

2023 / 6093 Biology**Paper 1**

25	A	The most popular choice was to select the lens and the ciliary muscles, thereby neglecting the role played by the cornea. A considerable number selected the cornea and the lens, which infers that they do not appreciate that the lens can only change shape by the action of the ciliary muscles
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Paper 2 Answer Scheme

Section A			
Qn No	Answer	Mark	Feedback
1(a)	X: pulmonary artery Y: right ventricle Z: tricuspid valve	1 1 1	Most candidates found this a straightforward, accessible question. Some candidates misapplied the letters to the structures and named correct structures but with the incorrect letter. Weaker responses referred to the wrong side of the heart, identifying X as the aorta or Z as the bicuspid valve.
1(b)	During atrial systole, right atrium wall contracts and is emptied of blood. During ventricular systole, right ventricle wall contracts and pressure in RV exceeds RA. Tricuspid valves close to prevent backflow to RA. Pressure in RV exceeds pulmonary artery. Semi-lunar valves open to allow blood to flow into pulmonary artery towards the	1 1 1 1	Many candidates had a good appreciation of the cardiac cycle. Several candidates did not appreciate that the AV valve in the right atrium is open before atrial contraction, and that the ventricle fills passively. Stronger responses described how the ventricle muscle or wall contracted, increasing the pressure. Some candidates thought the pressure increased due to the ventricle filling with blood. Weaker

	lungs.		responses confused the left and right sides of the heart, sometimes indicating that blood was pumped from one side of the heart into the other.
1(c)	Blood from right ventricle moves into the pulmonary artery and towards the lungs. Blood returns to left atrium via the pulmonary vein. Blood flows past the bicuspid valves into left ventricle. Left ventricle contracts, blood flows past the semi-lunar valves and enters aorta. Aorta branches into smaller arteries, including renal arteries, and then into capillaries. Blood flows into the kidneys.	1 1 1 1	There were many good accounts, with a clear and accurate sequence described. However, some candidates thought that the hepatic artery, hepatic portal vein, and hepatic vein take blood to the kidneys. Weaker responses indicated that the blood entered these vessels straight from the right ventricle, with no reference to the lungs at all.
2(a)(i)	Both chromosomes are the same shape and length. Both are chromosome 9, which means they have the same gene sequence/ loci.	1 1	Candidates generally understood the question but often answered without correct use of scientific terminology. They referred to the chromosomes being the same size rather than being the same length. Candidates who performed well knew that they had the same genes, gene loci or centromere positions, but some just talked about a single gene or alleles being the same.
2(a)(ii)	A body cell contains two copies of each chromosome / homologous pairs while a gamete contains only 1 copy.	1 1	Many candidates correctly used the terms haploid and diploid, although some thought the terms referred to the chromosomes themselves rather than the cells. Weaker responses made vague references to the number of chromatids,

			or chromosomes coming from each parent.
2(a)(iii)	Characteristic V-shape Spindle fibres attached to centromere, pulling towards opposite poles	1 1	Several candidates did not follow the instructions in the question to only draw one pair of homologous chromosomes. There was also some confusion between the first and second division of meiosis. Only stronger responses included the V shape as the chromosomes were pulled by the centromeres, but some were pointing in the wrong direction away from the poles.
2(b)	$\begin{array}{cc} ^A ^B & ^O ^O \\ ^A ^B & ^O ^O \\ ^A ^O & ^A ^O & ^B ^O & ^B ^O \\ A & A & B & B \end{array}$	1 1 1 1	This question was well answered by the majority of candidates, suggesting a good understanding of how to represent genetic crosses.
3(a)(i)	Mesophyll cells oxidise glucose during aerobic respiration to release energy for cellular processes Like synthesising high numbers of enzymes involved in photosynthesis	1 1	Most candidates were aware of the role of mitochondria in respiration, although some did not specify that this was 'aerobic'. Many candidates went on to explain how energy might be used in a mesophyll cell.
3(a)(ii)	Any two from: 1. Carbon dioxide 2. Water 3. Ions 4. ATP	1 1	The majority of candidates correctly named carbon dioxide and water as the substances leaving the mitochondrion. Weaker responses most commonly included 'oxygen' and 'glucose', indicating that products and reactants were confused, or that candidates mistook mitochondria for chloroplasts.

