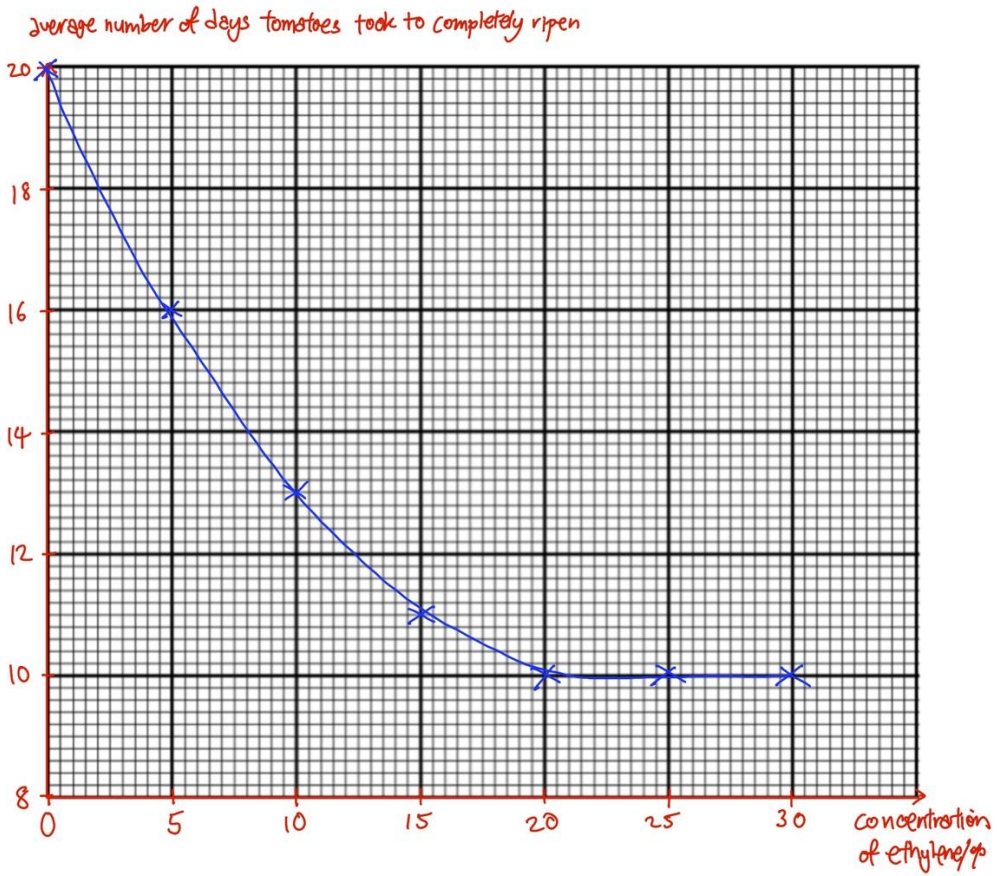
2024 FHSS 6093 Pure Biology Prelim Paper 2 Mark Scheme

