

2006
FORM VI
HSC TRIAL EXAMINATION

Biology CRIB

General Instructions

- Reading time 5 minutes
- Working time – 3 hours
- Board-approved calculators may be used
- Write using blue or black pen
- Draw diagrams using pencil
- Write your Candidate Number at the top of each page of Part B

Total marks: 100

Section I Pages 2 – 23

This section has two parts, Part A and Part B

Part A

Total marks: 15

- Attempt Questions 1 to 15
- Allow about 25 minutes for this Part

Part B

Total marks: 60

- Attempt Questions 16 to 30
- Allow about 1 hour 50 minutes for this Part

Section II Pages 25 - 29

Total marks: 25

- Attempt ONE Question from Option Questions
- Allow about 45 minutes for this Section

CHECKLIST

Each boy should have the following:

1 Question Paper	
1 Multiple-choice Answer Sheet	
1 4-page Writing Booklet	

Part A**Total marks: 15****Attempt Questions 1 to 15****Allow about 25 minutes for this Part**

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

Part B**Total marks: 60****Attempt Questions 16 to 30****Allow about 1 hour 45 minutes for this Part**

Answer the questions in the spaces provided.
Show all relevant working in questions involving calculations.

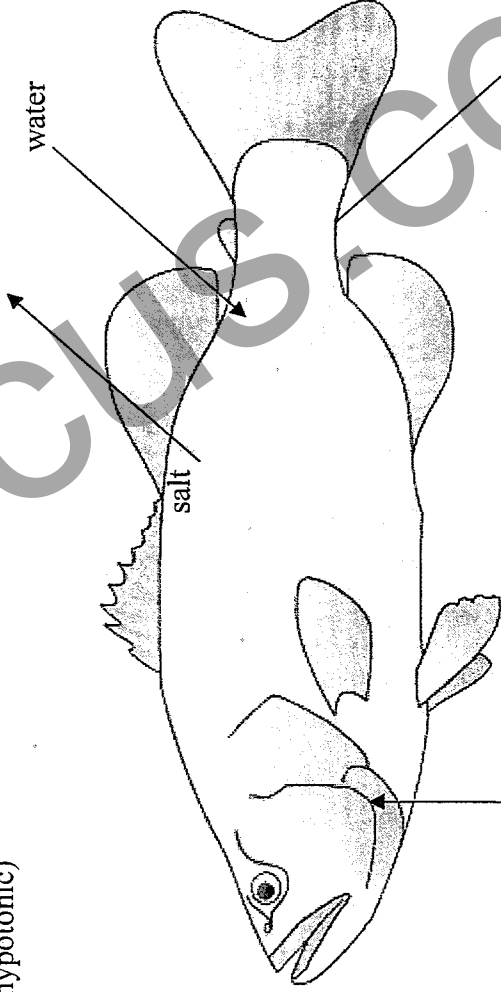
Marks**Question 16 (4 marks)**

Using the diagram below, outline the strategies used by a freshwater fish to cope with living in a hypotonic environment.

4

1 mark for indicating higher salt concentration inside fish than outside (i.e explain hypotonic)

1 mark for suggesting salt out, water in



1 mark for active absorption of salt in gills

1 mark for production of large quantities of dilute urine (ammonia)

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Marks**Question 17 (3 marks)**

Harry Kewell missed round of 16 of the World Cup, with suspected gout. Although humans usually produce very little uric acid, gout is caused by a high content of uric acid in the blood which accumulates as crystals in the joints and causes acute pain.

3

From Doug Conway Kaiserslautern, Germany
June 27, 2006

Uric acid crystals are commonly found as a nitrogenous waste product in some types of animals. Compare the major forms of nitrogenous wastes produced in animals, including the types of animals producing each form and how they affect water conservation. You may draw a table.