3(b)(i)	As cell diameter increases from 10 to 80 um, mean number of mitochondria increases from 80 to 700, by 620.	1	The vast majority of candidates described the relationship correctly.
3(b)(ii)	Root hair cell; Require a lot of energy to take in mineral salts by active transport; Xylem cell; No/ reduced protoplasm to have a hollow lumen to minimise resistance to flow of water and mineral salts.	1 1 1 1	Many candidates correctly named a cell that would have a greater density of mitochondria, for example, root hair cells and companion cells, and went on to make a correct reference to 'active transport' as the reason. Weaker responses incorrectly thought that water was moved by active transport. Candidates could also correctly name a cell with a lower density of mitochondria, although knowledge of reasons why fewer mitochondria might be required was less secure. Some candidates suggested that sieve tubes have 'no cytoplasm' or that epidermal cells require 'no energy'. Weaker responses gave the cell types the other way round, such as root hair cells having fewer mitochondria, or suggested non-cellular components such as 'stomata' or 'cuticle' instead of types of cells.
4(a)	Liver: all except last option Pancreas: 3rd and last option	5	This question was well answered by the majority of candidates.
4(b)	Running: Adrenaline released → liver converts glycogen stores to glucose. Blood glucose concentration rises. Glucose is oxidised during aerobic respiration to release	2	Many candidates could correctly identify the secretion of appropriate hormones in each situation. The most common error was to state

	energy for muscular contractions. Resting: More glucagon released. Low blood glucose after running is detected by receptors in pancreas. Pancreas secretes more glucagon and less insulin. Liver converts glycogen stores to glucose. Blood glucose rises.	3	or imply that the hormone itself was directly responsible for the formation or breakdown of glycogen, e.g. 'insulin converts glucose to glycogen'. Most candidates gave the correct spelling of 'glucagon' and 'glycogen'.
5(a)(i)	In the day, water evaporates from the moisture lining on the surface of cell B. Cell B loses water and water potential decreases. Water potential of cell B becomes lower than cell A. Water molecules move a region of higher water potential, A, to lower water potential, B Across a partially permeable membrane, via osmosis	1 1 1 1	Most candidates were confident in the use of the term 'water potential', and correctly used the water potentials of cell A and cell B, and the process of osmosis in their explanation. A large proportion added that this was through a partially permeable membrane. Stronger responses described why cell B had a lower water potential than cell A.
5(a)(ii)	Vacuole of mesophyll cell shrinks Cell membrane/ cytoplasm peels away from cell wall Cell appears flaccid, plasmolysed	1 1 1	Most candidates could describe the cell as being flaccid or plasmolysed. Several candidates could also correctly describe what happened to the vacuole, cytoplasm and cell surface membrane. Some candidates described the cytoplasm, rather than the cell membrane, detaching from the cell wall or suggested that the cell membrane, rather than the cytoplasm (or vacuole) shrunk in size. A few candidates drew diagrams, but many were unlabelled. Weaker responses described why the plant wilted (in terms of water potential) or described the appearance of the plant rather than the cell itself.

5(b)	Salt in seawater decreases the water potential of soil in farmland Water will move out from the roots of crop plants which have a higher water potential across a partially permeable membrane, via osmosis Plant cells lose too much water, causing them to wilt and die from lack of raw materials for photosynthesis	1 1 1	Most candidates found this question challenging. Although it was clear that most grasped the basic concepts, candidates found it difficult to phrase their answers in suitably accurate ways. They referred to the water potential of the 'plant' or 'root' rather than of the 'root hair cell'. Candidates who did refer to roots losing water (or gaining less water) did not develop their answer and did not refer to lack of water transported to the leaves. Some candidates acknowledged the reduction of photosynthesis in their response. Stronger responses referred to the lack of oxygen for respiration (in waterlogged soil) and its consequences. Weaker responses suggested that sea water would be absorbed by the plant, making the cells burst, or that the sea water would contain toxins which poisoned the plant.
Section B			
6(a)	P: larynx Q: bronchi R: trachea	1 1 1	In general, this question was answered well. P was the least well-recognised with many candidates naming pharynx instead of larynx. Q was sometimes mistakenly named as the bronchiole. R was correctly identified as the trachea by many candidates. A number of candidates reversed the correct answers for Q and R.
6(b)	Diaphragm muscle contracts and flattens, ribcage moves upwards and outwards	1	Most candidates were well versed in the action of the diaphragm and rib cage, and the effect on

