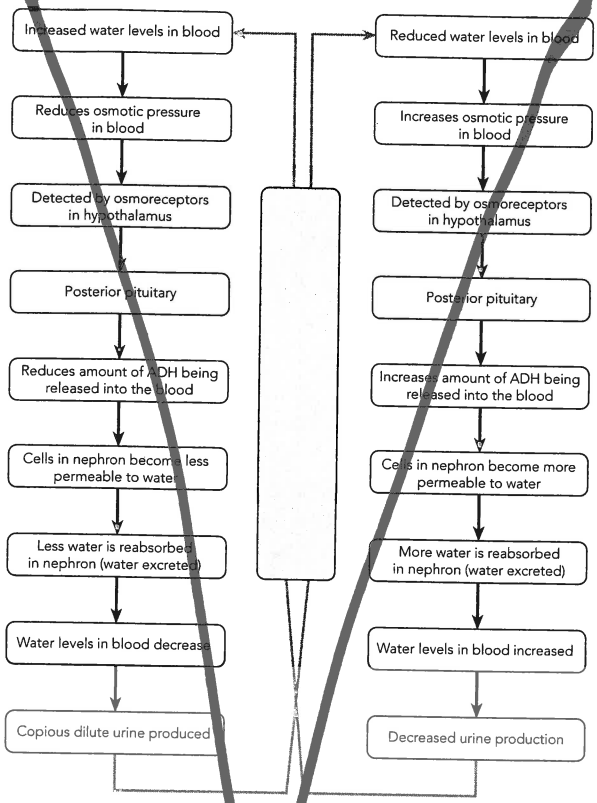
38.



39.

(a) *Dialysis is a process of separating large particles from small particles by a differentially-permeable (semi-permeable) membrane.*

(b) *In an artificial kidney machine, a tube made of cellophane (acting as a semi-permeable membrane), is connected to an artery on the patient (usually the radial artery in the arm). This tube is bathed in a special solution that is constantly replaced. The solution is warm and contains a carefully balanced mixture of substances such as glucose, amino acids and ions. This maintains a concentration gradient between the solution and the blood which causes waste materials to leave the blood. The blood minus the waste materials then flows back into the body via a vein. This form of dialysis is known as haemodialysis. More commonly used by patients at home is Continuous Abdominal Peritoneal Dialysis (CAPD). This involves a tube being connected into the belly, into the peritoneal space and the urea that has collected there, being flushed out of the abdominal cavity.*

(c) *As the kidney is from another person, the body into which the kidney has been transplanted recognizes it as foreign. Then the immune system reacts as if it was pathogenic and tries to get rid of it. (Infections are also possible at the site of dialysis either haemodialysis in the arm or CAPD in the belly). Patients with transplants have to take immunosuppressant drugs to prevent rejection of the kidney and this can then reduce their immune response to other antigens making them more susceptible to other diseases. A combination of drugs is used to reduce the chances of rejection. These could include tacrolimus, prednisone, azathioprine and micophenolate.*

40.

Receptor	Where found	Function
Aortic body	Aorta	Chemoreceptor – monitors the concentration of carbon dioxide and oxygen in the blood.
Carotid body	Carotid artery	Chemoreceptor- monitors the concentration of carbon dioxide and oxygen in the blood.

41. *Adrenalin produces effects similar to the sympathetic nervous system, i.e. it increases blood pressure by increasing heart rate and constricting blood vessels, increases sweating, causes dilation of pupils and decreases activity of the gut and glands. It stimulates metabolism, lipolysis and glycogenolysis, increases blood sugar level and increases production of ATP.*

42.

(a) *The number of alveoli decrease and their walls collapse producing fewer and bigger air sacs.*

(b) *As there are less alveoli, the total surface area thorough which gases could exchange is a lot smaller. As blood is moving more slowly through the lungs due to the collapse of lung tissue, less gas can be exchanged. With fibrosis, the elasticity of the lungs is affected and they do not expand as much as they used to, which also decreases gas exchange.*

(c) *Stop smoking, avoid air pollution.*

5: RESPONSE TO INFECTION

5.1 Bacteria and Viruses

Terminology

(i) *aerobic – uses or needs oxygen.*
(ii) *agar – a jelly produced from seaweed used to culture or grow microorganisms.*
(iii) *anaerobic – does not need or use oxygen.*
(iv) *autotrophic – makes its own food, a producer.*
(v) *bacteria – single celled microorganisms with no membrane-bound organelles. Many are harmless, many are decomposers but some cause diseases in humans.*
(vi) *binary fission – how bacteria reproduce: when one cell divides into two identical cells.*
(vii) *contaminate – means to pollute or infect.*

(viii) extracellular digestion – how bacteria feed – digestive enzymes are released on to their food which digests (breaks down) and the digested food particles are absorbed into the bacteria by diffusion.

