

Evolution, Biodiversity & Conservation

IB HL Study Guide

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Aligned to IB Biology HL 2025 syllabus — Theme A

Jump to section: Water · Diversity · Classification & Cladistics · Evolution & Speciation · Conservation · Mixed Practice · Predictions

Section 1: Water (A1.1)

Water is arguably the most important molecule in biology. Its unique properties — all derived from hydrogen bonding — make it essential for life. This section focuses specifically on the Theme A syllabus requirements; the Biochemistry guide also introduces water's role as a solvent in the context of biological molecules.

1.1 Hydrogen Bonding

Water (H₂O) is a **polar molecule**. The oxygen atom is more electronegative than hydrogen, creating partial charges: δ^- on oxygen and δ^+ on each hydrogen.

These partial charges allow water molecules to form **hydrogen bonds** — weak electrostatic attractions between the δ^+ hydrogen of one molecule and the δ^- oxygen of a neighbouring molecule. Each water molecule can form up to **four** hydrogen bonds simultaneously.

MEMORISE THIS

Key properties of water and their biological significance:

Property	Molecular Explanation	Biological Significance
High specific heat capacity ($4.18 \text{ J g}^{-1}\text{K}^{-1}$)	Many H-bonds must absorb energy before temperature rises	Aquatic environments remain thermally stable; body temperature is buffered
High latent heat of vaporisation (2260 J g^{-1})	Many H-bonds must break for water to evaporate	Sweating and transpiration provide effective cooling
Cohesion	H-bonds hold water molecules together	Creates surface tension; supports transpiration pull in xylem
Adhesion	H-bonds form between water and polar surfaces	Water adheres to xylem walls, aiding capillary action
Solvent properties	Polar water molecules surround and separate ions and polar solutes	Transport medium for metabolites, gases, and ions in blood and cytoplasm
Ice is less dense than liquid water	H-bonds form an open crystalline lattice at $0 \text{ }^\circ\text{C}$	Ice floats, insulating water below; aquatic organisms survive winter

EXAM ALERT

Common exam mistake: Students write that water “has a high boiling point” without explaining *why*. You must link every property back to **hydrogen bonding**. The chain of reasoning is: polarity → hydrogen bonds → property → biological significance. Missing any link loses marks.

1.2 Thermal Properties in Detail

Specific heat capacity is the energy required to raise the temperature of 1 g of a substance by $1 \text{ }^\circ\text{C}$. Water’s value ($4.18 \text{ J g}^{-1}\text{K}^{-1}$) is exceptionally high because energy is used to break hydrogen bonds rather than increase kinetic energy.

Biological consequence: Large bodies of water (oceans, lakes) resist temperature fluctuations, providing stable habitats. Organisms with high water content (humans are ~60% water) resist rapid body temperature changes.

Latent heat of vaporisation is the energy required to convert 1 g of liquid water to gas at its boiling point. Water’s high latent heat means that evaporating a small amount of water carries away a large amount of heat energy.

Biological consequence: Evaporative cooling is highly efficient — sweating in mammals, panting in dogs, and transpiration in plants all exploit this property.

1.3 Cohesion, Adhesion, and Transport

Cohesion (water-to-water attraction) creates **surface tension** — a “skin” at the water surface strong enough to support small organisms such as pond skaters.

Inside plants, cohesion is critical to the **transpiration-adhesion-cohesion-tension** mechanism:

1. Water evaporates from leaf mesophyll cells through stomata (**transpiration**).
2. This creates a **tension** (negative pressure) in the xylem.
3. **Cohesion** between water molecules transmits the tension down the xylem as a continuous column.
4. **Adhesion** between water molecules and the hydrophilic xylem walls prevents the column from pulling away.
5. Water is drawn up from the roots to replace what was lost.

IB TIP

IB exam tip: When explaining transpiration pull, always name both cohesion AND adhesion. Cohesion maintains the continuous water column; adhesion prevents it from collapsing away from the vessel walls. Naming only one will cost you a mark.

1.4 Solvent Properties

Because water is polar, it dissolves:

- **Ionic compounds** (e.g. NaCl) — water molecules surround individual ions, with δ^- oxygen facing cations and δ^+ hydrogen facing anions
- **Polar molecules** (e.g. glucose, amino acids) — hydrogen bonds form between water and polar groups on the solute

Hydrophobic (non-polar) substances such as lipids do not dissolve in water — they lack partial charges and cannot form hydrogen bonds with water.

