Paper 1:

B1 Cell Level Systems

B1.1 Cell Structures

B1.1a Describe how light microscopes and staining can be used to view cells

1. Light microscope.
2. Eyepiece lens, objective lenses, stage, stage clips, coarse focus wheel, fine focus wheel, light source (or mirror).
3. To increase contrast so cell structures are easier to see.
4. So light can pass through the specimen, producing a clearer image.
5. Magnification = image size ÷ actual size.
6. A light microscope can be used to compare the appearance and visible structures of different cell types.

B1.1b Explain how the main sub-cellular structures of eukaryotic cells (plants and animals) and prokaryotic cells are related to their functions

1. Eukaryotic cells contain a nucleus, cytoplasm, cell membrane, ribosomes and mitochondria; plant cells also contain a cell wall, chloroplasts and a permanent vacuole; prokaryotic cells have cytoplasm, cell membrane, cell wall, ribosomes, circular DNA and plasmids.
2. The nucleus contains genetic material (DNA) organised into chromosomes, which control the activities of the cell.
3. Mitochondria are the site of aerobic respiration, chloroplasts are the site of photosynthesis and ribosomes are the site of protein synthesis.
4. The cell membrane controls the movement of substances into and out of the cell because it is selectively permeable.
5. Plasmids are small circular rings of DNA found in prokaryotic cells.
6. Plant cells contain chloroplasts, a cell wall and a permanent vacuole; animal cells do not. Prokaryotic cells lack a nucleus and membrane-bound organelles but contain circular DNA and plasmids.

B1.1c Explain how electron microscopy has increased our understanding of sub-cellular structures

1. A microscope that uses electrons instead of light to produce images.
2. It uses electrons rather than light and has a much higher resolution.
3. Resolution is the ability to distinguish two points that are close together as separate.
4. Electrons have a much shorter wavelength than light, giving a higher resolution.
5. It has allowed scientists to see much smaller sub-cellular structures in greater detail.
6. Ribosomes, membranes and other ultrastructural details that cannot be seen clearly with a light microscope.

B1.2 What happens in cells (and what do cells need)?

B1.2a Describe DNA as a polymer

1. DNA is the genetic material found in cells.
2. A polymer is a large molecule made from many repeating monomers.
3. DNA consists of many repeating nucleotide monomers joined together.
4. Nucleotides.
5. The sequence of nucleotides stores genetic information.
6. It carries the genetic instructions needed to make proteins and control cell activities.

B1.2b Describe DNA as being made up of two strands forming a double helix

1. Double helix.
2. Two strands.
3. Two strands twisted around each other.
4. They run alongside each other in a spiral.
5. It consists of two complementary nucleotide strands.
6. The twisted two-stranded structure distinguishes DNA from other biological molecules.

B1.2c Describe that DNA is made from four different nucleotides; each nucleotide consisting of a common sugar and phosphate group with one of four different bases attached to the sugar

1. The basic building block (monomer) of DNA.
2. A sugar, a phosphate group and a nitrogen-containing base.
3. Adenine (A), thymine (T), cytosine (C) and guanine (G).
4. Adenine pairs with thymine, and cytosine pairs with guanine.
5. Because each base only pairs with its specific complementary base.
6. Complementary base pairing holds the two DNA strands together.

B1.2d Recall a simple description of protein synthesis

1. The process of making proteins from genetic information.
2. The DNA unzips and one strand is used as a template.
3. mRNA carries a copy of the genetic code from the nucleus to the ribosome.
4. Transcription occurs in the nucleus; translation occurs at ribosomes in the cytoplasm.
5. tRNA carries specific amino acids to the ribosome.
6. The sequence of DNA bases determines the order of amino acids.

B1.2e Explain simply how the structure of DNA affects the proteins made in protein synthesis

1. The sequence of DNA bases that determines the amino acid sequence.
2. A sequence of three DNA bases that codes for one amino acid.
3. Each DNA triplet codes for a specific amino acid, determining the protein produced.
4. A different base sequence changes the amino acid sequence, producing a different protein.
5. The DNA base sequence determines the amino acid sequence and therefore the protein's structure.
6. The order of amino acids determines the protein's shape and function.

B1.2f Describe experiments that can be used to investigate enzymatic reactions

1. To investigate how different factors affect enzyme activity.
2. By measuring the amount of product formed or substrate used over time.
3. Temperature, pH, substrate concentration or enzyme concentration.
4. All variables except the independent variable should be controlled.
5. To improve reliability and identify anomalous results.
6. Results can be presented in tables and graphs and analysed by comparing reaction rates.

B1.2g Explain the mechanism of enzyme action

1. A biological catalyst that speeds up chemical reactions without being used up.
2. The region of an enzyme where the substrate binds.
3. Only a substrate with a complementary shape fits into the active site.
4. They catalyse metabolic reactions in living organisms.
5. Temperature, pH, substrate concentration and enzyme concentration all affect reaction rate; very high temperatures or extreme pH can denature enzymes.

6. Another factor becomes limiting or all active sites become occupied, so the rate reaches a maximum.

B1.3 Respiration

B1.3a Describe cellular respiration as a universal chemical process, continuously occurring that supplies ATP in all living cells

1. The chemical process that releases energy from glucose to produce ATP.
2. It occurs in all living cells.
3. Cells require a continuous supply of ATP, so respiration occurs continuously.
4. Adenosine triphosphate (ATP), the cell's energy transfer molecule.
5. Respiration releases energy which is used to produce ATP.
6. ATP provides energy for processes such as active transport, muscle contraction and protein synthesis.

B1.3b Describe cellular respiration as an exothermic reaction

1. A reaction that releases energy to the surroundings.
2. It releases energy from glucose.
3. Energy is released and transferred to ATP, with some lost as heat.
4. To power metabolic processes in cells.
5. Endothermic reactions absorb energy, whereas respiration releases energy.
6. Cells need a continuous energy supply for life processes.

B1.3c Compare the processes of aerobic respiration and anaerobic respiration

1. Respiration using oxygen to release energy from glucose.
2. Respiration without oxygen to release energy from glucose.
3. Aerobic respiration requires oxygen; anaerobic respiration does not.
4. Aerobic: glucose + oxygen → carbon dioxide + water. Anaerobic (animals): glucose → lactic acid. Anaerobic (plants and fungi): glucose → ethanol + carbon dioxide.
5. Aerobic respiration releases much more ATP than anaerobic respiration.
6. Aerobic respiration completely breaks down glucose, releasing more energy.

B1.3d Explain the importance of sugars in the synthesis and breakdown of carbohydrates

1. Molecules made from sugar monomers.

2. A monomer is a small repeating unit; a polymer is a large molecule made from many monomers.
3. Sugars join together to form carbohydrate polymers.
4. Carbohydrates are broken down into simple sugars.
5. Sugars are used in respiration and to build carbohydrates.
6. Monomers join to form carbohydrate polymers, and polymers can be broken back down into monomers.

