

Paper 1

1	2	3	4	5	6	7	8	9	10
B	D	A	B	B	D	B	C	C	A
11	12	13	14	15	16	17	18	19	20
B	D	B	D	C	A	D	C	C	B
21	22	23	24	25	26	27	28	29	30
B	D	B	D	C	B	A	B	A	B
31	32	33	34	35	36	37	38	39	40
D	D	B	B	B	D	D	C	C	A

Paper 2

1a	- large / high, surface area to volume ratio / small / low, volume to surface area ratio (SA:V ratio) 5.95:1 Accept anything between 5:1 and 7:1 - no cell is far from surface / short (diffusion) distance with reference to diffusion of, oxygen / carbon dioxide / gases Poorly done – only one student made the calculation correctly for SA:V ratio. Should take note of calculations that need to be done when question asks to refer to the diagram. In addition, many students only mentioned either high surface area to volume ratio or the short diffusion distance. Both are true for a long and thin organism and are separate points.
bi	Homeostasis is the maintenance of a constant internal environment. Poorly done. Students should be clear this is a definition to know by heart.
bii	Any 3: - Freshwater has a higher water potential than the flatworm's body fluids, so water constantly enters the flatworm via osmosis. - By actively pumping ions into the tubules, it increases water potential in body cells which - Prevents cells from bursting/ rupturing. A challenging question, but those that understood the question scored very well. At the very least, students should take note that the salts are <u>excreted</u> which means body cells will have a higher water potential. This would be a clue to answering the question.
2ai	Mitochondrion

	Mitochondrion releases energy through aerobic respiration for the phagocyte to engulf pathogens / carry out phagocytosis. Some students still spelled it as mitochondrion, a grave error. Many did not refer to the white blood cell in question and merely stated the generic function of white blood cell.
a ii	Difference 1: - Capillary walls are only one cell thick, - whereas artery walls are thick and muscular. - This provides a short diffusion distance for rapid exchange of gases and nutrients in capillaries, - whereas thick muscular artery walls withstand the high blood pressure coming from the heart. OR Difference 2: - Artery walls contain elastic fibers, - whereas capillary walls lack elastic tissue. - Elastic fibers allow arteries to stretch and recoil to maintain high blood pressure, - while the absence of these layers in capillaries allows the vessel to be thin enough for efficient substance exchange. Generally well done.
Bi	0.1 to 0.42 seconds not well done. Most knew 0.1s was when ventricular systole started. However the duration was not correct after that. Students should refer to the textbook what the definition means.
b ii	- Pressure in ventricle is higher than in aorta, semi-lunar valve in aorta open. - Blood flows from ventricle into the aorta. Well done.
3a	- P: hepatic vein - Q: hepatic portal vein - R: hepatic artery Surprisingly, many were confused. Need to revise.
b	- When there is excess glucose, (increase is not accepted) <u>pancreas</u> secrete insulin which is transported to the liver.

	Liver converts excess glucose to glycogen Well done.
c	- Catalase has a <u>specific three-dimensional structural shape and active site.</u> - The substrate, hydrogen peroxide, has a <u>complementary shape</u> that fits into the <u>active site of catalase.</u> - This allows them to bind together to form an <u>enzyme-substrate complex</u> for catalysis to occur, whereas other metabolic substances do not have a complementary shape and cannot bind. Well done. Many wrote 3D shape, which is not specific enough.
4ai	Any 2: Urea/ creatinine / uric acid/ water / mineral salts Urea was a common answer. Many were not able to state that excess mineral salts and excess water has to be removed as well.
aii	Accept any 2 features with correct explanation (1m for feature, 1m for explanation) - Feature 1: Long, narrow, or highly coiled dialysis tubing Explanation: Provides a large surface area to volume ratio for faster diffusion of wastes - Feature 2: use of a partially permeable membrane. Explanation: allows small waste molecules (like urea) to pass through while preventing large blood cells/proteins from leaving. (must give example) - Feature 3: Counter-current flow mechanism / Blood and dialysis fluid flow in opposite directions. Also accept continuous replacement of dialysis fluid. Explanation: Maintains a steep concentration gradient for waste substances along the entire length of the tubing, preventing equilibrium from being reached and maximizing diffusion. Max 2 marks for features, max 2 marks for explanation. Well done.
b	Any 4 marks: - Increase in body temperature <u>above normal stimulates the thermoreceptors and hypothalamus.</u> - Arterioles in the skin dilate (vasodilate), allows more blood to flow through the <u>blood capillaries near the skin surface, increasing heat loss</u> through radiation, conduction, and convection. (must have the idea that more blood flow is to the skin)