1.5 Density Anomaly of Ice

Most substances are denser in the solid state. Water is anomalous: at 4 °C, liquid water reaches maximum density. Below 4 °C, hydrogen bonds lock molecules into an open lattice structure, making ice **less dense** than liquid water.

Biological significance: Ice floats, forming an insulating layer on the surface of lakes and oceans. Liquid water remains below, allowing aquatic organisms to survive through winter.

EXAM ALERT

Exam Alert: If asked to explain *why* ice floats, the expected answer has three steps: (1) hydrogen bonds form a regular open lattice in ice, (2) this lattice has greater spacing between molecules than liquid water, (3) therefore ice is less dense and floats. Simply writing “ice is less dense” without the molecular explanation will not earn full marks.

Section 2: Diversity of Organisms (A3.1)

2.1 Domains and Kingdoms

Living organisms are classified into three **domains** based on fundamental cell structure and molecular evidence:

MEMORISE THIS

The Three Domains

Domain	Cell Type	Key Features
Bacteria	Prokaryotic	No membrane-bound nucleus; peptidoglycan cell walls; circular DNA; 70S ribosomes
Archaea	Prokaryotic	No membrane-bound nucleus; unique membrane lipids (ether-linked); no peptidoglycan; extremophiles common
Eukarya	Eukaryotic	Membrane-bound nucleus and organelles; linear chromosomes; 80S ribosomes

Within Domain Eukarya, organisms are further classified into **kingdoms**:

MEMORISE THIS

Eukaryotic Kingdoms — Distinguishing Features

Kingdom	Cell Wall	Nutrition	Other Features
Animalia	Absent	Heterotrophic (ingestion)	Multicellular; no chloroplasts; nervous system in most
Plantae	Cellulose	Autotrophic (photosynthesis)	Multicellular; chloroplasts present; store starch
Fungi	Chitin	Heterotrophic (absorption / saprotrophic)	Mostly multicellular (yeasts are unicellular); hyphae network; store glycogen
Protista	Varies	Autotrophic, heterotrophic, or mixotrophic	Mostly unicellular; very diverse; “catch-all” group

IB TIP

IB exam tip: The IB often tests the distinction between Bacteria and Archaea. The key distinguishing features are: (1) Archaea have **ether-linked lipids** in their membranes (bacteria have ester-linked), (2) Archaea **lack peptidoglycan** in their cell walls, and (3) molecular evidence (rRNA sequences) shows Archaea are more closely related to Eukarya than to Bacteria.

2.2 Binomial Nomenclature

All species are given a two-part Latin name following the system developed by **Carl Linnaeus**:

- The first name is the **genus** (capitalised)
- The second name is the **species** (lowercase)
- The full name is always *italicised* (or underlined when handwritten)

Example: *Homo sapiens*, *Escherichia coli*, *Panthera leo*

EXAM ALERT

Exam Alert: In handwritten exams, you must **underline** each part of the binomial name separately (not a single continuous underline). Failure to italicise or underline correctly can lose marks. Also note: after the first full mention, you may abbreviate the genus (*H. sapiens*), but the species name is never used alone.

2.3 The Hierarchy of Taxa

Classification follows a nested hierarchy from broadest to most specific:

Domain → **Kingdom** → **Phylum** → **Class** → **Order** → **Family** → **Genus** → **Species**

MEMORISE THIS

Mnemonic: Dear King Philip Came Over For Good Spaghetti

Each level groups organisms by increasingly specific shared characteristics. Members of the same genus share more features than members of the same family.

Section 3: Classification and Cladistics (A3.2)

3.1 Phylogenetics and Cladograms

A **cladogram** is a branching diagram showing the **evolutionary relationships** between organisms based on shared derived characteristics. Each branch point (**node**) represents a common ancestor.

Key features of cladograms:

- **Clades** — a group consisting of an ancestor and all its descendants (a monophyletic group)
- **Nodes** — branch points representing speciation events
- **Root** — the common ancestor of all organisms in the cladogram
- **Outgroup** — a species included for comparison that is more distantly related

MEMORISE THIS

Cladogram terminology:

Term	Definition
Clade	An ancestor and all of its descendants — a complete branch of the tree
Node	A branching point representing a common ancestor where lineages diverged
Derived character	A trait that evolved after the divergence from the common ancestor (shared by the clade but not the outgroup)
Ancestral character	A trait present in the common ancestor and shared broadly
Outgroup	A taxon outside the group of interest, used to determine which characters are ancestral vs derived

💡 IB TIP

IB exam tip: When reading a cladogram, the number of **nodes** between two species indicates how distantly related they are — more nodes = more distant. **But be careful:** cladograms can be rotated around any node without changing the relationships. Two species on opposite sides of the diagram may be more closely related than two species that appear next to each other.