B1.3e Explain the importance of amino acids in the synthesis and breakdown of proteins

1. The monomers that make up proteins.
2. Amino acids join together to form proteins.
3. Proteins are broken down into amino acids.
4. Proteins are needed for growth, repair and making enzymes.
5. Monomers (amino acids) join to form protein polymers, which can later be broken down.
6. They are needed to make new proteins for growth and tissue repair.

B1.3f Explain the importance of fatty acids and glycerol in the synthesis and breakdown of lipids

1. Lipids are biological molecules including fats and oils.
2. Fatty acids and glycerol.
3. Fatty acids combine with glycerol to form lipids.
4. Lipids are broken down into fatty acids and glycerol.
5. Lipids are important for energy storage, insulation and cell membranes.
6. They are the monomers required to build and break down lipid molecules.

B1.4 Cell Division

B1.4a Describe the importance of mitosis in growth, repair and asexual reproduction

1. Cell division producing two genetically identical daughter cells.
2. It increases the number of cells for growth.
3. It replaces damaged or worn-out cells.
4. DNA is copied before division so each daughter cell receives identical chromosomes.
5. It produces genetically identical offspring from one parent.
6. It ensures each new cell has the correct chromosome number.

B1.4b Describe the main stages of the cell cycle, including DNA replication and mitosis

1. Cell growth, DNA replication, mitosis and cytokinesis.
2. DNA is copied to produce two identical sets of chromosomes.
3. The nucleus divides to produce two genetically identical nuclei.
4. The cytoplasm and cell membrane divide to form two cells.
5. So each daughter cell receives a complete set of chromosomes.
6. Two genetically identical daughter cells with the same chromosome number as the parent cell.

B1.4c Describe stem cells as unspecialised cells that can divide and differentiate into specialised cells

1. An unspecialised cell that can divide and differentiate.
2. The process by which a cell becomes specialised.
3. They have not yet developed a specialised function.
4. By switching specific genes on and off during differentiation.
5. Animal stem cells are found in embryos and some adult tissues; plant stem cells are found in meristems.
6. They provide new specialised cells for growth and tissue repair.

B1.4d Explain the potential benefits, risks and ethical issues associated with the use of stem cells in medicine

1. They can replace damaged cells and tissues to treat disease or injury.
2. Potential treatments for diseases and damaged tissues.
3. Rejection, tumour formation or infection.
4. Because embryos are destroyed to obtain embryonic stem cells.
5. Adult stem cells are less controversial but can form fewer cell types than embryonic stem cells.
6. Stem cells offer major medical benefits but raise ethical concerns, especially when embryos are used.

B1.4 Photosynthesis

B1.4a Describe photosynthetic organisms as the main producers of food and therefore biomass for life on Earth

1. Organisms that carry out photosynthesis, such as green plants and algae.
2. They make their own food by photosynthesis.
3. They use light energy to convert carbon dioxide and water into glucose.
4. The total mass of living material.
5. They produce the organic material that forms the base of food chains.

6. Most organisms depend directly or indirectly on photosynthesis for food and oxygen.

B1.4b Describe the process of photosynthesis

1. The process by which plants make glucose using light energy.
2. Carbon dioxide and water.
3. Glucose and oxygen.
4. Light energy is absorbed and used to make glucose from carbon dioxide and water.
5. In the chloroplasts.
6. Carbon dioxide + water → glucose + oxygen.

B1.4c Describe photosynthesis as an endothermic reaction

1. A reaction that absorbs energy from the surroundings.
2. Because it absorbs light energy.
3. Light from the Sun.
4. Light energy is converted into chemical energy stored in glucose.
5. Photosynthesis absorbs energy, whereas respiration releases energy.
6. Energy is needed to convert carbon dioxide and water into glucose.

B1.4d Describe experiments to investigate photosynthesis

1. To investigate the conditions needed for photosynthesis or the rate of photosynthesis.
2. Boil the leaf in water, heat it in ethanol, rinse it, add iodine solution and observe the colour change.
3. To kill the cells and stop chemical reactions.
4. To remove chlorophyll so the iodine colour change can be seen clearly.
5. Blue-black.
6. Starch is produced during photosynthesis, so a blue-black colour shows that photosynthesis has occurred.

B1.4e Explain the effect of temperature, light intensity and carbon dioxide concentration on the rate of photosynthesis

1. The rate increases with temperature up to the optimum, then decreases as enzymes denature.
2. The rate increases as light intensity increases until another factor becomes limiting.
3. The rate increases as carbon dioxide concentration increases until another factor becomes limiting.

4. Another factor becomes limiting.
5. Another factor becomes limiting.
6. Above the optimum temperature, enzymes involved in photosynthesis become denatured.

B1.4f Explain the interaction of temperature, light intensity and carbon dioxide concentration in limiting the rate of photosynthesis

1. The factor in shortest supply that limits the rate of photosynthesis.
2. If light intensity is too low, increasing other factors will have little effect.
3. If carbon dioxide concentration is too low, increasing other factors will have little effect.
4. If temperature is too low or too high, enzyme activity limits photosynthesis.
5. Graphs show where increasing one factor no longer increases the rate because another factor has become limiting.
6. Because another factor has become the limiting factor.

B2 Scaling Up

B2.1 Supplying the Cell

B2.1a Explain how substances are transported into and out of cells through diffusion, osmosis and active transport

1. The net movement of particles from a region of higher concentration to a region of lower concentration.
2. The net movement of water molecules through a partially permeable membrane from a region of higher water potential (dilute solution) to a region of lower water potential (more concentrated solution).
3. The movement of substances against the concentration gradient using energy from respiration.
4. Diffusion and osmosis move down a concentration (or water potential) gradient; active transport moves against the concentration gradient.
5. Diffusion transports oxygen and carbon dioxide; osmosis transports water; active transport transports substances such as mineral ions and glucose.
6. Water potential describes the tendency of water molecules to move. Water moves by osmosis from a region of higher water potential to a region of lower water potential.

B2.1b Describe the process of mitosis in growth, including the cell cycle

1. Cell division producing two genetically identical daughter cells.
2. The cell grows and increases the number of sub-cellular structures.
3. DNA is copied to produce identical chromosomes.
4. The cell grows further and prepares for mitosis.
5. Chromosomes separate so each new nucleus receives one copy of every chromosome.
6. It increases the number of genetically identical cells for growth.

B2.1c Explain the importance of cell differentiation

1. The process by which cells become specialised for specific functions.
2. It allows cells to carry out different functions efficiently.
3. Different specialised cells perform different jobs within the organism.
4. A cell adapted to carry out a particular function.
5. Examples include red blood cells, nerve cells, root hair cells and palisade cells.
6. Different tissues and organs require cells with specialised functions.

B2.1d Recall that stem cells are present in embryonic and adult animals, and meristems in plants

1. Unspecialised cells that can divide and differentiate.
2. In the embryo.
3. In tissues such as bone marrow.
4. Regions of actively dividing cells in plants.
5. At the tips of roots and shoots.
6. Animal stem cells are found in embryos and some adult tissues, whereas plant meristems continue producing new cells throughout life.

