Biology

Standard level

Paper 2

Markscheme

Question	Acceptable Answers	Notes	Marks
1 a)	Macrophage(s) **OR** phagocyte(s) ✔	Must specify immune cell type	1
1 b)	- Binds specifically to CD20 antigen on B-cells ✔ - Antibody's Fc region interacts with Fcγ receptors ✔		2
1 c)	- Chemo affects all dividing cells (non-specific) ✔ - ADCP targets only antigen-positive cells ✔	Comparison required	2
1 d)	- Binds antibody Fc region ✔ AND - Triggers phagocytosis **OR** signals engulfment ✔		2
1 e)	- Rituximab cannot bind ✔ - Treatment fails **OR** no ADCP occurs ✔		2
1 f)	- Innate: Macrophages perform destruction ✔ - Adaptive: Antibodies provide specificity ✔		2
1 g)	- Antigen presentation via MHC II ✔ - T-cell activation **OR** immune response initiation ✔		2
1 h)	- PRR recognition **OR** antibody binding ✔ - Opsonization enhances binding ✔		2

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2 a) (i)	Gonadotropin-releasing hormone (GnRH) ✔	Must specify hormone class/name	1
2 a) (ii)	Prevents natural ovulation **OR** allows controlled ovarian stimulation ✔		1
2 b)	Follicle-stimulating hormone (FSH) ✔		1
2 c)	- Human chorionic gonadotropin (hCG) ✔		1

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3 a) (i)	47 ✔	Must be an exact count	1
3 a) (ii)	Non-disjunction in meiosis I **OR** meiosis II ✔	Either division accepted	1
3 a) (iii)	Down syndrome ✔		1
3 b)	Amniocentesis **OR** chorionic villus sampling (CVS) ✔		1

Question	Acceptable Answers	Notes	Marks
4 a)	Small ribosomal subunit **OR** A-site/P-site (accept "ribosomal binding site") ✔	Must specify location	1
4 b) (i)	Codons on mRNA are read in sequence **OR** each codon codes for a specific amino acid ✔	Must link codons to amino acids	1

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4 b) (ii)	- Carries specific amino acids ✔ - Anticodon binds to complementary mRNA codon ✔	Both parts required	2
4 c)	Allows peptide bond formation between amino acids **OR** ensures correct positioning for elongation ✔		1

Question	Acceptable Answers	Notes	Marks
5 a)	Energy is lost as heat (respiration) **OR** not all biomass is consumed/digested **OR** metabolic waste (e.g., feces, urine) ✔	Must specify **one** valid energy loss pathway	1
5 b)	Fewer organisms at lower trophic levels **OR** ecosystem instability **OR** possible collapse of lower levels ✔		1
5 c)	- Less biomass due to energy loss (10% rule) ✔ - Higher energy per unit mass (more lipids/proteins) ✔		2

Question	Acceptable Answers	Notes	Marks
6 a)	Plants compete for light (shading), water (root growth), or nutrients (soil uptake) **OR**	Must specify **one** resource and its competitive consequence	1

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	survival/reproduction reduced for less competitive individuals ✔		
6 b)	- Allelopathy (chemical inhibition of competitors) **OR** - Root grafting (resource sharing) **OR** - Canopy partitioning (light optimization) ✔		1
6 c)	- Extend root surface area for nutrient/water uptake **OR** - Exchange nutrients (e.g., P, N) for plant carbohydrates **OR** - Enhance drought/pathogen resistance ✔	Must link fungal function to plant benefit	1

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7 a	- **Receptors** bind specific ligands (e.g., hormones, neurotransmitters) ✔. - Binding induces **conformational change** in receptor ✔. - Triggers **intracellular response** (e.g., signal transduction, gene expression) ✔.		3
7 b	- **Example**: Quorum sensing in *Vibrio fischeri* using autoinducers ✔. - **Significance**: Coordinates bioluminescence or biofilm formation ✔. **OR** - **Chemotaxis** in *E. coli* via attractant binding to membrane receptors ✔.	Award 1 for example, 1 for significance.	2

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	- **Significance**: Directs movement toward nutrients ✔.		
7 c	**Similarities**: Both are ligands; bind to receptors; mediate communication (1 max). **Differences**: - **Hormones**: Slow, long-distance (endocrine); e.g., insulin ✔. - **Neurotransmitters**: Fast, synaptic; e.g., acetylcholine ✔. **OR** - **Transport**: Hormones via blood; neurotransmitters via synaptic cleft ✔.	2 marks for similarity and 2 for difference	4
7 d	**Examples**: 1. **Insulin** (peptide hormone) ✔. 2. **Testosterone** (steroid hormone) ✔. 3. **Nitric oxide** (gas signaling molecule) ✔. **OR** - Cytokine OR Glucagon **Reasons**: **- Diverse solubility** (hydrophilic vs. hydrophobic ligands) ✔. - **Specificity** for target cells ✔. - **Variable persistence** (rapid vs. sustained signals) ✔.	Award 1 per example (max 3) + 1 per reason (max 3)	6

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8 a	1. **Skin**: Physical barrier ✔. 2. **Mucous membranes**: Trap pathogens **OR** secrete antimicrobial enzymes ✔. 3. **Mechanisms**: Cilia	Accept any combination totaling 2 distinct points.	2

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	movement **OR** lysozyme action **OR** acidic pH ✔.		
8 b	1. **Recognition**: Binds PAMPs via TLRs ✔. 2. **Engulfment**: Phagosome formation ✔. 3. **Destruction**: Lysosomal enzymes **OR** respiratory burst ✔. 4. **Presentation**: Antigens displayed on MHC-II ✔.		4
8 c	**Similarity**: Both protect against pathogens **OR** involve white blood cells ✔. **Differences**: - **Innate**: Fast response **OR** non-specific recognition ✔. - **Adaptive**: Slow response **OR** antigen-specific ✔. - **Memory**: Only in adaptive **OR** provides long-term immunity ✔. - **Diversity**: Adaptive has variable receptors **OR** somatic recombination ✔.	Must include 1 similarity + any 2 contrasts/differences of the 4	6
8 d	1. **Herd immunity**: Reduces transmission **OR** protects unvaccinated ✔. 2. **Threshold**: Depends on R_0 **OR** requires high vaccination rates ✔. 3. **Example**: Measles **OR** polio vaccination programs ✔.		3