

SYDNEY GRAMMAR SCHOOL



2003
FORM VI
HSC TRIAL EXAMINATION

Biology

CRIB

General Instructions

- 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

Section I Pages 2 - 20

Total marks: 75

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 28
- Allow about 1 hour 45 minutes for this Part

Section II Pages 21 - 23

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

Part B**Total marks: 60****Attempt Questions 16 to 28****Allow about 1 hour 45 minutes for this Part**

Class

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Answer the questions in the spaces provided.

Show all relevant working in questions involving calculations.

Marks**Question 16** (5 marks)

Homeostasis can be said to consist of two stages:

- detecting changes from the stable state.
- counteracting changes from the stable state.

5

Discuss this statement with reference to a named example.

DEFINITION OF HOMEOSTASIS: THE MAINTENANCE OF A CONSTANT (WITHIN FINE LIMITS) OF A CONSTANT INTERNAL ENVIRONMENT (1 MARK)

USING A NAMED EXAMPLE: RECEPTOR DETECTS EXTERNAL CHANGE (VIA STIMULI) AND SENDS INFORMATION VIA NERVOUS SYSTEM TO A CONTROL CENTRE (1 MARK).

FOR TEMPERATURE THIS IS THE HYPOTHALAMUS (NOTE SPELLING!). (1 MARK)

THE CONTROL CENTRE SENDS A MESSAGE TO AN EFFECTOR TO PROMOTE A RESPONSE (1 MARK).

NEGATIVE FEEDBACK OPERATES TO NULLIFY THE RESPONSE VIA THE RECEPTOR, CONTROL CENTRE, EFFECTOR (1 MARK)

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Marks**Question 17** (3 marks)

Describe three processes involved in the production and maintenance of the transpiration stream in flowering plants.

3

DESCRIPTIONS OF ANY 3 PROCESSES ARE REQUIRED - NOT JUST NAMES. (NO MARKS)

1. OSMOSIS: MOVEMENT OF WATER MOLECULES FROM A HIGH CONC. TO A LOW CONC. THROUGH A SELECTIVELY PERMEABLE MEMBRANE - FROM SOIL TO ROOT (1)
2. COHESION: ATTRACTION OF LIKE-MOLECULES E.G. WATER MOLECULES TO MAINTAIN A CONTINUOUS CHAIN OF MOLECULES (UNDER TENSION) (1)
3. ADHESION: ATTRACTION OF UNLIKE MOLECULES - WATER MOLECULES TO XYLEM TO PREVENT WATER MOLECULES MOVING BACK DOWN THE XYLEM
4. TRANSPIRATION: THE EVAPORATION OF WATER MOLECULES FROM STOMATA CAUSES A PULLING FORCE TO BE EXERTED ON WATER MOLECULES. THEREFORE, THE CHAIN OF WATER MOLECULES IS PULLED UP THE XYLEM
5. ROOT PRESSURE: PRESSURE OF WATER ENTERING XYLEM AT ROOT CAUSES A POSITIVE PRESSURE WHICH CAN PUSH THE WATER MOLECULES A SHORT DISTANCE UP THE XYLEM.

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Class

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Question 18 (4 marks)

In calico cats, the allele X^B produces black fur colour and the allele X^L produces yellow fur. These alleles show co-dominance and the hybrid form produces tortoiseshell fur colour. The genes are sex-linked.

A black female cat was mated with a yellow male cat and several offspring were produced. State the genotypes of the parents and the phenotypes (including sex) of all possible offspring. Show your working.

4

 $X^B X^B \times X^L Y$

(1 mark)

 $X^B X^L$ $X^B Y$ $X^B X^L$ $X^B Y$

(1 mark)

plus 1 mark for working/Punnett Sq

F'T

MB

F'T

MB

(1 mark)

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Class

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Question 19 (6 marks)

Compare the structure of arteries and veins in relation to how blood is moved through them.

6

MUST MAKE SIMILARITIES (OFTEN OMITTED) AS WELL AS DIFFERENCES:

BOTH HAVE A CENTRAL LUMEN THROUGH WHICH BLOOD CAN FLOW (1)

ARTERIES HAVE A THICKER, MORE MUSCULAR AND MORE ELASTIC WALL THAN VEINS (2).

