**Kelmscott Senior High School**

**Yr 12 ATAR Human Biology**

**Extended Response 2 (Homeostasis and Response to Infection)**

**ANSWER KEY**

**Question 1.**

(a) If a person is infected with Mycobacterium tuberculosis, antibodies are produced to fight the infection.

Describe the immune response that produces antibodies and explain how the antibodies act to fight the infection. (8 marks)

|  |  |
| --- | --- |
| **Desrciption** | **Marks** |
| Production of antibodies |  |
| Any five of: |  |
| * Antigen/pathogen (for tuberculosis) enter the body * Macrophage engulfs the pathogen * Displays the antigen on its surface/displays the antigen presenting cells (dendritic cells) * Specific B lymphocytes/B cells recognise the antigen * Sensitized and enlarged * Mitosis/cloning/dividing occurs * B lymphocytes/B cells produce plasma cells * Plasma cells produce antibodies (release into the blood stream) | 1 - 5 |
| Action of antibodies |  |
| Any three of: |  |
| * Inactivate antigens/neutralise antigens/form an antigen-antibody complex * Combine with foreign bacterial toxins * Coat bacteria/opsinisation * Enhance phagocytosis/make them more easily consumed by phagocytes (macrophages) * Cause leakage of contents/make cell membranes of bacteria permeable/ make cell membranes of foreign cells permeable * Dissolve organisms * Make soluble substances insoluble/form a precipitate/agglutination | 1 - 3 |
| **Total** | 8 |

(b) Explain how the cell mediated immune system acts to neutralise a foreign body.

(12 marks)

|  |  |
| --- | --- |
| **Description** | **Marks** |
| * Cell mediated immunity occurs after the bodies cells have been infected (1) * Cell mediated immunity deals with infected body cells (1) (bacterial, viral, parasitic) cancerous and transplanted cells (1) | 1 |
| * Circulating T-lymphocytes encounter antigen (1) / APC’s like macrophages and dendritic cells present antigen to T-lymphocytes (1) in lymph nodes (1) * T-lymphocytes with correct receptors (1) bind to non-self antigen and become activated (1) * Once activated – T-cell enlarges and proliferates into clones (1) * T-cell clone differentiation (1) | 1 - 3 |
| * T-killer cells (1)– circulate around the body (blood, lymph, lymphatic organs) (1) searching for antigens they’re sensitized to (1) * T-killer cells directly attack and kill other cells (1) * Release chemicals (e.g. perforin, lymphotaxin) that cause lysis of target cells (1)/ damage to target cell’s DNA(1)/ apoptosis(1)/ increases macrophage ability to kill cells(1) **(max of two of these points)** * Macrophages move to the site of infection to remove cell debris | 1 - 4 |
| * T-helper cells (1)release chemicals that increase B and T cell production (1) and antibody production (1) | 1 - 2 |
| * T-supressor cells (1) release chemicals that decrease activity of both B and T cells (1) when the infection/antigen has been successfully inactivated/destroyed (1), also prevent autoimmune reactions (1) | 1 |
| * T- memory cells (1) for future infection (1) | 1 |
| **Total** | 12 |

**Question 2.**

(a) Describe the positives and the negatives of immunising a child against all of the pathogens recommended on the immunisation schedule. (from your research sheet) (6 marks)

|  |  |
| --- | --- |
| **Description** | **Marks** |
| **POSITIVES** |  |
| * Increases herd immunity (1) * Longer life expectancy for the population(1) * Less cost for government to treat people with infectious illnesses(1) * Less loss of productivity from people missing work(1) * Infectious diseases may become eradicated(1) * Any Reasonable | 1 – 3 |
| **NEGATIVES** |  |
| * People may be allergic to the preservative(1) * Ethical considerations of the use of animals(1) * Ethical considerations over religious belief of people(1) * Vaccine may be contaminated/difficult to isolate from viruses/ possible link polio and HIV(1) * Some chance of adverse reaction to vaccine – developmental problems * Any reasonable | 1 – 3 |
| **Total** | **6** |

(b) Distinguish between specific and non-specific modes of resistance to a pathogen.

Name three (4) non-specific mechanisms and describe how they work and name two (2)specific mechanisms and describe how they work**.**  (14 marks)

