



## Units 3 and 4 Biology

### Practice Exam Question and Answer Booklet

Duration: 15 minutes reading time, 2 hours and 30 minutes writing time

Structure of book:

Section	Number of questions	Number of questions to be answered	Number of marks
A	40	40	40
B	7	7	70
		Total	110

- Students are permitted to bring into the examination room: pens, pencils, highlighters, erasers and rulers.
- Students are not permitted to bring into the examination room: blank sheets of paper and/or white out liquid/tape.
- No calculator is allowed in this examination.

Materials supplied:

- This question and answer booklet of 24 pages.

Instructions:

- You must complete all questions of the examination.
- Write all your answers in the spaces provided in this booklet.

## Section A – Multiple-choice questions

### Instructions

Answer all questions by circling your choice.

Choose the response that is correct or that best answers the question.

A correct answer scores 1, an incorrect answer scores 0.

Marks will not be deducted for incorrect answers.

No marks will be given if more than one answer is completed for any question.

### Question 1

Amylase is a type of enzyme involved in the breakdown of starches in the stomach. It would be reasonable to conclude that amylase is a:

- A. Storage protein
- B. Contractile protein
- C. Globular protein
- D. Hormonal protein

### Question 2

Which one of the following combinations of processes could have been involved in the production of mammalian urine?

- A. Endocytosis, diffusion and osmosis.
- B. Active transport, diffusion and exocytosis.
- C. Diffusion, active transport and osmosis.
- D. Osmosis, diffusion and secretion.

### Question 3

The membrane bound organelle containing digestive enzymes for the destruction of substances no longer required by the cell is the:

- A. endosome
- B. peroxisome
- C. melanosome
- D. lysosome

### Question 4

Biological Engineering is:

- A. The design, manufacture and synthesis of 'designer drugs' which work due to molecular specificity to target a particular disease or disorder
- B. The design of drugs to fit the specific lock and key structures of induced fit enzymes
- C. The generation of energy through biological fuels
- D. The manufacture of 'designer drugs' which can target a wide range of diseases due to specific molecular arrangements.

**Question 5**

Compound Y is composed of carbon, hydrogen, nitrogen, oxygen and sulphur. Compound Y is a:

- A. Carbohydrate
- B. Lipid
- C. Amino Acid
- D. Nucleic acid

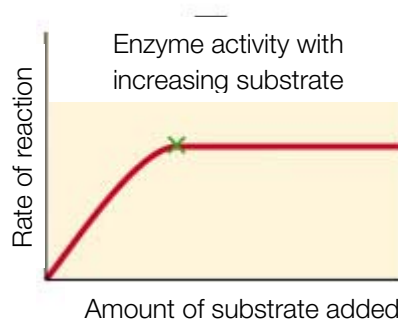
**Question 6**

Which of the following properties of water make it efficient in cooling organisms down?

- A. The cohesive nature of its molecules
- B. High specific heat capacity
- C. High polarity due to large differences in electronegativities of oxygen and hydrogen molecules
- D. Its ability to neutralise heat

**Question 7**

The graph depicted below shows the rate of enzyme activity (lactase) as substrate (lactose) is increased. The graph levels off at point X because:



- A. All enzyme active sites are temporarily occupied
- B. No more substrate is being added
- C. The amount of product produced has reached a constant level
- D. The enzyme has been denatured

**Question 8**

The study of the proteome is important to biologists because

- A. It encompasses all the genetic material in the cell and the way in which genes are linked.
- B. It means that a detailed database is kept of every protein found in humans, and this information can be used to create drugs and treat certain diseases.
- C. It details the complete array of proteins found in a cell and their interactions
- D. It encompasses all proteins and genes involved in infection and disease.

**Question 9**

The percentage of the nitrogenous base thymine in human DNA is 31.5 percent. This means that:

- A. The percentage of Uracil in DNA is 31.5 percent
- B. The percentage of Guanine in RNA is 31.5 percent
- C. The percentage of Cytosine in DNA is 18.5 percent
- D. The percentage of Adenine in RNA is 18.5 percent

**Question 10**

Steroid hormones have specific receptor sites only found on certain target cells. These receptors would be found

- A. In the plasma membrane
- B. On glycoproteins in the plasma membrane
- C. Protein Channels in the plasma membrane
- D. In the cytosol of target cells

**Question 11**

Which of the following temperature regulation systems does NOT assist cooling in plants?

