L-Università ta' Malta

MATSEC
Examinations Board

Marking Scheme

AM Biology

First Session 2025

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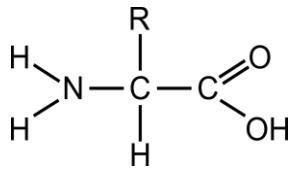
In the case of marking schemes that include model solutions or answers, it should be noted that these are not intended to be exhaustive. Variations and alternatives may also be acceptable. Examiners must consider all answers on their merits, and will have consulted with the MATSEC Examinations Board when in doubt.

PAPER I

Question			Suggested Answers	Marks distribution	Marks
1	a	i	 COOH; NH_2; H and R group; single bonds around central C.	Accept NH_2 and COOH as a group rather than as shown in diagram, accept R being H as in glycine. ½ ½ ½ ½	2
	b		Non-polar R groups are hydrophobic and do not interact well with water. In an aqueous environment, these groups tend to cluster together to exclude water. When the polypeptide folds and bends to form a protein, non-polar groups are buried inside the protein OR contributing to the formation of a stable globular structure.	1 1 1	3
	c		Collagen (fibrous protein) has a long, rope-like structure formed by triple helices, providing tensile strength for structural roles, such as in connective tissue. Insulin (globular protein) has a compact, spherical shape, enabling it to function as a hormone that interacts with specific receptors. The difference in shape reflects their functional specialisation; collagen for structural support and insulin for signalling.	1 1 1	3
	d	i	H-bonds; hydrophobic interactions (in aqueous); Van der Waals interactions; ionic interactions (in aqueous).	½ mark each for any two	1
		ii	Heat / Strong acids or alkalis / changes from the optimum / High concentration of salts / Heavy metals / Organic solvents / Alcohol / Detergents / UV /alcohol. Do not accept just the term e.g. pH or temperature.	½ mark each for any two	1
				Total:	**10**

2	a		Modified mouth-parts (fang-like to pierce exoskeleton) / Use it to transfer venom / Manipulate prey / Pincers to tear prey / Sensory role such as chelicerae with hair to detect movement or chemicals. Example: Spiders.	½ mark each for any two 1	2
	b		Radial symmetry allows interaction with environment from all directions / Allows for better protection from predators from all sides / Locomotory structures throughout in case of injury from one side. Example: Starfish, Sea urchin.	½ mark each for any two 1	2
	c		Streamlined body without a prominent head helps in moving through soil / Limited need for complex sensory organs or mouthparts, as they simply ingest soil for nutrients. Example: Earthworm.	½ mark each for any two 1	2
	d		Different forms utilise distinct habitats and food sources / occupying different ecological niches, competition among life stages is minimised. Example: Jellyfish.	½ mark each for any two 1	2
	e		Hooks enable firm attachment to host / Prevent dislodgement / Parasitic adaptation for remaining in host while food flows. Example: Tapeworm.	½ mark each for any two 1	2
				Total:	**10**
3	a	i	A Mucosa (also accept: mucosal layer). B Submucosa. C Muscles Layers (also accept: smooth muscle layer; circular and longitudinal muscle layer; muscularis externa). D Serosa.	½ ½ ½ ½	2
		ii	In the ileum, the mucosa is adapted for nutrient absorption with villi and microvilli that increase surface area simple columnar epithelium considered. In the buccal cavity, the mucosa is smoother, has stratified squamous epithelium, providing protection against mechanical damage and friction.	1 1	2
	b	i	When food enters the stomach, it stimulates stomach lining to release gastrin. Gastrin stimulates parietal cells to secrete hydrochloric acid (HCl), lowering the stomach's pH.	½ ½	3