Ammonia – freshwater only – low conservation of water

Urea – terrestrial and marine – medium conservation of water

Uric acid – birds/insects – high conservation of water

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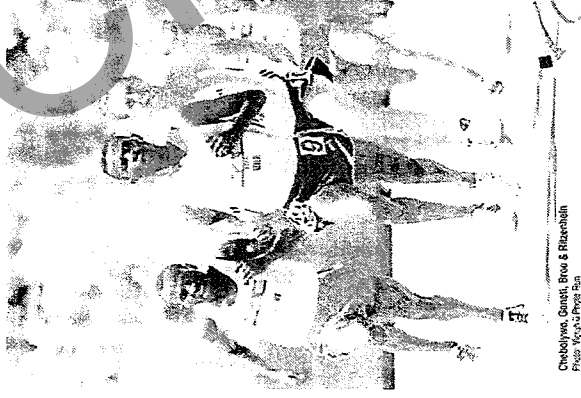
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Question 18 (2 marks)

One method to improve an athlete's physical performance is to have them train at high altitude where the oxygen concentration of the air is reduced. Although initially there may not be sufficient oxygen available for normal tissue metabolism (hypoxia) the body can respond physiologically over time in several ways to compensate for this deficiency of oxygen. The rate of acclimatisation varies among individuals and depends on the change in altitude.



Chelolywe, Ganset, Broe & Rianzhain
Photo: Weyna Press Run

Suggest a mechanism by which an infusion of red blood cells taken from an athlete who has been training at high altitude (i.e. blood doping) may enhance athletic performance at sea level.

2

Either more RBC's and more oxygen or more Hb and more oxygen (1 mark)
and why this enhances athletic performance (e.g. more energy production/more respiration) (1 mark)

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Question 19 (5 marks)

You are an endocrinologist who diagnoses a patient with Addison's disease, which is a disease of the kidney. Some of the symptoms for this disease include loss of weight, low blood pressure and salt craving.

- (a) What is the cause of Addison's disease?

1

Lack of Aldosterone

- (b) Explain the physiology behind **two** of the above symptoms.

4

Aldosterone causes uptake of salt (1 mark)

As a result more water is absorbed (1 mark)

With no aldosterone:

⇒ low water ∴ thirst (1 mark)

⇒ low water ∴ low b.pt (1 mark)

⇒ loss of salt ∴ salt craving (1 mark)

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Question 20 (6 marks)

- (a) Compare the responses of a named Australian ectotherm with a named Australian endotherm to a cold environment. 4

O – names of organisms (1 mark)

C – comparison of organisms (1 mark)

1 mark for each response

- (b) Explain why such homeostatic responses are essential for the survival of organisms. 2

Homeostasis is maintenance of stable temp and pH (1 mark)

Enzymes work best within narrow band of temp and pH (1 mark)

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Marks**Question 21** (5 marks)

Phenotypes are affected by the environment. Siamese cats are darker on their extremities, due to temperature effects on phenotypic expression. Expression of phenotype is a result of the interaction between genes and environment. Siamese cats and Himalayan rabbits both have dark coloured fur on their extremities, but not on the rest of their bodies.

- (a) Propose a mechanism by which the environment affects the phenotype of the above species. 2

Extremities are cooler than core (1 mark)

Genes are switched on/off according to temperature (1 mark)

- (b) Outline a first-hand investigation you have carried out to demonstrate the effects of environment on phenotype. 3

Barely seeds (reasonable number) (1 mark)

Grown in light/dark

Other conditions constant (1 mark)