- A. Leaves with a large surface area
- B. Positioning of stomata towards the ground
- C. Evaporation of water from plants
- D. Closing of stomata in the hottest part of the day

**Question 12**

The function of nephrons is to:

- A. Remove urine from the blood
- B. Filter waste products from the blood
- C. Filter waste products from the urine
- D. Remove glucose, amino acids and other ions from the blood.

**Question 13**

The organelles involved in the secretion of products from the cell are:

- A. vesicles and endoplasmic reticulum
- B. golgi apparatus and ribosomes
- C. golgi apparatus and vesicles
- D. endoplasmic reticulum and golgi apparatus

**Question 14**

A shoot tip bending towards light is due to

- A. Positive phototropism
- B. Negative phototropism
- C. Positive geotropism
- D. Negative geotropism

**Question 15**

Pain is caused by:

- A. An overstimulation of mechanoreceptors in the skin
- B. Damage to the ends of mechanoreceptors in the skin
- C. Inflammation from the non specific immune response
- D. Inflammation from the specific immune response

**Question 16**

Apical dominance in flowering plants is due to:

- A. Auxin produced in the lateral buds
- B. Auxin produced in the meristem
- C. Gibberellins found throughout the entire plant
- D. Abscisic acid found in the lateral buds

**Question 17**

The protein involved in the coagulation of plasma in the process of blood clotting is called

- A. Fibrin and it is a secondary protein
- B. Collagen and it is a secondary protein
- C. Fibrin and it is a tertiary protein
- D. Collagen and it is a tertiary protein

**Question 18**

The breaking down of 6-carbon glucose molecules to 3-carbon pyruvate molecules in glycolysis is:

- A. An anabolic, hydrolysis reaction
- B. A catabolic, hydrolysis reaction
- C. An anabolic, dehydration reaction
- D. A catabolic, dehydration reaction

**Question 19**

An enzyme is denatured when:

- A. Irreversible damage is done to the protein structure of its active site due to changes in temperature and pH.
- B. Irreversible damage is done to the protein structure of the entire enzyme due to changes in temperature and pH.
- C. Irreversible damage is done to the protein structure of its active site due to changes in temperature and pH outside the enzyme's optimal range.
- D. Irreversible damage is done to the protein structure of the entire enzyme due to changes in temperature and pH outside the enzyme's optimal range.

**Question 20**

The Krebs cycle occurs in the:

- A. Mitochondrial matrix
- B. Mitochondrial cristae
- C. Mitochondrial cytosol
- D. Mitochondrial membrane

**Question 21**

Prokaryotic cells replicate via:

- A. Binary Fission
- B. Mitosis
- C. Apoptosis
- D. Meiosis

**Question 22**

The genotype notation  $\frac{AB}{ab}$  means that:

- A. The individual is homozygous
- B. Genes A and B assort independently
- C. Genes A and B are linked
- D. The allele would be found in a gamete

**Question 23**

Theoretically, what proportion of offspring from a cross between parental genotypes Pp;Qq;Rr;Ss and Pp;qq;Rr;Ss would have the genotype pp;qq;rr;ss?

- A. 1/256
- B. 1/128
- C. 1/64
- D. 1/32

*Use the following information to answer questions 24 and 25:*

Gregor Mendel based much of his genetic discoveries on experiments involving the common pea plant. Colour is determined by two alleles, with yellow (Y) being dominant to green (y). Similarly, another gene determines texture with smooth (S) being dominant to wrinkled (s).

The genes assort independently. A student crossed a green wrinkled pea with a Smooth, Yellow pea to determine the yellow pea's genotype, and the results were as shown.

Phenotype of offspring	Number
Yellow, Smooth Peas	62
Yellow, Wrinkled Peas	58

**Question 24**

What type of cross has the student used to determine the genotype of the plant with yellow, smooth peas?

- A. A test cross
- B. A monohybrid cross
- C. A dihybrid cross
- D. A back cross

**Question 25**

The genotype of the plant bearing the yellow, smooth peas is:

- A. YYSs
- B. YySs
- C. YySS
- D. YYSS

*Use the following information to answer questions 26 and 27:*

Klinefelter's syndrome occurs when a male individual inherits an extra X chromosome. He produces less testosterone than normal males and is less muscular, as well as exhibiting other feminine features. It is often not diagnosed until the male reaches his teens and commences puberty, but may begin at any time in the male's life.