			When pH gets too low, cells in the stomach release somatostatin. Somatostatin inhibits further release of gastrin, thus reducing HCl production. As HCl secretion decreases, the stomach's pH starts to rise, reducing somatostatin release and allowing gastrin secretion to resume.	½ ½ 1	
		ii	Activation of pepsinogen to pepsin; Activation of prorenin to rennin ; Providing an optimum environment for enzyme activity; The acid kills many bacteria, thus acting as a defence mechanism; It denatures many proteins, their tertiary structure is altered, making them unfold and so easier to digest; Facilitates absorption of certain nutrients; Inactivates salivary amylase.	1 mark each for any three	3
	c		Salivary amylase Salivary glands/mouth/buccal cavity Maltose and dextrins (accept maltose only) Pepsin Chief cells / stomach Peptides (smaller protein fragments) (polypeptides not accepted) Lipase Pancreas Monoglycerides/Fatty acids and glycerol Carboxypeptidase Pancreas Amino acids + dipeptides or small peptides (one accepted) Lactase Small intestine (jejunum and ileum were accepted but NOT duodenum) glucose and galactose (both need to be mentioned)	½ for substrate ½ for products	5

	d		If bile duct is blocked, then bile does not make it into the intestines. If bile is not released, then fats are not emulsified and remain as large globules (may mention surface area) thus lowering the efficiency of lipase.	½ ½	1
				Total:	**16**
4	a		A. resting potential B. depolarization C. repolarization D. hyperpolarization	½ ½ ½ ½	2
	b	i	The size of the membrane potential spike (amplitude) is determined by the concentration of Na^+ ions, as this affects the number of sodium ions entering the axon from the extracellular fluid. A lower Na^+ ion concentration in seawater reduces the sodium ion gradient across the membrane, resulting in fewer Na^+ ions entering the cell during depolarisation. This weaker sodium influx leads to a smaller membrane potential (or smaller voltage change) and may prevent the neuron from reaching the threshold potential, impairing action potential generation.	1 1 1	3
		ii	Reduces internal (axial) resistance / Increases conduction velocity of the nerve impulse. Enhances rapid transmission over long distances.	1 1	2
		iii	The higher the temperature the faster the conductance, because enzymes work faster at high temperature e.g. those that control the Na-K pump. In ectothermes (e.g. squid): higher temperatures accelerate ion channel kinetics and conduction speed/ more KE and faster molecular movement. / Lower temperatures slow down these processes / dependents on environment for such process. In endothermes (e.g. humans): Body temperature is regulated, maintaining stable conduction speeds.	1 1 1	3
		iv	Loss of myelin decreases insulation around the axon / Disrupts saltatory conduction / Slows down the nerve conduction velocity / Can result in conduction block and less efficient signal transmission.	½ mark each	2

		v	Intensity of stimulus does not change the amplitude. The action potential is an all-or-none response. A stronger stimulus increases the frequency of action potentials, not their magnitude.	½ ½ 1	2
				Total:	**14**
5	a		A. Glycogenolysis B. Glycolysis C. Glycogenesis D. Gluconeogenesis	½ ½ ½ ½	2
	b		Transporting vessel(s): Hepatic portal vein. Reason: The hepatic portal vein carries nutrient-rich blood from the digestive tract directly to the liver, including absorbed glucose, for metabolism or storage.	1 1	2
	c	i	Process: C (Glycogenesis) accept either term or letter. Reason: During high-carbohydrate intake, excess glucose is stored as glycogen in the liver and muscles, providing an energy reserve for endurance activities like marathons.	½ 1 ½	2
		ii	Process: A (Glycogenolysis) accept either term or letter. Reason: At the start of intense exercise, the body rapidly breaks down stored glycogen to glucose for immediate energy.	½ 1 ½	2
		iii	Process: D (Gluconeogenesis) accept either term or letter. Reason: After prolonged exercise, glycogen stores are depleted, and the liver synthesises glucose from non-carbohydrate precursors to maintain blood glucose levels.	½ ½ 1	2
	d		Detoxification: The liver detoxifies harmful substances, including drugs and alcohol, making them safer for excretion. Protein Synthesis: It produces essential plasma proteins, such as albumin and clotting factors, crucial for maintaining blood volume and coagulation.	1 1	2
				Total:	**12**
6	a		Proteins that help package DNA into a compact, organised structure within nucleus. Function: to pack DNA into small space within cell nucleus; protects the DNA from damage.	½ ½ ½ ½	2
	b	i	Non-overlapping		1
		ii	Universal		1