B2.1e Describe the functions of stem cells in embryonic and adult animals, and meristems in plants

1. They can differentiate into almost any type of specialised cell.
2. They replace and repair damaged cells in certain tissues.
3. They produce new cells for growth and differentiation.
4. By dividing and then differentiating into specialised cell types.
5. They are essential for development, growth and tissue repair.
6. They allow plants to continue growing throughout life.

B2.1f Describe the difference between embryonic and adult stem cells in animals

1. Stem cells from embryos that can form almost any cell type.

2. Stem cells found in certain adult tissues that can produce a limited range of cell types.
3. Embryonic stem cells can produce many more cell types than adult stem cells.
4. They have not yet become specialised.
5. They have already become partly specialised.
6. Embryonic stem cells have the ability to divide and develop into almost any cell type in the human body, , whereas adult stem cells are more limited in the cell types they can produce.

B3 Organism Level Systems

B3.1 Coordination and Control – The Nervous System

B3.1a Describe the structure of the nervous system

1. The brain and spinal cord.
2. Sensory neurones carry impulses from receptors to the CNS; relay neurones carry impulses within the CNS; motor neurones carry impulses from the CNS to effectors.
3. They detect stimuli.
4. A tiny gap between neurones where neurotransmitters transmit nerve impulses.
5. Muscles or glands that bring about a response.
6. Receptors detect stimuli, sensory neurones carry impulses to the CNS, relay neurones process the information, motor neurones carry impulses to effectors, and effectors produce the response.

B3.1b Explain how the components of the nervous system can produce a coordinated response

1. To detect and respond to changes throughout the body.
2. They detect stimuli and convert them into nerve impulses.
3. Nerve impulses travel from receptors to the CNS and then to effectors.
4. It processes information and coordinates the response.
5. Different receptors detect different types of stimuli.
6. Receptors, neurones, the CNS and effectors work together to produce coordinated responses.

B3.1c Explain how the structure of a reflex arc is related to its function

1. A rapid, automatic response to a stimulus.
2. Receptor → sensory neurone → relay neurone → motor neurone → effector.
3. It carries nerve impulses from the receptor to the CNS.
4. It passes impulses between sensory and motor neurones within the CNS.
5. The motor neurone carries impulses to the effector, which produces the response.
6. It follows a short pathway through the CNS, allowing a rapid automatic response.

B3.1d Explain how the main structures of the eye are related to their functions

1. It refracts light entering the eye.
2. The iris changes the size of the pupil to control light entering the eye.
3. It is the opening that allows light into the eye.
4. The ciliary muscles alter the shape of the lens by changing the tension in the suspensory ligaments to focus light on the retina.
5. The retina contains light receptors and the optic nerve carries impulses to the brain.
6. Each structure is adapted to focus light accurately onto the retina for clear vision.

B3.1e Describe common defects of the eye and explain how some of these problems may be overcome

1. An inability to distinguish certain colours.
2. The eye is too long or the lens is too powerful, so distant images focus in front of the retina.
3. The eye is too short or the lens is not powerful enough, so near images focus behind the retina.
4. Concave (diverging) lenses.
5. Convex (converging) lenses.
6. Corrective lenses alter the path of light so images focus on the retina.

B3.1f Describe the structure and function of the brain

1. Conscious thought, intelligence, memory and voluntary actions.
2. Coordination of balance and muscular movement.
3. Control of unconscious activities such as breathing and heart rate.
4. The hypothalamus regulates internal conditions and links the nervous and endocrine systems; the pituitary gland releases hormones.
5. Different regions perform specialised functions and work together to coordinate the body.
6. Different brain regions are specialised for different functions.

B3.1g Explain some of the difficulties of investigating brain function

1. The brain is complex and difficult to study without causing damage.
2. They provide information about the functions of damaged brain regions.
3. They are limited because every injury is different and evidence may not apply to everyone.
4. The risk of harming patients and the need for informed consent.
5. Ethical restrictions limit the types of investigations that can be carried out.
6. Both practical and ethical issues make research into brain function difficult.

B3.1h Explain some of the limitations in treating damage and disease in the brain and other parts of the nervous system

1. Nervous tissue has very limited ability to regenerate.
2. Surgery may damage nearby healthy nervous tissue.
3. Many areas are difficult to reach safely without causing damage.
4. Nervous tissue is difficult to repair and treatments are often limited.
5. Treatments may not fully restore lost function.
6. The delicate nature and poor regenerative ability of nervous tissue make treatment difficult.

B3.2 Coordination and Control – The Endocrine System

B3.2a Describe the principles of hormonal coordination and control by the human endocrine system

1. Coordination of body functions using hormones.
2. A system of glands that secrete hormones.
3. Hormones act as chemical messengers.
4. They are transported in the bloodstream.
5. They produce and release hormones.
6. Hormones only affect target organs or cells with specific receptors.

B3.2b Explain the roles of thyroxine and adrenaline in the body

1. It regulates metabolic rate, growth and development.
2. Thyroxine levels are controlled by negative feedback.
3. It prepares the body for a fight-or-flight response.
4. It increases heart rate, breathing rate and blood glucose concentration.
5. It keeps thyroxine levels within a normal range.

6. Thyroxine regulates metabolism, whereas adrenaline prepares the body for emergencies.

B3.2c Describe the role of hormones in human reproduction including the control of the menstrual cycle

1. It rebuilds the uterine lining and stimulates LH release while inhibiting FSH.
2. It maintains the uterine lining after ovulation.
3. It stimulates egg maturation in the ovaries.
4. It stimulates sperm production and male secondary sexual characteristics.
5. Hormones regulate egg maturation, ovulation and maintenance of the uterus.
6. They control the reproductive processes required for successful reproduction.

B3.2d Explain the interactions of FSH, LH, oestrogen and progesterone in the control of the menstrual cycle

1. It stimulates egg maturation and oestrogen production.
2. It triggers ovulation.
3. Oestrogen inhibits FSH and stimulates LH.
4. It maintains the uterine lining and inhibits FSH and LH.
5. They interact through positive and negative feedback to regulate the menstrual cycle.
6. They ensure the correct timing of egg maturation, ovulation and preparation of the uterus.

B3.2e Explain the use of hormones in contraception and evaluate hormonal and non-hormonal methods of contraception

1. Hormones are used to prevent ovulation or reduce the chance of fertilisation.
2. Hormonal methods prevent pregnancy by inhibiting FSH and LH, preventing ovulation.
3. Examples include condoms, diaphragms and copper IUDs.
4. Advantages include high effectiveness and convenience; disadvantages include possible side effects and no protection against STIs.
5. Advantages include no hormonal side effects; condoms also reduce STI transmission, but some methods are less effective if not used correctly.
6. Hormonal contraception is generally more effective, while non-hormonal methods may avoid hormonal side effects and some protect against STIs.

B3.2f Explain the use of hormones in modern reproductive technologies to treat infertility

1. Hormones are used to stimulate egg maturation and ovulation.
2. Fertility drugs contain FSH and/or LH to stimulate egg development and ovulation.
3. FSH stimulates egg maturation and LH triggers ovulation.
4. To increase the chance of successful fertilisation.
5. They increase the chance of pregnancy in people experiencing infertility.
6. Hormonal treatments can improve fertility but may increase the risk of multiple pregnancies and other side effects.