(ix) fungi (singular fungus) – unicellular or multicellular organisms that are mostly saprophytic. (A few are parasitic and cause diseases such as ringworm and thrush.) Includes yeasts, molds, mushrooms and toadstools.

(x) germ – casual name for disease causing organisms.

(xi) heterotroph – cannot make its own food, consumer.

(xii) microbe – used to describe a microscopic organism.

(xiii) microscopic – can only be seen using a microscope.

(xiv) parasite – an organism that gets its energy by feeding on living organisms, e.g. flea, tapeworm.

(xv) pathogen – a disease causing organism.

(xvi) replicate – making more of the same, used to describe reproduction of viruses.

(xvii) saprophyte – an organism that gets its energy by feeding on non-living organic matter, e.g. fungi.

(xviii) toxins – by-products of bacterial metabolism or bacterial wastes that can be harmful to other organisms, e.g. it is the toxin produced by tetanus bacteria that causes the disease.

(xix) virus – a sub-microscopic agent basically made of a piece of nucleic acid (either RNA or DNA) covered by a protein coat. It cannot reproduce itself, but infects living cells and relies on them to replicate it.

Review Questions

1. *Organisms which are too small to be seen with your eye so a microscope has to be used. They include viruses, bacteria and fungi such as yeasts.*

2.

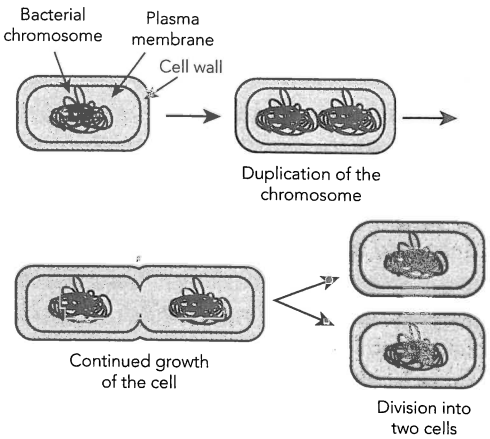
Bacteria	Viruses
• Found in a variety of habitats. • Can be seen with a light microscope. • Most are harmless to us; they are decomposers. • Some produce chemicals called toxins which are poisonous to other organisms. • Single celled spherical (cocci), rod shaped (bacilli) and spiral shaped (spirochaetes). Found singly, in chains or colonies. • Have rigid cell wall except the spirochaetes which have a flexible cell wall. • No distinct nucleus. • Can be killed by antibiotics. • Can be cultured on artificial media and so are easily studied. • Only reproduce in moist conditions by binary or simple fission. Some species of bacteria can form an endospore in adverse conditions. Endospores can survive extreme heat, a lack of moisture, exposure to radiation and many toxic chemicals.	• Can be seen with an electron microscope. • Vary in shape and composition. • Have a protein coat surrounding a core of nucleic acid (DNA or RNA). • Can only live and multiply inside other living cells. They can infect a variety of organisms and cause the infected cell to manufacture new virus particles. • Are not harmed by antibiotics. • Can only be cultured (grown) in living cells (often hen's eggs) so difficult to study. Can be seen with an electron microscope. • Vary in shape and composition. • Have a protein coat surrounding a core of nucleic acid (DNA or RNA). • Are not harmed by antibiotics.

3. *Cocci, bacilli, spirochaetes.*
4.

(a) The colour (of the capsule).
(b) How they stain in different dyes.
(c) The conditions they need for growth.

5. *Moisture, food, and warmth, with or without oxygen.*
6.

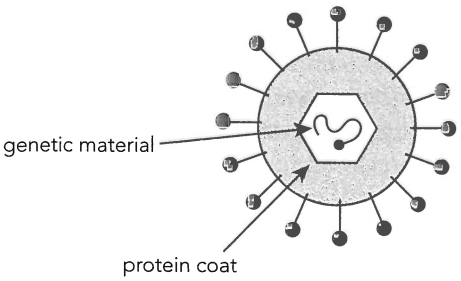
(a) Binary (or simple) fission
(b)



(c) *Less than 5.5 hours, less than 9 hours, less than 10.5 hours.*

7. *Chlamydia, cholera, gonorrhoea, meningitis (bacterial), pneumonia, tetanus, tooth decay (dental caries), tuberculosis, typhoid, syphilis, whooping cough.*

