Section A: Living organisms and the environment

A1: Living organisms and cells

No.	Answers	Further Explanations
1	B	
2	D	Moving from one place to another to obtain food. Plants are unable to move their entire bodies from one location to another and they make their own food. This means that not all living organisms move from one place to another to obtain food.
3	B	
4	A	
5	A	W Structure W is a chloroplast and photosynthesis takes place in chloroplasts.
6	D	Organelle: endoplasmic reticulum Function: supports the cell when turgid The endoplasmic reticulum is a series of tubules that transports substances throughout the cytoplasm; it does not support the cell.
7	B	
8	D	They can only reproduce inside other living cells. Viruses cannot reproduce on their own, they can only survive and reproduce inside a host cell.
9	B	
10	A	
11	D	

No.	Answers	Further Explanations
12	C	The level of the sugar solution in the funnel will go up. As a result of osmosis taking place, water molecules will move through the Visking tubing, which is a semi-permeable or partially permeable membrane, from the beaker into the more concentrated sugar solution. This will cause the volume of the sugar solution in the thistle funnel to increase and the level to go up.
13	B	
14	C	Plant cells: become turgid Animal cells: burst Water will move into both cells by osmosis. Plant cells will become turgid as the vacuole and cytoplasm will swell and press against the cell wall. Animal cells do not have a cell wall. When water enters these cells, the cells will swell and eventually burst.
15	D	

A2: Photosynthesis, food chains and cycles

No.	Answers	Further Explanations
1	C	
2	B	
3	A	
4	D	I, III and IV only **I**, **III** and **IV**: Glucose produced during photosynthesis can be used in respiration to produce energy, converted to starch and stored, or converted to sucrose and transported around the plant. **II**: Glucose cannot pass out of plants by diffusion.
5	C	
6	B	

No.	Answers	Further Explanations
7	C	Lizard The hibiscus is the producer in the food chain and the butterfly is the primary consumer, as it feeds on the producer. The lizard is the secondary consumer, as it feeds on the primary consumer.
8	C	I, II and III only **I** and **II**: The hibiscus is a plant, so it is a producer and the butterfly feeds on the hibiscus, so it occupies the second trophic level. **III**: The cat feeds on the lizard, so an increase in the number of cats will cause a decrease in the number of lizards. **IV**: The lizard feeds on the butterfly, so an increase in the number of lizards will cause the number of butterflies to decrease, not increase.
9	A	
10	D	Snapper Energy decreases along a food chain as it passes from one trophic level to the next. This is because organisms at each level release energy during respiration. Energy is also lost to the environment as heat and in waste products. As a result, the snapper, which feeds at the highest trophic level in the chain shown, will receive the least energy.
11	B	Coral Herbivores feed on plants or plant material, and phytoplankton are microscopic plants. Because coral feeds on phytoplankton, coral must be a herbivore.
12	C	Omnivores Omnivores feed on both plant and animal material. The diet described consists of both plant and animal materials, so monkeys must be omnivores.
13	A	I only **I**: Energy flows through ecosystems from producers to primary consumers and then on to secondary consumers and finally to tertiary consumers, but it is not recycled back to producers. **II**, **III** and **IV**: Organisms at each trophic level do release energy in respiration, energy does flow through ecosystems in one direction only and organisms do lose some energy to their surroundings as heat.

No.	Answers	Further Explanations
14	C	
15	B	Human activity: deforestation Impact: increased CO_2 in atmosphere Deforestation results in an increase in atmospheric carbon dioxide because it reduces the number of trees that are present to absorb carbon dioxide from the air during photosynthesis. Less carbon dioxide is, therefore, removed from the air, resulting in levels increasing.
16	D	P: assimilation R: nitrogen fixation Plants absorb nitrates from the soil and convert them to protein by a process known as assimilation. Nitrogen-fixing bacteria in the root nodules of leguminous plants convert nitrogen in the air into ammonium compounds by a process known as nitrogen fixation. The plants then use the ammonium compounds to make protein.
17	B	

Section B: Life processes

B1: Nutrition (1)

No.	Answers	Further Explanations
1	B	
2	A	
3	D	
4	D	
5	A	
6	C	Calcium Calcium is needed for the growth and development of healthy bones and teeth and it helps blood to clot. Bobby's symptoms, therefore, indicate a deficiency of calcium.

No.	Answers	Further Explanations
7	D	
8	D	
9	A	
10	C	
11	C	Protein and reducing sugar Benedict's reagent is used to test for reducing sugars, and the colour change from blue to brick-red indicates reducing sugars are present. Iodine solution is used to test for starch, and because there is no colour change, no starch is present. Sodium hydroxide and copper sulfate solutions are used to test for protein (the biuret test), and the colour change from blue to purple indicates protein is present.
12	A	Lipid The test described is the grease spot test for lipids (fats and oils). The translucent mark was a positive result, indicating the presence of lipids.
13	A	
14	A	I and II only **I**: Dietary fibre, also known as roughage, adds bulk to the food in the digestive system, which stimulates peristalsis and helps to keep the food moving. **II**: By helping to keep the food moving, dietary fibre causes the food to be removed regularly, which helps to reduce the risk of colon cancer. **III**: Dietary fibre adds bulk to the food in the digestive system, it does not reduce the bulk of the food.
15	C	**I**, **II** and **IV** only **I**, **II** and **IV**: Apple, cabbage and wholegrain cereal are high in dietary fibre, and foods that are high in dietary fibre are most likely to help prevent constipation. **III**: White flour is low in dietary fibre, so is unlikely to help prevent constipation.