**Question 26**

The best way to diagnose this syndrome would be:

- A. DNA profiling (gel electrophoresis)
- B. Complete karyotyping
- C. Normal testosterone level analysis
- D. Pedigree chart

**Question 27**

The best term to describe the cause of this syndrome would be:

- A. Aneuploidy
- B. Polyploidy
- C. Mutation
- D. Non disjunction

**Question 28**

Helicase is used in:

- A. DNA replication, where the new DNA strand is synthesised in the 3' to 5' direction
- B. Transcription, where it separates the template strand of DNA
- C. Transcription, where it catalyses the production of messenger RNA strands
- D. DNA replication, where the new DNA strand is synthesised in the 5' to 3' direction

**Question 29**

A man is affected by a sex linked dominant trait. His wife however, is not affected. Which statement is true for their children?

- A. All daughters and none of the sons will have the trait
- B. Half of the daughters and half of the sons will have the trait
- C. Half of the daughters and none of the sons will have the trait
- D. There is a  $\frac{1}{4}$  chance that each child may inherit the trait

**Question 30**

A cline is a:

- A. Geographic boundary separating two species that have diverged from one ancestral species
- B. A naturally occurring clone of a plant
- C. Continuous variation in the phenotype of a species over its range due to differences in the selection pressures of different environments.
- D. Variation in the genotype of a species over a geographical range due to different selecting pressures.

**Question 31**

Which of the following is NOT a potential cause of evolutionary change?

- A. Bottleneck effect
- B. Mutation
- C. Non-random mating
- D. Asexual reproduction

**Question 32**

A population is in genetic equilibrium. This means that:

- A. There are more heterozygotes than homozygotes in the population
- B. Allele frequencies in a population fluctuate around constant proportions
- C. Allele frequencies follow a constant generational pattern
- D. There are more homozygotes than heterozygotes in the population

**Question 33**

Gel electrophoresis can separate DNA samples based on their:

- A. Mass
- B. Charge
- C. Mass and Charge
- D. Relative proportions of purines and pyrimidines



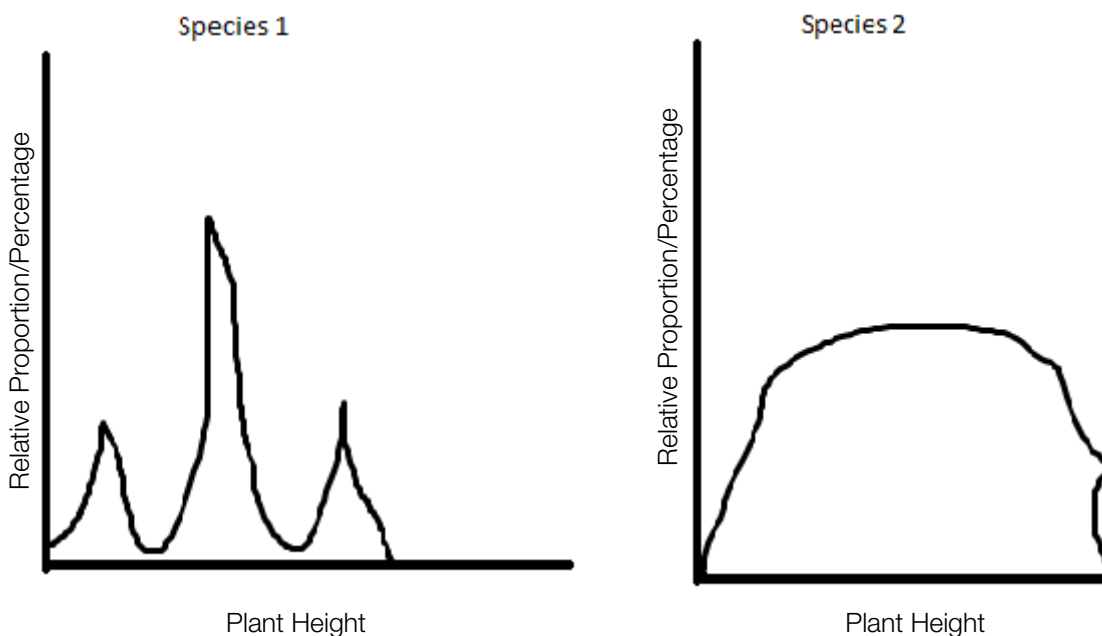
**Question 34**

DNA sampling produces unique DNA profiles of individuals, which have various uses, from determining paternities to determining who is guilty at a crime scene. This is due to the fact that each individual has a unique set of:

- A. Blood proteins
- B. Amino acids
- C. Genes in his/her chromosomes
- D. Variation in his/her DNA sequence

*Use the following information to answer questions 35 and 36:*

A field biologist measured the heights of 200 grasses, 100 from species 1 and 100 from species 2. Study the following graphs. The area under the peaks corresponds to the frequency of the plants of each height.