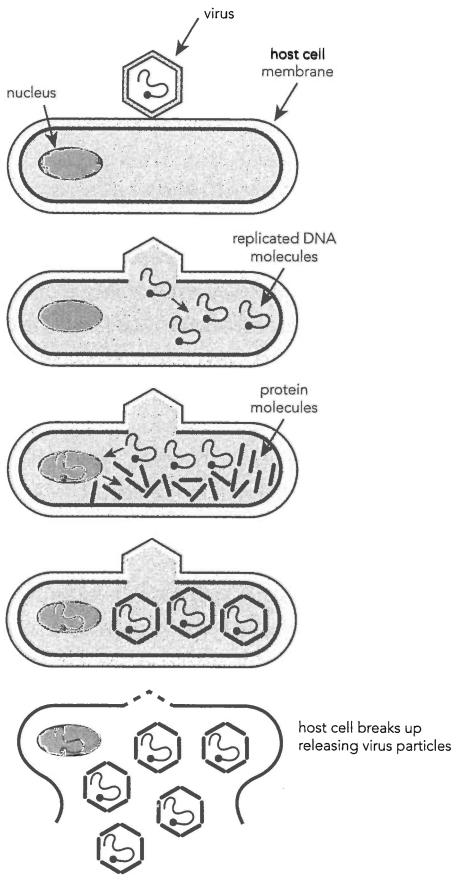
8.



9. *No as they do not carry out any of the processes of living things, i.e. do not move, respire, respond, grow, reproduce, excrete or feed.*

10. *They need a living host cell in which to reproduce. They reprogram the DNA or RNA of the host cell to make more virus particles.*

11.



12. *The organism is usually only found affecting one organism (the host), it does not jump species.*

13. *Viruses that attack bacteria.*

14. *Chicken pox, colds, cold sores, Ebola, genital herpes, glandular fever, hepatitis A & B, HIV, influenza, Lyme disease, measles, meningitis (viral), Ross River virus, rabies, rubella, shingles, smallpox, warts.*

5.2 Transmission and Invasion of Pathogens

Terminology

(i) acid – a solution which has a pH of less than 7 or a solid which gives hydrogen ions (H^+) when dissolved in water.

(ii) antiseptic – a chemical that will kill microorganisms but is safe to use on our bodies.

(iii) carrier – is a person who has the disease without suffering from it and spreads it to other people.

(iv) cerumen – ear wax, which is a sticky or crumbly wax secreted by the glands in the auditory canal.

(v) cilia (singular cilium) – short hair-like structures protruding from specialised cells which beat rhythmically to either move the cell along or move substances over the cell.

(vi) disease – refers to an absence of health in the body, i.e. the body does not function as well as it should due to some factor – stress, a pathogen, etc.

(vii) disinfectant – a chemical that will kill microorganisms and will kill our cells too, so should not be used on our bodies.

(viii) epidermis – the outer layer of skin.

(ix) enzyme – a protein that speeds up the rate of a chemical reaction in a living organism without itself being used up in the reaction.

(x) hygiene – the maintenance of a clean and healthy body.

(xi) incubation period – the length of time from when the person was infected with the disease until symptoms are produced.

(xii) infection – the effect brought about on the functioning of the body by the invasion and multiplication of disease causing organisms.

(xiii) infectious – refers to a disease that can be passed on from one person to another.

(xiv) lacrimal glands – the glands in the eyes which secrete tears.

(xv) mucus – a viscous fluid produced by glands which consists mainly of glycoprotein. It either acts as a lubricant or protects an internal surface.

(xvi) pathogen – a disease causing organism.

(xvii) permeable – something that allows other substances to pass through it.

(xviii) sebaceous glands – glands in the skin that secrete oil, which softens the skin and prevents the hair from becoming brittle. It also inhibits the growth of some bacteria.

(xix) symptom – a specific sign of a disease that can be used to help diagnose the particular disorder.

(xx) topical preparations – chemicals that are applied to the external surfaces of the body to help repair damaged tissue, protect it from damage or cure a disease, e.g. creams

and ointments.

(xxi) vector – organisms that transfer the pathogens from one organism to another, e.g. mosquitoes, fleas.

(xxii) virulence – refers to the strength of, or how bad a particular pathogen is.

Review Questions

1.

(a) The body's natural protection consists of three lines of defence. The first line consists of external barriers (skin, nasal hairs, cilia, stomach acidity, tears, saliva, sweat, ear wax, urine, vaginal acidity, mucus and mucosa). The second line includes large white blood cells (macrophages), neutrophils, inflammation and temperature rise(resulting in increased production of T lymphocytes and makes reactions faster so the body may repair itself quicker). The third line is the immunity to specific pathogens provided by the lymphocytes (B and T cells). Both the second and third lines of defence are mainly internal.

Assisted protection is anything a person can do artificially to add to this natural protection. This includes the use of antiseptic creams, antibiotics, antivirals, good hygiene, and taking precautions to minimise the spread of communicable disease.