No.	Answers	Further Explanations
16	D	
17	C	I, II and IV only **I**, **II** and **IV**: Eating too much food, i.e. having too much energy in the diet, as well as not eating enough food, i.e. having too little energy in the diet, both contribute to malnutrition. Malnutrition also results from eating nutrients in the wrong proportions. **III**: Improper hygiene in food preparation contributes to the spread of some pathogenic diseases, but it does not contribute to malnutrition.
18	D	
19	A	
20	B	
21	B	Professional athlete Daily energy requirements generally increase with age, therefore, the newborn baby would be expected to have the lowest daily energy requirement followed by the 5-year-old child. The office worker and the professional athlete are adults so their daily energy requirements would be expected to be higher. The level of activity associated with office work is low, while that associated with being an athlete is very high. This means the professional athlete would have the highest daily energy requirement.
22	B	weight/height^2 Body Mass Index (BMI) is calculated using weight (measured in kg) divided by height (measured in m) squared. BMI = weight (kg)/height (m)^2

B2: Nutrition (2)

No.	Answers	Further Explanations
1	A	
2	A	

No.	Answers	Further Explanations
3	C	To crush and grind food The tooth labelled I is a premolar and the function of premolars is to crush and grind food.
4	D	
5	C	
6	B	
7	B	II only **II**: Using dental floss daily helps to remove plaque from between the teeth, which helps to reduce the likelihood of tooth decay, it does not contribute to it. **I**: Grinding teeth contributes to tooth decay because it wears down the protective enamel of the tooth. **III**: Sugary foods contribute to tooth decay because bacteria in plaque feed on the sugars and make acids which damage tooth enamel. **IV**: Acidic fruit juices contribute to tooth decay because the acid in the juices damages tooth enamel.
8	B	Viruses in plaque produce acids. It is bacteria in plaque which produce the acids that cause tooth decay, not viruses.
9	D	
10	D	Are unaffected by temperature changes As temperature increases, enzyme activity increases up to the optimum temperature at which enzyme activity is at its fastest. As temperature increases above the optimum, enzyme activity decreases and enzymes start to be denatured. Enzyme activity is, therefore, affected by temperature change.
11	C	Chemical reactions would take place at a slower rate. Enzymes are biological catalysts. They speed up chemical reactions that take place in living organisms. Therefore, if cells did not produce enzymes, chemical reactions would take place much more slowly.

No.	Answers	Further Explanations
12	C	III Salivary amylase is present in the saliva in the mouth, where it begins digestion of starch. Saliva has a pH of between 7 and 8, and enzyme III has an optimum pH of 7, so it is most likely that enzyme III is salivary amylase.
13	B	Stomach Enzyme I has an optimum pH of 2 and this low pH is found in the stomach so that the enzymes pepsin and rennin can work at their optimum.
14	A	
15	D	
16	B	
17	D	
18	B	F Structure F is the stomach, and pepsin in the gastric juice produced in the stomach begins to catalyse the breakdown of protein into peptides.
19	C	H Structure H is the colon, and any food that is not digested in the small intestine passes into the colon, where water and mineral salts are absorbed from it.
20	D	
21	C	
22	B	
23	A	Urea Excess amino acids are deaminated in the liver. During this process, the amine group is removed from amino acids and is converted into the waste product, urea, which is excreted by the kidneys.

No.	Answers	Further Explanations
24	B	I and III only **I** and **III**: Glucose can be used by body cells to release energy in respiration and any excess can be converted to glycogen and stored. **II**: Hormones are made mainly from protein, not glucose. **IV**: Cell membranes are made of protein and lipid molecules, not glucose.
25	D	Fatty acids and glycerol Structure X is the lacteal and the lacteal absorbs fatty substances, including fatty acids and glycerol.
26	A	

B3: The respiratory system

No.	Answers	Further Explanations
1	A	Remove carbon dioxide produced in respiration Breathing movements cause air to be moved into and out of the lungs. This is important because it ensures that the carbon dioxide produced in aerobic respiration is continually removed from the body so that it does not build up and poison cells.
2	A	
3	C	R Structure R is an alveolus, which is where oxygen and carbon dioxide are exchanged in the lungs.
4	D	III and IV only **III** and **IV**: When the diaphragm contracts it flattens and this, together with the ribs moving upwards, causes the volume of the thorax to increase and the pressure to decrease, resulting in air being inhaled. **I** and **II**: When the external intercostal muscles relax, the ribcage moves downwards and inwards which causes the volume of the thorax to decrease and pressure to increase, and results in exhalation, not inhalation.
5	B	

No.	Answers	Further Explanations
6	A	
7	C	I and III only **I**: At high altitude there is less oxygen in the air, meaning that less oxygen is inhaled in each breath, so the breathing rate increases in order to supply enough oxygen to the cells. **III**: Anxiety causes the rate of respiration to increase, so the rate of breathing increases to supply the cells with the extra oxygen they need and to remove the extra carbon dioxide produced. **II**: During sleep the rate of respiration decreases, so the breathing rate decreases because the cells do not need as much oxygen, the rate does not increase.
8	D	
9	D	Carbon dioxide The arrows show the movement of a substance out of the blood plasma into the alveolus. Carbon dioxide is in a higher concentration in the plasma than in the air in the alveoli, so it diffuses from the plasma into the air to be exhaled.
10	B	
11	C	I, III and IV only **I**: Gaseous exchange surfaces must be moist so that the gases can dissolve before they diffuse through. **III**: Gaseous exchange surfaces must have a large surface area so that large quantities of gases can be exchanged. **IV**: Gaseous exchange surfaces must be thin so that gases can diffuse through them quickly. **II**: Gaseous exchange surfaces must be permeable in order for gases to diffuse through them, they must not be impermeable.
12	A	
13	B	

No.	Answers	Further Explanations
14	B	
15	C	Aerobic respiration: produces a small amount of energy Anaerobic respiration: produces a large amount of energy During aerobic respiration all the energy is released from the glucose because it is fully broken down into carbon dioxide and water, therefore large amounts of energy are produced. During anaerobic respiration, not all the energy is released from the glucose because it is not fully broken down. At least one product always contains energy, therefore only small amounts of energy are produced.
16	C	
17	B	
18	B	
19	C	
20	D	Trinidad and Tobago Differences between male and female smoking-related deaths: • Barbados: 64 – 37 = 27 • Guyana: 329 – 195 = 134 • Jamaica: 1119 – 379 = 740 • Trinidad and Tobago: 925 – 148 = 777

B4: The circulatory system

No.	Answers	Further Explanations
1	B	The human body has a small surface area to volume ratio. As organisms increase in size, their surface area to volume ratio decreases. Humans are relatively large so have a small surface area to volume ratio. Diffusion through their body surface is not adequate to supply their body cells with their requirements and to remove their waste, so a transport system is needed to carry substances around the human body.