	c		Failure to initiate translation. If translated by another start codon later in the sequence, the protein may lose function.	1 1	2
	d		If mutation changes codon there is a chance that the amino acid remains unchanged. Therefore, the silent mutation conserves the amino acid and thus the protein function.	1 1	2
	e		DNA polymerase III		1
	f		Insertion Substitution	1 1	2
	g		Example: example 1 Explanation: Altered Amino Acid Sequence or premature Stop Codon formation; Disruption of Gene Expression.	½ ½ 1	2
				Total:	**13**
7	a	i	Altering one of the nucleotides does not allow EcoRI to recognise the recognition sequence and thus not cleave the DNA.	1 1	2
		ii	The DNA of interest may attach at different location on the plasmid.		1
		iii	Single-stranded overhangs only pair with complementary sequences.		1
	b		Forms the phosphodiester bonds between the plasmid DNA and the inserted DNA.	1 1	2
	c		Mention repeated cycles 1. Denaturation 2. Annealing 3. Extension The enzyme Taq polymerase synthesises new strands by adding nucleotides, creating copies of the target gene.	½ ½ ½ ½ 1	3
	d		Rapid and efficient production of human proteins in large quantities. GMOs are easier and cheaper to grow in controlled environments, compared to traditional methods that may involve more complex and costly processes, such as extracting proteins from animal sources. Using microorganisms eliminates the risk of animal-derived diseases.	1 mark each for any two	2
				Total:	**11**

8	a	i	Arrange trophic levels from producers at the base to tertiary consumers at the top. Write the number of individuals for each level: Tertiary Consumers: 10 Secondary Consumers: 100 Primary Consumers: 1000 Producers: 10000 The pyramid should be widest at the base and narrowest at the top, reflecting the decreasing number of organisms at each level.		1
		ii	Tertiary Consumers: 10×10=100 kg Secondary Consumers: 100×5=500 kg Primary Consumers: 1000×2=2000 kg Producers: 10000×0.5=5000 kg The pyramid of biomass should show the largest biomass at the base (producers) and the smallest at the top (tertiary consumers).	1 mark for working 1 mark for values 1	3
		iii	Tertiary Consumers: 10% of 1000=100 kcal Secondary Consumers: 10% of 10000=1000 kcal Primary Consumers: 10% of 100000=10000 kcal Producers: Capture 100000 kcal The pyramid should be widest at the base (producers with the most energy) and narrowest at the top (tertiary consumers with the least energy).	1 mark for working 1 mark for values 1	3
	b	i	Tree → Caterpillars → Birds → Hawk (accept alternatives).		1
		ii	Energy decreases at each trophic level with roughly 10% energy making it to the next level, meaning less energy is available to support organisms at higher levels. Biomass decrease accordingly because each level requires a larger base to support fewer individuals above.	1 1	2
	c	i	Nitrogen-Fixing Bacteria: Convert atmospheric nitrogen (N_2) into ammonia (NH_3) or ammonium ions (NH_4^+). Decomposers: Break down dead organisms and waste products, releasing nitrogen in the form of ammonium ions (NH_4^+) (may include term ammonification). These nitrogen products are then taken by plants and become part of biomolecules.	1 1 1	3
		ii	Proteins / nucleic acids	½ mark each	1
				Total:	**14**