B3.2g Explain how plant hormones are important in the control and coordination of plant growth and development, with reference to the role of auxins in phototropisms and gravitropisms

1. Auxins stimulate cell elongation in plant shoots.
2. Auxins accumulate on the shaded side, causing greater cell elongation so the shoot bends towards the light.
3. Auxins accumulate on the lower side of shoots, causing the shoot to grow upwards.
4. Cells with more auxin elongate more, causing bending.
5. Auxins coordinate growth by controlling cell elongation.
6. Unequal auxin distribution causes growth responses to light and gravity.

B3.2h Describe some of the variety of effects of plant hormones, relating to auxins, gibberellins and ethene

1. They stimulate cell elongation and root development.
2. They stimulate seed germination.
3. They stimulate stem growth.
4. It stimulates fruit ripening.
5. It promotes flower opening and leaf fall.
6. Auxins mainly control growth responses, gibberellins promote growth and germination, and ethene controls fruit ripening and ageing.

B3.2i Describe some of the different ways in which people use plant hormones to control plant growth

1. Selective herbicides kill broad-leaved weeds without harming grasses.
2. Auxins stimulate root formation in cuttings.
3. Plant hormones stimulate fruit development without fertilisation.
4. Gibberellins can break seed dormancy and stimulate germination.
5. They improve crop production and plant propagation.

6. Different plant hormones are used to control growth, germination, rooting and fruit production.

B3.3 Maintaining Internal Environments

B3.3a Explain the importance of maintaining a constant internal environment in response to internal and external change

1. Homeostasis.
2. It keeps conditions suitable for enzyme-controlled metabolic reactions.
3. Metabolic reactions depend on enzymes working at their optimum conditions.
4. Internal changes such as exercise alter body temperature and blood glucose concentration.
5. External changes such as environmental temperature affect body temperature.
6. Maintaining stable internal conditions allows cells and enzymes to function effectively.

B3.3b Describe the function of the skin in the control of body temperature

1. Thermoreceptors in the skin detect temperature changes.
2. Sweat evaporates, removing heat from the body.
3. Muscle contractions generate heat.
4. Blood vessels widen, increasing blood flow near the skin to lose heat.
5. Blood vessels narrow, reducing blood flow near the skin to conserve heat.
6. Sweating, shivering, vasodilation and vasoconstriction help maintain body temperature.

B3.3c Explain how insulin controls blood sugar levels in the body

1. It lowers blood glucose concentration.
2. When blood glucose concentration becomes too high.
3. It increases the uptake of glucose by cells and stimulates conversion of glucose to glycogen.
4. They convert glucose into glycogen for storage.
5. It prevents blood glucose concentration from becoming too high.
6. Insulin lowers blood glucose concentration back towards normal levels.

B3.3d Explain how glucagon interacts with insulin to control blood sugar levels in the body

1. It raises blood glucose concentration.

2. When blood glucose concentration becomes too low.
3. It stimulates the breakdown of glycogen into glucose.
4. Insulin lowers blood glucose while glucagon raises it.
5. They maintain blood glucose concentration within a normal range.
6. They work together through negative feedback to regulate blood glucose concentration.

B3.3e Compare type 1 and type 2 diabetes and explain how they can be treated

1. A condition where the pancreas produces little or no insulin.
2. A condition where body cells no longer respond properly to insulin.
3. Insulin injections, careful monitoring of blood glucose and controlled diet.
4. Lifestyle changes such as diet and exercise, and medication if required.
5. Type 1 involves lack of insulin production; Type 2 involves insulin resistance and is often linked to lifestyle.
6. Because the causes of the two conditions are different (Type 1 born with little to no insulin vs Type 2 cells not responsive/ are resistant to insulin)

B3.3f Explain the effect on cells of osmotic changes in body fluids

1. Water enters the cells by osmosis, causing them to swell and possibly burst (lysis).
2. Water leaves the cells by osmosis, causing them to shrink (crenate).
3. There is no net movement of water into or out of the cells.
4. The bursting of an animal cell when too much water enters by osmosis.
5. Water moves out of the cell by osmosis into the surrounding fluid.
6. Animal cells swell, shrink or remain unchanged depending on the water potential of the surrounding body fluids.

B3.3g Describe the function of the kidneys in maintaining the water balance of the body

1. They regulate the body's water content by controlling how much water is reabsorbed.
2. By changing the amount of water reabsorbed into the blood.
3. By varying the amount of water reabsorbed before urine is produced.
4. To maintain homeostasis and normal cell function.
5. They reabsorb more water, producing a smaller volume of concentrated urine.
6. They regulate water content by adjusting the concentration and volume of urine.

B3.3h Describe the gross structure of the kidney and the structure of the kidney tubule

1. Cortex, medulla, pelvis and kidney tubules (nephrons).
2. The cortex contains filtration units; the medulla contains loops of the kidney tubules where water balance is regulated.
3. It filters blood and selectively reabsorbs useful substances.
4. It has a large surface area and a good blood supply for efficient reabsorption.
5. Water, glucose, ions, urea and other small molecules.
6. Filtration followed by selective reabsorption enables the kidneys to regulate water balance.

B3.3i Describe the effect of ADH on the permeability of the kidney tubules

1. Antidiuretic hormone.
2. It increases the permeability of the kidney tubules to water.
3. More water is reabsorbed into the bloodstream.
4. Urine becomes more concentrated and its volume decreases.
5. ADH secretion changes in response to blood water content through negative feedback.
6. ADH regulates water reabsorption to maintain water balance.

B3.3j Explain the response of the body to different temperature and osmotic challenges

1. More ADH is released, more water is reabsorbed and concentrated urine is produced.
2. Less ADH is released, less water is reabsorbed and dilute urine is produced.
3. More water is conserved by increasing ADH release.
4. It encourages water intake when blood water potential falls.
5. They alter the amount of water reabsorbed according to the body's needs.
6. Negative feedback regulates body temperature and water balance despite changing environmental conditions.

Paper 2:

B4 Community Level Systems

B4.1 Ecosystems

B4.1a Recall that many different materials cycle through the abiotic and biotic components of an ecosystem

1. Materials move repeatedly between living organisms and the non-living environment.
2. Non-living parts of the ecosystem, such as air, water and soil.
3. Living organisms within the ecosystem.
4. Materials are taken up by organisms and returned to the environment through processes such as decomposition.
5. Carbon and nitrogen.
6. They are needed continuously by living organisms and must be recycled because supplies are limited.

B4.1b Explain the role of microorganisms in the cycling of materials through an ecosystem

1. They act as decomposers, recycling materials.
2. The breakdown of dead organisms and waste.
3. They break down dead material and release nutrients back into the environment.
4. They recycle nutrients for reuse by plants and other organisms.
5. They release nutrients from dead organisms and waste into the soil and atmosphere.
6. Their decomposition activities maintain the continuous recycling of materials in ecosystems.