3.2 Homologous vs Analogous Structures

Homologous structures are anatomical features in different species that share a **common evolutionary origin** but may serve different functions. They provide evidence for **divergent evolution**.

- **Example:** The pentadactyl limb — the forelimbs of humans, whales, bats, and dogs all contain the same basic bone pattern (humerus, radius, ulna, carpals, metacarpals, phalanges) despite being used for grasping, swimming, flying, and running.

Analogous structures are features that serve similar functions but have **different evolutionary origins**. They result from **convergent evolution** — similar environmental pressures produce similar adaptations independently.

- **Example:** Wings of insects and wings of birds — both used for flight but structurally unrelated.

⚠️ EXAM ALERT

Exam Alert: Homologous structures indicate **common ancestry** and are used to construct cladograms. Analogous structures indicate **convergent evolution** and must **NOT** be used for classification — they would create false groupings. IB mark schemes often penalise students who confuse the two.

3.3 Molecular Evidence for Classification

Modern classification relies heavily on **molecular evidence** — comparisons of DNA base sequences, amino acid sequences, and ribosomal RNA.

Why molecular evidence is preferred:

- More objective than morphological comparisons
- Can be quantified precisely (percentage similarity)
- Less affected by convergent evolution
- Can be used even when organisms look very different externally

Key examples:

- **rRNA sequences** established the three-domain system (Archaea are molecularly closer to Eukarya than to Bacteria)
- **Cytochrome c** amino acid sequences — more similar between closely related species (human and chimpanzee differ by 0 amino acids; human and yeast differ by ~40)
- **DNA hybridisation** — heating double-stranded DNA from two species to measure how similar their sequences are

MEMORISE THIS

Molecular clocks:

The concept that mutations accumulate at a roughly constant rate over time. By counting the number of differences in a protein or DNA sequence between two species, scientists can estimate **when** they diverged from a common ancestor. The more differences, the longer ago they diverged.

Limitation: Mutation rates are not perfectly constant — they vary between genes, lineages, and over time. Molecular clocks must be calibrated against the fossil record.

Section 4: Evolution and Speciation (A4.1)

The meiosis-genetics guide introduces speciation through gene pools (D2.3). This section goes deeper into the evidence for evolution and the mechanisms of natural selection and speciation.

4.1 Evidence for Evolution

MEMORISE THIS

Five lines of evidence for evolution:

Evidence	Explanation	Example
Fossil record	Shows change in organisms over geological time; transitional forms link groups	<i>Archaeopteryx</i> — transitional between reptiles and birds (feathers + teeth + bony tail)
Homologous structures	Shared anatomy from common ancestor, modified for different functions	Pentadactyl limb in mammals, birds, reptiles
Vestigial structures	Reduced, non-functional remnants of structures that were functional in ancestors	Human appendix; whale pelvic bones; flightless bird wings
Molecular evidence	DNA/protein sequence similarity correlates with evolutionary relatedness	Human and chimpanzee DNA ~98.7% identical
Biogeography	Distribution of species reflects evolutionary history and continental drift	Marsupials concentrated in Australia; Darwin's finches on Galápagos

 **IB TIP**

IB exam tip: When asked to “discuss the evidence for evolution,” include at least three lines of evidence from different categories. The strongest answers link molecular AND morphological evidence to show consistency. For example: “Molecular evidence confirms the groupings suggested by homologous structures, strengthening the case for common ancestry.”

4.2 Natural Selection

Natural selection is the mechanism of evolution proposed by Darwin. It acts on **phenotypic variation** within a population.

The four conditions for natural selection:

1. **Variation** — individuals in a population show variation in their traits (caused by mutation and sexual reproduction)
2. **Overproduction** — more offspring are produced than can survive
3. **Competition** — individuals compete for limited resources (food, territory, mates)
4. **Differential survival and reproduction** — individuals with traits better suited to the environment are more likely to survive and reproduce, passing their alleles to the next generation

Over many generations, the frequency of advantageous alleles increases in the population — this is **evolution by natural selection**.

EXAM ALERT

Exam Alert — Lamarckian vs Darwinian language: Never write that organisms “develop” a trait *because* they need it, or that traits are passed on because they were “used.” Evolution does not have purpose or foresight. Correct phrasing: “Individuals with the trait had a selective advantage, so the allele frequency increased in the population over generations.”