(b) External assisted protection generally involves the application of barriers and creams (e.g. condoms and 'patches') to external surfaces, i.e. skin and mucosa. Internal assisted protection involves the use of vaccines and ingested antibiotics, which enter the body's internal environment and supplement the second and third lines of its natural defence.

2.

(a) Breaks, tears, cuts in the skin surface often require an application of antiseptics to prevent microorganisms from entering the body.

(b) Ear wax should be cleaned from the external opening auditory canal so that a build up of microorganism laden wax does not occur.

(c) Care should be taken to avoid damage to the mucosa of the alimentary canal, vagina, anal passage, mouth and respiratory system so that microorganisms do not enter our bodies through damaged areas.

3.

(a) This means keeping our bodies clean, taking care not to infect others with diseases we may have and taking precautions not to contract (catch) infections.

(b) Washing hands after going to the toilet, handling tampons, before eating, cooking or handling food, after being near someone who has a cough or cold and after handling pets.

(c) Changing tampons and sanitary napkins four to five times per day and wash hands before and after changing. Avoid soaps which may irritate the vaginal skin as this may make infections such as thrush more likely. Urination after sexual intercourse can flush out bacteria in the bladder and urethra which can cause cystitis.

(d) Men who are uncircumcised should roll back the foreskin and clean underneath with mild soap and plenty of water.

4.

(a) Inhaling droplets containing pathogenic organisms from the air. These droplets come from people coughing, sneezing or spitting.

(b) Contact directly with an infected person or indirectly by handling their clothes or bedding.

(c) Eating or drinking contaminated food or water. These can be contaminated by faecal matter or from airborne pathogens.

(d) By vectors, e.g. malaria is spread to people when a mosquito containing Plasmodium (the microorganism that causes malaria) bites somebody and injects the parasite into them.

(e) Piercing skin, e.g. tetanus, hepatitis C.

5. *Lysozyme (enzymes that can destroy bacteria) are found in sweat, tears, saliva, nasal secretions; acidic gastic juice in the stomach (pH 1-2); digestive enzymes; cerumen in ears; acidic secretions in the vagina; urine is acidic, it flows periodically which flushes away organisms.*

6.

(a) skin – tough, waterproof, protects lower tissues from bacterial infection. Oil secretions from sebaceous glands have antiseptic properties.

(b) ear wax – traps bacteria, fungi (and small insects). Also destroys some bacteria.

(c) mouth - saliva contains lysozyme which has antibacterial properties.

(d) nasal hairs- trap dust which may carry bacterial and fungal spores.

(e) vaginal fluid – acid secretions keep vagina free from most bacterial and fungal infections.

(f) stomach acid – destroys most ingested bacteria. Few get through to the small intestine.

(g) tears – contain lysozyme, a protein which may assist white blood cells in engulfing bacteria.

(h) urine – acidity reduces the number of microorganisms that can survive in the urethra.

(i) respiratory cilia – carry mucus which is often laden with bacterial and fungal spores out of

the respiratory system.

(j) *mucous membranes – line the respiratory and alimentary tracts forming a continuous physical barrier. They also contain large populations of friendly, harmless bacteria that can inhibit the growth of pathogens.*

7.

(a) *Stomach, vagina, skin.*

(b) *The low pH means that these areas are acidic. The acidity kills most microorganisms as they are not adapted to live in acidic conditions.*

8.

(a) *The digestive system (salivary glands, gastric pits in the stomach, intestinal glands) and the respiratory system (nasal cavity, trachea, bronchi, bronchioles).*

(b) *Mucus which lines the digestive tract protects it from physical damage (e.g. abrasion) and chemical damage (e.g. acids, digestive enzymes) by providing a physical barrier. Therefore microorganisms are generally prevented from moving from the lining into the internal environment (i.e. into blood, intercellular and intracellular fluids).*
Mucus on the lining of the respiratory system traps pathogens (bacterial and fungal spores on dust particles) and is swept up to the top of the trachea and into the opening of the oesophagus by cilia and swallowed. The microorganisms are then destroyed by the acids and enzymes in the stomach.