**Question 35**

Which is the most likely mechanism for the control of height in Species 1?

- A. Height is controlled by two genes, each of which are co-dominant, and by environmental factors.
- B. Height is controlled by a single gene with a co-dominant allele, and by environmental factors.
- C. Height is controlled by a single gene with two alleles, and tall is dominant to short.
- D. Height is controlled by many genes, each of which have two co dominant alleles.

**Question 36**

The results obtained for species 2 are best explained by:

- A. There are many gene loci involved in the control of plant height.
- B. Environmental factors do not affect the growth of the plants
- C. Height is controlled at a single locus, but there are many alleles involved
- D. Height is determined by environmental factors only

**Question 37**

An unusually high incidence of a particular genetic trait was found in a small, isolated, population of bears. This was most likely a result of:

- A. Convergent evolution
- B. Divergent evolution
- C. Genetic drift
- D. Speciation

**Question 38**

A fossil was found of a primate. Which piece of evidence would be useful in determining whether it was an ape or an early hominid?

- A. It had opposing digits
- B. It was determined to be approximately 2 and a half million years old
- C. Its jaw was parabolic in shape
- D. The fossil had a wide trunk, relative to its body length

**Question 39**

A gene coding for a naturally occurring protein that acts as an insecticide, found in certain bacteria, was inserted into a plant crop in a bid to reduce the use of chemical sprays as insecticide. The plant species was thus:

- A. A vector
- B. A clone
- C. A transgenic organism
- D. A plasmid

**Question 40**

Which of the following structures indicate convergent evolution?

- A. Comparative embryology
- B. Vestigial structures
- C. Homologous structures
- D. Analogous structures

## Section B – Short-answer questions

### Instructions

Answer all questions in the spaces provided.

Unless otherwise indicated, the diagrams in this book are not drawn to scale.

### Questions

#### Question 1

a.

- i. What is the name for the hormone involved in the dropping of leaves in deciduous trees?

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1 mark

- ii. Briefly compare the modes of transport of hormones in plants compared to animals.

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1 mark

- b. A hormone was produced in a human endocrine gland and travelled to its target cell, which was located adjacent to another type of cell. The hormone came in contact with this other cell, but the cell did not respond to it. Explain the reason for this.

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2 marks

c.

- i. Consider a human hormone you have studied this year. Name the hormone and the endocrine gland it is produced in.

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1 mark

ii. Explain how this hormone has its effect, making reference to signal transduction.

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2 marks

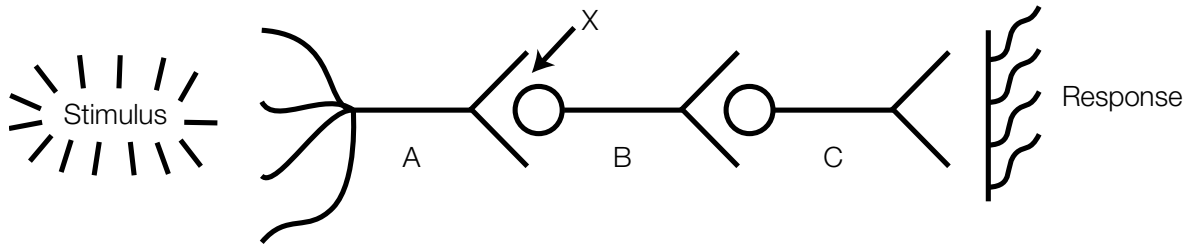
iii. Draw a negative feedback loop involving this hormone.

2 marks

**Total 9 marks**

**Question 2**

The diagram below shows a nervous response with three neurons, A, B and C being involved in detecting a stimulus, sending a nervous impulse and generating a response.



- a. What is the term to describe an action potential strong enough to generate a nervous response?

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1 mark

- b. When this action potential has been generated, electrical changes occur in the cell. Briefly describe these changes, referring to specific ions.

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2 marks

- c. In a reflex arc response, one of these neurons would be missing. Explain which neuron (A, B or C) this would be.