B4.1c Explain the importance of the carbon cycle and the water cycle to living organisms

1. It recycles carbon needed for photosynthesis and other biological molecules.
2. It recycles water needed for life processes.
3. They maintain suitable environmental conditions for living organisms.
4. The water cycle continuously recycles fresh water.
5. They recycle essential materials required by living organisms.
6. Carbon cycle: photosynthesis, feeding, respiration, decomposition and combustion. Water cycle: evaporation, condensation, precipitation and transpiration.

B4.1d Explain the effect of factors such as temperature, water content and oxygen availability on rate of decomposition

1. Higher temperatures increase decomposition up to an optimum.
2. More water generally increases decomposition.
3. More oxygen increases aerobic decomposition.
4. Aerobic decomposition uses oxygen; anaerobic decomposition occurs without oxygen.
5. Their enzymes work more effectively under favourable conditions.
6. Warm, moist and oxygen-rich conditions produce the fastest rates of decomposition.

B4.1e Describe different levels of organisation in an ecosystem

1. A single living organism.
2. All the organisms of one species living in the same area.
3. All the populations of different species living and interacting in the same area.
4. A community together with the abiotic (non-living) environment.
5. Individual organism → Population → Community → Ecosystem.
6. A population contains one species, a community contains all the populations in an area, and an ecosystem includes the community and the abiotic environment.

B4.1f Explain how abiotic and biotic factors can affect communities

1. Non-living factors in an ecosystem.
2. Temperature, light intensity, moisture level and soil pH affect the size and distribution of communities.
3. Living factors in an ecosystem.
4. Predators reduce the size of prey populations.
5. Food availability affects the size of populations because organisms compete for resources.
6. Abiotic and biotic factors together determine the size and distribution of communities.

B4.1g Describe the importance of interdependence and competition in a community

1. Organisms depend on each other for survival.
2. One organism kills and eats another organism.
3. A relationship in which both organisms benefit.
4. A relationship in which one organism benefits and the other is harmed.
5. Changes to one population can affect all the other organisms in the community.

6. Competition occurs when organisms require the same limited resources, such as food, water, light, space or mates.

B4.1h Describe the differences between the trophic levels of organisms within an ecosystem

1. The feeding position of an organism in a food chain.
2. An organism that makes its own food, usually by photosynthesis.
3. An organism that obtains energy by feeding on other organisms.
4. Producers occupy the first trophic level; consumers occupy higher trophic levels.
5. Energy is transferred by feeding.
6. Trophic levels describe the feeding relationships and transfer of energy through an ecosystem.

B4.1i Describe pyramids of biomass and explain, with examples, how biomass is lost between the different trophic levels

1. A diagram showing the biomass at each trophic level.
2. Biomass is lost between trophic levels.
3. Biomass is lost in faeces and undigested material.
4. Biomass is lost in waste products such as urea.
5. Biomass is lost because materials are respired to release energy.
6. Egestion, excretion and respiration reduce the biomass available for transfer to the next trophic level.

B4.1j Calculate the efficiency of biomass transfers between trophic levels and explain how this affects the number of trophic levels in a food chain

1. The percentage of biomass transferred from one trophic level to the next.
2. Percentage efficiency = (Biomass transferred ÷ Biomass available) × 100
3. 10%
4. 15%
5. Because biomass is lost by egestion, excretion and respiration.
6. Since only a small proportion of biomass is transferred at each trophic level, food chains usually contain only a limited number of trophic levels.

B5 Genes, Inheritance and Selection

B5.1 Inheritance

B5.1a Explain the following terms: gamete, chromosome, gene, allele/variant, dominant, recessive, homozygous, heterozygous, genotype and phenotype

1. A sex cell (sperm or egg) containing a haploid set of chromosomes.
2. A chromosome is a long DNA molecule; a gene is a section of DNA that codes for a protein; an allele (variant) is a different version of a gene.
3. A dominant allele is expressed if present; a recessive allele is only expressed when two copies are present.
4. Homozygous means two identical alleles; heterozygous means two different alleles.
5. Genotype is the genetic makeup of an organism; phenotype is its observable characteristics.
6. Brown eyes.

B5.1b Describe the genome as the entire genetic material of an organism

1. The complete genetic material of an organism.
2. All of an organism's DNA, including all of its genes.
3. A chromosome is one DNA molecule; the genome is the complete set of DNA.
4. A gene is a section of DNA; the genome includes every gene.
5. Yes, almost all cells contain the same genome.
6. It contains the instructions for the development and functioning of the organism.

B5.1c Describe that the genome, and its interaction with the environment, influence the development of the phenotype of an organism

1. Genes provide the instructions that influence characteristics.
2. Environmental factors can affect how characteristics develop.
3. Variation with distinct categories and no intermediates.
4. Variation showing a continuous range of values.
5. Discontinuous: blood group. Continuous: height.
6. Phenotype is determined by the interaction between genes and the environment.

B5.1d Recall that all variants arise from mutations, and that most have no effect on the phenotype, some influence phenotype and a very few determine phenotype

1. A change in the DNA sequence.
2. Mutations.
3. Most have no effect.
4. Some affect the phenotype.
5. Very few determine the phenotype.
6. Different mutations affect different genes or gene expression, so their effects vary.

B5.1e Describe how genetic variants may influence phenotype

1. It may change the amino acid sequence and the protein produced.
2. It may change the protein's shape and function.
3. It may alter the shape of the active site so the enzyme no longer works properly.
4. It may affect gene expression.
5. They can alter whether, when or how much a gene is expressed.
6. Coding DNA mutations alter proteins directly; non-coding DNA mutations alter gene expression.

B5.1f Explain some of the advantages and disadvantages of asexual and sexual reproduction in a range of organisms

1. Advantage: only one parent is needed and reproduction is rapid. Disadvantage: little or no genetic variation.
2. Advantage: produces genetic variation. Disadvantage: requires two parents and is slower.
3. Asexual reproduction usually produces more offspring.
4. Asexual reproduction.
5. Genetic variation increases the chance that some individuals will survive environmental change.
6. Sexual reproduction produces variation that increases survival in changing environments despite being slower.

B5.1g Explain the terms haploid and diploid

1. A cell containing one set of chromosomes.
2. A cell containing two sets of chromosomes.
3. Sperm and egg cells.
4. Body cells.
5. Haploid cells have half the chromosome number of diploid cells.

6. So fertilisation restores the normal diploid chromosome number.

B5.1h Explain the role of meiotic cell division in halving the chromosome number to form gametes

1. Cell division that produces haploid gametes.
2. To produce gametes with half the normal chromosome number.
3. Gametes.
4. So fertilisation restores the diploid chromosome number.
5. Fertilisation combines two haploid gametes to produce a diploid zygote.
6. Meiosis produces genetically varied gametes through independent assortment and recombination.