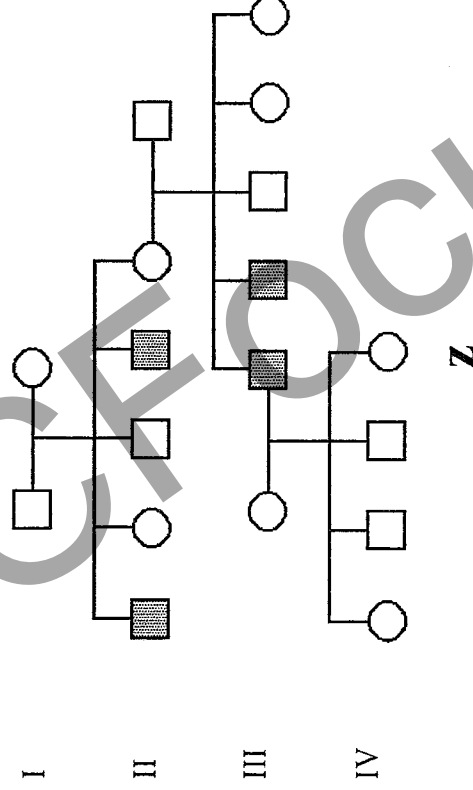
Results (1 mark)

Light necessary for chlorophyll production (1 mark)

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Marks**Question 22** (4 marks)

Becker's muscular dystrophy is a sex-linked muscular disorder which occurs in approximately 5 in 100,000 male births. Symptoms usually appear in men about age 12, but may sometimes begin later. The average age of becoming unable to walk is 25-30. Women rarely develop symptoms. Below is a pedigree for the disorder.



- (a) Is the disorder likely to be dominant or recessive? Give an explanation for your choice. 1

Recessive – if dominant, offspring in generation II would all have same genotype/phenotype

- (b) Predict the likely genotypic and phenotypic ratio of offspring of a mating between Z and a male that does not have the disease. 3

	X^B	X^b
X^B	$X^B X^B$	$X^B X^b$
Y	$X^B Y$	$X^b Y$

1 mark for punnet square

1 mark for genotypic ratio

1 mark for phenotypic ratio

Phenotypic ratio is 2 normal female : 1 normal male : 1 diseased male

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Question 23 (5 marks)

Below is an mRNA sequence as it appears in the ribsome ready for translation and the universal code for translating this base sequence into an amino acid sequence.

AUGCUGCGUAA CUUUGGCUGA

Nucleotide position in codon				
first	second			third
	U	C	A	G
U	UUU - Phe UUC - Phe UUA - Leu UUG - Leu	UCU - Ser UCC - Ser UCA - Ser UCG - Ser	UAU - Tyr UAC - Tyr UAA - Stop UAG - Stop	UGU - Cys UGC - Cys UGA - Stop UGG - Trp
C	CUU - Leu CUC - Leu CUA - Leu CUG - Leu	CCU - Pro CCC - Pro CCA - Pro CCG - Pro	CAU - His CAC - His CAA - Gln CAG - Gln	CGU - Arg CGC - Arg CGA - Arg CGG - Arg
A	AUU - Ile AUC - Ile AUA - Ile AUG - Start	ACU - Thr ACC - Thr ACA - Thr ACG - Thr	AAU - Asn AAC - Asn AAA - Lys AAG - Lys	AGU - Ser AGC - Ser AGA - Arg AGG - Arg
G	GUU - Val GUC - Val GUA - Val GUG - Val	GCU - Ala GCC - Ala GCA - Ala GCG - Ala	GAU - Asp GAC - Asp GAA - Glu GAG - Glu	GGU - Gly GGC - Gly GGA - Gly GGG - Gly

- (a) Using the universal code above, it can be seen that **AUG** is the start codon for this particular gene. What will be the amino acid sequence produced by the remainder of this particular base sequence?

Start - Leu - Arg - Asn - Phe - Gly - Stop

Question 23 continued on next page.

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- (b) There are many different types of mutations. Insertions add one or more extra nucleotides into the DNA. Using the same sequence of RNA, predict the amino acid sequence produced by the insertion of the base C (cytosine) at the position marked by the arrow.

AUGCUGC GUAACUUUGGCUGA

↑
C

START – LEU – PRO – STOP (did not get mark if amino acids after stop were included)

- (c) Explain how mutations in DNA may lead to the generation of new alleles. **2**

Change in DNA sequence in alleles must occur in sex cells (gametes) (1 mark)

This is only way mutation can be passed on to next generation.