9. *It separates the digestive cavity from the blood and internal organs. To reach the liver, heart, kidneys, brain, etc, microorganisms (and nutrients) must first pass through this barrier. The contents of the digestive tract are usually considered outside of the internal body.*

10. *Individuals should: cover nose and mouth when sneezing; wash hands regularly; not share towels, drinking cups and toothbrushes; clean table surfaces, kitchen benches regularly; stay at home if infected; remain at least one metre away from others if infected, etc.*

11. *Communicable disease – any disease that can be spread from one person to another; contagious – can be easily passed from one person to another by direct or indirect contact (via breathing, clothing, etc); non-communicable – cannot be passed from one person to another.*

12. *An endemic disease is always present in an area, e.g. malaria in some tropical places such as Central Africa, Indonesia, Thailand. An epidemic occurs when there is a sudden outbreak of disease in an area and it affects a lot of people in a short time, e.g. influenza in winter. A pandemic is a world-wide epidemic, e.g. Spanish flu*

5.3 Non-Specific Defence Mechanisms

Terminology

(i) *antibiotic drug – a chemical that kills or harms bacteria.*

(ii) *antiviral drug – drugs that have been designed to kill or treat the symptoms of a viral disease.*

(iii) *fever – an abnormally high body temperature.*

(iv) *histamine – a substance that is released by damaged cells that causes vasodilation and the permeability of capillaries to increase. This is important in inflammation and allergic responses.*

(v) *immunity – is the resistance to infection or disease by invading pathogens.*

(vi) *inflammation – a defensive response to attack by microbes as well as physical agents (such as heat and sharp objects, etc) or chemical agents such as acids, bases and gases. It is recognised by redness, swelling, heat and pain.*

(vii) *interferon – small protein molecules produced by virus infected host cells. It inhibits other cells from producing more virus particles.*

(viii) *lymphocyte – a type of white blood cell (leucocyte) that is produced in the bone marrow. They are involved in the immune response, e.g. T and B cells.*

(ix) *macrophage – a type of white blood cell that actively carries out phagocytosis.*

(x) *non-specific (natural) immunity – general defences within a host such as physical and mechanical barriers (e.g. skin, mucous membranes), chemicals (e.g. lyzozyme), specialised cells and cellular processes (phagocytosis).*

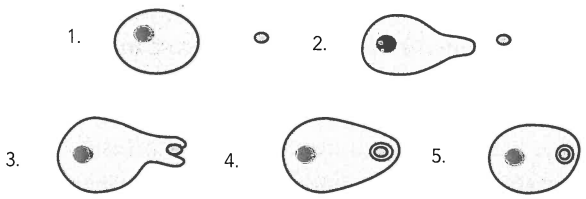
(xi) *phagocyte – a type of white blood cell that engulfs particles such as bacteria and viruses.*

(xii) *pus – a mass of dead phagocytes, dead bacterial cells and fluid.*

(xiii) *toxic – describes a substance that is poisonous when above a certain concentration.*

Review Questions

1. *Phagocytosis is the ingestion of bacteria and dead cell material or particles by cells. It is the major function of macrophages (generally known as white blood cells).*



2.

(a) *The lymphatic system is a series of vein – like vessels that generally follow the circulatory system. These lymph vessels contain fluid called lymph which is derived from interstitial fluid. Along the vessels are swellings called lymph nodes which contain a lot of macrophages and lymphocytes. The lymphatic system also includes some organs that contain lymphatic tissue and bone marrow.*

(b) *The lymphatic system helps to protect the body against the spread of disease by removing bacteria from lymph. The lymphocytes (a type of white blood cell found in lymphatic tissue) carry out immune responses which are specific defence mechanisms.*

3. *Contraction of skeletal muscles squeezes lymph through the vessels. Valves present in the vessels ensure that lymph moves in one direction only.*

4. *Tonsils, adenoids, spleen, thymus gland, small intestine and bone marrow.*

5. *As lymph enters the lymph nodes, fibres inside the lymph node act as a filter and trap bacteria. These are then destroyed by phagocytes and lymphocytes in the lymph node.*

6.

(a) *Inflammation is triggered by damage to tissues of the body caused by a microbe or a wound.*

(b) *It produces redness, heat, swelling, and pain.*

(c) *The damaged cells release chemicals that affect capillaries nearby. The capillaries dilate producing the redness of the overlying skin. Increased blood flow to the area produces the heat. At the same time, the white blood cells in the capillaries are stimulated and they phagocytise bacteria or release histamine which causes fluid from the blood to move into the tissue fluid. This causes the swelling. Pain is caused by damage to nerve endings in the area. After a few days of engulfing bacteria or damaged tissues, the cells involved die themselves. This collection of dead cells and fluid is called pus. It either exits through the surface of the body or is broken down internally.*

7.

(a) *A drug is any substance that is taken deliberately to affect the functioning of the body in some way.*

(b) *A medicine that can only be obtained from a pharmacist through the written direction (prescription) of a doctor.*

(c) *'Safe' in this context means that it is harmful to the target pathogen but in its correct dosage will cause little, if any, harm to the host's cells.*

8.