B5.1i Explain single gene inheritance in the context of homozygous and heterozygous crosses involving dominant and recessive genes

1. The inheritance of a characteristic controlled by one gene.
2. Homozygous dominant has two dominant alleles (e.g. TT); homozygous recessive has two recessive alleles (e.g. tt).
3. The dominant phenotype is expressed.
4. A dominant allele masks the effect of a recessive allele.
5. Genotypes: all Tt. Phenotypes: all show the dominant characteristic.
6. Homozygous and heterozygous crosses show how dominant alleles are expressed and recessive alleles are only expressed when homozygous.

B5.1j Predict the results of single gene crosses

1. A diagram used to predict the possible genotypes of offspring.
2. By placing the parental alleles around the grid and combining them.
3. BB, Bb, Bb, bb.
4. 25% (1 in 4).
5. 50% (2 in 4).
6. They predict probabilities, not the exact outcome of individual families.

B5.1k Describe sex determination in humans using a genetic cross

1. The X and Y chromosomes.
2. XX.
3. XY.
4. Eggs always carry an X chromosome, whereas sperm carry either X or Y.
5. XX, XX, XY, XY → 50% male.
6. Half of the sperm carry X chromosomes and half carry Y chromosomes.

B5.1l Recall that most phenotypic features are the result of multiple genes rather than single gene inheritance

1. A characteristic controlled by more than one gene.
2. Because many characteristics are influenced by several genes acting together.
3. Height.
4. Single gene inheritance is controlled by one gene; multiple gene inheritance is controlled by several genes.
5. Because the combined effects of many genes produce a range of phenotypes.
6. Because most characteristics are influenced by several genes rather than just one.

B5.1m Describe the development of our understanding of genetics

1. An Austrian monk and scientist.
2. Investigations into inheritance using pea plants.
3. That characteristics are inherited through discrete units (genes).
4. His ideas were ahead of the available scientific evidence and technology.
5. The discovery of chromosomes, genes and DNA supported his conclusions.
6. His work laid the foundations of modern genetics and our understanding of inheritance.

B5.2 Natural Selection and Evolution

B5.2a State that there is usually extensive genetic variation within a population of a species

1. Differences in alleles between individuals of the same species.
2. Because mutations and sexual reproduction produce different allele combinations.
3. It allows populations to adapt to changing environments.
4. No. Individuals usually have different combinations of alleles.
5. Different alleles produce different characteristics.
6. It provides the variation on which natural selection acts.

B5.2b Describe the impact of developments in biology on classification systems

1. Artificial classification is based on observable features; natural classification is based on evolutionary relationships.
2. The study of evolutionary relationships using DNA and molecular evidence.

3. By comparing DNA base sequences to determine how closely related organisms are.
4. New evidence from genetics and molecular biology has improved classification.
5. DNA evidence is more reliable because it is less affected by environmental factors than appearance.
6. Molecular phylogenetics has produced classification systems that better reflect evolutionary relationships.

B5.2c Explain how evolution occurs through the natural selection of variants that have given rise to phenotypes best suited to their environment

1. The process in which individuals with advantageous inherited characteristics are more likely to survive and reproduce.
2. Mutations produce new genetic variants.
3. They are better adapted to survive and reproduce in that environment.
4. Individuals with advantageous alleles survive, reproduce and pass them to their offspring.
5. Advantageous alleles become more common over many generations.
6. Mutation creates variation; natural selection favours advantageous variants, leading to evolution.

B5.2d Describe evolution as a change in the inherited characteristics of a population over time, through a process of natural selection, which may result in the formation of new species

1. A change in the inherited characteristics of a population over time.
2. Because populations contain genetic variation whereas individuals do not evolve genetically during their lifetime.
3. Individuals with advantageous characteristics reproduce more successfully, changing allele frequencies over generations.
4. Continued natural selection and isolation can eventually produce a new species.
5. Because many generations are needed for sufficient genetic changes to accumulate.
6. Natural selection gradually changes populations until they may become reproductively isolated and form new species.

B5.2e Describe the evidence for evolution

1. Fossils show that organisms have changed over time.
2. Antibiotic resistance develops through natural selection.

3. Resistant bacteria survive treatment, reproduce and pass on resistance alleles.
4. The fossil record shows the appearance, change and extinction of organisms over time.
5. Random mutations produce resistant bacteria, which survive antibiotics and reproduce.
6. Fossils and antibiotic-resistant bacteria both provide evidence that evolution occurs through natural selection.

B5.2f Describe the work of Darwin and Wallace in the development of the theory of evolution by natural selection and explain the impact of these ideas on modern biology

1. Scientists who developed the theory of evolution by natural selection.
2. The theory of evolution by natural selection.
3. There was insufficient scientific evidence at the time and many people held conflicting beliefs.
4. It underpins modern biology and explains the diversity of life.
5. A collection of seeds stored to conserve plant biodiversity and genetic diversity.
6. Their work transformed our understanding of evolution and forms the basis of modern evolutionary biology.

B6 Global Challenges

B6.1 Monitoring and Maintaining the Environment

B6.1a Explain how to carry out a field investigation into the distribution and abundance of organisms in a habitat and how to determine their numbers in a given area

1. Distribution is where organisms are found; abundance is the number of organisms present.
2. Random sampling estimates abundance; transects investigate changes in distribution across a habitat.
3. Quadrats sample plants or slow-moving organisms; pooters collect small invertebrates; nets collect flying or aquatic organisms; identification keys identify species.
4. A sample is captured, marked, released, recaptured and the proportion of marked organisms is used to estimate population size.
5. 3000 daisies.

6. Field investigations use sampling techniques and scaling up to estimate the abundance and distribution of organisms in habitats.

B6.1 Monitoring and Maintaining the Environment (continued)

B6.1b Describe both positive and negative human interactions within ecosystems and explain their impact on biodiversity

1. The variety of different species in an ecosystem or on Earth.
2. Habitat conservation and captive breeding programmes.
3. Deforestation and overhunting.
4. They protect species, habitats and genetic diversity.
5. They destroy habitats, reduce populations and may cause extinctions.
6. Human activities can either conserve or reduce biodiversity depending on how ecosystems are managed.

B6.1c Explain some of the benefits and challenges of maintaining local and global biodiversity

1. It maintains stable ecosystems and preserves resources for future generations.
2. Different countries may have different priorities, costs and environmental policies.
3. To determine whether they are effective.
4. Tourism that conserves the environment and benefits local communities.
5. It provides income that encourages conservation of habitats and wildlife.
6. Conserving biodiversity has environmental and economic benefits but requires international cooperation and long-term monitoring.

B6.1d Evaluate the evidence for the impact of environmental changes on the distribution of organisms, with reference to water and atmospheric gases

1. Changes in water availability can alter where organisms can survive.
2. Changes in atmospheric gases, such as carbon dioxide, can affect the distribution of organisms.
3. Distribution surveys, long-term monitoring and environmental measurements.
4. Reliable evidence is needed before identifying causes of environmental change.

5. Drier conditions may have contributed to the disappearance, but further evidence from repeated surveys and environmental data would strengthen the conclusion.
6. Conclusions should be based on sufficient, reliable evidence linking environmental changes with changes in organism distribution.