PAPER II

Question			Suggested Answers	Marks distribution	Marks
SECTION A					
1	a		Wildfires darken the landscape, so darker-coloured animals are better camouflaged. Increases survival through altered predator–prey dynamics / reduced predation.	1 1	2
	b		High reproductive rates / short generation times. Accelerates spread and fixation of advantageous alleles.	1 1	2
	c		Wildfires cause habitat fragmentation, leaving isolated patches. Leads to reduced gene flow and increased inbreeding within populations.	1 1	2
	d		Inbreeding increases homozygosity of harmful recessive alleles. Results in reduced fitness / survival (inbreeding depression).	1 1	2
	e		Repeated fires create selection pressure for dark-coloured individuals. Fragmentation reduces genetic mixing, retaining dark-colour alleles. Inbreeding in small populations increases frequency of melanistic alleles.	1 1 1	3
	f		In small, isolated populations, genetic drift may fix non-adaptive traits. Inbreeding increases expression of recessive albino alleles.	1 1	2
	g		Geographical isolation prevents gene flow between populations. Leads to divergent evolution and possible reproductive isolation / speciation.	1 1	2
	h		Sympatric speciation.		1
	i		Succession altered and fire-adapted species become dominant. Biodiversity declines if repeated fires prevent stable communities. Soil nutrients and vegetation structure altered, changing long-term community composition.	1 1 1	3
	j		Wildfires release carbon dioxide stored in vegetation back into the atmosphere.	1	2

			Increased frequency of wildfires elevates greenhouse gas emissions, thereby exacerbating global warming.	1	
	k		Periodic shedding of pollutant-loaded skin reduces bioaccumulation / toxicity of substances. Enhances survival in polluted environments.	1 1	2
	i		Habitat destruction Climate change Other types of pollution such as light and noise	1 mark each for any two	2
				Total:	**25**

SECTION B					
1			**Introduction** • Plant and animal cells are eukaryotic have membrane bound organelles and the genetic material is membrane-bound in a nucleus. • They have similarities and structural differences reflecting their distinct roles in organisms.	½ ½ 1	2
			Similarities - **Shared organelles and their functions:** • **Nucleus and nuclear envelope** Contains genetic material and regulates cellular activities. • **Nucleolus** Produces ribosomal RNA and assembles ribosomes (0.5m). • **Endoplasmic reticulum (smooth and rough**) Rough ER further processes/ modifies proteins; smooth ER synthesizes lipids and detoxifies chemicals. • **80S Ribosomes** Site of protein synthesis. • **Golgi apparatus** Modifies, sorts, and packages proteins and lipids for secretion or internal use. • **Mitochondria** Have a double membrane, with the inner membrane folded into cristae to increase surface area for ATP production through oxidative phosphorylation.	½ ½ ½ ½ ½ ½ ½ ½ ½ ½ ½ ½	11

			• The matrix contains enzymes for the Krebs cycle and mitochondrial DNA, allowing independent protein synthesis essential for cellular respiration. • **Cell membrane** selective permeability • **Cytoskeleton** Provides structural support, enables intracellular transport, and assists in cell division. • **Peroxisomes** Found in both plant and animal cells, play a crucial role in oxidative metabolism. • **Cytoplasm** Site of chemical reactions/holds organelles/shape and support/storage of molecules.	½ ½ ½ ½ ½ ½ ½ ½ ½ ½	
			Differences • **Cell wall:** Found in plant cells, made up of cellulose; absent in animal cells. Provides structural support and shape in plant cells • **Chloroplasts**: Found in plant cells; absent in animal cells. Contain chlorophyll which absorbs light energy and changes it to chemical energy and is used in photosynthesis Chloroplasts are surrounded by a double membrane and contain thylakoid membranes arranged in stacks called grana, which increase the surface area for light absorption during photosynthesis. The stroma contains enzymes for the Calvin cycle and DNA for protein synthesis, enabling the chloroplast to function autonomously. • **Centrioles and basal bodies**: Found in animal cells; generally, absent in plant cells. Involved in organizing microtubules during cell division and forming the basis of cilia and flagella.	 ½ ½ ½ ½ ½ ½ ½ ½ ½ ½ ½ ½ ½	11