4.3 Gene Pools and Allele Frequencies

A **gene pool** is the total of all alleles for all genes in a population. **Allele frequency** is the proportion of a specific allele among all alleles for that gene.

Evolution can be defined as a **change in allele frequencies** in a population over time. Factors that change allele frequencies include:

- **Natural selection** — differential survival and reproduction
- **Genetic drift** — random changes in allele frequency, especially in small populations
- **Gene flow** — migration of alleles between populations
- **Mutation** — introduces new alleles

4.4 Types of Speciation

Speciation is the formation of new species through the evolution of **reproductive isolation**. Once populations can no longer interbreed to produce fertile offspring, they are considered separate species.

MEMORISE THIS

Allopatric vs Sympatric Speciation

Feature	Allopatric	Sympatric
Geographic separation	Required — a physical barrier divides the population	Not required — occurs within the same area
Mechanism of isolation	Physical barrier prevents gene flow	Ecological, behavioural, or chromosomal barriers (e.g. polyploidy)
Common in	Animals and plants	Primarily plants (polyploidy); some insects and fish
Speed	Gradual (many generations)	Can be rapid (polyploidy is near-instantaneous)
Classic example	Darwin’s finches on Galápagos Islands	Allopolyploid wheat (<i>Triticum aestivum</i>)

Allopatric speciation — step by step:

1. A geographic barrier (river, mountain range, ocean) splits a population
2. Gene flow between sub-populations ceases

3. Different selection pressures, mutations, and drift act on each group
4. Allele frequencies diverge over time
5. Reproductive isolation develops — if populations meet again, they can no longer interbreed

Sympatric speciation — polyploidy example:

1. An error in meiosis or mitosis doubles the chromosome number
2. The polyploid individual cannot produce fertile offspring with diploid members of the original species
3. If the polyploid can self-fertilise or mate with other polyploids, a new species arises in a single generation

4.5 Adaptive Radiation

Adaptive radiation is the rapid diversification of a single ancestral lineage into many new species, each adapted to a different ecological niche.

Conditions that promote adaptive radiation:

- Colonisation of a new, relatively empty habitat (e.g. volcanic islands)
- Mass extinction events that create vacant niches
- Evolution of a key innovation that opens new ecological opportunities

Classic example — Darwin’s finches:

- A single ancestral finch species colonised the Galápagos Islands
- Different islands had different food sources (seeds, insects, cacti)
- Natural selection favoured different beak shapes on each island
- Over time, 13+ species evolved with beaks adapted to specific diets

4.6 Punctuated Equilibrium vs Gradualism

MEMORISE THIS

Two models of evolutionary tempo:

Model	Description
Gradualism	Species evolve slowly and continuously over long periods; change is constant and incremental
Punctuated equilibrium	Long periods of little change (stasis) punctuated by brief episodes of rapid speciation, often triggered by environmental change

The fossil record frequently shows patterns consistent with punctuated equilibrium — species appear suddenly, remain unchanged for millions of years, then disappear or change rapidly. However, the two models are not mutually exclusive; different lineages may follow different patterns.

Section 5: Conservation of Biodiversity (A4.2)

5.1 Biodiversity Metrics

Biodiversity has three levels:

- **Genetic diversity** — variety of alleles within a species
- **Species diversity** — number and relative abundance of species in a community
- **Ecosystem diversity** — variety of habitats and ecosystems in a region

Species diversity has two components:

- **Species richness** — the total number of different species present
- **Species evenness** — how equally individuals are distributed among species

MEMORISE THIS

Simpson's Diversity Index (also covered in the Ecology guide, Section 3.1):

$$D = 1 - \sum \left(\frac{n}{N} \right)^2$$

- D ranges from 0 (no diversity) to 1 (maximum diversity)
- n = number of individuals of each species
- N = total number of all individuals
- Higher D = greater species diversity

A community with 5 species of 20 individuals each ($D = 0.80$) is more diverse than a community with 5 species where one has 96 individuals and the others have 1 each ($D = 0.08$).