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Question 24 (2 marks)**2**

The rhesus (Rh) factor is an antigen found on the surface of red blood cells. If you are Rh positive (Rh⁺) your cells have the antigen and if you are Rh negative (Rh⁻) your cells do not have the antigen.

A man who was Rh⁺ marries a woman who is Rh⁻. The man's father was Rh⁻.

Rh⁺ is dominant to Rh⁻. Predict the percentage chance of this couple having a Rh⁻ child.

Key (1 mark) e.g. R = rhesus positive

r = rhesus negative

punnet square and other working + %chance (1 mark)

i.e. man = Rr

woman = rr

	R	r
r	Rr	rr
r	Rr	rr

∴ 50% chance

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Question 25 (3 marks)

Discuss two reasons why Mendel's work was not recognised by the scientific community at the time he published his findings.

3

Any two good reasons and a discussion of the reasons

e.g not published widely

not recognised as a scientist

maths unusual

no understanding of genetics

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Marks**Question 26** (6 marks)

No scientific theory is formulated in a social and political vacuum.

6

Discuss this statement in relation to the historical development of theories of evolution.

Darwin's theory of evolution by natural selection was published in the mid 19th century. He proposed that there had been a gradual evolution of forms and that change was brought about by environmental pressures for survival. He was not the first to tackle the problem of diversity of forms Lamarck had previously put forward the idea that characteristics acquired during an organism's lifetime could be passed on to their offspring. At the time these men were formulating their ideas the predominant theory to account for biodiversity was special creation where God created all organisms separately. The Church was a powerful influence both politically and socially and so Darwin's theory was in direct contradiction to the church's teachings. However the discovery and interest in fossils, the rise of scientific thought, ideas about the struggle for survival in industrial cities were all contributing to the questioning of the church and its teachings. Even the building of canals and railway cuttings and deeper coal mines were showing that the age of the earth was not 6000 years but much older. Evidence was building up that scientists could no longer ignore.

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Marks**Question 27** (2 marks)

Distinguish between non-infectious disease and infectious disease.

2

Correctly distinguishes between infectious and non-infectious diseases.

Infectious diseases always caused by a pathogen transmitted from an infected host to an infected individual.

Non-infectious disease caused by factors other than a pathogen e.g. exposure to an environmental factor, dietary, inherited

Only 1 mark for correctly defining one of the disease types.

Question 28 (3 marks)

After hurricane Katrina hit the Gulf Coast of the United States of America in August 2005, people were removed from flooded areas because the authorities were afraid that the water and sewage systems and the electricity supply were not working. As a result, the food and water supply and personal hygiene could not be maintained.

3

Using hurricane Katrina as an example, explain how cleanliness in food, water and personal hygiene practices assist in the control of disease.

Correctly explains how cleanliness in food and water and personal hygiene control disease.

When water and sewerage systems are not working, food and water can become contaminated by faecal matter containing microorganisms

Ingestion of food/water contaminated by flood water can lead to widespread disease

After participating in flood cleanup activities and after handling contaminated articles hands and other items should be washed with soap/water – water should be disinfected

All 3 of the above for 3 marks, 2 of the above for 2 marks and 1 of the above for 1 mark

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Question 29 (5 marks)For a **named** infectious disease:

(a)

State how the disease is transmitted.

1

e.g. Malaria – caused by protozoan parasite that is transmitted to human bloodstream by bite of anophales mosquito which acts as a vector

(b)

State the major symptoms of the disease.

2

Any two major symptoms.

Shivering, fever, headaches, nausea, sweating, lethargy, (flu like symptoms)

Weakness, body aches, vomiting.

(c)

Explain how the disease could be prevented.

2

Destroy/avoid being bitten by Anophales mosquitoes (vector)

Once infected serious disease prevented by effective antimalarial drugs in early stages

vaccine

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Question 30 (5 marks)

A mysterious disease outbreak occurs in a colony of Koalas living in the forests around the Lucus Heights nuclear reactor. Ten sick animals are found to be suffering from the same symptoms; weight loss, skin lesions and foul breath. Radioactive contamination of the local environment is suspected. However, blood tests of the sick animals reveal that they have a type of bacterium in their blood. Describe the steps that you would undertake to prove that this particular bacterium is the cause of the disease.