ARTERIES HAVE THESE FEATURES TO COPE WITH BLOOD UNDER VERY HIGH PRESSURE (1) AND CAN ALSO ASSIST IN EXPANDING AND RECOILING TO ACCOMMODATE PULSE OF BLOOD (1).

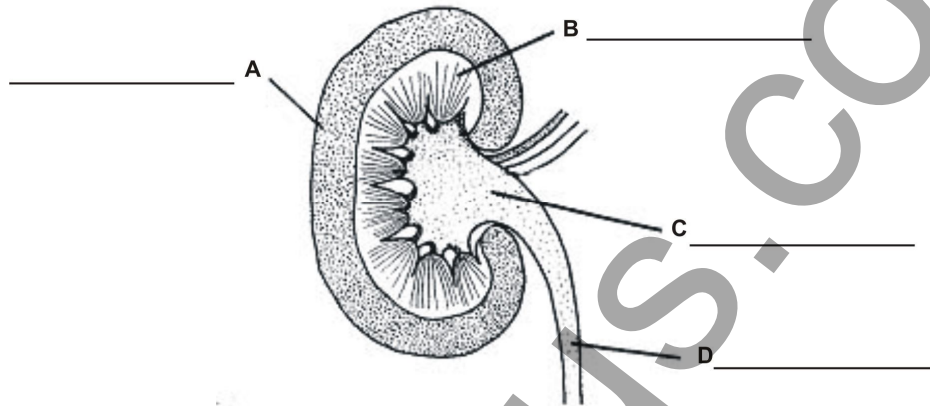
VEINS HAVE A THINNER WALL (BUT ARE NOT SMALLER IN DIAMETER), WITH LESS MUSCLE AND LESS ELASTIC TISSUE BECAUSE BLOOD IS UNDER LOWER PRESSURE (1). OR

VALVES ARE PRESENT TO PREVENT BACK-FLOW OF BLOOD IN VEINS. BLOOD MOVEMENT IS ASSISTED BY SKELETAL MUSCLE TO PUSH BLOOD FORWARDS,

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Marks**Question 20** (4 marks)

- (a) Identify the parts labelled A, B, C and D on this diagram of the internal structure of a human kidney. 2



- (b) Identify the main function of: 2

- (i) part A

FILTRATION = 1 MARK

- (ii) part B

RE-ABSORPTION = 1 MARK

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Marks**Question 21** (4 marks)

Outline the need for oxygen in living cells and explain the adaptive advantage of haemoglobin in the circulatory system of a mammal. **4**

INDICATION THAT OXYGEN IS REQUIRED FOR EFFICIENT RESPIRATION (IE EQUATION) **1**

RESPIRATION **LIBERATES ENERGY** (IN THE FORM OF ATP) WHICH CAN BE USED TO DRIVE METABOLISM. (NB NO MARKS FOR SIMPLY SAYING OXYGEN IS NEEDED FOR METABOLISM)

1

HAEMOGLOBIN CAN "FIX" O₂ MAKING IT 100X MORE SOLUBLE THAN IN PLASMA

1

THIS ALLOWS LARGE QUANTITIES OF O₂ TO BE DELIVERED TO TISSUES FAR FROM THE SITE OF O₂ ABSORPTION AND THEREFORE ALLOWS FOR

-THE EVOLUTION OF LARGER AND MORE COMPLEX ORGANISMS.

-FASTER/MORE EFFICIENT METABOLISM ETC

1

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Marks**Question 22** (2 marks)

Explain why the removal of carbon dioxide from the cells of an organism is essential for its survival.

2

CO₂ WHEN DISSOLVED IN THE CYTOPLASM WILL FORM H₂CO₃ .

1

THIS IS ACIDIC AND WILL HAVE A DETRIMENTAL EFFECT ON THE EFFICIENCY OF ENZYMES WHICH OPERATE OPTIMALLY AT A SPECIFIC PH.

