

2024 Sec 4 Express Biology Prelim (6093)
Marking Scheme

Paper 1

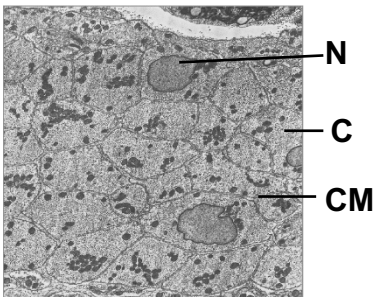
1	2	3	4	5	6	7	8	9	10
B	B	B	D	A	A	C	C	B	C

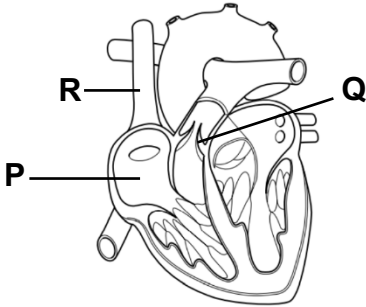
11	12	13	14	15	16	17	18	19	20
C	D	D	A	D	B	B	C	D	B

21	22	23	24	25	26	27	28	29	30
A	A	A	C	B	C	C	C	D	B

31	32	33	34	35	36	37	38	39	40
A	C	D	A	C	D	B	D	C	C

Paper 2
Section A

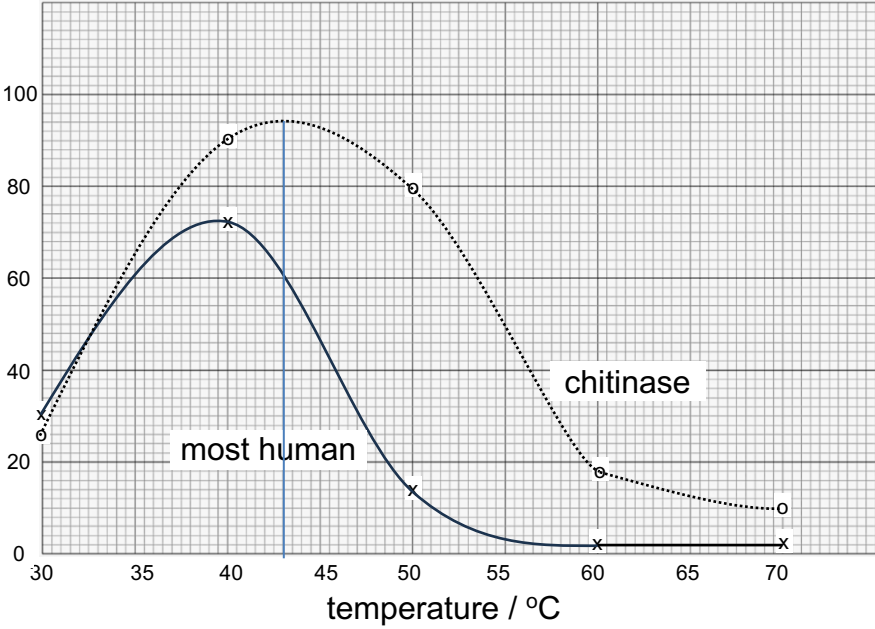
1	a	Accept any of nucleus (N), cytoplasm (C) or cell membrane (CM) 	1
	b i	Circular muscles contract and relax in a rhythmic wave-like motion to push food down the small intestine;	1
	b ii	More mitochondria allow more energy to be released via higher rate of aerobic respiration;	1
	c	Any organs with circular muscles; e.g Stomach OR oesophagus OR large intestine OR Eye OR rectum R: small intestine, duodenum, jejunum	1
	d i	Red blood cell OR muscle cells OR any acceptable answers R: root hair cell	1
		Red blood cell: - Contain <u>haemoglobin</u> to <u>carry oxygen molecules</u>; <u>Lack nucleus</u> to allow <u>more volume/space</u> to contain <u>haemoglobin</u>; <u>Circular biconcave shape</u> to allow <u>larger surface: volume ratio</u>; <u>Flexible</u> and able to <u>squeeze through blood capillaries</u> OR	2