			• **Large central vacuole**: Found in plant cells; small or absent in animal cells. Maintains cell turgor and stores nutrients and waste products. • **Lysosomes**: Mostly found in animal cells; needed for cellular break down of waste; less common in plant cells. • **Storage products / granules:** Starch in plant cells versus glycogen in animal cells. • **Intercellular connections** Plasmodesmata in plant cells versus tight junctions in animal cells	½ ½ ½ ½ ½ ½ ½ ½ ½	
			Conclusion Summary of similarities and differences		1
2			Introduction: • **Population:** A group of organisms belonging to the same species inhabiting the same area at the same time. • **Density-dependent factors:** Factors whose effects on population size intensify as the population density increases. • **Density-independent factors:** • Factors that impact populations regardless of their density. • **Limiting factors:** Factors that constrain a population's size and slows or stops it from growing. • **Carrying capacity:** the maximum population size an ecosystem can sustain.	½ ½ ½ ½ ½ ½ ½ ½ ½	5
			Density-Dependent Limiting Factors and population regulation Factors and explanation such as (but not limited to): • **Competition** for food, space, and mates (inter-specific and intraspecific). • **Predation**: how predator-prey interactions influence population size. • **Disease**: how higher population densities lead to increased disease transmission.	½ for mentioning factor 1 mark for explanation	

			• **Parasitism**: Higher population densities provide more hosts, allowing parasites to reproduce and infect more organisms. • **Territoriality**: as population density rises, individuals may compete • **Overcrowding**: may affect birth rate because of stress; • stress results in the following features which all reduce population size: lowering reproductive rate / slower growth/ reduced resistance to disease / reduced parental care / young abandon the nest at an early stage, with consequent reduction in chances for survival/ cannibalism of young.		
			Overview on the impact on population regulation and size • Reducing individual survival and reproduction rates. • Help stabilise population size by limiting growth when resources are scarce or competition is high. • Prevent populations from growing beyond the carrying capacity of the environment. Growth graph: sigmoid curve		4
			Density-Independent Limiting Factors and population regulation Factors and explanation such as (but not limited to): • **Weather events**: extreme weather, such as storms or droughts. • **Natural disasters**: wildfires, floods, earthquakes. **Climate change**: temperature fluctuations or sea-level rise affect ecosystems.	½ for mentioning factor 1 mark for explanation	
			Overview on the impact on population regulation • Can cause sudden population crashes or shifts, drastically altering the ecosystem's balance. • Graph: Boom and bust While they are not dependent on population density, they can influence carrying capacity by reducing available resources or altering environmental conditions that sustain life.		3
			Adequate concluding remarks.		1

3			**Introduction** • Function of the immune system: The immune system's role in protecting the body from pathogens. • The innate immune system: Innate immunity includes the first and second lines of defence, which are non-specific and non-adaptive – does not differentiate between different invaders.	1 1	2
			First Line of Defence Passive mechanism: prevents entry of pathogens		1
			Physical and Chemical Barriers <u>Skin:</u> • Physical barrier: The skin has an outer keratinised layer which acts as a tough, waterproof barrier that prevents pathogen entry. • Chemical barrier: Secretions like sweat and sebum create an acidic environment that inhibits pathogen growth. • Mechanical barrier: Constant shedding of skin cells (desquamation) removes potential pathogens.	1 mark each for any two	2
			<u>Mucus:</u> • Mucus traps pathogens in respiratory, digestive, and urogenital tracts. • Cilia in the respiratory tract help move trapped pathogens out by coughing, sneezing or swallowing. <u>Antimicrobial Secretions:</u> • Lysozyme in tears, saliva, and mucus breaks down bacterial cell walls; is bactericidal for many Gram-positive bacteria. • Stomach acid and proteases destroy ingested pathogens or mention of acid in vagina. • Commensal microorganisms (compete with pathogens)	1 mark each for any four	4
			Second Line of Defence: Cellular and Molecular Defences Active mechanism – destroys pathogens that entered the body		1
			<u>Inflammatory Response:</u> • It is a set of local cellular and vascular responses to tissue damage or infection which accelerates destruction and phagocytic removal of pathogens and debris. • Tissue macrophages near the site of invasion, become mobile and phagocytically active; local	1 mark each	6