No.	Answers	Further Explanations
2	D	
3	A	1 and 2 Blood vessels 1 and 2 are the vena cava and pulmonary artery respectively. The vena cava carries deoxygenated blood from the body back to the heart and the pulmonary artery carries this deoxygenated blood from the heart to the lungs to get rid of carbon dioxide and pick up oxygen.
4	D	
5	A	F Chamber F is the right atrium. The pacemaker of the heart is composed of a group of specialised cells in the walls of the right atrium.
6	D	
7	C	
8	B	Left ventricle The left ventricle pumps blood long distances around the body. The right ventricle pumps blood to the neighbouring lungs and the atria pump blood to the ventricles. The left ventricle must, therefore, create more pressure than the other chambers to pump the blood the longer distances.
9	D	Pressure when the ventricles contract The figure 120 is the systolic pressure, i.e. 120 mmHg. This is the pressure of blood in the arteries resulting from contraction of the ventricles as they pump blood out of the heart.
10	A	Atrial systole The upper chambers of the heart are the atria and the contraction of a chamber is known as systole.
11	B	
12	B	Twice Humans have a double circulation, meaning that during one complete circulation around the body the blood flows from the heart to the lungs, back to the heart and then to the body.

No.	Answers	Further Explanations
13	C	
14	B	Arteries: valves are present Veins: valves are absent Arteries carry high-pressure, fast-flowing blood, so they don't need valves to prevent the blood from flowing backwards. Veins carry low-pressure, slow-flowing blood, so contain valves to prevent the blood from flowing backwards.
15	A	Cell A is shaped like a biconcave disc so it is a red blood cell. Red blood cells contain haemoglobin, which combines with oxygen to form oxyhaemoglobin in order to transport oxygen around the body.
16	C	Cell C has an irregular shape and a lobed nucleus, so is a phagocyte. Phagocytes move using pseudopodia and engulf and destroy pathogens in the blood, i.e. bacteria and viruses.
17	B	Cell B has a rounded shape and a large round nucleus, so is a lymphocyte. Lymphocytes produce antibodies and antitoxins against foreign antigens of pathogens and toxins produced by pathogens in the body.
18	B	I and III only **I** and **III**: Red blood cells are more numerous than white blood cells or platelets and they are made in the red bone. **II**: Red blood cells lack nuclei and other organelles. **IV**: Red blood cells only live for 3 to 4 months, they do not live as long as 6 to 8 months.
19	B	
20	D	
21	C	
22	C	94 Each small square represents 2 deaths per 100 000 population. The X representing the number of deaths recorded in St. Lucia in 2009 is 7 small squares above 80, giving an additional 14 deaths per 100 000 population.

No.	Answers	Further Explanations
23	A	A high-cholesterol diet CVD stands for cardiovascular disease, and any factor which leads to blood vessels becoming narrower or blocked by a build-up of fatty material called plaque within their walls can contribute to its development. One of these factors is a diet high in cholesterol.
24	B	I and III only **I**: Lymph in lymph capillaries or lacteals in the villi of the ileum absorbs fatty acids produced in digestion and transports them to the blood. **III**: Lymphocytes and phagocytes in lymph nodes or glands help destroy microorganisms or pathogens present in lymph. **II**: The lymphatic system drains excess fluid from tissue spaces around cells, it does not supply excess fluid to these spaces.
25	A	
26	D	

B5: The skeletal system

No.	Answers	Further Explanations
1	C	I and III only **I** and **III**: The appendicular skeleton is composed of the girdles and limbs. The scapula is part of the pectoral girdle and the tibia is a bone in the lower hindlimb. **II**: The sternum forms the centre of the ribcage so is part of the axial skeleton, not the appendicular skeleton.
2	D	
3	A	
4	B	Fixed Structure P is the cranium of the skull. It is made up of several bones that are held together by fixed or immoveable joints.

No.	Answers	Further Explanations
5	A	To make vitamin D Vitamin D is produced by the action of sunlight on the skin, it is not produced by the skeleton.
6	C	3 Structure 3 is compact bone, which is dense, hard and strong. It forms the shaft of the long bones of the limbs and is the main contributor to the strength of these bones.
7	B	II and III only **II** and **III**: Part 2 is spongy bone, which contains red bone marrow. Red bone marrow produces red blood cells, white blood cells and platelets. **I**: Compact bone makes up the outside of the shaft of long limb bones, it is not found in the ends of these bones.
8	A	
9	D	Is a shock absorber Articular cartilage acts as a shock absorber in synovial joints, and the intervertebral discs of cartilage act as shock absorbers between the vertebrae of the vertebral column.
10	D	
11	D	It allows movement in all planes The joint shown is a ball and socket joint, which is a moveable joint. It allows movement in all directions or planes.
12	A	To lubricate the joint Part X is the synovial fluid. It is secreted by the synovial membrane and lubricates the joint, allowing friction-free movement.
13	B	
14	B	
15	D	

No.	Answers	Further Explanations
16	C	Contracts to bend the elbow joint On contraction, the flexor muscle is the muscle that bends a joint, therefore the flexor muscle of the upper arm contracts to bend the elbow joint.
17	D	Biceps: relaxes Triceps: contracts The biceps muscle is the flexor and the triceps is the extensor of the elbow joint. To straighten the joint, the triceps, or extensor, must contract while the biceps, or flexor, relaxes.
18	B	Muscle tone is reduced Exercise helps to develop and increase the slight tension that exists in muscles even when no physical activity is being done, known as muscle tone. Exercise does not reduce muscle tone.
19	C	
20	C	I, III and IV only **I**: Bad posture strains muscles and causes them to need more energy to keep the body upright, which leads to fatigue and backache. **III**: Bad posture leads to compression of the lungs and airways, making breathing less efficient. **IV**: Bad posture causes the main blood vessels to become compressed. **II**: Bad posture leads to compression of the digestive system, making digestion less efficient, not more efficient.