	- Sweat glands become more active and <u>secrete more sweat</u> onto the skin surface. As the water in the <u>sweat evaporates</u>, it absorbs latent heat of vaporisation from the body, significantly cooling the skin - The body may also <u>decrease its metabolic rate</u> to reduce the amount of heat released by internal chemical reactions. Body temperature decreases back to normal. Those who did study got most of the points, although most missed the first point about where the thermoreceptors are.
5a	Any 1: Bacterial DNA is not enclosed in a nucleus / lies free in the cytoplasm (whereas human DNA is inside a nucleus). OR Bacterial DNA is circular (whereas human DNA is linear). Done well.
b	Any 3: - The bacteria possess foreign proteins/structures on their surface called <u>antigens</u>. - White blood cells <u>recognize/bind to these foreign antigens</u> as non-self. - This <u>stimulates</u> the specific <u>white blood cells to multiply</u> and <u>produce/secrete antibodies</u>. - The structural shape of these antibodies is complementary to the specific antigens, allowing them to bind to and destroy the bacteria. Not done well. Most do not know what antigens are. Should be clear that white blood cells recognize antigens, and then not just produce the antibodies, but the white blood cells themselves multiply.
ci	- Enzyme: Restriction enzyme - Function: <u>cuts DNA</u> strands at specific nucleotide sequences (restriction sites) to create <u>complementary sticky ends</u> on both the target gene and the plasmid vector, allowing them to join together. Most did not get the second point, many for not spelling complementary correctly.
cii	DNA ligase
ciii	- Transformation (Step Y): The <u>recombinant plasmid is mixed with a bacterium</u> such as E. coli - Temporary <u>heat/electric shock</u> is applied. This <u>opens pores</u> in the bacterium for the plasmid to enter - Bacteria are grown in a <u>fermenter</u> for <u>mass production</u> - Insulin protein is <u>extracted and purified</u>.

	Many missed the point that the plasmid needs to be mixed with the bacterium. Also that the bacteria needs to multiply in a fermenter.				
6a	1m each for correct variation <table border="1"> <tr> <td>continuous variation</td><td>discontinuous</td></tr> <tr> <td>Height weight</td><td>Blood group</td></tr> </table> Well done.	continuous variation	discontinuous	Height weight	Blood group
continuous variation	discontinuous				
Height weight	Blood group				
b	Couple 3 - For Aisha and Divya to have blood group O, they must inherit one recessive I^O allele from each parent. Therefore, <u>both biological parents must possess at least one I^O allele.</u> - For Brenda to have blood group A $I^A I^O$ and Chloe to have blood group B $I^B I^O$, the <u>I^A allele must come from one parent and the I^B allele from the other.</u> - Consequently, the parents must be heterozygous, with the genotypes <u>$I^A I^O$ (Group A) and $I^B I^O$ (Group B)</u>, which allows them to pass on the I^A, I^B, or I^O alleles to their offspring. The explanation is the focus of the answer, due to the word explain. Students should take note of that and flesh out the logic of the answer and not just the answer itself, which most students were able to get. Students who explained why it is not the other couples get the answer by logical deduction, but marks are only awarded to explaining why couple 3 must be the parents, which is what the question is asking. To explain, focus on the movement of the alleles. Not enough to just say all three alleles must be present. Which parent has these alleles, and the <u>why</u> must be explained.				
c	25% Very well done.				
7a	- State the Trend: The rate of transpiration is higher in Setup 1 (150 g/m²/hour than in Setup 2 45 g/m²/hour) - Low atmospheric humidity in Setup 1 creates a <u>steep water vapor concentration gradient</u> between the damp <u>intercellular air spaces</u> of the spongy mesophyll and the <u>external atmosphere/air outside</u>, water diffuses out at a faster rate Most did not get the key words for the second point.				
b	Any 2: [Describe]				

	- In Setup 3, the high temperature (<u>42°C</u>) vs causes a high rate of transpiration, causing the stomatal aperture to narrow/close <u>6.5 mu 1.8 mu</u> [Explain] - Because the <u>guard cells</u> are mostly <u>flaccid</u>, the diffusion of atmospheric carbon dioxide into the intercellular air spaces of the leaf is severely restricted - CO₂ concentration becomes a limiting factor/ decrease CO₂ results in a decrease in photosynthetic rate - the high temperature of 42°C exceeds the optimum temperature for enzymes for photosynthesis and enzymes start to denature to accept wilting of the plant?
7c	Any 4: - Evaporation: This is the physical change of state where liquid water turns into water vapor. - Within the leaf, this takes place at the <u>thin film of moisture</u> lining the surface of the spongy <u>mesophyll cells</u> into <u>the intercellular air spaces</u>. - Transpiration is the loss of water vapor from the aerial parts of a plant (mainly through the stomata of the leaves) - The water vapor inside the intercellular air spaces <u>diffuses</u> out down its <u>from a higher concentration to a lower concentration/ down the concentration gradient</u> into the surrounding atmosphere, primarily through the stomata. - Evaporation is a physical process that can occur from non-living surfaces, while transpiration occurs only in a living plant. Very poorly done. Many were confused about what evaporation means for the plant, and misunderstood the question.
8a	Self-pollination advantages: (max 2) - Only requires one parent / - independent of external pollinators (like insects or wind); increases chances of successful pollination; - preserves beneficial genetic traits from the parent. Cross-pollination advantages: - Combines different alleles from two distinct parents, leading to greater genetic variation in the offspring; - makes the species more adaptable to environmental changes / less prone to inheriting recessive genetic diseases.

