Question	Part	Answer	Notes	Marks	
1	a	Competitive inhibitor has a similar structure to the substrate	*Do not allow descriptions of non-competitive inhibition*	3	AQA A Level Biology Paper 1 2025
		Allowing it to bind to the active site of the enzyme			
		Binding of the inhibitor to the enzyme's active site prevents the substrate from binding			
	b	Both reaction velocities (with and without methotrexate) approach the same point		1	
	c	Without methotrexate = (120 * 0.1)/(0.2 + 0.1)		4	
		12/0.3 = 40 mmol/min			
		With methotrexate = (120 * 0.1)/(0.5 + 0.1)			
		12/0.6 = 20 mmol/min	*Credit idea that competitive inhibitor reduces velocity by 2X*		
	d	Methotrexate inhibits dihydrofolate reductase	*Credit idea of inhibiting synthesis (S) phase*	3	
		Inhibition affects rapidly dividing cells, such as cancer cells			
		Slowing or preventing formation of tumour			
2	a	Chloroplasts have a double membrane		2	
		Internal membrane system, which includes the thylakoids			
		Thylakoids are disc-shaped sacs stacked into columns known as grana			
		Thylakoids contain chlorophyll, the pigment essential for capturing light energy	*Credit any 2 relevant points*		
	b	D - Increased chloroplast density in the palisade mesophyll cells to maximise light absorption		2	
		E - Stomata on the lower surface of the leaf to reduce water loss while allowing gas exchange			
	c	Area of leaf = 20 * 30 = 600 cm^2		2	
		8 * 12 * 600 = 57,600 µM of glucose			
	d	The cells are broken up by homogenisation	*Credit reference to ice cold, isotonic buffer*	4	
		Centrifuge first spun at low speed			
		To remove denser organelles	*Credit formation of pellet containing organelles*		
		Supernatant resuspended and centrifuged again			
		Chloroplast ribosomes (70S) distinguished from cytoplasmic ribosomes (80S) in root	*Credit sedimentation rate during ultracentrifugation*		
		Because 70S ribosomes are less dense			

3	a	Small population leads to reduced gene pool		2	
		Which reduces genetic variation/genetic bottleneck has occurred	*Credit greater likelihood of inbreeding*		
	b	Indian rhino has larger population so likely to have greater genetic diversity		4	
		This may enhance their genetic robustness and resilience against diseases	*Credit reference to hybrid vigour*		
		Greater differences in mtDNA in Indian rhino than Javan rhino	*Cross-breeding with the Indian rhino might impact the genetic integrity of the Sumatran rhino compared to the Javan rhino, which is more genetically similar and might preserve more species-specific traits*		
		May have poor behavioural compatibility with Indian rhino	*Credit reference to courtship behaviour*		
	c	Ancient rhinocerotid as the common ancestor for both the *Rhinoceros* and *Dicerorhinus* genera	*Rhinoceros unicornis (Indian Rhino)* *Rhinoceros* *Rhinoceros sondaicus (Javan Rhino)* *Ancient Rhinocerotid* *Dicerorhinus sumatrensis (Sumatran Rhino)*	3	
		Rhinoceros and *Dicerorhinus* are two separate branches diverging from the rhinocerotid			
		R. sondaicus and R. unicornis more closely related			
	d	Before clearance: $N(N\text{-}1) = 999{,}000$; $\Sigma n(n\text{-}1) = 185{,}592$		3	
		D before clearance = 5.38	*1 mark for D before clearance*		
		After clearance: $N(N\text{-}1) = 54{,}522$ $\Sigma n(n\text{-}1) = 10{,}858$			
		D after clearance = 5.02	*1 mark for D after clearance*		
		0.35/5.38 *100 = 6.7%	*Allow some tolerance for rounding errors*		
	e	Sumatran populations are isolated within patches	*Credit platinum or silver*	2	
		So only mate with members of same small community/genetic inbreeding	*Credit inbreeding depression or reduced fitness*		
		Increased vulnerability to poachers			
		Reduced access to resources	*Credit other reasonable answers*		
4	a	SEM produces high resolution image	*Do not credit high magnification*	2	
		Image is 3D			
	b	$\pi r^2 h$ of cylinder - 2 hemispheres: $\pi * 0.1^2 * 2.8 = 0.088$ μm^3	*Vol. of rod shaped bacteria can be calculated by splitting the shape into a cylindrical core and 2 semicircular hemispheres on each side*	4	
		Vol of the 2 hemispheres: $4/3\pi r^3 = 4/3\pi * 0.1^3 = 0.000419$			
		0.088 + 0.000419 = 0.0884 μm^3	*Give 2 marks vol. of cylinder and remaining 2 for correct answer*		
	c	Gut microbiome might compete with pathogens	*Credit reference to competitive exclusion*	2	
		For nutrients			
		Gut microbiome might form barrier/stimulate immune system	*Credit other reasonable answers*		
	d	At lower drug concentrations (20 and 50 mg/L) CampyloClear more effective		3	
		But only value at 20 mg/L statistically significant	*Due to no overlap of error bars*		
		At higher concentrations Azithromycin more effective			
		May be justified as lower concentration of drug may lead to fewer side effects	*This is an assumption*		
		But Azithromycin at 200 mg/L has shortest recovery time of any treatment			
		So may not be justified			
	e	CampyloClear more effective than Azithromycin at lower concentrations		2	
		Because monoclonal antibody forms complementary antigen-antibody complexes	*Credit reference to high specificity and strong binding affinity*		
		CC binds to CJ antigens			