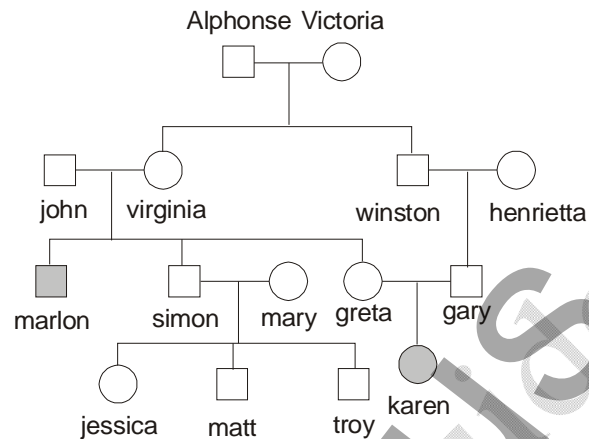
1

(MUST TALK ABOUT EFFECT OF CO₂ ON CELLS)

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Marks**Question 23** (5 marks)

Study the human pedigree for the inheritance of the disease *phenylketonuria* (PKU).



- (a) Using the symbols N = normal and n = PKU, state the genotypes of:

2

- (i) john

Nn 1

- (ii) marlon

nn 1

- (b) Explain why the mutation causing this disease probably occurred in either Alphonse or Victoria rather than in a later generation.

2

IT IS VERY UNLIKELY THAT THE MUTATION SPONTANEOUSLY OCCURRED TWICE (IE IN VIRGINIA AND WINSTON OR HENRIETTA OR GARY) 1

ALPHONSE AND VICTORIA ARE THE COMMON ANCESTORS OF ONE OF MARLON'S PARENTS AND **BOTH** OF KAREN'S PARENTS **OR** DESCENDENTS OF BOTH OF ALPHONSE'S AND VICTORIA'S CHILDREN HAD PKU 1

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Marks

Question 23 (continued)

- (c) State the probability of a second child of Greta and Gary inheriting the allele. (*show working*) **1**

75%

Question 24 (4 marks)

There are many theories to explain the considerable diversity of life on Earth.

In an experiment on the effects of an insecticide on flea infestations of a domestic dog, it was found that after the first two treatments the insecticide was effective. However, after some months, a third treatment was less effective and many fleas remained alive. **4**

Give a reasoned scientific explanation for these observations.

THE INSECTICIDE IS ACTING AS A SELECTIVE AGENT

1

INITIALLY THE INSECTICIDE KILLED MOST OF THE FLEAS

1

HOWEVER, SOME FLEAS WERE IMMUNE TO ITS EFFECTS **1**

THESE THEN BRED AND SOON BECAME THE DOMINANT FORM (MOST NUMEROUS), RENDERING THE INSECTICIDE INEFFECTIVE.

1

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Marks**Question 25** (8 marks)

DNA is a complex molecule found in almost all living organisms.

- (a) Use a labelled diagram to illustrate the process of DNA replication. **3**

MARKS AWARDED FOR -

UNZIPS (AND UNWINDS) **1**

FREE NUCLEOTIDES PAIRING WITH SINGLE STRANDS

1

NEW DOUBLE STRANDS FORMING (BEHIND NUCLEOTIDE ATTACHMENT SITE OF UNZIPPING HELIX) **1**

NB MANY STUDENTS DID NOT ILLUSTRATE THE PROCESS, INSTEAD SIMPLY DRAWING THE END RESULTS.

- (b) Name a mutagen. **1**

RADIATION, NAMED CHEMICAL, BIOLOGICAL AGENT.

- (c) Draw a simple flow chart to illustrate how changes in DNA structure can result in changes in cell activity. **4**

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CHANGED DNA BASE SEQUENCE
  ↓
ALTERED TRANSCRIPT
  ↓
DIFFERENT AMINO ACID SEQUENCE
  ↓
CHANGED TERTIARY STRUCTURE (PROTEIN)
  ↓
ENZYME WITH ALTERED FUNCTIONALITY
  ↓
CATALYSIS OF REACTION(S) CHANGED
  ↓
DIFFERENT CELL ACTIVITY

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5 OR 6 CLEAR STEPS - **4** MARKS

4 CLEAR STEPS - **3** MARKS

3 CLEAR STEPS - **2** MARKS

2 CLEAR STEPS - **1** MARK

NB - IT IS CLEAR THAT MANY STUDENTS HAVE NO IDEA WHAT A FLOW CHART IT. IT IS EQUALLY CLEAR THAT THE REST HAVE A VERY LIMITED UNDERSTANDING OF THE RELATIONSHIP BETWEEN DNA STRUCTURE AND CELL ACTIVITY.