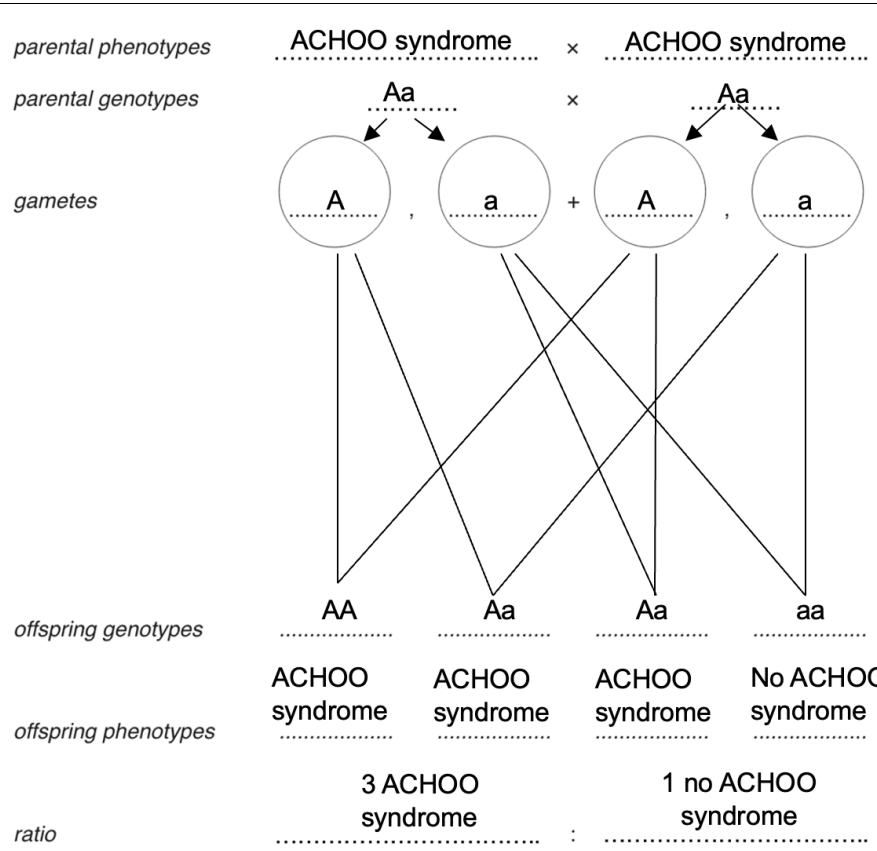
Section A

Qn		Mark Scheme	Marks	Examiner's Comment
1	**a**	Any 4 • polygalacturonase acts as the lock, pectin acts as the key (active site of polygalacturonase is the keyhole) • The specific 3D shape of the active site of polygalacturonase is complementary to the shape of pectin • Pectin fits and binds to the active site of polygalacturonase to form the enzyme-substrate complex • Activation energy of the reaction is lowered • reaction takes place at the active site to form mono-galacturonate, which leave the active site, which is available to bind with the next substrate molecule	4	Many did not mention fit and bind. Many did not mention that the activation energy is lowered
	b	• Plots accurate; • Axes correct with units; • Best-fit curve • Appropriate Scales Note: if odd scale, penalise 2m for plot + scale;	4	Graph was generally well plotted. A number of candidates use a scale of 10 boxes to 5 days for the y-axis, which caused their graphs to occupy less than half the space.

				
	c	Describe: • As concentration of ethylene increased from 0% to 20%, (polygalacturonase concentration increased), average number of days tomatoes took to completely ripen decreased from 20 days to 10 days, (by 10 days). Reject: as concentration of polygalacturonase increased from 0% to 20%...) BOD: if did not calculate difference in number of days decreased	3	Many quoted data for ethylene but referred to concentration of polygalacturonase increasing by those amounts instead, which is not correct.

		Explain: • As polygalacturonase concentration increases, there is a higher frequency of effective collision between enzyme and substrate molecules • Higher rate of formation of enzyme-substrate complex and thus products Describe: • As concentration of ethylene increased from 20% to 30%, (polygalacturonase concentration increased), average number of days tomatoes took to completely ripen remained constant at 10 days. BOD: if mistake of describing the % changes as concentration of polygalacturonase changing is made again Explain: • Enzyme concentration is no longer the limiting factor BOD: concentration of ethylene is no longer the limiting factor • Idea of all pectin (substrates) being bound to polygalacturonase (enzymes), so any further increase in enzyme concentration does not increase rate of reaction/ decrease number of days taken.		(e.g. when concentration of polygalacturonase increased from 0% to 20%...) Many did not gain credit for the explanation as candidates simply stated that more enzymes breaks down more substrate.
	d	• Ripening bananas release ethylene + ethylene triggers the activity of polygalacturonase • Idea of causing other ripe fruits to overripe, which may spoil/soften the fruits	2	Well done
2	**a**	• G: oesophagus • H: stomach	2	Well done
	b	• E	1	Many candidates indicated F instead.
	ci	• Poor muscular coordination / slower reaction time (reject: decreased reaction time)/ blurred vision when intoxicated • Increased risk of traffic accidents/ result in dangerous driving	2	Well done
	ii	• Consume less carbohydrates Reject: dialysis, as alcohol when absorbed first makes its way the liver before it can reach the veins for dialysis to remove excess alcohol, so the alcohol would have already exerted its effects on the liver	1	Well done