(a) *Antibiotics are chemicals/drugs that kill or injure bacteria (they interfere with the reproduction of bacteria) that cause infections.*

(b) *Which bacteria caused the infection, possible side effects, potential allergy, cost, etc.*

(c) *Because if you stop when you feel better, there may still be some bacteria alive in your body. These bacteria may have a higher tolerance to the antibiotic than other bacteria and will not be killed by it. It is these 'resistant' bacteria that reproduce, passing on this resistance to the next generation. This then has ramifications for you or other people if these drug-resistant bacteria are released into society, e.g. Staphlococcus aureus, also known as 'golden staph'.*

9.

(a) *Drugs that have been designed to kill or treat the symptoms of a viral infection.*

(b) *Antibiotics are produced from fungi or plants, designed generally to kill or injure bacteria, can only be used for bacterial infections. Antiviral drugs are designed to either prevent the virus from entering its host cell or to prevent the host cell from making replicates of the virus. It does not kill the virus, just reduces its rate of replication. They are useless against bacterial infections and are only available for a few viral infections.*

(c) *HIV, herpes, influenza.*

(d) *Both pass across the external barriers (generally across the lining of the digestive tract in the small intestine) and move into the blood. They are then carried internally via the circulatory system to their target pathogens.*

5.4 Specific Defence Mechanisms

Terminology

(i) *adaptive (specific) immunity – a type of immunity that develops after exposure to pathogens. It provides protection against harmful microorganisms by recognising non-self (foreign) cells or antigens. It can be acquired actively or passively and includes humoral and cell-mediated responses. Consequently, over time the immune system is able to increasingly recognise specific antigens.*

(ii) *antibody – a protein (immunoglobulin) produced by B lymphocytes in response to the presence of an antigen. It is released into the blood stream.*

(iii) *antigen – a foreign substance, often a protein, that is not produced by the body. Its presence stimulates the production of antibodies.*

(iv) *autoimmune response – when the immune*

system attacks its own tissues. A cause of diseases such as rheumatoid arthritis, lupus and multiple sclerosis.

(v) B cell (B lymphocyte) – a special sort of lymphocyte that produces antibodies.

(vi) immune response – the body's response to a specific antigen.

(vii) immunisation – refers to the artificial introduction of weakened antigens or pathogens into somebody so they can develop the appropriate antibodies without suffering from the disease.

(viii) infection – the effect on the functioning of the body caused by the invasion and multiplication of pathogens in the body.

(ix) meningitis – inflammation of the meninges, the membranes covering the brain and spinal cord. May be caused by bacteria, viruses or protozoans.

(x) plasma cell – the B lymphocyte cell which produces antibodies.

(xi) resistance – refers to the need for larger and larger doses of antibiotics to kill a microorganism. It is due to the fact that maybe not all of the microorganisms are killed by the antibiotic. Perhaps the course of treatment was not finished. Those bacteria that survive, reproduce, and produce more like them. Over time this leads to the microorganism becoming more and more resistant. If this happens, the antibiotic is no longer effective against this disease and new antibiotics have to be developed.

(xii) specific immunity (or immunity) – refers to the body's resistance to infection by pathogens that have got past the non-specific defences. Each reaction is designed individually for each particular antigen.

(xiii) T cell (T lymphocyte) – a lymphocyte that can kill antigens such as fungi and viruses.

(xiv) vaccine – a substance that stimulates the immune system to produce antibodies to a particular antigen without an individual having to be infected with it.

Review Questions

1.

(a) Adaptive – means that the response of the lymphatic tissue depends on what the antigen is.

(b) Specific – each antigen stimulates the production of only one particular antibody.

(c) Memory – refers to the fact that the immune system responds more strongly and faster to a second or later invasion by a pathogen due to the presence of specific memory cells. These cells are produced as part of the immune response to an antigen.

(d) Self – are those cells and tissues that are part of the body, non-self are cells or tissues, or particles from somebody or something else.

2.

T Lymphocytes	B Lymphocytes
Form in bone marrow. Long-lived. Move to thymus during foetal development and just after birth. Mature in thymus (hence T-cells) Responsible for cell mediated immunity. Most effective against viruses, fungi, transplanted cells, cancer cells and some bacteria.	Form in bone marrow. Short-lived. Mature in bone marrow (hence B-cells). Responsible for antibody (humoral) mediated immunity. Effective against bacterial and acute viral infections.

3.

