**Copy of BCC LogoBelmont City College**

**YR12 HUMAN BIOLOGY 2023 Unit 3**

**Task 4: Extended Response – Homeostasis and Immune System**

**ANSWERS**  Total Mark: /40

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| **Question 1** | **(20 marks)** |
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During a trip to the Australian bush, a young man was lost for over six hours. The day on which he was lost was particularly hot, with temperatures peaking at 42°C. After a day’s rest, the young man recovered from his experience with no lasting ill-effects.

1. Use a homeostatic feedback loop to describe the **physiological** mechanisms that would have been operating to maintain his internal body temperature during the six hours he was lost in the bush. (10 marks)

**1 mark for all headings present and in order, then 9 marks from the following:**

Stimulus: Increased/ Rising Body Temperature (1)

Receptor: Thermoreceptors (0.5) in skin and hypothalamus (0.5)

Modulator: Hypothalamus receives message (0.5) about elevated body temperature and

coordinates cooling responses (0.5).

Effector(s): Blood vessels (0.5) and sweat glands (0.5) in skin

Response: Vasodilation (0.5) allows increased blood flow to skin so heat can be released. (0.5)

Sweating (0.5) allows sweat to evaporate (0.5) from skin, drawing heat with it (0.5).

Feedback: Negative feedback (0.5). Body temperature returns to homeostatic set point (1), stimulus no longer present (0.5), cycle stops (0.5).

1. Explain how the mechanisms required to maintain homeostasis of the man’s internal body temperature would have also triggered the homeostatic processes involved in the

maintenance of his body fluid concentration. (10 marks)

The man would have lost fluid through sweating (1), therefore increasing osmotic pressure in the blood (or decreasing water concentration) (0.5)

Which is detected by osmoreceptors in the hypothalamus (0.5)

The hypothalamus sends signals to the cerebral cortex (0.5), which initiates the thirst response

So the man will feel thirsty and seek water (0.5).

The hypothalamus (0.5) also coordinates the release of Antidiuretic Hormone (0.5) from the posterior pituitary (0.5).

Increased osmotic pressure also stimulates the adrenal cortex (0.5) to produce aldosterone (0.5).

ADH and aldosterone both act on the DCT and collecting ducts 0.5) of the nephron (0.5)

ADH stimulates the active reabsorption of water into the bloodstream from the tubules (0.5)

Aldosterone stimulates Na+ reabsorption and K+ secretion (0.5). Water moves into the tubules with the Na+, via osmosis.(0.5)

The reabsorbed water and any water drunk by the man help to return osmotic pressure/water concentration to set point. (1)

The process will stop due to negative feedback (0.5) once the man is rescued, stops sweating, is able to drink water and the osmotic pressure of his blood returns to normal (0.5).

**Question 2 (20 marks)**

The World Health Organisation is currently working on trying to eliminate polio by using a range of vaccination programs. Vaccinations are used to develop immunity in a population. However traditional vaccines can come with associated risks and ethical concerns so more modern techniques are being tested to produce vaccines that are more effective and have less associated risks.

1. Describe two broad types of vaccine, and discuss some of the risks and ethical concerns that are associated with vaccines. (10 marks)

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| --- | --- |
| **Description** | **Marks** |
| 1. Attenuated (1)    * virulence of pathogen reduced (1) via culturing in a series of chick embryos (1)    * weakened pathogen in vaccine stimulates specific immune response (0.5) without causing disease (0.5) 2. Killed/Inactivated (1)    * Pathogen is killed using heat or chemicals (0.5) so cannot cause disease (0.5)    * Antigenic site still present (1) so vaccine can still stimulate specific immune response (1) 3. Toxoid Vaccine (1)    * Toxins from pathogen inactivated using heat or chemicals (0.5) so cannot cause disease (0.5)    * Antigenic site still present (1) so vaccine can still stimulate a specific immune response (1) 4. Sub-unit vaccine (1)    * Uses a fragment of pathogen (0.5) so cannot cause disease (0.5)    * Antigenic site still present (1) so vaccine can still stimulate a specific immune response (1) | Only mark 2, for max 4 marks each  **1 mark for 1 point** |
| Risks   * allergic reaction * cross-species disease introduction * preservatives in vaccines can cause health issues |
| Ethical concerns   * how vaccine manufactured * how vaccine tested * use of human tissue * religious stance | **1 mark for 1 point** |
| **Total** | **10** |

1. Viruses such as polio enter the body and cause both a humoral and cell-mediated response. Describe the steps that occur during a humoral immune response. (10 marks)

B lymphocytes in blood and lymphoid tissue (0.5) have many unique receptors on their surface (0.5)

Antigen Presenting Cell/ Macrophage engulfs pathogen (0.5), processes it and presents antigen on it’s surface (0.5)

APC presents antigen to B lymphocyte with a matching receptor (1)

B lymphocyte becomes sensitised (0.5) for the specific pathogen (0.5) (eg polio virus)

B lymphocyte enlarges (0.5) and clones (0.5), producing many more sensitised B-cells (0.5)

Most cloned B lymphocytes become plasma cells (0.5)

Plasma cells produce antibody (0.5) specific for the antigen originally presented (0.5) (in this case polio antigen)

Antibody is released and binds to antigenic sites (0.5) on the specific pathogens (0.5) (eg polio virus)

The pathogens are neutralised. (0.5)

Some cloned B-cells become memory B-cells. (0.5)

These remain in circulation (0.5) so that the response proceeds more quickly (0.5) when that pathogen is encountered again. (0.5)