	Environmental changes is what allows variation to be selected for in the species. Not enough to simply say cross pollination allows the species to thrive in the environment. Many did not compare the advantages of cross pollination and should know what compare means.
b	Any 3: • The pollen grain absorbs the sugary fluid secreted by the stigma and germinates to form a pollen tube. • The pollen tube grows down the style towards the ovary, • secreting enzymes to digest the surrounding style tissue along the way. • The tube enters the ovule through a tiny opening called the micropyle, • where the tip of the tube bursts to release the male gametes to fuse with the female gamete. Question was well done with most students getting the full marks.
c	Any 3: • The placenta contains numerous <u>finger-like projections</u> / <u>villi</u> that protrude into maternal blood spaces, maximizing the rate of diffusion. • The membrane separating the maternal blood from the fetal capillaries is only thin layer of tissue/one cell thick, allowing rapid exchange of substances. • Fetal capillaries inside the villi maintain a <u>continuous</u>, one-way blood <u>flow</u>, which constantly maintains a steep concentration gradient for quick transport. • The physical barrier keeps maternal and fetal blood separate, preventing the fetus's blood vessels from bursting due to high maternal blood pressure, and protecting the fetus from maternal pathogens/mismatched blood group agglutination. [1m] Having capillaries doesn't automatically mean a steep concentration gradient. To maintain the steep gradient, blood flow has to be continuous, so that substances that have diffused in to the blood are transported away. Question is on adaptations. That there are capillaries is not an adaptation as capillaries are present in many parts of the body for the exchange of substances.
9a	• Tar
b	• This alters the triplet codes, resulting in a different sequence of amino acids being joined together during translation/protein synthesis. • The altered amino acid sequence causes the protein to change its three-dimensional shape • The incorrectly shaped protein cannot perform its normal biological role, leading to uncontrolled cell division (tumor growth) or a loss of elasticity/surface area in lung tissue (disrupted lung function).

c	• Similarity: All five countries show an overall trend where mortality rates initially increase to a peak before showing a subsequent decrease/ All countries are simultaneously experiencing a decline in lung cancer mortality rates from 1995 to 2006. • Data Support (Similarities): For example, the United Kingdom peaks at approximately 74 deaths per 100,000 around 1973–1975 before falling to 34 deaths per 100,000 by 2006. Similarly, the United States peaks later at 56 deaths per 100,000 in 1990 before dropping to 41 deaths per 100,000 by 2006. Differences in Trends • Timing of Peaks: The countries reached their maximum mortality rates at vastly different times. • Data support: Finland and the UK peaked early (mid-1970s), the US and Spain peaked around 1990–1995, while Hungary peaked latest (mid-1990s) • Magnitude of Mortality Rates: Hungary consistently maintains a significantly higher peak and overall mortality rate in the latter half of the graph compared to all other nations/ Spain maintains the lowest mortality rates for the majority of the timeline. • Data Support (Differences): Finland peaked early in 1970 at 70 deaths per 100,000, whereas Hungary peaked much later in 1993–1995 at a much higher value of 85 deaths per 100,000. Spain started at the lowest rate of roughly 7 deaths per 100,000 in 1950, while the UK started at the highest rate of 38 deaths per 100,000 in the same year.
10a	• Plants contain chlorophyll, which absorbs light energy and converts it into chemical energy during photosynthesis. • This energy is passed to consumers along the food chain, so plants occupy the first trophic level
b	Any 2: • Not all of the organism at one trophic level is eaten by the next; some parts, such as bones, hair or roots, are not consumed, lost as uneaten parts or dead bodies. • of the material that is eaten, some is not digested and is lost as faeces during egestion • some of the energy absorbed is lost in excretory products such as urea • a large proportion of the energy in the food is released during respiration and used for life processes such as movement, growth and active transport; this energy is eventually lost to the surroundings as heat.

c	Correct tally and freq = 1m each		
	percentage of cell wall material digested (%)	tally	frequency (number of species)
	31 – 40		3
	41 – 50		9
	51 – 60		8
	61 – 70		4
d	• Axes Scaling: Continuous, linear scale used for both axes. • Labeling: The y-axis must be labeled "Frequency" or "Number of Species", and the x-axis labeled "Percentage of cell wall material digested (%)". • Plotting Accuracy (P): All 4 bars are plotted perfectly matching the frequencies • Histogram Structure (S): Equal bar widths matching the class intervals, and no gaps left between the bars (as a histogram represents continuous data intervals, unlike a bar chart).		