WORKED EXAMPLE

Worked Example: Comparing Diversity

Two forest plots are surveyed:

Plot A:

Species	Individuals (n)	$(n/N)^2$
Oak	40	0.1600
Birch	30	0.0900
Pine	20	0.0400
Elm	10	0.0100
Total	100	

$$D_A = 1 - (0.1600 + 0.0900 + 0.0400 + 0.0100) = 1 - 0.3000 = 0.700$$

Plot B:

Species	Individuals (n)	$(n/N)^2$
Oak	85	0.7225
Birch	5	0.0025
Pine	5	0.0025
Elm	5	0.0025
Total	100	

$$D_B = 1 - (0.7225 + 0.0025 + 0.0025 + 0.0025) = 1 - 0.7300 = 0.270$$

Conclusion: Plot A ($D = 0.700$) has much greater species diversity than Plot B ($D = 0.270$) despite having the same species richness (4 species each). The difference is due to **evenness** — Plot A has a more even distribution of individuals.

5.2 Threats to Biodiversity

MEMORISE THIS

Major threats to biodiversity (HIPPO):

Threat	Explanation
Habitat loss	Deforestation, urbanisation, agriculture — the single greatest threat
Invasive species	Non-native species outcompete, predate, or spread disease to native species
Pollution	Chemical contamination, eutrophication, plastic waste
Population growth (human)	Drives all other threats through increased resource demand
Overexploitation	Overfishing, overhunting, unsustainable harvesting

Climate change is increasingly recognised as a major additional driver, causing habitat shifts, ocean acidification, and phenological mismatches.

5.3 Habitat Fragmentation and Edge Effects

Habitat fragmentation occurs when a large, continuous habitat is divided into smaller, isolated patches by human activities (roads, agriculture, urban development).

Consequences:

- Smaller populations in each fragment → increased **genetic drift** and **inbreeding**
- Reduced gene flow between fragments → reduced genetic diversity
- Species requiring large ranges (top predators) cannot be sustained
- **Edge effects** become proportionally greater in smaller fragments

Edge effects are changes in environmental conditions (temperature, humidity, light, wind) at the boundary between a habitat and the surrounding modified landscape. Species adapted to the interior of a habitat may not survive at the edge.

💡 IB TIP

IB exam tip: When discussing conservation strategies, always link back to fragmentation. **Wildlife corridors** connect fragments to restore gene flow. The effectiveness of a protected area depends not just on its total area but on its **shape** — a circular reserve has less edge relative to area than a long, narrow one.

5.4 In Situ vs Ex Situ Conservation

📖 MEMORISE THIS

Conservation strategies compared:

Feature	In Situ (on-site)	Ex Situ (off-site)
Definition	Conserving species in their natural habitat	Conserving species outside their natural habitat
Examples	National parks, marine reserves, wildlife corridors, buffer zones	Zoos, botanical gardens, seed banks, captive breeding programmes
Advantages	Maintains ecological relationships; protects entire ecosystems; larger populations	Protects species from immediate extinction; allows research and breeding programmes
Disadvantages	Difficult to enforce; cannot protect against catastrophic events; expensive to manage	Small populations → inbreeding; loss of natural behaviours; expensive to maintain
Best for	Species with viable wild populations and habitat remaining	Critically endangered species; genetic preservation

EXAM ALERT

Exam Alert: IB questions frequently ask you to evaluate conservation strategies. The strongest answers discuss **both** in situ and ex situ approaches as **complementary**, not alternatives. Example: captive breeding (ex situ) followed by reintroduction into a protected reserve (in situ) — as done with the Arabian oryx and California condor.

5.5 CITES

CITES (Convention on International Trade in Endangered Species) is an international agreement that regulates the trade of wildlife and wildlife products.

- **Appendix I:** Species threatened with extinction — trade is banned except in exceptional circumstances (e.g. African elephant ivory, great apes)
- **Appendix II:** Species not yet threatened but trade must be controlled to prevent decline (e.g. many corals, orchids)
- **Appendix III:** Species protected in at least one country that has asked others for help controlling trade

IB TIP

IB exam tip: CITES regulates **international trade** only. It does not directly protect habitats or prevent domestic exploitation. When evaluating its effectiveness, mention that enforcement depends on individual countries, illegal trade remains a major problem, and CITES works best alongside habitat protection and community-based conservation.