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Marks**Question 26** (5 marks)

Describe a first-hand investigation that you have performed to demonstrate the effect of changes in temperature on the activity of an enzyme.

5

1 MARK FOR NAMING THE ENZYME AND THE SUBSTRATE

1 MARK FOR STATING 2 DIFFERENT TEMPERATURES

1 MARK FOR KEEPING ALL OTHER FACTORS CONSTANT

1 MARK FOR A REASONABLE RESULT

1 MARK FOR A METHOD THAT WOULD WORK

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Marks**Question 27** (3 marks)

Draw a labelled diagram to illustrate a simple model for the specificity of enzymes to their substrate.

3

1 MARK FOR SUBSTRATE AND ENZYME CORRECTLY LABELLED

1 MARK FOR CORRECT SHAPE & MATCH-UP

1 MARK FOR LOCATING AND IDENTIFYING ACTIVE SITE

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Marks

Question 28 (7 marks)

Using specific examples, describe how the Theory of Evolution is supported by:

7

- palaeontology
- comparative anatomy
- biogeography

THE THEORY OF EVOLUTION STATES THAT PRESENT-DAY ORGANISMS CAME FROM PRE-EXISTING COMMON ANCESTORS WHICH CHANGED OVER LONG PERIODS OF TIME. (1 MARK)

PALAEONTOLOGY IS THE SCIENTIFIC STUDY OF FOSSILS AND ALL ASPECTS OF EXTINCT LIFE. THE FOSSIL RECORD, PRESERVED IN LAYERS OF SEDIMENTARY ROCK (OF KNOWN AGE), PROVIDES CLEAR EVIDENCE OF CHANGES FROM SIMPLE ORGANISMS TO MORE COMPLEX ORGANISMS. EXAMPLE: ARCHAEOPTERYX FOSSILS SUGGEST TRANSITIONAL FORMS (2 MARKS)

COMPARATIVE ANATOMY SHOWS SIMILAR STRUCTURES IN DIFFERENT ORGANISMS. THESE HOMOLOGOUS STRUCTURES SUGGEST A COMMON ANCESTRY WITH CHANGES DUE TO ADAPTATION TO SPECIFIC FUNCTION. EXAMPLE: THE PENTADACTYL LIMB OF MANY VERTEBRATES SHOWS SIMILAR BASIC STRUCTURE MODIFIED FOR SPECIALIZED FUNCTIONS, SUGGESTING COMMON ANCESTRY (2 MARKS)

BIOGEOGRAPHY REFERS TO THE GEOGRAPHICAL DISTRIBUTION OF BOTH LIVING AND FOSSIL ORGANISMS. THE DISTINCTIVE AND SOMETIMES UNIQUE FAUNA AND FLORA FOUND ON VARIOUS ISLANDS AND CONTINENTS SUPPORTS THE THEORY THAT THESE ORGANISMS EVOLVED FROM ANCESTRAL SPECIES WITHIN THAT GEOGRAPHIC REGION (FURTHER SUPPORTED BY PLATE TECTONICS/CONTINENTAL DRIFT) EXAMPLE: FLIGHTLESS BIRDS FOUND ON QUITE SEPARATE AND DISTANT CONTINENTS (2 MARKS)

Note: Biogeography not well understood; several boys incorrectly used convergent evolution as an example

Section II**Total marks: 25****Attempt ONE question from Questions 29 - 33****Allow about 45 minutes for this section**