5

1. *All koalas showing symptoms of the disease must contain the bacteria in their blood sample*
2. *The bacteria must be isolated and grown in pure culture in the lab*
3. *When a healthy individual is inoculated with the isolated bacteria, the healthy host must develop symptoms of the disease*
4. *The bacteria must be isolated from the induced host and be shown to be the same bacteria as originally cultured*
5. *Demonstrates high level of understanding or relate to that disease*

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Section II**Total marks: 25****Attempt ONE question from Questions 31 - 34****Allow about 45 minutes for this section**

Answer the question in a writing booklet. Extra writing booklets are available.

	PAGES
Question 31 Communication	27
Question 32 Biotechnology	
Question 33 Genetics - The Code Broken?	29
Question 34 The Human Story	
Question 34 Biochemistry	

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Question 31 – Communication (25 marks)

- (a) Identify the role of receptors in animals. **1**
- (b) Depth perception is highly evolved in primates and many predators. Explain the processes involved in depth perception. **2**
- (c) (i) Draw a detailed diagram to show how light is refracted in the mammalian eye onto the fovea. **2**
- (ii) Compare the refractive power of the lens from rest to maximum accommodation. **2**
- (d) Describe the condition known as cataracts and the ways technology can be used to overcome the effects of cataracts. **5**
- (e) During your Biology course, you performed a first-hand investigation of a mammalian eye to gather first-hand data to relate structure to function. Describe the investigation you carried out and the conclusions that were reached. **6**
- (f) Compare the nature and functioning of photoreceptor cells in mammals, insects and in one other animal. **7**

ANSWERS

- (a) *To detect stimuli (changes in either the internal or external environment) (1 mark)*
- (b) *requires 2 sources of information (binocular or stereoscopic vision) (1 mark). Slightly different images from both eyes are overlapped and used by brain to determine distances (1 mark)*
- (c) (i) *diagram showing light rays converging on the fovea (1 mark) correctly label the fovea, lens, cornea, light rays (1 mark)*
(ii) *at rest refractive power is low, while at max accommodation refractive power is high (1 mark)*
at rest lens is flattened and thin, while at max accommodation it is more rounded/convex (1 mark)
- (d) *description of cataracts – clouding of the normally clear lens (1 mark)*
3 good points about technology.
e.g. A surgical operation can be performed to replace a cloudy lens with an artificial lens called an intraocular lens. It is a simple operation that can be done under a local anaesthetic. A small incision is made in the front of the eye where the cornea meets the sclera. A small probe is inserted and the lens is bombarded with high frequency ultrasonic sound. This breaks the lens into pieces which are removed. A new lens is put in place.
- (e) *First hand investigation. Equipment list – or specified within answer (1 mark)*
Method (2 marks), Risk assessment (1 mark), Results/conclusion (2 marks)

(f) for each of the 3 animal types.

- nature of photoreceptors
- function of photoreceptors
- direct comparison made (1 mark)

} (2 marks = 6 marks)

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Animal	Visual system	Photopigment	Colour vision
Planaria (flatworm)	• cup eye with no lens • no image formed- only detects presence and direction of light • photocells are ocelli, which produce an impulse when light falls on them	Rhodopsin	No
Bee	• compound eye consisting of many ommatidia made up of a cornea and a lens made of a crystalline cone • receptor cells produce an electrical impulse when light falls on them	Rhodopsin; able to detect motion very accurately	Yes, including UV
Octopus	Single –lens eye forming an image	Rhodopsin	Yes, also polarised light
Hawk	Single –lens eye forming an image	Rhodopsin; four types of cone cells	Yes; four colour visual system
human	Single –lens eye forming an image	Rhodopsin; three types of cone cells and one type of rod cell	Yes; three colour visual system