B6: Excretion and homeostasis

No.	Answers	Further Explanations
1	C	
2	B	Faeces Metabolic waste is composed of waste substances produced during metabolic activities in the body. Faeces are undigested food material. This material has not been produced by the body's metabolism, so is not considered to be metabolic waste.

No.	Answers	Further Explanations
3	B	I and II only **I**: Most waste products are toxic and can damage and kill cells if they are not removed from the body. **II**: Excretion removes waste substances that are in excess in the body and by doing this it helps to maintain a constant internal environment. **III**: Removal of waste products from the body does not help to break down food.
4	D	
5	A	
6	C	Store urine Structure J is the bladder, which stores urine until it is passed out of the body.
7	A	V Structure V is the glomerulus, where pressure on the blood increases due to the narrowing of the arteriole as it enters the capillaries. This forces small molecules through the capillary walls into Bowman's capsule by a process known as ultrafiltration.
8	A	I, II and III only **I**, **II** and **III**: Vitamins, glucose and amino acids are small enough molecules to pass through the walls of the capillaries in the glomerulus, and enter the filtrate. **IV**: Red blood cells are too big to pass out of the capillaries in the glomerulus, so they are not found in the filtrate.
9	C	Glucose All the glucose in the filtrate of a healthy individual should be reabsorbed into the blood in the capillaries surrounding the first or proximal convoluted tubule, so none should be present in the urine.
10	D	
11	D	

No.	Answers	Further Explanations
12	C	II and III only Layer P is the subcutaneous layer. **II**: The subcutaneous layer can protect the body against damage by acting as 'padding'. **III**: The subcutaneous layer helps to insulate the body against heat loss in low environmental temperatures. **I**: The epidermis of the skin, not the subcutaneous layer, protects the body against the Sun's harmful ultraviolet rays.
13	C	Part N will constrict Part N is a capillary network. On a cold day vasoconstriction occurs, which is the narrowing of the arterioles and capillaries in the skin. This causes less blood to flow through them, so less heat is lost through the skin and more is retained in the body.
14	D	
15	B	
16	D	Role of insulin: glucose ⟶ glycogen Blood glucose concentration: decreases Insulin is secreted by the pancreas when the blood glucose level rises above normal. This insulin stimulates the body cells to absorb glucose for respiration and the liver and muscle cells to convert the excess glucose into glycogen. This results in the blood glucose concentration decreasing.
17	B	Reabsorb more water from the filtrate The antidiuretic hormone or ADH is secreted by the pituitary gland when the blood plasma becomes too concentrated. It causes the kidneys to reabsorb more water from the filtrate so that very little is lost in the urine.

No.	Answers	Further Explanations
18	C	II and IV only **II** and **IV**: During cold weather very little sweating occurs so very little water is lost in sweat and blood plasma becomes more dilute. Drinking a lot of water also dilutes the blood plasma. In both situations the kidneys reabsorb very little water and large amounts of dilute urine are produced. **I** and **III**: During exercise, sweating occurs so the body loses a lot of water in the sweat and the blood plasma becomes more concentrated. Eating a lot of salty foods also causes the blood plasma to become concentrated. In both situations the kidneys reabsorb a lot of water and small amounts of concentrated urine are produced, not large amounts of dilute urine.
19	A	
20	B	

B7: Coordination and control

No.	Answers	Further Explanations
1	D	
2	C	
3	A	
4	C	Controls heart rate and breathing rate Region M is the medulla oblongata, which controls automatic, involuntary activities such as heart rate and breathing rate.
5	B	
6	A	
7	C	From the central nervous system to effectors The nerve cell shown is a motor neurone whose job is to transmit impulses from the central nervous system or CNS to effectors.
8	D	

No.	Answers	Further Explanations
9	D	
10	D	To ensure impulses travel in one direction only The neurone from which the impulses are travelling releases a neurotransmitter into the synapse, which diffuses across the synapse and triggers an impulse in the adjacent neurone. This ensures that impulses only travel in one direction.
11	B	II and III only **II** and **III**: Reflex actions are automatic, involuntary responses to a stimulus, they are not learned and they are not voluntary. **I**: Reflex actions occur rapidly because they do not require conscious thought.
12	B	Structure B is the sensory neurone which carries impulses from the receptor to the CNS.
13	A	Structure A is a receptor which detects a particular stimulus, or change in the environment, and initiates impulses in the sensory neurone, B.
14	A	Receptor(s): cells of the retina Effectors: eyelid muscles The retina is composed of light-sensitive cells which detect the approaching object, so the cells of the retina are the receptors. The blinking response is caused by contraction of the muscles of the eyelids, so these muscles are the effectors.
15	C	
16	A	I only **I**: The cerebrum is the part of the brain in which conscious thought and decision-making take place, and voluntary actions involve both these processes. **II**: Involuntary actions involve simple pathways because the same response always results from the same stimulus, they do not involve complex pathways. **III** and **IV**: Voluntary actions can involve the spinal cord as well as the brain, and involuntary actions can involve the brain as well as the spinal cord, depending on which part of the body detects the stimulus and which part will respond.