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

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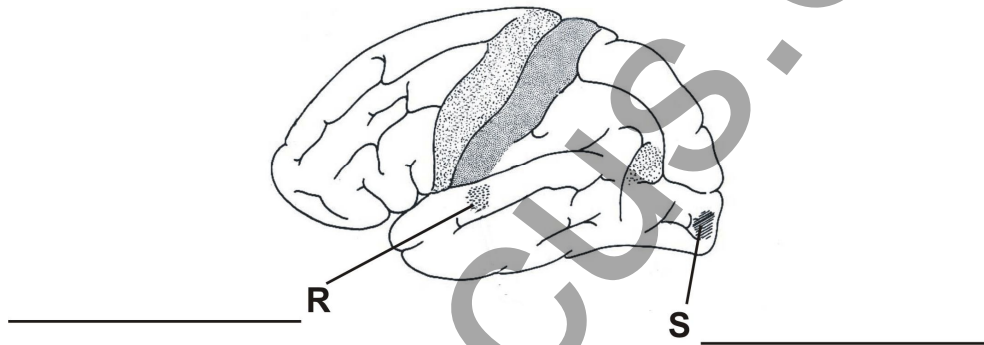
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Question 32	The Human Story	
Question 33	Biochemistry	

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Marks**Question 29 – Communication (25 marks)**

- (a) (i) Where is the vitreous humour located in the eye? You may draw a labelled sketch of the eye if you wish. **1**
- (ii) On the diagram of the brain below state the functions of the areas labelled R and S. **2**

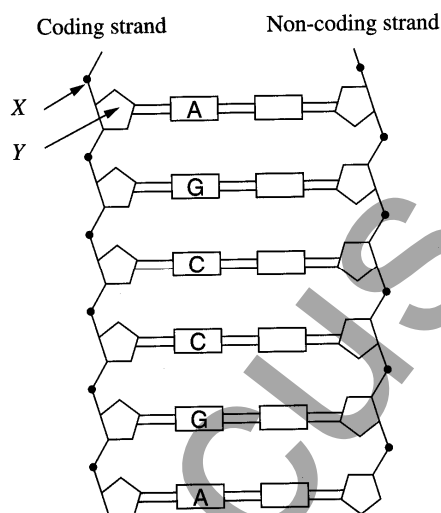


- (b) (i) How would you gather information on the wavelengths of the electromagnetic spectrum which can be detected by animals other than humans? In your answer explain how you would assess the reliability of the information that you had collected. **2**
- (ii) Draw a detailed diagram to show how the lens of the eye refracts light onto the fovea. **2**
- (c) Outline the structure of the human larynx and the associated structures that assist the production of intelligible sounds. In your answer explain how each structure helps to produce the sounds. **5**
- (d) Describe one technology which is used to help a named visual impairment and one technology which is used to overcome a named auditory impairment. In your answer you should clearly explain the defect, how it affects the sufferer and how the technology helps to overcome the defect. **6**
- (e) Explain the role of the photoreceptors in vision. **7**

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Marks**Question 31 Genetics – The Code Broken? (25 marks)**

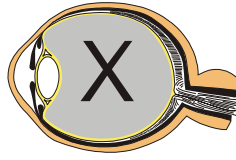
- (a) The diagram shows a simplified model of a DNA molecule.



- (i) Identify the chemical substances represented by X and Y 1
- (ii) Reading from the top downwards, this section of DNA would code for the amino acid sequence *Serine – Arginine*. State the anti-codon triplets found on those tRNA molecules that mobilize Serine and Arginine. 2
- (b) Is it possible for a female with blood type A and a male with blood type B to have children with four different blood types? Show working. 2
- (c) Describe the evidence which indicates the presence of ancestral vertebrate gene homologues (homologous genes) in lower animal classes such as insects. 2
- (d) In pea plants, the allele for green seeds (G) is dominant to the allele for yellow seeds (g). The allele for tall plants (T) is dominant to the allele for short plants (t). Pure breeding tall/green plants were crossed with pure breeding yellow/short plants to produce the heterozygous F₁ generation. These F₁ plants were then crossed to produce the F₂ generation. 5
- Predict the difference in the phenotype ratio of the F₂ generation if (i) the alleles for colour and height are independently inherited; and (ii) the alleles for colour and height are linked. (*show working*)
- (e) Using one specific example, describe the effect of a named and/or described genetic mutation on human health. 6
- (f) Distinguish between gene cloning and whole organism cloning in terms of the processes and beneficial products. 7