(a) In a cell mediated response, lymphocytes called T cells are involved. There are two main sorts of T cells – cytotoxic 'Killer' T's and helper T cells. When a phagocyte engulfs a pathogen or non-self cell, a fragment of the cell that has been engulfed attaches to a special protein called major histocompatibility complex (MHC). This is then displayed on the cell membrane and presented to T cells in a lymph node. This activates the T cells which enlarge and form a clone of cells that all recognise the same antigen. MHC is genetically determined and is unique to each individual. There are two sorts of MHC, Class I and II. If the antigen is coupled to MHC Class I, killer T cells are activated. They travel through the body directly destroying cells that have the same antigen, or by attracting macrophages, or suppressor T's which help to prevent autoimmune responses. If the antigen is coupled to MHC Class II, helper T cells are activated. They then activate killer T and B cells to produce antibodies. Some clone cells remain as long-lived memory T cells in the lymphatic tissue that will recognize the pathogen if it ever invades again. Their presence initiates a faster response to the antigen next time it invades. T cells are most effective against viruses, fungi, transplanted (foreign) cells, cancer cells and some bacteria.

(b) In an antibody mediated (humoral) response, B cells produce and release antibodies into the blood where they bind to and destroy antigens. B cells have antibodies on the surface of their cells. When they combine with a particular antigen, they are then 'recognised' by a helper T cell. This activates the B cell and it divides to form a clone. The cells in the clone become either plasma cells or memory cells. Plasma cells manufacture and release large quantities of antibodies specific to the antigen. These antibodies circulate in the blood and lymph and bind

to the antigens to form antibody-antigen complexes. This inactivates and destroys the antigen. Memory cells stay in the body as a record of what antibodies have been made. If the body should be invaded by the same antigen, these memory cells recognise it and the immune system will respond faster to it. B cells stay in the lymphoid tissues, but when they are exposed to an antigen, a surface receptor on the cell recognises the antigen. The B cells are activated and they enlarge and divide to produce a clone, forming plasma and memory cells and the antigen is destroyed.

4. *When the B cells are activated by an antigen, they start to divide and produce two types of cells. Some of these cells are plasma cells – mature B cells that go on to manufacture and release antibodies specific to the antigen. The other type of cells are called memory cells – long-lived cells that stay in the body and provide long term protection against the pathogen that stimulated their production in the first place.*

5.

(a) *Primary immune response describes the initial reaction when a pathogen invades the body. It takes time for the immune system to recognise the antigen and produce specific defences against it. Consequently, a person can be affected by it and fall sick.*

(b) *A secondary immune response occurs when the body is exposed to a pathogen a second time. Long-lived memory cells produced after the initial exposure quickly recognise the pathogen and produce large quantities of antibodies and killer T cells to counteract it. As the response is so fast, symptoms of the infection may not have time to develop.*

6.

(a) *Acquired Immuno Deficiency Syndrome*

(b) *A virus called Human Immunodeficiency Virus (H.I.V.)*

(c) *By having vaginal, oral or anal sex with a person who is infected with it; sharing needles used for intravenous drug use; it can be passed through the placenta from mother to child; contact with open wounds; using blood products before 1985.*

(d) *In the early stages they include fatigue, fever, swollen lymph glands and headache. Six weeks to six months after infection, antibodies for HIV can be detected in blood tests.*

Over the next few years the lymph glands in the neck, armpits and groin enlarge. Patients can also develop a rare form of pneumonia or a rare skin cancer called Kaposi's sarcoma. Patients are also more susceptible to tuberculosis, chronic diarrhoea, herpes simplex, shingles and other infections.

In the last few years of life many AIDS patients suffer from a type of dementia which involves losing motor function, reasoning ability and may alter their behaviour.

(e) *The only way is to stop the virus being transferred from one person to another. Methods include: abstinence, using condoms, sterilising contaminated hypodermic needles or not sharing them, not getting pregnant if you are HIV positive.*

(f) *The treatments that are available are designed to keep HIV at a low level in the body. Over 20 drugs (anti-AIDS drugs, also called antiretroviral) are available for patients with HIV. They stop the virus from replicating, or entering cells and are often used in combination to prevent drug resistance developing. HIV attaches to a protein (CD4) on the outside of the helper T cells. This helps the virus to enter the helper T. Helper T cells are important in the immune system, so after attack by HIV there are less of them and the immune system is weakened. Consequently, HIV patients are susceptible to 'opportunistic' infections such as a type of pneumonia or thrush. There are a range of treatments available to these specific diseases that they suffer from. AIDS patients are also given high doses of vitamins and encouraged to maintain a healthy diet and engage in exercise programs.*

7. *Their own natural immunity, meticulous hygiene in treating the sick and handling their bedding, wastes (covering up and washing their hands), spraying disinfectants and careful transport and disposal of the bodies.*

8.

	Natural immunity	Artificial immunity
Passive immunity	Antibodies are passed from mother to child through placenta or breast milk. As antibodies are short-lived this only protects the child until its own immune system has developed and produced its own antibodies and the relevant memory cells.	Antibodies injected directly, e.g. rabies and tetanus.
Active immunity	Antibodies develop from having had the disease. Life long immunity due to memory cells.	Antibodies develop as a result of vaccinating with an antigen that stimulates their production.