No.	Answers	Further Explanations
17	C	Sense organ: skin Stimulus: gravity The skin contains receptors that detect pain, pressure, touch and temperature, it does not have any receptors that detect gravity.
18	D	
19	A	Refracts light rays Part S is the cornea. Its role is to refract (bend) light rays so they can be brought to a focus on the retina.
20	C	X Structure X is the retina. It contains rods and cones, which are the light-sensitive cells of the eye.
21	B	
22	C	Circular muscles of the iris: relax Radial muscles of the iris: contract Pupil: dilates The reduction in light intensity causes the circular muscles of the iris to relax and the radial muscles of the iris to contract. This causes the pupil to dilate, allowing as much light as possible to enter the eye.
23	D	To view a near object, the ciliary muscles contract, which causes the suspensory ligaments to slacken and the lens to bulge or become fatter. The nearer the object is to the eye, the fatter the lens becomes in order to bend the light rays enough to focus on the retina. Option D has the fattest lens, so is accommodated to view the nearest object.
24	B	Long-sightedness The light rays from the near point are brought to a focus behind the retina because the eyeball is too short or the lens is too flat (thin).
25	C	To correct the sight defect shown, the light rays need to be bent inwards before they enter they eye. This is done by wearing converging (convex) lenses.
26	A	

No.	Answers	Further Explanations
27	D	
28	D	H Structure H is an adrenal gland, which secretes the hormone adrenaline. Adrenaline increases the rate of respiration, the breathing rate and the heart rate. It prepares the body for fight or flight, by making more energy available to muscle cells in a very short time.
29	C	H Structure H is the pancreas, which secretes the hormones insulin and glucagon. Both hormones are involved in regulating blood glucose levels.
30	A	
31	D	

B8: The reproductive system

No.	Answers	Further Explanations
1	B	Sexual reproduction: involves mitosis Asexual reproduction: involves meiosis Sexual reproduction involves the formation of male and female gametes by two parents during cell division known as meiosis, not mitosis. Asexual reproduction involves one parent and the offspring are produced by cell division known as mitosis, not meiosis.
2	A	Fertilisation: V Implantation: X Structure V is the fallopian tube or oviduct, where fertilisation normally takes place. Structure X is the uterus lining where the embryo is implanted.
3	D	T Structure T is the testes, where the spermatozoa or sperm are produced from puberty onwards, and these are the male gametes.

No.	Answers	Further Explanations
4	C	To add fluid secretions to sperm Structure P is the seminal vesicle, which secretes a fluid that mixes with sperm and secretions from the prostate gland to form semen.
5	D	II and III only **II**: Sperm are able to swim using their tails once mixed with secretions from the prostate gland and seminal vesicles. **III**: Sperm can live for 2 to 3 days in the female body after sexual intercourse. **I**: Sperm are produced from puberty onwards, they are not produced from birth.
6	B	Cervical cancer Cervical cancer is usually caused by the human papilloma virus or HPV.
7	D	
8	A	
9	D	Hormone: follicle-stimulating hormone Secreted by the: Graafian follicle The follicle-stimulating hormone is secreted by the pituitary gland, not the Graafian follicle, which secretes oestrogen.
10	C	
11	B	III only **III**: Fertilisation forms the zygote, which divides by mitosis to form a ball of cells known as the embryo, that becomes implanted into the uterus lining. **I**: After fertilisation, the corpus luteum remains in the ovary and secretes increasing amounts of progesterone, so the level of progesterone rises, it does not fall. **II**: After fertilisation the high level of progesterone inhibits the release of follicle-stimulating hormone (FSH) by the pituitary gland, so no more follicles mature in an ovary.

No.	Answers	Further Explanations
12	D	
13	B	
14	A	
15	D	
16	C	It is unaffected by the mother's diet. Breast milk is affected by the mother's diet because many substances can travel from the mother's bloodstream into breast milk.
17	B	Birth control method: intra-uterine device (IUD) How it works: prevents ovulation An intra-uterine device can prevent sperm reaching ova and implantation of the embryo, but it does not prevent ovulation.
18	B	I, II and III only **I**: The contraceptive pill is very reliable if taken correctly. **II**: The contraceptive pill is easy to use because only one pill has to be taken daily. **III**: The contraceptive pill makes menstruation lighter, shorter and less painful. **IV**: The contraceptive pill is a hormone pill taken orally, so it cannot prevent the transmission of sexually transmitted infections.
19	A	
20	C	

Section C: Heredity and variation

C1: Cell division and variation

No.	Answers	Further Explanations
1	C	

No.	Answers	Further Explanations
2	B	I and III only **I** and **III**: Mitosis results in the formation of two daughter cells that are genetically identical to each other. **II**: Mitosis produces two daughter cells, not four. **IV**: Mitosis takes place in all body (somatic) cells except in the cells of the reproductive organs, so it does not take place during gamete production.
3	C	Mitosis produces two cells which should have the same number and composition of chromosomes as the parent cell.
4	B	4 The diploid number is the number of chromosomes in a body cell. The cell shown has 8 chromatids, which must have been formed from 4 chromosomes each making a copy of themselves at the start of mitosis. The diagram also shows 4 chromatids moving to each pole, and these will become chromosomes in the two daughter cells produced, maintaining the diploid number.
5	D	I, III and IV only **I** and **III**: Mitosis is the method by which all cells of a multicellular organism are formed, so it is essential for growth and repair of damaged tissues. **IV**: All the daughter cells produced in mitosis have the same number of chromosomes as the parent cells, therefore mitosis maintains the species number of chromosomes. **II**: Mitosis is not involved in gamete production, so it does not play a part in sexual reproduction.
6	B	
7	A	
8	D	
9	C	The ovaries Meiosis takes place in the reproductive organs during the formation of gametes. The ovaries are the female reproductive organs where meiosis occurs to produce ova.