B6.2 Feeding the Human Race

B6.2a Describe some of the biological factors affecting levels of food security

1. Having enough safe and nutritious food for the population.
2. More people require more food.
3. Increased demand for meat means more crops are used to feed livestock.
4. They reduce crop and livestock yields.
5. Climate change and extreme weather can reduce food production.
6. Sustainability and the cost of agricultural inputs affect the amount of food that can be produced.

B6.2b Describe and explain some possible agricultural solutions to the demands of the growing human population

1. Growing plants without soil using nutrient solutions.
2. The use of living organisms to control pests.
3. By introducing desirable genes into crops.
4. They replace mineral ions needed for plant growth.
5. They reduce crop losses caused by pests.
6. Hydroponics, biological control, gene technology, fertilisers and pesticides can all increase food production.

B6.2c Explain the impact of the selective breeding of food plants and domesticated animals

1. Choosing parents with desirable characteristics and breeding them together.
2. Repeatedly breed individuals showing the desired characteristics over many generations.
3. Higher yields, disease resistance and improved quality.
4. Faster growth, higher milk yield or greater meat production.
5. Reduced genetic variation and increased risk of inherited disorders.
6. Selective breeding has increased agricultural productivity but may reduce genetic diversity.

B6.2d Describe genetic engineering as a process which involves modifying the genome of an organism to introduce desirable characteristics

1. Modifying an organism's genome by inserting genes for desirable characteristics.
2. Changing the DNA of an organism.
3. A useful inherited characteristic.
4. Genetic engineering directly changes DNA, whereas selective breeding relies on choosing parents.
5. Herbicide resistance (or insect resistance).
6. Genetic engineering introduces specific genes to produce organisms with desirable characteristics.

B6.2e Describe the main steps in the process of genetic engineering

1. To cut DNA at specific base sequences.
2. Short overhanging DNA ends that can join with complementary DNA.
3. To join DNA fragments together.
4. They carry the desired gene into host cells.
5. Bacteria replicate the modified plasmid, and antibiotic resistance markers identify successfully modified cells.
6. The required gene is cut out using restriction enzymes, inserted into a plasmid with DNA ligase, transferred into bacteria and identified using antibiotic resistance markers.

B6.2f Explain some of the possible benefits and risks of using gene technology in modern agriculture

1. Increased crop yields; crops resistant to pests or disease.
2. Reduced genetic diversity; possible effects on wild species or ecosystems.
3. Safety, environmental impact, cost and effectiveness.
4. Concerns about modifying organisms, animal welfare and ownership of GM organisms.
5. To ensure the benefits outweigh the risks to people and the environment.
6. Gene technology has the potential to improve food production but must be carefully assessed for environmental, ethical and safety risks.

B6.2g Describe and explain some possible biotechnological solutions to the demands of the growing human population

1. The use of living organisms or biological processes to produce useful products.
2. Altering an organism's DNA to introduce desirable characteristics.

3. They may be resistant to pests, diseases or herbicides, increasing yields.
4. They may grow faster, resist disease or produce more food.
5. Bt maize (or Golden Rice).
6. Biotechnology, including genetic modification, can increase food production and help meet the demands of a growing population.

B6.3 Monitoring and Maintaining Health

B6.3a Describe the relationship between health and disease

1. A state of physical and mental well-being.
2. A condition that impairs normal body function.
3. It can reduce the body's ability to function normally.
4. Yes. Poor health can result from non-communicable diseases, mental illness or poor lifestyle.
5. Disease reduces overall physical or mental well-being.
6. Health and disease are closely linked because disease reduces normal body function and well-being.

B6.3b Describe different types of diseases

1. A disease caused by pathogens that can be passed between organisms.
2. A disease that cannot be passed between organisms.
3. Measles.
4. Coronary heart disease.
5. Communicable diseases are infectious; non-communicable diseases are not.
6. Pathogens spread communicable diseases, whereas non-communicable diseases have non-infectious causes.

B6.3c Describe the interactions between different types of disease

1. HIV weakens the immune system, increasing susceptibility to tuberculosis.
2. HPV infection increases the risk of cervical cancer.
3. One disease can weaken the body or damage tissues, increasing the risk of another disease.
4. HIV/AIDS and tuberculosis; HPV and cervical cancer.
5. They are less able to defend against pathogens and disease.
6. Communicable diseases can increase the likelihood of developing other communicable or non-communicable diseases.

B6.3d Explain how communicable diseases (caused by viruses, bacteria, protists and fungi) are spread in animals and plants

1. Viruses, bacteria, protists and fungi.
2. By direct contact, air, water, contaminated food or vectors.
3. By wind, water, insect vectors, direct contact or contaminated soil.
4. More pathogens increase the chance of transmission.
5. 5%
6. Pathogens spread through various routes, allowing communicable diseases to infect animals and plants.

B6.3e Explain how the spread of communicable diseases may be reduced or prevented in animals and plants

1. They identify infected individuals by detecting pathogen antigens.
2. It identifies pathogen DNA.
3. Visible symptoms can indicate disease.
4. It allows infected organisms to be isolated or treated before the disease spreads.
5. Detecting infected organisms reduces opportunities for transmission.
6. Antigen testing, DNA testing and visual identification help detect disease early and reduce its spread.

B6.3f Describe a minimum of one common human infection, one plant disease and sexually transmitted infections in humans including HIV/AIDS

1. Viral: measles; bacterial: Salmonella food poisoning; fungal: athlete's foot.
2. HIV, a virus that attacks the immune system.
3. Tobacco mosaic virus (TMV).
4. Barley powdery mildew (*Erysiphe graminis*).
5. Crown gall disease (*Agrobacterium tumefaciens*).
6. TMV – virus; barley powdery mildew – fungus; crown gall disease – bacterium.

B6.3g Describe physical plant defence responses to disease

1. It forms a protective barrier that reduces pathogen entry and water loss.
2. It provides a strong barrier that helps prevent pathogens entering plant cells.
3. Because it physically blocks pathogens from entering the plant.
4. Because it acts as a tough physical barrier against infection.
5. They reduce the likelihood of pathogens entering plant tissues.

6. Plants use physical barriers such as the waxy cuticle and cell walls to defend against disease.

B6.3h Describe chemical plant defence responses

1. Chemicals produced by plants that kill or inhibit microorganisms.
2. They kill pathogens or stop their growth.
3. Because they protect the plant using chemical substances rather than physical barriers.
4. To destroy or inhibit pathogens.
5. They reduce infection by killing or preventing the growth of microorganisms.
6. Plants produce antimicrobial chemicals that help protect them against disease.

B6.3i Describe different ways plant diseases can be detected and identified, in the lab and in the field

1. By testing for pathogen DNA.
2. By detecting pathogen antigens.
3. By observing visible symptoms.
4. By identifying pathogens under a microscope.
5. Laboratory diagnosis uses tests such as DNA analysis or microscopy; field diagnosis relies mainly on observation of symptoms.
6. Plant diseases can be identified using DNA testing, antigen testing, microscopy and field observations.