Q 29 - COMMUNICATIONS OPTION CRIB

- (a) (i) BETWEEN THE LENS AND THE RETINA



- (ii) R - sound
S - vision

- (b) (i) 1 mark - REASONABLE SOURCES SUCH AS THE INTERNET, JOURNALS & BOOKS - MUST NAME 2

1 mark - SOURCE - i.e. UNI ETC
DATA - i.e. RECENT

- (ii) 1 mark FOR SHOWING LIGHT RAYS REFRACTED BY LENS
1 mark FOR CORRECT DRAWING i.e. FOCUS ON RETINA

- (c) 2 marks - ACCURATE DESCRIPTION OF LARYNX, 2 STRUCTURES WELL DEFINED

1 mark - HOW IT WORKS
OR

1 mark - FOR GOOD DESCRIPTION OF CARDS
1 mark - FOR HIGH / LOW PITCH
1 mark - FOR VOLUME

2 marks - FOR STRUCTURE RELATING TO FUNCTION OF
2 OTHER STRUCTURES. ONE MUST BE THE LUNGS.

- | | |
|----------------------|----------------------|
| (d) 3 marks - VISION | 3 marks - HEARING |
| 1 mark - DESCRIPTION | 1 mark - DESCRIPTION |
| 1 mark - TECHNOLOGY | 1 mark - TECHNOLOGY |
| 1 mark - EXPLANATION | 1 mark - EXPLANATION |

(e) ESSENTIAL INFORMATION

- 1 mark - RODS AND CONES IN RETINA → VISUAL CORTEX OF THE BRAIN
- 1 mark - CONTAIN LIGHT SENSITIVE PIGMENTS e.g. RHODOPSIN
- 1 mark - FOR DISTRIBUTION OF EACH TYPE OF CELL
- 1 mark - FOR NERVOUS ATTACHMENT OF EACH CELL TYPE
- 1 mark - FOR FUNCTION OF RODS
- 1 mark - FUNCTION OF CONES - TRICHROMATIC VISION
- 1 mark - FOR VISUAL ACUITY AND CONES

Q31 - GENETICS OPTION CRIB

(a) (i) X = phosphate Y = sugar (1 mark for both)

(ii) UCG GCU (also accept AGC GCU) (2 marks)

(b) Yes, it is possible (0 marks)

if mother is heterozygous A ($I^A i$) & father is heterozygous B ($I^B i$),

then children can be A ($I^A i$), B ($I^B i$), AB ($I^A I^B$) or O (ii)

(Punnett Square should used) (2 marks)

(c) Homeotic genes discovered in fruit flies - all contain homeobox (similar regions);

homeobox genes were then found in mice (now called Hox genes); then found in many other multicellular organisms. These genes have similar structure and function.

also accept: evidence from mutations causing limb development in wrong parts of body (2 marks)

(d) Statement defining/explaining **independent vs linked inheritance** (1 mark)

If the alleles for colour and height are **independently inherited**:

F1: GgTt X GgTt

F2: 9 green/tall : 3 green/short : 3 yellow/tall : 1 yellow/short (1 mark)

If the alleles for colour and height are **linked**:

F1: GT/gt X GT/gt

F2: 3 green/tall : 1 yellow/short (1 mark)

working or Punnett Squares for each (2 marks)

- (e) genetic information contributes to human health by determining many aspects of metabolism and physiology
(1 mark)

mutations are changes to the genetic code which alter metabolism (1 mark)

specific named example of genetic disease
(1 mark)

accurate description and explanation of effect of mutation (3 marks)

- (f) gene cloning produces copies of a single gene; whole-organism cloning produces copies of the entire genome of the organism
(2 marks)

processes: gene cloning - by recombinant DNA using bacteria, etc (1 mark)
whole organism - by nuclear transfer , etc
(1 mark)

benefits: gene cloning - production of useful products (insulin, gene probes, etc)
whole organism - production of commercially desirable agricultural products
(2 marks)

extra depth of knowledge, general introduction or extra details (1 mark)