No.	Answers	Further Explanations
10	B	20 Sperm cells are the male gametes, that are produced by meiosis. Meiosis forms daughter cells with half the diploid number of chromosomes.
11	D	
12	C	I, II and IV only **I**: Genetic variation results in differences between organisms on which natural selection can act. **II** and **IV**: Genetic variation enables species to adapt to changing environmental conditions, which improves their chances of survival. **III**: Genetic variation results from new combinations of genes being constantly created, it does not ensure that favourable combinations of genes are maintained.
13	A	Genetic variation: occurs in populations that reproduce sexually only Environmental variation: occurs in populations that reproduce asexually only One cause of genetic variation is mutation, and mutations can occur in populations that reproduce both sexually and asexually. Environmental variation is caused by different factors in an organism's environment, and all organisms are affected by their environment, whether they reproduce sexually or asexually.
14	D	III and IV only Discontinuous variation is where characteristics show clear-cut differences and individuals can be divided into distinct categories based on the characteristic. **III** and **IV**: Individuals can be divided into distinct blood groups and are either able or unable to roll their tongues. **I** and **II**: Individuals cannot be put into distinct categories based on height or weight, so these traits do not show discontinuous variation.
15	A	

C2: Inheritance and genetic engineering

<table>
<tr><th>No.</th><th>Answers</th><th>Further Explanations</th></tr>
<tr><td>1</td><td>A</td><td></td></tr>
<tr><td>2</td><td>B</td><td></td></tr>
<tr><td>3</td><td>A</td><td></td></tr>
<tr><td>4</td><td>C</td><td></td></tr>
<tr><td>5</td><td>C</td><td>III only

III: Recessive alleles show in the phenotype of an individual only if their paired alleles are also recessive.

I: Only a few recessive alleles cause disease, they do not always cause disease.

II: Recessive alleles do show in the phenotype if their paired allele is also recessive.</td></tr>
<tr><td>6</td><td>B</td><td>Aa and Aa

Both parents have normal pigmentation, so they must both have one dominant allele, A, in their genotypes. If they have an albino child with genotype aa, they must both have one recessive allele, a, to pass on to the child. This means both parents have the genotype Aa.

Shown as a Punnett square:

<table><tr><td>gametes</td><td>(A)</td><td>(a)</td></tr><tr><td>(A)</td><td>AA</td><td>Aa</td></tr><tr><td>(a)</td><td>Aa</td><td>aa</td></tr></table></td></tr>
<tr><td>7</td><td>B</td><td>Hb^AHb^S

A person who has the sickle cell trait is heterozygous, having received the Hb^A allele from one parent and the Hb^S allele from the other parent.</td></tr>
</table>

<table>
<tr><th>No.</th><th>Answers</th><th>Further Explanations</th></tr>
<tr><td>8</td><td>D</td><td>0%

Using T to represent the dominant allele for tongue rolling and t to represent the recessive allele for non-tongue rolling, both parents will have the genotype tt, as they are both non-tongue rollers. It is not possible for their children to be tongue rollers, as neither parent has a dominant allele, T, to pass on.

Shown as a Punnett square:

<table>
<tr><td>gametes</td><td>(t)</td><td>(t)</td></tr>
<tr><td>(t)</td><td>tt</td><td>tt</td></tr>
<tr><td>(t)</td><td>tt</td><td>tt</td></tr>
</table>
</td></tr>
<tr><td>9</td><td>C</td><td></td></tr>
<tr><td>10</td><td>B</td><td></td></tr>
<tr><td>11</td><td>C</td><td>X^hX^h

Person J is a female, so must have the genotype XX. She is also a haemophiliac, so must have two recessive alleles, h, one carried on each X chromosome.</td></tr>
<tr><td>12</td><td>D</td><td>0%

The normal female is homozygous, so must have the genotype X^HX^H. She can only pass on an X chromosome carrying the dominant allele, H, for normal clotting to each son. Person K is a male, so he passes on his Y chromosome to each of his sons and this chromosome does not carry the allele for blood clotting. All of their sons will, therefore, have the genotype X^HY and have normal blood clotting.

Shown as a Punnett square:

<table>
<tr><td>gametes</td><td>(X^h)</td><td>(Y)</td></tr>
<tr><td>(X^H)</td><td>X^HX^h</td><td>X^HY</td></tr>
<tr><td>(X^H)</td><td>X^HX^h</td><td>X^HY</td></tr>
</table>
</td></tr>
</table>

No.	Answers	Further Explanations
13	C	
14	D	II, III and IV only **II**, **III** and **IV**: Genetic engineering involves changing the traits of one organism by inserting genetic material from a different organism into its DNA. The technique is used to produce drugs and vaccines, increase the nutritional value of food and increase the yields of crops and animals. **I**: Cloning involves making genetically identical copies of an individual, so genetic engineering cannot be used to produce human clones.
15	B	Reduced use of chemical pesticides Genetic engineering is being used to produce pest-resistant crops, which will reduce the need for, and the use of, chemical pesticides that are harmful to human health and the environment. Therefore, reduced use of chemical pesticides is not a disadvantage of genetic engineering, it is an advantage.