	Increases thoracic volume and decreases air pressure in lung below atmospheric pressure, allowing air to be forced into lungs	1	both volume and pressure in the lungs. Many went further than was required and described the contraction and relaxation of internal and external intercostal muscles. Candidates who performed less well gave general answers stating that the diaphragm and ribs affected both inhalation and exhalation by causing changes in volume and pressure, but not explaining either in detail.
6(c)	Tar Carcinogen and can causes lung cancer Paralyses cilia and prevents them from sweeping away mucus and trapped particles, increasing risk of infection/ bronchitis Carbon monoxide Binds preferentially and irreversibly with haemoglobin, reducing oxygen-carrying capacity of RBC Increases risk of coronary heart disease	1 1 1 1	The majority of candidates demonstrated a good understanding of the effects of the two components of tobacco smoke on health. The most common answers for tar were for the carcinogenic effect, linked to cancer or the paralysis of cilia, linked to non-removal of mucus and pathogens. Candidates were also very familiar with the effect of carbon monoxide and almost all described the binding with haemoglobin, forming carboxyhaemoglobin, and went on to link this to reduced oxygen transport.
7(a)	oceans	1	Almost all candidates could make a suitable suggestion, normally the ocean or sea.

7(b)(i)	<table><tr><th rowspan="2">land use</th><th colspan="2">Estimated mass of carbon released into the atmosphere in a year / million tonnes</th></tr><tr><th>1990</th><th>2015</th></tr><tr><td>urban</td><td>0.0</td><td>0.5</td></tr><tr><td>Industrial farming</td><td>2.9</td><td>64.3</td></tr><tr><td>Small-holder farming</td><td>20.7</td><td>49.1</td></tr><tr><td>Undeveloped land</td><td>12.0</td><td>13.6</td></tr><tr><td>Tall shrubs</td><td>4.1</td><td>9.2</td></tr><tr><td>Degraded peat swamp</td><td>12.1</td><td>9.4</td></tr></table> table headers with units 2 columns correct values, allow 1 error consistent d.p. within columns	land use	Estimated mass of carbon released into the atmosphere in a year / million tonnes		1990	2015	urban	0.0	0.5	Industrial farming	2.9	64.3	Small-holder farming	20.7	49.1	Undeveloped land	12.0	13.6	Tall shrubs	4.1	9.2	Degraded peat swamp	12.1	9.4	1 1 1 1	Although the majority of candidates could construct a table, a significant proportion did not include all the headings that would be needed to complete it. A common heading error was to omit 'land use' as a heading, or to omit 'mass' in the release of carbon heading. Better performing candidates were aware that units should be separated from the rest of the heading either by using a solidus (/) or writing the units in brackets. The common data entry errors were to give the value for urban in 1990 as 0 rather than 0.0 or to simply enter a dash in the data cell. A small number of candidates presented the data in two separate tables or by joining two tables together.
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7(b)(ii)	$(49.1 - 20.7) / 20.7 \times 100\%$ $= 137\%$	1 1	The majority of candidates correctly calculated the percentage increase. Candidates who performed less well divided by 49.1 instead of by 20.7 or did not multiply by 100.																							
7(b)(iii)	During respiration, the living vegetation, as well as the organisms living in it, release carbon dioxide into the atmosphere.	1	Candidates found this question challenging. The majority of answers mentioned microorganisms feeding on peat, which is taken from the stem of																							

