly, Mendel's ground-breaking work in genetics was probably so far ahead of its time that it was simply not understood until much later.	9.3.1, 9.3.2 H1, H2, H4 - Compares reception of Darwin's and Mendel's work and provides clear reasons for the differences between the two 3 - Compares reception of Darwin's and Mendel's work, but with limited reasoning given for the differences between the two 2 - Compares reception of Darwin's and Mendel's work without any reasons provided OR - Provides reasons for differences in reception without clarifying how the work of the two scientists was received differently 1
Question 23	
(a) As seen in the pedigree between individuals 10 and 11, when close family members intermarry, the likelihood of detrimental genetic disorders appearing in the offspring is greatly increased. The offspring of 10 and 11 show a higher incidence of the genetic trait than other families in the pedigree. This occurs because most genetic disorders are recessive. When two closely related family members intermarry, it increases the probability that the two people are carrying a recessive allele each (or one or even both individuals are carrying two copies of the recessive allele) that can be passed onto the next generation.	9.3.2, 9.3.3 H4, H6, H9 - Explains why many cultures restrict intermarriage between closely related family members by relating it to a higher likelihood of recessive genetic traits appearing in the offspring, with reference to example from pedigree 2 - Minimal explanation given without relating intermarriage to higher likelihood of recessive genetic traits appearing in the offspring 1
(b) (i) 100 % of the male offspring will be affected. (ii) None (0 %) of the female offspring will be affected.	9.3.3 H9 - Correctly identifies chances of affected males and females in the offspring 2 - Correctly identifies chances of affected males only OR - Correctly identifies chances of affected females only 1

Part B (Continued)

Sample answer

Sample answer	Syllabus content, course outcomes and marking guide
Question 24	
(a) A form of insect-resistant cauliflower has been developed by locating a gene in the snowdrop plant that produces a compound that affects insect digestion. The desired gene is isolated and excised from the rest of the snowdrop DNA. It is then inserted into the cauliflower DNA using a viral vector (or other similar means). The snowdrop gene is now part of the cauliflower DNA. The newly developed cauliflower strain is resistant to insects.	9.3.5 H6, H8, H9 • Outlines steps involved in development of a transgenic species, including choosing the desired gene, excising from the donor species' DNA, and inserting it into the recipient species' DNA 2 • Outlines some of the steps involved in the development of a transgenic species 1
(b) The development and use of transgenic species leads to many ethical issues. Some people who oppose the development of transgenic species cite the fact that the technology is still very new and we do not fully know what problems may arise in transgenic organisms in the future. There also exists the argument that many of the transgenic species developed for agricultural use will only lead to economic growth for those who can afford the technology, leaving poorer farmers and developing countries to fend for themselves. Studies of the use of transgenic species have also already shown that some transgenic species can have an adverse effect on the biodiversity within 'wild' populations. In addition, the process of gene manipulation itself angers some individuals who believe that we should not be tampering with nature – 'playing God'. On the other hand, the use and development of transgenic species, if done with enough foresight and careful application, can help to solve many of the world's food production problems, e.g. by developing species that are drought-resistant for use in arid countries. The development of insect-resistant crop species will also mean that fewer chemicals will need to be used, ensuring that ecological damage is minimised. Biodiversity may be able to be conserved through the use of transgenic species if endangered plants or animals can be genetically altered to better suit different environments and thus be able to thrive. Finally, the addition of small segments of DNA to a species genome are unlikely to have any marked effect on the species' overall genetic make-up and will render them largely unchanged.	9.3.5 H4, H5, H7, H8 • Discusses at least TWO areas of concern associated with the development and use of transgenic species. • Provides both arguments for and against the use of transgenic species 6 • Discusses at least TWO areas of concern associated with transgenic species. • Provides an argument for or against the use of transgenic species 4–5 • Discusses ONE relevant area of concern associated with transgenic species. • Provides both arguments for and against the use of transgenic species 2–3 • Identifies ONE relevant area of concern associated with transgenic species OR • Provides an argument for or against the use of transgenic species 1

Part B (Continued)

Sample answer	Syllabus content, course outcomes and marking guide
Question 25	
(a) 30°C	9.2.1 H6, H14 States that the optimum temperature is 30°C, within a range of 28°C to 34°C 1
(b) Substrate concentration or pH.	9.2.1 H6, H14 States substrate concentration or pH as factors affecting enzyme activity 1
(c) As the temperature increases the enzyme may become denatured, reducing its effectiveness and activity.	9.2.1 H6, H14 - States that as temperature increases beyond a certain point, enzyme activity decreases. - States the increase in temperature may denature the enzyme 2 - States that as temperature increases beyond a certain point enzyme activity decreases 1
Question 26	
(a) Placing a micrometer onto the stage of the microscope to determine the field of view for each magnification. Gain a focus under high power of the prepared blood slide and then estimate the number of red blood cells and white blood cells which will fit across the field of view. Divide this by the size of the field of view.	9.2.2 H11 - Correctly states a method for finding the field of view. - Gains a focus under high power. - Describes a correct method for estimating cell size 3 - Correctly states a method for finding the field of view. - Gains a focus. - Describes a method for estimating cell size 2 - Gains a focus under high power. 1
(b) Oxygen is not very soluble in water and therefore must be carried in the blood by haemoglobin contained in the red blood cells. The presence of haemoglobin increases the blood's ability to carry oxygen in the blood.	9.2.2 H10 - States that oxygen is not very soluble. - States that red blood cells contain haemoglobin OR - Haemoglobin increases the blood's oxygen-carrying capacity 2 - States that red blood cells contain haemoglobin 1

Part B (Continued)

Sample answer

Syllabus content, course outcomes and marking guide

Question 27

	<i>xylem</i>	<i>phloem</i>
<i>features</i>	hollow tubes water moves up the plant	companion cells organic substances move around the plant in phloem
<i>characteristics</i>	walls strengthened with lignin	wall porous

9.2.2

H6

- Correctly states two facts about xylem vessels.
- Correctly states two facts about phloem vessels 4
- Constructs closed table with two columns.
- Correctly states one fact about xylem vessels.
- Correctly states one fact about phloem vessels 3
- Constructs closed table with two columns AND
- Correctly states one fact about xylem vessels OR
- Correctly states one fact about phloem vessels 2
- Constructs closed table with two columns 1

Question 28

People who cannot secrete aldosterone have Addison's disease. People with this disease must take hormone replacement therapy (HRT) to stay healthy. Aldosterone increases the reabsorption of sodium. By taking aldosterone tablets the person can maintain the balance of sodium in their body.