Section D: Disease and its impact on humans

D1: Disease (1)

No.	Answers	Further Explanations
1	A	I and II only The World Health Organization (WHO) defines good health as 'a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity'. **I** and **II**: Physical well-being and social well-being are referred to in the definition as being components of good health. **III** and **IV**: Access to clean water and health insurance coverage are not referred to in the definition as components of good health.
2	C	
3	B	
4	D	

No.	Answers	Further Explanations
5	A	
6	D	I and IV only Signs of a disease can be detected or measured by someone other than the person affected by the disease. **I** and **IV**: A rash and an abnormal heart rate can be detected by someone else, so are signs of a disease. **II** and **III**: Pain and fatigue can only be detected by the person affected by the disease and not by another person, so they are symptoms of the disease, not signs.
7	C	
8	D	
9	C	
10	D	Rupturing of the walls of the alveoli Asthma affects the bronchi and bronchioles, it does not cause the walls of the alveoli to rupture.
11	D	I, III and IV only **I** and **IV**: Being obese can increase the pressure of blood in the arteries, which may result in hypertension or coronary heart disease. **III**: Being obese increases a person's risk of developing type II diabetes mellitus, which is related to diet. **II**: Type I diabetes mellitus develops mainly in young children and it is not caused by a person being obese.
12	A	
13	D	
14	C	

No.	Answers	Further Explanations
15	B	III and IV only **III** and **IV**: Influenza and tuberculosis are spread by airborne droplets from the respiratory system. If an infected person coughs or sneezes in a crowded place, the pathogens that cause these diseases can be spread to others. **I** and **II**: The pathogens that cause cholera and typhoid are transmitted in contaminated water and food, so being in an overcrowded place cannot spread these pathogens on to others.
16	C	Ringworm Ringworm is caused by a fungus and fungicide ointments are used to treat diseases caused by fungi.
17	A	
18	C	I, III and IV only **I**, **III** and **IV**: HIV/AIDS can be spread by receiving blood from an infected person, from mother to baby during breastfeeding and by having unprotected sexual intercourse with an infected person. **II**: HIV/AIDS is spread in certain body fluids such as blood, semen and breast milk, it is not spread in saliva, so cannot be transmitted by sharing eating utensils with an infected person.
19	B	
20	B	
21	B	Syphilis *Treponema pallidium*, the bacterium causing syphilis, and the HIV virus can both pass across the placenta from a mother to her unborn baby. Of these two pathogens, syphilis is known to cause stillbirths.
22	D	Improved standards of living Disease within populations reduces standards of living, it does not improve them.
23	C	

No.	Answers	Further Explanations
24	D	The virus that causes AIDS was only discovered a few years before 1985. The HIV virus that causes AIDS was discovered in 1983. Until then, not much was known about the disease and data collection would have been limited.

D2: Disease (2)

No.	Answers	Further Explanations
1	C	
2	A	
3	B	
4	C	
5	A	Housing development A is next to the dump, that is infested with rats. Because rats are vectors for leptospirosis, the residents in this housing development are most likely to suffer from that disease.
6	D	II, III and IV only **II**, **III** and **IV**: Houseflies collect pathogens on their legs, body and mouthparts, and also take them into their gut when they feed on organic waste and faeces. They then transfer these pathogens onto human food by defecating, walking and feeding on the food. **I**: Houseflies do not bite a person and inject saliva into them, so do not spread pathogens in this way.
7	A	Stage A is the adult, and it is the adult that carries bacteria from waste organic matter and faeces to human food.
8	B	
9	C	I, II and III only **I**, **II** and **III**: Mosquito eggs are laid in water and the larvae and pupae also live in the water, so draining stagnant water will directly affect these three stages because their environment will be destroyed. **IV**: Adults fly in the air, they do not live in water, so they are not directly affected by draining stagnant water.

No.	Answers	Further Explanations
10	C	Spraying with insecticides Leptospirosis is spread by rats and domestic animals. Because these organisms are not insects, they would not be harmed by insecticides which are used to kill insects.
11	D	
12	C	Washing hands once per day Hands should be washed often throughout the day to maintain personal hygiene, especially before preparing and consuming meals and after using the toilet, they should not only be washed once.
13	D	
14	C	I, II and III only **I**, **II** and **III**: Boiling, pasteurisation and autoclaving completely destroy all microorganisms present, so are methods of sterilisation. **IV**: Deep freezing prevents the growth of microorganisms but does not destroy them, so it is not a method of sterilisation.
15	B	
16	C	
17	B	
18	A	L: antibody M: antigen M is an antigen on the cell membrane of the pathogen. L is a specific antibody produced in response to the antigen.
19	B	Natural passive immunity During breastfeeding, antibodies are passed from the mother to the baby in the breast milk, especially colostrum. This is a natural process. It is also a passive process because the baby's body does not produce the antibodies, they are introduced.

No.	Answers	Further Explanations
20	D	Artificial passive immunity Injection with a serum is an artificial means by which antibodies are introduced into the body. It is also a passive process because the antibodies are not produced inside the body.
21	D	Immunity is the same as immunisation. Immunity is the body's resistance to a disease, which may be innate or acquired. However, immunisation is the process by which a person is made immune or resistant to a disease. This is often done by administering a vaccine.
22	D	By becoming infected with a disease and recovering from it. Active immunity is brought about by antibodies being produced by lymphocytes in response to antigens that have entered the body. One way theses antigens can enter the body is by the person being infected with the disease.
23	A	
24	B	Sedatives Sedatives are prescription drugs that slow down the activity of the nervous system. They calm the patient, ease agitation and permit sleep.
25	C	
26	A	I and III only **I**: Alcohol is a depressant of the central nervous system which causes slurred speech after consumption. **III**: Alcohol increases excretion of water by the kidneys, which can lead to dehydration after consumption. **II**: Because alcohol depresses the central nervous system it slows reflexes, it does not cause them to be faster. **IV**: Heavy drinking of alcohol over several years leads to cirrhosis of the liver, which is a long-term effect, not a short-term effect.

No.	Answers	Further Explanations
27	B	I and II only **I** and **II**: Drug misuse places increased demands on health services and leads to increased crime. **III**: Drug misuse can lead to people committing suicide, so it leads to a higher suicide rate, not a lower rate.
28	B	165 Impaired performance = 55% of respondents Number of respondents = 300 And 55/100 × 300 = 165

Section E: The impact of health practices on the environment

E1: Pollution and water

No.	Answers	Further Explanations
1	D	
2	A	Nitrates Nitrates contribute to eutrophication in bodies of water, so they are water pollutants, not air pollutants.
3	B	I and III only **I**: Oxides of sulfur and nitrogen released into the air during the combustion of fossil fuels in industry contribute to the formation of acid rain. **III**: Carbon dioxide released into the air during the combustion of fossil fuels in industry contributes to the greenhouse effect and global warming. **II**: Eutrophication is caused by nitrate and phosphate ions being released into bodies of water, not into the air, so it is not a type of air pollution.

