Copy of BCC Logo**Belmont City College 2023**

**Year 12 ATAR Human Biology Unit 3**

**Task 3: Test – Homeostasis and Immune Systems**

Name: ………………………………………….………….. **Total Mark /60**

**Section One: Multiple Choice (10 Marks)**

Place a cross (X) through the selected letter:  
  
1. A B C D 6. A B C D

2. A B C D 7. A B C D

3. A B C D 8. A B C D

4. A B C D 9. A B C D

5. A B C D 10. A B C D

**Section Two: Short Answer (30 Marks)**

**Question 11 (7 marks)**

Rosalind goes for a run before breakfast. Use a steady-state control model to show the most important homeostatic mechanism involved in maintaining blood glucose homeostasis while she is running.

1 mark for all headings correct (Stimulus, Receptor, Modulator, Effector, Response, Feedback)

Stimulus: Falling blood glucose (0.5)

Receptor: Alpha cells in pancreatic islets (0.5) detect falling blood glucose *no marks for just pancreas, or pancreatic cells*

Modulator: Alpha cells in pancreatic islets (0.5) interpret falling blood glucose and secrete glucagon (0.5) as a messenger

Effector: Liver (1) is acted on by glucagon

Response: Glycogenolysis (0.5) (production of glucose from glycogen) occurs and glucose is released

into the blood stream (0.5)

Feedback: Negative Feedback (0.5) :Blood glucose rises back to set point (0.5), stimulus is reduced/eliminated (0.5) and the cycle stops (0.5).

*Note – actions only get marks if they are matched to a correct heading (use your professional judgement here)*

**Question 12 (8 marks)**

Free divers are athletes who descend underwater as far as possible without breathing apparatus. Before diving into the water, the free diver deliberately hyperventilates.

1. State what hyperventilation is and what effect it has on the gas concentration of the blood. (2)

*Hyperventilation is rapid breathing (1). It means additional CO2 is exhaled (0.5), lowering CO2 concentration in the blood. (0.5)*

1. Explain how voluntary hyperventilation allows the free diver to stay underwater for longer (3)

*The lower CO2 concentration in the blood (0.5) means the chemoreceptors (0.5) in the aorta, carotid arteries and medulla oblongata (0.5) take longer to detect the rising levels*

*of CO2 (0.5) , and therefore for the medulla oblongata (0.5) to trigger an intense need to surface and breathe. (0.5)*

1. Explain how drowning is a risk if a person hyperventilates before diving, even in relatively shallow water: (3)

*Hyperventilation before diving means that CO2 levels are lower on entering the water (0.5), so it takes longer (0.5) for the levels to reach the threshold to trigger breathing (0.5). If O2 levels become too low (0.5) before the need to breathe is triggered (0.5), the person will become unconscious due to lack of oxygen and drown. (0.5)*

**Question 13 (4 marks)**

Immunity can be classed as passive or active and natural or artificial. Complete the table

below, giving a description and example of each type of immunity. (4 marks)

\*Must have description and example to get mark. No half marks.

|  |  |  |
| --- | --- | --- |
| Description | | |
|  | Passive | Active |
| Natural | *Antibodies that enter the body via natural routes to bind specific pathogens  Babies gain antibody passively from their mother via breast milk / colostrum /placenta* | *Manufactures of antibodies and memory cells via humoral and cell mediated immunity processes, in response to natural pathogen exposure.*  *When someone is exposed to measles, they will develop antibody to measles and memory cells so that the person will combat the measles virus much more quickly on subsequent exposures.* |
| Artificial | *Antibody introduced through artificial methods to bind specific pathogens  Someone bitten by a snake is given antivenom produced in a laboratory, that contains antibody against the venom* | *Artificial introduction of modified antigen to trigger manufacture of antibody and memory cells.   Vaccination introduces antigen artificially, causing a person’s body to manufacture antibody via humoral and cell-mediated immunity processes.* |

**Question 14 (7 marks)**

Ms Byrne is working in veterinary practice and gets bitten on her thumb by a mouse. The next day, her thumb is red, swollen and painful.

a) Which non-specific immune process is occurring in Ms Byrne’s thumb? (1 mark)

Inflammation (1)

b) Describe the processes occurring in Ms Byrne’s thumb between when the mouse bites her, and when the stage is set for tissue healing. (6 marks)

Tissue damage occurs (0.5) and pathogens may be introduced (0.5)

Mast cells release histamine (0.5) which causes local blood vessels to become dilated and leaky (0.5), allowing phagocytes to enter the area (0.5).

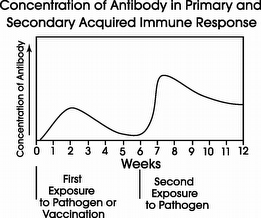
Mast cells release heparin (0.5) to prevent clotting in the immediate area (0.5)

Complement Proteins are activated (0.5) and attract phagocytes (0.5) which enter the area and engulf and digest dead cells and bacteria (0.5)

Once pathogens are cleared, mast cells and complement stop messaging (0.5). Local capillaries return to normal, phagocytosis ceases (0.5) and the stage is set for tissue healing.

**Question 15 (4 marks)**

The graph below shows how the body responds to two successive infections of the same viral pathogen. Use this information to answer the question below.



Using the information in the graph above, discuss why it is unlikely that a person who has had this virus and recovered is unlikely to become ill if exposed to the pathogen again. (4 marks)

* First exposure triggers antibody mediated immunity to develop
* Memory cells are also produced which remain in circulation
* If exposed to same pathogen again, memory cells recognise pathogen quickly
* Much more antibody is then produced quickly and pathogen is eliminated before symptoms can develop on second exposure.

**Section Three: Extended Answer (20 marks)**

**Question 16 (10 marks)**

Fever is an important non-specific defence against invading pathogens. Explain how the process of fever works, and explain why someone with a fever would shiver and feel cold, despite rising body temperature

Any 10 of the below, clearly and logically presented:

After encountering infection, WBC produce pyrogens (1)

Pyrogens affect the hypothalamus, raising the homeostatic set point to a higher temperature (1)

The hypothalamus initiates warming responses (1) to raise body temperature to the new set point (1)

The person will feel cold because their body temperature is lower than the new temporary set point (1)***.***

Warming responses include shivering, vasoconstriction, seeking warmth (1) until the body reaches the new temperature set point (1)

When the infection has been eliminated, the immune systems stops producing pyrogens (1) and the homeostatic set point returns to normal (1)

The person will then feel hot, as their body temperature is now above the normal set point (1)

Cooling responses are activated (1) including sweating and vasodilation (1) until body temperature homeostasis is regained.

**Question 17 (10 marks)**

During vigorous exercise, people develop increased rate and depth of respiration. This continues for some time after exercise ceases. Explain why increased rate and depth of respiration continues after exercise ceases.

Any 10 of the below, clearly and logically presented:

Muscle contraction during exercise consumes O2 (1) and produces CO2 waste (1).   
  
The increased CO2 is the stimulus (1) for increased rate and depth of breathing (1) so that CO2 can return to homeostatic levels (1).

If not enough O2 is available during exercise, the muscles use anaerobic respiration (1), and build up lactic acid (1). This is called Oxygen Debt (1)

After exercise is finished, lactic acid is put back through aerobic respiration (1), using additional oxygen (1) and producing CO2 waste (1). This keeps CO2 levels high after exercise is finished (1) which stimulates increased rate and depth of breathing (1), until all the lactic acid has been converted (1).