9.2.3

H4

- States the disease is called Addison's disease.
- Correctly states the role of aldosterone in the body.
- Explains that by taking HRT the body's balance can be maintained 3
- States the disease is called Addison's disease.
- Explains that by taking HRT the body can function normally 2
- Correctly states the role of aldosterone in the body 1

Question 29

The hypothalamus is the temperature control centre of the body. If it detects a change in the ambient temperature through heat receptors in the skin (for example) then the hypothalamus alerts effectors like blood vessels to constrict or dilate to conserve or release more heat. Shivering can be triggered in response to a lower temperature and the thyroid can also be stimulated to increase metabolism.

9.2.1

H6

- Identifies receptors as detecting a change.
- States three correct responses to a change to a lower temperature 4
- Identifies receptors as detecting a change.
- States two correct responses to a change to a lower temperature 3
- Identifies receptors as detecting a change.
- States one correct response to a change to a lower temperature 2
- States a correct response to a change to a lower temperature 1

Section II

Question 30

Communication

Sample answer

		Syllabus content, course outcomes and marking guide
(a) Humans have two eyes that capture an image and send that image to the brain. The brain combines these images together by matching up the similarities and adding the small differences. This creates a 3-D picture, with width, height and depth.		9.5.4 H2, H13 - Complete answer with explanation 2 - Poor answer or explanation only 1
(b) (i) 1. Tympanic membrane 2. auditory nerve 3. cochlea 4. Eustachian tube		9.5.6 H3, H5, H13 4 correct 2 2 correct 1
(ii) An artificial hearing device such as a hearing aid is used when the membrane is ruptured. It helps to amplify vibrations so that the nerves of the cochlea are physically stimulated. The normal auditory pathway is used. The affected person must have adequate residual hearing. The limitations of this technology is that background noise is a problem; distance is limited to less than 3 metres; it does not assist if there is damage to the inner ear; it cannot amplify too much and that the user may still need to lip read.		9.5.6 H3, H5, H13 - Correctly identifies, evaluates and discusses at least one limitation. 3–4 - Correctly identifies and evaluates, but no limitation mentioned or identified OR - Correctly identifies. Limitation mentioned but no evaluation of the technology 2 - Identifies only 1
(c) (i)		9.5.7 H2, H13 - Ion flow in all three segments correctly stated 3 - Ion flow in two segments correctly stated 2 - Ion flow in one segment correctly stated 1
(ii) The resting potential of a nerve membrane is – 70 mV. An action potential will not be produced if the stimulus is weak or if depolarisation does not reach the critical threshold. The threshold is approximately 15 mV more positive than the resting potential, i.e. approximately – 55 mV.		9.5.7 H2, H6 - Full explanation 2 - Description only. 1
(d) (i) Mammals have rods and cones. Rods detect black and white and are sensitive to light whereas cones detect colour. Pigments in the cones are sensitive to different wavelengths of light. Insects have compound eyes, each eye being made up on small units called ommatidia. This allows for a mosaic image to form as each ommatidia sees part of an object. Efficient at detecting movement. Planarians have a pigment cup with few photoreceptor cells. Useful in detecting light only as the image is unclear.		9.5.4 H2, H13 - Provides correct detail for each animal . . . 3 - Provides correct detail for two animals . . . 2 - Provides correct detail for one animal . . . 1
(ii) Rods have only one pigment, rhodopsin. This allows humans to see in black, white and greys (not colour) and are very sensitive to light responding to low light intensities.		9.5.4 H2, H13 - Complete answer 2 - Poor answer 1

Question 30 Communication (Continued)

Question 30	Communication (Continued)	Syllabus content, course outcomes and marking guide
Sample answer		
(c) Cataract surgery involves the removal of the cloudy lens and replacing it with an artificial lens that is usually made of plastic or silica. The implication for this in society is that: • it improves the quality of life by allowing people with impaired vision to have improved eyesight; • organisations such as the Fred Hollow Foundation have made the operation available to many third world nations at a cost effective price; • operations are simple, the more recent being small incisions that do not require a stitch. People with myopia can see near objects clearly, but distant objects are blurred because the image falls in front of the retina. Myopia can be corrected by people wearing concave lenses in spectacles or contact lenses. People with hyperopia can see distant objects clearly but near objects are blurred because the image falls behind the retina. This can be corrected by convex lenses in spectacles or contact lenses. The lens within the eye does not need to be replaced.	9.5.3 H3, H13, H5 • Describes a technology used to prevent blindness from cataracts. • Discuss at least one implication for society. • Discusses technology used to correct myopia and hyperopia and states how it would be different to that for treating cataracts 6–7 • Describes technology used to prevent blindness from cataracts. • Discusses technology to correct hyperopia and myopia 4–5 • Describes technology to prevent blindness from cataracts and implication for society. • Very little discussion of hyperopia and myopia 2–3 • Limited discussion of one aspect of the question 1	