

Exercise walk-through

4.5

Evolution and speciation (statements 5.23–5.26)

Pearson Edexcel · International A-Level · Biology

Energy in, energy through, energy lost

Follow the energy: photosynthesis fixes it, food chains lose it, microbes recycle it, and immunity spends it.

- WBI14 is the first IA2 paper.
- 105 minutes, 90 marks, all compulsory.
- Topics 5 and 6 together on one paper.
- Calculation-heavy after Unit 1.

Selection filters, isolation splits

Directional : one extreme favoured,
the mean shifts - resistance alleles spread

Stabilising : the average favoured, both extremes trimmed

Isolation : barrier (**allopatric**) or behaviour (**sympatric**) stops gene flow

Speciation : diverged
populations can no longer interbreed

Check yourself

Your turn

Grassland NPP is 40 000 kJ per square metre per year. At 10% per transfer, what reaches second-order consumers?

- A. 400 kJ - two transfers of 10%
- B. 4 000 kJ - one transfer
- C. 40 kJ - three transfers
- D. 400 000 kJ - the food chain multiplies energy

Exercises 2.1·2.3

2.1 Define evolution in terms of alleles. [1]

2.2 Contrast directional and stabilising selection. [2]

2.3 State the difference between allopatric and sympatric speciation. [2]

Exercises 2.1·2.3

2.1 Define evolution in terms of alleles. [1]

2.1 A change in the frequency of alleles in a population over generations.

2.2 Contrast directional and stabilising selection. [2]

2.2 Directional favours one extreme and shifts the mean; stabilising favours the average and trims both extremes.

2.3 State the difference between allopatric and sympatric speciation. [2]

2.3 Allopatric: populations separated physically; sympatric: populations in the same area isolated reproductively without a physical barrier.

Exercises 3.1·3.2

3.1 Hawthorn flies lay eggs in hawthorn fruit; a population on apple trees now lays in apples and mates on apple trees only. Explain how this sympatric split began and how it leads to two species, even with no physical barrier. [5]

3.2 The frequency of a recessive allele falls from 0.20 to 0.05 over eight generations in a fish population after an introduced predator. Explain the change in terms of selection, and predict what would happen to the frequency if the predator were removed. [4]

Exercises 3.1·3.2

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3.1 A mutation or behavioural change made some flies lay in apples; apple-mating flies meet and mate with each other, not with hawthorn flies – assortative mating; the two sub-populations' allele frequencies diverge by selection and drift in their different fruits; over generations the differences accumulate until mating between them produces no viable or fertile offspring – reproductive isolation in the same habitat is sympatric speciation.

3.2 The frequency of a recessive allele falls from 0.20 to 0.05 over eight generations in a fish population after an introduced predator. Explain the change in terms of selection, and predict what would happen to the frequency if the predator were removed. [4]

3.2 The predator selectively removes the fish showing the recessive trait; carriers pass the allele on at lower frequency each generation, so q falls $0.20 \rightarrow 0.05$. Remove the predator and the selection pressure vanishes: the allele would drift or slowly recover, held only by any residual cost/benefit of the trait.

Exercise 3.3

3.3 A paper concludes “reforestation cannot offset national emissions.” Describe two pieces of evidence you would want before judging the claim, and explain how each could support or undermine it. [5]

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3.3 Evidence 1: the annual carbon uptake of the reforested area versus national emissions – if uptake is a small fraction, the claim holds; if it scales with plausible planting, the claim fails. Evidence 2: the time profile – forests take decades to reach full uptake while emissions are annual; saturation and fire/disease risk could reverse the store. Judgement needs the ratio now and across decades.