3	**a**	• Increase in light intensity detected by photoreceptors on the retina, which generate nerve impulse • Nerve impulse transmitted along sensory neurone in optic nerve • Across synapse, with help of neurotransmitter • To relay neurone in brain • Nerve impulse transmitted to motor neurone, then to effector, which are the diaphragm muscle, abdominal muscles and muscles at the back of the throat Reject: if it is stated that nerve impulses are transmitted from motor neurone to effector across synapse. • These muscles contract to cause sneezing	5	Many forgot to mention that the photoreceptors generate nerve impulse after detecting the stimulus. Some candidates did not specify the location of the sensory neurones. Many candidates thought the relay neurone receiving this nerve impulse is in the spinal cord. Some wrote that the brain generates a nerve impulse that leads to the sneezing reflex. This is a reflex action, not voluntary action, so this should not happen Some candidates did not use the term "effector".
	bi	Let A represent the allele for having ACHOO syndrome Let a represent the allele for not having ACHOO syndrome	1 mark for legend	Generally well done. Most common mistake was candidates not specifying which

		 BOD: for no arrow from parental genotypes to gametes	1 mark for parental phenotype and genotype 1 mark for gametes and offspring genotype (cross lines must be present) 1 mark for offspring phenotype and ratio	phenotypes the ratio 3:1 is referring to.
	ii	Probability of child having ACHOO syndrome = ¾ Probability of child having ACHOO syndrome and being a girl = ¾ * ½ = 3/8 or 0.375 Ecf allowed from bi if student mistakenly thought that ACHOO is a recessive trait	1 1	
4	**ai**	40%/20% = 2 times	1	

	ii	• Estrogen stimulates repair and thickening of uterine lining Reject: Estrogen repairs/thickens the uterine lining • High concentration of estrogen triggers ovulation	2	Some students described the role of progesterone instead, failing to notice that the study had a focus on ovulation, which is not regulated by progesterone.
	b	• Carbon monoxide from cigarette **smoke** binds irreversibly with haemoglobin in maternal blood to form carboxyhaemoglobin • Reduced oxygen carrying capacity of mother's red blood cell • Lesser oxygen transported to placenta and diffused to fetus/ Lesser oxygen transported to the fetus via the umbilical cord REJECT: carbon monoxide diffused to fetus OR • Carbon monoxide from cigarette **smoke** increases rate of fatty deposits in inner arterial wall • Lumen of arteries narrowed • Rate of oxygen transported to placenta and fetus decreases /Lesser oxygen transported to the fetus via the umbilical cord OR • Nicotine from cigarette **smoke** increases risk of blood clots in arteries • Lumen of arteries narrowed • Rate of oxygen transported to placenta and fetus decreases /Lesser oxygen transported to the fetus via the umbilical cord	3	Most chose to explain the effect of carbon monoxide on oxygen carrying capacity. Students did not mention that oxygen is first transported to the placenta before diffusing to the fetus.
	c	• Glucose is carried in the blood plasma • Small intestine → hepatic portal vein → liver • → hepatic vein → vena cava → heart	5	Many jumped directly from small intestine to the umbilical cord, thus missing the

		• → pulmonary artery → lungs → pulmonary vein • → heart → aorta → placenta • → umbilical vein → fetus		entire marking point of this question.
5	**a**	• Gradient plots to be shown on graph at time = 40 hours • Gradient calculation + correct calculation of final answer (0.8 mg/h) ECF: if gradient plot read wrongly but gradient calculation is done correctly	1 1	Many candidates calculated the rate over 40 hours, instead of the instantaneous rate <u>at</u> 40 hours.
	b	• <u>Aerobic respiration inhibited</u> in batch P, <u>no/less energy released,</u> • only/mainly diffusion happening • Quantity of nitrate ions absorbed in batch P <u>plateaus</u> after 10 hours as <u>equilibrium</u> has been reached (no more net intake of nitrate ions) • <u>Aerobic respiration able to occur</u> in batch N, <u>energy released</u> • <u>Active transport</u> (and diffusion) able to take place • to <u>absorb nitrate ions at a higher rate</u> <u>against the concentration gradient</u>	4	Many did not mention the process that is happening for P (only stating that active transport is not occurring)
	ci	Diffusion	1	Many did not read the question on what happens after 60 hours, and gave their guesses based on all possibilities (E.g. transpiration, photosynthesis, etc.)
	ii	2 points for 1 mark • Concentration of nitrate ion in <u>cell sap</u> of root hair cells higher than that of distilled water • Net movement of nitrate ions out of <u>root hair cells into distilled water</u> • <u>Down concentration gradient</u> • through <u>partially permeable</u> cell surface membrane	2	
6	**a**	• cornea	1	Common mistake: lens
	bi	• A: fovea • B: blindspot	2	Well answered
	ii	• more rod cells than cone cells in the retina ; • ref. to uneven distribution of rod cells either side of fovea ; • no rod cells and no cone cells at blind spot ; • optic nerve enters /leaves retina at blind spot ; • only cone cells at the fovea / no rod cells at the fovea ;	5	No ecf from 6bi