		Muscle cell: - Has <u>many mitochondria</u> to <u>generate energy through aerobic respiration</u>; - Has <u>many nucleic</u> to <u>increase protein synthesis</u>; Any acceptable specialised cells like nerve, liver, heart, etc are accepted with correct adaptations	
2	a	Carbohydrate: - Immediate source or energy OR energy storage as glycogen; Fats: - Energy storage; - Insulation (of heat) - Protection of vital organs against physical injury; - Main component of membrane; Any 2 points, one from each carbohydrate and fats.	2
	b	- Mix a portion of the man's meal with water and decant; - Using 2 cm³ of the decanted solution, add 2 cm³ of biuret solution and mix - If protein is present, mixture will turn violet otherwise mixture will remain blue;	3
	c i	- Person may not have enough insulin in his body; - To stimulate liver to convert the excess glucose to store as glycogen;	2
	c ii	Insulin can be digested by enzymes/protease OR insulin structure affected by pH. R: insulin cannot be absorbed	1
3	a	 All labelled correctly - 2 marks, Any 1 or 2 labelled correctly – 1 mark	2
	b	- Blood <u>circulates heart twice</u> via pulmonary circulation and the systemic circulation; - In pulmonary circulation, deoxygenated <u>blood</u> is <u>carried from heart to lungs</u> to be oxygenated and then <u>back to the heart</u>; - In systemic circulation, oxygenated <u>blood</u> is pumped <u>from the heart to the rest of the body</u> and deoxygenated blood is carried back to the heart; Any 2 points	2
	c i	Coronary arteries	1

	ii	- Heart tissue/cells will receive less oxygen and glucose and will - Less respiration occurring, releasing less energy, cells die and person may suffer heart attack;	2
	iii	Either: smoking OR age OR sedentary lifestyle OR genetics OR unhealthy diet; Any 2 of the above.	2
4	a	Aerobic respiration (R: respiration)	1
	b i	At 20th minute	1
	b ii	2%	1
	c	- Decreasing oxygen level in the seal's body will reduce the rate of aerobic respiration; - Seal muscle cells will start to undergo anaerobic respiration;	2
	c	- Lactic acid amount will decrease; - Lactic acid is sent to the seal's liver to be converted to glucose;	2
5	a	- High temperature / heat stimulate the receptors to generate nerve impulses sent to the spinal cord by sensory neurone, Z - Sensory neurons transmit nerve impulse to relay neurone, Y via a chemical synapse and from relay neurone to motor neurone, X via another chemical synapse - Motor neurons transmit nerve impulse to effect, the muscles which will contract to withdraw the hand from the hot object.	3
	b	- Person will still be able to feel the heat but will not be able to move hand away immediately/involuntarily/via reflex - Sensory neurone is able to transmit nerve impulse to spinal cord for it to be transmitted to brain to sense the pain	2
	c	Similarity: - Both the nervous and hormonal systems play crucial roles in regulate functions such - maintain homeostasis; - Respond to stimuli; Differences (nervous vs hormonal): - Relatively fast vs slow; - Short lived vs long lived; - Transported by neurone vs blood; - Nerve impulses vs hormone; - Usually localised vs usually more than one target organ; - Can be voluntary/involuntary vs definitely involuntary; One answer from similarity and one answer from any of the differences.	2
6	a	- K: burning OR combustion (of fossil fuels); - L: respiration; - M: photosynthesis;	3
	b	Ocean OR any acceptable source of carbon sink	1

	c	- Burning of fossil fuel leads to increase in carbon dioxide level; - The accumulation of greenhouse gases in the atmosphere traps more heat and leading to an increase in global temperatures/global warming	2
	(d)	- Prevent extinction AND - Prevent disruption to carbon cycles - e.g of preventing greenhouse gases from increasing (CO² or otherwise is accepted) R: population control (food chain/web) or any non biodiversity/ecosystem related answers.	
7	a	Restriction enzyme;	1
	b i	<u>Both the plasmid vector and the gene of interest/target gene</u> are treated with the <u>same</u> restriction enzyme(s) to form complementary sticky ends <u>DNA ligase</u> is used to seal up the plasmid with the gene of interest/target gene; R: ligase	2
	b ii	- Recombinant plasmid are introduced into cotton plant cells via <u>heat/electrical shock</u>; - Cotton plants with <u>recombinant plasmid are transformed</u> and will produce the toxic protein;	2
	c	- New protein in GM food might cause allergy; - GM plant seeds cannot germinate; - Animals are used in research; - Possible biological warfare; - Antibiotic resistant bacteria; - Selective individuals having the benefits; R: religious, safety, personal concerns	2
8	a	<u>Abnormal cilia cannot move mucus</u> containing pathogens from the <u>respiratory tract</u>; <u>Pathogens</u> (examples accepted) in the mucus multiply and cause infection in the respiratory tract;	2
	b	- Dd; - Individual 13/child of 6 is affected/homozygous recessive, would have inherited one recessive allele from 6. Since 6 is normal, 6 must have one dominant allele. OR - Individual 1 / parent of 6 is homozygous recessive, would have passed the recessive allele to 6	2
	c i	- Genotype of parents: Dd x Dd; - Gametes: D, d, D, d (all circled); - Genotype of offspring: DD, Dd, Dd, Dd; - Phenotype of offspring: Normal, carrier, affected; 3 marks for all rows correct, 2 marks for three rows correct, 1 mark for one/two rows correct;	3
	c ii	- Probability of child getting PCD = $\frac{1}{4}$ OR 25% - Probability of child being female = $\frac{1}{2}$ OR 50%	2