			macrophages are reinforced by the migration of blood neutrophils and monocytes into the region attracted by chemotaxis. • Neutrophils- rapid response to infection, engulf and digest pathogens via phagocytosis. • Monocytes- develop into macrophages when they enter tissues, acting as long-term defenders by engulfing and digesting pathogens. • Basophils and mast cells release histamine which acts as a vasodilator, thus increasing blood flow, causing redness and raising the temperature locally. • There is increased capillary permeability, causing oedema. Plasma proteins also leak out so that a meshwork of fibrin clot is laid down to provide mechanical barrier to the spread of infection.		
			<u>Natural Killer Cells (NKCs):</u> Function: • NKCs target and kill virus-infected cells and cancer cells. They release cytotoxic chemicals (e.g., perforin and granzymes) that cause cell lysis. Cytokines • Signalling proteins produced by macrophages and NKC amongst others, regulate immune responses, including inflammation and the recruitment of immune cells to sites of infection.	1 mark each	2
			<u>Complement Proteins:</u> • Activation of the complement cascade system of plasma proteins. (Functions) some attract phagocytes by chemotaxis some are involved in opsonisation some punch holes in the cell surface membranes of bacteria, causing these cells to swell and burst, some promote inflammation agglutination • Blood Clotting (Major Stages) Vasoconstriction: Blood vessels constrict to reduce blood loss. Platelet Plug Formation: Platelets aggregate at the site of injury, forming a temporary plug. Coagulation: Activation of clotting factors leads to the formation of fibrin threads that stabilize the clot.	1 ½ mark each for any four 1 1	6

			Conclusion Emphasize how these mechanisms work together to prevent infection and promote healing or any other adequate concluding remarks.	1	
4			**Introduction.** Explanation of what mass flow systems are which should include mention to circulatory systems. Mention of the components of a circulatory system, that is pump, vessel and transporting medium.	 1 1	2
			Mention of the transition from open to closed circulatory systems. Mention of the transition from single to double circulatory systems. Mention made to the inability of simple diffusion to accommodate the requirements of multicellular organisms.	1 1 1	3
			Circulation in insects. Defined as an open circulatory system. Presence of dorsal vessel (tubular heart) that pumps blood (haemolymph) in one direction towards the body (may include diagram to represent this). Mixing of blood (haemolymph) Presence of a haemocoel and its limitations: Loss of pressure. Loss of blood (haemolymph) when damaged. Loss of transporting medium directionality.	 1 1 1 1 1 1	6
			Circulation in fish. Defined as a closed single circulatory system. Presence of one heart that is responsible for the generation of pressure. Mention of deoxygenated blood is present within the heart. Heart has only one atrium and one ventricle and thus generated pressure may be limited (may include diagram to represent this) Mention of blood moving first to the gills and then the rest of the body. Blood is enclosed so pressure is more contained than in insects. Pressure is the main limiting factor that does not enable an increase in size or increase in activity.	 1 1 1 1 1 1 1	7

			Circulation in mammals Defined as a closed double circulatory system. Presence of a quadruple chambered heart (may include diagram to represent this) Mention of both oxygenated and deoxygenated blood present within the heart. Mention of blood direction and its prevention of backflow. Remark on the musculature of the heart and its ability to generate pressure. Comment on the necessity of a double circulatory system in relation to pressure difference.	1 1 1 1 1 1	6
			Conclusion Explanation as to why such exhibited circulatory features do allow for an increase in body size when compared with others or any other adequate concluding remarks.		1
				Total:	**50**

SECTION C					
1	a		Mention of circular muscles and their orientation within earthworms. Mention of longitudinal muscles and their orientation within earthworms. Explanation of relationship between contraction and relaxation of both muscles. The relationship of the substratum texture and aid it gives to muscular motion.	1 1 2 1	**5**
	b		Composition of exoskeleton that creates rigidity (chitin must be mentioned). Explanation as to how such rigidity is needed for movement (mention of anchorage is necessary). Explanation of how the exoskeleton supports the lever motion of insect muscles. Reference to parts of the jointed appendages and flexible cuticle at joints that are not covered by an exoskeleton. Link should be made to articulation.	1 2 1 1	5
	c		Explanation of the function of tendons in mammals. Mention of origin and insertion. Explanation of how origin and insertion work when muscle contraction to move bone. Explanation of how origin and insertion work when muscle relaxes.	1 1 2 1	5