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2 marks

- d. Name a stimulus and the type of receptors that detect it that cause the nervous response of shivering.

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2 marks

- e. Explain how the stimulus detected in question d. is transmitted at point X in the diagram, which represents an interneural synapse.

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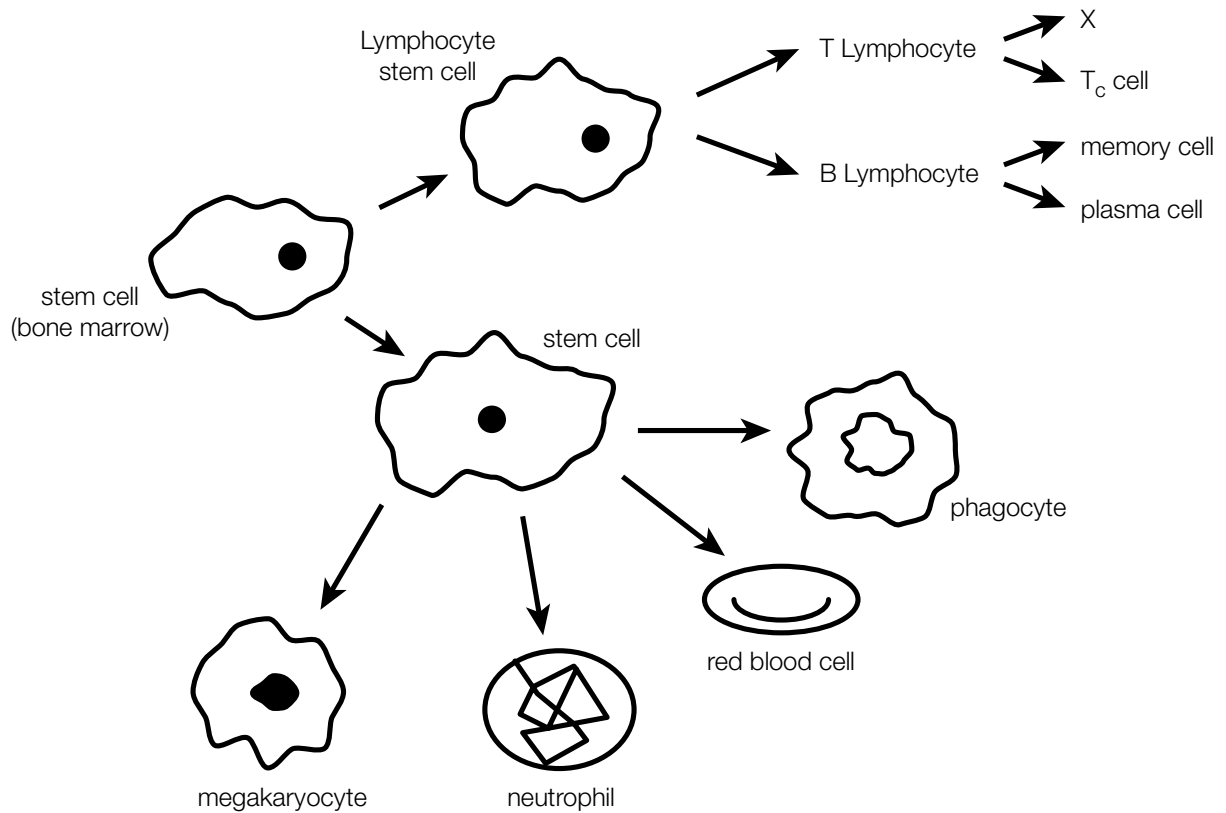
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1 mark

**Total 8 marks**

**Question 3**

Stem cells from the bone marrow can differentiate into a number of specialised cells, some of which are involved in the immune response.



a.

i. From the diagram above, select a cell involved in the **specific** immune response and outline its function.

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2 marks

ii. From the diagram above, select a cell involved in the non-specific immune response and outline its function.

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2 marks

iii. Name another type of T cell, represented by X on the diagram above.

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1 mark

- b. Recently, there has been much research into possible treatments of diseases caused by autoimmune attacks on cells.
- i. What is meant by the term autoimmune disease?

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1 mark

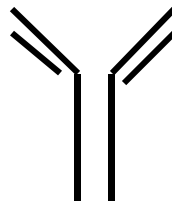
- ii. What chemicals are present in the blood of a person with an autoimmune disease that are not present in the blood of someone without the disease?