5	a	3 hydrogen bonds drawn		2	
		Between O of G and H of C; H of G and N of C; H of G and O of C	*From top to bottom of the molecules*		
	b	Guanine is phosphorylated into GTP		2	
		Through the hydrolysis of ATP	*Credit ATP donates phosphate groups*		
	c	mRNA		2	
		tRNA			
		Ribosomal subunits	*Credit small ribosomal unit and large ribosomal subunit*		
	d	1 hour = 3,600 seconds	*1 mark for this understanding*	2	
		50 mg/L = 54,000 bonds			
		100 mg/L = 36,000 bonds			
		50 mg/L = 18,000 bonds	*1 mark for 3 correct values*		
	e	At higher concentrations, GTP may act as a substrate inhibitor	*Credit references to non-competitive inhibition*	3	
		GTP may change shape of active sites of enzymes involved in protein synthesis			
		Activity of enzymes reduced to reduce resource wastage or overproduction of proteins	*Credit other reasonable answers*		
	f	Biuret test used to test for the presence of peptide bonds		4	
		Blue to purple colour change is observed with increasing conc. of proteins			
		Colorimeter is used to measure intensity of purple colour			
		Calibration curve with known concentrations of protein is needed	*Rate of protein synthesis can be derived from this*		
6	a	A - Xylem		3	
		B - Phloem			
		C - Companion cell			
	b	Sucrose is actively transported into the phloem tissue		4	
		This lowers the water potential inside the phloem			
		Water enters the phloem by osmosis from the xylem or surrounding cells			
		This increases the hydrostatic pressure in the phloem	*Credit reference to pressure gradient*		
		Flow of sap from source to sink			
		Sucrose taken up at sink (so water potential increases)			
		Some water returns to xylem or surrounding cells at sink			
	c	Aphids placed on the bark of normal and inhibitor-treated trees		4	
		Aphids placed at same height in both trees			
		Carefully cut aphids post-insertion to leave just the mouthparts			
		Collect sap from mouthparts			
		Over same period of time			
		Replicate across multiple trees, control temperature and humidity	*Credit any reasonable control variables*		
	d	Starch is insoluble in water - preventing osmotic changes in cells		2	
		Starch can be packed tightly/compactly into granules			
		Large amount of energy in a small space			

7	a	Bilayer has hydrophilic heads facing outwards and hydrophobic tails facing inwards		5	
		This means a barrier is formed to water-soluble substances			
		Bilayer is fluid - proteins can move laterally within it			
		Facilitating cellular processes like cell signalling and endocytosis			
		Cholesterol adds stability to the bilayer			
		Helping to maintain membrane integrity at different temperatures			
		Proteins are embedded within the bilayer			
		Functioning as receptors, channels or enzymes			
	b	Diss. curve shows the percentage saturation of haemoglobin with oxygen at various ppO2		5	
		At high ppO2 (such as in the lungs), the curve shows a high level of saturation			
		Indicating a strong affinity of haemoglobin for oxygen in oxygen-rich environments			
		At low ppO2 (such as in respiring tissues), the curve shows less saturation			
		Indicating a lower affinity as oxygen is released to tissues			
		Binding of one oxygen molecule increases the affinity for subsequent oxygen molecules	*Credit reference to cooperative binding*		
		Middle of the curve is steep as small changes in oxygen pressure lead to large changes in ppO2			
		S' shape reflects the plateau at higher oxygen levels			
		Where additional oxygen does not significantly increase saturation			
	c	High blood pressure can damage endothelium, making atheroma formation more likely		5	
		Damage to the endothelium attracts white blood cells and lipids from the blood			
		Which accumulate and form fatty streaks			
		Over time, deposits will harden to form fibrous plaques known as atheromas			
		These restrict blood flow and increase blood pressure further			
		Arteries narrow, starving the heart muscle of oxygen			
		May eventually lead to myocardial infarction	*Credit references to blood clots*		
		As heart muscle cells begin to die from a lack of oxygen			