Mixed Practice — Exam Style

10 MCQs covering all sections (IB Paper 1 style)

1. **[Water]** Which property of water is most directly responsible for the cooling effect of sweating?
 - A. High specific heat capacity
 - B. High latent heat of vaporisation
 - C. Cohesion between water molecules
 - D. Solvent properties of water
2. **[Water]** Ice floats on liquid water because:
 - A. Ice molecules have less kinetic energy than liquid water molecules
 - B. Hydrogen bonds in ice form an open lattice structure, making ice less dense
 - C. Water molecules in ice are smaller than in liquid water

- D. Ice contains fewer hydrogen bonds than liquid water
3. **[Diversity]** Which feature distinguishes Archaea from Bacteria?
- A. Archaea have a membrane-bound nucleus
 - B. Archaea have 80S ribosomes
 - C. Archaea lack peptidoglycan in their cell walls
 - D. Archaea are all heterotrophic
4. **[Classification]** Two species share a homologous structure. This indicates:
- A. They evolved in similar environments
 - B. They share a common ancestor
 - C. They have identical DNA sequences
 - D. They occupy the same ecological niche
5. **[Classification]** **HL** In a cladogram, a clade is defined as:
- A. Any two species that are positioned next to each other
 - B. An ancestor and all of its descendants
 - C. A group of species that look similar
 - D. The outgroup and its closest relative
6. **[Evolution]** Which of the following is NOT required for natural selection to occur?
- A. Variation in traits within a population
 - B. Overproduction of offspring
 - C. Inheritance of acquired characteristics
 - D. Differential survival and reproduction
7. **[Evolution]** Adaptive radiation is best described as:
- A. The extinction of multiple species at the same time
 - B. The gradual change of one species into another
 - C. The rapid diversification of one lineage into many species occupying different niches
 - D. The convergent evolution of unrelated species

8. **[Conservation]** Simpson's Diversity Index is 0.85 for Habitat X and 0.35 for Habitat Y. Which conclusion is correct?
- A. Habitat X has fewer species than Habitat Y
 - B. Habitat X has greater species diversity than Habitat Y
 - C. Habitat Y has greater species evenness
 - D. Both habitats have the same species richness
9. **[Conservation]** Which is an example of ex situ conservation?
- A. Establishing a marine protected area
 - B. Creating a wildlife corridor between forest fragments
 - C. Maintaining a captive breeding programme in a zoo
 - D. Banning hunting within a national park
10. **[Conservation]** Habitat fragmentation leads to reduced biodiversity primarily because:
- A. Fragments receive more rainfall than continuous habitats
 - B. Smaller, isolated populations experience increased genetic drift and inbreeding
 - C. Edge effects cause fragments to become warmer, benefiting all species equally
 - D. Fragmentation increases gene flow between populations

► Show Answers

May 2026 Prediction Questions

EXAM ALERT

These are NOT official IB questions. These are trend-based practice questions reflecting topic areas and question styles most likely to appear on the May 2026 IB Biology HL Paper 2. Based on recent exam patterns (2022—2025), expect heavy weighting on: molecular evidence for classification, conservation strategies and their evaluation, and the mechanism of natural selection applied to specific scenarios.

 **WORKED EXAMPLE**

Question 1 [Classification & Molecular Evidence] [~8 marks]

Scientists compared amino acid sequences of a protein found in five species. The table shows the number of amino acid differences between each pair.

	Species A	Species B	Species C	Species D	Species E
Species A	—	5	12	30	45
Species B	5	—	10	28	43
Species C	12	10	—	25	40
Species D	30	28	25	—	42
Species E	45	43	40	42	—

(a) Using the data, identify which two species are most closely related. Justify your answer. [2]

(b) Explain why molecular evidence is considered more reliable than morphological evidence for determining evolutionary relationships. [3]

(c) Outline how a molecular clock could be used to estimate the time of divergence between Species A and Species D. [3]

► Show Solution

 **WORKED EXAMPLE**

Question 2 [Natural Selection & Speciation] [~8 marks]

A population of beetles living on a grassland is separated into two groups when a new river forms. The northern group lives on light-coloured sandy soil; the southern group lives on dark volcanic soil. Both groups are preyed upon by birds that hunt by sight.

(a) Using the theory of natural selection, explain how the two populations might develop different body colours over many generations. [4]

(b) Explain the type of speciation that could result from this scenario and the conditions required for speciation to be complete. [2]

(c) Suggest how scientists could test whether the two populations have become separate species. [2]

► Show Solution

 **WORKED EXAMPLE**

Question 3 [Conservation] [~7 marks]

A tropical island has experienced rapid deforestation for palm oil plantations. Several endemic bird species are now confined to small, isolated forest fragments.

(a) Explain why small, isolated populations are at greater risk of extinction than large, connected populations. [3]

(b) Evaluate the use of in situ and ex situ conservation strategies for protecting the endemic bird species. [4]

► Show Solution

IB Biology HL – Evolution, Biodiversity & Conservation – Complete Study Guide – 2025 Syllabus – Good luck!