|  |  |  |
| --- | --- | --- |
| **Category** | **Protective mechanism** | **Marks** |
| Non-specific will protect against any pathogen/antigen | | 1 |
| Specific will only protect against 1 type of pathogen’ | | 1 |
| **Sub-total** | | **2** |
| **Non-Specific** |  |  |
| Skin (1) | Mechanical barrier preventing entry | 2 |
| Acidic surface (skin) (1) | Skin secretions (sweat and sebum) ↓pH inhibits bacterial growth; sebum has bactericidal chemicals (1) | 2 |
| Keratin(1) | Resistance against acids, bases and bacterial enzymes(1) | 2 |
| Intact mucous membranes(1) | Mechanical barrier preventing entry (1) | 2 |
| Mucous(1) | Traps microorganisms in respiratory and digestive tracts(1) | 2 |
| Nasal hairs(1) | Filter and trap microorganisms in nasal passages(1) | 2 |
| Cilia(1) | Propel debris-laden mucous away from lower respiratory surfaces(1) | 2 |
| Gastric juice(1) | Conc. HCl and proteases destroy pathogens(1) | 2 |
| Acidic vaginal surface(1) | Inhibits most bacterial and fungal growth(1) | 2 |
| Tears and saliva(1) | Continual lubrication and cleansing eyes and oral cavity – contain lysosome that destroy microorganisms(1) | 2 |
| Urine(1) | Normal ↓pH inhibits bacterial growth and flushes out lower urinary tract(1) | 2 |
| Phagocytes(1) | Engulf, ingest and destroy pathogens(1) | 2 |
| Natural killer cells(1) | Promote lysis of cells infected with viruses or cancerous body cells (don’t need specific antigen recognition) (1) | 2 |
| Inflammatory response (1) | Prevents spread of injurious agents to adjacent tissues, ↑ attraction of phagocytes, disposes of dead cells and pathogens, ↑ MR of cells to ↑ rate of repair(1) | 2 |
| Interferons(1) | Release by virus-infected cells that protect uninfected cells from virus takeover, Mobilise immune responses(1) | 2 |
| Complement(1) | Lyses microorganisms, ↑ phagocytosis by opsinisation, ↑↑↑ inflammatory response and immune responses(1) | 2 |
| Fever(1) | ↑ body temp inhibits microbial multiplication, ↑ body repair processes(1) | 2 |
| **Sub-total** | | **8** |
| **Specific** | | |
| Antibody mediated (1) | Antibodies specific to 1 antigen/pathogen destroy(1) | 2 |
| Cell mediated (1) | Cells specific to 1 antigen presented on infected body cells (viral, cancerous, transplants) (1) | 2 |
|  | **Sub-total** | **4** |
|  | **Total** | **14** |

**Question 3.**

(a) There are several hormones involved in the maintenance of optimal glucose levels in the blood.

Identify **three** of these hormones, state the specific location where they are produced and explain how they assist in the maintenance of optimal blood glucose levels. (12 marks)

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| --- | --- |
| **Description** | **Marks** |
| Four marks each: one for hormone, one for source, two for regulation.  Any three of the following hormones | |
| **Glucagon** | 1 |
| Produced by the alpha cells/Islets of Langerhans/Pancreatic islets | 1 |
| Any two of:   * Glycogenolysis of glycogen/breakdown of glycogen into glucose in the liver * Gluconeogenesis of lipids/breakdown of lipids into glucose/lipolysis in the liver/adipose tissue * Gluconeogenesis (or deamination) of amino acids/breakdown of amino acids into glucose | 1 – 2 |
| **or** |  |
| **Cortisol** | 1 |
| Produced by the adrenal cortex | 1 |
| Any two of:   * Glycogenolysis of glycogen/breakdown of glycogen to glucose * Removal of amino acids from muscle cells * Amino acids transported to liver for Gluconeogenesis (or deamination) /amino acids to glucose | 1 - 2 |
| **or** |  |
| **Adrenaline/noradrenaline** | 1 |
| Produced by the adrenal medulla | 1 |
| Any two of:   * Glycogenolysis of glycogen/breakdown of glycogen to glucose * Glycogen in muscles is acted uponto produce lactic acid/lactic acid is converted to glucose in the liver * Increased number of insulin receptors on cell surface/increased sensitivity of insulin receptors | 1 - 2 |
| **or** |  |
| **Insulin** | 1 |
| Produced by the beta cells/Islets of Langerhans/pancreatic islets | 1 |
| Any two of:   * Glycogenesis of glucose/conversion of glucose to glycogen in liver/muscles * Conversion of glucose into lipids in adipose tissue * Transport of glucose into cells/acts as a receptor for glucose on cell membranes (for respiration) | 1 - 2 |
| **or** |  |
| **Thyroxine** | 1 |
| Produced by the thyroid gland | 1 |
| Enhances absorption of glucose from the small intestine (into the blood stream) | 1 |
| Increased glucose metabolism in cells/reduced blood glucose due to increased respiration | 1 |
| **Total** | **12** |

(b) The inability to maintain optimal blood glucose levels results in the condition called diabetes mellitus. This condition occurs in two different forms known as Type 1 and Type 2.

In what ways are these two forms of diabetes mellitus similar and how do they differ? (8 marks)

|  |  |  |
| --- | --- | --- |
| **Description** | | **Marks** |
| **Similarities**  Any two of: | | |
| Abnormally high blood glucose levels/hyperglycaemia | | 1 - 2 |
| High levels of glucose excreted in urine | |
| Complications such as kidney failure/heart disease/stroke/nerve damage/eye problems | |
| **Differences**  Any three of: | | |
| Type 1 | Type 2 |  |
| * Usually begins in childhood/ born with it | * Usually adult onset/occurs in people over 45 | 1 - 6 |
| * A fault in the immune system/destructionof beta cells/islet cells | * Lifestyle disease/caused by obesity/lack of exercise/high blood pressure/diet high in fat and salt/diet low in fibre/high blood cholesterol/smoking |
| * Inability to produce insulin | * Can produce insulin |
| * Cells are able to respond normally to insulin | * Cells are not able to respond to insulin/cells unable to take up glucose from the blood/insulin resistance |
| * Treatment by injections/programmable pump for regular supply of insulin | * Treatment by changing lifestyle choices/weight loss/exercise/monitoring blood glucose levels |
| **Total** | | **8** |