	d		Mention of aerobic respiration yielding ATP to allow for muscle contraction. Explanation of how ATP is used by myosin to create cross bridges to include: • Power stroke – release of ADP + P • Detachment of myosin head via ATP • Hydrolysis of ATP Explanation of state of muscle contraction when ATP is not present; inability for myosin to detach from actin.	1 1 1 1 1	5
	e		Explanation of the composition of spongy bone. Explanation of the composition of compact bone. Reference to the need of compact bone to act as solid anchor for forces to act upon. Reference to the need of spongy bone to dampen the weight of bone and how this allows for better movement. Mention of ramification if one of these components is absent.	1 1 1 1 1	5
				Total:	**25**
2	a		Explanation of the term genetic diversity (link to chromosomes is necessary). Explanation of how genetic diversity happens during meiosis. • Crossing over (chiasmata formation is necessary) • Random alignment Independent assortment	1 2 1 1	5
	b		Explanation of what type of anomalies that may occur during gamete formation (base mutations and chromosomal mutations). Mention of how reduction divisions lack mechanisms that double check chromosomal numbers. Mention that gametes still form with an abnormal number of chromosomes or base pair errors. Example to support the above argument.	1 1 1 2	5
	c		Explanation of what FSH and LH and their site of production (anterior pituitary). In males FSH: act on Sertoli cells to signal the beginning of spermatogenesis. LH: act on Leydig cells to stimulate testosterone production.	1 1 1	5

			In females. FSH: help with the maturation of follicle cells. LH: induces the release of the gamete into the reproductive system.	 1 1	
	d		Definition of what hCG is and its role in foetal development. Mention of the source of production (placenta). Explanation of its concentration levels in the early stages of pregnancy and the vital importance of such. Mention of why progesterone is not a good indicative of early pregnancy (link with the longevity of the corpus luteum is necessary), or that there could be other factors that influence progesterone level.	2 1 1 1	5
	e		Mention that mitochondria have their own DNA independent from their hosts' DNA. Mention the acrosome reaction and that sperm mitochondria degrade. Explanation of why mitochondria are not transferred to the female gamete. Mention that maternal mitochondrial DNA is the only passed down mtDNA and thus can be used to trace maternal lineages.	1 2 1 1	5
				Total:	**25**

PAPER III

Question			Suggested Answers	Marks distribution	Marks
1	a		Figure 1 Tracheophyta / Polypodiophyta Sporophyte Figure 2 Bryophyta Gametophyte Figure 3 Tracheophyta / Magnoliophyta Sporophyte Figure 4 Tracheophyta / Magnoliophyta Sporophyte	**1** **½** **1** **½** **1** **½** **1** **½**	6
	b	i	Monoecious – as both male and female sex organs are present (bisexual plants)	½ ½	1
		ii	actinomorphic – radial symmetry	½ each	1
		iii	Dicot – floral parts multiple of 4	½ each	1
		iv		1 1	2
				Total:	**11**

2	a	i	A Upper epidermis B Palisade parenchyma C Aerenchyma D Lower epidermis	½ mark each	2
		ii	Stomata only on the upper epidermis Large air spaces in the mesophyll provide buoyancy.	½ for each mention 1 mark for explanation	3
	b	i	E Hairs / trichomes F Waxy cuticle G Guard cells H Xylem	½ mark each	2
		ii	Label E: To keep high humidity within the leaf; lower rate of transpiration Label F: To lower permeability of leaf surface to lower rate of transpiration Label G: guard cells / stomata in crypt to lower rate of transpiration	1 1 1	3
		iii	Thick outer cuticle: lower rate of transpiration / accept rolled leaves and hinge cells / needle like shape		2
	c	i	Wind / light intensity / humidity in room – as these factors influence the rate of hotosynthesis	1 mark each for any two 1	3
		ii	Cuticle thickness or chemical composition of cuticle		1
		iii	Low permeable cuticle = lower rate of transpiration		1
		iv	Cacti live in dry environment, so thick cuticle lowers rate of transpiration		1
		v	Different number of stomata and explain	1 1	2
				Total:	**20**
3	a	i	Male: DdEe Female: DdEe		1
		ii	9:3:3:1		1
		iii	45:15:15:5	1 mark for working 1 mark for answer	2
		iv	That the alleles assort independently		1
		v	$(48-45)^2 / 45 = 0.200$ $(9-15)^2 / 15 = 2.400$ $(16-15)^2 / 15 = 0.067$ $(7-5)^2 / 5 = 0.800$ 3.467	1 1 1 1 1	5
		vi	3		1