B6.3j Explain how white blood cells and platelets are adapted to their defence functions in the blood

1. To defend the body against pathogens.
2. Phagocytosis, producing antibodies and producing antitoxins.
3. To help blood clot.
4. It seals wounds, preventing pathogen entry and reducing blood loss.
5. White blood cells recognise pathogens, destroy them and produce antibodies and antitoxins.
6. White blood cells defend against infection, while platelets prevent pathogen entry by clotting blood.

B6.3k Describe the non-specific defence systems of the human body against pathogens

1. Defences that act against any pathogen rather than a specific one.
2. Skin, mucus, cilia and stomach acid.

3. It forms a physical barrier to pathogens.
4. It kills many pathogens that enter with food.
5. Mucus traps pathogens and cilia move the mucus out of the airways.
6. Physical and chemical barriers help prevent pathogens entering the body.

B6.3l Explain the role of the immune system of the human body in defence against disease

1. To detect and destroy pathogens.
2. By recognising foreign antigens on their surface.
3. Proteins that bind specifically to antigens.
4. Chemicals that neutralise toxins produced by pathogens.
5. They remain in the body and produce antibodies rapidly if the same pathogen enters again.
6. The immune system recognises pathogens, destroys them and provides long-term immunity through memory cells.

B6.3m Describe how monoclonal antibodies are produced

1. Identical antibodies produced by identical immune cells.
2. B-lymphocytes and tumour cells.
3. A fused cell formed from a B-lymphocyte and a tumour cell.
4. They divide rapidly and produce one type of antibody.
5. By growing hybridoma cells in culture.
6. B-lymphocytes are fused with tumour cells to form hybridomas, which produce large quantities of identical antibodies.

B6.3n Describe some of the ways in which monoclonal antibodies can be used

1. They detect the hormone hCG in urine.
2. They bind to specific antigens on prostate cancer cells to detect the disease.
3. They can carry drugs or radioactive substances directly to cancer cells.
4. They bind specifically to target antigens, making disease detection highly accurate.
5. Because they have a specific complementary shape to one antigen.
6. Monoclonal antibodies are used in pregnancy testing, disease diagnosis and targeted treatments.

B6.3o Explain the use of vaccines and medicines in the prevention and treatment of disease

1. They stimulate the immune system to produce memory cells without causing disease.
2. Antibiotics kill bacteria; antivirals slow the replication of viruses; antiseptics kill microorganisms on external surfaces.
3. Because viruses reproduce inside body cells and antibiotics only target bacteria.
4. They stimulate the production of memory cells that respond rapidly to future infections.
5. Medicines prevent, control or treat disease depending on their mode of action.
6. Vaccines prevent disease by producing immunity, while medicines such as antibiotics, antivirals and antiseptics treat or control infections.

B6.3p Explain the aseptic techniques used in culturing organisms

1. To disinfect equipment and kill microorganisms.
2. To sterilise the loop before transferring microorganisms.
3. To sterilise equipment and culture media before use.
4. The updraught from the flame reduces contamination by airborne microorganisms.
5. ≈452 mm^2 ($\pi \times 12^2 \approx 452.4$ mm^2).
6. Aseptic techniques involve sterilising equipment, minimising contamination and safely culturing microorganisms.

B6.3q Describe the processes of discovery and development of potential new medicines

1. Laboratory testing using cells, tissues and animals.
2. Testing new medicines in humans.
3. To assess safety and potential effectiveness before use in humans.
4. To test safety, effectiveness and the correct dosage.
5. To ensure medicines are safe, effective and used at appropriate doses.
6. New medicines are developed through preclinical testing followed by phased clinical trials.

B6.3r Recall that many non-communicable human diseases are caused by the interaction of a number of factors

1. Because genetic, lifestyle and environmental factors all contribute.
2. Cardiovascular disease, cancer, type 2 diabetes and liver disease.
3. Poor diet, smoking and lack of exercise increase the risk.
4. Poor nutrition and obesity increase the risk.
5. Genetic inheritance and environmental influences both affect disease risk.
6. Most non-communicable diseases result from several interacting genetic, lifestyle and environmental factors.

B6.3s Evaluate some different treatments for cardiovascular disease

1. Regular exercise (or a healthier diet/stop smoking).
2. Statins.
3. Coronary artery bypass surgery (or inserting a stent).
4. They are less invasive and may reduce the need for surgery.
5. 80%
6. Lifestyle changes have few side effects but require commitment; medicines can be effective but may have side effects; surgery can be highly effective but carries greater risk and cost.

B6.3t Analyse the effect of lifestyle factors on the incidence of non-communicable diseases at local, national and global levels

1. Lack of exercise, poor diet, alcohol consumption and smoking.
2. It increases the risk of obesity, cardiovascular disease and type 2 diabetes.
3. It increases the risk of obesity, cardiovascular disease and type 2 diabetes.
4. Smoking increases the risk of lung cancer and cardiovascular disease; excessive alcohol increases the risk of liver disease and other illnesses.
5. 15%
6. Lifestyle factors increase the incidence of non-communicable diseases locally, nationally and globally by increasing exposure to disease risk factors.

B6.3u Describe cancer as the result of changes in cells that lead to uncontrolled growth and division

1. A disease caused by uncontrolled cell growth and division.
2. Mutations that disrupt normal control of the cell cycle.
3. It forms tumours and can damage healthy tissues.
4. Uncontrolled cell division produces a mass of abnormal cells.
5. Normal cell division is regulated; cancer cell division is uncontrolled.
6. Cancer develops when mutations cause cells to divide uncontrollably, forming tumours.

B6.3v Discuss potential benefits and risks associated with the use of stem cells in medicine

1. Unspecialised cells that can divide and differentiate into specialised cell types.
2. They can replace damaged or diseased cells and tissues.
3. The immune system recognises the transplanted tissue as foreign and attacks it.

4. Replace damaged tissues; potential treatments for diseases such as paralysis or diabetes.
5. Risk of immune rejection; ethical concerns over the use of embryonic stem cells.
6. Stem cells have the potential to treat disease by replacing damaged tissues, but there are risks such as immune rejection and ethical concerns.

B6.3w Explain some of the possible benefits and risks of using gene technology in medicine

1. Treat inherited disorders; produce medicines such as insulin.
2. Unexpected side effects; ethical concerns about altering genes.
3. Safety, effectiveness and long-term effects.
4. Concerns about modifying human genes and the possible effects on future generations.
5. To ensure it is safe, effective and that the benefits outweigh the risks.
6. Gene technology offers major medical benefits but must be carefully evaluated for safety, ethical and practical reasons.

B6.3x Discuss the potential importance for medicine of our increasing understanding of the human genome

1. It can identify people who are at increased genetic risk of certain diseases.
2. Medicines designed to work with a person's genetic makeup.
3. It can lead to more effective and personalised treatments.
4. Because treatments can be matched to an individual's genes rather than using the same treatment for everyone.
5. Increased understanding of the human genome allows improved prediction, prevention and personalised treatment of disease.
6. Knowledge of the human genome helps identify genetic variants that increase the risk of disease, allowing earlier diagnosis and prevention. It also allows scientists to develop targeted drugs designed to treat specific genetic causes of disease, making treatments more effective and reducing side effects.