No.	Answers	Further Explanations
4	C	I, II and III only **I** and **II**: Chemical fertilisers and pesticides can both enter bodies of water during heavy rains, causing water pollution. **III**: Dumping of refuse into waterways leads directly to water pollution. **IV**: Burning of fossil fuels releases various gases into the atmosphere which contribute to air pollution, not to water pollution.
5	A	Typhoid Typhoid is caused by a bacterium which is transmitted in contaminated food and water, it is not caused by a pollutant present in the air.
6	B	
7	D	II, III and IV only **II**, **III** and **IV**: Proper sewage treatment, stricter laws and penalties and public education can all help to control water pollution. **I**: Non-biodegradable detergents do not break down in the environment, so using them contributes to water pollution, it does not help to control it.
8	B	I and III only **I**: Trees help to remove carbon dioxide from the atmosphere, so planting more trees should reduce atmospheric carbon dioxide levels and global warming. **III**: Alternative energy sources do not release carbon dioxide into the atmosphere, so using them in place of burning fossil fuels should reduce atmospheric carbon dioxide levels and global warming. **II:** Many factories burn fossil fuels, which release carbon dioxide into the atmosphere. Building more factories will increase carbon dioxide levels and global warming, not reduce them.
9	C	Transpiration Process 3 shows the loss of water vapour from the leaves of plants, which is known as transpiration.

No.	Answers	Further Explanations
10	B	The Sun Process 1 is evaporation, the process by which surface water becomes water vapour in the atmosphere. The energy needed for this process to take place is provided by the Sun.
11	D	I, II and IV only **I** and **IV**: Boiling and adding sterilizing tablets both kill microorganisms in water, so both methods can be used to treat water in the home. **II**: Filtering removes suspended material, so can be used to treat water in the home. **III**: Freezing makes microorganisms inactive, but it does not kill them because they will be reactivated when the ice melts, so it cannot be used to treat water in the home.
12	C	
13	A	0 Coliform bacteria indicate the presence of other pathogens in water, therefore, safe drinking water should not contain any colonies of coliform bacteria.
14	C	
15	B	
16	D	
17	C	II and III only **II**: Water may be contaminated by pathogens that cause various intestinal diseases which have diarrhoea as a symptom. **III**: Water may be contaminated by heavy-metal ions, including mercury, which leads to mercury poisoning. **I**: Bronchitis is caused by pathogens inhaled from the air or by smoking cigarettes, it is not caused by water contaminated by pathogens.
18	A	

E2: Sewage and solid waste disposal

No.	Answers	Further Explanations
1	D	
2	B	
3	D	
4	B	I, II and III only **I** and **III**: Sludge produced during sedimentation is used to produce methane or to make fertiliser, and large objects are removed using screens in both methods of sewage treatment. **II**: The effluent produced by the initial treatment process is mixed with compressed air in aeration tanks and aerobic bacteria decompose the organic matter in the activated sludge method. **IV**: The effluent produced by the initial treatment process is sprayed onto stones covered with aerobic bacteria and protozoa in the biological filter method of sewage treatment, not in the activated sludge method.
5	A	
6	A	P Structure P is the ventilation pipe which allows the escape of gases produced in the pit during the breakdown of organic matter.
7	B	To keep out flies and rats Structure R is the lid or seat cover which prevents the entry of vectors, such as rats and flies, into the pit.
8	C	I and IV only **I**: Sandy soil is the most suitable because it is permeable so allows fluids to drain from the pit. **IV**: The latrine should be positioned downhill from water sources so that fluids drain away from these sources and not into them causing contamination. **II**: The pit should be at least 3 metres deep, not 1 metre. **III**: The latrine should be as far away from a reservoir as possible to prevent contamination of the water, it should not be close.

No.	Answers	Further Explanations
9	A	They do not contribute to groundwater pollution Pit latrines often contribute to groundwater pollution in the Caribbean.
10	D	
11	C	
12	B	Composting Composting is the best method because it breaks the plant material down into useful organic fertiliser rich in minerals, which reduces the use of harmful chemical fertilsers, and it also reduces the volume of solid waste entering landfills.
13	A	
14	C	I and II only **I** and **II**: Compaction involves applying pressure to the refuse to squeeze it together. This reduces its volume and makes it hard for vectors to penetrate into it. **III**: Bacteria are too small to be affected by compaction, so it does not reduce their numbers.
15	A	Recycling Recycling releases some harmful substances into the environment, but incineration, using landfills and dumping in the oceans release greater amounts. In addition, recycling separates and reprocesses waste materials into new products, therefore it makes natural resources and energy last longer and it reduces the amount of solid waste to be disposed of by other methods, which reduces pollution.
16	C	
17	D	It is a breeding place for vectors of disease The disease with the highest incidence among the residents living near to the dump is malaria (40% of residents living nearby). Malaria is carried by mosquitoes which are using the swamp as a breeding place.

No.	Answers	Further Explanations
18	B	Cholera and diarrhoea 20% of residents living far away from the swamp suffer from cholera, whereas only 15% living nearby suffer. 12% of residents living far away from the swamp suffer from diarrhoea, whereas only 10% living nearby suffer.
19	A	Reduce Miss Joyce is reducing the amount of plastic waste to be disposed of in landfills by carrying her own bag.
20	D	
21	B	
22	C	A wooden stool Wood is an organic material of plant origin so it can be broken down by microorganisms.