		vii	Not significant, P value obtained lower than critical value; most likely as the genes assort independently then they occur on different chromosomes	1 1 1	3
	b	i	Hear threat coming, e.g hunters or other predators		1
		ii	Dependent on genotype of parents Suitable male genotypes ddEe Suitable female genotypes DDEe or DdEe Highlighting the right combinations produce SOME offspring with dark fur long ears Mention that some genotypes (may include examples but not necessary) are not suitable as they will never produce offspring with the mentioned characteristics	1 ½ ½ ½ ½ 1	4
				Total:	**19**

IV - Practical

Question			Suggested Answers	Marks distribution	Marks
1	a		Foam produced due CO_2, the faster it is produced the higher the metabolic activity.	½ ½	1
	b		Concentration of substrate influences rate so only one variable that is the sugar is present is to be tested	½ ½	1
	c		Different disaccharides have different structures and different glycosidic bond; enzymes have specific active sites Mentioning of specific glycosidic bonds or for the mention of specific enzymes associated with such breakdown.	½ ½ ½ ½	2
	d		Place 5 ml sugar solution in test tube and add a levelled spoon of yeast Mix/shake tube contents to produce a homogeneous mixture and allow to stand Mark the initial starting point Check how much foam was produced after a given time / or time taken to reach a given point Repeat the above for all sugars Mix same amounts and same mixing/shaking each time Repeat the experiment using only distilled water instead of sugar solution as control Repeat each experiment at least two times	1 1 1 2 1 1 1 1	10

			Experimental procedure explained in a clear and scientific way	1	
	e		Levelled teaspoon of yeast for equal amounts Yeast was added at the same time Sugars were siphoned with a syringe and then added at the same time Test-tube handled slowly not to disturb foam Test-tube held from the top to minimise changes in temperature Same time allocated to each reaction for fairness	1 mark each precaution 1 mark each justification	2 2
	f		Clearly constructed table Clear labels Inclusion of control in the table Columns including results obtained (we are expecting this to be height of froth produced; but cannot exclude for example time taken to reach let say 5 cm height) Duplication of results Average of results	1 1 1 1 1 1	6
	g		Bar graph; The graph should show type of sugar on the x-axis against height of foam on the y-axis (or maybe rate as 1/t for time taken to reach a given height, accept alternatives) Appropriate scale Title according to their plot Appropriate use of axis (dependent and independent) Appropriate labelling of y-axis and units Appropriate labelling of x-axis and units Correct plotting (according to the results table)	1½ ½ ½ ½ ½ + ½ ½ + ½ 1	6
	h		Fastest sucrose Slower maltose No fermentation lactose (same as control)	½ ½ 1	2
	i		No substrate presents no fermentation in control Yeast does not produce lactase to digest lactose Yeast has higher concentration of invertase to digest sucrose or invertase acts faster Yeast has lower concentration of maltase or maltase acts slower	1 1 1 1	4
	j		Breaking sucrose outside the cell produces monosaccharides that are easily absorbed and quickly fermented or metabolised within the cell	1	2

			Since sucrose is broken within the cell, then yeast needs to take up maltose, which may be a slower process	1	
	k		Temperature fluctuations pH fluctuations Foam does not produce an exact measurable quantity/bubbles may pop Some CO_2 may not be trapped in bubbles and escape, thus not contributing to formation of froth Yeast is a living organism, so behaviour may vary between samples		2
				Total:	**40**