		Hence probability of child being female with PCD = $\frac{1}{2} \times \frac{1}{4} = \underline{\frac{1}{8}}$ OR <u>12.5%</u> OR <u>0.125</u> NO ECF if ci answers are wrong.	
	c iii	Having PCD <u>does not cause individual to die</u>, can still give rise to offsprings having the recessive allele for PCD; OR exist as <u>carriers</u> to pass on the allele;	1

9	a	 relative enzyme activity / % temperature / °C chitinase most human • Line (L) – line/curve accepted + identify chitinase/most human either by labelling or including a key; • Axes (A) – labelled and correct orientation + all interval labelled; • Scale (S) – occupy at least 70% of grid + no ODD scale (1.5 box etc) • Points – all plotted correctly	4
	b	• Based on student's graph;	1
	c	• Some of the enzyme are starting to denature and can no longer bind to substrate	1
	d	• Higher optimal temperature for chitinase than most human enzyme + QV • Higher activity for most human enzyme at 25 °C; • Some enzymes are still functioning at high temperature (70-80 °C); + QV Any 2 points OR any valid points stated;	2
	e	• <u>Breaks down dead organic matter</u> and return the <u>nutrients to be used by other organisms (example plants)</u>; • <u>carbon dioxide is released</u> during the breaking down of dead matter and <u>returned to the atmosphere</u>;	2

Section B			
10	a	• Photosynthesis converts light energy from the sun into chemical energy in the form of glucose that is consumed by other organisms along the food chain • Photosynthesis produces oxygen as a byproduct. All aerobic organisms, including humans, rely on oxygen for cellular respiration, a process that releases energy from glucose. • Photosynthesis absorbs carbon dioxide (CO₂) from the atmosphere. This helps regulate atmospheric CO₂ levels, which is crucial for maintaining Earth's climate and preventing extreme greenhouse effects/ global warming • Photosynthesis is a vital component of the carbon cycle, balancing carbon among the atmosphere, biosphere, and geosphere.	3
	b	• During day time when photosynthesis is occurring, stomata is open so that carbon dioxide can enter • Water vapour in the leaf will diffuse out of the leaf into atmosphere via opened stomata	2
	c i	• As wind speed increases from 0 to 30 km/hr, rate of transpiration increases from 5 to 25 au • Increase in wind speed blows the water vapour away from the leaves, increasing water vapour concentration gradient between atmosphere and intercellular air spaces • More water vapour will diffuse out of the leave per unit time / rate of diffusion of water vapour out of leave decreases • As wind speed increases from 30 to 40 km/hr, rate of transpiration decreases from 25 to 10 au • Rate of transpiration / water loss is greater than rate of water absorption/water uptake, stomata will close to prevent excessive loss of water	4
	c ii	• Temperature, light intensity, stomata density, air pressure, humidity; Any 2 for 1 mark	1
11	a	• Condition that <u>causes body to function less effectively</u>; • Can be <u>spread from person to person</u> through various means;	2
	b i	• Prevention: one sexual partner or abstain from sexual intercourse + QV to justify OR • male wear condom + QV to justify OR • don't share instruments that are likely to break the skin + QV to justify OR • go to reliable operators if require services that involve needles + QV to justify OR	3

	b ii	• HIV remained <u>dormant in infected person</u> without symptoms or signs; • Infected person may not be diagnosed immediately hence not knowing true reason of being infected; • Any reasonable explanations;	3
	c	• Affects cell wall (osmotic pressure causing cell to burst) but viruses have not cell wall • Affects ribosomes, inhibit protein synthesis but viruses have no ribosomes • Affects cell membrane (unable to regulate movement of substances) but viruses have no cell membrane • Affects production of nutrients/enzyme (e.g folic acid) but viruses cannot produce nutrients/enzymes	3

END OF PAPER