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SECTION A / MULTIPLE-CHOICE QUESTIONS

INSTRUCTIONS FOR SECTION A

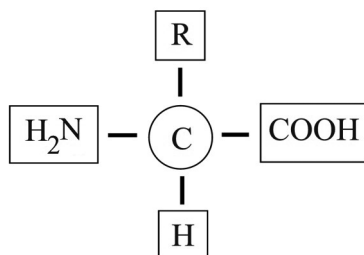
- Answer **all** questions in pencil on the answer sheet provided for multiple-choice questions.
 Choose the response that is **correct** for the question.
 A correct answer scores 1, an incorrect answer scores 0.
 Marks will **not** be deducted for incorrect answers.
 No marks will be given if more than one answer is completed for any question.

The following information is required for Questions 1 and 2.

There are over 100 amino acids found in living cells however there are only 20 which commonly occur in proteins. The behaviour of each amino acid is determined by its chemical structure.

Question 1

The general structure of an amino acid can be represented by the following diagram.



Each amino acid has different chemical properties due to the presence of the

- | | |
|------------------------------------|-----------------------|
| A. carboxyl group (COOH). | C. hydrogen atom (H). |
| B. amine group (NH ₂). | D. side chain (R). |

Question 2

The formation of polypeptide chains can begin when two amino acids are joined together by a peptide bond. This process is best described as

- | | | |
|----------------------------|---|--------------------------------------|
| A. amino acid + amino acid | → | dipeptide + water (condensation). |
| B. amino acid + amino acid | → | dipeptide + hydrogen (condensation). |
| C. amino acid + amino acid | ← | dipeptide + water (hydrolysis). |
| D. amino acid + amino acid | ← | dipeptide + hydrogen (hydrolysis). |

Question 3

Polypeptide chains can undergo precise folding to form fibrous or globular proteins. Globular proteins fold into a spherical shape, have a tertiary structure and are water soluble. They are most likely to exhibit

- | |
|---|
| A. α -helix coils, β -pleated sheets and have a structural role in cells. |
| B. α -helix coils, β -pleated sheets and have a contractile role in cells. |
| C. α -helix coils, β -pleated sheets, disulfide bridges and have a transport role in cells. |
| D. α -helix coils, β -pleated sheets, disulfide bridges and have a structural role in cells. |

for 11 amino acids. According to the rule of base pairing (A pairs with T, C pairs with G), the complementary base sequences of DNA for the normal and the mutant triplets are TTG (normal) and ATG (mutant).

Question 4b i: 1 mark
A – adenine

Question 4b ii: 1 mark
Different DNA triplets can code for the same amino acid.

- The genetic code demonstrates a built in redundancy which means that different DNA triplets can code for the same amino acid e.g. AAC and GAC both code for *leucine* and TAA and TAG both code for *isoleucine*.
- It is possible, using DNA diagnostic methods, to identify individuals who have the A → T mutation at position 438 and who are at risk of developing MSUD.

Question 4c: 1 mark
Development of MSUD can be averted with modification of diet e.g. restriction of leucine, isoleucine, valine through a modified protein diet.

Question 4d: 2 marks
Taqman Assay enables more rapid diagnosis of infants with MSUD prior to clinical disease and because of its rapid screening time (and increased sensitivity and validity in terms of a lower % of samples requiring repeat testing) it is likely to be of economic advantage.

- When considering suitability for commercial application it is necessary to consider the most efficient, effective and inexpensive method of testing. As demonstrated by the comparative study, it is the Taqman Assay.

Mark allocation: 4d.
1 mark – Taqman Assay
1 mark – rapid screening time (and increased sensitivity as well as validity) lends it to commercial application

Question 5a: 1 mark
Food OR water OR air OR through bites from a vector (e.g. mosquito, tick, flea)

- Parasites can enter a host in a variety of ways, depending on their type. Generally, the most common strategies for entry include through food and/or water, air and through bites from a vector (e.g. mosquito, tick, flea).

Question 5b: 2 marks
Presence would induce the production of antibodies assisted by macrophages and eosinophils.

- Flatworms present a size problem to the immune system as they are too big to phagocytose. They present as ‘non-self’ to the host immune system, which is detected by macrophages which present ‘non-self’ antigens (from flatworms) to helper T cells. When helper T cells are activated they respond in 2 ways. They produce cloned activated helper T cells (which can produce B cells and antibodies) and memory helper T cells. In addition, eosinophils align themselves against the external wall of the flatworm and release destructive enzymes from cytoplasmic granules.

Question 5c: 1 mark
The host is protected from infection by any future invasions of that particular flatworm.

- Whilst the antibodies generated by B cells do not provide protection from the resident flatworm, their sheer numbers (due to recognition by the memory cells and rapid proliferation of more antibodies) ensure protection from new invasions.

Question 5d i: 1 mark
‘Self’ describes all the components (receptors and antigens) that are recognised by the immune system of an organism as being part of that particular organism.

Question 5d ii: 1 mark
Flatworms could coat themselves with host antigens (e.g. ABO blood group antigens OR histocompatibility molecules).

- If a parasite is able to remain undetected by the immune system of its host it will maximise its chance of survival. If the flatworm is capable of incorporating the antigens of its host into its exterior surfaces, then it will appear as ‘self’ and be protected from attack by the immune system. The exact mechanism by which a flatworm does this is not yet fully understood.

Mark allocation: 5b.
1 mark – resident flatworm induces production of antibodies
1 mark – production of antibodies is assisted by macrophages and eosinophils

Question 6a: 1 mark
The overstimulation of sweat glands is likely to be due to the autonomic nervous system because it is this system that is responsible for transmitting messages to glands (and smooth muscle and heart muscle).

Question 6b i: 1 mark
Acetylcholine or any suitable neurotransmitter.

Question 6b ii: 1 mark
Acetylcholine changes the permeability of postsynaptic membranes to specific ions thereby enabling transfer of nerve impulse which results in contraction of sweat gland and release of sweat.

- Acetylcholine is one of the most common neurotransmitters and functions by binding to receptors on post synaptic membranes, thus altering their permeability to specific ions.

Question 6c: 1 mark
Cutting segments of the sympathetic nerve impedes the normal transmission of nerve signals and thus reduces sweating.

- Nerve signals require a medium along which the electrical impulse can pass. If there is a gap in the neuron the nerve impulse will terminate at the break. This occurs naturally at the end of an axon however release of neurotransmitters ensures the impulse continues toward its destination. When cuts are made in the neuron, there is no way for the impulse to continue.

Question 7a: 1 mark
Myelin forms an insulating coat around processes of nerve cells and speeds the transmission of nerve impulses.

- Myelin is fatty connective tissue (white matter) which forms an insulating coat around processes of nerve cells. Myelin speeds transmission of nerve impulses by electrically insulating nerves from the surrounding environment. Myelin is produced by cells known as oligodendrocytes.