	Combustion, using peat as a fuel source, would also cause stored carbon to be converted to carbon dioxide to be released into the atmosphere. When the peat swamp is drained, decomposition of drained peat by decomposers would also contribute carbon dioxide release to the atmosphere. The rapid growth of decomposers will also increase rate of aerobic respiration, releasing more carbon dioxide to the atmosphere.	1 1 1	the question, rather than specifically mentioning <u>decomposers or decomposition by bacteria or fungi</u>. Several answers stated in error that the dead plant remains formed fossil fuels, rather than understanding that the peat prevented plant remains from fully decomposing or knowing that fossil fuels require millions of years and huge pressure to form. Some candidates did appreciate that decomposers would respire aerobically and release carbon dioxide. However, few appreciated the consequence of draining the soil, on carbon stored as carbon compounds in the dead matter. Some went on to describe various ways in which the land is used by humans, often featuring the burning of fossil fuels.
8E(a)(i)	As the age of women increases from 18 to 32, variability in cycle length decreases. As the age of women increases from 18 to 21, mean cycle length increases from 29.7 days to 30.5 days, by 0.8 days. As the age of women increases from 21 to 45, mean cycle length decreases from 30.5 days to 27.1 days, by 3.4 days.	1 1 1	Candidates found this question challenging. Candidates who performed well focused on identifying extreme points in the data sets for the 'range' and the 'mean' on the graph and were able to draw clear conclusions. However, several responses missed trends that altered at different points in the age range. Several attempts at conclusions using these specific data quotes only gave part of the trend. The accurate reading of all the data required was not always seen and some candidates stated that the data had been collected from 15- to 17-year-olds, which had no data plots.

8E(a)(ii)	Data from a very large sample size can be obtained so data can be more statistically significant / reliable. App can help track information over an extended period of time. App can help obtain data from a more diverse sample population since it works beyond geographical and physical limitations.	1 1 1	This question was quite well answered by several candidates who realised that the question related to using the app to collect data, rather than processing the data to obtain results. The reference to a large sample size and easy or accurate data collection was the most common correct answer.
8E(b)	Day 1-5: Oestrogen and progesterone levels are low. Uterine lining breaks down and is discharged together with the unfertilised egg through the vagina. Day 6-10: Oestrogen levels start to rise, uterine lining begins to build up and be repaired. Days 11-14: Oestrogen levels peak, triggering ovulation on day 14. Oestrogen levels then start to decline. Day 15-28: Progesterone levels start to rise, causing uterine lining to continue to thicken and be maintained. If no fertilisation, progesterone levels decrease. Cycle repeats.	1 1 1 1	Most candidates knew that the hormones involved in the menstrual cycle included oestrogen and progesterone. They also knew the function of these hormones related to their effect on the lining of the uterus and the menstrual cycle.
8O(a)	Nephron filters blood to remove metabolic waste like urea, excess salt and water via ultrafiltration. Nephron reabsorbs useful substances like glucose, amino acids, some salt and water back into blood via selective reabsorption. Afferent arteriole is wider/ larger than efferent arteriole high hydrostatic pressure in glomerular capillaries for ultrafiltration to occur efficiently	1 1	Most candidates were confident of the processes that were carried out in the glomerulus and the various parts of the kidney tubule. Many candidates correctly described ultrafiltration and selective reabsorption, and the afferent arteriole having greater width than the efferent arteriole, creating high blood pressure or high hydrostatic pressure. Many were able to

	Capillary wall/ Bowman's capsule wall are partially permeable, allowing only small molecules e.g. glucose, amino acids to pass through but not large molecules e.g. plasma proteins, blood cells to pass through for ultrafiltration Nephron is closely associated with capillaries where useful substances are reabsorbed into the bloodstream. PCT: glucose, amino acids, salt and water. Loop of Henle, DCT: salt and water Collecting duct: water	1 1	talk about a network of blood capillaries and long tubules but did not further explain why this was advantageous. Some accounts simply described the functions with no reference to the adaptations. Candidates who performed less well incorrectly stated that 'diffusion' occurs during ultrafiltration, or only described the arterioles as having 'different' diameters, or one being 'thicker' or 'bigger' than the other.
8O(b)	ADH increases permeability of nephron to water at walls of collecting duct Higher rate of selective absorption → more water taken from glomerular filtrate back into the bloodstream Higher volume of water in the blood, leading to lower salt concentration	1 1 1	Most candidates demonstrated a good understanding of the effects of high concentrations of ADH. Weaker responses named incorrect parts of the nephron.
8O(c)	As age increases from 0 to 80, the number of patients with SIADH increases from 1 to 48, by 47. The age group with the lowest number of SIADH patients is 0 to 20. The age group with the highest number of SIADH patients is 61 to 80. As age increases from 80 to 100, the number of patients with SIADH decreases steeply from 48 to 4, by 44.	1 1 1	A number of candidates inappropriately presented a list of data quotes instead of stating conclusions. However, many candidates did draw correct conclusions. Some used imprecise terminology such as 'more' or 'less' rather than 'most' or 'least'.