9. *Weakened strains (attenuated) of bacteria or viruses, neutralised toxins, (toxoids) or a genetically engineered vaccine.*

10.

(a) *No, Immunisation is not compulsory although availability of welfare benefits may be linked to child immunisation.*

(b) *Measles, mumps, chicken pox, tetanus, pertussis (whooping cough), diphtheria, rubella, polio, hepatitis A & B, cholera, typhoid, human papilloma virus, influenza, Hib, tuberculosis, meningococcal infection.*

(c) *HIV (AIDS), dengue fever, common cold, malaria.*

(d) *Streptococcus pneumoniae is a bacterium which may cause ear infections, pneumonia and meningitis.*
Hib (Haemophilus influenzae type B) is a bacterium which may cause infection of the meninges (membranes which enclose the brain and spinal cord), the upper respiratory tract and other parts of the body.
Meningococcal C is a strain of bacterium (Neisseria meningitidis) which causes a disease which develops rapidly and may cause brain damage and death. The bacterium can infect the meninges or can be carried to major organs, joints and connective tissue. It causes serious damage to these body parts. Symptoms include high fever, headaches, sleepiness, joint and muscle pain, stiff neck, light sensitivity and rash.

6: MUTATIONS

Terminology

(i) *allele – the alternative form of a gene.*

(ii) *autosomal chromosome (autosome) – a chromosome which is not a sex chromosome. A normal human somatic cell contains 22 pairs (44) of autosomes.*

(iii) *cancer – the uncontrolled growth of cells, often able to spread (metastase) via the circulatory or lymphatic system to invade other tissue.*

(iv) *centromere – the point of attachment of two chromatids. The spindle fibres attach to the centromere during cell division.*

(v) *chromosome – a strand of DNA that carries the genetic information of an organism.*

(vi) *deleterious – having a harmful effect, e.g. smoking tobacco.*

(vii) *DNA replication – the process in which DNA copies itself prior to cell division. This ensures that the cells produced all contain the same genetic information.*

(viii) *gene – a segment of DNA that codes, or determines a particular trait or characteristic.*

(ix) *genotype – the genetic make-up of an organism for a particular trait, e.g. rr or Rr*

(x) *germ line cell – a cell that gives rise to gametes (sperm or ova). If a mutation occurs in a germ cell then it may be inherited by a person in the next generation.*

(xi) *karyotype – is a picture showing the total number and general appearance of chromosomes within the nucleus of a cell. The chromosomes have been stained, matched up for size and shape and organised in pairs in order from the biggest to the smallest (1 to 22 in humans).*

(xii) *meiosis – cell division process that produces gametes (sperm or ova). The normal diploid number of chromosomes is reduced to the haploid number in this process, e.g. in human the diploid number of 46 chromosomes per somatic cell is reduced to 23 chromosomes in each gamete.*

(xiii) *metaphase – the stage in cell division (mitosis or meiosis) in which chromosomes are lined up along the 'equator' of a cell.*

(xiv) *missense mutation – produced by a change in the base sequence of a DNA triplet. This results in an altered protein whose biological function may be affected.*

(xv) *mitosis – the cell division process that produces new cells for growth and repair.*

(xvi) *mutagen – a mutation causing agent, e.g chemicals, radiation, viruses, high temperature.*

(xvii) *mutant – an organism that has a mutation.*

(xviii) *mutation – a sudden and permanent change to the genetic code which makes an offspring different to its parents. When the change occurs in a germ line cell, it may be inherited by future generations.*

(xix) *nitrogenous base – organic compounds containing nitrogen which make up the genetic code in DNA and RNA molecules, e.g. cytosine, guanine, adenine, thymine and uracil.*

(xx) *nonsense mutation – caused by a change in a nucleotide in a codon. It produces a stop codon which affects protein synthesis and related metabolic pathways.*

(xxi) *nucleotide – the structural unit of DNA made up of a sugar molecule (deoxyribose), nitrogenous base and phosphate.*

(xxii) *phenotype – the expression of a particular genotype, e.g. blue eyes, curly hair.*

(xxiii) *silent mutation – occurs when a nucleotide is changed in a base sequence but the change has no effect on the amino acid that is coded for, due to the degeneracy in the genetic code.*

(xxiv) *somatic cell – a non-sex cell (not sperm or ova). Muscle, nerve, connective and epidermal cells are somatic.*

(xxv) *variation – generally a small difference between two members of the same species. Variation in the offspring of sexually reproducing organisms is greater than*