Markscheme

(paper 1B HL)

Question			Answers	Notes	Total
1	a		• *Haplochromis obliquidens* is a keystone species; • Its removal leads to a significant decrease in biodiversity; • When present, species richness is maintained OR increased with time;	Award one mark for answer and one mark for reasoning.	2
	b	i	• $Total\ population = M \times \frac{N}{R} = 71 \times \frac{139}{15}$; • $\approx 657.933 = \mathbf{658;}$	Accept 657.	2
		ii	• The population is closed (no immigration/emigration, births, or deaths); • Marking does not affect the animal's survival or behavior; • No loss of marks between captures; • Equal chance of capture for all individuals; • Complete mixing occurs between release and recapture;	Accept any valid assumption.	1
		iii	• Fewer marked individuals will survive and be recaptured; • Resulting in an overestimation of the population size;		2
	c		• Long-term **decrease** in dissolved oxygen levels; • *H. obliquidens* eat algae → their removal causes algal overgrowth → leads to eutrophication → increased decomposition → (Increased BOD) → oxygen depletion;	Answer in brackets is not necessary to earn marks. BOD = Biochemical oxygen demand	2

2	a	i	• To provide a baseline/comparison;		1
		ii	• Increased/uncontrolled cell division; • Trp53 is a tumor suppressor gene that normally halts cell division or induces apoptosis in damaged cells;	Accept mark only if answer is supported with correct reasoning.	1
	b		• A successful knockout is indicated by the absence of a DNA band in the knockout sample compared to the wild-type; OR • DNA band in the knockout sample is replaced by a distinct band representing the altered knockout allele;	Accept replacement of the allele during knockout rather than just deletion.	1
	c	i	• Individuals with the edited disease resistance gene survive/reproduce more; • With time, there is an increased beneficial allele frequency in the population;		2
		ii	• **Off-target effects** (altering genes not intended for editing) – changes could accumulate and disrupt important biological functions/traits; • **Ecological imbalance** – Gene-edited individuals may outcompete others, or change predator–prey dynamics, leading to loss of other species or collapse of existing food webs; • **Gene spread to other species** (through interbreeding or horizontal gene transfer) – cause unintended evolutionary changes in non-target species; • **Reduced genetic diversity** – reducing ability of population to adapt to environmental changes, increasing risk of extinction;	Explanation is not necessary to earn marks. Exact wording not required to earn marks.	2

	d			Answers do not need to be presented in a table format. Award one mark for each correct row. Allow a maximum of 2 marks for advantages and a maximum of 2 marks for disadvantages.	4

	CRISPR	Selective Breeding
Advantages	Highly precise;	More accepted;
	Fast;	Less risks of unintended genetic effects;
	Allows to add genes which are not present in the population;	Preserves natural selection mechanism;
Diadvantages	Ethical concerns;	Slow (may require multiple generations);
	Risk of off-target mutations;	Less precise;
	Requires advanced lab technology and expertise;	Can inadvertently select for harmful linked traits;

3	a		• DNA (Deoxyribonucleic Acid);	Accept ^{32}P-labeled DNA	1
	b		• Carbon is in both proteins and DNA; • Radioactive carbon wouldn't allow the macromolecules to be distinguished (cannot know whether protein or DNA entered);		2
	c	i	• False;		1
		ii	• Viruses lack ribosomes and enzymes for replication; • They rely on host's cellular machinery to reproduce;		2

4	a	i	• $\frac{28-62}{62} \times 100 = \frac{-34}{62} \times 100 \approx -54.8\%$; • The membrane fluidity decreased by 54.8% when the desaturase inhibitor is added at 5℃;	Working is necessary to earn full marks. Accept any answer between -54 and -55.	2
		ii	• Double bonds cause kinks that prevent phospholipids from forming hydrogen bonds and packing closely together;		1
	b	i	• The arctic species phospholipid movement is higher than in the temperate species at 5 °C (with 62% of movement in arctic species and only 33% in the temperate species);		1
		ii	• Arctic species may contain more / more active / higher expression of fatty acid desaturase enzymes compared to temperate species;	Award point for any valid deduction.	1
		iii	• Allows arctic species to be better adapted to cold temperatures as their membranes do not loose fluidity as significantly when exposed to colder temperatures; • Cell membranes are able to retain membrane function (e.g., transport, enzyme activity) in arctic species in cold environments;		1
	c		• At low temperatures, the addition of cholesterol increases membrane fluidity; • The cholesterol prevents the tight packing of phospholipids, thus allowing more movement;	Point earned for correct effect of fluidity and explanation.	1
	d		**Phagocytosis (Endocytosis)** • Fluidity allows the macrophage membrane to extend around and engulf pathogens via endocytosis; **Ameboid movement** • Membrane fluidity is needed to form extended sections of their plasma membrane to squeeze through capillaries to enter and leave body tissue; **Exocytosis** • The release of signaling molecules (cytokines) requires fluidity of the membrane to fuse an intracellular vesicle to the plasma membrane, causing their release to act on neighboring cells and assist in the immune response;	Accept any valid reason with correct explanation for both marks.	2