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1 mark

- iii. On the following diagram of an antibody, circle the antigen-binding sites.



1 mark



c.

- i. Explain the key difference between active and passive immunity.

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1 mark

- ii. For each of the examples listed below, circle whether they are examples of active or passive immunity.

A person is given a dose of anti-venom found in the blood of a horse following a dangerous snake bite.

Active / Passive

After contracting chicken pox, you never contract it again.

Active / Passive

A baby is automatically resistant to German measles after drinking the breast milk of its mother, who has immunity.

Active / Passive

3 marks

**Total 12 marks**

**Question 4**

Below is a depiction of the genetic code.

Codon – Base Position			Amino Acid
1	2	3	
A	A	A or G	Lysine
A	A	C or U	Asparagines
A	C	A C G U	Threonine
A	G	A or G	Arginine
A	G	C or U	Serine
A	U	A C or U	Isoleucine
A	U	G	Methionine
C	A	A or G	Glutamine
C	A	C or U	Histidine
C	C	A C G U	Proline
C	G	A C G U	Arginine
C	U	A C G U	Leucine
G	A	A or G	Glutamic acid
G	A	C or U	Aspartic acid
G	C	A C G U	Alanine
G	G	A C G U	Glycine
G	U	A C G U	Valine
U	A	A or G	NONSENSE – STOP
U	A	C or U	Tyrosine
U	C	A C G U	Serine
U	G	A	NONSENSE – STOP
U	G	C or U	Cysteine
U	G	G	Tryptophan
U	U	A or G	Leucine
U	U	C or U	Phenylalanine

- a. The genetic code is often described as redundant. What is meant by this term?

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1 mark

- b. What is RNA polymerase and what does it do?

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2 marks

- c. Describe the process in which an mRNA molecule is synthesised in the nucleus, and name this process.

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3 marks

- d. Describe the process in which a polypeptide is formed at the ribosome, and name this process.

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3 marks

- e. Are the codes represented in the table for DNA or RNA? Explain.

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2 marks

- f. A healthy polypeptide has the following series of codons:

AUGCCUAGGGAAUGA

The following are two mutated forms of the messenger RNA molecule that code for the polypeptide above.

AUGCGUAGGGAAUGA (mutation a)  
AUGCCCUAGGGAAUGA (mutation b)

What types of mutations are mutations a and b respectively?

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2 marks

- g. Is an individual with mutation a. or an individual with mutation b. more likely to suffer serious consequences? Explain your choice.

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2 marks

**Total: 15 marks**

**Question 5**

- a. An example of an X-linked recessive disorder is red-green colour blindness. A woman with normal colour vision, whose father was colour-blind marries a colour-blind man. What possible genotypes are there for the colour-blind man's mother?

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2 marks

- b. Explain, using a punnet square, the probability that if the couple have a child, it will be a colour-blind boy.

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2 marks

- c. What proportion of all the girls produced by these parents could be expected to have normal colour vision?

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1 mark

- d. Of all the children of these parents, what proportion can be expected to have normal colour vision?

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1 mark

**Total: 6 marks**

**Question 6**

Genetic technologies have come a very long way in the past few decades. Recently, much research has been put into the idea of harnessing the insulin producing gene in pig DNA and inserting it into the cells of humans with Type 1 Diabetes, as they lack the ability to produce this important hormone.

- a. Explain briefly the main steps involved in implanting this gene into a human cell, using diagrams.

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3 marks

The Polymerase Chain Reaction is an indispensable genetic tool used in replicating miniscule genetic samples into ones large enough for analysis.

- b.  
i. Give one example where the Polymerase Chain Reaction (PCR) could be useful.

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1 mark

- ii. Outline the main steps in the Polymerase Chain Reaction, including the terms primers, annealing, heating, taq polymerase, semi-conservative. The use of diagrams is encouraged.

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3 marks

**Total: 7 marks**

**Question 7**

a. Define and give an example of the term 'bottleneck effect'.

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2 marks

b. Chimpanzees are the closest living relative to modern humans (98% of our genomes are similar). Explain, in terms of natural selection, how the two species diverged.

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3 marks

c. Explain, using examples, the differences between convergent and divergent evolution.

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2 marks



- d. There are many techniques employed to provide evidence for evolution. Outline in brief detail three of these.

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6 marks

**Total: 13 marks**

End of Booklet

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