		• maximum number of cone cells are at the, fovea / 0 degrees ; • maximum number of rod cells at 20–21 degrees ; • data quote include units ;		
	ci	• Sensory neurone	1	
	ii	• They transmit nerve impulses generated • from the photoreceptors to the brain If any other neurone is stated in ci), max 1m given for “transmit nerve impulses”	2	
7	**ai**	Bacteria	1	
	ii	Plasmid	1	
	b	**Invalid (max 3m)** • Humans overcome viruses using their adaptive immune system/active immunity/antibodies, not by evolving • Immune system able to adapt to new strains of viruses within a very short time period/operate on a shorter timeframe than evolution • Quick production of vaccines can provide protection before any infection • Weakened virus injected, where its antigens stimulate antibody production by lymphocytes • Memory cells produced for immunological memory/long-term immunity • Memory cells recognise virus’ antigens during reinfection, triggering a rapid immune response • Use of antiviral drugs to defeat the viruses **Valid (max 3m)** • Some viruses are mutation-prone • develop new antigens, avoiding detection by memory cells/antibodies • Unable to stimulate immune response in humans, humans fall ill and may die • Viruses can evolve faster than vaccines can be produced/ time needed for production of safe vaccines • Viruses can evolve mechanisms to evade/shut down the immune system and its ability to adapt (e.g. HIV)	4	

	c	• Viral DNA used as template to synthesis mRNA (reject: DNA converted to mRNA) via transcription in the nucleus • Ribosome uses mRNA/viral RNA to synthesise specific sequence of amino acids / polypeptide chain via translation in the cytoplasm • Polypeptide chain folds up to form viral protein • Viral protein may be further processed, packaged and modified in the Golgi apparatus.	4	Many students jump straight into stating that ribosomes synthesise proteins, without elaborating on transcription and translation. Candidates should also be aware that Golgi is spelled with a capital G.

Section B

Question 8 was the more popular choice. However, candidates who chose question 9 generally did much better. Candidates are advised to choose their question more carefully in Section B.

For candidates who did both questions, only Q8 will be considered.

8	**a**	25.22 *150/100 = 37.83 g	1	
	b	Any five: • Photosynthesis ; • in leaves / green parts of plants / in mesophyll / chloroplasts / using chlorophyll ; • using light energy ; • water + soil through the roots/ root hair cells / irrigation from roots ; • carbon dioxide + air through stomata ; • produce glucose / $C_6H_{12}O_6$; • converted to starch ;	5	
	c	Any four (note: all explanations must link back to carbon): • These plants are food source to/ fed on by other organisms, transferring carbon compounds from one trophic level to another • These plants may eventually be buried underground and subjected to high pressure over time to form fossil fuels, trapping carbon underground • Combustion of biofuel/these plants (reject coal/natural gas/ fossil fuels) to release carbon dioxide • These plants are decomposed by microorganisms to release carbon dioxide • These plants carry out respiration, breaking down nutrients to release carbon dioxide into the atmosphere Reject: dissolution of carbon dioxide into/out of ocean (not related to rice, maize and wheat)	4	

9	**a**	• loss of habitat ; • population decrease /migration ; • extinction /endangerment, of species ;	4	

		• loss of biodiversity ; • less food ; • idea of food chains /food webs disrupted ;		

	b	• Light intensity increases
		  ○ Stomata open wider → rate of transpiration increases
		• Temperature increases
		  ○ Rate of evaporation increases → rate of transpiration increases
		• Humidity decreases
		  ○ <u>Steeper concentration gradient</u> of water vapour between atmosphere and intercellular air spaces → rate of transpiration increases
		• Wind speed increases
		  ○ Water vapour quickly carried away by wind, <u>steeper concentration gradient</u> of water vapour between atmosphere and intercellular air spaces → rate of transpiration increases
		
		Marks only awarded if explanations are tagged to the correct factor
			6	